SCHOOL OF BASIC AND APPLIED SCIENCES

GALGOTIAS UNIVERSITY

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COURSE BOOK
SOBAS-2020
Volume-I

Curriculum and syllabus for School of Basic and Applied Sciences

GALGOTIAS UNIVERSITY
(Under the Uttar Pradesh Private Universities Act No. 12 of 2019)

CONTENTS

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Basic and Applied Sciences

Program: B.Sc (Hons) Chemistry

Scheme: 2020 – 2023

Curriculum

Semester I									
Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	**BSCC1003**	**Inorganic Chemistry I**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
2	**BSCC1051**	**Inorganic Chemistry-I Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
3	**BMAT1041**	**Foundation Course in Mathematics**	**5**	**1**	**0**	**6**	**30**	**20**	**50**
4	**BCSE1021**	**Programming in C and Python**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
5	**BCSE1031**	**Programming in C and Python Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
6	**BBS09P1101**	**Hands on Basic Techniques and Instrumentation**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
7	xxxx	Environmental Science	**0**	**0**	1	0.5			
8	xxxx	AI and Machine learning				2			
9	xxxx	Liberal Art				0.5			
10	xxxx	BEC-B1				3			
11	xxxx	Soft Skill							
12	xxxx	Computer Awareness							
		Total	**13**	**1**	**13**	26			
Semester II									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	**BSCC1002**	**Physical Chemistry I**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
2	**BSCC1052**	**Physical Chemistry-I Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
3	**BSCG1001**	**Nanoscience and Nanotechnology**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
4	**BSCG1051**	**Nanoscience and Nanotechnology lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
5	**BSCP1043**	**General Physics**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
	BSCP1044	**Physics Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
6	**BBS05T5101**	**Elective (Analytical Methods in Chemistry)**	**3**	**0**	**0**	**3**	**30**	**20**	**50**
7	**BSCS1062**	**Analytical Techniques and Instrumentation Lab**	**2**	**0**	**0**	**2**	**50**	**-**	**50**
8	xxxx	BEC- B2				3			

9	xxxx	***Two week social internship (during summer)							
		Total	**17**	**0**	**12**	26			

Semester III									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	**BSCC2001**	**Organic Chemistry I**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
2	**BSCC2051**	**Organic Chemistry-I Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
3	**BSCC2002**	**Physical Chemistry II**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
4	**BSCC2052**	**Physical Chemistry II Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
5	**BSCC2003**	**Inorganic Chemistry II**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
6	**BSCC2053**	**Inorganic Chemistry II Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
7	**BSCC2004**	**Organic Chemistry II**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
8	**BSCC2054**	**Organic Chemistry II lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
9	**BBS05T5102**	**Industrial Chemistry**	**3**	**0**	**0**	**3**	**30**	**20**	**50**
		Total	**19**		**16**	27			

Semester IV									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	**BBS05T2101**	**Physical Chemistry III**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
2	**BBS05P2101**	**Physical Chemistry III Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
3	**BSCC2006**	**Inorganic Chemistry III**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
4	**BSCC2056**	**Inorganic Chemistry III Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
5	**BSCC2007**	**Organic Chemistry III**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
6	**BSCC2057**	**Organic Chemistry III Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
7	**BSCC2101**	Green Chemistry	**4**	**0**	**0**	**4**	**30**	**20**	**50**
8	Xxxx	Waste Management	**0**	**0**	**2**	**1**	**50**	**-**	**50**
9	**BBS09T2411**	Research Methodology and Statistics	**2**	**0**	**0**	**2**	**30**	**20**	**50**

10	Xxxx	IPR				**0.5**			
11	xxxx	Foreign Language				**0.5**			
		Total	**18**	**0**	**14**	26			
Semester V									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	**BSCC3001**	**Organic Chemistry IV**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
2	**BBS05P3101**	**Organic Chemistry IV Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
3	**BSCC3002**	**Physical Chemistry IV**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
4	**BSCC3052**	**Physical Chemistry IV Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
5	**BSCC3003**	**Inorganic Chemistry IV**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
6	**BSCC3053**	**Inorganic Chemistry IV Lab**	**0**	**0**	**4**	**2**	**50**	**-**	**50**
7	**BSCC3004**	**Organic Chemistry V**	**4**	**0**	**0**	**4**	**30**	**20**	**50**
8	**BBS05T5103**	Battery Technology	**3**	**0**	**0**	**3**	**30**	**20**	**50**
9	xxxx	Campus to corporate				2			
		Total	**19**	**0**	**12**	27			
Semester VI									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	**BSCC3151**	**Project**	**-**	**-**	**-**	**12**	**50**	**-**	**50**
Total Credit=144									

List of Electives

Sl No	**Course Code**	**Name of the Electives**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	**BBS05T5101**	Analytical Methods in Chemistry	**3**	**0**	**0**	**3**	**30**	**20**	**50**
2	**BSCC2101**	Green Chemistry	**4**	**0**	**0**	**4**	**30**	**20**	**50**
3	**BSCC2102**	**COMPUTATIONAL CHEMISTRY**	**4**	**0**	**0**	**3**	**30**	**20**	**50**
4	**BBS05T5102**	Industrial Chemistry	**3**	**0**	**0**	**3**	**30**	**20**	**50**
5	**BSCC3102**	**NOVEL INORGANIC SOLIDS**	**4**	**0**	**0**	**3**	**30**	**20**	**50**
6	**BSCC3103**	**POLYMER CHEMISTRY**	**4**	**0**	**0**	**3**	**30**	**20**	**50**
7	**BSCC3104**	**MOLECULAR MODELLING & DRUG DESIGN**	**4**	**0**	**0**	**3**	**30**	**20**	**50**
8	**BBS05T5103**	Battery Technology	**3**	**0**	**0**	**3**	**30**	**20**	**50**

Name of The Course	INORGANICCHEMISTRY I				
Course Code	**BSCC1003**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of Inorganic Chemistry.**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives: **The course reviews the structure of the atom, which is a necessary pre-requisite in understanding the nature of Chemical Bonding in compounds. It provides basic knowledge about Ionic, Covalent and Metallic bonding and explains that Chemical Bonding is best regarded as a continuum between the three cases. It discusses the Periodicity in properties with reference to the *s*and *p* block, which is necessary in understanding their group chemistry.**

Course Outcomes:

CO1	**Describe the basic concept and principle of atomic structure (K2).**
CO2	**Discuss the periodic properties of s and p block element to locate their position in periodic table. (K2)**
CO3	**Determine the properties and shape of molecules by various theories of chemical bonding. (K3).**
CO4	**Understand the bonding in metals and various chemical forces, interactions and redox reaction (K2).**
CO5	**Apply the basic knowledge of inorganic chemistry for real applications (K3).**
CO6	**Elaborate the recent advancements in inorganic chemistry. (K6).**

Text Book (s)

- **Lee,J.D.*ConciseInorganicChemistry*ELBS,1991.**
- **Douglas, B.E. and McDaniel, D.H. *Concepts &Models of Inorganic Chemistry* Oxford,1970**

Reference Book (s)

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- **Douglas, B.E. and McDaniel, D.H. *Concepts &Models of Inorganic Chemistry* Oxford,1970**
- **Atkins,P.W.&Paula,J.*PhysicalChemistry*,10thEd.,OxfordUniversityPress,2014.**
- **Day,M.C.andSelbin,J.*TheoreticalInorganicChemistry*,ACSPublications,1962.**
- **Rodger,G.E.*InorganicandSolidStateChemistry*,CengageLearningIndiaEdition,2002.**

Unit-1: Atomic Structure	10hrs

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave

functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau'sprinciple and its limitations.

Unit-2: Periodicity of Elements 12hrs

Detailed discussion of the following properties of the elements, with reference to *s* and *p*-block.

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic radii (van der Waals) (c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.

Unit-3: Chemical Bonding- (Ionic and Covalent bond) 14hrs

(i) *Ionic bond:* General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its applications, Solvation energy.

(ii) *Covalent bond:* Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

Unit-4: Chemical Bonding- (Metallic bond and Chemical Forces) 8hrs

(iii) *Metallic Bond:*Pool model of metallic bonding, Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. **(iv) *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points,**	
Unit-5: Redox Reaction	6hrs
Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.	
Unit-6: Recent advancements of various inorganic chemistry concepts	4hrs
Recent Advancements in metal catalyzed redox chemistry, New elements discovered in Periodic table and their properties, Recent advancement in Chemical bonding.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	INORGANIC CHEMISTRYI LAB				
Course Code	**BSCC1051**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of Titration, Concentration of solution.**				
Antirequisite					
		L	T	P	C
		0	**0**	**4**	**2**

Course Objectives:

Understand and perform different types of volumetric titration.

Course Outcomes

CO1	1. Understand the basics of titrimetric analysis and calibration of appratus (K2).
CO2	**Prepare solutions of different Molarity/ Normality of titrants (K4).**
CO3	3. Demonstrate and determine the strength of the given acid by acid-base titration (K3).
CO4	4. Gain hands on experience in the different aspects of oxidation-reduction titrimetry (K4).
CO5	5. Apply the basic knowledge of experiments in inorganic analysis (K3).

Text Book (s)

Vogel's Textbook of Quantitative Chemical Analysis, Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C., 5th Edn., **Longman Scientific & Technical, England, *(John Wiley and Sons Inc, 605 Third Avenue, New York NY 10158).***

Reference Book (s)

Mendham,J.,A.I.Vogel's*QuantitativeChemicalAnalysis6thEd.*,Pearson,2009.

Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education, 2002.
Marr & Rockett *Practical Inorganic Chemistry*. John Wiley & Sons 1972.

Unit-1 Titrimetric Analysis **(i) Calibration and use of apparatus** **(ii)Preparation of solutions of different Molarity/Normality of titrants**
Unit-2 Acid-BaseTitrations
(i) Estimation of carbonate and hydroxide present together in mixture. **(ii)Estimationofcarbonateandbicarbonatepresenttogetherinamixture.** **(iii) Estimation of free alkali present in different soaps/detergents**
Unit-3 Oxidation-Reduction Titrimetry
(i) Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution. (ii) Estimation of oxalic acid and sodium oxalate in a given mixture. **(iii) Estimation of Fe(II) with $K_2Cr_2O_7$ using internal indicator (diphenylamine,N-phenyl anthranilic acid).**

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	**50**	**100**

Name of The Course	Foundation Course in Mathematics				
Course Code	**BMAT1041**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.**				
Antirequisite					
		L	T	P	C
		5	**1**	**0**	**6**

Course Objectives:

The objective of this course is to introduce the students to fundamental mathematical techniques and basic computer skills that will help them in solving chemistry problems. It aims to make the students understand the concept of uncertainty and error in experimental data. Learn the use of different software for data tabulation, calculation, graph plotting, data analysis and document preparation.

Course Outcomes:

CO1	**Understand different functions and progressions and solve the problems based on it. (K3)**
CO2	**Explain the different types of matrices and solve the differential equations. (K3)**
CO3	**Understand the basics of differential calculus. (K2)**
CO4	**Evaluate the problems based on integral calulus. (K3)**
CO5	**Understand the basics of probability. (K2)**

CO6	**Analyse application of BCG Matrix to market growth.(K6)**

Text Book (s)/Reference Book (s)

1. Calculus and Analytic Geometry : *G. B. Thomas, R. L. Finney*, **Pearson Education, Asia.**
2. Statistical Methods :*S.P. Gupta*, **Sultan Chand and Sons**
3. Engineering Mathematics : *B.S. Grewal*, **Khanna Publishers.**

Unit-1	10hrs
Algebra: **Fundamentals, mathematical functions, logarithms, the exponential function, polynomial expressions, Factorization and division of Polynomials, Partial fractions, Binomial Expansion, Arithmetic Progression, Geometric Progression, Infinite Geometric Progression.**	
Unit-2	10hrs
Matrices & Determinants**: Types of matrices, basic operations of matrices, determinant of a matrix and it's properties, matrix inverse, elementary row and column operations, rank of a matrix, consistency of a linear system of equations, solution of a linear system by Gauss Elimination method.**	
Unit-3	10hrs
Differential Calculus: **Differentiation of a function of a single variable, product rule, quotient rule, chain rule of differentiation, Taylor's series, Applications of derivatives: Rate of change, increasing/decreasing functions, tangents and normals, maxima and minima.**	
Unit-4	10hrs
Integral Calculus: **Integral of elementary functions, standard results, Integration by substitutions, by parts and partial fraction methods, Definite integral, Even and odd functions, Properties of definite integral and application in finding the area.**	
Unit-5	10hrs
Probability: **Basicconcepts of probability, Random variable and its probability distribution, Binomial, Poisson and Normal distributions**	
Unit-6	4hrs
BCG matrix and its application to market sharing growth.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Programming in C and Python				
Course Code	**BCSE1021**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream**				
Co requisite	**Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.**				
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

The aim of the paper is to make the students of chemistry familiar with the working of computer, programming language, QBASIC and use of software as a tool to understand chemistry, and solve chemistry based problems.

Course Outcomes:

CO1	Understand and explain the basics of computer & its components, logic development and data input and output.
CO2	Explain the control systems and function.
CO3	Explain the arrays, structure, union and pointer.
CO4	Explain control flow structure and function in python.
CO5	Apply the Classes and objects in python.
CO6	Analyze the real world data using python libraries

Text Book (s)/Reference Book (s)

1. P Kanetkar Yashvant, Let us C, BPB Publications, New Delhi, Seventh Edition.
2. E. Balagurusami, Programming in ANSI C, Tata McGraw Hill, Fourth Edition.
3. Schaum Outline Series,Programming in C.
4. Mark Lutz ,"Learning Python", O Reily, 4th Edition, 2009, ISBN: 978-0-596-15806-4
5. Mark Lutz ,"Programming Python ", O Reily, 4th Edition, 2010, ISBN 9780596158118.
6. Tim Hall and J-P Stacey ,"Python 3 for Absolute Beginners" , 2009, SBN:9781430216322

Unit-1 10hrs

Introduction to computers:
Units of computers, Block Diagram, Generation of Computers, Characteristics of Computers, Different types of Memory, Input and Output Devices.
Logic Development and Program Development Tools:
Data Representation, Flowcharts, Problem Analysis, Pseudo Code and Algorithms, Program Debugging, Compilation and Execution.
Fundamentals:
Character Set, Identifiers and Key Words, Data Types, Constants, Variables, Expressions, Statements
Operations and Expressions:
Arithmetic Operators, Unary Operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Library functions.
Data Input and Output:
Single Character Input, Single Character Output, Entering Input Data, More About Scan Functions, Writing Output Data, More About Print Functions, Gets and Puts Functions, Interactive Programming.

Unit-2	10hrs
Control Structures: Introduction, Decision Making with If – Statement, If Else and Nested If, While And Do-While, For Loop. Jump Statements: Break, Continue, Goto, Switch Statement. **Functions:** Introduction To Functions, Function Declaration, Function Categories, Standard Functions, Parameters And Parameter Passing, Pass – By Value/Reference, Recursion, Global and Local Variables, Storage Classes.	
Unit-3	10hrs
Arrays: Introduction to Arrays, Array Declaration, Single and Multidimensional, Array, Memory Representation, Matrices, Strings, String Handling Functions. **Structure and Union:** Declaration of Structure, Accessing Structure Members, Structure Initialization, Arrays of Structure, Nested Structures, Unions. **Pointers:** Introduction To Pointers, Address Operator And Pointers, Declaring and Initializing Pointers, Assignment through Pointers, Pointers and Arrays.	
Unit-4	10hrs
CORE PYTHON : BASICS **Introduction to Python, Python Interpreter and its working, Syntax and Semantics, Data Types, Assignments and Expressions, Control Flow Statements, Sequences and Dictionaries, Functions and lambda expressions**	
Unit-5	10hrs
CORE PYTHON : ADVANCED FEATURES **Iterations and Comprehensions, Handling text files, Modules, Classes and OOP**	
Unit-6 Data Analysis (Python toolboxes/libraries) NumP, SciPy , Pandas, ChemPy	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Programming in C and Python Lab
Course Code	**BCSE1031**
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry**

Co requisite	**Students should have fundamental knowledge of Computer and it's application.**				
		L	T	P	C
		0	**0**	**4**	**2**

Course Objectives:

The aim of the paper is to make the students of chemistry familiar with the working of computer programming language, QBASIC and use of software as a tool to understand chemistry, and solve chemistry based problems.

Course Outcomes

CO1	Understand the different codes to execute the program.
CO2	Write the program for numbers and mathematical calculations.
CO3	Write the print command to the given program.
CO4	Write the program for control structure in python.
CO5	Understand the concept of classes and objects in python.

1. Write a program in C to find greatest of three numbers.
2. Write a program in C to find gross salary of a person
3. Write a program in C to find grade of a student given his marks.
4. Write a program in C to find divisor or factorial of a given number.
5. Write a program in C to print first ten natural numbers.
6. Write a program in C to print first ten even and odd numbers.
7. Write a program in python to print n terms of Fibonacci series.
8. Write a program in python to find all prime numbers within a given range.
9. Write a program in python to demonstrate working of classes and objects

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	**50**	**100**

Name of The Course	Hands on Basic Techniques and Measurements				
Course Code	**BBS09P1101**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of physics, chemistry and biology.**				
Antirequisite					
		L	T	P	C
		0	**0**	**4**	**2**

Course Objectives:

The main purpose of this laboratory is to provide the students an appreciation for basic techniques in applied sciences. It is also aimed to provide the students a degree of competence in the laboratory skills required for accurate and precise analysis. Therefore it is expected that the students will demonstrate proficiency in synthesizing some material in laboratory.

Course Outcomes

CO1	**Explain and operate the microscope for measurements.(K2)**
CO2	**Prepare Soap and Resins and understand the mechanism of preparartion. (K5)**
CO3	**Preparation of biodiesel from Vegetable oil/ Waste cooking oil and characterize it. (K5)**
CO4	**Apply the skill to solder and connect the electronic components. (K3)**
CO5	**Understand the functioning of CRO and develop the ability to use the micrometers. (K2)**

Text Book (s)/ Reference Book (s)

1. Georg Stehli , The Microscope And How to Use It, English edition, 1970.
2. M.Sayer and A. Mansingh, PHI Learning. Measurement, Instrumentation and **Experiment Design in Physics & Engineering, 2005.**

3. Stocchi, E.(1990),Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.

1. Different types of microscopes and its applications.

2. Preparation of Urea-formaldehyde Resin
3. Preparation of Soap
4. Preparation of Biodiesel from Vegetable oil/Waste cooking oil.
5. Characterization of biodiesel (TLC, Acid value and viscosity)
6. Soldering of electrical circuits
7. Measurement with Vernier calipers, Screw gauge and spherometer
8. Operation of oscilloscope
9. Familiarization with linear, logarithmic and polar graphs for plotting of experimental data
10. Assembling of elementary electric circuits using breadboard.

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	**50**	**100**

Name of The Course	PHYSICALCHEMISTRY I				
Course Code	BSCC1002				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

1. Understand states of matter and interchange of states, intermolecular interactions.

2. Understand state of equilibrium, concept of pH, buffers, acids and bases indicators.

Course Outcomes

CO1	**Describe the various models and behavior of ideal as well as real gases. (K2)**
CO2	**Describe the effect of various factors on the physical properties of a liquid. (K2)**
CO3	**Determine the various crystal structure and their properties. (K4)**

CO4	**Describe the properties of acids and bases. (K2)**
CO5	**Determine the pH scale, buffer action and applications of buffer solution. (K4)**
CO6	**Elaborate the recent advancement in different states of matter and analyse their utility. (K6)**

Text Book (s)

1. Atkins, P. W. & Paula, J. de ***Atkin's Physical Chemistry***10th Ed., Oxford University Press (2014).

Reference Book (s)

1. Castellan, G. W. ***Physical Chemistry***4th Ed. Narosa (2004).
2. Engel, T. & Reid, P. ***Physical Chemistry***3rd Ed. Pearson (2013

Unit-1 Gaseous state	12 hrs
Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.Behaviour of real gases: Deviations from ideal gas behavior, compressibility factor, Z, and its variation with pressure for different gases; Causes of deviation from ideal behavior; Van der Waals equation of state, its derivation and application in explaining real gas behavior; Calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms	
Unit-2 Liquid state	6 hrs
Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapor pressure, surface tension and coefficient of viscosity, and their determination; Effect of addition of various solutes on surface tension and viscosity; Explanation of cleansing action of detergents; Temperature variation of viscosity of liquids and comparison with that of gases.	
Unit-3 Solid state	14 hrs
Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.	
Unit-4 Ionic Equilibria-I	6 hrs
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water; Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).	

Unit-5 Ionic Equilibria-II	12 hrs
Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts; applications of solubility product principle; Qualitative treatment of acid – base titration curves (calculation of pH at various stages).Theory of acid–base indicators; selection of indicators and their limitations.	
Unit-6 Future Trends in States of Matter	**4hrs**
Recent advancement in different states of matter, Liquid crystal, Application of Liquid crystal	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	PHYSICALCHEMISTRY I Lab			
Course Code	BSCC1052			
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**			
Corequisite	**Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.**			
Antirequisite				
	L	T	P	C
	0	**0**	**4**	**2**

Course Objectives:

1. Determine the surface tension and viscosity of different solvent and solutions
2. Determine pH of buffer soutions and perform pH metric titrations.

Course Outcomes

CO1	**Measure the surface tension of solutions by different techniques. (K4)**
CO2	**Operate Ostwald's viscometer to measure viscosity of different solutions.(K3)**
CO3	Prepare buffer solutions of different pH and study the effects on pH by addition of acid/base. (K4)
CO4	**Perform pH metric titration of acid against base. (K3)**
CO5	Determine dissociation constant of a acid. (K2)

Text Book (s)

- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R.Chand& Co.: New Delhi (2011).

Reference Book (s)

Athawale, V. D. &Mathur, P. *Experimental Physical Chemistry* New Age

1. Surface tension measurements.

a. Determine the surface tension by (i) drop number (ii) drop weight method.

b. Study the variation of surface tension of detergent solutions with concentration.

2. Viscosity measurement using Ostwald's viscometer**.**

a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature.

b. Study the variation of viscosity of sucrose solution with the concentration of solute.

3. pH metry

a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.

b. Preparation of buffer solutions of different pH

i. Sodium acetate-acetic acid

ii. Ammonium chloride-ammonium hydroxide

c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base.

d. Determination of dissociation constant of a weak acid.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	**50**	**100**

Name of The Course	Nanoscience and Nanotechnology				
Course Code	**BSCG1001**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

Students will understand the basics of Nanoscience and Nanotechnology and present a comprehensive introduction to importance of Nanoscience and Nanotechnology.

Course Outcomes

CO1	**Describe the basic science behind the properties of materials at the nanometer scale. (K2)**
CO2	**Illustrate the concept of physical and chemical method, application and fabrication of nanostructures. (K3)**
CO3	**Generalize and introduce the methods of preparation, methods of purification and applications of carbon nano materials. (K3)**
CO4	**Apply the concepts of nano energy conversion materials.(K3)**
CO5	**Generalize the importance of nano-catalysis. (K2)**
CO6	**Formulate the rudimentary knowledge of photovoltaic devices and propose synthesis of quantum junction solar cells. (K6)**

Text Book (s)

1. Introduction to Nanotechnology C P Poole, Frank J. Owens, John Wiley & Sons, 2011, ISBN 978-81-265-1099-3.
2. Introduction to Nanoscience and Nanotechnology, KK Chattopadhyay, A N Banerjee, Phi Learning Pvt Ltd., New Delhi, 2012, ISBN-978-81-203-3608-7.
3. Nanotechnology Science Innovation & Opportunity, Lynn E Foster, Pearson publication, 2008, ISBN-9788131711187.
4. The Chemistry of Nanomaterials C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, Wiley-VCH Verlag GmbH & Co. KGaA, 2004 ISBN 3-527-30507-6

Reference Book (s)

1. The Evolution of Dip-pen nanolithography, D.Ginger ,H,Zang and C.A. Mirkin, Angw. Chem.. Int. Ed., 2004,43, 30-45.
2. Carbon Materials and Nanotechnology, Anke Krueger, Wiley –VCH Verlag GmbH & Co., 2010, ISBN-10: 3527318038.
3. Nanotechnology, J.F. Mongillo Greenwood Press London, 2008, ISBN–13: 978–0–313–33880–9.
4. Microfabricationa and naomanufacuing, M.J Jackson, CRC Press Taylor & Francis Group 2006
5. **Jiang Tang et al., Quantum Junction Solar Cells, Nano Lett. 2012, 12, 4889−4894**

Unit-1 Introduction to Nanoscience and Nanotechnology 10 hrs
Introduction to Nanoscience and Nanotechnology, materials vs nanomaterials, Nanoscale effects on properties, Surface energies, Melting point, Optical (SPR), Magnetic, and Electrical properties, Tools to explore nanomaterials, Fundamental of Nanospintronics, Nanomedicine, Nanostructured materials, Energy conversion processes.
Unit-2Nanomaterials preparation 10 hrs
Classification of Nanomaterials, Different approaches in synthesis, Nanomaterials synthesis and processing, Physical and chemical methods of synthesis, Synthesis of nanowires and fabrication of nanostructures, Lithography, Dip-pen nanolithography.
Unit-3 Carbon Materials 10 hrs

General introduction to carbon materials, Fullerenes, preparation, properties and application of fullerenes Carbon Nanotubes, Functionalization of nanotubes, Graphene- Preparation, properties and applications.
Unit-4 Nanomaterials in Energy Conversion devices 10 hrs
Principles of photovoltaics and photo electrochemical cell, Optical properties of SC nanomaterials, Photovoltaics cell, Silicon- Extraction, Single crystal growth, TiO2 based cells, Dye sensitization, Photoelectrochemical cells.
Unit-5 Nanocatalysis and ethics in nanotechnology 10 hrs
Introduction to nanocatalysis, , Bulk vs nanoscale surfaces, Major properties, Applications of nanocatalysts, Societal concern of nanotechnology.
Unit- 6 Quantum Junction Solar Cells 4 hrs
Photovoltaic devices, Colloidal Quantum dot cells, Efficiency of solar cells

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Nanoscience and Nanotechnology lab			
Course Code	**BSCG1051**			
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**			
Corequisite	**Chemistry as major or one of the subjects along with Physics, Mathematics and Biology/any branch of biosciences as minor subjects at 12^{th} level.**			
Antirequisite				
	L	T	P	C
	0	**0**	**4**	**2**

Course Objectives:

Synthesis and characterization of different Nanoparticles.

Course Outcomes

CO1	Describe basics of nanoscience and nanotechnology. (K2)
CO2	Synthesis of nanoparticles by different materials. (K5)
CO3	Describe the general characteristics of nanosize materials. (K2)
CO4	Demonstrate the nanomaterials characterization by UV. (K3)
CO5	Correlate the nano-materials properties & identify appropriate applications as well as ethical aspects. (K4)

Text Book (s)

1. Vogel, A. I. Vogel’s Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.
2. Carbon Materials and Nanotechnology, Anke Krueger, Wiley –VCH Verlag GmbH & Co., 2010.
3. Nanotechnology, J.F. Mongillo Greenwood Press London, 2008.
4. Introduction to Nanotechnology C P Poole, Frank J. Owens, John Wiley & Sons, 2011.
5. Microfabricationa and naomanufacuing, M.J Jackson, CRC Press

Reference Book (s)

1. Carbon Materials and Nanotechnology, Anke Krueger, Wiley –VCH Verlag GmbH & Co., 2010, ISBN-10: 3527318038.
2. Nanotechnology, J.F. Mongillo Greenwood Press London, 2008, ISBN–13: 978–0–313–33880–9.

List of Experiments
1. Preparation of Ag nano particle and characterization. 2. Preparation and characterization of CaO nanoparticles. 3. Preparation and characterization of ZnO nanoparticles. 4. Synthesis of ZnS nanoparticles and Characterization of synthesized nanoparticles by different techniques. 5. Preparation of Cunanoparticles and Characterization by UV-Vis spectrophometer. 6. Synthesis of CdS nanoparticle UV-Vis and IR characterization. 7. Synthesis of MnO nanoparticles under optimized conditions using different Manganese salts (Manganese acetate and Manganese nitrate) and Characterization by UV-Vis spectrophometer and other characterization techniques. 8. Optimization and study of the size variation of Manganese oxide nanoparticles using time variation and temperature variation. 9. Synthesis of Nickel Oxide nanoparticles from Nickel Nitrate and optimization of conditions. Characterization by UV-Vis spectrophometer. 10. Synthesis of Copper nanoparticle from Copper Sulphate in presence of Ascorbic acid and optimization of conditions. UV-Visible and IR characterization.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	**50**	**100**

Name of The Course	General Physics				
Course Code	**BSCP1043**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with physics as a major subject**				
Corequisite	**School level knowledge in Physics**				
Antirequisite	-				
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

General Physics is designed to inculcate the basic knowledge of quantum physics in modern technology. Student will study the laser technology and its production. They will come to know about their application in various fields of life. Students will be familiar with Optics in Interference and diffraction of light and resolving power. They will learn about dielectric materials.

Course Outcomes:

After the completion of this course, the students will be able to :

CO1	Explain the concept of Material particle and De-Broglie hypothesis.
CO2	**Interpret interference, diffraction and Laser with applications.**
CO3	Describe the free electron theory and Fermi level.
CO4	Employ the idea of dielectric with applications.

CO5	Demonstrate the origin of magnetism and Hall effect .
CO6	**Predict the new concept of achieving the superconductivity at high temperature for its feasible applications.**

Text Book (s):

1. **Arthur Beiser, S Rai Choudhury, Shobhit Mahajan, (2009), Concepts of Modern Physics, 6th Edition, Tata-McGraw Hill. ISBN- 9780070151550.**
2. **Neeraj Mehta, (2011), Applied Physics For Engineers, New Arrivals – PHI, ISBN-9788120342422.**
3. **Engineering Physics, B K Pandey, S Chaturvedi, Cengage Learning, ISBN: 137788131517611**

Reference Book (s):

1. **Robert Kolenkow, David Kleppner (2007), An Introduction to Mechanics, 1st Edition, Tata-McGraw Hill.**
2. **B.B. Laud, Lasers and Non-Linear Optics (2011), 3rd Edition, New Ages International.**
3. **William Silfvast (2002), Laser Fundamentals, Cambridge University Press.**
4. **David. J. Griffiths (2009), Introduction to Electrodynamics, 3rd Edition, PHI Learning.**
5. **Arthur Beiser (2003), Concepts of Modern Physics, 6th Edition, Tata-McGraw Hill.**
6. **Kittel (2001), Solid State Physics, 7th Edition, John Wiley & Sons.**
7. Neil W Ashcroft and N David Mermin, (2003), Solid State Physics, Cengage Learning, ISBN-9788131500521.
8. Pillai S O, Solid State Physics,(2010), sixth edition, New Age International (P) Ltd. ISBN-9788122427264
9. A. P. Drozdov, P. P. Kong, V. S. Minkov, S. P. Besedin, M. A. Kuzovnikov, S. Mozaffari, L. Balicas, F. F. Balakirev, D. E. Graf, V. B. Prakapenka, E. Greenberg, D. A. Knyazev, M. Tkacz, M. I. Eremets. Superconductivity at 250 K in lanthanum hydride under high pressures. *Nature*, 2019; 569 (7757): 528 DOI: 10.1038/s41586-019-1201-8

Unit-1 Quantum Mechanics	12 hours
Wave-Particle duality, de-Broglie waves, Davisson & Germer Experiment (Experimental verification of de-Broglie waves), Heisenberg Uncertainty Principle and its Applications, Schrodinger's wave equations, Particle in a Box, Compton Effect.	
Unit-2 Optics and LASER	12 hours
Interference: Interference of Light, Biprism experiment, displacement of fringes, interference sin thin films, wedge shaped film, Newton's rings. Diffraction: Single and double slit, Diffraction grating, Grating spectra, Rayleigh's criterion and resolving power of grating. Einstein's coefficients, Population Inversion,Three level and four level laser, Laser characteristics, He-Ne laser and applications.	
Unit-3 Free electron theory	8 hours
Lorentz classical free electron theory and its limitations, Drude theory of conduction, Thermal conductivity, Weidemann-Franz law, Quantum theory of free electron, Fermi level, Density of states, Fermi-Dirac distribution, Thermionic emission, Richardson equation.	
Unit-4 Dielectric materials	8 hours
Dielectrics introduction, Polarization and dielectric constant, Polarization mechanism: Ionic, Electronic, orientational and space charge polarization, Bound charges and their physical interpretation, Electric displacement vector, Equation of electric field inside dielectrics, Clausius–Mossotti relation, Dielectric losses, Dielectric breakdown and types, Applications of dielectric materials.	
Unit-5 Magnetism	5 hours

Origin of magnetization, Orbital and spin magnetic moment, Classification and properties of magnetic materials, Hall effect, Langevin's theory of diamagnetism, Hysteresis curve, soft and hard magnetic materials
Unit-6 Application of General Physics 4 hrs
Recent advancement in General Physics: The superconductor at the highest temperature, latest approach and description of new superconductor

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Physics Lab				
Course Code	**BSCP1044**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with physics as major subject**				
Corequisite	**Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.**				
Antirequisite					
		L	T	P	C
		0	**0**	**4**	**2**

Course Outcomes:

CO1	**Operate and handle the instruments effectively and safely in the physics laboratory –K2**
CO2	**Determine the Planck constant and Stefan's constant–K3**
CO3	**Calculate the wavelength of Laser and monochromatic light. K3**
CO4	**Calculate Hall coefficient and Hysteresis curve for a given material-K3**
CO5	**Determine the characteristics of solar cell and AC frequency -K3**

Text Book (s)/Reference Book (s)

1. B.Sc. Practical Physics by C.L Arora ,S. Chand Limited, 2001.

2. B.Sc. Practical Physics by Harnam Singh,S. Chand Limited, 2000.
2.

1. Spectrometer – angle of prism and minimum deviation of solid prism.
2. Spectrometer – Grating, Wavelength of different lines of mercury spectrum.
3. Newton's rings- Wave length of the mono-chromatic light.
4. Determination of Stefan's Constant
5. Determination of Planck's constant
6. Wavelength determination of He-Ne laser
7. B-H curve for magnetic material
8. Determination of Hall coefficient
9. Frequency of AC mains using sonometer
10. Characteristics of solar cell.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks

50	**50**	**100**

Name of The Course	ANALYTICAL METHODS IN CHEMISTRY
Course Code	BBS05T5101
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry**
Co-requisite	**Students should have fundamental knowledge of Analytical Chemistry**
Anti-requisite	

	L	T	P	C
	3	**0**	**0**	**3**

Course Objectives:

1. Concept of sampling, Accuracy, Precision, Statistical test data-F, Q,and t test.

2. The course exposes students to the laws of spectroscopy and selection rules governing the possibletransitions in the different regions of the electromagnetic spectra. Thermal and electroanalyticalmethods of analysis are also dealt with. Students are exposed to important separation methods likesolvent extraction and chromatography. The practicals expose students to latest instrumentation andthey learn to detect analytes in a mixture.

Course Outcomes

CO1	**Develop the knowledge of statistical analysis and to perform experiment with accuracy and precision. (K2)**
CO2	**Understand basic principle of instrument like Flame Photometer,UV-VISIBLE and IR spectroscopy. (K2)**
CO3	Ill Understand the basic principles of Thermogravimetric analysis. (K2)
CO4	IllUnderstand the principles and how to perform pH metric, potentiometric and conductometric titrations. (K2)
CO5	Il Illustrate different extraction and chromatographic techniques for analysis of reaction mixtures.(K3)
CO6	A Analyze the use of advance instruments for characterization of compounds. (K6)

Reference Books

□ Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

□ Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.

□ Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

□ Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.

□ Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009. □ Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.

Unit I:Qualitative and quantitative aspects of analysis	**5 hrs**
Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.	
Unit II:Optical methods of analysis	10 hrs

Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. **Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques.** **Structural illustration through interpretation of data.**
Unit-3: Thermal methods of analysis**:** **5 hrs**
Theory of thermogravimetry (TG), basic principle of instrumentation.Techniques for quantitative estimation of Ca and Mg from their mixture
Unit-4: Electroanalytical methods **5 hrs**
Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points.
Unit-5: Separation techniques **15 hrs**
Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation.Technique of extraction: batch, continuous and counter current extractions.Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. **Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC. Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios. reagents.**
Unit-6 Recent Advancements in Analytical Chemistry 4 hrs
Advance Techniques in UV and IR, LC-MS and it's application, 2-D NMR and uses

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Analytical Techniques and Instrumentation**
Course Code	BSCS1062

Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Basic analytical techniques**				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

The main purpose of this laboratory is to provide the students an appreciation for basic instrumental technique. It is also aimed to provide the students a degree of competence in the laboratory skills required for accurate and precise analysis. Therefore it is expected that the students will demonstrate proficiency in the theory underlying analytical techniques.

Course Outcomes

CO1	Determine quantitatively the strength of different samples using redox, complexometric and iodometric titrations. (K4)
CO2	Employ the water and food product analysis. (K3)
CO3	Analyze different acid base mixtures by conductivity measurements. (K4)
CO4	Estimation of iron in different food products by spectrophotometric analysis. (K4)
CO5	Illustrate different chromatographic technique for analysis and separation of mixtures. (K3)

Text Book (s)

1.Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.

2.Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

3. Dean, J. A. Analytical Chemistry Handbook, McGraw Hill, 2004.

4. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

Reference Books

1. Willard, H.H., Merritt, L.L., Dean, J. &Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988. 2

2. Skoog, D.A., Holler, F.J. & Crouch, S. Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.
3. Cooper, T.G. The Tools of Biochemistry, John Wiley & Sons, N.Y. USA. 16 (1977).

1. Redox Titration: To determine the strength of Ferrous ions in Mohr's Salt solution by titrating it against a known KMnO4 solution
2. Redox Titration:To determine the strength of Ferrous ions in Mohr's Salt solution by using the external indicator method
3. Complexometric Titration:Estimation of Calcium and Magnesium ions in Calcium carbonate sample by complexometric titration
4. Complexometric Titration:Estimation of Ni^{2+} ions in a given solution by the formation of Ni-DMG complex
5. Analysis of Water Sample: Estimation of total hardness in a given hard water sample.
6. Analysis of Water Sample: Determination of Dissolved Oxygen (DO) in a given water sample
7. Perform the following Conductometric **titrations:** i. Strong acid vs. strong base ii. Weak acid vs. strong base iii. Strong acid vs. weak base
8. Analysis of Food Products:Identification of adulterants in food items such as in Milk and Honey
9. Analysis of Food Products:Determining Vitamin C concentration in food products.
10. Chromatography: Paper chromatographic technique on separation of different mixtures.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	ORGANIC CHEMISTRY I				
Course Code	BSCC2001				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Basic knowledge of Organic Chemistry**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

The course develop a sound knowledge on Organic Chemistry.In this course to establish the applications of these concepts, the functional groups- alkanes, alkenes, alkynes and aromatic hydrocarbons- are introduced and the chemistry of these compounds will be explained with the help of various mechanism, reactions, energy diagrams and rules. The constitution of the course strongly aids in the paramount learning of the concepts and their applications.

Course Outcomes

CO1	**Explain the basics of organic compounds and various reaction involved in organic chemistry (K2)**
CO2	**Develop skills to Illustrate various stereochemical processes, projections, optical isomerism and nomenclature. (K3)**
CO3	**Identify the chemistry and reactions of aliphatic hydrocarbons. (K3)**
CO4	**Apply the basic understanding in conformational analysis of alkanes and cyclohexane. (K3)**
CO5	**Simplify basic principles and different chemical reactions of aromatic compounds. (K4)**
CO6	**Elaborate the knowledge of recent advancement in the field of organic chemistry. (K6)**

Reference Books:

1. **Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt.**

Ltd. (Pearson Education).

2. **Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).**
3. **Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry ofNatural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education.**
4. **Eliel, E. L. &Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London, 1994.**
5. **Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, New Age International, 2005.**
6. **McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning IndiaEdition, 2013.**

Unit-1: Basics of Organic Chemistry	10 hrs
Organic Compounds: **Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.** ***Electronic Displacements:*** **Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.**	
Unit-2:Stereochemistry	10 hrs
Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.	

***Optical Isomerism:* Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.**
Unit-3:Chemistry of Aliphatic Hydrocarbons-I 10 hrs
A. Carbon-Carbon sigma bonds **Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.** B. Carbon-Carbon pi bonds: **Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.** ***Reactions of alkenes:* Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.** ***Reactions of alkynes:* Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.**
Unit-4: Chemistry of Aliphatic Hydrocarbons-I 8 hrs
Cycloalkanes and Conformational Analysis **Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.**
Unit-5:Aromatic Hydrocarbon 8 hrs
Aromaticity: **Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.**
Unit-6: Recent Advancement in Organic Chemistry 4 hrs
Sustainable and Green Chemical reactions with applications

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	ORGANIC CHEMISTRY I LAB
Course Code	**BSCC2051**
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**
Corequisite	**Students should have fundamental knowledge of Organic chemistry**
Antirequisite	

	L	T	P	C
	0	**0**	**4**	**2**

Course Objectives:

Perform crystallization and determine boiling point and melting point of organic compound.

Course Outcomes

CO1	**Understand the basics of organic analysis and calibration of apparatus (K2).**
CO2	**Purification of organic compounds by crystallization method (K2).**
CO3	**Determination of boiling point and melting point of organic compounds (K2).**

CO4	**Separate the mixture of organic compounds by different chromatographic techniques (K3).**
CO5	**Measure the readings accurately and handle apparatus safely. K2**

Text Book (s)

Vogel's Textbook of Quantitative Chemical Analysis, Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C., 5th Edn., **Longman Scientific & Technical, England*, (John Wiley and Sons Inc, 605 Third Avenue, New York NY 10158).***

Reference Book (s)

- **Mann,F.G.&Saunders,B.C.*PracticalOrganicChemistry*,PearsonEducation (2009).**
- **Furniss,B.S.;Hannaford,A.J.;Smith,P.W.G.;Tatchell,A.R.*PracticalOrganic Chemistry*,5*th Ed.*,Pearson(2012)**

Unit-1
1.Checkingthecalibrationofthethermometer **2.Purificationoforganiccompoundsbycrystallizationusingthefollowingsolvents:** **a. Water** **b. Alcohol** **c. Alcohol-Water**
Unit-2
3. Determination of the melting points of above compounds and unknown organic compounds(meltingpointapparatus) **4. Effectofimpuritiesonthemeltingpoint–mixedmeltingpointof twounknownorganic compounds** **5.Determinationofboilingpointofliquidcompounds.(boilingpointlowerthanandmore than100°Cbydistillationandcapillarymethod)**
Unit-3
a. Separationofamixtureoftwoaminoacidsbyascendingandhorizontalpaper chromatography **b. Separationofamixtureoftwosugarsbyascendingpaperchromatography** **c. Separation ofamixtureofo-andp-nitrophenol oro-andp-aminophenol by thinlayerchromatography(TLC).**

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	**50**	**100**

Name of The Course	PHYSICALCHEMISTRY II				
Course Code	BSCC2002				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of Physical Chemistry**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

1. The aim of this course is to make students understand the concepts of energy, heat, work, enthalpy, entropy, free energies and the relation between them.
2. To apply these processes, extend the thermodynamic properties to the system of variable compositions, equilibrium and colligative properties.

Course Outcomes

CO1	**Demonstrate the concepts of thermodynamics. (K3)**
CO2	**Determine the enthalpy, its application and the factors affecting the enthalpy of the reaction. (K4)**
CO3	**Describe Partial molar quantities and thermodynamic functions. (K2)**
CO4	**Describe the different criteria of thermodynamic equilibrium and derive equilibrium constants. (K2)**
CO5	**Determine the factors affecting various colligative properties of the solution. (K4)**
CO6	**Elaborate the knowledge of recent advancement in the field of physical chemistry. (K6)**

Text Books

1. Atkins, P. W. & Paula, J. de ***Atkin's Physical Chemistry***10th Ed., Oxford University Press (2014).

Reference Books

1. Castellan, G. W. ***Physical Chemistry***4th Ed. Narosa (2004).
2. Engel, T. & Reid, P. ***Physical Chemistry***3rd Ed. Pearson (2013).
3. Levine, I .N. ***Physical Chemistry***6th Ed., Tata Mc Graw Hill (2010).

Unit-1 Chemical Thermodynamics	18 hrs
Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. **First law:Concept of heat, *q*, work, *w*, internal energy, *U*, and statement of first law; enthalpy, *H*, relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions.**	

Second Law:Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy; Calculation of entropy change for reversible and irreversible processes, Entropy changes for Ideal gas. **Third Law:Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions:Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. . Isotherms of real gases and their comparison with van der Waals isotherms**
Unit-2Thermochemistry 8 hrs
Hess's Law, Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's Law and equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.
Unit-3 Systems of Variable Composition 8 hrs
Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs- Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.
Unit-4 Chemical Equilibrium 8 hrs
Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants *Kp*, *Kc* and *Kx*. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.
Unit-5 Solutions and Colligative Properties 8 hrs **Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions.** **Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.**
Unit 6 Recent advancement in Physical chemistry 4 hrs
Solar Cells, Water treatment, Photochemistry

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	PHYSICAL CHEMISTRY II LAB				
Course Code	**BSCC2052**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of Physical Chemistry**				
Antirequisite					
		L	T	P	C
		0	**0**	**4**	**2**

Course Objectives:

Students will able to operate calorimeter to determine heat capacity and enthalpy of ionization.

Course Outcomes

CO1	**Determine the heat capacity using calorimetric technique. (K4)**
CO2	**Calculate the enthalpy of ionization of ethanoic acid. (K4)**
CO3	**Determine the enthalpy of hydration of copper sulphate. (K4)**
CO4	**Determine the basicity/proticity of polyprotic acid by thermochemical method. (K4)**
CO5	**Describe the solubility of benzoic acid and calculate the enthalpy value. (K2)**

Text Books

1. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R.Chand & Co.: New Delhi (2011).

Reference Books

1. Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New Age.

1. Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
2. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Calculation of the enthalpy of ionization of ethanoic acid.
4. Determination of heat capacity of the calorimeter and integral enthalpy (endothermic andexothermic) solution of salts.
5. Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
6. Determination of enthalpy of hydration of copper sulphate.

7. Study of the solubility of benzoic acid in water and determination of ΔH.

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	**50**	**100**

Name of The Course	INORGANIC CHEMISTRY II				
Course Code	**BSCC2003**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Basic knowledge of Inorganic Chemistry**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

To make students aware about the basic knowledge of Inorganic Chemistry.

Course Outcomes

CO1	**Illustrate the basic principles and processes of metallurgy. K2**
CO2	**Catergorize various classes of acids and bases adopting the basic concepts. K4**
CO3	**Interpret the properties and applications of s- and p- block elements. K2**
CO4	**Illustrate the structure, preparation and application of p-block elements.K2**
CO5	**Simplify the molecular shapes and properties of noble gas compounds.K4**
CO6	**Elaborate the recent development in the application of s and p block elements. K6**

Reference Books:

Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.

 Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994.

 Greenwood, N.N. & Earnshaw. Chemistry of the Elements, ButterworthHeinemann. 1997.

 Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999.

 Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

 Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4th Ed., Pearson, 2010. Atkin, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press

Unit-1: General Principles of Metallurgy	8 hrs
Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy, wet cyanide process for silver & gold. Methods of purification of metals: Electrolytic, van Arkel-de Boer process and Mond's process, Zone refining.	
Unit-2: Acids and Bases	8 hrs

Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB).
Unit-3: Chemistry of s and p block Elements 12 hrs
Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial.
Unit-4: Compounds p block Elements 12 hrs
Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Borates, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, and basic properties of halogens
Unit-5: Noble Gases 10 hrs
Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF2). Molecular shapes of noble gas compounds (VSEPR theory).
Unit-6: Application of s and p block elements and Noble gases 4 hrs
Recent advancement and development in field of compounds of s and p block elements and Noble gases.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	INORGANIC CHEMISTRY II LAB				
Course Code	BSCC2053				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge Inorganic Chemistry**				
Antirequisite					
		L	T	P	C
		0	**0**	**4**	**2**

Course Objectives:

To introduce different experiments to test basic understanding of Inorganic Chemistry.

Course Outcomes

CO1	**Estimate the strength of Copper using sodium thiosulphate solution.**
CO2	**Calculate the strength of Dissolved Oxygen in a given water sample.**
CO3	**Estimate the strength of available Chlorine in bleaching powder.**

CO4	**Estimate the amount of metals in a given sample complexometrically.**
CO5	**Synthesize various types of double salts.**

Reference Book (s)

Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

(A) Iodometric Titrations **(i) Estimation of Cu(II) using sodium thiosulphate solution.** **(ii) Estimation of dissolved oxygen in given sample of water.** **(iii) Estimation of available chlorine in bleaching powder.** (B) Complexometric Titrations **(i) Estimation of calcium in a given sample.** **(ii) Estimation of magnesium in a given sample.** **(iii) Estimation of zinc using EDTA solution.** (C) Inorganic preparations **(i) Mohr Salt** **(ii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.**

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	**50**	**100**

Name of The Course	**ORGANIC CHEMISTRY II**				
Course Code	BSCC2004				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Basic Concepts of Organic Chemistry**				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives: The objective is to study various mechanisms related to nucleophilic and electrophilic substitutions, structure, reactivity and preparation methods.

Course Outcomes

CO1	Identify and differentiate the mechanism of nucleophilic substitution reactions and eliminations reactions in alkyl halides and aryl halides along with the stereochemistry. (K3)
CO2	Explain the preparation and compare the properties and relative reactivity of 1°, 2°, 3° alcohols, phenols and ethers.(K2)

CO3	**Discuss Structure, reactivity and preparation; of carbonyl compounds and differentiate the Nucleophilic additions, and Nucleophilic addition-elimination reactions along with related named reactions.(K6)**
CO4	Analyze the preparation methods and properties of carboxylic acid derivatives. (K4)
CO5	Discuss the preparation methods and reactions of sulphur containing compounds. (K6)
CO6	Identify the role of different reaction mechanisms in recent development.(K3)

Text Book (s)

· Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

· Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

Reference Book (s)

· Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc.

· McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.

Unit-1 Chemistry of Halogenated Hydrocarbons:	**14hrs**
Alkyl halides: Methods of preparation, nucleophilic substitution reactions – S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.*Aryl halides*: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; SNAr, Benzyne mechanism.Relative reactivity of alkyl and aryl halides towards nucleophilic substitution reactions.Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.	
Unit-2 Alcohols, Phenols, Ethers and Epoxides:	**12 hrs**
Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;*Phenols*: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism; *Ethers and Epoxides*: Preparation and reactions with acid.	
Unit-3 Carbonyl Compounds	**12 hrs**

Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, Michael addition. Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.
Unit-4 Carboxylic Acids and their Derivatives **8 hrs**
Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of maleic and fumaric acids;Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmannbromamide degradation and Curtius rearrangement.
Unit-5 Sulphur containing compounds **4hrs**
Preparation and reactions of thiols, thioethers and sulphonic acids.
Unit-6 Recent applications of organic reaction mechanism 4 hrs
Identify the role of different reaction mechanisms in recent development

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**ORGANIC CHEMISTRY-II Lab**				
Course Code	BSCC2054				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Basic analytical techniques**				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course

Objectives: The objective is to analyse the presence of extra elements and functional groups in organic compounds.

Course Outcomes

CO1	Analyze qualitatively the presence of extra elements (K4).
CO2	Perform the tests of functional groups in unknown organic compounds (K4).
CO3	Identify the functional groups in unknown organic compounds (K4).
CO4	Handle the apparatus and perform the tests accurately.

Text Book (s)

· Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education(2009)

· Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical OrganicChemistry, 5th Ed., Pearson (2012)

Reference Book (s)

· Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis, University Press (2000).

· Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry:Qualitative Analysis, University Press (2000).

1. Detection of extra elements.
2. Functional group test for nitro, amine and amide groups.

3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds)

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	Industrial Chemistry				
Course Code	BBS05T5102				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as a major subject.**				
Co-requisite	**Students should have fundamental knowledge of Inorganic compounds and uses**				
Anti-requisite					
		L	T	P	C
		3	**0**	**0**	**3**

Course Objectives:

The course introduces learners to the diverse roles of inorganic materials in the industry. It gives an insight into how these raw materials are converted into products used in day to day life. Students learn about silicates, fertilizers, surface coatings, batteries, engineering materials for mechanical construction as well as the emerging area of nano-sized materials. The course helps develop the interest of students in the frontier areas of inorganic and material chemistry.

Course Outcomes

CO1	**Explain the composition and applications of the different kinds of glass.(K2)**
CO2	**State the composition of cement and discuss the mechanism of setting of cement. .(K3)**
CO3	**Explain the suitability of fertilizers for different kinds of crops and soil. (K2)**
CO4	E Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings. (K2)
CO5	**List and analyze the properties of engineering materials for mechanical construction used in day to day life. (K3)**
CO6	**Elaborate the recent advancements in Industrial Chemistry and analyze their fruitfulness for sustainable environment. (K6)**

Reference Books

West, A. R., Solid State Chemistry and Its Application, Wiley
Smart, L. E., Moore, E. A., Solid State Chemistry An Introduction CRC Press Taylor & Francis.
Rao, C. N. R., Gopalakrishnan, J. New Direction of Solid State Chemistry, Cambridge University Press.
Felder, R. M. and Rousseau, R.W., Elementary Principles of Chemical Processes, Wiley Publishers,

New Delhi, 2005.
Atkins, Peter, and Tina Overton. Shriver and Atkins' inorganic chemistry. Oxford University Press, USA, 2010.
Kingery, W. D., Bowen H. K. and Uhlmann, D. R. Introduction to Ceramics, Wiley Publishers, New Delhi, 1976.
Kent, J. A. (ed) Riegel's Handbook of Industrial Chemistry, 9 th Ed., CBS Publishers, New Delhi, 1997
Jain, P. C. and Jain, M. Engineering Chemistry, Dhanpat Rai & Sons, Delhi 2015
Gopalan, R., Venkappayya, D. and Nagarajan, S. Engineering Chemistry, Vikas Publications, New Delhi, 2004.
Sharma, B. K. Engineering Chemistry, Goel Publishing House, Meerut, 2015

Unit 1: Silicate Industries	5 hrs
Glass: **Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of glass wool and optical fibre.**	
Unit 2: Ceramics and Cement	5 hrs
Ceramics: **Brief introduction to types of ceramics. glazing of ceramics.** *Cement*: **Manufacture of Portland cement and the setting process, Different types of cements: quick settingcements, eco-friendly cement (slag cement), pozzolana cement.**	
Unit 3: Fertilizers	**5 hrs**
Different types of fertilizers (N, P and K). Importance of fertilizers, chemistry involved in the manufacture of the fertilizers, Biofertilizers and it's application	
Unit-4: Surface Coatings**:**	**15 hrs**
Brief introduction to and classification of surface coatings, paints and pigments: formulation, composition and related properties, pigment volume concentration (PVC)and critical pigment volume concentration (CPVC), fillers, thinners, enamels and emulsifying agents. Special paints: heat retardant, fire retardant, eco-friendly paints, plastic paints, water and oil paints. Preliminary methods for surface preparation, metallic coating (electrolytic and electroless with reference to chrome plating and nickel plating), metal spraying and anodizing, Lubricants and bioadditives.	
Unit-5: Engineering materials for mechanical construction	**10 hrs**
Classification, Composition, characteristics and applications of various types of irons, steels, thermoplastics, thermosets and composite materials and dendrimers.	
Unit-6: Future Trends of Industrial Chemistry	4 hrs
Biofuel and Bioenergy, Biodiesel and it's application, Advantages of Biolubricant, Biomass to Bioenergy.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	PHYSICAL CHEMISTRY-III

Course Code	BBS05T2101				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject.**				
Corequisite	**Students should have fundamental knowledge of Physical Chemistry**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

1. Understand concepts of phase, co-existence of phases, phase diagram, CST and distribution law.
2. Understand surface phenomenon, adsorption isotherms, BET Equation.
3. Apply and analyze the principles of Electrochemistry.

Course Outcomes

CO1	Understand the principles of phase equilibrium diagram for one and two component system with its applications. (K2)
CO2	Determine the theoretical and experimental methods of chemical kinetics. (K3)
CO3	Generalize different theories of adsorption and Illustrate different principles and mechanism of catalytic reactions. (K3)
CO4	Describe basic concepts of conductance and applications of conductance measurement (K2)
CO5	Solve the problems based on laws related to electrochemistry, solubility product and hydrolysis constant of salts and Calculate EMF of Cell (K3)
CO6	

Text Book (s)

- Peter Atkins & Julio De Paula, Physical Chemistry 10th Ed., Oxford University Press(2014)
- Castellan, G. W. Physical Chemistry, 4th Ed., Narosa (2004).
- McQuarrie, D. A. & Simon, J. D., Molecular Thermodynamics, Viva Books Pvt. Ltd.:New Delhi (2004).
- Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
- · Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP (2009).
- · Barrow, G. M., Physical Chemistry 5th Ed., Tata McGraw Hill: New Delhi (2006).

Unit-1 Phase Equilibria	**12 hrs**
Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications. **Phase diagrams for systems of solid-liquid equilibria, Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes.**	
Unit-2 Chemical Kinetics	**12 hrs**

Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and steady-state approximation in reaction mechanisms (iv) chain reactions. **Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates.**	
Unit-3 Surface chemistry and Catalysis	**08 hrs**
Physical adsorption, chemisorption, adsorption isotherms, Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.	
Unit-4 Conductance	**14hrs**
Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation. Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) Conductometric titrations, and (v) Hydrolysis constants of salts.	
Unit-5 Electrochemistry	**16 hrs**
Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers.	
Unit-6 Recent Advancement in Electrochemistry	**04 hrs**

Application of nanotubes and nanoparticles in electrochemistry towards biosensing, Electrochemistry towards Scanning Electron Microscopy

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	PHYSICAL CHEMISTRY -III LAB				
Course Code	**BBS05P2101**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry**				
Corequisite	**Students should have fundamental knowledge of Physical Chemistry.**				
Antirequisite					
		L	T	P	C
		0	**0**	**4**	**2**

Course Objectives:

1. **Measure critical temperature, distribution co-efficient and study the kinetics of reactions.**
2. **Study of Potentiometric titrations of a combination of different types of solutions.**

Course Outcomes

CO1	Determine the composition and critical solution temperature for phenol-water system.(K4)
CO2	Estimate the distribution of acetic/benzoic acid between water and cyclohexane. (K3)
CO3	Determine the kinetics of different chemical reaction and Asses Freundlich and Langmuir isotherms for adsorption. (K4)
CO4	Measure equivalent conductance, degree of dissociation and dissociation constant of a weak acid conductometrically. (**K3**)
CO5	Perform various types of Potentiometric titrations. (**K4**)

Text Book (s)

 Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

 Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).

 Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

I. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it. **II. Distribution of acetic/ benzoic acid between water and cyclohexane.**

III. Study the kinetics of the following reactions.

a. Acid hydrolysis of methyl acetate with hydrochloric acid.

b. Saponification of ethyl acetate.

IV. Adsorption: Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

V. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

VI. Perform the following Potentiometric **titrations:**

i. Strong acid vs. strong base

ii. Weak acid vs. strong base

iii. Dibasic acid vs. strong base

iv. Potassium dichromate vs. Mohr's salt

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	**50**	**100**

Name of The Course	INORGANIC CHEMISTRY-III
Course Code	BSCC2006
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**
Corequisite	**Students should have fundamental knowledge of Inorganic Chemistry**
Antirequisite	

L	T	P	C
4	**0**	**0**	**4**

Course Objectives:

The course introduces the students to coordination compounds which find manifold applications in diverseareas like qualitative and quantitative analysis, metallurgy, as catalysts in industrial processes as medicines,paints and pigments as well as in life. The student is also familiarized with the d and f block elements and gets an idea about horizontal similarity in a period in addition to vertical similarity in a group.

Course Outcomes

CO1	**Illustrate about basic concepts of various theories in Coordination chemistry (K2)**
CO2	**Analyze different properties of complex compounds on the basis theories of coordination chemistry. (K4)**
CO3	**Generalize the various properties and chemistry of some important transition metal compounds. (K3)**
CO4	**Describe the properties of Lanthanoids and Actinoids. (K2)**
CO5	**Determine the different reaction rates, kinetics and reaction mechanisms. (K4)**
CO6	**Elaborate the recent advancements in Coordination chemistry. (K6)**

Text Book (s)

Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.

Reference Book (s)

- **Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977.**
- **Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing Company 1994.**
- **Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry Wiley-VCH, 1999**
- **Basolo, F, and Pearson, R.C. Mechanisms of Inorganic Chemistry, John Wiley & Sons, NY, 1967.**
- **Greenwood, N.N. & Earnshaw A. Chemistry of the Elements, ButterworthHeinemann, 1997.**

Unit-1 Coordination Chemistry I	6 hrs
Werner's theory, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding.	
Unit-2 Coordination Chemistry II	10 hrs
Crystal field theory, measurement of Δo. Calculation of CFSE in weak and strong fields, concept of pairing energies, factors affecting the magnitude of Δo. Evidences of CFT. Jahn-Teller theorem, octahedral, square planar geometry. Qualitative aspect of Ligand field and MO Theory.	
Unit-3 Transition Elements	14 hrs
General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states. Difference between the first, second and third transition series. Chemistry of Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy). Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, $K_3[Fe(CN)_6]$, $Na_2[Fe(CN)_5NO]$, $Na_3[Co(NO_2)_6]$, $[Co(NH_3)_6]Cl_3$.	
Unit-4 Lanthanoids and Actinoids	8 hrs
Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanoide contraction, separation of lanthanoides (ion-exchange method only).	
Unit-5 Reaction Kinetics and Mechanism	12hrs
Introduction to inorganic reaction mechanisms, Substitution reactions in square planar complexes, Trans effect, theories of trans effect, Thermodynamic (Chelate, HSAB) and Kinetic stability (Labile and Inert), Kinetics of octahedral substitution, Ligand field effects and reaction rates.	
Unit-6 Recent Advancements in Coordination Chemistry	4 hrs
N-donor ligands in coordination chemistry, Heteroaromatic alcohol as Ligands, coordination clusters and coordination polymers	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	INORGANIC CHEMISTRY III LAB				
Course Code	BSCC2056				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of Inorganic Chemistry**				
Antirequisite					
		L	T	P	C
		0	**0**	**4**	**2**

Course Objectives:

Students will able to perform gravimetric analysis and synthesize complex compounds.

Course Outcomes

CO1	**Analyze the concept of gravimetric analysis. (K3)**
CO2	**Estimate the amount of different ions gravimetrically. (K5)**
CO3	**Synthesize different inorganic coordination complexes. (K6)**
CO4	**Analyze the principles involved in chromatographic separations. (K3)**
CO5	**Employ paper chromatographic technique for separation of metal ions. (K3)**

Text Book (s)

Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

1. Estimation of nickel (II) using Dimethylglyoxime (DMG).
2. Estimation of copper as CuSCN
3. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
4. Preparations of Tetraamminecopper(II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$
5. Preparations of Cis and trans $K[Cr(C_2O_4)_2.(H_2O)_2]$ Potassium dioxalatodiaquachromate (III)
6. Preparations of Potassium tris(oxalato)ferrate(III)
7. Chromatographic separations by paper chromatographic separation of Ni (II) and Co (II)
8. Paper chromatographic separation of Cu (II) and Cd (II)

Continuous Assessment Pattern

Internal Assessment (IA)	External Exam (ETE)	Total Marks
50	**50**	**100**

Name of The Course	**ORGANIC CHEMISTRY III**

Course Code	**BSCC2007**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of Organic Chemistry**				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives: The objective is to study the preparation methods and chemical & medicinal properties of nitrogen containing compounds, polynuclear hydrocarbons, heterocyclic compounds, alkaloids & terpenes.

Course Outcomes

CO1	Illustrate preparation methods and chemical properties of nitrogen containing compounds. (K3)
CO2	Determine structure and preparation methods of polynuclear hydrocarbons. (K2)
CO3	Generalize classification, synthesis methods and reaction. mechanisms of heterocyclic compounds. (K3)
CO4	Determine structure, preparation methods, properties and medicinal importance of alkaloids**.(K3)**
CO5	Deduce the structures of various terpenes along with their synthetic methods**. (K3)**
CO6	Compile the recent therapeutic uses of Alkaloids and Terpenes. (K6)

Text Book (s)

· Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India)Pvt. Ltd. (Pearson Education).

· Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd.(Pearson

Education).

· Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry ofNatural Products),

Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

· Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, JohnWelly & Sons (1976).

Reference Book (s)

Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc.

· McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage LearningIndia Edition, 2013.

· Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P)Ltd. Pub.

· Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.

· Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, Prajati Parakashan(2010).

Unit-1 Nitrogen Containing Functional Groups	**16 hrs**
Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications.	
Unit-2 Polynuclear Hydrocarbons	**6 hrs**
Reactions of naphthalene, phenanthrene and anthracene Structure, Preparation and structure elucidation.	
Unit-3 Heterocyclic Compounds	**17 hrs**
Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, DoebnerMiller synthesis. Derivatives of furan: Furfural	
Unit-4 Alkaloids	**5 hrs**
Natural occurrence, General structural features, Isolation and their physiological action, Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Nicotine. Medicinal importance of Nicotine, Quinine, Morphine, Cocaine, and Reserpine.	
Unit-5 Terpenes	6 hrs
Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and α-terpineol.	
Unit-6 Recent advancement in Natural Product Chemistry	**4 hrs**
Advance Therapeutic use of Alkaloids and Terpenes, Advance use of Heterocyclic compounds	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**ORGANIC CHEMISTRY III Lab**				
Course Code	BSCC2057				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Basic knowledge of Organic Chemistry**				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives: The objective is to synthesize different organic compounds.

Course Outcomes

CO1	Prepare acetyl derivatives of amines both by conventional and green method.(K3)
CO2	Prepare acetyl derivatives of phenols both by conventional and green method.(K3)
CO3	**Synthesize benzoyl derivatives of anilines and phenols.(K5)**
CO4	**Synthesize nitro derivative of salicylic acid both by conventional and green method.(K5)**
CO5	Produce hydrolyzed derivative of ester or amide and semicarbazide derivatives of carbonyl compounds.(K3)

Text Book (s)/ Reference Books

 Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)

 Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012)

 Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

 Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

Organic preparations:

i. Acetylation of one of the following compounds: amines (aniline, o-, m-, p-toluidines and o-, m-, p-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method:

a. Using conventional method. **b. Using green approach** **ii. Benzolyation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and one of the following phenols (β-naphthol, resorcinol, pcresol) by Schotten-Baumann reaction.** **iii. Nitration of any one of the following:** **a. Acetanilide/nitrobenzene by conventional method** **b. Salicylic acid by green approach (using ceric ammonium nitrate).** **iv. Hydrolysis of amides and esters.** **v. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.** **The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.**

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	Green Chemistry				
Course Code	BSCC 2101				
Prerequisite	**Students should have the basic knowledge of various green chemistry principles and various other alternate methods that can be opted in place of the conventional methods.**				
Co-requisite	**This course involves the basic understanding about various green chemistry principles, alternate routes, designing of green reactions and the future trends.**				
Anti-requisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

Course Outcomes

CO1	**Identify the scope of environmental studies and its need in present day society. (K3)**
CO2	**Illustrate the 12 basic principles of Green Chemistry. (K2)**
CO3	**Explain the upcoming new trends in green chemistry synthesis and some real world experiences. (K2)**

CO4	**Identify the use of Microwaves and Ultrasonic waves in Green Chemistry. (K3)**
CO5	**Analyze the role of sustainable development in Green Chemistry. (K4)**
CO6	**Compile the various latest green technologies based on green chemistry principles. (K6)**

Text Book (s)

- **Ahluwalia, V.K. & Kidwai, M.R.** ***New Trends in Green Chemistry*****, Anamalaya Publishers (2005).**
- **Anastas, P.T. & Warner, J.K.:** ***Green Chemistry - Theory and Practical*****, Oxford University Press (1998).**
- **Matlack, A.S.** ***Introduction to Green Chemistry*****, Marcel Dekker (2001).**
- **Cann, M.C. & Connely, M.E.** ***Real-World cases in Green Chemistry*****, American Chemical Society, Washington (2000).**

Reference Book (s)

- **Ryan, M.A. & Tinnesand, M.** ***Introduction to Green Chemistry*****, American Chemical Society, Washington (2002).**
- **Lancaster, M.** ***Green Chemistry: An Introductory Text*** **RSC Publishing, 2nd Edition, 2010.**

Unit 1 Introduction to Green Chemistry	6 hrs
What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.	
Unit 2 Principles of Green Chemistry and Designing a Chemical synthesis	15 hrs
Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following: • **Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.** • **Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent.** • **Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy.** • **Use of catalytic reagents, comparison of heterogeneous and homogeneous catalysis.** • **Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD, subdivision of ISD, minimization, simplification, substitution, moderation and limitation.** • **Strengthening/ development of analytical techniques to prevent and minimize the**	

generation of hazardous substances in chemical processes.	
Unit-3 Green Synthesis of Some compounds	5 hrs
Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis).	
Unit-4: Green Reactions and some real world cases	10 hrs
1. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; Diels-Alder reaction and Decarboxylation reaction. **2. Ultrasound assisted reactions: Sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine)** **3. Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO2 for precision cleaning and dry cleaning of garments.**	
Unit-5 Sustainable development and future trends	8 hrs
Oxidation reagents and catalysts; Biomimetic, multifunctional reagents, Green chemistry in sustainable development and Zero Waste Technology, innovative products.	
Unit-6 Latest advancements in Green chemistry and technology	6hrs
Negative effect of heavy metals on humans and environment, Future status of green chemistry, Green and sustainable future of science and technology, Green economy.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Course Code	Course Name	L	T	P	C
BBS09T2411	RESEARCH METHODOLOGY AND STATISTICS	2	0	0	2

Course Objective: **The objective of the course is to impart research based knowledge to the students. They would be taught the various ways of data collection, research methodologies adopted in different settings, and statistical methods.**

Course Outcome:

CO1	**Students will get separately familiar with terms research and methodology, respectively.**
CO2	**Identifying different type of research sampling and research design.**
CO2	**Students will understand raw data, primary data, secondary data and their different methods of collection.**
CO4	**Students will appraise the application of sampling through statistics.**

CO5	**Students will get familiar with different descriptors of statistics to analyse data both quantitatively and qualitatively.**
CO6	**Students will develop the statistical analysis indulges in modern research for drug designing.**

Text & References:

- **Broota, K. D., Experimental designs in psychological research, Wiley eastern, New York, 1992.**
- **Guilford, Statistics in Psychology and Education, McGraw Hill, New York, 1986.**
- **J T Walker, Statistics in Criminology and Criminal Justice analysis and Interpretation**
- **Leo, A., & Hoekman, D. H. (1995). *Exploring QSAR*. American Chemical Society.**
- **Chanin Nantasenamat, Chartchalerm Isarankura-Na-Ayudhya, Thanakorn Naenna, Virapong Prachayasittikul, A Practical Overview of Quantitative Structure- Activity Relationship. EXCLI Journal 2009;8:74-88.**
- **Wiktor Pronobis, Alexandre Tkatchenko, and Klaus-Robert Muller, J. Chem. Theory Comput. 2018, 14, 2991−3003**

Unit-1: Introduction to Research Methodology 6 hrs **Definition, concept and research in science; Introduction to Research Methodology, Research methodology in science.**
Unit-2 : Research in Scientific and Social Settings 5hrs **Research Design: Research Sampling, rationale for using a particular sampling procedure, Probability.**
Unit-3: Tools of Data Collection 5hrs **Data and its types, Methods for Collecting Data, Observation method, Questionnaire, Other Methods**
Unit- 4: Introduction to Statics 4hrs **Introduction to statistics (Biostatistics); Sample and Population, parametric and non parametric statistics.**
Unit- 5: Descriptive Statistics 5hrs **Measures of central tendency; Measures of dispersion and deviation; graphical representation of the data.Correlation and Regression**
Unit 6: Recent research advances 3 hrs **Descriptors, Quantitative structure-activity relationship (QSAR) , Quantitative structure-property relationship(QSPR), Drug designing.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Organic Chemistry IV
Course Code	**BSCC3001**

Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of Organic Chemistry**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

The focus area of this course is on the chemistry of biomolecules i.e. amino acids, peptides, proteins, enzymes, carbohydrates and lipids. Through the study of energetics in biological systems, it aims to build the concept of metabolism for biological systems more lucid.

Course Outcomes

CO1	**Describe the components structure and reaction of nucleic acid. (K2)**
CO2	**Illustrate the classification, synthesis, structure and properties of amino acids. (K3)**
CO3	**Determine the mechanism of enzyme action and role different factors. (K3)**
CO4	**Categorize the Carbohydrates and their biological importance (K2)**
CO5	**Illustrate the metabolism, formation and mechanism of ATP to understand the concept of energy in biosystems. (K3)**
CO6	**Compile the advance therapeutic uses of different biomolecules. (K6)**

Reference Books:

1. **Berg, J.M., Tymoczko, J.L. &Stryer, L. (2006) *Biochemistry*. 6th Ed. W.H. Freeman and Co.**
2. **Nelson, D.L., Cox, M.M. &Lehninger, A.L. (2009) *Principles of Biochemistry. IVEdition.* W.H. Freeman and Co.**
3. **Murray, R.K., Granner, D.K., Mayes, P.A. &Rodwell, V.W. (2009) *Harper'sIllustrated Biochemistry*. XXVIII edition. Lange Medical Books/ McGraw-Hill.**
4. **Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.**
5. **Arthur, I. V. *Quantitative Organic Analysis,* Pearson.**

Unit 1 Nucleic Acids	8 hrs
Components of nucleic acids, Nucleosides and nucleotides;Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.	
Unit 2 Amino Acids, Peptides and Proteins	12 hrs
Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, p*K*a values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups -Solid-phase synthesis.	
Unit 3 Enzymes	8 hrs

Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes.Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).
Unit 4 Carbohydrates 10hrs
Occurrence, classification and their biological importance.Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani- Fischer synthesis and Ruff degradation;Disaccharides – Structure elucidation of maltose, lactose and sucrose.Polysaccharides – Elementary treatment of starch, cellulose and glycogen.
Unit 5 Lipids & Concept of Energy in Biosystems 10hrs
Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenntion of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity. Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism). ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change. Agents for transfer of electrons in biological redox systems: NAD^+, FAD.Conversion of food to energy: Outline of catabolic pathways of carbohydrate- glycolysis, fermentation, Krebs cycle. Overview of catabolic pathways of fat and protein. Interrelationship in the metabolic pathways of protein, fat and carbohydrate. Caloric value of food, standard caloric content of food types.
Unit 6 Bio-medical Applications of Biomolecules (4 lectures)
Recent advances in Biomolecules as therapeutic Agents

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Experiment 1. **Estimation of glycine by Sorenson's formalin method.**
Experiment 2. **Study of the titration curve of glycine.**
Experiment 3. **Study of the action of salivary amylase on starch at optimum conditions.**
Experiment 4. **Effect of temperature on the action of salivary amylase.**
Experiment 5. **Saponification value of an oil or a fat.**
Experiment 6. **Determination of Iodine number of an oil/ fat**
Exp.7. **Extraction of caffeine from tea leaves.**

Exp.8. **Preparation of sodium polyacrylate.**
Exp.9. **Preparation of methyl orange.**

Course Objectives:

Students will able to estimate amino acids and determine saponification value and Iodine number of an oil or a fat

Course Outcomes

CO1	**Estimation and titration of gycine. (K4)**
CO2	**Analyze the action and effect of temperature of amylase. (K3)**
CO3	**Determine the saponification value and Iodine number of an oil or a fat. (K4)**
CO4	**Extract and characterize organic compounds from plant products (K5)**
CO5	**Prepare and Characterize different dyes. (K5)**

Text Book (s)/ Reference Book (s)

- **Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.**

Name of The Course	ORGANIC CHEMISTRY -IV LAB				
Course Code	BBS05P3101				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of Organic Chemistry**				
Antirequisite					
		L	T	P	C
		0	**0**	**4**	**2**

- Arthur, I. V. *Quantitative Organic Analysis*, Pearson

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	**50**	**100**

Name of The Course	Physical Chemistry IV				
Course Code	BSCC3002				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of Physical Chemistry**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

1. The objective of this course is to identify the limitations of classical mechanics and the need of quantum chemistry.
2. To familiarize the students with postulates of quantum chemistry and apply them to derive equations for various models and hydrogen atoms.

Course Outcomes

CO1	D Describe fundamentals concepts of quantum mechanics and its applications. (K2)
CO2	**Determine the properties and shape of molecules by various theories of chemical bonding. (K3)** **bonding.**
CO3	Distinguish the electromagnetic radiation with molecules and various types of spectra. (K4)
CO4	Apply the method of various spectroscopic techniques for characterization and analysis. (K3)
CO5	E Explain photochemical reactions with example. (K2)
CO6	D Compile recent advancements in different field of physical chemistry(K6)

Text Book (s)/Reference Book (s)

1. Banwell, C. N. &McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).
3. House, J. E. *Fundamentals of Quantum Chemistry* 2nd Ed. Elsevier: USA (2004).
4. Kakkar, R. *Atomic & Molecular Spectroscopy*: *Concepts & Applications*, Cambridge University Press (2015).
5. Lowe, J. P. & Peterson, K. *Quantum Chemistry*, Academic Press (2005).

Unit 1 Quantum Chemistry 12 hrs
Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy.Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. Rigid rotator model of rotation of diatomic molecule.Schrödinger equation, transformation to spherical polar coordinates.Separation of variables. Spherical harmonics. Discussion of solution .Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. **Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).**

Unit 2 Chemical bonding: 10 hrs
Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of $H2^+$. Bonding and antibonding orbitals.Qualitative extension to H2. Comparison of LCAO-MO and VB treatments of H2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB).Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH).Localised and non-localised molecular orbitals treatment of triatomic (BeH2, H2O) molecules. Qualitative MO theory and its application to AH2 type molecules.
Unit 3 Molecular Spectroscopy I: 10 hrs
Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. **Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.** **Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.**
Unit 4 Molecular Spectroscopy II: 10 hrs
Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. **Electronic spectroscopy: Franck-Condon principle, Morse potential energy curve for diatomic molecules, electronic transitions, singlet and triplet states, terms, symbols, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model, Walsh Diagrams.** **Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.** **Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.**
Unit 5 Photochemistry 8 hrs

Name of The Course	PHYSICAL CHEMISTRY -IV LAB				
Course Code	BSCC3052				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry**				
Corequisite	**Students should have fundamental knowledge of Physical Chemistry**				
Antirequisite					
		L	T	P	C
		0	**0**	**4**	**2**

Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.
Unit 6 Recent Advancement in Physical Chemistry 04 hrs
Comparative study of classical, statistical and quantum mechanics, applications of spectroscopic and photochemical techniques

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Course Objectives:

Students will able to operate UV spectrophotometer and Colorimeter.

Course Outcomes

CO1	**Recognize basic laboratory rules and basic principles of lab safety. (K2)**
CO2	**Operate the UV/Visible spectroscopy and analyse, determine theparameter of solutions. (K4)**
CO3	**Estimate the 200-350 nm UV spectra of the given compounds in water. (K3)**
CO4	**Determine the concentrations, kinetics and dissociation constant by using Colourimetry. (K4)**
CO5	Perform colorimetric analysis of compounds using UV spectrophotometer. (K4)

Text Book (s)/Reference Book (s)

- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in PhysicalChemistry 8th Ed.;* McGraw-

Hill: New York (2003).

- Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rdEd.;* W.H. Freeman & Co.: New York (2003).

UV/Visible spectroscopy
Experiment 1. **Study the 200-500 nm absorbance spectra of KMnO4 and K2Cr2O7 (in 0.1 M H2SO4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).**
Experiment 2. **Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of K2Cr2O7.**
Experiment 3. **Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.**
Colourimetry
Experiment 4. **Verify Lambert-Beer's law and determine the concentration of CuSO4/KMnO4/K2Cr2O7 in a solution of unknown concentration** .
Experiment 5. **Determine the concentrations of KMnO4 and K2Cr2O7 in a mixture.**
Experiment 6. **Study the kinetics of iodination of propanone in acidic medium.**
Experiment 7. **Determine the amount of iron present in a sample using 1,10-phenathroline.**
Experiment 8.**Determine the dissociation constant of an indicator (phenolphthalein).**
Experiment 9.**Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.**
Experiment 10. **Analysis of the given vibration-rotation spectrum of HCl(g).**

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	**50**	**100**

Name of The Course	INORGANIC CHEMISTRY IV				
Course Code	**BSCC3003**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have the basic knowledge of Inorganic chemistry**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

1. **To impart the knowledge of key concepts of Organometallic compounds**
2. **To present a comprehensive introduction to inorganic chemistry.**

Course Outcomes

CO1	**Analyze the inorganic cations , anions and solubility products. K4**
CO2	**Illustrate the structures of mononuclear and binuclear carbonyls and its MO diagram. K3**
CO3	**Correlate the basic reactions and concept of metal alkyls and ferrocene. K4**
CO4	**Determine the beneficiary and toxic role of ions in biological and medicinal system. K4**
CO5	**Illustrate the catalytic properties of Organometallic in industrial processes. K3**
CO6	**Discuss the recent development in field of organometallic compounds. K6**

Text Book (s)

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall, 1996.
- Cotton, F.A.G.; Wilkinson & Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.;* Wiley India,
- Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson,2006.
- Sharpe, A.G. *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005
- Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry3rd Ed.*, John Wiley and Sons, NY, 1994.
- Greenwood, N.N. & Earnshaw, A. *Chemistry of the Elements*, *Elsevier 2nd Ed*, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).

Reference Book (s)

- . Lee, J.D. *Concise Inorganic Chemistry 5th Ed.*, John Wiley and sons 2008.
- Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.
- Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
- Basolo, F. & Pearson, R. *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed.*, John Wiley & Sons Inc; NY.
- Purcell, K.F. & Kotz, J.C., *Inorganic Chemistry*, W.B. Saunders Co. 1977
- Miessler, G. L. & Tarr, D.A. *Inorganic Chemistry 4th Ed.*, Pearson, 2010.
- Collman, J. P. *et al. Principles and Applications of Organotransition Metal Chemistry*. Mill Valley, CA: University Science Books, 1987.
- Crabtree, R. H. *The Organometallic Chemistry of the Transition Metals*. *j* New York, NY: John Wiley, 2000.
- Spessard, G. O. & Miessler, G.L. *Organometallic Chemistry*. Upper Saddle River, NJ: Prentice-Hall, 1996.

Unit-1 :Theoretical Principles in Qualitative Analysis (H_2S Scheme) 14 hrs
Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II. Analysis of anions and cations.

Unit-2 Organometallic Compounds	10 hrs
Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. □-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.	
Unit-3 Metal Alkyls and Aryls	8 hrs
Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Aromaticity. Comparison of aromaticity and reactivity with that of benzene.	
Unit-4 Bioinorganic Chemistry	10 hrs
Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.Iron and its applications in bio-systems, Haemoglobin; Storage and transfer of iron.	
Unit-5 Catalysis by Organometallic Compounds	8 hrs
Study of the following industrial processes and their mechanism:1. Alkene hydrogenation (Wilkinsons Catalyst), 2. Hydroformylation (Co salts)3. Wacker Process, 4. Synthetic gasoline (Fischer Tropsch reaction)5. Synthesis gas by metal carbonyl complexes	
Unit -6 Application of organometallic compounds	4 hrs
Recent Advancement and development in the field organometallic compounds and their uses.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	INORGANIC CHEMISTRY IV Lab
Course Code	**BSCC3053**
Prerequisite	**Students should have the knowledge of atoms, elements, anions and cations.**
Corequisite	

Antirequisite					
		L	T	P	C
		0	**0**	**4**	**2**

Course Objectives:

1. **To impart the knowledge of key concepts of analysis of cations and anions.**
2. **To present a comprehensive introduction to inorganic chemistry.**

Course Outcomes

CO1	**Analyze qualitatively the mixtures containing anions and cations. K4**
CO2	**Evaluate the spot tests by spectrophotometric method. K5**
CO3	**Synthesis of inorganic complexes and its Ligand exchange reactions. K5**
CO4	**Test the spectrochemical series. K4**
CO5	**Synthesize Ammine complex of Ni(II) and its ligands. K5**

Text Book (s)

- Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education, 2002.
- Marr & Rockett *Practical Inorganic Chemistry*. John Wiley & Sons 1972.

Reference Book (s)

- Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education, 2002.

Unit-1 :
Qualitative semi micro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested: **CO_3^{2-}, NO_2^-, S_2^-, SO_3^{2-},$S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, K^+,Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+},Sr^{2+}, Ca^{2+}, Mg^{2+}**
Unit-2
Mixtures should preferably contain one interfering anion, or **insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3)** or **combination of anions e.g. $CO_3^{2-}$and SO_3^{2-}, NO^{2-} and NO^{3-}, Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO^{3-} and Br^-, NO^{3-} and I^-.** **Spot tests should be done whenever possible.**
Unit-3
Measurement of 10 Dq by spectrophotometric method
Unit-4
Verification of spectrochemical series
Unit-5
Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	**50**	**100**

Name of The Course	ORGANIC CHEMISTRY V				
Course Code	BSCC3004				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Students should have fundamental knowledge of Organic Chemistry**				
Antirequisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

The core course of Organic Chemistry V deals with some classes of organic compounds finding applications in everyday life namely; polymers, dyes, lipids and pharmaceutical compounds. The chemistry of these compounds in general will be explained through naturally occurring and synthetic compounds. The course also introduces the learner to various tools and techniques for identifying and characterizing the organic compounds through their interactions with electromagnetic radiation viz. IR, NMR and UV- Visible spectroscopy

Course Outcomes

CO1	1. Explain the concepts of UV,IR and NMR spectra of simple organic molecules. (K2)
CO2	**Analyze and apply UV,IR and NMR spectroscopy for identification of organic compounds. (K4)**
CO3	3. Generalize the Classification, structure and therapeutic uses of pharmaceutical compounds. (K2)
CO4	4. Compare synthetic and natural dyes with their structure elucidation. (K4)
CO5	5. Demonstrate different types of polymer and characterize them. (K2)
CO6	**Elaborate Modern Spectroscopic techniques & its applications .(K6)**

Text Book (s)/Reference Book (s)

- Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
- Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
- Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Graham Solomons, T.W. *Organic Chemistry,* John Wiley & Sons, Inc.
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry,* Oxford University Press.
- Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Prakashan (2010). Kemp, W. *Organic Spectroscopy*, Palgrave.
- Pavia, D. L. *et al. Introduction to Spectroscopy* 5th Ed. Cengage Learning India Ed.2015

Unit-1 Organic Spectroscopy I 12 hours
General principles Introduction to absorption and emission spectroscopy.   ***UV Spectroscopy:*** **Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α,β unsaturated aldehydes, ketones,carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.**   ***IR Spectroscopy:*** **Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.**
Unit-2 Organic Spectroscopy II 8 hours
NMR Spectroscopy: **Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds. Applications of IR, UV and NMR for identification of simple organic molecules**
Unit-3 Pharmaceutical Compounds: Structure and Importance 10 hrs
Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).
Unit-4 Dyes 8 hrs
Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.
Unit-5 Polymers 12 hrs
Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index. Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene);

Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.
Unit-6 Modern Spectroscopic techniques 8hrs
Raman Spectroscopy: Standard Raman Spectroscopy vs Resonance-enhanced Raman Spectroscopy , Mass Spectrometry-: Introduction of theory, ionization methods, molecule fragmentation & applications, Photoelectron spectroscopy: x-ray and Auger photoelectron spectroscopy & applications

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Battery Technology				
Course Code	**BBS05T5103**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject**				
Corequisite	**Basic knowledge of Thermodynamics, Chemical Kinetics and Electrochemistry.**				
Antirequisite					
		L	T	P	C
		3	**0**	**0**	**3**

Course Objectives:

To impart knowledge of advanced electrochemistry and relevant analytical techniques

Course Outcomes

CO1	E Explain the basic physical concepts of thermodynamics and kinetics involved in electrochemical reactions (**K2**)
CO2	Ill Illustrate the characterization methods of batteries and interpret concepts describing battery performance (**K2**)
CO3	**Interpret the recent developments battery systems.** (K3)
CO4	**Analyze the requirements of battery systems for automotive applications and understand the modelling of battery systems** (K4)
CO5	**Explain solar energy conversion in terms of nanotechnology** (K2)
CO6	**Compile the recent advanced technologies adopted by Battery Industry. (K6)**

Reference Book (s)

1. T.Minami, M.Tatsumisago,M.Wakihara,C. Iwakura,S. Kohijiya, Solid state ionics for batteries, Springer Publication, 2009
2. Sandeep Dhameja, Electric Vehicle Battery Systems, Newnes publication, 2001
3. Bard, Allen J., and Larry R. Faulkner. Electrochemical Methods: Fundamentals and Applications. 2nd ed.,Wiley– VCH, Verlag, GmbH, 2000

4. Masataka Wakihara and Osamu Yamamoto, Lithium ion Batteries Fundamental and Performance,Wiley–VCH, Verlag GmbH, 1999
5. Robert A.Huggins, Advanced Batteries – Materials science aspects,Springer, 2009
6. Nanoscience and Nanotechnology: Fundamentals of Frontiers by M.S. Ramachandra Rao, Shubra Singh
7. Introduction to Nanotechnology By Charles P. Poole, Jr., Frank J. Owens.

Unit-1 Introduction to Electrochemical energy storage	8 hrs
Introduction to battery technologies, Electromotive force- Reversible cells- Relation between electrical energy and energy content of a cell-Free energy changes and electromotive force in cell- Current challenges in Energy storage Technologies.	
Unit-2 Major Battery Chemistry Development and testing	10 hrs
Battery performance evaluation- Primary battery - Service time- Voltage data- Service life – ohmic load curve- Effect of operating temperature on service life. Secondary batteries- Discharge curves, Terminal voltages- Plateau voltage –Lead acid Batteries – Construction and application.	
Unit-3 Recent Technologies	10 hrs
Recent development of electrode materials in lithium ion batteries- Recent development of solid electrolytes and their application to solid state batteries-Polymer solid electrolytes for lithium ion conduction– Thin Film solid state Batteries: Fundamentals, Constriction and application – Super Capacitors: Fundamental, Construction and application.	
Unit-4 Batteries for Automotives – Future prospects	8 hrs
Degrees of vehicle electrification - Battery size vs. application -USABC and DOE targets for vehicular energy storage systems - Analysis and Simulation of batteries - Equivalent circuit and life modeling – Environmental concerns in battery production – recycling of batteries	
Unit-5 Improvements in solar energy conversion and storage	10 hrs
Better energy-efficient lighting; stronger and lighter materials that will improve energy transportation efficiency; Energy Storage: Fuel Cells, Carbon Nanotubes for energy storage, Hydrogen Storage in Carbon Nanotubes, Use of nanoscale catalysts to save energy and increase the productivity in industry, Rechargeable batteries based on Nanomaterials, Nanoscale optical, liquid crystal and magnetic devices	
Unit-6 Future Trends of Battery Technology	4 hrs
Recent Advance technology adopted in Battery Industry	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	NOVEL INORGANIC SOLIDS
Course Code	BSCC 3102
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry**
Co-requisite	**Students should have fundamental knowledge of Inorganic chemistry**
Anti-requisite	

	L	T	P	C
	4	**0**	**0**	**4**

Course Objectives:

Solid-state chemistry also referred as material chemistry currently has emerged with great focus on novelinorganic solids. It has found enormous applications in both industrial and research arenas and have helped toshape modern day recyclable adsorbents and catalysts. Novel inorganic-organic hybrid nanocomposites havereceived a lot of attention because of their abundance and cost-effective nature they can be utilized ascatalysts, as a nano reactor to host reactants for synthesis and for the controlled release of biomolecules.Materials such as semiconductors, metals, composites, nanomaterials, carbon or high-tech ceramics make lifeeasier in this era and are great sources of industrial growth and technological changes. Therefore, its exposureto the undergraduates with science backgrounds can groom them for future researches.

Course Outcomes

CO1	**Understand the mechanism of solid-state synthesis and explain about the different characterization techniques and their principle**
CO2	**Understand the concept of nanomaterials, their synthesis and properties.**
CO3	Ill Appreciate the existence of bioinorganic nanomaterials.
CO4	E Explain the importance of composites, conducting polymers and their applications
CO5	**Understand the usage of solid materials in various instruments, batteries, etc. which help them toappreciate the real life importance of these materials**
CO6	**Compile recent advancements in Novel Inorganic Solids.**

Reference Books

 Shriver & Atkins. Inorganic Chemistry, Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012)

 Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry. John Wiley & Sons, 1974.

 Poole, C.P. & Owens, F.J. Introduction to Nanotechnology John Wiley & Sons, 2003.

 Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Unit I: Synthesis and modification of inorganic solids and their Importance	16 hrs

Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods. Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments. Molecular material and fullerides, molecular materials & chemistry – one-dimensional metals, molecular magnets, inorganic liquid crystals.	
Unit II: Nanomaterials	8 hrs
Overview of nanostructures and nanomaterials: classification. **Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites..**	
Unit-3: Introduction to engineering materials for mechanical construction**:**	8 hrs
Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.	
Unit-4:Composite materials	8 hrs
Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites.	
Unit-5: Speciality polymers	10 hrs
Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ion-exchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.	
Unit-6: Recent Advancements in Novel Inorganic Solids	4 hrs
Recent trends and Application of Novel Inorganic Solids	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	POLYMER CHEMISTRY				
Course Code	BSCC 3103				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry**				
Co-requisite	**Students should have fundamental knowledge of Polymers**				
Anti-requisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

The primary objective of this paper is to help the student to know about the synthesis, properties andapplications of polymers.

Course Outcomes

CO1	**Understand about different mechanisms of polymerization and also polymerization techniques.**
CO2	**Evaluate kinetic chain length of polymers based on their mechanism and differentiate between polymers and copolymers**
CO3	Ill Differentiate between glass transition temperature (Tg) and crystalline melting point (Tm)
CO4	K Develop knowledge about solid and solution properties of polymers
CO5	**Learn properties and applications of various useful polymers in our daily life.**
CO6	**Compile recent advancement and technology adopted in the field of Polymer Chemistry.**

Reference Books

 R.B. Seymour & C.E. Carraher: Polymer Chemistry: An Introduction, Marcel Dekker, Inc. New York, 1981. G. Odian: Principles of Polymerization, 4th Ed. Wiley, 2004.

 F.W. Billmeyer: Textbook of Polymer Science, 2nd Ed. Wiley Interscience, 1971.

 P. Ghosh: Polymer Science & Technology, Tata McGraw-Hill Education, 1991.

 R.W. Lenz: Organic Chemistry of Synthetic High Polymers. Interscience Publishers, New York, 1967.

Unit I:Introduction and history of polymeric materials	**4 hrs**
Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.	
Unit II:Functionality and its importance	**6 hrs**
Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization.	
Unit-3:Kinetics of Polymerization**:**	**6 hrs**

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.
Unit-4:Crystallization and crystallinity**: 24 hrs**
Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. Determination of molecular weight of polymers (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. Glass transition temperature (Tg) and determination of Tg, Factors affecting glass transition temperature (Tg). **Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory- Huggins theory, Lower and Upper critical solution temperatures.**
Unit-5: Properties of Polymers (Physical, thermal, Flow & Mechanical Properties) **10 hrs**
Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers,polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].
Unit-6: Recent Trends in Polymer Chemistry 4 hrs
Recent advancement in Polymers and their application

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	MOLECULAR MODELLING & DRUG DESIGN				
Course Code	BSCC 3104				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry**				
Co-requisite	**Students should have fundamental knowledge of Drugs**				
Anti-requisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

The primary objective of this paper is to help the student to know about molecular modeling, simulation and designing of drugs.

Course Outcomes

CO1	**Understandthe concepts of molecular modeling.**
CO2	**Differentiate between bond stretching and bending vibrations.**
CO3	Ill Develop the knowledge of computer simulation.
CO4	K Understand Molecular Dynamics & Monte Carlo Simulation
CO5	**Learn how to predict structure and design of drugs.**
CO6	**Analyze recent trends going on in the field of Molecular modeling and drug design.**

Reference Books

- **A.R. Leach, Molecular Modelling Principles and Application, Longman, 2001.**
- **J.M. Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.**
- **Satya Prakash Gupta, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.**

Unit I: Introduction to Molecular Modelling**:**	8 hrs
Introduction. Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces. Molecular Graphics. Surfaces	
Unit II: Force Fields**:**	10 hrs
Fields. Bond Stretching. Angle Bending. Introduction to nonbonded interactions. Electrostatic interactions. van der Waals Interactions. Hydrogen bonding in Molecular Mechanics.	
Unit-3: Energy Minimization and Computer Simulation	10 hrs
Minimization and related methods for exploring the energy surface. Non-derivative method, First and second order minimization methods. Simple thermodynamic properties and Phase Space. Boundaries. Analyzing the results of a simulation and estimating Errors.	
Unit-4:Molecular Dynamics & Monte Carlo Simulation	10hrs
Molecular Dynamics Simulation Methods. Molecular Dynamics using simple models. Molecular Dynamics with continuous potentials. Molecular Dynamics at constant temperature and pressure. Metropolis method. Monte Carlo simulation of polymers.	
Unit-5: Structure Prediction and Drug Design	12 hrs
Structure prediction - Introduction to comparative Modeling. Sequence alignment. Constructing and evaluating a comparative model. Predicting protein structures by 'Threading', Molecular docking. Structure based de novo ligand design, Drug Discovery – Chemoinformatics – QSAR.	
Unit-6: Recent Trends in Molecular Modeling and Drug Designing	4 hrs
Advance technology adapted for modelling and Drug Design	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Computational Chemistry				
Course Code	BSCC 2102				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry**				
Co-requisite	**Students should have fundamental knowledge of Computer and Mathematics**				
Anti-requisite					
		L	T	P	C
		4	**0**	**0**	**4**

Course Objectives:

The objective of this course is to introduce the students to fundamental mathematical techniques and basic computer skills that will help them in solving chemistry problems.

Course Outcomes

CO1	**Explain most commonly used commands and library functions used in Computer BASIC programming. (K2)**
CO2	**Develop algorithm to solve problems and write corresponding programs in BASIC. (K3)**
CO3	**Design BASIC programs for performing calculations involved in labory experiments and research work. (K4)**
CO4	**Practice various spreadsheet software to perform calculations and plot graphs. (K3)**
CO5	**Eloborate recent advancements in Computational Chemistry. (K6)**

Text Books

1. V. Rajaraman, *Fortran 90*, Prentice Hall (India), New Delhi (1997)
2. C. Xavier, Fortran 77 and Numerical Methods, New Age International Pvt. Ltd. Publishers, New Delhi (1994)

Reference Books

1. S. Lipschutz and A. Poe, Schaum's Outline Series - Theory and Problems of Programming with Fortran including structured Fortran, Mc Graw Hill Book Company, Singapore (1982)
2. K. V. Raman, *Computers in Chemistry*, Tata McGraw Hill (1993).

Unit I:Basics	14 hrs
Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages.	

Unit II: C Programming:	12 hrs
Introduction; style of C language ,character and key words, variables and constants in C, arithmetic , relational , logical and bitwise operators in C, ternary, cast, & and * pointer operators, Size of operator input and output in C : content , conditional and switch statement in C; break and continue statement in loop. Storage classes in C functions array and pointers C, structure and unions, types of statement , preprocessor- define and includes simple programming in C.	
Unit-3 Molecular Modelling	12 hrs
Elementary ideas of molecular mechanics and practical MO methods. Computation of stable state energies and geometries of molecules; vibrational states and electron distribution; Potential energy surfaces.	
Unit-4 Numerical methods	12 hrs
Roots of equations: Numerical methods for roots of equations: Quadratic formula, iterative method. Differential calculus: Numerical differentiation. Integral calculus: Numerical integration (Trapezoidal and Simpson's rule), probability distributions and mean values. Simultaneous equations: Matrix manipulation: addition, multiplication. Handling of experimental data.	
Unit-5 Recent Trends in Computational Chemistry	
Recent Advancements in Computational Chemistry and Application	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

Program: BSc (H) Physics

Scheme: 2020-2021

SCHOOL OF BASIC AND APPLIED SCIENCES

Vision:

To be recognized globally as a center of excellence in imparting value-based education in Basic and Applied Sciences by creating innovation in fundamental and multidisciplinary research

Mission:

M1. To excel in imparting contemporary knowledge and skills by developing an educational ecosystem with diverse interests and talents.

M2. To perform cutting edge research leading to innovation in sciences through national and international collaborations.

M3. To develop solutions for the emerging challenges in Basic and Applied Science to cater the needs of society.

M4. To attract best quality faculty to facilitate knowledge and develop confidence in our graduates to succeed in the world.

Program Educational Objectives: The graduates shall:

PEO1: Be successful professionals in Academia, Industry, Government and Entrepreneurship.

PEO2: Graduates shall pursue higher education/research at institute of national and international repute.

PEO3: Effectively address the challenges of the society and undertake the projects for bridging the gap between industry and societal needs.

Program Specific Objectives The Graduates shall be able to:

PSO1: Demonstrate the conceptual knowledge and proficiency of optics and smart materials for device applications.

PSO2: Acquire industrial exposure and scientific knowledge through industry internship and research based learning.

Program Outcomes After the completion of the program the graduates will be able to

PO1: Apply the principles and conceptual knowledge of Physics to solve the practical problems in different areas of science and technology.

PO2: Develop the mathematical skills and methods to solve the problems in their core areas and other interdisciplinary subjects.

PO3: Identify, formulate and resolve the emerging challenges based on design, experiment, data interpretation and analysis of results.

PO4: Design a system, component, or methods to meet desired needs within realistic constraints such as environmental, health, safety, manufacturability, and sustainability.

PO5: Develop the ability in using modern tools for design and analysis of scientific and societal problems.

PO6: Work in teams on multi-disciplinary projects in research organizations and industries and present the report in a full scientific approach with professional ethics.

PO7: Build up communication skills, both written and oral, to specialized and non-specialized audiences.

PO8: Develop the ability to critically evaluate theories, methods, principles, and applications of pure and applied science in multidisciplinary domain.

Curriculum

Program: B.Sc. (H) Physics, SBAS									
Scheme: 2020 – 2023									
Program Structure									
Semester 1									
Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCP1001	Wave and Optics	4	-	-	4	30	20	50
2	BSCP1002	Wave and Optics Lab	-	-	4	2	50		50
3	BMAT1041	Foundation Course in Mathematics	5	1	-	6	30	20	50
4	BCSE1021	Programming in C and Python	4	-	-	4	30	20	50
5	BCSE1031	Programming in C and Python Lab	-	-	4	2	50		50
6	BBS09P1101	Hands on Basic Techniques and Measurements	-	-	4	2	50		50
7	xxxx	AI and Machine learning				2			
8	xxxx	Liberal art				0.5			
9	xxxx	EVS				0.5			
10	xxxx	BEC1				3			
		Soft skill				0			
		Computer awareness				0			
			Total			26			
Semester II									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCP1003	Mathematical Physics I	4	-	-	4	30	20	50
2	BSCP1004	Mathematical Physics I Lab	-	-	4	2	50		50
3	BBS09T1201	Optical Instruments and applications	3			3	30	20	50
4	BSCG1001	Nanoscience and Nanotechnology	4	-	-	4	30	20	50
5	BSCG1051	Nanoscience and Nanotechnology lab	-	-	4	2	50		50
6	BSCC1043	General Chemistry	4	-	-	4	30	20	50
7	BSCC1044	General Chemistry Lab	-	-	4	2	50		50
8	xxxx	BEC- B2				3			
	xxxx	***Two week social internship (during summer break)							
			Total			24			

Semester III									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCP2001	Mathematical Physics II	4	-	-	4	30	20	50
2	BSCP2002	Mathematical Physics II Lab	-	-	4	2	50		50
3	BSCP2003	Electricity and Magnetism	4	-	-	4	30	20	50
4	BSCP2004	Electricity and Magnetism Lab	-	-	4	2	50		50
5	BSCP2005	Elements of Modern Physics	4	-	-	4	30	20	50
6	BSCP2006	Elements of Modern Physics Lab	-	-	4	2	50		50
7	BBS09T2301	Classical Mechanics	4	-	-	4	30	20	50
8	BSCP2051	Elective-I	4	-	-	4	30	20	50
			Total			26			
Semester IV									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BBS09T2401	Electromagnetic Theory	4	0	-	4	30	20	50
2	BSCP2009	Mathematical Physics III	4	-	-	4	30	20	50
3	BSCP2011	Solid State Physics	4	-	-	4	30	20	50
4	BSCP2013	Analog Systems and Applications	4	-	-	4	30	20	50
5	BBS09P2401	Solid State Electronics Lab	-	-	4	2	50		50
6	BSCP2052	Elective II	4	-	-	4	30	20	50
7	BBS09T2411	Research Methodology and Statistics	2			2	30	20	50
9	Xxxx	IPR				0.5			
10	xxxx	Foreign Language				0.5			
11	xxxx	Waste Management			2	1	50		50
			total			26			
Semester V									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCP3001	Quantum Mechanics & Applications	4	-	-	4	30	20	50
2	BSCP3002	Thermal Physics lab	-	-	4	2	50		50
3	BSCP3003	Statistical Mechanics	4	-	-	4	30	20	50
4	BSCP3005	Digital Systems and Applications	4	-	-	4	30	20	50
5	BSCP3006	Digital Systems and Applications Lab	-	-	4	2	50		50

6	BSCP3009	Heat and Thermodynamics	4		-	4	30	20	50
7	BSCP3051	Elective-III	4		-	4	30	20	50
8	xxxx	Campus to corporate				2			
			Total			26			
Semester VI									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCP9999	Project	-	-	-	12	50		50
			total			12			
Total Credits of the program=140									

List of Electives

Elective-1

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCP2051	Laser Physics	4	-	-	4	30	20	50
2	BBS09T5321	Astronomy and Astrophysics	4	-	-	4	30	20	50

Elective-2

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCP2052	Classical Dynamics	4	-	-	4	30	20	50
2	BBS09T5421	Physics of Devices and Communication Systems	4	-	-	4	30	20	50

Elective-3

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCP3051	Nuclear and Particle Physics	4	-	-	4	30	20	50
2	BBS09T5521	Material Synthesis and Characterization Technique	4	-	-	4	30	20	50
3	BBS09T5522	Medical Physics	**4**	**-**	**-**	**4**	**30**	**20**	**50**

Name of The Course	Wave and Optics				
Course Code	BSCP1001				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives:

Students will learn how several waves or parts of waves interact and understand the diffraction and interference phenomena. Students will also learn the conditions required for such phenomena to appear.

Course Outcomes

CO1	Discuss the superposition of Collinear/perpendicular harmonics having same/different frequencies.
CO2	Explain type of waves and their velocities for different mediums.
CO3	Understand formation and characteristics of standing waves in different system.
CO4	Interpret phenomenon of interference and explain the various optical phenomenon based on it.
CO5	Interpret diffraction phenomenon and its applications.
CO6	Development the diffraction tomography in field of wave and optics.

Text Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw- Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.

Reference Books

1. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
2. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
3. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
4. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.

Reference: https://www.sciencedirect.com/science/article/pii/B9780121860301500072

Unit 1: Superposition of Harmonic Oscillations: (10 h) Superposition of collinear Harmonic oscillations: Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their uses.

Unit 2: Wave Motion: (12 h) Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.
Unit 3 Superposition of Two Harmonic Waves: (10 h) Standing (Stationary) Waves in a String: Fixed and Free Ends. Normal Modes of Stretched Strings. Plucked and Struck Strings. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.
Unit 4 Interference: (10 h) Electromagnetic nature of light. Huygens Principle, Division of amplitude and wavefront. Young's double slit experiment. Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel film. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.
Unit-5:Diffraction: (8 h) Fraunhofer diffraction: Single slit, Diffraction grating. Resolving power of grating. Fresnel Diffraction, concept of Zone plate.
Unit-6: Diffraction Tomography Recent development in wave and optics in diffraction tomography : X-ray diffraction measurements, Principle and theory of Diffraction Tomography.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Programming in C and Python				
Course Code	BCSE1021				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Co requisite	Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.				
		L	T	P	C
		4	0	0	4

Course Objectives:

The aim of this course is to make the students of physics familiar with the working of computer, programming language, QBASIC and use of software as a tool to understand physics, and solve physics based problems.

Course Outcomes:

CO1	Understand and explain the basics of computer & its components, logic development and data input and output.
CO2	Explain the control systems and function.
CO3	Explain the arrays, structure, union and pointer.
CO4	Explain control flow structure and function in python.
CO5	Apply the Classes and objects in python.
CO6	Analyze the real world data using python libraries

Text Book (s)/Reference Book (s)

7. P Kanetkar Yashvant, Let us C, BPB Publications, New Delhi, Seventh Edition.
8. E. Balagurusami, Programming in ANSI C, Tata McGraw Hill, Fourth Edition.
9. Schaum Outline Series,Programming in C.
10. Mark Lutz ,"Learning Python", O Reily, 4th Edition, 2009, ISBN: 978-0-596-15806-4
11. Mark Lutz ,"Programming Python ", O Reily, 4th Edition, 2010, ISBN 9780596158118.
12. Tim Hall and J-P Stacey ,"Python 3 for Absolute Beginners" , 2009, SBN:9781430216322

Unit-1 10hrs

Introduction to computers:
Units of computers, Block Diagram, Generation of Computers, Characteristics of Computers, Different types of Memory, Input and Output Devices.
Logic Development and Program Development Tools:
Data Representation, Flowcharts, Problem Analysis, Pseudo Code and Algorithms, Program Debugging, Compilation and Execution.
Fundamentals:
Character Set, Identifiers and Key Words, Data Types, Constants, Variables, Expressions, Statements
Operations and Expressions:
Arithmetic Operators, Unary Operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Library functions.
Data Input and Output:
Single Character Input, Single Character Output, Entering Input Data, More About Scan Functions, Writing Output Data, More About Print Functions, Gets and Puts Functions, Interactive Programming.

Unit-2 10hrs

Control Structures:
Introduction, Decision Making with If – Statement, If Else and Nested If, While And Do-While, For Loop.
Jump Statements: Break, Continue, Goto, Switch Statement.
Functions:
Introduction To Functions, Function Declaration, Function Categories, Standard Functions, Parameters And Parameter Passing, Pass – By Value/Reference, Recursion, Global and Local Variables, Storage Classes.

Unit-3 10hrs

Arrays:

Introduction to Arrays, Array Declaration, Single and Multidimensional, Array, Memory Representation, Matrices, Strings, String Handling Functions. Structure and Union: Declaration of Structure, Accessing Structure Members, Structure Initialization, Arrays of Structure, Nested Structures, Unions. Pointers: Introduction To Pointers, Address Operator And Pointers, Declaring and Initializing Pointers, Assignment through Pointers, Pointers and Arrays.
Unit-4 CORE PYTHON : BASICS 10hrs Introduction to Python, Python Interpreter and its working, Syntax and Semantics, Data Types, Assignments and Expressions, Control Flow Statements, Sequences and Dictionaries, Functions and lambda expressions
Unit-5 CORE PYTHON : ADVANCED FEATURES 10hrs Iterations and Comprehensions, Handling text files, Modules, Classes and OOP
Unit-6 Data Analysis (Python toolboxes/libraries) NumP, SciPy , Pandas, ChemPy

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	General Chemistry				
Course Code	BSCC1043				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives: This course is provided to the students for basics knowledge of Physical, organic and stereochemistry as well as some organic compound and the reactions. Using the concepts of basics chemistry, students can analyse the problems based on some chemical reactions.

Course Outcomes

CO1	Describe the theoretical models to explain the structure of an atom and orbital.
CO2	Determine ionic and covalent properties of compounds by various theories of chemical bonding and draw the MO diagram of different molecules.
CO3	Describe the fundamental properties of Organic Compound.
CO4	Illustrate the geometry of organic molecules by applying the principles of stereochemistry.
CO5	Describe different reactions and their mechanisms of Aliphatic Hydrocarbons.
CO6	Elaborate the advantages of Green approach over conventional chemical approach.

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. &Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
6. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.7. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
8. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
9. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
10. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
11. Bahl, A. &Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.

Unit-1 Atomic Structure: (14h)

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbital) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum

numbers, orbital angular momentum and quantum numbers ml and ms. Shapes of s, p and d

atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin

quantum number (ms).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability

of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of

atomic orbitals, Anomalous electronic configurations.

Unit- 2 Chemical Bonding and Molecular Structure (16 h)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches.
Unit-3 Fundamentals of Organic Chemistry (8 h) Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.
Unit-4 Stereochemistry (10 h) Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis – trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).
Unit-V Aliphatic Hydrocarbons (12 h) Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation. Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.
Unit-6 Recent advancements in Chemistry for Society Green Chemistry, Principles of Green Chemistry, Advantages of Green synthesis methods over conventional methods

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Foundation Course in Mathematics				
Course Code	BMAT1041				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite					
		L	T	P	C
		5	1	0	6

Course Objectives:

The students will learn about fundamentals of algebra and its application. They will understand the matrix, calculus and probability theory useful for solving the different physical problems

Course Outcomes

CO1	Understand different functions and progressions and solve the problems based on it.
CO2	Explain the different types of matrices and solve the differential equations.
CO3	Apply the basics of differential calculus to solve the related problems
CO4	Evaluate the problems based on integral calculus
CO5	Describe the basics of probability distribution
CO6	Analyse application of BCG Matrix to market growth.

Text Books

1. Calculus and Analytic Geometry : *G. B. Thomas, R. L. Finney*, Pearson Education, Asia.
2. Statistical Method: *S.P. Gupta*, Sultan Chand and Sons

Reference Books:

Engineering Mathematics: *B.S. Grewal*, Khanna Publishers

Unit 1: Algebra: (10 h) Fundamentals, mathematical functions, logarithms, the exponential function, polynomial expressions, Factorization and division of Polynomials, Partial fractions, Binomial Expansion, Arithmetic Progression, Geometric Progression, Infinite Geometric Progression.
Unit 2: Matrices & Determinants: (10 h) Types of matrices, basic operations of matrices, determinant of a matrix and it's properties, matrix inverse, elementary row and column operations, rank of a matrix, consistency of a linear system of equations, solution of a linear system by Gauss Elimination method.
Unit 3 Differential Calculus: (10 h) Differentiation of a function of a single variable, product rule, quotient rule, chain rule of differentiation, Taylor's series, Applications of derivatives: Rate of change, increasing/decreasing functions, tangents and normals, maxima and minima.

Unit 4 Integral Calculus: (10 h) Integral of elementary functions, standard results, Integration by substitutions, by parts and partial fraction methods, Definite integral, Even and odd functions, Properties of definite integral and application in finding the area.	
Unit-5:Probability: (10 h) Basic concepts of probability, Random variable and its probability distribution, Binomial, Poisson and Normal distributions.	
Unit-6 Application of Foundation Course in Mathematics (4h)	
BCG matrix and its application to market sharing growth.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Mathematical Physics-I				
Course Code	BSCP1003				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: The students will learn about first and second order differential equations and its application. They will understand and apply the concept of vector differentiation and integration to solve the problems. Students will learn about different coordinate systems and probability theory useful for solving the physical problems

Course Outcomes

CO1	Apply the concept of basic mathematical technique in physics
CO2	Interpret the mathematical technique in physical model
CO3	Analyze the concept of rotations and coordinate systems.
CO4	Analyze the vector diff. and integrations and able to solve the problems based on it.
CO5	Apply the probability distribution function in different models
CO6	Formulate the model using Monte Carlo methods in the specific application.

Text Books

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7thEdn.,Elsevier.
2. An introduction to ordinary differential equations, E.A.Coddington,2009, PHI learning

Reference Books

1. Mathematical Physics, Goswami, 1st edition, Cengage Learning

2. Engineering Mathematics,S.PalandS.C.Bhunia,2015,OxfordUniversityPress
3. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, WileyIndia.
4. EssentialMathematicalMethods,K.F.Riley&M.P.Hobson,2011,CambridgeUniv.Press

Palmowski, Z. andRolski, T. (2002). A technique for exponential change of measure for Markov processes. *Bernoulli* 8 (6), 767–785

Talay, D. andTubaro, L. (1990). Expansion of the global error for numerical schemes solving stochastic differential equations. *Stoch. Anal. Appl.* 8 (4), 483–509

Unit-I Calculus: (14 h) Intuitive ideas of continuous, differentiable, etc. functions and plotting of curves. Approximation: Taylor and binomial series (statements only). First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor, with simple illustration. Constrained Maximization using Lagrange Multipliers.
Unit-II Vector Differentiation: (8 h) Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.
Unit-III Vector Integration: (12h) Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).
Unit-IV Orthogonal Curvilinear Coordinates: (8 h) Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.
Unit-V Introduction to probability: (8Lectures) Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance.
Unit VI: Application Mathematical Physics I (4Lectures) Recent advancement in Applied Probability: Thinning and multilevel Monte Carlo methods for piecewise deterministic (Markov) processes with an application to a stochastic Morris–Lecar model

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Optical Instruments and applications				
Course Code	BBS09T1201				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite	-				
		L	T	P	C
		3	-	-	3

Course Objectives:

The objective of this course is to provide the knowledge of different types of lenses and their application for image formation, various aberrations produced in the image and their removal methods. The students will also learn about the optical instruments designed using the lenses. They will also understand the polarization in the light, the production of polarized light and optical rotation of light.

Course Outcomes

CO1	Explain different types of lenses and image formation
CO2	Describe the various aberrations in the image formed by the lenses and methods to remove these aberrations
CO3	Describe the construction and working of different optical instruments and their applications
CO4	Illustrate the polarization of light and explain the methods to produce polarized light
CO5	Explain the retardation plates and describe the optical rotation
CO6	Plan for a research project on optical approaches which can be used for solving environmental issues.

Text Books:

1. A textbook of Optics: N. Subrahmanyam, Brijlal and M. N. Avadhanulu.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill

Reference Books:

1. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
2. Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996, Cambridge Univ. Press
3. Reference: https://scholars.direct/Articles/photonics-and-optics/rapo-1-003.pdf

Unit I Lenses and image formation	8h
Fermat's principle, Principle of extremum path, the aplanatic points of a sphere and other applications. General theory of image formation: Cardinal points of an optical system; general relationship, thick lens and lens combinations, telephoto lenses.	
Unit II Aberration in image	8h
Aberration in images: Chromatic aberrations; achromatic combination of lenses in contact and separated lenses, Monochromatic aberration and their reduction, aspherical mirrors and Schmidt corrector plates, oil immersion objectives.	
Unit III Optical Instruments:	8h
Entrance and exit pupils, need for a multiple lens eyepiece, common types of Eyepieces and their working and applications, resolving power of optical instruments, optical microscopes	
Unit IV : Polarisation of light	8h
Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Polaroid	
Unit V : Retardation plates and polarimeter	8h
Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Analysis of Polarized Light. Rotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Specific rotation. Laurent's half-shade polarimeter.	
Unit VI: Recent advancements in Optical Instruments and applications	(4h)
Novel Optical Flocculation Approach for Chemical Contaminations in the Water Treatment Using Micro/Nano Polymeric Beads	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Nanoscience and Nanotechnology				
Course Code	BSCG1001				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives: The objective of this course is to provide some knowledge in the field of nano science and technology. The students will learn about the preparation techniques of nano materials, properties of carbon nano materials for advanced technology and also the societal implication of nano technology.

Course Outcomes

CO1	Describe the basic science behind the properties of materials at the nanometer scale.
CO2	Illustrate the concept of physical and chemical method, application and fabrication of nanostructures.
CO3	Generalize and introduce the methods of preparation, methods of purification and applications of carbon nano materials.
CO4	Apply the concepts of nano energy conversion materials.
CO5	Generalize the importance of nano-catalysis.
CO6	Formulate the rudimentary knowledge of photovoltaic devices and propose synthesis of quantum junction solar cells.

Text Books:

1. Introduction to Nanotechnology C P Poole, Frank J. Owens, John Wiley & Sons, 2011, ISBN 978-81-265-1099-3.
2. Introduction to Nanoscience and Nanotechnology, KK Chattopadhyay, A N Banerjee, Phi Learning Pvt Ltd., New Delhi, 2012, ISBN-978-81-203-3608-7.
3. Nanotechnology Science Innovation & Opportunity, Lynn E Foster, Pearson publication, 2008, ISBN-9788131711187.

Reference Books

1. The Evolution of Dip-pen nanolithography, D.Ginger ,H,Zang and C.A. Mirkin, Angw. Chem.. Int. Ed., 2004,43, 30-45.
2. Carbon Materials and Nanotechnology, Anke Krueger, Wiley –VCH Verlag GmbH & Co., 2010, ISBN-10: 3527318038.
3. Jiang Tang et al., Quantum Junction Solar Cells, Nano Lett. 2012, 12, 4889−4894

Unit-I Introduction to Nanoscience and nanotechnology (10 h) Origin and properties of Nanomaterials, Bulk materials vs Nanomaterials, Fundamental of Nanospintronics, Nanomedicine, Nanostructured materials
Unit-II Nanomaterials preparation (10 h) Classification of Nanomaterials, Different approaches in synthesis, Growth mechanism of nanomaterials
Unit-III Carbon Materials (10 h) Carbon Materials; Fullerenes, Carbon Nanotubes, Graphene
Unit-IV Nanomaterials in Energy Conversion devices (10 h) Nanomaterials in Energy Conversion devices, Semiconductors nanostructures, Photovoltaics, Solar Cell

Unit-V Nanocatalysis and ethics in nanotechnology	(10 h)
Introduction to nanocatalysis, Assembling nanocatalysts, metallic, metaloxide nanocrystals, nanoclusters, mesoporous materials , Applications of nanocatalysts , Societal concern of nanotechnology	
Unit VI- Quantum Junction Solar Cells Photovoltaic devices, Colloidal Quantum dot cells, Efficiency of solar cells	(4h)

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Electricity and Magnetism				
Course Code	BSCP2003				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives: This course provides the basics of electrostatics and law of electrostatics to calculate the potential and electric fields of charged particles. The students will also come to know the working of capacitors. The knowledge of different types of dielectric and magnetic materials will help the students to design the instruments working on the principle of electrostatics and magnetostatics.

Course Outcomes:

CO1	Explain the electric field and potential to anlyse the problems based on it.
CO2	Apply the concept of charge and its storage and explain the capacitors application
CO3	Explain the properties of dielectric materials and apply in various devices K2
CO4	Understand the magnetic field and various law based on it to apply the in many electrical circuits.
CO5	Understand the magnetic properties of magnetic materials and the behavior of EM wave in it.
CO6	Plan for the effective work on the certain ferrous materials and study its characteristics .

Text Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury,2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, McGraw-Hill Education
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn. , Benjamin Cummings.

Reference Books:

1. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
2. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
3. Electricity and Magnetism, J.H.Fewkes&J.Yarwood.Vol.I, Oxford Univ. Press.

4. Basic Electronics: Devices, Circuits and it Fundamentals. By Santiram Kal, Prentice hall of India, 2006.
5. A. M. Kuzmenko, D. Szaller, Th. Kain, V. Dziom, L. Weymann, A. Shuvaev, Anna Pimenov, A. A. Mukhin, V. Yu. Ivanov, I. A. Gudim, L. N. Bezmaternykh, A. Pimenov. Switching of Magnons by Electric and Magnetic Fields in Multiferroic Borates. *Physical Review Letters*, 2018; 120 (2) DOI: 10.1103/PhysRevLett.120.027203

UNIT 1: Electric Field and Electric Potential (12h) Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole.
Unit 2: Applications of Electrostatics (10h) Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor.
Unit 3: Dielectric Properties of Matter: (10h) Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics.
Unit 4: Magnetic Field: (10 h) Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field.
Unit 5: Magnetic Properties of Matter: (10h) Magnetization vector (M). Magnetic Intensity (H).Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis. Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.
Unit-VI Application of Electricity and Magnetism (4h) Recent advancement in Electricity and Magnetism: Electrical fields to control the magnetic oscillations in certain ferrous materials, Magnetic data storage, electrical writing.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Elements of Modern Physics				
Course Code	BSCP2005				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives: This course provides the basic knowledge of modern physics which includes the fundamentals of duality of quantum particle and SWE and it solutions. They will come to know about basics of nuclear structure and nuclear transformation. Also students will learn about the Holography and it applications.

Course Outcomes:

CO1	Explain the duality nature of quantum system and apply the concepts to verify and calculate the energy of the system.
CO2	Apply the Schrodinger Wave equation to solve the potential barrier problem
CO3	Explain the nuclear structure by various nuclear models and calculate the nuclear energy
CO4	Interpret the nuclear transformation and understand the various nuclear phenomenon
CO5	Explain the principle of holography and its applications
CO6	Organize the elementary knowledge of Dark matters to propose new research ideas in the field of Modern physics.

Text Books:

1. Concepts of Modern Physics, Arthur Beiser, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, Pearson Education.

Reference Books

1. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
2. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
3. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, Tata McGraw-Hill Co.
4. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
5. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
6. Introduction to Modern Physics, Richtmyer, Kennard, Coop, 2002, Tata McGraw Hill
7. Research Articles
8. https://science.nasa.gov/astrophysics/focus-areas/what-is-dark-energy
9. https://home.cern/science/physics/dark-matter

Unit 1: Wave particle Duality: (10 h) Blackbody Radiation , Planck's Radiation Law, Quantum theory of Light; Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Group and Phase velocities and relation between them. Gamma ray microscope thought experiment; Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Estimating minimum energy of a confined particle using uncertainty principle.
Unit 2: Quantum Mechanics: (10 h) Schrodinger equation for non-relativistic particles; Momentum and Energy operators; physical interpretation of a wave function, probabilities and normalization; One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum mechanical scattering and tunnelling in one dimension-across a step potential & rectangular potential barrier (brief explanation)
Unit 3: Nuclear Structure: (10 h) Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.
Unit 4: Nuclear transformation: (10 h) Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay, Pauli's prediction of neutrino; Gamma ray emission. Fusion- mass deficit, generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions)
Unit 5 Holography (10 h) Coherent source and monochromatic light. Interference of light waves. 2D Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves.
Unit-6: Application of Modern Physics
Recent development in Modern Physics: Fundamental aspects of dark matter in modern physics, Applicational horizons of dark matter, Recent research trends.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Classical Mechanics
Course Code	BBS09T2301

Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite	-				
		L	T	P	C
		4	0	0	4

Course Objectives: This course is designed to make the students familiar with the dynamics of the rotational motion of the body. They will also learn the motion of the particle in gravitational and central force. The Elasticity and fluid dynamics are also provided for the basic knowledge. The knowledge of theory of relativity is useful for students in nuclear physics and quantum mechanics.

Course Outcomes:

CO1	Explain the conservation laws of momentum and energy and centre of mass and apply them to solve the related Problems.
CO2	Explain the rotational dynamics of mechanical systems and calculate the moment of inertia.
CO3	Apply the concept of potentials and fields, central forces, two body problem and Kepler's laws to solve the related problems
CO4	Explain the ideas of elasticity, elastic constants, twisting torque and fluid motion and Poiseuille's equation.
CO5	Describe different types of frames of references and fundamental ideas of special theory of relativity
CO6	Students will be able to develop separation between COM and COP

Text Books:

1. An introduction to mechanics by Daniel Kleppner, Robert J. Kolenkow (McGraw-Hill)
2. Mechanics Berkeley physics course, v.1: By Charles Kittel,Walter Knight, Malvin Ruderman,Carl Helmholz,Burton Moyer, (Tata McGraw-Hill)
3. Mechanics by D S Mathur (S. Chand & Company Limited)

Reference Books:

4. Mechanics by Keith R. Symon (Addison Wesley)
5. University Physics by F W Sears, M W Zemansky and H D Young (Narosa Publishing House)
6. Age-related reduction in sagittal plane center of mass motion during obstacle crossing", Michael E. Hahn, Li-Shan Chou, Journal of Biomechanics, 37 (2004) 837-844, doi:10.1016/j.jbiomech.2003.11.010

UNIT :1 Fundamentals of Dynamics (10 h) Dynamics of a System of Particles. Centre of Mass. Conservation of Momentum. Idea of Conservation of Momentum from Newton's Third Law. Impulse. Momentum of Variable Mass System: Motion of Rocket. Work and Energy Theorem:- Work and Kinetic Energy Theorem. Conservative and Non- Conservative Forces. Potential Energy. Energy Diagram. Stable and Unstable Equilibrium. Gravitational Potential Energy. Elastic Potential Energy. Force as Gradient of Potential Energy. Work and Potential energy. Work done by Non-conservative Forces. Law of Conservation of Energy.

UNIT :2 Rotational Dynamics (10 h) Angular Momentum of a Particle and System of Particles. Torque. Conservation of Angular Momentum. Rotation about a Fixed Axis. Moment of Inertia. Calculation of Moment of Inertia for Rectangular, Cylindrical, and Spherical Bodies. Kinetic Energy of Rotation. Motion involving both Translation and Rotation.
UNIT :3 Gravitation and Central Force Motion (10 h) Law of gravitation. Inertial and Gravitational Mass. Potential and Field due to Spherical Shell and Solid Sphere. Motion of a Particle under Central Force Field. Two Body Problem and its Reduction to One Body Problem and its Solution. The Energy Equation and Energy Diagram. Kepler's Laws (Ideas Only). Orbits of Artificial Satellites.
UNIT :4 Elasticity and Fluid Motion (10 h) Some definitions and different types of co-efficients of elasticity. Theorems on stress and strain. Relation Between Elastic Constants. Bending of beams. Twisting Torque on a Cylinder or wire. Properties of fluids. The continuity equation. Kinematics of Moving Fluids:- Poiseuille's Equation for Flow of a Liquid through a Capillary-Tube.
UNIT :5 Special theory of Relativity (10 h) Reference Frames :- Inertial Frames and Galilean Transformations. Non-inertial Frames and Fictitious Forces. Michelson-Morley Experiment and its Outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and Order of Events. Lorentz Contraction. Time Dilation. Relativistic Transformation of Velocity. Relativistic Addition of Velocities. Variation of Mass with Velocity. Rest Mass and Mass-less Particles. Mass energy Equivalence
Unit VI Application of Classical Mechanics (4h) Recent advancement in classical mechanics : Center of mass and center of pressure, balance control, sagittal plane, study of A/P distance between COM and COP

Name of The Course	Mathematical Physics-II				
Course Code	BSCP2001				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics and physics				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives:

This course provides the knowledge of periodic function and Fourier series. The students will also learn about some special functions used to solve the various physical problems. The knowledge of partial differential equation is very useful to solve many physics related problems

Course Outcomes

CO1	Explain the periodic function and apply it to determine the Fourier coefficients
CO2	Understand Fourier Series and apply the knowledge so solve the problems.
CO3	Apply the various special function to solve the physics related problems
CO4	Apply the special integration and solve the problems based on this integration
CO5	Solve the various physical problems using the partial differential equation
CO6	Develop the solution of second order differential equation using Homotopy Perturbation Method

Text Books:

1. MathematicalMethodsforPhysicists:Arfken,Weber,Harris,Elsevier.
2. Fourier Analysis by M.R. Spiegel, TataMcGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, ThomsonBrooks/Cole.

Reference Books:

1. Differential Equations, George F. Simmons, TataMcGraw-Hill.
2. PartialDifferentialEquationsforScientists&Engineers,S.J.Farlow,DoverPub.
3. EngineeringMathematics,S.PalandS.C.Bhunia,2015,OxfordUniversityPress
4. MathematicalmethodsforScientists&Engineers,D.A.McQuarrie,VivaBooks

References:

1. Yusufo˘glu, E. 2009, Improved homotopy perturbation method for solving Fredholm type integro-differential equations, Chaos, Solitons & Fractals, 41, 28
2. Zhou, S., & Wu, H. 2012, Analytical solutions of nonlinear Poisson–Boltzmann equation for colloidal particles immersed in a general electrolyte solution by homotopy perturbation technique, Colloid and Polymer Science, 290, 1165

Unit-I Periodic functions (12h) Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients.
Unit-II Fourier Series (12h) Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series.Parseval Identity.
Unit-III Frobenius Method and Special Functions: (12h) Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions ($J_o(x)$and$J_1(x)$) and Orthogonality.
Unit-IV Some Special Integrals: (12h) Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions.

Unit-V Partial Differential Equations: (12 h) Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string, Diffusion Equation.	
Unit VI: Application Mathematical Physics II (4h) Recent advancement in (In Differential Equations): A Study of General First-order Partial Differential Equations Using Homotopy Perturbation Method	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Electromagnetic Theory				
Course Code	BBS09T2401				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics				
Antirequisite	-				
		L	T	P	C
		4	0	0	4

Course Objectives: The course of Electromagnetic Theory is designed to provide the knowledge of electrodynamics and the Maxwell's equations. The students will understand the mechanism of E M wave propagation in different mediums, both in unbounded and in waveguide. This course gives clear understanding of the EM wave characteristics such as reflection, refraction, polarization, total internal reflection etc.

Course Outcomes

CO1	Explain the electrodynamics of the charge and interpret the induction phenomenon
CO2	Describe concept for the formulation of Maxwell's equations in electrodynamics
CO3	Explain the concepts of EM Wave Propagation in Unbounded Media and its application in dielectric media.
CO4	Discuss the EM Wave in Bounded Media
CO5	Describe the propagation of EM wave and different modes in waveguides.
CO6	Propose the concepts of millimeter wave in developing new research ideas toward communication & technology fields.

Text Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.

Reference Books

1. Electromagnetic Fields & Waves, P.Lorrain&D.Corson, 1970, W.H.Freeman& Co.
2. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
3. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press

References:

1. Electromagnetic Fields & Waves, P.Lorrain&D.Corson, 1970, W.H.Freeman& Co.
2. https://www.sciencedirect.com/science/article/pii/B9780128022078000010
3. https://www.sciencedirect.com/science/article/pii/B9780444522047500286

Unit 1: Electrodynamics: (10 h) Introduction to Electrodynamics, Electromotive force: Electromotive force, Motional emf, Electromagnetic Induction: Faraday's law, The Induced Electric field, Inductance, Energy in Magnetic Fields
Unit 2: Maxwell Equations: (10 h) Review of Maxwell's equations. Maxwell's correction in Ampere's law, Displacement Current, Boundary Conditions at Interface between Different Media, Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density
Unit 3: EM Wave Propagation in Media: (10 h) Transverse nature of plane EM waves, Plane EM waves through vacuum and dielectric medium, refractive index and dielectric constant, Propagation through conducting media, relaxation time, skin depth
Unit 4: : EM Wave in Unbounded Media: (10 h) Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at Normal Incidence, Reflection & Refraction of plane waves at Oblique Incidence, Laws of Reflection & Refraction. Fresnel's Formulae, Brewster's law, Total internal reflection, Concept of polarization and problems.
Unit 5: Wave Guides: (10 h) Introduction, Rectangular Waveguides, Transverse Magnetic (TM) modes, Transverse Electric (TE) modes, Wave propagation in the waveguide, Power transmission & attenuation
Unit-6: Application of Electromagnetic Theory: (4h) Recent development in Electromagnetic Theory: Fundamental aspects of Millimeter waves in Electromagnetic theory, Applications of Millimeter wave, Recent research trend of millimeter wave systems and technologies.

Continuous Assessment Pattern

Name of The Course	ANALOG SYSTEMS AND APPLICATIONS
Course Code	BSCP2013
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics
Antirequisite	-

L	T	P	C
4	-	-	4

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Course Objectives: Student will acquire gain about the basic concepts of semiconductors and the dynamics of charge carrier. They will also learn the working of diodes and its applications. Further, the transistors are introduced for the study of its characteristics and applications as amplifiers. Moreover, students learn about operational amplifiers as adder, integrator, differentiator and many other applications.

Course Outcomes

CO1	Explain the basics of semiconductors and their dynamical properties
CO2	Describe the different types of diodes and their applications
CO3	Describe the bipolar transistors and its characteristics to apply in different electronic circuits
CO4	Explain the different types of amplifier and oscillators to be used for many electronic applications
CO5	Explain the operational amplifier and its characteristics
CO6	Propose the energy efficient analog circuit for the nanoscale technology

Text Book:

1. Integrated Electronics, J. Millman and C.C. Halkias , Tata Mc-Graw Hill.
2. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6^{th} Edn., PHI Learning

1. Electronics: Fundamentals and Applications, J.D. Ryder, Prentice Hall.
2. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3^{rd} Ed., 2012, Tata Mc-Graw hill
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4^{th} edition, Prentice Hall

Reference: T. Ytterdal, "Design of energy efficient analog circuits in nanoscale CMOS technologies," 2010 10th IEEE International Conference on Solid-State and Integrated Circuit Technology, Shanghai, 2010, pp. 184-187, doi: 10.1109/ICSICT.2010.5667806.

UNIT:-1 Semiconductors: (10 h)
P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction.

UNIT:-2 Diodes Applications	(10 h)
Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter , Zener Diode and Voltage Regulation. Principle and working of LEDs, Photodiode and Solar Cell.	
UNIT:-3 Bipolar Junction transistors:	(10 h)
n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Active, Cutoff and Saturation Regions. Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains.	
UNIT:-4 Amplifiers and Oscillators:	(10 h)
Classification of Class A, B & C Amplifiers. Coupled Amplifier: Two stage RC-coupled amplifier and its frequency response. Feedback in Amplifiers; Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, Hartley & Colpitts oscillators.	
UNIT:-5 Operational Amplifiers:	(10 h)
Characteristics of an Ideal and Practical Op-Amp. open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground. Applications of Op-Amps; Inverting and non-inverting amplifiers, Adder, Subtractor, Differentiator, Integrator, Log amplifier, Wein bridge oscillator.	
Unit VI: Application of Analog Systems	(4h)
Recent advancement in Analog Systems: Design of energy efficient analog circuits in nanoscale CMOS technologies	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Research Methodology and Statistics**
Course Code	**BBS09T2411**

Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite	-				
		L	**T**	**P**	**C**
		2	**-**	**-**	**2**

Course Objective: The objective of the course is to impart research based knowledge to the students. They would be taught the various ways of data collection, research methodologies adopted in different settings, and statistical methods.

Course Outcome:

CO1	Students will get separately familiar with terms research and methodology, respectively.
CO2	Identifying different type of research sampling and research design.
CO3	Students will understand raw data, primary data, secondary data and their different methods of collection.
CO4	Students will appraise the application of sampling through statistics.
CO5	Students will get familiar with different descriptors of statistics to analyse data both quantitatively and qualitatively.
CO6	Students will develop the statistical analysis indulges in modern research for drug designing.

Text & References:

- Broota, K. D., Experimental designs in psychological research, Wiley eastern, New York, 1992.
- Guilford, Statistics in Psychology and Education**,** McGraw Hill, New York, 1986.
- J T Walker, Statistics in Criminology and Criminal Justice analysis and Interpretation
- Leo, A., & Hoekman, D. H. (1995). *Exploring QSAR*. American Chemical Society.
- Chanin Nantasenamat, Chartchalerm Isarankura-Na-Ayudhya, Thanakorn Naenna, Virapong Prachayasittikul, A Practical Overview of Quantitative Structure- Activity Relationship. EXCLI Journal 2009;8:74-88.
- Wiktor Pronobis, Alexandre Tkatchenko, and Klaus-Robert Muller, J. Chem. Theory Comput. 2018, 14, 2991−3003

Course Contents:

Module I: Introduction to Research Methodology 6- Lectures
Definition, concept and research in science; Introduction to Research Methodology, Research methodology in science.
Module II: Research in Scientific and Social Settings 5- Lectures
Research Design: Research Sampling, rationale for using a particular sampling procedure, Probability.

Module III: Tools of Data Collection	**5-Lectures**
Data and its types, Methods for Collecting Data, Observation method, Questionnaire, Other Methods	
Module IV: Introduction to Statistics	**4-Lectures**
Introduction to statistics (Biostatistics); Sample and Population, parametric and non parametric statistics.	
Module V: Descriptive Statistics	**5-Lectures**
Measures of central tendency; Measures of dispersion and deviation; graphical representation of the data. Correlation and Regression	
Unit 6: Recent research advances	**3 hrs**
Descriptors, Quantitative structure-activity relationship (QSAR) , Quantitative structure-property relationship(QSPR), Drug designing.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	SOLID STATE PHYSICS				
Course Code	BSCP2011				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives: The aim of this subject is to provide the knowledge of crystal structure and determination method of crystal structure. Students will also learn the theory and properties of dielectrics, magnetic and semiconducting materials alog with the superconductivity behaviours of materials.

Course Outcomes

CO1	Explain the crystal structure and categorize them based on their characteristics.
CO2	Describe the elementary lattice dynamics and explain the specific heat of solids
CO3	Explain the types of magnetic materials and their properties
CO4	Describe the basics of dielectrics materials and its parameters.
CO5	Explain the different types of semiconductors and superconductors and their applications
CO6	Plan the construction of Graphene based nanostructured devices such as-diodes.

Text Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India 95
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill

Reference Books:

1. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Cengage Learning
2. Elementary Solid State Physics, 1/e M. Ali Omar,Pearson India
3. Solid State Physics, M.A. Wahab, 2011, Narosa Publications State

Reference:

Di Bartolomeo, Graphene Schottky diodes, Physics Reports, Volume 606, 8 January 2016, Pages 1-58

Unit 1: Crystal Structure: (10h) Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law.
Unit 2: Elementary Lattice Dynamics: (10 h) Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3law
Unit 3: Magnetic Properties of Matter: (10 h) Dia-, Para-, Ferri- and Ferromagnetic Materials. Domains. Quantum Mechanical Treatment of Paramagnetism.Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss.
Unit 4: Dielectric Properties of Materials: (8 h) Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion.
Unit 5 Semiconductor theory and Superconductors (12 h) Kronig Penny model. Band Gaps and Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient. Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Applications
Unit VI- Graphene Schottky diodes Graphene Schottky diodes: An experimental review of the rectifying Graphene/semiconductor heterojunction

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Mathematical Physics-III
Course Code	BSCP2009
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics
Antirequisite	-

	L	T	P	C
	4	-	-	4

Course Objectives:

The objective of this course is to develop students with certain mathematical techniques, and to highlight applications of mathematical method to physical systems.

Course Outcomes

CO1	Understand the basics of complex functions and analytical functions
CO2	Solve the problems based on integration of complex variables
CO3	Understand Fourier transform and apply it to solve the differential equations
CO4	Understand Laplace transform and its properties
CO5	Apply the Laplace transform to solve the 1st and 2nd order differential equations.
CO6	Design the solution model using Laplace Transformations in various fields

Text Books

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge UniversityPress
2. MathematicsforPhysicists,P.DenneryandA.Krzywicki, ,DoverPublications
3. ComplexVariables,A.S.Fokas&M.J.Ablowitz,8thEd.,2011,CambridgeUniv.Press

Reference Books

1. Mathematics for Physicists,P.DenneryandA.Krzywicki,1967,DoverPublications
2. ComplexVariables,A.S.Fokas&M.J.Ablowitz,8thEd.,2011,CambridgeUniv.Press
3. Complex Variables, A.K. Kapoor, 2014, Cambridge Univ.Press

References:

1.Tania Bakhos, Arvin K. Saibaba, Peter K. Kitanids. [2015] A fast algorithm for parabolic pde-based inverse problemsbased on Laplace transforms and flexible krylov solvers. Journal of computational Physics, 299: 940 - 954.

2.Zahra WK, Hikal MM, Taher A. Bahnasy. [2017] Solutions for fractional order electrical circuits in Laplace transform a non - standard finite difference method. Journal of the EgyptianMathematical Society, pp 1-10.

3.Sumit Gupta, Devendra kumar, Jagdev Singh [2015] Analytical solutions of convection-diffusion problems by combining Laplace transform method and homotopy perturbation. Alexandria Engineering Journal, 54: 645 – 651

Unit-I Complex Analysis-I (12 h)

Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions.

Unit-II Complex Analysis-II (12 h) Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Integral formula. Laurent and Taylor's expansion. Residues and Residue Theorem.
Unit-III Fourier Transforms: (12 h) Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). application of Fourier Transforms: Application of Fourier Transforms to differential equations: One dimensional Wave.
Unit-IV Laplace Transforms: (12 h) Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1^{st} and 2^{nd}order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT.
Unit-V Application of Laplace Transforms (12 h) Application of Laplace Transforms to 2^{nd} order Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits, Coupled differential equations of 1^{st} order. Solution of heat flow along infinite bar using Laplace transform.
Unit VI: Application Mathematical Physics III (In Laplace Transformations) (4h) Recent advancement in (In Laplace Transformations): A review on applications of Laplace Transformations in various fields

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Heat and Thermodynamics
Course Code	BSCP3009

Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives: The objective of this course is to acquire knowledge in heat transfer, entropy, production of low temperature and liquefaction of gases, thermal radiation and statistical thermodynamics

Course Outcomes

CO1	Understand the concepts of Zeroth and First laws of thermodynamics.
CO2	Identify and apply the concepts of second laws of thermodynamics, in particular entropy, to solve problems in thermodynamic systems such as gases, heat engines and refrigerators etc.
CO3	Analyze the thermodynamic relations between the functions.
CO4	Apply the classical theory of particles to a system of ideal gas.
CO5	Differentiate between real gas and ideal gas and describe the various experiments based on it.
CO6	Plan for a research project in the field of Manufacturing Processes.

Text Book:

1 Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, McGraw-Hill.

2 A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, Indian Press

Reference Books:

1Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, Tata McGraw-Hill

2 Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer

3 Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. Narosa.

Reference: https://doi.org/10.3390/inventions4020028

UNIT-1: Zeroth and First Law of Thermodynamics: (8 h) Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes,
UNIT-2: Second Law of Thermodynamics and Entropy: (12 h) Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics, Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics.

Unit-3: Thermodynamic Potentials: (10 h) Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations Derivations and applications of Maxwell's Relations, Maxwell's Relations: Clausius Clapeyron equation, Values of Cp-Cv, TdS Equations, Joule-Kelvin coefficient for Ideal and Van der Waal Gases, Energy equations, Change of Temperature during Adiabatic Process.
UNIT-4: Kinetic Theory of Gases: (10 h) Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas , Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases. Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: Viscosity, Thermal Conductivity and Diffusion.
UNIT-5: Real Gases: (10 h) Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Temperature of Inversion. Joule- Thomson Cooling.
Unit VI: Recent advancements in Heat and Thermodynamics (4h) Thermodynamics in the 21st Century: Thermodynamics of Manufacturing Processes—The Workpiece and the Machinery

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	DIGITAL SYSTEMS AND APPLICATIONS			
Course Code	BSCP3005			
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream			
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics			
Antirequisite	-			
	L	T	P	C
	4	-	-	4

Course Objectives:

The primary objective of this course is to prepare the students to perform the analysis and design of various digital electronic circuits with memory operations. Objective is also to cultivate skills in students to execute mathematical and logical operation by using digital circuits.

Course Outcomes

CO1	Differentiate between analog and digital circuits and interpret the working of logic gates.
CO2	Apply the Boolean laws and De Morgan's theorem to simplify logic circuits and convert a truth table to its equivalent Boolean expression using SOP,POS,K Map methods.
CO3	Describe the design and operation of various combinational circuits.
CO4	Explain the design and operation of various sequential circuits.
CO5	Identify the block diagram of IC555 and explain the working of multivibrators, registers, counters, RAM, ROM.
CO6	Create good quality digital audio systems with acquiring knowledge on Bluetooth wireless headphones, Hearing aids, iPod, Sound Microphones.

Text Book:

1.Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, TataMcGraw
2.Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.

Reference Books:

1. Digital Electronics G K Kharate ,2010, Oxford University Press
2.Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, PHI Learning
3. Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill

Reference: Louis E.Frenzel Jr. Austin, TX, United States https://doi.org/10.1016/B978-0-12-811641-8.00010-2

UNIT:-1 Digital Circuits: (10h) Difference between Analog and Digital Circuits, Binary Numbers, Decimal to Binary and Binary to Decimal Conversion.BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application.
UNIT:-2 Boolean algebra: (10h) De Morgan's Theorems. Boolean Laws. Simplification of Logic CircuitusingBooleanAlgebra.FundamentalProducts.IdeaofMintermsandMaxterms.Conversion of a Truth table into Equivalent Logic Circuit by Sum of Products Method and Karnaugh Map.
UNIT:-3 Arithmetic and Combinational circuits: (10 h) Binary Addition, Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders.

UNIT:-4 Sequential Circuits: (10h) SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.	
UNIT:-5 Computer Organization: (10h) IC555: block diagram and applications: Astable multivibrator and Monostable multi vibrator, Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits), Counters (4bits):Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter, Input/Output Devices .Data storage (idea of RAM and ROM).Memory	
UNIT-VI: - Audio Electronics; (4h) Audio, Audio compression, Bluetooth wireless headphones, Compact disks Digital audio, Hearing aids, iPod, Sound Microphones	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Quantum Mechanics & Applications				
Course Code	BSCP3001				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives:

The primary objective of this course is to develop familiarity with the physical concepts and facility with the mathematical methods of quantum mechanics. A secondary, but still very important objective is to cultivate student skills at formulating and solving physics problems using Schrodinger Equations and Heisenberg Uncertainty Principle.

Course Outcomes

CO1	Interpret Schrodinger time dependent equation and describe the wave functions/ quantum operators to obtain information about a quantum particle and system.
CO2	Interpret Schrodinger time independent equation and describe Hamiltonian, Eigen States and Eigen values of a quantum system.

CO3	Solve the Schrödinger equations for 1-D quantum systems (e.g. square well, harmonic oscillator).
CO4	Solve time independent Schrodinger equation in spherical polar coordinates to obtain radial wave functions for Hydrogen like atoms.
CO5	Discuss the behavior of atoms in electric and magnetic fields and describe electron spin ,space quantization, electron magnetic moment, etc.
CO6	Develop some concept about the Quantum communication system by using surface acoustic waves.

Text Books:

1. NouredineZettili,Quantum Mechanics: concepts and applications, 2nd Edition, Wiley, UK, 2009f
2. Introduction to Quantum Mechanics, D.J. Griffith, 2ndEd. 2005, Pearson Education

Reference Books:

3. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2ndEd., 2002, Wiley.
4. Quantum Mechanics, Leonard I. Schiff, 3rdEd. 2010, Tata McGraw Hill.
5. Reference: Bienfait et al., Science 364, 368–371 (2019)
   DOI: 10.1126/science.aaw8415

Unit I: Time Dependent Schrodinger Equation: (12 h) Basics Postulates of Quantum Mechanics; Properties of Wave Function. Interpretation of Wave Function Position, momentum & Energy operators; Time dependent Schrodinger equation and dynamical evolution of a quantum state; Normalization. Linearity and Superposition Principles. Eigen values and Eigen functions. Expectation values of position & momentum. Wave Function of a Free Particle. Commutation relations between the operators. Compatible observables and simultaneous measurements. Ehrenfest theorem.
Unit II: Time Independent Schrodinger Equation (10 h) Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wavefunction as a linear combination of energy eigenfunctions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; wave packets, Position-momentum uncertainty principle.
Unit III: One Dimensional Problems: (10 h) continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem- square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions, zero point energy.
Unit IV: Quantum Theory of Hydrogen-like Atoms: (10 h) Time independent Schrodinger equation in spherical polar coordinates; separation of variables for the second order partial differential equation; angular momentum operator and quantum numbers; Radial wavefunctions; Orbital angular momentum quantum numbers ; probability density

Unit V:Atoms in Electric and Magnetic Fields: (8 h) Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Spin Magnetic Moment. Stern-Gerlach Experiment. Normal Zeeman Effect: Electron Magnetic Moment and Magnetic Energy.
Unit VI Application of Quantum communication (4h) Recent advancement in Quantum mechanics: Phonon-mediated quantum state transfer and remote qubit entanglement

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	STATISTICAL MECHANICS				
Course Code	BSCP3003				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives:

- To understand statistics performed under different constraint over microscopic particles consequence established macroscopic properties.
- To get familiar with different type of particle distributions in realm of classical and quantum physics.

Course Outcomes

CO1	Apply the ensemble concepts for determination of thermodynamic functions.
CO2	Explain the properties of radiation using classical and quantum theory
CO3	Distinguish between classical and quantum theory of radiation.
CO4	Apply the Bose-Einstein statistic to non degenerate and strongly degenerate Bose gas.
CO5	Apply the Fermi-Dirac statistics to non-relativistic and relativistic Fermi gas.
CO6	Student will get familiar with different type of phase transition and associated characteristics.

Text Book:

1 Statistical Mechanics, R.K. Patharia, Butterworth Heinemann: , Oxford University Press.

2 Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill

Reference Books:

1.Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir, Prentice Hall

2.Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger,Narosa.

3.Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, Springer

Reference: Papon P., Leblond J., Meijer P.H.E. (2002) Thermodynamics and Statistical Mechanics of Phase Transitions. In: The Physics of Phase Transitions. Advanced Texts in Physics. Springer, Berlin, Heidelberg

UNIT:-1 Classical Statistics: (12 h) Macrostate & Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature.
UNIT:-2 Classical Theory of Radiation: (10 h) Properties of Thermal Radiation, Blackbody Radiation, Pure temperature dependence, Kirchhoff's law, Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure, Wien's Displacement law Wien's Distribution Law, Saha's Ionization Formula, Rayleigh-Jean's Law, Ultraviolet Catastrophe
UNIT:-3 Quantum Theory of Radiation: (8 h) Spectral Distribution of Black Body Radiation, Planck's Quantum Postulates, Planck's Law of Blackbody Radiation: Deduction of Wien's Distribution Law, Rayleigh-Jeans Law, Stefan-Boltzmann Law, Wien's Displacement law from Planck's law
UNIT:-4 Bose-Einstein Statistics: (10 h) B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and Thermodynamic functions of photon gas.
UNIT:-5 Fermi-Dirac Statistics: (10 h) Fermi-Dirac Distribution Law, Thermodynamic functions of a completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit.

Unit VI. Phase Transition.	(4h)
Example of phase transition, Characteristics of phase transitions, Classification of phase transitions	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Detailed Syllabus (Laboratory)

Name of The Course	**Wave and Optics Lab**				
Course Code	**BSCP1002**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives: Students will learn the working principles of experiments and perform different experiments based on waves and optics.

Course Outcomes

CO1	Operate and handle the instruments effectively and safely in the physics laboratory
CO2	Apply the graphical ability to determine the physical constants with maximum accuracy
CO3	Verify the given physical laws by the existing instruments and interpret the basic principles.
CO4	Apply the knowledge of instruments such as spectrometer to measure the angular spectrum of light and hence to determine the physical properties of the material
CO5	Apply the fundamental principles of optics to design and perform the experiments to be realized for practical applications

Text Book (s)

1. B.Sc. Practical Physics by C.L Arora , S. Chand Limited.
2. B.Sc. Practical Physics by Harnam Singh, S. Chand Limited.

Reference Book (s)

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed.,Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, Heinemann Educational Publishers

List of Experiments
1. To determine the Refractive Index of the Material of a Prism using Sodium Light. 2. To determine Dispersive Power of the Material of a Prism using Mercury Light 3. To determine the value of Cauchy Constants. 4. To determine the Resolving Power of a Prism. 5. To determine wavelength of sodium light using Fresnel Biprism. 6. To determine wavelength of sodium light using Newton's Rings. 7. To determine the wavelength of Laser light using Diffraction of Single Slit. 8. To determine wavelength of (1) Sodium and (2) Spectral lines of the Mercury light using plane diffraction Grating 9. Polarisation of light and Brewster law 10. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2 – T Law. 11. To study Lissajous Figures 12. Familiarization with Schuster`s focussing; determination of angle of prism.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	Programming in C and Python Lab				
Course Code	BCSE1031				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics				
Co requisite	Students should have fundamental knowledge of Computer and it's application.				
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

The aim of the lab is to make the students of physics familiar with the working of computer programming language, QBASIC and use of software as a tool to understand physics, and solve physics based problems.

Course Outcomes

CO1	Understand the different codes to execute the program.
CO2	Write the program for numbers and mathematical calculations.
CO3	Write the print command to the given program.
CO4	Write the program for control structure in python.
CO5	Understand the concept of classes and objects in python.

1. Write a program in C to find greatest of three numbers.
2. Write a program in C to find gross salary of a person
3. Write a program in C to find grade of a student given his marks.
4. Write a program in C to find divisor or factorial of a given number.
5. Write a program in C to print first ten natural numbers.
6. Write a program in C to print first ten even and odd numbers.
7. Write a program in python to print n terms of Fibonacci series.
8. Write a program in python to find all prime numbers within a given range.
9. Write a program in python to demonstrate working of classes and objects

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	50	100

Name of The Course	**Hands on Basic Techniques and Measurements**				
Course Code	BBS09P1101				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics				
Corequisite	Students should have fundamental knowledge of physics, chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

The main purpose of this laboratory is to provide the students an appreciation for basic techniques in applied sciences. It is also aimed to provide the students a degree of competence in the laboratory skills required for accurate and precise analysis. Therefore it is expected that the students will demonstrate proficiency in synthesizing some material in laboratory.

Course Outcomes

CO1	Explain and operate the microscope for measurements.(K2)
CO2	Prepare Soap and Resins and understand the mechanism of preparartion. (K5)
CO3	Preparation of biodiesel from Vegetable oil/ Waste cooking oil and characterize it. (K5)
CO4	Apply the skill to solder and connect the electronic components. (K3)
CO5	Understand the functioning of CRO and develop the ability to use the micrometers. (K2)

Text Book (s)/ Reference Book (s)

1. Georg Stehli , The Microscope And How to Use It, English edition, 1970.
2. M.Sayer and A. Mansingh, PHI Learning. Measurement, Instrumentation and Experiment Design in Physics & Engineering, 2005.
3. Stocchi, E.(1990),Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.

1. Different types of microscopes and its applications.
2. Preparation of Urea-formaldehyde Resin
3. Preparation of Soap
4. Preparation of Biodiesel from Vegetable oil/ Waste cooking oil.
5. Characterization of biodiesel (TLC, Acid value and viscosity)
6. Soldering of electrical circuits
7. Measurement with Vernier calipers, Screw gauge and spherometer
8. Operation of oscilloscope
9. Familiarization with linear, logarithmic and polar graphs for plotting of experimental data
10. Assembling of elementary electric circuits using breadboard.

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	50	100

Name of The Course	**Mathematical Physics-I Lab**				
Course Code	**BSCP1004**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives: The objective of this lab is to make the students able to make programs of numerical methods and solve the problems using the various programming language such as C++ and python.

Course Outcomes

CO1	Describe the codes for solving mathematical problems and utilize different function loops.
CO2	Develop the programming code to solve any given algebraic equation
CO3	Develop the programming code to perform matrix operations.
CO4	Develop the programming code to solve any given first order differential equation
CO5	Develop the programming code to Integrate a given function

Text Book (s)

1. Introduction to Numerical Analysis, S.S. Sastry, 5thEdn., 2012, PHI Learning Pvt.Ltd.
2. Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Pub.

Reference Book (s)

1. Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rdEdn., 2007, Cambridge University Press.
2. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
3. Elementary Numerical Analysis, K.E. Atkinson, 3 rdEdn., 2007, Wiley India Edition.
4. An Introduction to computational Physics, T.Pang, 2ndEdn. , 2006,Cambridge Univ. Press
5. Computational Physics, Darren Walker, 1stEdn., 2015, Scientific International Pvt.Ltd.

Contents

Introduction and Overview of programming language (C/C++/python)

Basics of scientific computing

Errors and error Analysis

Review of Programming fundamentals

Programs:

Random number generation

Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods

Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation

Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method

Solution of Ordinary Differential Equations (ODE)

First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**General Chemistry Lab**				
Course Code	**BSCC1044**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives: This lab is provided for students to learn the basic chemistry experiments and to understand how to find various chemical compounds in the mixtures.

Course Outcomes

CO1	Handle the instruments and apparatus carefully
CO2	Measure the readings of experiments accurately

CO3	Perform volumetric titration to estimate the amount of a compound present in a mixture
CO4	Employ different volumetric titration techniques to estimate the amount of acids, salts and ions
CO5	Perform different chromatographic techniques to identify the compounds present in a mixture

Text Book (s)

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.

Reference Book (s)

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition.

2. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman.

List of Experiments
A: Inorganic Chemistry - Volumetric Analysis 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. 2. Estimation of oxalic acid by titrating it with KMnO4. 3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4. 4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator. 5. Estimation of Cu (II) ions iodometrically using Na2S2O3. ***Section B: Organic Chemistry*** 1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements) 2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given) (a) Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography (b) Identify and separate the sugars present in the given mixture by paper chromatography.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	Nanoscience and Nanotechnology Lab				
Course Code	**BSCG1051**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives: The objective of this lab is to provide the basic knowledge of Nanoscience and nanotechnology, synthesis and its characterisation using UV techniques. Students will also learn the properties and its vast applications.

Course Outcomes

CO1	Describe basics of nanoscience and nanotechnology
CO2	Synthesis of nano particles by different materials
CO3	Describe the general characteristics of nanosize materials.
CO4	Demonstrate the nanomaterials characterization by UV techniques.
CO5	Correlate the nano-materials properties & identify appropriate applications as well as its ethical aspects

Text Book (s)

1. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.
2. Carbon Materials and Nanotechnology, Anke Krueger, Wiley –VCH Verlag GmbH & Co., 2010.
3. Nanotechnology, J.F. Mongillo Greenwood Press London, 2008.

Reference Book (s)

1. Introduction to Nanotechnology C P Poole, Frank J. Owens, John Wiley & Sons, 2011.
2. Micro fabrication and nano- manufacturing, M.J Jackson, CRC Press

   Taylor & Francis Group 2006.

List of Experiments
11. Preparation of Ag nanoparticles and characterization. 12. Preparation and characterization of CaO nanoparticles. 13. Preparation and characterization of ZnO nanoparticles. 14. Synthesis of ZnS nanoparticles and Characterization of synthesized nanoparticles by different techniques. 15. Preparation of Cu nanoparticles and Characterization by UV-Vis spectrophotometer. 16. Synthesis of CdS nanoparticles UV-Vis and IR characterization. 17. Catalytic reduction of *p*-nitrophenol by Ag nanoparticle 18. Synthesis of magnetic Fe_2O_3 nanoparticles. 19. Synthesis of MnO nanoparticles under optimized conditions using different Manganese salts (Manganese acetate and Manganese nitrate) and Characterization by UV-Vis spectrophotometer and other characterization techniques.

20. Optimization and study of the size variation of Manganese oxide nanoparticles using time variation and temperature variation.
21. Synthesis of Nickel Oxide nanoparticles from Nickel Nitrate and optimization of conditions. Characterization by UV-Vis spectrophotometer.
22. Synthesis of Copper nanoparticles from Copper Sulphate in presence of Ascorbic acid and optimization of conditions.UV-Visible and IR characterization.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**Elements of Modern Physics Lab**				
Course Code	**BSCP2006**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives: Student will perform the various experiments based on Laser, optical fibre, quantum mechanics

Course Outcomes

CO1	Operate and handle the physics instruments effectively and safely in the laboratory
CO2	Determine the wavelength of monochromatic light using different methods.
CO3	Apply the skill to measure the physical constants of the material in the lab
CO4	Illustrate the experiments of optical fibre.
CO5	Interpret the working of the experiments using the fundamental principle of physics

Text Book (s)

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011,Kitab Mahal

Reference Book (s)

1. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, Heinemann Educational Publishers

List of Experiments
1. Measurement of Planck's constant using photo-detector 2. To determine the Planck's constant using LEDs of at least 4 different colours. 3. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet. 4. To show the tunneling effect in tunnel diode using I-V characteristics. 5. To determine the wavelength of diode laser source using diffraction of single slit. 6. To determine the wavelength of laser using diffraction of double slits. 7. To determine wavelength of He-Ne laser using plane diffraction grating 8. To determine Angular spread of He-Ne laser using plane diffraction grating 9. Determination of Laser divergence 10. Determination of Numerical Aperture of Optical fibre 11. Study of signal attenuation in optical fibre using laser source.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**Mathematical Physics-II Lab**				
Course Code	**BSCP2002**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives: The objective of this lab is to develop the ability to write the program using Sci lab. The student will learn the programming for curve fitting, matrix solution, special function, solution for ODE and partial differential equations.

Course Outcomes

CO1	Understand the basics of Scilab and apply to execute the various commands.
CO2	Develop the programs for curve fitting, least square fitting etc.
CO3	Develop the programs for Solution of Linear system of equations
CO4	Develop the programs for various special functions

CO5	Develop the programs for Solution of ordinary differential equation and partial differential equation

Text Book (s)

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., Cambridge University Press
2. Complex Variables, A.S.Fokas &M.J.Ablowitz,8thEd.,2011,CambridgeUniv.Press
3. Computational Physics, D.Walker, 1stEdn., 2015, Scientific International Pvt.Ltd.
4. Scilab (A free software to Matlab): H. Ramchandran, A.S.Nair. 2011S.Chand&Company

Reference Book (s)

1. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer
2. Scilab by example: M. Affouf 2012, ISBN:978-1479203444
3. ScilabImageProcessing:LambertM.Surhone.2010BetascriptPublishing
4. www.**scilab**.in/textbook_companion/generate_book/291

Contents: Computational Programming using Scilab/Python
Introduction to Numerical computation software Scilab: Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Multidimensional arrays, Sub array, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3Dplotting, Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization. User defined functions, Introduction to Scilab functions,Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multi dimensional arrays, an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program. **Curve fitting, Least square fit, Goodness of fit, standard deviation -** Ohms law to calculate R, Hooke's law to calculate spring constant **Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method.** Diagonalization of matrices, Inverse of a matrix, Eigenvectors, eigen values problems - Solution of mesh equations of electric circuits (3 meshes), Solution of coupled spring mass systems (3 masses). **Generation of Special functions using User defined functions in Scilab:** Generating and plotting Legendre Polynomials, Generating and plotting Bessel function **Solution of ODE** First order Differential equation Euler, modified Euler and Runge-Kutta second order methods, Second order differential equation Fixed difference method **Partial differential equations-** Wave equation, Heat equation, Poisson equation, Laplace equation

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**ELECTRICITY AND MAGNETISM LAB**				
Course Code	**BSCP2004**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives: Objective of this lab is to make the students to learn about using the multimeter, breadboard and electronic components. They will gain the skills to connect the LCR circuits and perform the experiments. Also verify the basic circuit theorems, and measure the resistance using Ballistic Galvanometer.

Course Outcomes

CO1	Operate and handle the electronic instruments effectively and safely in the physics laboratory
CO2	Apply the skill to measure the resistance and voltage using multimeter
CO3	Connect the electronic circuits using breadboard
CO4	Apply the skill to measure the resistance by Ballistic Galvanometer
CO5	Interpret the resonance due to LCR circuit and measure the various parameters.

Text Book (s)

1. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, KitabMahal

2. Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
3. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, Vani Pub.

Reference Book (s)

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House
2. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted, Heinemann Educational Publishers

List of Experiments
1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses. 2. To study the characteristics of a series RC Circuit. 3. To determine an unknown Low Resistance using Potentiometer. 4. Measurement of field strength B and its variation in a solenoid (determine dB/dx) 5. To verify the Thevenin and Norton theorems. 6. To determine self inductance of a coil by Anderson's bridge. 7. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width. 8. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer 9. Determine a high resistance by leakage method using Ballistic Galvanometer. 10. To determine the mutual inductance of two coils by Absolute method.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	Solid State Electronics Lab			
Course Code	BBS09P2401			
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics			
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	4	2

Course Objectives: This lab is designed to provide the knowledge how to perform the experiments to study the characteristics of diode and transistors. Students will also learn the various application of diode and transistors as voltage regulators, amplifiers etc.

Course Outcomes

CO1	Perform the experiments based on semiconductor and magnetic materials and interpret the results
CO2	Explain the I-V characteristics of different diodes and their applications
CO3	Perform the experiments of transistor in various mode and explain the characteristics
CO4	Demonstrate the application of transistor as amplifier and calculate the gain
CO5	Perform the experiments using operational amplifier and illustrate its various application

Text Book (s)

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Edn., 2011, KitabMahal
3. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
4. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4^{th} edition, 2000, Prentice Hall.

Reference Book (s)

1. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition,
2. reprinted 1985, Heinemann Educational Publishers
3. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
5. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson

List of Experiments

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To study the BH curve of iron using a Solenoid and determine the energy loss.
3. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four-probe method (room temperature to 150 oC) and to determine its band gap.
4. To determine the Hall coefficient of a semiconductor sample
5. To study V-I characteristics of PN junction diode, and Light emitting diode.
6. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
7. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
8. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
9. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
10. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
11. To investigate the use of an op-amp as an Integrator.
12. To investigate the use of an op-amp as a Differentiator.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	Thermal Physics lab			
Course Code	BSCP3002			
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics			
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	4	2

Course Objectives: The thermal Physics lab is offered to students for their experimental hand on to measure Planck constant, Stefan's constant, and coefficient of thermal conductivity. Also students will learn about the applications of thermo couples.

Course Outcomes

CO1	Operate and handle the instruments effectively and safely in the physics laboratory –K2
CO2	Determine the Planck constant and Stefan's constant–K3
CO3	Calculate the Thermal conductivity by various methods. K3
CO4	Calculate the temperature coefficient of resistance-K3
CO5	Use the thermocouple and perform the different experiments. -K3

Text Book (s)

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.
3. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, Vani Publication.

Reference Book (s)

1. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

List of Experiments
1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method. 2. Measurement of Planck's constant using black body radiation. 3. To determine Stefan's Constant.

4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.

5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.

6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.

7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.

8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.

9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system

10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**Digital Systems and Applications Lab**				
Course Code	**BSCP3006**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Physics				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives: The objective of this lab is to provide the skills to students about testing and the diode transistor and other electronic components. The student will learn how to design the various logic gates, adder, subtractor and flip flops using diodes, transistors and ICs.

Course Outcomes

CO1	Operate and handle the instruments effectively and safely in the physics laboratory K2
CO2	Employ the understanding of logic gates using transistors and diodes to design switches, AND, OR, NOT, XOR gates. K3
CO3	Design logic gate circuits and verify the truth table. K3
CO4	Design the adder and subtractor using ICs. K3
CO5	Demonstrate and design the various flip flops using ICs. K4

Text Book (s)

- Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGrawHill.
- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-GrawHill.

Reference Book (s)

- Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, PrenticeHall.
- Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa, 2010, PHILearning.

List of Experiments
1. To measure (a)Voltage, and(b)Time period of a periodic wave form using CRO. 2. To test a Diode and Transistor using a Multimeter. 3. To design a switch (NOT gate) using a transistor. 4. To verify and design AND,OR,NOT and XOR gates using NAND gates. 5. To design a combinational logic system for a specified Truth Table. 6. To convert a Boolean expression into logic circuit and design it using logic gate ICs. 7. To minimize a given logic circuit. 8. Half Adder, Full Adder and 4-bit binary Adder. 9. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C. 10. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates. 11. To build JK Master-slave flip-flop using Flip-Flop ICs 12. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Elective Courses

Elective-I

Name of The Course	Laser Physics
Course Code	BSCP2051
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream

Corequisite	Students should have fundamental knowledge of subjects like mathematics and physics				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives: This course is designed to make the students familiar with the different types of laser, their properties, working principle and applications in various fields

Course Outcomes

CO1	Explain the laser properties and the condition to achieve the laser action
CO2	Explain the quantum theory of radiation and spectral line broadening
CO3	Identify the dynamics of the laser process and describe it to realize the laser light.
CO4	Describe the different types of laser and their production methods.
CO5	Explain the various application of laser in industry, medical and other fields.
CO6	Prepare the digital image hologram in the recent research field of laser.

Text Books:

1. B. B. Laud Lasers and Nonlinear optics (2^{nd}Edn.). New Delhi: New Age international (P) Limited
2. K. Thyagarajan, A. K. Ghatak, Lasers: Theory and Applications. New Delhi: Macmillan India Ltd

Reference Books:

1. Anthony Seigman , Lasers,. University Science Books,
2. Walter Koechner ,Solid State Laser Engineering, Springer Science & Business Media
3. L. V. Tarasov, Laser Physics. Moscow: Mir Publisher
4. L. Allen, Essentials of Lasers. Oxford: Pergamon Press

References:

1. Martin J. Richardson John D. Wiltshire, The Hologram: Principles and Techniques, Technology & Engineering, John Wiley & Sons, November 22, 2017.
2. Recent advances in self-interference incoherent digital holography, Advances in Optics and Photonics, Vol. 11, Issue 1, pp. 1-66, (2019)
3. https://doi.org/10.1364/AOP.11.000001
4. https://doi.org/10.1364/AO.53.000G44

UNIT I LASER PROPERTIES (8hr) Light waves and photons, optical directionality, interactivity, monochromaticity and coherence, quantum transitions in absorption and Emission of light. The active medium, meta stable state, creating population inversion, Laser gain curve.
UNIT II QUANTUM THEORY OF RADIATION (8hr) Einstein's quantum theory of radiation, Einstein coefficients and their relationship. Shape and width of spectral lines, line broadening mechanism, and Doppler broadening.

UNIT III DYNAMICS OF LASER PROCESSES (12hr) Optical resonators of various kinds and their role in confinement of laser beam. Control of laser output: Interactivity, control of spectral characteristics, method of Q switching, Pulsed Lasing, mode locking for ultra-short pulses, modifying the spatial structure of laser output, Frequency transformations in nonlinear media, wave front correction of laser output, Light beam manipulation.
UNIT IV TYPES OF LASERS (12hr) Solid state laser, organic dye laser, photo dissociation lasers, Molecular Laser (CO2 laser), Electro ionization Lasers, Chemical Lasers, Semiconductor Lasers.
UNIT V APPLICATIONS OF LASERS (10hr) Nonlinear optics: harmonic generation, second harmonic generation, phase matching and optical mixing, Lasers in optical communications: different types of optical fibre (brief description) and applications, ranging and measurement
Unit VI- Recent development in application of laser in holography (4hr) Digital Image Hologram, E-beam Lithographic grating, Grating security feature.

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Astronomy and Astrophysics				
Course Code	**BBS09T5321**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics and physics				
Antirequisite	-				
		L	**T**	**P**	**C**
		4	-	-	4

Course Objective:

This course aims to provide a broad overview of astronomy and astrophysics to students. They will learn the various parameters used in astronomy, formation and characteristics of the Sun and Solar System, including the planets, Telescopes, the birth, life and death of stars, Black Holes and Supernova.

Course Outcomes:

S.No	COs
CO1	Describe the various parameters used in astronomy.
CO2	Identify the various coordinate system used in astronomy.
CO3	Describe the working principle of the astronomical telescopes.
CO4	Explain the mechanism of star formation and various stages of evolution, including Red giant, White Dwarfs, Neutron Star, Black Holes and Supernova.
CO5	Demonstrate an understanding of the basic physical processes in the Sun and origin of Solar system;
CO6	Plan a project on Black hole studies

Text Books:

1. An Introduction to Modern Astrophysics and Cosmology (Second Edition), B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co., 2006
2. An Introduction to Astronomy and Astrophysics, Pankaj Jain, CRC Press Taylor & Francis Group, 2015
3. Astrophysics for Physicists, by ArnabRaiChoudhuri, 2012 Cambridge University Press.
4. Textbook of Astronomy and Astrophysics with elements of cosmology, V. B. Bhatia, Narosa Publication, 2001

Reference Books:

1. Introductory Astronomy and Astrophysics (Fourth Edition), M. Zeilik and S. A. Gregory
2. Saunders College Publishing, 1998 Fundamental of Astronomy (Fifth Edition), H. Karttunen et al. Springer, 2007
3. The Cosmic Perspective (Eighth Edition), J. O. Bennet, M. Donahue, N. Schneider & M. Voit, Pearson Publications, 2017
4. The Physical Universe: An Introduction to Astronomy, Frank Shu, Oxford University Press, 1985
5. Astrophysics: Stars and Galaxies, K. D. Abhyankar, Universities Press, 2001

   Reference: Leor Barack1, Vitor Cardoso et.al Classical and Quantum Gravity, Volume 36, Number 14

Unit-I Basic Astronomical Parameters	**(10 Lectures)**
Astronomical scales and dimensions: Light Distances, Stellar Parallax, Angular Sizes and Distances, Brightness, Radiant Flux and Luminosity, Apparent and Absolute magnitude scale, Distance Modulus, Measurement of Astronomical Quantities (Distances, Stellar Radii, Masses of Stars from binary orbits, Stellar Temperature, Color index of stars)	
Unit-II The celestial sphere and the coordinate systems	**(10 Lectures)**
Celestial Sphere, Geometry of a Sphere, Astronomical Coordinate Systems, Horizon System, Equatorial System, Ecliptic System, Galactic Coordinate System, Space Velocity and Proper Motion of Stars, Coordinate transformation between Horizon and Equatorial system, Measurement of Time, Sidereal Time, Apparent Solar Time, Mean Solar Time, Equation of Time, Julian Date, Stellar spectra: Spectral types and their temperature dependence, Hertzsprung-Russell Diagram	
Unit-III Astronomical telescopes and techniques:	**(10 Lectures)**
Atmospheric Windows, Optical telescopes, Radio telescope, Telescope mountings, Magnification, Light gathering power, resolving power and diffraction limit, Detection limit of telescope, Modern terrestrial and space telescopes (GMRT, Keck, Chandra, HST).	
Unit-IV Star Formation and Stellar Evolution	**(10 Lectures)**

Pressure Gradient, Mass Distribution, Temperature Gradient, Equation of State, Derivation of Ideal Gas Law, Radiation Pressure, Energy Production in Stars, Nuclear Fusion Reactions, Nuclear Reaction Rate,, Energy Released in Nuclear Reactions, Early Stage of Star Formation, Evolution on the Main Sequence, Degenerate Free Electron Gas, Evolution beyond the Main Sequence, Population I and II Stars, Red giant, White Dwarfs, Neutron Star, Black Holes, Supernova
Unit-V The Sun and the Solar System: (10 Lectures)
Solar Atmosphere, Solar Photosphere, Chromosphere, Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics, Sunspots and the Solar Cycle, Origin of the Solar System (The Nebular Model, Tidal Forces, Planetary Rings and their formation); Extra Solar Planets.
UNIT-6: Recent development in Astronomy (4h) Black holes, gravitational waves and fundamental physics: a roadmap

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Elective-II

Name of The Course	Classical Dynamics				
Course Code	BSCP2052				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives: Objective of this course is to provide the advanced knowledge of applying the classical mechanics for point charge particle in a field, and also to find the equation of dynamical particles. Students will also learn the advanced topics on special theory of relativity and fluid dynamics.

Course Outcomes

CO1	Apply the concept of classical mechanics to solve the motion of a charge particle in external electric and magnetic fields
CO2	Describe the Dynamics of Point Particles
CO3	Explain the motion of a Particle in a central force field
CO4	Estimate the motion of a particle in a relativistic limit
CO5	Explain the dynamics and the motion of fluids

CO6	Propose the ideas in the field of phase space and phase configurations

Text Books:

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rdEdn. 2002, Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.

Reference Books:

1. Classical Mechanics, R. Douglas Gregory, 2015, Cambridge University Press.
2. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
3. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press

Reference: Donald T. Greenwood (1989). Classical Dynamics, Dover Publications; Revised ed. edition (July 7, 1997)

Unit-1: Classical Mechanics of Point Particles: (12 h) Review of Newtonian Mechanics; Application to the motion of a charge particle in external electric and magnetic fields- motion in uniform electric field, magnetic field- gyro radius and gyro frequency, motion in crossed electric and magnetic fields.
Unit-2: Dynamics of Point Particles: (10 h) Generalized coordinates and velocities, Hamilton's principle, Lagrangian and the Euler-Lagrange equations, one-dimensional examples of the Euler-Lagrange equations- one-dimensional Simple Harmonic Oscillations and falling body in uniform gravity.
Unit 3: Central force: (10 h) Particle in a central force field- conservation of angular momentum and energy, Equation of motion, Application, Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator, solution of Hamilton's equation for Simple Harmonic Oscillations;
Unit 4: Special Theory of Relativity: (10 h) Postulates of Special Theory of Relativity. Lorentz Transformations. Minkowski space. The invariant interval, light cone and world lines. Space-time diagrams. Time -dilation, length contraction and twin paradox. Four-vectors: space-like, time-like and light-like. Four-velocity and acceleration.
Unit 5: Fluid Dynamics: (10 h) Density and pressure in a fluid, an element of fluid and its velocity, continuity equation and mass conservation, stream-lined motion, laminar flow, Poiseuille's equation for flow of a liquid through a pipe, Navier-Stokes equation, qualitative description of turbulence, Reynolds number.

Unit VI Application of Classical Dynamics (4h) Generalized coordinate, velocity and momentum. Configuration space and phase space. Phase Portraits, The pendulum, Phase portrait, Elliptic function.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**PHYSICS OF DEVICES AND COMMUNICATION SYSTEMS**			
Course Code	**BBS09T5421**			
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream			
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry			
Antirequisite	-			
	L	**T**	**P**	**C**
	4	**-**	**-**	**4**

Course Objective:
In this course the students will get familiarized with the working of semiconductor devices, power supply and filters. They will get an insight into the various processes involved in device fabrication. Also, they will be given an overview of communication systems and Digital Data Communication Standards.

Course Outcomes

S.NO	**COs**
CO1	Interpret the working, characteristics and applications of various semiconductor devices.
CO2	Explain diagrammatically the operation of power supply and differentiate between the working and applications of a variety of filters.
CO3	Illustrate the different processes involved in device fabrication.
CO4	Identify the different building blocks of serial and parallel communication system
CO5	Explain the basic structure of electronic communication system and the importance of different modulations in communication.
CO6	Organize the concept of Li-Fi communication and apply it with 5G / Wi-Fi technology

Text Books:

1. Physics of Semiconductor Devices, S.M. Sze & K.K. Ng, 3rd Ed.2008, John Wiley &Sons
2. Electronic Communication systems, G. Kennedy, 1999, Tata McGrawHill.

3. Introduction to Measurements & Instrumentation, A.K. Ghosh, 3rd Ed., 2009, PHI Learning Pvt.Ltd.

Reference Books:

1. Electronic devices and integrated circuits, A.K. Singh, 2011, PHI Learning Pvt.Ltd.
2. Op-Amps & Linear Integrated Circuits, R.A.Gayakwad,4 Ed. 2000,PHI Learning Pvt.Ltd
3. Electronic Devices and Circuits, A. Mottershead, 1998, PHI Learning Pvt.Ltd.
4. PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall ofIndia

Unit I Semiconductor Devices: 12 h Characteristic and small signal equivalent circuits of UJT and JFET. Metal- semiconductor Junction. Metal oxide semiconductor (MOS) device. MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, CMOS. Tunnel diode.
Unit II Power supply and Filters: 8h Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters.
Unit III Processing of Devices: 10h Basic process flow for IC fabrication, Electronic grade silicon. Crystal plane and orientation. Defects in the lattice. Oxide layer. Oxidation Technique for Si. Metallization technique. Positive and Negative Masks. Optical lithography. Electron lithography. Lift off Technique. Diffusion and implantation.
Unit IV Digital Data Communication Standards: 8h Serial Communications: RS232, Handshaking, Implementation of RS232 on PC. Universal Serial Bus (USB): USB standards, Types and elements of USB transfers. Devices (Basic idea of UART). Parallel Communications: General Purpose Interface Bus (GPIB), GPIB signals and lines, Handshaking and interface management, Implementation of a GPIB on a PC. Basic idea of sending data through a COM port.
Unit V Introduction to communication systems: 12h Block diagram of electronic communication system, Need for modulation. Amplitude modulation. Modulation Index. Analysis of Amplitude Modulated wave. Sideband frequencies in AM wave. CE Amplitude Modulator. Demodulation of AM wave using Diode Detector. basic idea of Frequency, Phase, Pulse and Digital Modulation
Unit VI- **Physics of Devices and Communication Systems** Transmission of data through light, Coexistence of Wi-Fi and Li-Fi toward 5G: concepts, opportunities, and challenges

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Elective-III

Name of The Course	Nuclear and Particle Physics				
Course Code	BSCP3051				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics				
Antirequisite	-				
		L	T	P	C
		4	-	-	4

Course Objectives:

This course introduces the modern nuclear and particle physics to the students. They will learn basic nuclear properties, nuclear force, elementary particles and their interactions. This course will cover various decay modes of nucleus, nuclear reactions, particle detection, fundamental constituents of matter, their classifications, symmetry laws and fundamental interactions between the particles.

Course Outcomes

CO1	Explain in details of the atomic nucleus and its general properties
CO2	Interpret the various decay process of nuclei and explain the kinematics.
CO3	Describe the nuclear reactions and radiation interaction with matter
CO4	Explain the basic principle of particle detection and describe different accelerators
CO5	Indentify the fundamental constituents of matter and explain the conservation laws.
CO6	Plan a project on scattering experiments at LHC

Text Books:

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd.).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill).

Reference Books:

1. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia).
2. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
3. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
4. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
5. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing).

Reference: J. Phys. G 46 (2019) 12, 123001 DOI: 10.1088/1361-6471/ab4698

Module 1: General Properties of Nuclei (10 h) Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. Liquid drop model approach, semi empirical mass formula and significance of its various terms.	
Module 2: Radioactivity decay (10 h) Laws of radioactivity, Laws of radioactive decay, Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. β-decay: energy kinematics for γ-decay, positron emission, electron capture, neutrino hypothesis. Gamma decay: Gamma rays emission & kinematics, internal conversion.	
Module 3: Nuclear Radiation and Nuclear Reactions (10 h) Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering), Energy loss due to ionization (Bethe-Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, pair production, neutron interaction with matter.	
Module 4: Particle Acceleration and Detection (12 h) Basic principle of Ionization chamber and GM Counter, Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector, Van-de Graaff generator(Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.	
Module 5: Particle physics (12 Lectures) Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model.	
UNIT-6: Advance in Particle physics (4 h) Exploring the energy frontier with deep inelastic scattering at the LHC	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Material Synthesis and Characterization Technique**
Course Code	BBS09T5521

Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Objective: This course focuses on the fundamental aspects of materials science which is very useful for the graduate students. The course discusses the basic structure of solids, classification of materials based on the structure and the correlation between the structure and properties. The aim is also to provide students with the knowledge of techniques used for synthesis and characterization of nanomaterials.

Course Outcomes:

S. No	COs
CO1	Describe the various methods used to determine the Crystal Structures such as- JSPDS, Indexing etc.
CO2	Demonstrate thermal characterization techniques used for microstructure examination and various phases.
CO3	Identify the microscopy techniques to investigate optical, structural and surface morphology of materials.
CO4	Explain the different methods involved in nanomaterial synthesis.
CO5	Describe the basic working principle of vacuum pump and physical process used in growth of thin film.
CO6	Plan the construction of Graphene based nanostructured photovoltaic devices such as- solar cells, battery etc.

Text Books

1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
2. Materials Science and Engineering: An Introduction; William D. Callister, Jr., David G. Rethwisch, 8th Ed., 2019, John Wiley & Sons, Inc.
3. Nanostructures and Nanomaterials: Synthesis, Properties, and Applications, Cao; World Scientific Publishing Company, 2011.
4. Materials Science of Thin Films; Milton Ohring; Academic Press; 2001.

Reference Books

1. Microstructural characterization of materials, D. Brandon and W. Kaplan, John Wiley & Sons, 2013.
2. Surface Characterization Methods: Principles, Techniques and Applications; Milling; CRC Press; 1999.
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill.
4. Thin Film Fundamentals; Goswami; New Age International Pvt. Ltd; 2007.

Unit I: Determination of Crystal Structure	**10h**
Miller's Plane and indices, Diffraction of *X*-rays from powder samples, Bragg's X-ray spectrometer and its working principle, Concept of Peak Shape, Determination of crystal size and strain (Williamson-Hall Plot, Indexing and structure solution from powder diffraction data (JCPDS Pattern), Electron Diffraction and Neutron diffraction, Berger's Vector, Experimental methods of dislocations.	

Unit II: Thermal Characterization	**10h**
Point defects and Dislocations, Phase Diagram: Basic principle, Simple binary systems, Solid solutions, Eutectic systems: Application, Super lattices - Intermediate and interstitial phases, Liquid crystal, Thermal characterization: DSC, TGA, DTA, Impedance Spectroscopy: Bode Plot and Nyquist Plot.	
Unit III: Characterization Techniques	**10h**
Light microscopy- bright field, dark field, phase contrast illumination, Spectrophotometry, Ellipsometry, Luminescence spectroscopy, UV-Vis Spectroscopy, Fourier Transform infrared (FTIR) spectroscopy, Raman spectroscopy, Scanning Electron Microscope (SEM), Atomic force microscopy (AFM).Transmission electron microscope (TEM).	
Unit IV: Synthesis Methods	**10h**
Classification of nanomaterials, Top-down and Bottom-up approach, Overview of different fabrication and synthesis techniques.Physical Vapor Deposition, Pulsed Laser Deposition, Molecular Beam Epitaxy,hydrothermal method	
Unit V: Vacuum Pump and Thin Film Growth	**10h**
Vacuum Generation: Basic terms and concepts; Continuum and Kinetic gas theory;Types of flow; Vacuum pumps – Principle of operation, Rotary pump, Diffusion Pump, Turbo molecular Pump (TMP), Cryogenic Pump. Nucleation and Growth: Film formation and structure; Thermodynamics of nucleation, Nucleation theories: Capillarity model – homogeneous and heterogeneous nucleation, Post-nucleation growth; Deposition parameters; Epitaxy; Thin film structure, Thickness measurement , basics of lithography	
Unit VI- Application of Material Synthesis and Characterization Technique	**4h**
Structure of Graphene, synthesis of Graphene and nanostructure, Hybrid structure of Graphene, Applications-solar cells, battery, biomedical etc	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Medical Physics**				
Course Code	**BBS09T5522**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

The aim of the paper is to make the students familiar with the activities of the physical bodies, effect of radiations and different techniques to measure the biological activities in the physical body

Course Outcomes:

CO1	Understand and explain the mechanics, energy household and pressure system of the body.
CO2	Understand and explain the acoustics, optical system and electrical system of the body
CO3	Describe the production of x-rays and the diagnostic nuclear medicine
CO4	Describe the radiation physics , detection and the principles of radiation protection
CO5	Explain the principle and working of medical imaging instruments for the measurement of diagnosis of the body
CO6	Modify the anesthetic molecular interaction to enhance the surgical procedure

Text Books:

1. Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley

2. Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi

3. Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins

Reference Books:

1. Physics of the human body, Irving P. Herman, Springer(2007).

2. Physics of Radiation Therapy : F M Khan - Williams and Wilkins, 3rd edition(2003)

3. The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition

4. The Physics of Radiology-H E Johns andCunningham.

5. Reference: Kundu et al. ***Current Drug Delivery, V- 15,*** 1381-1392 (2018)

Unit I PHYSICS OF THE BODY-I	**10h**
Mechanics of the body: Skeleton, forces, and body stability. Muscles and the dynamics of body movement, Physics of body crashing. **Energy household of the body:** Energy balance in the body, Energy consumption of the body, Heat losses of the body, **Pressure system of the body:** Physics of breathing, Physics of cardiovascular system.	
Unit II PHYSICS OF THE BODY-II	**10h**
Acoustics of the body: Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound. **Optical system of the body:** Physics of the eye. **Electrical system of the body:** Physics of the nervous system, Electrical signals and information transfer.	
Unit III PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS	**10h**
X-RAYS: Electromagnetic spectrum – production of x-rays – x-ray spectra- Brehmsstrahlung-Characteristic x-ray – X-ray tubes – Coolidge tube – x-ray tube design– tube cooling stationary mode – Rotating anode x-ray tube – Tube rating – quality and intensity of x-ray. X-ray generator circuits – half wave and full wave rectification. Diagnostic nuclear medicine: Radiopharmaceuticals for radioisotope imaging, Radioisotope imaging equipment, Single photon and positron emission tomography.	
Unit IV RADIATION PHYSICS:	**10h**

Radiation units - exposure - absorbed dose – units: rad, gray- relative biological effectiveness - effective dose - inverse square law - interaction of radiation with matter - linear attenuation coefficient. Radiation Detectors -Thimble chamber- condenser chambers – Geiger counter – Scintillation counter – ionization chamber – Dosimeters Principles of radiation protection – protective materials-radiation effects – somatic, genetic stochastic & deterministic effect, Personal monitoring devices – thermo-luminescent (TLD) film badge – pocket dosimeter. Radiation dosimetry, Natural radioactivity, Biological effects of radiation, Radiation monitors

Unit V MEDICAL IMAGING PHYSICS: 10h

X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR) – NMR imaging – MRI Radiological imaging – Radiography – Filters – grids – cassette – X-ray film – film processing – fluoroscopy – computed tomography scanner – principle function – display – generations– mammography. Ultrasound imaging – magnetic resonance imaging – thyroid uptake system – Gamma camera (Only Principle, function and display)

Unit VI Application of Medical Physics (4h)

Recent advancement in Medical Physics: Anesthetic Molecule Interaction of Noble Gases with Proteins and Lipids and their Effect

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Basic and Applied Sciences
Department of Life Sciences
Division of Microbiology

Programme: B.Sc. (Hons) Microbiology

Scheme: 2020 – 2023

Date of BoS: 22.04.2020

Galgotias University

Vision

"To be known globally for value-based education, research, creativity and innovation"

Mission

1. **Establish state-of-the-art facilities for world class education and research.**
2. **Collaborate with industry and society to align the curriculum,**
3. **Involve in societal outreach programs to identify concerns and provide sustainable ethical solutions.**
4. **Encourage life-long learning and team-based problem solving through an enabling environment.**

School of Basic and Applied Sciences

Vision:

To be recognized globally as a center of excellence in imparting value-based education in Basic and Applied Sciences by creating innovation in fundamental and multidisciplinary research.

Mission

M1: To excel in imparting contemporary knowledge and skills by developing an educational ecosystem with diverse interests and talents.

M2: To perform cutting edge research leading to innovation in sciences through national and international collaborations.

M3: To develop solutions for the emerging challenges in Basic and Applied Science to cater the needs of society.

M4: To attract best quality faculty to facilitate knowledge and develop confidence in our graduates to succeed in the world.

Preamble

B.Sc.(Hons) Microbiology is an undergraduate Microbiology course. Microbiology is the branch of the science that deals with the study of microscopic organisms. Microscopic organisms are any living organism that is either a single cell, a cell cluster or has no cells at all. Microorganisms are responsible for the disease so the course usually studies about the immune system (Immunology). The applicants of the program study about the subjects and topics like Macromolecular Structure & Analysis, Basic Microscopy & Instrumentation, Principles of Transmission Genetics, Principles of Immunology, Computational Biology, etc. The duration of the course is three years and the complete syllabus of the program is divided into six semesters.

Scope of the Proposed Programme

The B.Sc., programme of three years is designed to help all the students to get good quality education in the field of Microbiology so that they can pursue Post Graduation or find employment. The ultimate aim is to enable the students to develop an integrated approach for understanding the various life science problems at the molecular level. In addition, the present curriculum gives scope for the students entering different modules to update their knowledge depending upon the employment opportunities in each area. Various practical courses have been designed not only to enable the students to appreciate scientific basis of various life processes but also to train them for self-employment.

There is a greater demand globally for trained manpower in the area of microbiology .After completion of the course candidate can work as Bacteriologist, Biochemist, Geneticist, and Industrial Microbiologist , Food Microbiologist, Ecologist, Environmental Microbiologist Medical Microbiologist , Weed Scientist , Science Adviser, Research Development, in Multinational Companies, Public Sectors, Quality Control Labs, Biopharmaceuticals companies, Food industries as well as in Universities and the present curriculum will cater to that needs.

The course will provide solid foundation for all the students regardless of background and will gain a comprehensive understanding of the microbial tools, microorganisms and allied areas, including clinical and research aspects and with the special attention to current development in the discipline.

Eligibility

Candidate for admission to the first year of B.Sc. Degree Course in Microbiology shall be required to have passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in cience stream with a minimum of 50 % marks in aggregate.

Programme Objectives

- To ignite young minds, from different backgrounds, to understand the world of microorganism through application based learning.
- To provide high quality teaching to the students through traditional classroom teaching as well as varied exposure to audio-visual aids and hands on training on various aspects of Microbiology and allied biological subjects. More emphasis is given on understanding the subject rather than rote learning.
- Develop skills as a self-directed learner, recognize continuing educational needs.
- To equip the students to occupy important positions in Research, Industries and related organizations.
- To inspire the students to apply their knowledge gained for the development of society in general.

PSO1	**Igniting young minds, from different backgrounds to understand the world of microorganisms through application based learning.**
PSO2	**Equip students with analytical and technical skills to practice evidence based microbiology for industrial applications.**

Program Educational Objectives (PEO)

PEO1: The graduates shall be successful professionals in Academia, Industry, Government and Entrepreneurship.

PEO2: The graduates shall pursue higher education/research at institute of national and international repute.

PEO3: The graduate shall effectively address the challenges of the society and undertake the projects for bridging the gap between industry and societal needs.

Programme Outcomes (POs)

PO1: **Apply the principles and conceptual knowledge of basic and applied science to understand and solve the complex biological problems.**

PO2: **Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of biological reactions.**

PO3: **Create, select and apply appropriate techniques, resources and modern science and research tools within a defined specification that meet specified needs with appropriate consideration for public health and safety.**

PO4: **Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal issues and the consequent responsibilities relevant to the professional biologist.**

PO5: **Understand the impact of professional life sciences solutions in communal and environmental contexts and demonstrate knowledge and need for sustainable development.**

PO6: **Articulate ideas, comprehend and write effective reports, documentation and to communicate effectively with the basic and applied sciences community and with society at large, professionally and ethically.**

PO7: **Demonstrate knowledge and understanding of science and technical principles to manage projects in multidisciplinary research areas and function effectively as an individual, and as a member or leader in diverse resource teams.**

PO8: **Seeking stimulation and to exploring numerous opportunities to engage in independent and life-long learning in the broadest context of technological change.**

Programme Specific Outcome (PSOs):

Detailed Syllabus

Curriculum 2020-2023

Sl. No	Course Code	Name of the Course	L	T	P	C	IA	MTE	ETE
Semester 1									
							Assessment Pattern		
1.	BSDB1001	Chemistry	4	0	0	4	30	20	50
2.	BSDB1002	Fundamental of Cell Biology	4	0	0	4	30	20	50
3.	BSDB1003	Biochemistry	4	0	0	4	30	20	50
4.	BSMB1004	Introduction to Microbial World	4	0	0	4	30	20	50
5.	BSBA1061	Hands on Workshop on Basic Analytical Techniques and Measurements	0	0	4	2	50		50
6.	BSMB1012	Microbiology Lab-I	0	0	6	3	50		50
7	xxxx	Liberal Art				0.5			
8	xxxx	Soft Skill				0			
9	xxxx	Environmental Science		-	-	0.5			
10	xxxx	AI and Machine learning				2			
11	xxxx	BEC- B1				3			
12	xxxx	Computer awareness				0			
		Total				27			
Semester II									
Sl No	Course Code	Name of the Course	L	T	P	C	IA	MTE	ETE
							Assessment Pattern		
1	BSBD1007	Bioinstrumentation-I	4	0	0	4	30	20	50
2	BSMB1006	Bacteriology	4	0	0	4	30	20	50
3	BSMB1007	Phycology and Mycology	4	0	0	4	30	20	50
4	BSDB1011	Concept of immunology	4	0	0	4	30	20	50
5	BSMB1013	Microbiology Lab-II	0	0	6	3	30	20	50
6	xxxx	BEC- B1				3			
7	xxxx	***Two week social internship (during summer)							
		Total				22			
Semester -III									
Sl No	Course Code	Name of the Course	L	T	P	C	IA	MTE	ETE
							Assessment Pattern		
1	BSDB2001	Fundamentals of Molecular Biology	4	0	0	4	30	20	50
2	BSDB2002	Bioinstrumentation-II	4	0	0	4	30	20	50
3	BSMB2003	Microbial Physiology and Metabolism	4	0	0	4	30	20	50
4	BSMB2002	Virology	4	0	0	4	30	20	50
5	BSMB2014	Microbiology Lab-III	0	0	6	3	50		50
6	BSMB2015	Microbiology Lab-IV	0	0	6	3	50		50
7	BSDB2006	Web based Course/Seminar-I	0	0	0	2	50		50
		Total				24			
Semester IV									
Sl No	Course Code	Name of the Course	L	T	P	C	IA	MTE	ETE
							Assessment Pattern		
1	BCSE1020	Programming Language in C and Python	4	0	0	4	30	20	50
2	BSDB2010	Biotechnology	4	0	0	4	30	20	50

3	BSMB2006	Food and Agricultural Microbiology	4	0	0	4	30	20	50
4	BSDB2008	Plant Pathology	4	0	0	2	30	20	50
5	XXXX	Elective (Group-I, GE)	4	0	0	4	30	20	50
6	BSMB2017	Microbiology Lab -V	0	0	6	3	50		50
7	BCSE1031	Programming Languages Laboratory	0	0	6	3	50		50
8	XXXX	IPR				1			
9	XXXX	Foreign Language				1			
10	XXXX	Presentation/reveiw paper				2			
11	BBSO9P2411	Research methodology and Statistics	2			2	30	20	50
		Total				30			
		Semester V							
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSBC3001	Minor Project*	0	0	0	3	50		50
2	BSMB3003	Microbial Genetics and Genomics	4	0	0	4	30	20	50
3	BSDB3004	Medical Microbiology	4	0	0	4	30	20	50
4	BSMB3005	Industrial Microbiology	4	0	0	4	30	20	50
5	XXXX	Elective (Group-II, DSE)	4	0	0	4	30	20	50
6	BSMB3010	Microbiology Lab-VI	4	0	6	3	50		50
7	BSMB3011	Microbiology Lab-VII	4	0	6	3	50		50
8	XXXX	Campus to corporate				2			
		Total				27			
		Semester VI							
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSMB9997	Dissertation	0	0	0	12	50		50
2	BSDB3010	Web based Course/Seminar-II	0	0	0	2	50		50
		Total				14			
		Grand Total				144			

*Minor project will be done in IV Semester; credit will be evaluated in V Semester

List of Electives

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
Group I									
	BSDB2011	Bioinformatics	4	0	0	4	30	20	50
	BSDB2012	Biostatistics	4	0	0	4	30	20	50
	BSDB2013	Biophysics	4	0	0	4	30	20	50
	BSDB2014	Organic Farming	4	0	0	4	30	20	50
	BSDB2015	Biofertilizers and Pesticides	4	0	0	4	30	20	50
Group II									
	BSDB3011	Nanobiotechnology	4	0	0	4	30	20	50
	BSDB3012	Bioresource Management	4	0	0	4	30	20	50
	BSDB3013	Biosafety and IPR	4	0	0	4	30	20	50
	BSDB3015	Mushroom Culture Technology	4	0	0	4	30	20	50
	BSDB3016	Parasitology	4	0	0	4	30	20	50

COURSE CURRICULUM

SEMESTER - I

Name of The Course	**CHEMISTRY**				
Course Code	**BSDB1001**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.

Course Outcomes

CO1	**Understand atomic structure with various Bohrs, Aufbau, Pauli's principles.**
CO2	**Demonstrate chemical thermodynamics, law of thermodynamics.**
CO3	**Interpret chemical bonding and molecular forces.**
CO4	Express the knowledge Stereochemistry.
CO5	**Interpret the ionic equilibria.**
CO6	**Evaluate the recent advancement in chemistry.**

Text Book (s)

1. J.D. Lee : A New Concise Inorganic Chemistry, E.L.B.S.
2. P.W. Atkins : Physical Chemistry, Oxford University Press

Reference Book (s)

1. R.T. Morrison &R.N.Boyd : Organic Chemistry, Prentice Hall
2. James E.Huheeyetl. : Inorganic Chemistry : Principles of Structure and reactivity

Unit-1: ATOMIC STRUCTURE 10 hours
Recapitulation of Bohr's theory and its limitations, dual behavior of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Quantum numbers and their significance. Shapes of s, p, d and f orbitals. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.
Unit-2: CHEMICAL THERMODYNAMICS 10 hours
Introduction of thermodynamics, state of system, state variables, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes.Laws of Thermodynamics.
Unit-3: CHEMICAL BONDING AND MOLECULAR FORCES 09 hours

Introduction to ionic interactions and covalent bond, inter-molecular and intra-molecular forces, types of intermolecular forces and their characteristics: ion-dipole, dipole-dipole, dipole-induced dipole and dispersion (London) forces, hydrogen bond (intra-molecular and inter-molecular), effect of inter/intra-molecular forces on structure of different biomolecules.
Unit-4: STEREOCHEMISTRY 08 hours **Optical isomerism: Optical activity, specific rotation, enantiomerism, D and L designation, racemic modification, R and S sequence rules, diasteroisomers. Conformational isomers: conformation of ethane and butane, interconversion of projection formula, cyclohexane (mono- and di-substituted), resolution, optical purity, Walden inversion, enantiotopic and diastereotopichydrogens and prochiral centers. Geometrical isomerism: Definition, nomenclature– E and Z.**
Unit-5: IONIC EQUILIBRIA 08 hours **Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionizationconstant and ionic product of water. Ionization of weak acids and base, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.Buffer solutions. Qualitative treatment of acid base titration curves. Theory of acid – base indicators.**
Unit-6 Recent Advancement in Chemistry 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**FUNDAMENTAL OF CELL BIOLOGY**				
Course Code	**BSDB1002**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.

2. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

Course Outcomes

CO1	**Identify cell types, structure, functions and differentiate between various cell organelles.**
CO2	**Interpret the membrane biochemistry and transport of ions across the membrane.**
CO3	**Summarize the different types Cell-Cell Interaction and cellular communication.**
CO4	**Demonstrate protein sorting and transport.**
CO5	**Express the knowledge cell aging and death.**
CO6	**Evaluate the recent advancement in fundamental of Cell Biology**

Text Book(s)

1. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893-300-6.
2. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN:13:978-1- 4641-0981-2 / ISBN:10: 1-4641-0981-8.

Reference Book (s)

1. Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4.

Unit-2:STRUCTURE OF CELL	**7 hours**
Introduction to the cell, its chemical composition, Cell types - organization of prokaryotic and eukaryotic cells, Plant and animal cells: variation in structure and function, cell theory. Structure and functions of cell organelles – Nucleus, mitochondria, chloroplast, ribosome, lysosomes.	
Unit-2:MEMBRANE BIOCHEMISTRY	**7 hours**
Membrane: chemical composition and its structural plan; molecular model of cell membrane - fluid mosaic model and membrane fluidity; Overview of types of transport systems and macromolecule transport: Exocytosis; Endocytosis; Pinocytosis and phagocytosis.	
Unit-3:CELLULAR COMMUNICATION	**7 hours**
Cell Wall: Eukaryotic cell wall, Extracellular matrix and cell matrix interactions, Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata. Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules.	
Unit-4:PROTEIN SORTING AND TRANSPORT	**12 hours**
Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus.	
Unit-5:CELL CYCLE AND CELL DEATH	**10 hours**
Cell cycle - phases of cell cycle; cell division - mitosis and meiosis; Cell cycle regulation; Cell aging and death - necrosis and apoptosis; Stem cells. Types: Embryonic stem cell, induced pluripotent stem cells.	
Unit-6 Recent Advancement in Cell Biology	**04hours**
Research article/ Review paper/ MOOC	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOCHEMISTRY**				
Course Code	**BSDB1003**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: The course objectives are as following -

- **Demonstrate knowledge and understanding of the molecular machinery of living cells;**
- **Demonstrate knowledge and understanding of the principles that govern the structures of macromolecules and their participation in molecular recognition.**

Course Outcomes

CO1	**Understand Chemical and physical foundations of biomolecules like carbohydrates.**
CO2	**Identify major classes of storage and structural lipids.**
CO3	**Understand the properties of amino acids, proteins and nucleic acids**
CO4	**Interpret basic concepts in enzymology and Vitamins function.**
CO5	**Express the knowledge in the area Bioenergetics.**
CO6	**Evaluate the recent advancement in Biochemistry.**

Text Book (s)

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone

Reference Book (s)

1. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
2. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

Unit-1:CARBOHYDRATES	**07 hours**
Chemical and physical foundations of biomolecules, Carbohydrates: structure of sugars, classification, properties, chemical reactions, stereoisomerism and optical isomers of sugars, carbohydrate derivatives.	
Unit-2:LIPIDS	**07 hours**
Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids, Lipids with specific biological functions, micelles and liposomes	
Unit-3:AMINO ACIDS, PROTEINS AND NUCELIC ACIDS	**12 hours**

Amino acids; classification, chemical reactions and physical properties; biosynthesis and catabolism; Nucleotides; biosynthesis and catabolism.
Unit-4:ENZYMES AND VITAMINS 10 hours
Basic concepts in enzymology, enzyme classification, Enzyme kinetics, Enzyme inhibition: competitive, noncompetitive and uncompetitive inhibition, allosteric enzymes, Vitamins and cofactors: structure, distribution and biological properties
Unit-5:BIOENERGETICS 08 hours
First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy and Entropy and mathematical relationship among them, Standard free energy change and equilibrium constant, Coupled reactions and additive nature of standard free energy change, Energy rich compounds: Phosphoenolpyruvate, 1,3- Bisphosphoglycerate, Thioesters, ATP
Unit-6 Recent Advancement in BIOCHEMISTRY 04hours
Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**INTRODUCTION TO MICROBIAL WORLD**				
Course Code	**BSMB1004**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of light in biological system.

Course Outcomes

CO1	**Identify history and scope and techniques in microbiology.**
CO2	**Differentiate between various classes of microbial world**
CO3	**Understand the Viruses, viroids and prions.**
CO4	Express the knowledge in the area of bacteria, algae and fungi.
CO5	**Interpret the Protozoa and of Scope of Microbiology.**
CO6	**Evaluate the recent advancement in Microbiology**

Text Book (s)

1. Microbiology; Lansing M Prescott, John P. Harley, Donald A Klein, Sixth edition, McGraw Hill Higher education.
2. 2. General Microbiology; R.Y. Ingraham, J.L. Wheels, M.L. Painter.Thess Macmillan Press Ltd.

Reference Book (s)

1. Brock Biology of Microorganism; M.T, Martinko, J.M. Parker, Prentice-Hall.
2. 4. Microbiology; M.J. Pelczar, E.C.S Chan and N.R. Kreig, Tata MacGraw Hill.

Unit-1:INTRODUCTION TO MICROBIOLOGY 8 hours **Development of microbiology as a discipline, Spontaneous generation *vs*.biogenesis, development of various microbiological techniques, concept of fermentation, establishment of fields of medical microbiology, immunology and environmental microbiology**
Unit-2:DIVERSITY OF MICROBIAL WORLD (12 hours) **Systems of classification: Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi andProtozoa) with emphasis on distribution and occurrence, morphology, mode ofreproduction and economic importance.**
Unit-3:VIRUSES, VIROIDS AND PRIONS (07 hours) **A general introduction with special reference to the structure of the following: TMV, poliovirus, T4 and λ phage, lytic and lysogenic cycles**
Unit-4:BACTERIA, ALGAE AND FUNGI (12 hours) **Eubacteria, chlamydiae&rickettsiae (obligateintracellular parasites), mycoplasma, and archaebacteria (extremophiles).** **History of phycology, General characteristics of algae including occurrence, thallus organization, algae cell ultrastructure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction.Historical developments in the field of Mycology including significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism.**
Unit-5PROTOZOA AND AN OVERVIEW OF SCOPE OF MICROBIOLOGY **(05 hours)** **General characteristics with special reference to *Amoeba, Paramecium and Giardia***
Unit-6 Recent Advancement in Microbial world 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Hands on Workshop on Basic Analytical Techniques and Measurements**				
Course Code	**BSBA1061**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**

Course Objectives:

- To provide the knowledge of the scientific instruments in life sciences and biotechnology along with the applications.
- This will enable the students to understand all the subjects of biological sciences as these tools and techniques will be used therein.
- Also acquire the basic knowledge of the microbiological techniques to be applied in the laboratory.
- To know the general microbiological techniques for isolation of pure cultures of microorganisms.

Course Outcomes

CO1	**Demonstration of principle and application of different types of microscope**
CO2	**Analysis and preparation of nano-particles**
CO3	Preparation of solution and calculation of molarity, normality and surface tension of given solution
CO4	**Soldering and assembling of electric circuits**
CO5	**Demonstration of measurement with Vernier calipers, Screw, spherometer and oscilloscope**
CO6	Lab report

Referred Books:

1. Georg Stehli **,The Microscope And How to Use It,** English edition, 1970.
2. M.Sayer and A. Mansingh, PHI Learning. Measurement, Instrumentation and Experiment Design in Physics & Engineering, 2005.
3. Aliofkhazraei, Mahmood, Handbook of Nanoparticles, Springer, 2016
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. Inorganic Chemistry:Principles of Structure and Reactivity, Pearson Education India, 2006.

1. Different types of microscopes and its applications.
2. Direct analysis of nanoparticles.
3. Preparation of nano- particles.
4. Preparation of solution and molarity and normality calculation.

5. Measurement of surface tension and viscosity of given liquid.
6. Soldering of electrical circuits
7. Measurement with Vernier calipers, Screw gauge and spherometer
8. Operation of oscilloscope
9. Familiarization with linear, logarithmic and polar graphs for plotting of experimental data
10. Assembling of elementary electric circuits using breadboard.

Continuous Assessment Pattern

Internal Assessment Lab (IA)	Mid Term Lab (MTE)	End Term Lab (ETE)	Total Marks
50		50	100

Name of The Course	**MICROBIOLOGY LAB I**				
Course Code	**BSMB1012**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives:

- Supporting or strengthening theoretical knowledge.
- Experiencing the pleasure of discovery and development of their psycho-motor skills.
- Teaching how scientific knowledge may be used in daily life.
- Increasing creative thinking skills.
- Gains in scientific working methods and higher order thinking skills.
- Developing manual dexterity by using tools and equipment and allowing students to apply skills instead of memorizing.

Course Outcomes

CO1	**Demonstrate the basic principle and applications of important instruments**
CO2	**Handle and maintenance of glassware**
CO3	**Preparation of microbiological media**
CO4	Qualitative analysis of biomolecules
CO5	**Demonstration of different cell cycle**

CO6	Lab report

Text Books

1. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGrawHill International.
3. Atlas RM. (1997). Principles of Microbiology. 2nd edition. M.T.BrownPublishers.Education Limited.

S.N.	Name of Practicals
1.	**Study of the life history of the following scientists and their contributions with the help of their photographs: Anton von Leeuwenhoek, Linus Pauling, KaryMullis, Robert Hooke and Alexander Fleming.**
2.	**To study the principle and applications of important instruments (Microscope, Spectrophotometer, autoclave, Centrifuge) used in the microbiology laboratory.**
3.	**Qualitative analysis of carbohydrates present in the given solution.**
4.	**Qualitative analysis of amino acid and protein present in the given solution.**
5.	**Qualitative analysis of lipid present in the given solution.**
6.	**To understand the principle of Osmosis and Diffusion**
7.	**Demonstration of different stages of mitosis.**
8.	**Demonstration the different stages of meiosis.**

Continuous Assessment Pattern

Internal Assessment Lab (IA)	Mid Term Lab (MTE)	End Term Lab (ETE)	Total Marks
50		50	100

SEMESTER – II

Name of The Course	**BIOINSTRUMENTATION-I**				
Course Code	**BSDB1007**				
Prerequisite	**Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have the basic knowledge of chemistry and environmental science.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students will understand the principle and application of basic instruments and the fundamental concept of microscopy, spectroscopy and radioisotopic techniques.

CO1	**Describe different types of microscopes for the study of cell, identification of cellular changes within organs**
CO2	**Explain various kind centrifugation techniques for study of separation of different cells and cellular organs**
CO3	**Describe the Principles and applications of chromatography, separation techniques based on chromatography, types of chromatography and application in industry**
CO4	**Explains absorbance based techniques like Visible and UV spectroscopy, Basic concepts and applications of MS and NMR.**
CO5	**Explain basic concepts of crystallography and its application**
CO6	**Evaluate the recent advancement in Bioinstrumentation.**

Text Book (s)

1. **Principles and Techniques of Practical Biochemistry Wilson, K., Walker, J. (eds.); Cambridge University Press, Cambridge, 2000, 784 pp., ISBN 0-521-65873.**

2. **An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.**

Reference Book

1. **Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.**
1. **Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.**

Unit-1 : Separation techniques (08hours)
Different methods of protein precipitation: Precipitation using inorganic salts (salting out) and organic solvents, isoelectric precipitation, Dialysis, Ultrafilteration, Lyophilization
Unit-2 MICROBIAL TECHNIQUES (8 hours)
Buffer, Principle and working of pH meter, Laminar-air flow. Decontamination, sterilisation and disinfection techniques, media preparation technique, Culture of Human, Plant & Animal cells. Preparation of microbial, animal and plant samples for microscopy.
Unit-3 MICROSCOPY (10 hours)

Basic principles and applications of - Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM, Confocal Laser microscopy, Radio Microscopy.
Unit-4: CENTRIFUGATION (10 hours)
Basic Principle of Centrifugation, Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation, density gradient methods and their applications
Unit-5 : COLORIMETRY AND SPECTROSCOPY (10 hours)
Simple theory of the absorption of light by molecules, Beer-Lambert law, Principle and use of study of absorption spectra of biomolecules.Visible and UV spectroscopy.Colorimetry, turbidometry, Spectrofluorimetry, nephelometry and luminometry.
Unit-6 Recent Advancement in BACTERIOLOGY 04hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BACTERIOLOGY				
Course Code	BSMB1006				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of structure, classification of various groups of bacteria.

Course Outcomes

CO1	Understand cell organization andIdentify the structure of Gram positive and gram negative bacteria.
CO2	Demonstrate various bacteriological techniques likePure culture isolation and cultivation of bacteria.
CO3	Interpret the growth nutrition and reproduction in bacteria.
CO4	Understand the bacterial systematics.

CO5	**Express the knowledge in the area important archaeal and eubacterial groups.**
CO6	**Evaluate the recent advancement in Bacteriology.**

Text Books:

1. Atlas RM. (1997). *Principles of Microbiology*. 2nd edition. WM.T.BrownPublishers.
2. Black JG. (2008). *Microbiology: Principles and Explorations*. 7th edition. PrenticeHall
3. Madigan MT, and Martinko JM. (2006). *Brock Biology of Micro-organisms*. 8thedition. Parker J. Prentice Hall International, Inc.
4. PelczarJr MJ, Chan ECS, and Krieg NR. (2004). *Microbiology*. 5th edition TataMcGraw Hill.

Reference Book (s)

1. Srivastava S and Srivastava PS. (2003). *Understanding Bacteria*. Kluwer AcademicPublishers, Dordrecht.
2. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). *GeneralMicrobiology*. 5th edition McMillan.
3. Tortora GJ, Funke BR, and Case CL. (2008). *Microbiology: An Introduction*. 9thedition Pearson Education.
4. Willey JM, Sherwood LM, and Woolverton CJ. (2008). *Prescott, Harley andKlein's Microbiology*. 7th edition. McGraw Hill Higher Education.

Unit-1:CELL ORGANIZATION	**10 hours**
Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili.Cell-wall: Composition and detailed structure of gram positive and gram-negativecell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms,lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes.Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome andPlasmids. Endospore: Structure, formation, stages of sporulation.	
Unit-2:BACTERIOLOGICAL TECHNIQUES	**(07 hours)**
Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria	
Unit-3:GROWTH NUTRITION AND REPRODUCTION IN BACTERIA	**(12 hours)**
Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media **Sterilization and Disinfection:*Physical methods of microbial control*: heat, low temperature, high pressure,filtration, desiccation, osmotic pressure, radiation *Chemical methods of microbial control*: disinfectants, types and mode of action.** **Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate**	
Unit-5:IMPORTANT ARCHAEAL AND EUBACTERIAL GROUPS	**8 hours**
Archaebacteria: General characteristics, phylogenetic overview, Methanogens ,thermophiles and Halophiles(*Halobacterium, Halococcus*)] Eubacteria: Morphology, metabolism, ecological significance and economic importance of following groups: Gram Negative, Gram Positive, cyanobacteria	
Unit-6 Recent Advancement in BACTERIOLOGY	**04hours**
Research article/ Review paper/ MOOC	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	PHYCOLOGY AND MYCOLOGY				
Course Code	BSMB1007				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the diversity, classification, interaction and ecological importance of algae and fungi

Course Outcomes

CO1	Understand cell organization and Identify the structure of Gram positive and gram negative bacteria.
CO2	Demonstrate various bacteriological techniques like Pure culture isolation and cultivation of bacteria.
CO3	Interpret the growth nutrition and reproduction in bacteria.
CO4	Understand the bacterial systematics.
CO5	Express the knowledge in the area important archaeal and eubacterial groups.
CO6	Evaluate the recent advancement in Phycology And Mycology

Text Books:

1. Phycology (4th Edition) R.L. Lee, Cambridge University Press, 2008.
2. Algae- An introduction to Phycology- C Van den Hoek, DG Mann, HM Janes, Cambridge University Press,1995.
3. Hand Book of Microalgal culture. Ed by A. Richmond. Blackwell Publishing House,2003
4. The Mycota- Esser, K. and Bennet J. W. (Eds.)
5. An Introduction to Mycology - Mehrotra, R.S. and Aneja, K.R.

Reference Book (s)

1. Algae- Anatomy, Biochemistry and biotechnology-L. Barsanti& P. Gualtieri. Taylor & Francis,2006.

2. Molecular Biology of Cyanobacteria- DA Bryant. Kluwer Academic Publisher,1995.
3. Introduction to Fungi- John Webster and Roland W.S. Weber
4. Introductory Mycology -Alexopoulos C.J., C.W. Mims and M. Blackwell.

Unit-1:INTRODUCTION TO PHYCOLOGY (05 hours) **Introduction, Classification of Algae**
Unit-2:LIFE CYCLES OF SOME ALGAL CLASSES 10 hours **a) Chlorophyceae: Volvox, Coleochaete, b) Charophyceae: Chara (c) Diatoms: General features with reference to pinnate and centric diatoms, d) Xanthophyceae: Vaucheria ,e) Phaeophyceae: Ectocarpus ,f) Rhodophyceae: Polysiphonia ,g) Cyanobacteria: Nostoc**
Unit-3:APPLICATIONS OF ALGAE (07 hours) **Applications of Algae in Agriculture, Industry, Environment and Food.**
Unit-4: CLASSIFICATION, OCCURRENCE, SOMATIC STRUCTURE AND LIFE CYCLES OF FUNGI (12 hours) **a) Cellular slime molds - Dictyostelium ,b) True slime molds (Myxomycetes) – Physarum, c) Oomycetes - Saprolegnia, Phytophthora ,d) Chytridiomycetes – Neocallimastix, e) Zygomycetes – Mucor , f) Ascomycetes - Saccharomyces, Penicillium, Neurospora, g) Basidiomycetes – Agaricus, h) Deuteromycetes - Candida, Alternaria**
Unit-5:APPLICATION OF FUNGI (12 hours) **Economic importance of fungi with examples in Agriculture, Environment, Industry, Medicine, Food, Biodeterioration (of wood, paper, textile, leather),Mycotoxins, Ecology of fungi: concept of fungistatic, fungicidal.**
Unit-6 Recent Advancement in PHYCOLOGY AND MYCOLOGY 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**CONCEPT OF IMMUNOLOGY**				
Course Code	**BSDB1011**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

- To provide students with a foundation in immunological processes

- To provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology

Course Outcome:

CO1	**Describe the basic concept of immunology**
CO2	**It describeshow immuneresponse work in our body and explain defense mechanisms by CTL and NK cells**
CO3	**Demonstrate complementary system, organ transplantation, Antigen processing and presentation by MHC complex**
CO4	**Elucidate immunological disorders autoimmunity, hypersensitivity and immunodeficiency.**
CO5	**Evaluate vaccine production, Immunization, immunotherapy**
CO6	**Evaluate the recent advancement in Immunology**

Text Book (s)

1. Immunology, 6th edition, (2006), J. Kuby et al, W.H. Freeman and Company, New York. ISBN-13: 978-1429202114.
2. Roitt"s Essential Immunology, 12th edition, (2011), Wiley-Blackwell Science. ISBN-13: 978-1405196833.
3. Cellular and Molecular Immunology, 7th edition, (2011). Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. Saunders. ISBN-13: 978-1437715286.

Reference Book (s):

1. Murphy K, Travers P, Walport M. (2008). Janeway'sImmunobiology. 7th edition Garland Science Publishers, New York.
2. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill
3. Livingstone Publishers, Edinberg.
4. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

Unit -1: INTRODUCTION TO IMMUNE SYSTEM 10 hours **Types of immunity; organs and cells involved in immune system; Antigen, haptens, adjuvants, antigenicity, antigenic determinants and epitopes; Antibody structure and functions; Theories of antibody formation; Antibody diversity.**
Unit -2: IMMUNE RESPONSE 8 hours **Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance.**
Unit -3: COMPLEMENT SYSTEM AND MAJOR HISTOCOMPATIBILITY COMPLEX10 hours **Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation. MHC - Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways).Transplantation - types, genetics of transplantation, graft versus host reactions.**
Unit -4: IMMUNOLOGICAL DISORDERS 12 hours

Types of AutoimmUnity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens, causes and therapy for cancers.
Unit -5: VACCINES AND IMMUNOLOGICAL TECHNIQUES. 10 hours **Vaccines - Types and their characteristics; Immunization practices-immunoprophylaxis and immunotherapy.Immunological techniques -Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy.**
Unit-6 Recent Advancement in CONCEPT OF IMMUNOLOGY. 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**MICROBIOLOGY LAB II**				
Course Code	**BSMB1013**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objective:Students are able to prepare the microbial medium, describe the principle of pH meter, centrifugation and microscopy.

Course Outcome

CO1	**Preparation of pure culture by different methods**
CO2	**Understanding and usage of different component of compound microscope and centrifuge**
CO3	**Understanding and usage of different component of pH meter and determination of pH of milk and different water**
CO4	Preparation of gram's staining and mobility for bacteria
CO5	**Understand the basic principle of blood group and Rh typing**
CO6	Lab report

List of Practical

1.	Isolation of microorganisms by streak plate method.
2.	To isolate the microorganisms by spread plate method.
3.	Estimation of CFU count by spread plate method/pour plate method.
4.	Understanding the different components and working principle of light microscope using pre-prepared slide.
5.	Preparation of onion cell slide to study cell morphology using light microscope.
6.	To perform the isoelectric precipitation of casein present in milk.
7.	To determine the pH of 0.1 M NaOH and tap water using pH meter.
8.	Demonstrating the basic principle of centrifugation and calculating the relation between RCF and RPM during centrifugation.
9.	To perform gram staining of given sample.
10.	Motility by hanging drop method.
11.	Separate serum from the blood sample (demonstration).
12.	To perform immuno-diffusion by Ouchterlony/ Mancini method.
13.	Grouping of blood and Rh typing.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	0	50	100

SEMESTER -III

Name of The Course	**FUNDAMENTAL OF MOLECULAR BIOLOGY**				
Course Code	**BSDB2001**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:Students are able to determine the process and regulation of replication, translation and transcription.

Course Outcome:

CO1	**Explain the functional and structural organization of genetic material**
CO2	**Illustrate the different stages of DNA replication and type of DNA repair**
CO3	**Explain detail process of transcription and its regulation**
CO4	**Elucidate the mechanism of translation and posttranslational modification**
CO5	**Summarize the basic concept of gene regulation in pro and eukaryotes**
CO6	**Evaluate recent advancement in Molecular Biology**

Text Book (s)

1. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.
2. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.

References Book (s)

1. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN:13:978-1- 4641-0981-2 / ISBN:10: 1-4641-0981-8.
2. Molecular biology of the gene, (4thed)J D Watson, Benjamin/Cummings publ. Co Inc.

Unit - 1: NUCLEIC ACID STRUCTURE AND ORGANIZATION 8 hours **DNA and RNA as genetic material, chemical structure, base composition and types of nucleic acids, supercoiling of DNA, DNA reassociation kinetics (cot curve analysis), DNA organization into chromatin, bacterial and eukaryotic genomic organization.**
Unit - 2: DNA REPLICATION AND REPAIR 8 hours **Enzymes and proteins of DNA replication, prokaryotic and eukaryotic replication mechanism, replication in phages and retroviruses, Mutagenesis, DNA damage and repair mechanisms**
Unit - 3: TRANSCRIPTION 10 hours **Transcription in prokaryotes and eukaryotes.Mechanism of transcription, enzymes and transcription factors. Post-transcriptional modifications in mRNA, rRNA andtRNA.**
Unit - 4: TRANSLATION (12 hours) **Genetic code - properties of the genetic code, deciphering of the genetic code.Translation in prokaryotes and eukaryotes; Translational mechanism in prokaryotes and eukaryotes, post translational modification and transport of proteins.**
Unit - 5: REGULATION OF GENE EXPRESSION 10 hours **Regulation of gene expression in prokaryotes - The operon concept, lac &tryp operons.Transcriptional control. Post translational control. Regulation in eukaryotes - Control by promoter, enhancer and silencers.Cis-trans elements.DNA methylation & gene expression.**
Unit-6 Recent Advancement in FUNDAMENTAL OF MOLECULAR BIOLOGY. 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BIOINSTRUMENTATION-II				
Course Code	BSDB2002				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: : Students are able to determine the principle of advanced spectroscopy, chromatographic techniques

CO1	Describe different types of electrophoretic techniques for separation and isolation of biomolecules.
CO2	Explain various kinds of Spectroscopic techniques to characterize and detect structural changes in biomolecules.
CO3	Describe the principle and applications of various chromatographic techniques.
CO4	Explain the different types of radioactive detection techniques.
CO5	Demonstrate the principle of Sanger and Maxam Gilbert method of Nucleotide sequencing.
CO6	Evaluate recent advancement in bio analytical techniques.

Text Book (s)

3. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.
4. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.

Reference Book

1. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300- 6.

Unit-1 : ELECTROPHORESIS	(10 hours)
Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis	
Unit-2 : ADVANCED SPECTROSCOPY	(10 hours)

Basic concepts - Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD), Fluorescence spectroscopy, Infrared spectroscopy, FTIR, NMR spectroscopy. Mass spectroscopy- MALDI-TOF, Nano-SIMS (10L) .
Unit-3 CHROMATOGRAPHY (10 hours)
Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ionexchange chromatography and affinity chromatography, GLC, HPLC.
Unit-4: RADIOGRAPHY (10 hours)
Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Autoradiography, FISH-MAR, Pulse chase experiment, Liquid scintillation counting, Phosphor imaging, IRMA, Dosimetry. .
Unit-5 : ADVANCED TECHNIQUES (08 hours)
Chemical synthesis of nucleotides and peptides, Sequencing of proteins and nucleic acids, Enzyme purification and assay techniques.
Unit-6 Recent Advancement in bio analytical techniques. 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**MICROBIAL PHYSIOLOGY AND METABOLISM**				
Course Code	**BSMB2003**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

Students are able to understand the basic concept of microbial nutrition, growth, control, and cultivation method in microbiology.

The course will emphasize determination of growth curve of microbial growth and influence of environment and primary and secondary metabolism. It will also enhance the knowledge of microbial metabolism of biomolecules.

Course Outcome:

CO1	**Describe the brief introduction of microbial culture and their growth curve**
CO2	**Explain type of transport system in prokaryotes**

CO3	**Explain basic biochemistry of aerobic and anaerobic respiration.**
CO4	**Illustrate the process of photosynthesis in various bacterial system**
CO5	**Discuss about role of bacteria in nitrogen cycle**
CO6	**Evaluate recent advancement in Microbial Physiology and Metabolism**

TextBook (s)

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. PrenticeHall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.

References Book (s)

1. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition,
2. McMillan Press.
3. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education

Unit-1: MICROBIAL GROWTH AND EFFECT OF ENVIRONMENT ON MICROBIAL GROWTH (12 hours)
Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture,generation time and specific growth rate, synchronous growth, diauxic growth curve.Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles,extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity(halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe),barophilic.Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy,Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.
Unit-2: PRINCIPLES OF PHYSIOLOGY 8 hours
Nutrient transport in prokaryotic cell, Passive and facilitated diffusion, Primary and secondary active transport, concept of uniport, symport and antiport,Signal transduction in bacteria, Microbial cell surfaces , Bacterial Bioluminescence, Microbial toxins
Unit-3: CHEMOHETEROTROPHIC METABOLISM - AEROBIC RESPIRATION, ANAEROBIC RESPIRATION AND FERMENTATION (12 hours)
Concept of aerobic respiration, anaerobic respiration and fermentation, Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial, ETC, electron transport phosphorylation, uncouplers and inhibitors. **Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentativeand heterofermentative pathways**
Unit- 4: CHEMOLITHOTROPHIC AND PHOTOTROPHIC METABOLISM **(09 hours)**
Introduction to aerobic and anaerobic chemolithotrophy with an example each.Hydrogenoxidation(definition and reaction) and methanogenesis (definition and reaction). Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic*vs.*

oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria
Unit- 5: NITROGEN METABOLISM (06 hours) **Introduction to biological nitrogen fixation:Ammonia assimilation, Assimilatory nitrate reduction,dissimilatory nitrate reduction, denitrification.**
Unit-6 Recent Advancement in MICROBIAL PHYSIOLOGY AND METABOLISM 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**VIROLOGY**				
Course Code	**BSMB2002**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students will understand the classification, basic characteristics and ultra structure of viruses. The course will emphasize on developing an understanding the virus life cycles and their interactions with host cells.

Course Outcomes

CO1	**Explain the structure and general property of Virus and virus like particle**
CO2	**Elucidate the classification and feature of different Virus groups**
CO3	**Explain about the genetic material of virus and basic concept of bacteriophage**
CO4	**Explain the life cycle of virus and it's transmission**
CO5	**Describe the strategies to prevent viral diseases and its therapeutic role**
CO6	**Evaluate recent advancement in Virology**

TextBooks

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.

3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.

REFERENCES Books

1. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
2. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.

Unit- 1: INTRODUCTION, STRUCTURE AND PURIFICATION OF VIRUSES **8 hours** **Discovery of viruses, nature and definition of viruses, general properties of viruses.Concept of viroids, virusoids, satellite viruses and prions. Theories of viral origin ,Capsid symmetry, enveloped and non-enveloped viruses,Isolation, purification and cultivation of viruses**
Unit-2: VIRAL TAXONOMY (07 hours) **Classification and nomenclature of different groups of viruses infecting microbes, plants and animals.**
Unit -3: SALIENT FEATURES OF VIRAL GENOMES AND BACTERIOPHAGES (12 hours) **Unusual bases (TMV, T4 phage), overlapping genes (ΦX174, Hepatitis B virus),alternate splicing (Picornavirus), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), ambisense genomes (arenavirus), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (influenza virus) and non segmented genomes (picornavirus), capping and tailing (TMV).** **Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda and P1 phage), concept of early and late proteins, regulation of transcription in lambda phage and applications of bacteriophages.**
Unit- 4: VIRAL MULTIPLICATION, REPLICATION AND TRANSMISSION STRATEGIES 8 hours **Interaction of viruses with cellular receptors and entry of viruses.Replication strategies of viruses as per Baltimore classification.Assembly, maturation and release of virions. Concept of defective particles Transmission: Persistent and non-persistent mode**
Unit-5: PREVENTION, CONTROL OF VIRAL DISEASES AND APPLICATIONS OF VIROLOGY (07 hours) **General principles of viral vaccination, Antiviral compounds, interferons and viral vaccines, Use of viral vectors in cloning and expression, Gene therapy and Phage display**
Unit-6 Recent Advancement in VIROLOGY 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	**Web based course/seminar**				
Course Code	**BSDB2006**				
Prerequisite	**Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**0**	**2**

Course Objectives:

- **Students are** directly engage and learn particular subject of their interest. This strengthens the fundamentals of the student in the course.
- It gives the students the opportunities to explore new areas of interest . Also gives students the opportunity to learn in greater depth the subjects they wish to master.
- Promotes the self-learning initiative of the students – where their own motivation is what drives them to complete the course. This fosters the habit of keeping oneself updated always by means of self-study.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**ETE**	**Total Marks**
50		**50**	**100**

Name of The Course	**MICROBIOLOGY LAB-III**				
Course Code	**BSMB2014**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objective:

Student will learntostudy microbial growth and metabolic processes. They will gain knowledge the about techniques used for study and characterization of cellular DNA and proteins. Study structure of viruses and their characterization.

Course Outcome:

CO1	**Study the different types of DNA and RNA and demonstration of the semi-conservative replication of DNA**
CO2	**Preparation of DNA isolation from microorganism**
CO3	Estimation of the quantity and quality of genetic material
CO4	**Visualization of genetic material**
CO5	**Demonstration of principle and application of agarose and PAGE gel electrophoresis**
CO6	Lab report

Text Book (s)

1. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
2. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition.
3. Blackwell Publishing, Oxford, U.K.
4. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons

Reference Book (s):

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
3. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.

1. Study of different types of DNA and RNA using micrographs and model / schematic representations.
2. Study of semi-conservative replication of DNA through micrographs / schematic representations
3. Isolation of genomic DNA from *E. coli*
4. Estimation of DNA using UV spectrometer.
5. Isolation of RNA using UV spectrometer.
6. Demonstration of resolution and visualization of DNA by Agarose Gel Electrophoresis.
7. Demonstration of resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).

Continuous Assessment Pattern

Internal Assessment (IA) Lab	Mid Term Test (MTE)	End Term Test Lab (ETE)	Total Marks
50	0	50	100

Name of The Course	**MICROBIOLOGY LAB-IV**				
Course Code	**BSMB2015**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**BSMB2002 and BSMB2003**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objective:
Student will learntostudy microbial growth and metabolic processes. They will gain knowledge the about techniques used for study and characterization of cellular DNA and proteins. Study structure of viruses and their characterization.

Course Outcome:

CO1	**Demonstration of bacterial growth.**
CO2	**Estimation of generation time and growth curve of bacterial growth.**
CO3	Determine the effect of temperature and pH on bacterial growth.
CO4	**Alcoholic fermentation**
CO5	**Preparation of isolation, purification and cultivation of viruses**
CO6	Lab report

Text Book (s)

5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
6. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition.
7. Blackwell Publishing, Oxford, U.K.
8. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons

Reference Book (s):

4. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
5. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
6. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.

1. Study and plot the growth curve of *E. coli* by tubidometric method.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.
3. Effect of temperature on growth of *E. coli*.
4. Effect of pH on growth of *E. coli*.
5. Demonstration of alcoholic fermentation.

6. Study the morphological structures of viruses (DNA and RNA) and their important characters using electron micrographs.
7. Demonstration of isolation of viruses.
8. Demonstration of purification of viruses.
9. Demonstration of cultivation of viruses.

Continuous Assessment Pattern

Internal Assessment (IA) Lab	Mid Term Test (MTE)	End Term Test Lab (ETE)	Total Marks
50	0	50	100

EMESTER – IV

Name of The Course	**PROGRAMMING LANGUAGES**				
Course Code	**BCSE1020**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of and basic knowledge of the computers.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

Course Outcome:

CO1	**Understand about the computers, Logic Development and Program Development Tools, Operations and Expressions.**
CO2	Identify Data Input and Output, Interactive Programming. Control Structures and functions.
CO3	Interpret Arrays, Structure and Union.
CO4	Interpret the applications of Pointers, Initializing Pointers, Creating the data files.
CO5	**Express the knowledge in the area of C++.**

Text Book (s)

13. P KanetkarYashvant, Let us C, BPB Publications, New Delhi, Seventh Edition.
14. E. Balagurusami, Programming in ANSI C, Tata McGraw Hill, Fourth Edition.

Reference Book (s)

1. Schaum Outline Series,Programming in C.
2. HerbtzSchildt, "C++: The Complete Reference", Fourth Edition, McGrawHill.

3. John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition,2000.

Unit-I	**10 hours**
Introduction to computers: Units of computers, Block Diagram, Generation of Computers, Characteristics of Computers, Phases of Computers, Different types of Memory, Input and Output Devices. **Logic Development and Program Development Tools:** Data Representation, Flowcharts, Problem Analysis, Decision Trees/Tables, Pseudo Code and Algorithms, ProgramDebugging, Compilation and Execution. **Fundamentals:** Character Set, Identifiers and Key Words, Data Types, Constants, Variables, Expressions, Statements, Symbolic Constants. **Operations and Expressions:** Arithmetic Operators, Unary Operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Library functions.	
Unit-2:	**10 hours**
Data Input and Output: Single Character Input, Single Character Output, Entering Input Data, More About Scan Functions, Writing Output Data, More About Print Functions, Gets and Puts Functions, Interactive Programming. **Control Structures:** Introduction, Decision Making with If – Statement, If Else and Nested If, While And Do-While, For Loop. Jump Statements: Break, Continue, Goto, Switch Statement. **Functions:** Introduction To Functions, Function Declaration, Function Categories, Standard Functions, Parameters And Parameter Passing, Pass – By Value/Reference, Recursion, Global and Local Variables, Storage Classes.	
Unit-3:	**10 hours**
Arrays: Introduction to Arrays, Array Declaration, Single and Multidimensional, Array, Memory Representation, Matrices, Strings, String Handling Functions. **Structure and Union:** Declaration of Structure, Accessing Structure Members, Structure Initialization, Arrays of Structure, Nested Structures, Unions.	
Unit-4:	**10 hours**
Pointers: Introduction To Pointers, Address Operator And Pointers, Declaring and Initializing Pointers, Assignment through Pointers, Pointers and Arrays. **Files:** Introduction, Creating a Data File, Opening and Closing a Data File, Processing a Data File.	
Unit-5:	**10 hours**
Using Classes in C^{++}: Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors, Overview of Template classes and their use.Introduction to Inheritance and Polymorphism	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOTECHNOLOGY**				
Course Code	**BSDB2010**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objective:

Students will understand the molecular methods and applications of recombinant DNA technology and gene transfer techniques.

Course Outcome:

CO1	**Brief account of plant tissue culture and advantages of somatic hybridization**
CO2	**Explain the basic techniques of cell culture**
CO3	**Describe the different methods of DNA sequencing**
CO4	**Describe the type and process of genetic exchange**
CO5	**Explain the various categories of transposable element**
CO6	**Evaluate the application of Biotechnology in research and deployment**

Text Book (s)

1. Principles of Gene Manipulations 1994 by Old and Primrose Blackwell Scientific Publications.
2. DNA Cloning: A Practical Approach by D.M. Glower and B.D. Hames, IRL Press, Oxford. 1995.
3. Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers, Oxford. 1994.
4. Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford 1998.

References Book (s)

1. PCR Technology - Principles and Applications for DNA Amplification by Henry A. Erlich (Ed.) Stockton Press. 1989.
2. Biotechnology: A Guide to Genetic Engineering by Peters.
3. Genetic Engineering – 2000 by Nicholl.
4. Recombinant DNA and Biotechnology: Guide for Teachers. 2nd Edition by Helen Kreuz. 2001. ASM Publications.

Unit -1: INTRODUCTION TO PLANT BIOTECHNOLOGY 8 hours
Basic introduction to animal and plant biotechnology; types of plant tissue culture, Somatic hybridization

Unit -2: INTRODUCTION TO ANIMAL BIOTECHNOLOGY 8 hours Animal Biotechnology - organ culture; cell culture and initiation of cell culture; evolution of continuous cell lines.
Unit -3: CONSTRUCTION OF DNA LIBRARIES 10 hours Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA), Quantification and storage of nucleic acids, Construction of cDNA library, Construction of Genomic library, Screening and preservation of DNA libraries, DNA Sequencing and cloning strategies.
Unit -4: GENE TRANSFER TECHNIQUES 10 hours Gene transfer techniques: biological methods; chemical methods; physical or mechanical methods.
Unit -5: TRANSGENICS 10 hours Plant Genetic Engineering: Restriction enzymes; Transformation of plant cells; different type of vectors including viral vectors and their benefits; Screening and selection of transformants, PCR and hybridization methods; Application of transgenic science in plant and animal improvement.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**FOOD AND AGRICULTURAL MICROBIOLOGY**				
Course Code	**BSMB2006**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objective:

Student will understand the role of microorganisms in food industry and food spoilage. Further, it also helps to better understand the mode of food preservation and the quality of different foods can be preserved following the various international guidelines.

Course Outcome

CO1	**Explain the role of microorganism in food industry**
CO2	**Describe the uses of microorganism in dairy products**
CO3	**Explain the application of baker's yeast and other microbial products**
CO4	**Describe benefits of use of microorganism over chemicals in agriculture**
CO5	**Brief account of tissue culture and transgenic crops**
CO6	**Evaluate the application of Food and Agricultural Microbiology**

Text Book (s)

1. TE Frazier and Klesthoff (2004) Food Microbiology
2. James,MJ(2005) Modern Food Microbiology, 4th edition

Reference Book (s)

1. Adams, MR and Moss, MO (2003) Food Microbiology

Unit-I: INTRODUCTION TO FOOD MICROBIOLOGY 08 hours **Food as substrate for microorganisms: Microorganisms important in food microbiology and their importance, principles of food preservation, Asepsis- removal of microorganisms Factors influencing microbial growth in food, chemical preservatives and food additives, canning, Contamination and Spoilage, Food borne infection and intoxications.**
Unit-2: DAIRY TECHNOLOGY 10 hours **Starter cultures, Cheese production, Fermented foods and other dairy products, Evaluation and role of Probiotics, Nutraceuticals, food control agencies and its regulations.**
Unit -3: BIOMASS PRODUCTION AND APPLICATIONS 07 hours **Fungal biomass- baker's yeast and single cell oil, Mushroom cultivation, Use of Algal biomass, Microbial production for food and feed, Carotenoid pigments- β-carotene, lycopene**
Unit-4: MICROBES IN AGRICULTURE 08 hours **Biofertilizer: types, production and applications,Mycorrhizae: classification and significance, Vermicomposting, Bioinsecticides: their production by bacterial fungal and viral, Integrated pest management**
Unit-5: AGRICULTURE TECHNOLOGY 10 hours **Organic matter decomposition, Microbial plant hormones, Tissue culture technology and commercial application,Transgenic crops and Plants.**
Unit-6 Recent Advancement in FOOD AND AGRICULTURAL MICROBIOLOGY 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**

30	**20**	**50**	**100**

Name of The Course	**PLANT PATHOLOGY**
Course Code	**BSMB2008**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**
Antirequisite	

	L	T	P	C
	4	**0**	**0**	**4**

Course Objectives: To acquaint the students with the science of phytopathology; its objectives, general concepts and classification of plant diseases

Course Outcome:

CO1	**Describe the different stages of disease development and molecular Koch's postulates.**
CO2	**Explain the difference among monocyclic, polycyclic and polyetic diseases.**
CO3	**Explain the adverse effect of pathogen on plant physiology, resistance genes and type of defense mechanisms.**
CO4	**Explain various majors to control plant disease.**
CO5	**Discuss the pathophysiology and symptoms of any two plant disease caused by fungi.**
CO6	**Evaluate the recent advancement in plant pathology.**

TEXT & REFERENCES Book (s):

1. Agrios GN. (2006). *Plant Pathology*. 5th edition. Academic press, San Diego,
2. Lucas JA. (1998). *Plant Pathology and Plant Pathogens*. 3rd edition. Blackwell Science, Oxford.
3. Mehrotra RS. (1994). *Plant Pathology*. Tata McGraw-Hill Limited.

TEXT & REFERENCES Book (s):

1. Rangaswami G. (2005). *Diseases of Crop Plants in India*. 4th edition. Prentice Hall of India Pvt. Ltd., New Delhi.
2. Singh RS. (1998). *Plant Diseases Management*. 7th edition. Oxford & IBH, New Delhi

Unit-1: INTRODUCTION AND HISTORY OF PLANT PATHOLOGY 10 hours
Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social

impact of plant diseases. Significant landmarks in the field of plant pathology, molecular Koch's postulates. Contributions of eminent Indian plant pathologists, Stages in development of a disease:nfection, invasion, colonization, dissemination of pathogens and perennation.

Unit-2: PLANT DISEASE EPIDEMIOLOGY 07 hours

Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases and its relevance in Indian context.

Unit -3: HOST PATHOGEN INTERACTION 12 hours

A. *Microbial Pathogenicity*

Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction).

B. *Genetics of Plant Diseases*

Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance– horizontal & vertical, apparent resistance.

C. *Defense Mechanisms in Plants*

Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histologicalcorklayer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response(HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins,plantibodies, phenolics, quinones, oxidative bursts].

Unit-4: CONTROL OF PLANT DISEASES 10 hours

Principles & practices involved in the management of plant diseases by different methods, *viz.* regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals. biological - suppressive soils, antagonistic microbes-bacteria and fungi, trap plants genetic engineering of disease resistant plants- with plant derived genes and pathogen derived genes

Unit-5: SPECIFIC PLANT DISEASES 8 hours

Study of some important plant diseases giving emphasis on its etiological agent, symptoms,epidemiology and controlImportant diseases caused by fungi, phytopathogenic bacteria, phytoplasmas, viruses, viroids.

Unit-6 Recent Advancement in PLANT PATHOLOGY 04hours

Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Course Code	Course Name	L	T	P	C
BBS09T2411	RESEARCH METHODOLOGY AND STATISTICS	2	0	0	2

Course Objective: The objective of the course is to impart research based knowledge to the students. They would be taught the various ways of data collection, research methodologies adopted in different settings, and statistical methods.

Course Outcome:

CO1	**Students will get separately familiar with terms research and methodology, respectively.**
CO2	**Identifying different type of research sampling and research design.**
CO2	**Students will understand raw data, primary data, secondary data and their different methods of collection.**
CO4	**Students will appraise the application of sampling through statistics.**
CO5	**Students will get familiar with different descriptors of statistics to analyse data both quantitatively and qualitatively.**
CO6	**Students will develop the statistical analysis indulges in modern research for drug designing.**

Course Contents:

Module I: Introduction to Research Methodology 6-Lectures
Definition, concept and research in science; Introduction to Research Methodology, Research methodology in science.
Module II: Research in Scientific and Social Settings 5-Lectures
Research Design: Research Sampling, rationale for using a particular sampling procedure, Probability.
Module III: Tools of Data Collection 5-Lectures
Data and its types, Methods for Collecting Data, Observation method, Questionnaire, Other Methods
Module IV: Introduction to Statistics 4-Lectures
Introduction to statistics (Biostatistics); Sample and Population, parametric and non parametric statistics.
Module V: Descriptive Statistics 5-Lectures
Measures of central tendency; Measures of dispersion and deviation; graphical representation of the data. Correlation and Regression
Unit 6: Recent research advances 3 lectures **Descriptors, Quantitative structure-activity relationship (QSAR) , Quantitative structure-property relationship(QSPR), Drug designing.**

Text & References:

- **Broota, K. D., Experimental designs in psychological research, Wiley eastern, New York, 1992.**
- **Guilford, Statistics in Psychology and Education, McGraw Hill, New York, 1986.**
- **J T Walker, Statistics in Criminology and Criminal Justice analysis and Interpretation**
  - **Leo, A., & Hoekman, D. H. (1995). *Exploring QSAR*. American Chemical Society.**
  - **Chanin Nantasenamat, Chartchalerm Isarankura-Na-Ayudhya, Thanakorn Naenna, Virapong Prachayasittikul, A Practical Overview of Quantitative Structure- Activity Relationship. EXCLI Journal 2009;8:74-88.**
  - **Wiktor Pronobis, Alexandre Tkatchenko, and Klaus-Robert Muller, J. Chem. Theory Comput. 2018, 14, 2991−3003**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	MICROBIOLOGY LAB V			
Course Code	BSMB2017			
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.			
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.			
Antirequisite				
	L	T	P	C
	0	0	6	3

Course ObjectivesStudent will learntostudy isolation and characterization of genetic material. They will gain knowledge the about techniques used for study and characterization of cellular DNA and proteins. Study the role of microbes and plant pathogens.

Course Outcome:

CO1	**Demonstration of the isolation of plasmids**
CO2	**Study the application of restriction and ligation enzymes**
CO3	Estimation of the quantity and quality of genetic material
CO4	**Interpretation of gel electropherograms**
CO5	**Roe of microbe as plant pathogens**
CO6	Lab report

Text Books

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
3. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,

4. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. BlackwellScience, Oxford.

Reference Book (s)

1. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
2. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
3. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
4. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hallof India Pvt. Ltd., New Delhi.

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1. Demonstration of isolation of Plasmid DNA from *E.coli*.
2. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis
3. To study the Ligation of DNA fragments
4. Interpretation of sequencing gel electropherograms
5. Amplification of DNA by PCR.
6. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.
7. Study of important diseases of crop plants by cutting sections of infected plant material - Albugo,Puccinia, Ustilago, Fusarium, Colletotrichum.
8. Study microflora of different types of soils.
9. Design and functioning of a biogas plant
10. Isolation of cellulose degrading organisms.

Continuous Assessment Pattern

Internal Assessment Lab (IA)	Mid Term Test (MTE)	End Term Test Lab (ETE)	Total Marks
50		50	100

Name of The Course	**PROGRAMMING LANGUAGES LABORATORY**				
Course Code	**BCSE1031**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding and a basic knowledge of the computing**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objective:

Students are able to understand the basic data structures used in programming (such as arrays and array lists).

Text / References Books:

1. **E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.**
2. **Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011.**
3. **John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.**
4. **Harry, H. Chaudhary, "Head First C++ Programming: The Definitive Beginner's Guide", First Create space Inc, O-D Publishing, LLC USA.**

1. Write a program to find greatest of three numbers.
2. Write a program to find gross salary of a person
3. Write a program to find grade of a student given his marks.
4. Write a program to find divisor or factorial of a given number.
5. Write a program to print first ten natural numbers.
6. Write a program to print first ten even and odd numbers.
7. Write a program to find grade of a list of students given their marks.
8. Create Matrix class. Write a menu-driven program to perform following Matrix operations (2-D array implementation): 9. Sum b) Difference c) Product d) Transpose

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
50		**50**	**100**

SEMESTER - V

Name of The Course	**MINOR PROJECT**			
Course Code	**BSMB3001**			
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**			
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**			
Antirequisite				
	L	**T**	**P**	**C**
	0	**0**	**0**	**3**

COURSE CONTENTS:

Minor Project is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. The duration of Minor project is 1 month (4-6 weeks). A Minor Project may be given in lieu of a discipline specific elective paper/Microbiology.This should be done

in consultation with the faculty supervisor and agency supervisor under whom he / she is getting trained. The project report should be around 20 pages and chaptered as follows:

Chapter I: Introduction
Chapter II: Review of Literature
Chapter -3:: Methodology
Chapter IV: Results&Discussion
Chapter V: Summary and Conclusion

The research should be original and should be action oriented in that the results should be able to throw light on some of the important unexplored areas that would be of practical use to the microbiologists.

Students are expected to decide on the specific project area and title, and carry out substantial portion of the literature survey during the end of their 4th semester.After the end of their 4thsemester ETEs, each student will be asked to make presentation about the project including literature available, objective sought and work plan including methodologiesto the Student Project Monitoring Committee constituted by the HOD. The Project Work may be a work based on theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, etc. or a combination of these. The final project report will be evaluated by a panel of examiners consisting of HOD, Guide and Co-guide (wherever applicable) and an External Examiner. Viva-voce examination for the same will be conducted.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	MICROBIAL GENETICS AND GENOMICS				
Course Code	BSMB3003				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives:The objective of the course is to familiarize the students with the basic concepts in genetic engineering; to acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology; and to appraise them about applications genetic engineering.

Course Outcome:

CO1	Explain the Mendelian Laws of inheritance and its application in Genetics

CO2	**Explain genomic configuration of prokaryotes, type and underlying mechanism of mutation**
CO3	**Explain the type and uses of plasmids**
CO4	**Describe the type and process of genetic exchange**
CO5	**Explain the various categories of transposable element**
CO6	**Evaluate the recent advancement in biochemistry of basic metabolic pathway.**

Text & References Book (s):

1. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings.
2. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
3. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning.

Unit-I MENDELIAN GENETICS 10 hours **Genetic terminology Impact of Genetics on other disciplines. Mendelian Laws of inheritance, its application in animal Genetics, analysis of results of Genetic crosses by various methods. Codominance, incomplete dominance, RFLP markers, gene interactions, multiple alleles.**
Unit-2: GENOME ORGANIZATION AND MUTATIONS 10 hours **Genome organization: *E. coli, Saccharomyces*, *Tetrahymena*. Organelle genome: Chroloroplast and Mitochondria. Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations. Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes.**
Unit-2:I PLASMIDS 8 hours **Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast-2 µ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids.**
Unit-IV MECHANISMS OF GENETIC EXCHANGE 8 hours **Transformation - Discovery, mechanism of natural competence. Conjugation - Discovery, mechanism, Hfr and F' strains,Interrupted mating technique and time ofentrymapping.Transduction - Generalized transduction, specialized transduction, LFT & HFT lysates,Mapping by recombination and co-transduction of markers.**
Unit-V TRANSPOSABLE ELEMENTS (07 hours) **Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon.Eukaryotic transposable elements - Yeast (Ty retrotransposon), Drosophila (P elements), Maize (Ac/Ds).Uses of transposons and transposition.**
Unit-6 Recent Advancement in MICROBIAL GENETICS AND GENOMICS 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	MEDICAL MICROBIOLOGY				
Course Code	BSDB3004				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives:

- To introduce basic principles and application relevance of clinical disease
- The course will provide the conceptual basis for understanding pathogenic microorganisms and particularly address the fundamental mechanisms of their pathogenicity.
- It will also provide opportunities for a student to develop diagnostic skills in microbiology, including the practical application and interpretation of laboratory tests for the diagnosis of infectious diseases.

Course Outcome:

CO1	Overview of microorganism, routes of transmission, pathogenesis and treatment
CO2	Explain molecular diagnosis of microbial diseases, study of diagnostic techniques PCR, ELISA
CO3	Describe Characteristics, diagnosis, treatment, prevention and control of bacterial disease, gastrointestinal and viral disease
CO4	Explains about protozoans infection, route of infection and treatment, types of fungus and causative agents of fungal disease
CO5	Principle of antibiotics and its application for treatments of various kinds of disease
CO6	Evaluate the recent advancement in Medical Microbiology

Text Book (s):

1. Chaechter M. Medoff G. and Eisenstein BC. (1993) Mechanism of Microbial Diseases 2nd edition. Williams and Wilkins, Baltimore.
2. Collee, JG. Duguid JP, Fraser AG, Marimon BP. (1989) Mackie and McCartney Practical Medical Microbiology, 13th Edition. Churchill Livingstone.

References Book (s):

1. Pharmaceutical Microbiology – Edt. byW.B.Hugo&A.D.Russell Sixth edition. Blackwell scientific Publications.
2. Analytical Microbiology –Edt by Frederick Kavanagh Volume I &II.Academic Press New York.

Unit-1: BASICS IN MEDICAL MICROBIOLOGY 10 hours

Infectious diseases overview.Medically important microbes.Microbial diseases - sources, route of transmission. Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity,Virulence, Toxigenicity Pathogenesis, Microbial virulence and virulence factors - Signs and symptoms of microbial diseases. Treatment, Prevention and control of microbial infections.Immunity of microbial diseases.

Unit-2: DIAGNOSIS OF MICROBIAL DISEASES 10 hours

Collection, transport and preliminary processing of clinical pathogens.Clinical, microbiological, immunological and molecular diagnosis of microbial diseases.Modern methods of microbial diagnosis. Principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests,Complement fixation, PCR, DNA probes).

Unit-3: BACTERIAL DISEASES AND VIRAL DISEASES 15hours Characteristics, diagnosis, treatment, prevention and control of diseases caused by Bacteria,

The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control

Respiratory Diseases: *Streptococcus pyogenes*, *Haemophilusinfluenzae*, *Mycobacterium tuberculosis*

Gastrointestinal Diseases: *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Helicobacter pylori*Others: *Staphylococcus aureus*, *Bacillus anthracis*, *Clostridium tetani*, *Treponemapallidum*,*Clostridiumdifficie.*

List of viral diseases of various organ systems and their causative agents.

Symptoms, mode of transmission, prophylaxis and control of Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis

Unit-4: PROTOZOAN AND FUNGAL DISEASES 8 hours

List of diseases of various organ systems and their causative agents.The following diseases in detailwith Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar. Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tineapedis (Athlete's foot),Systemic mycoses: Histoplasmosis, Opportunistic mycoses: Candidiasis

Unit-5: ANTIBIOTICS, SYNTHETIC ANTIMICROBIAL AGENTS AND ACTION MECHANISM OF ANTIBIOTICS

07 hours

Antibiotics and synthetic antimicrobial agents,Antifungal antibiotics, antitumor substances.Peptide antibiotics, Chloramphenicol, Sulphonamides and Quinolinone antimicrobial agents. Chemical disinfectants, antiseptics and preservatives, Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid andprotein synthesis). Bacterial resistance to antibiotics, Penetrating defenses – How the antimicrobial agents reach the targets (cellular permeability barrier, cellular transport system and drug diffusion).

Unit-6 Recent Advancement in MEDICAL MICROBIOLOGY 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**INDUSTRIAL MICROBIOLOGY**				
Course Code	**BSMB3005**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

The students will learn to integrate the knowledge of microbial strains, fermentation processes used in microbial industry. Students will study biochemistry of the processes and their application to the biotechnological processes.

Course Outcome:

CO1	**Describe the important microbial strain of industrial importance and their uses in microbial industry.**
CO2	**Explain different type of fermentation process, and factor effecting fermentation process**
CO3	**Explain principle of centrifugation and process of lyophilization**
CO4	**Explain method of production of Vitamin and pauster effect**
CO5	**Explain enzyme immobilization technique and it's advantages**
CO6	**Evaluate the recent advancement in Industrial Microbiology**

Text Book (s)

1. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
2. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology. 1st edition. Bios Scientific Publishers Limited. USA
3. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001). Industrial Microbiology: An Introduction. 1st edition. Wiley – Blackwell

Reference Book (s)

1. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company

2. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
3. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5.

Unit-4: INTRODUCTION TO INDUSTRIAL MICROBIOLOGY 07 hours **Brief history and developments in industrial microbiology, Isolation of industrially important microbial strains and fermentation media: Crude and synthetic media; molasses, corn steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates**
Unit-2: TYPES OF FERMENTATION PROCESSES, BIO-REACTORS AND MEASUREMENT OF FERMENTATION PARAMETERS 10 hours **Types of fermentation processes - Solid-state and liquid-state (stationary and submerged)fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters, Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration**
Unit -3: DOWN-STREAM PROCESSING 07 hours **Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying**
Unit-4: MICROBIAL PRODUCTION OF INDUSTRIAL PRODUCTS 10 hours **Citric acid, ethanol, penicillin, glutamic acid, Vitamin B12, Enzymes (amylase, protease, lipase) Wine, beer**
Unit-5: ENZYME IMMOBILIZATION 10 hours **Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes.**
Unit-6 Recent Advancement in INDUSTRIAL MICROBIOLOGY 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	**MICROBIOLOGY LAB-VI**
Course Code	**BSMB3010**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**
Antirequisite	

	L	T	P	C
	0	0	6	3

Course Objectives:Students are able to understand the basic techniques of medical microbiology and immunology

Course Outcome :

CO1	**Demonstration of micro flora on skin and mouth**
CO2	**Demonstration of antibacterial sensitivity**
CO3	Preparation of different type of medias for identification of pathogenic bacteria
CO4	**Demonstration of different disease photographs.**
CO5	**Demonstration of stages of parasite in RBCs using photomicrograph**
CO6	Lab report

Text and Reference Book (s)

1. Aneja KR. Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai. 2005
2. Horold J Benson. Microbiological Applications. Laboratory Manual in General Microbiology. 7th International Edition, WCB McGraw – Hill, Boston. 1998
3. James G Cappuccino & Natalie Sherman Microbiology : A Laboratory manual. 6th Edition, Published by Pearson Education. 2004
4. 5. Dubey RC and Maheswari DK. Practical Microbiology 1st Edition, S. Chand & Company Ltd., New Delhi. 2004
5. Myer's and Koshi's Manual of Diagnostic Procedures in Medical Microbiology and Immunology / Serology. Published by Department of Clinical Microbiology, CMC and Hospital, Vellore, Tamil Nadu. 2001

1. Study of bacterial flora of skin by swab method.
2. Study of bacterial flora of mouth by swab method.
3. Perform antibacterial sensitivity by Kirby-Bauer method.
4. Study of composition and use of important differential media for identification of pathogenic bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS.
5. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms).
6. Study of various stages of Malarial parasite in RBCs using permanent mounts/Photomicrographs

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	**MICROBIOLOGY LAB-VII**				
Course Code	**BSMB3011**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives:Students are able to understand the basic techniques of medical microbiology and immunology

Course Outcome :

CO1	**Understand the preparation of master and replica plates.**
CO2	**Demonstrate the effect of chemicals and radiation on bacterial cells**
CO3	Demonstration of conjugation and Ames test
CO4	**Demonstration of different types of fermenters.**
CO5	**Visit report**
CO6	Lab report

Text and Reference Book (s)

6. Aneja KR. Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai. 2005
7. Horold J Benson. Microbiological Applications. Laboratory Manual in General Microbiology. 7th International Edition, WCB McGraw – Hill, Boston. 1998
8. James G Cappuccino & Natalie Sherman Microbiology : A Laboratory manual. 6th Edition, Published by Pearson Education. 2004
9. 5. Dubey RC and Maheswari DK. Practical Microbiology 1st Edition, S. Chand & Company Ltd., New Delhi. 2004
10. Myer's and Koshi's Manual of Diagnostic Procedures in Medical Microbiology and Immunology / Serology. Published by Department of Clinical Microbiology, CMC and Hospital, Vellore, Tamil Nadu. 2001

1. Preparation of Master and Replica Plates.
2. Study the effect of chemical (HNO2) and physical (UV) mutagens on bacterial cells
3. Study survival curve of bacteria after exposure to ultraviolet (UV) light.
4. Demonstration of Bacterial Conjugation.
5. Demonstration of Ames test.
6. Study different parts of fermenter.
7. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

ame of The Course	**DISSERTATION**				
Course Code	**BSMB9997**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**0**	**12**

Course Objectives: To gain knowledge and understanding of research problems and related principles to manage projects in multidisciplinary research areas.

Course Outcome

CO1	Demonstrate the use of knowledge of basic and applied sciences in project based learning.
CO2	Organizes experiments and researches, perform analysis and interpret data for the designed project.
CO3	Cooperate effectively as an individual and as a member in the research team.
CO4	Systematize the articulated ideas, comprehend and write effective reports, documentation and to communicate effectively.
CO5	**Demonstrate knowledge and understanding of research problems and related principles to manage projects in multidisciplinary research areas.**

COURSE CONTENTS:

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. The duration of the Project work/Dissertation is 6 months. A Project/Dissertation work may be given in lieu of a discipline specific elective paper/Biochemistry.This should be done in consultation with the faculty supervisor and agency supervisor under whom he / she is getting trained. The project report should be around 100 pages and chaptered as follows:

Chapter I: Introduction

Chapter II: Review of Literature

Chapter -3:: Methodology

Chapter IV: Data Analysis and Results

Chapter V: Discussion of Results

Chapter VI: Summary and Conclusion

The research should be original and should be action oriented in that the results should be able to throw light on some of the important unexplored areas that would be of practical use to the forensic experts.

Students are expected to decide on the specific project area and title, and carry out substantial portion of the literature survey during the end of their 5thsemester.After the end of their 5thsemester ETEs, each student will be asked to make presentation about the project including literature available, objective sought and work plan including methodologiesto the Student Project Monitoring Committee constituted by the

HOD. The Project Work may be a work based on theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, etc. or a combination of these. The final project report will be evaluated by a panel of examiners consisting of HOD, Guide and Co-guide (wherever applicable) and an External Examiner. Viva-voce examination for the same will be conducted.

The following weightage is assigned at each stage of Student Project evaluation.

Reference Book (s)	Reference Book (s)
Zeroth Review	Project scopes and Proposal
Review I	Methods of project Implementation
Review II	Technical Achievement
Review -3:	Innovation and contribution
Final Evaluation	Overall achievement
(External evaluation)	Project Report Evaluation

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	Web based course/seminar			
Course Code	BSDB3010			
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.			
Corequisite	Students should have understanding of general biology.			
Antirequisite				
	L	T	P	C
	0	0	0	2

Course Objectives:

- **Students are** directly engage and learn particular subject of their interest. This strengthens the fundamentals of the student in the course.
- It gives the students the opportunities to explore new areas of interest . Also gives students the opportunity to learn in greater depth the subjects they wish to master.
- Promotes the self-learning initiative of the students – where their own motivation is what drives them to complete the course. This fosters the habit of keeping oneself updated always by means of self-study.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	ETE	Total Marks
50		50	100

ELECTIVES

GROUP-I

Name of The Course	**BIOINFORMATICS**				
Course Code	**BSDB2011**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the computer science.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of bioinformatics.
Course Outcomes

CO1	**Describe the Introduction of Computer Fundamentals**
CO2	**It Interpret the Introduction of Bioinformatics and Biological Databases**
CO3	**Demonstrate Sequence Alignments, Phylogeny and Phylogenetic trees**
CO4	**Evaluate Genome organization and analysis**
CO5	**EvaluateProtein Structure Predictions**
CO6	**To elaborate the recent development in field of Bioinformatics**

Text Book (s)

1. **Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House**
2. **Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications**
3. **Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student** Edition
4. **Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications,** genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. **Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell**

Reference Book (s)

1. **Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House**
2. **Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications**
3. **Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student** Edition
4. **Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications,** genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. **Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell**

Unit-1 INTRODUCTION TO COMPUTER FUNDAMENTALS 12 hours **RDBMS - Definition of relational database, Mode of data transfer (FTP, SFTP, SCP), advantage of encrypted data transfer.**
Unit-2 INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES 10hours **Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB.**

Unit-3 SEQUENCE ALIGNMENTS, PHYLOGENY AND PHYLOGENETIC TREES 09hours **Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices. Types of phylogenetic trees, Different approaches of phylogenetic tree construction -UPGMA, Neighbour joining, Maximum Parsomony, Maximum likelihood.**
Unit-4 GENOME ORGANIZATION AND ANALYSIS 08 hours **Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes; Genome, transcriptome, proteome, 2-D gel electrophoresis, Maldi Toff spectroscopy; Major features of completed genomes: *E.coli, S.cerevisiae, Arabidopsis,* Human.**
Unit-5 PROTEIN STRUCTURE PREDICTIONS 08 hours **Hierarchy of protein structure - primary, secondary and tertiary structures, modelling; Structural Classes, Motifs, Folds and Domains; Protein structure prediction in presence and absence of structure template; Energy minimizations and evaluation by Ramachandran plot Protein structure and rational drug design.**
Unit-6 RECENT ADVANCEMENT IN Bioinformatics 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOSTATISTICS**				
Course Code	**BSDB2012**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the statistics.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biostatistics.
Course Outcomes
Course Outcomes

CO1	**Understand Measures of central tendency, Correlation and Regression**
CO2	**Interpret Mean and Variance, namely Binomial, Poisson**
CO3	**Demonstrate parametric and non-parametric statistics.**
CO4	Illustrate the Sampling Distributions, Standard Error, Testing of Hypothesis
CO5	**Illustrate the Large Sample Test based and Small sample test**
CO6	**To elaborate the recent development in field of Biostatistics**

Text Book (s)

1. Edmondson and D. Druce : Advanced Biology Statistics, Oxford University Press; 1996.
2. W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004

Reference Book (s)

1. Edmondson and D. Druce : Advanced Biology Statistics, Oxford University Press; 1996.
2. W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004

Unit-1	**12 hours**
Measures of central tendency, Measures of dispersion; skewness, kurtosis; Elementary Probability and basic laws; Discrete and Continuous Random variable, Mathematical Expectation; Curve Fitting; Correlation and Regression. Emphasis on examples from Biological Sciences.	
Unit-2	**10hours**
Mean and Variance of Discrete and Continuous Distributions namely Binomial, Poisson, Geometric, Weibull, Logistic and Normal distribution. Fitting of Distributions.	
Unit-3	**09 hours**
Statistical methods: Scope of statistics: utility and misuse. Principles of statistical analysis of biological data. Sampling parameters. Difference between sample and Population, Sampling Errors, Censoring, difference between parametric and non-parametric statistics.	
Unit-4	**08hours**
Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom.	
Unit-5	**08hours**
Large Sample Test based on Normal Distribution, Small sample test based on t-test, Z- test and F test; Confidence Interval; Distribution-free test - Chi-square test. Basic introduction to Multivariate statistics, etc.	
Unit-6 RECENT ADVANCEMENT IN Biostatistics 04hours **Research article/ Review paper/ MOOC**	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOPHYSICS**				
Course Code	**BSDB2013**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the physics.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biophysics.

Course Outcomes

CO1	**Understand numerical models with non-linear algebraic equations, numerical integration.**
CO2	**Describe the principle and working of crystallography.**
CO3	**Interpret the applications of numerical methods in biological systems.**
CO4	**Demonstrate the use of quantum biology.**
CO5	**Understand the theoretical modeling of biomolecules.**
CO6	**To elaborate the recent development in field of Biophysics**

Text Book (s)

1. A Textbook of Biophysics: For Medical Science and Biological Science Students by RN Roy
2. Introduction to Biophysics by Pranab Kumar Banerjee
3. An Introduction to Biophysics by David Burns
4. Fundamentals and Techniques of Biophysics and Molecular Biology by Pranav Kumar
5. Biological Physics: Energy, Information, Life by Philip Nelson

Reference Book (s)

1. A Textbook of Biophysics: For Medical Science and Biological Science Students by RN Roy
2. Introduction to Biophysics by Pranab Kumar Banerjee
3. An Introduction to Biophysics by David Burns
4. Fundamentals and Techniques of Biophysics and Molecular Biology by Pranav Kumar
5. Biological Physics: Energy, Information, Life by Philip Nelson

Unit-1 NUMERICAL METHODS 12 hours **Introduction to numerical methods, solutions to non-linear algebraic equations by the method of iteration and Newton aphson method, numerical integration by trapezoidal rule and simpson's rule, numerical solution of ordinary differential equations by picard's method of successive approximation, Euler's method and Runge-Kutta method.**
Unit-2 ELEMENTARY CRYSTALLOGRAPHY 10 hours **Introduction, symmetry in crystals, lattices and unit cells, crystal systems, Bravais lattices, elements of symmetry- rotation axis, mirror planes and center of inversion, point group symmetry- monoaxial point groups, polyaxial point groups, translational symmetry- screw axis and glide planes, space group, equivalent points, X-ray diffraction and Bragg equation.**
Unit-3 MATHEMATICAL METHODS AND THEIR APPLICATIONS IN BIOLOGICAL SYSTEMS 09hours

Ordinary differential equations of the first degree and first order (variable separable method, linear equation), linear differential equations of the second order with constant coefficients, the Laplace Transform, Inverse Laplace transform, application of Laplace transform to solutions of differential equations, Fourier series and their applications.
Unit-4 QUANTUM BIOLOGY AND ITS USES 08hours **Classical mechanics, Newton, Lagrange and Hamilton's equations, Schrodinger's equation and its complete solution for S.H.O, central force and angular momentum.**
Unit-5 THEORETICAL MODELING OF BIOMOLECULAR SYSTEMS 08hours **Basic principles of modeling, modeling by energy minimization technique, concept of rotation about bonds, energy minimization by basic technique for small molecules, Ramachandran plot, torsional space minimization, energy minimization in cartesian space, molecular mechanics-basic principle, molecular dynamics basic principles.**
Unit-6 RECENT ADVANCEMENT IN BIOPHYSICS 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**ORGANIC FARMING**				
Course Code	**BSDB2014**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: To provide a broad foundation in organic farming.

Course Outcomes

CO1	**To understand the basic concept of organic farming.**
CO2	**To describe the concept of green manuring.**
CO3	**To identify the different methods of organic plant protection**
CO4	**To explain various types of organic crop production methods.**
CO5	**To understand the basic concept of farm economy.**
CO6	**To elaborate the recent development in field of Organic Farming**

Text Book (s)

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay -Publication, New Delhi.

Reference Book (s)

1. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
2. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.
3. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic _Farming Akta Prakashan, Nadiad

Unit-1 INTRODUCTION TO ORGANIC FARMING 08 hour **Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.**
Unit-2 ORGANIC PLANT NUTRIENT MANAGEMENT 10 hour **Organic farming systems, soil tillage, land preparation and mulching,Choice of varieties. Propagation-seed, planting materials and seed treatments, water management Green manuring, composting- principles, stages, types and factors, composting methods, Vermi composting, Bulky organic manures, concentrated organic manures, organic preparations, organic amendments and sludges**
Unit-3 ORGANIC PLANT PROTECTION 09 hours **Plant protection- cultural, mechanical, botanical pesticides, control agents, Weed management, Standards for organic inputs- plant protection.**
Unit-4 ORGANIC CROP PRODUCTION PRACTICES 10 hours **Organic crop production methods- rice, coconut. Organic crop production methods- vegetables- okra, amaranthus, cucurbits. Livestock component in organic farming. Sustainable Agriculture-Apiculture, Mushroom cultivation.**
Unit-5ORGANIC CERTIFICATION 08 hours **Farm economy: Basic concept of economics- demand &supply, economic viability of a farm. Basic production principles, reducing expenses, ways to increase returns, cost of production system. Benefit/ cost ratio, marketing, imports and exports. Policies and incentives of organic production. Farm inspection and certification. Terrace farming.**
Unit-6 RECENT ADVANCEMENT IN ORGANIC FARMING 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOFERTILIZERS AND PESTICIDES**				
Course Code	**BSDB2015**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: To provide basic understanding of biofertilizer and pesticides.
Course Outcomes

CO1	**To understand the basic concept of biofertilizer.**
CO2	**To identify the role of azospirillium as biofertilizer .**
CO3	**To explain the process of nitrogen fixation.**
CO4	**To explain various types of mycorrhizal association.**
CO5	**To elucidate the basic concept of pest and pest management .**
CO6	**To elaborate the recent development in field of Biofertilizers and Pesticides**

Text Book (s)
1.Palaniappan SP &Anandurai K. 1999. Organic Farming–Theory and Practice. Scientific Publishers, Jodhpur
2. Joshi, M. 2014. New Vistas of Organic Farming 2nd Ed. Scientific Publishers, Jodhpur.
3. Farming system : Theory and Practice - S.A.Solaimalai
Reference Book (s)

1. Organic Farming: Theory and Practice- S.P.Palaniappan and K.A. Annadurai
2. A hand book of Organic Farming by A.K.Sharma

Unit-1 INTRODUCTION TO BIOFERTILIZERS 08 hour **General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.**
Unit-2 AZOSPIRILLUM 10 hour **Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication**
Unit-3 CYANOBACTERIA 09 hours **Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.**
Unit-4 MYCORRHIZAL ASSOCIATION 10 hours **Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.**

Unit-5 PEST & PEST MANAGEMENT	**08 hours**
Classification of pesticides on chemical nature and according to target species, mode of action, Methods of pest controls – Classification: Natural & applied control [Physical, mechanical, cultural, biological, genetic, regulatory, chemical controls] Integrated pest management..	
Unit-6 RECENT ADVANCEMENT IN BIOFERTILIZERS AND PESTICIDES	**04hours**
Research article/ Review paper/ MOOC	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**NANOBIOTECHNOLOGY**				
Course Code	**BSDB3011**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of nanotechnology.

Course Outcomes

CO1	**Understand the fundamentals of nanotechnology**
CO2	**Demonstrate the physical and chemical methods of synthesis of nanomaterials**
CO3	**Demonstrate the biological methods of synthesis of nanomaterials**
CO4	**Generalize the use of nanomaterials in biotechnology**
CO5	**Illustrate the applications of nanobiotechnology**
CO6	**To elaborate the recent development in field of Nanobiotechnology**

Text Book (s)

1. Nanobiotechnology: Concepts,Applications and Perspectives (2004), ChristofM.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
2. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
3. Pradeep T., “A Textbook of Nanoscience and Nanotechnology”, Tata McGraw Hill Education Pvt. Ltd., 2012.
4. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002.

Reference Book (s)

1. Nanobiotechnology: Concepts,Applications and Perspectives (2004), ChristofM.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
2. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
3. Pradeep T., “A Textbook of Nanoscience and Nanotechnology”, Tata McGraw Hill Education Pvt. Ltd., 2012.
4. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002.

Unit-1 INTRODUCTION TO NANOTECHNOLOGY 10 hours **Historical perspectives, Existence of nanostructures in nature, Nanoscale Properties (Electrical, Optical, Chemical) Nanomaterials - Quantum Dots,Wells and Wires, nanotubes, graphene, nanogold, nanosilver and metal oxides, Nanopolymers.**
Unit-2 SYNTHESIS OF NANOMATERIALS 10hours **Physical Methods: Ball Milling, Electrodeposition, DC/RF Magnetron Sputtering, Molecular Beam Epitaxy (MBE).Chemical Methods: Metal Nanocrystals by Reduction, Solvothermal Synthesis, Photochemical Synthesis, Chemical Vapor Deposition (CVD), Metal Oxide - Chemical Vapor Deposition (MOCVD).**
Unit-3BIOLOGICAL SYNTHESIS OF NANOMATERIALS10 hours **Synthesis using Microorganisms, Synthesis using Biological templates, synthesis using plants and plant extracts.**
Unit-4 NANOMATERIAL IN BIOTECHNOLOGY 08 hours **Biological nanomaterials and Biomimetic synthesis of nanomaterials – magnetosomes, spider milk, bone, shell. Device based on assemblies of nanoparticles and biomaterials – Bioelectronic devices, nanocircuitry, nanomechanical devices, computational devices.**
Unit-5 APPLICATIONS OF NANOBIOTECHNOLOGY 08 hours **Nanobiosensors, molecular imaging using nanoparticles, targeted drug delivery. Applications in health and disease - infectious and chronic. Nanobiotechnological applications in Environment and food - detection and mitigation.**
Unit-6 RECENT ADVANCEMENT IN NANOBIOTECHNOLOGY RIGHTS 04HOURS **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIORESOURCE MANAGEMENT**
Course Code	**BSDB3012**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**

Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of bioresource management.
Course Outcomes

CO1	Illustrate the different types of aquaculture
CO2	Summarize the purpose of culturing economically important organisms
CO3	Illustrate the importance of vermiculture
CO4	Describe the origin and importance of cultivated plants
CO5	Generalize the economic uses of various plant products

Text Book (s)

1. ManjuYadav, Economic Zoology- Discovery publishing house, New Delhi
2. Lee R E,. Phycology 1999

Reference Book (s)

1. ManjuYadav, Economic Zoology- Discovery publishing house, New Delhi
2. Lee R E,. Phycology 1999

Unit-1 AQUACULTURE 10 hours **Introduction to aquaculture; Prawn culture, Methods of prawn fishing, Preservation and processing of prawn; Pearl culture and status of pearl culture in India; Economically important fishes of India. Setting up of a fish farm, Monoculture and composite fish culture, Bundh breeding, Induced breeding, methods of fishing, Fish preservation and processing; Identification of fish diseases and their control; Snakes and snake venoms.**
Unit-2 ECONOMIC ZOOLOGY 08 hours **Overview of Sericulture, Apiculture, Lac culture, Poultry culture, Dairy industry.**
Unit-3 VERMICULTURE 08hours **Introduction and scope, Species of earthworm, Characteristics features ofearthworm. Overview of methods of vermicomposting, Role of earthworm in solid waste management. Vermiwash- its importance, Vermicompost as bio-fertilizer.**
Unit-4CULTIVATED PLANTS 10 hours **Cultivated Plants: origin and importance with particular reference to the works of A. de Candolle and Vavilov (especially centers of diversity, primary and secondary centers, multiple origin); a brief account of Harlan and Hawkes theories; examples of major introductions; practices of floriculture, agroforestry, sericulture. BT crops (brief account).**
Unit-5ECONOMIC USE OF PLANT PRODUCTS 10 hours **Definition, Classification, Names, Morphology and economic uses of important cereals, legumes (pulses and fodders), fruits and vegetables, spices and condiments, beverages, oils and fats, essential oils, medicinal plants, hallucinogens (psychotropic drugs), timber plants, fibre plants, natural rubber, resins, raw materials for paper. A brief account of crop improvement technologies, biosafety considerations, natural products.**
Unit-6 Recent Advancement in mushroom technology 04hours

Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS				
Course Code	BSDB3013				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of biosafety and intellectual property rights

Course Outcomes

CO1	Understand the fundamentals of biosafety
CO2	Summarize the guidelines of biosafety
CO3	Understand the concepts of intellectual property
CO4	Describe the grant of patents, agreements and treaties

Text Book (s)

1. Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt.Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.
5. Goel D &Prashar S (2013). IPR, Biosafety and Bioethics. Pearson
6. Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.

Reference Book (s)

1. Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt.Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.
5. Goel D &Prashar S (2013). IPR, Biosafety and Bioethics. Pearson
6. Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.

Unit-1 INTRODCUTION TO BIOSAFETY 07 hours

Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms.
Unit-2 BIOSAFETY GUIDELINES 10hours **Biosafety Guidelines: Biosafety guidelines and regulations (National and International);GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol. Guidelines for using radioisotopes in laboratories and precautions.**
Unit-3INTRODUCTION TO INTELLECTUAL PROPERTY10hours **Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR –patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).**
Unit-4GRANT OF PATENT, AGREEMENTS AND TREATIES10 hours **Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional,Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing andagreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patentowner. Agreements and Treaties: GATT, TRIPS, WIPO, Budapest Treaty on international recognition of the deposit of microorganisms etc.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	MUSHROOM CULTIVATION TECHNOLOGY				
Course Code	BSDB3015				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of mushroom cultivation technology.

Course Outcomes

CO1	**Understand the values of mushroom.**
CO2	**Describe the technology used for cultivation of mushroom**
CO3	**Demonstrate the concepts of mushroom bed preparation.**
CO4	**Demonstrate the process of storage and its nutritional value.**
CO5	**Understand the concepts of types of foods prepared from mushroom.**

Text Book (s)

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Reference Book (s)

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Unit-1 INTRODUCTION TO MUSHROOM CULTIVATION 06 hours **Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - Volvariellavolvacea, Pleurotuscitrinopileatus, Agaricusbisporus.**
Unit-2 CULTIVATION TECHNOLOGY - I 08 hours **Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication.**
Unit-3CULTIVATION TECHNOLOGY-II 08hours **Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.**
Unit-4 STORAGE AND NUTRITION 10 hours **Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.**
Unit-5FOOD PREPARATION 08 hours

Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**PARASITOLOGY**				
Course Code	**BSDB3016**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of parasitology

Course Outcomes

CO1	**Describe the basic concept Parasitology**
CO2	**Interpret about the Parasitic Protists and disease caused by it**
CO3	**Interpret Parasitic Platyhelminthes**
CO4	**Elucidate Parasitic Nematodes**
CO5	**Illustrate Parasitic Arthropoda and Parasitic Vertebrates**

Text Book (s)

1. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
2. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger
3. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group
4. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
5. Rattan LalIchhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
6. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
7. Thomas C. Cheng (1986). General Parasitology, II Edition, Academic Press Inc
8. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd. DSE

Reference Book (s)

1. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
2. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger
3. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group

4. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
5. Rattan LalIchhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
6. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
7. Thomas C. Cheng (1986). General Parasitology, II Edition, Academic Press Inc
8. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd. DSE

Unit-1 INTRODUCTION TO PARASITOLOGY 04 hours **Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship.**
Unit-2 PARASITIC PROTISTS 12hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoebahistolytica, Giardia intestinalis, Trypanosomagambiense, Leishmaniadonovani, Plasmodium vivax.**
Unit-3PARASITIC PLATYHELMINTHES08hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsisbuski, Schistosomahaematobium,Taeniasolium and Hymenolepis nana.**
Unit-4PARASITIC NEMATODES 12 hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Ascarislumbricoides, Ancylostomaduodenale, Wuchereriabancrofti and Trichinellaspiralis. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylencus (lesion nematode).**
Unit-5PARASITIC ARTHROPODA AND PARASITIC VERTEBRATES08 hours **Biology, importance and control of ticks, mites, Pediculushumanus (head and body louse), Xenopsyllacheopis and Cimexlectularius, A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat.**
Unit-6 RECENT ADVANCEMENT IN PARASITE BIOLOGY 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Basic and Applied Sciences
Department of Life Sciences
Division of Biochemistry

Programme: B.Sc. (Hons.) Biochemistry

Scheme: 2020 – 2023

Date of BOS: 22.04.2020

Galgotias University

Vision

"To be known globally for value-based education, research, creativity and innovation"

Mission

5. **Establish state-of-the-art facilities for world class education and research.**
6. **Collaborate with industry and society to align the curriculum,**
7. **Involve in societal outreach programs to identify concerns and provide sustainable ethical solutions.**
8. **Encourage life-long learning and team-based problem solving through an enabling environment.**

School of Basic and Applied Sciences

Vision:

To be recognized globally as a center of excellence in imparting value-based education in Basic and Applied Sciences by creating innovation in fundamental and multidisciplinary research.

Mission

M1: To excel in imparting contemporary knowledge and skills by developing an educational ecosystem with diverse interests and talents.

M2: To perform cutting edge research leading to innovation in sciences through national and international collaborations.

M3: To develop solutions for the emerging challenges in Basic and Applied Science to cater the needs of society.

M4: To attract best quality faculty to facilitate knowledge and develop confidence in our graduates to succeed in the world.

PREAMBLE

Biochemistry is a central basic discipline to all branches of Biology/ Life Sciences. It deals with the chemical nature, function, structure, energetic and pathways of synthesis and degradation of simple to complex biological and/or cellular molecules to understand the various aspects of cellular and molecular functions in development, health and disease with applications in Biotechnology and Medicine.

B.Sc Biochemistry course will provide the students a grounding in a subject that forms the basis of virtually all of the biological sciences. Many exciting discoveries made in this area have contributed to our understanding of life, the solving of medical problems, and to the discovery and production of safe and effective drugs. You will gain a broad introduction to biological sciences, covering key concepts such as – biochemistry, genetics, microbiology, molecular biology, immunology, etc.In addition, the students will study the aspects of chemistry that are relevant to biological systems.

The programme aims to impart a thorough knowledge of the principle and theories pertaining to the different areas of Biochemistry such as Molecular Biology, Genetic Engineering, Biotechnology, Bioinformatics, Cell signalling, Microbial Cellular Communication, Immunology,. In addition, the programmes aim at imparting academic excellence, personality development, systematic and disciplined work and scientific temper among students to face the challanges in the field of Biosciences. Students are regularly encouraged to update their practical skills with hands on experience in the state-of-the-art laboratories.

ELIGIBILITY

Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry shall be required to have passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry with a minimum of 60 % marks in aggregate (55 % marks in case of SC/ST students).

SCOPE OF THE PROPOSED PROGRAMME

The B.Sc., programme of three years is designed to help all the students to get good quality education in the field of Biochemistry so that they can pursue Post Graduation or find employment. The ultimate aim is to enable the students to develop an integrated approach for understanding the various life science problems at the molecular level. In addition, the present curriculum gives scope for the students entering different modules to update their knowledge depending upon the employment opportunities in each area. Various practical courses have been designed not only to enable the students to appreciate scientific basis of various life processes but also to train them for self-employment. There is a greater demand globally for trained manpower in the area of Biochemists for Research and Development, in Multinational Companies, Public Sectors, Quality Control Labs, Biopharmaceuticals companies, Food industries as well as in Universities and the present curriculum will cater to that needs.

The course will provide solid foundation for all the students regardless of background and will gain a comprehensive understanding of the principles of Biochemistry and allied areas, including clinical and research aspects and with the special attention to current development in the discipline.

PROGRAMME OBJECTIVES

- To ignite young minds, from different backgrounds, to understand the world of biochemical reactions through application based learning. This learning would develop their reasoning power and train them for future career in research.
- To provide high quality teaching to the students through traditional classroom teaching as well as varied exposure to audio-visual aids and hands on training on various aspects of biotechnology and allied biological subjects. More emphasis is given on understanding the subject rather than rote learning.
- Develop skills as a self-directed learner, recognize continuing educational needs.
- To equip the students to occupy important positions in Research, Industries and related organizations.
- To inspire the students to apply their knowledge gained for the development of society in general.

Program Educational Objectives (PEO)

PEO1: The graduates shall be successful professionals in Academia, Industry, Government and Entrepreneurship.

PEO2: The graduates shall pursue higher education/research at institute of national and international repute.

PEO3: The graduate shall effectively address the challenges of the society and undertake the projects for bridging the gap between industry and societal needs.

Programme Outcomes (POs)

PSO1	Igniting young minds, from different backgrounds to understand the world of biochemical reactions through application based learning.
PSO2	Equip students with analytical and technical skills to practice evidence based biochemistry for industrial applications.

PO1: Apply the principles and conceptual knowledge of basic and applied science to understand and solve the complex biological problems.

PO2: Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of biological reactions.

PO3: Create, select and apply appropriate techniques, resources and modern science and research tools within a defined specification that meet specified needs with appropriate consideration for public health and safety.

PO4: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal issues and the consequent responsibilities relevant to the professional biologist.

PO5: Understand the impact of professional life sciences solutions in communal and environmental contexts and demonstrate knowledge and need for sustainable development.

PO6: Articulate ideas, comprehend and write effective reports, documentation and to communicate effectively with the basic and applied sciences community and with society at large, professionally and ethically.

PO7: Demonstrate knowledge and understanding of science and technical principles to manage projects in multidisciplinary research areas and function effectively as an individual, and as a member or leader in diverse resource teams.

PO8: Seeking stimulation and to exploring numerous opportunities to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcome (PSOs):

Programme structure 2020-2023

Semester I									
Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB1001	Chemistry	4	0	0	4	30	20	50
2	BSDB1002	Fundamentals of Cell Biology	4	0	0	4	30	20	50
3	BSBC1004	Biological Macromolecules	4	0	0	4	30	20	50
4	BSBC1005	Enzymes	4	0	0	4	30	20	50
5	BSBA1061	Hands on Workshop on Basic Analytical Techniques and Measurements	0	0	4	2	50		50
6	BSBC1012	Biochemistry Lab-I	0	0	6	3	50		50
7	xxxx	Liberal Art				0.5			
8	xxxx	Soft Skill				0			
9	xxxx	Environmental Science		-	-	0.5			
10	xxxx	AI and Machine learning				2			
11	xxxx	BEC- B1				3			
12	xxxx	Computer awareness				0			
			Total			27			

Semester II									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSBD1007	Bioinstrumentation-I	4	0	0	4	30	20	50
2	BSBC1008	Membrane Biology and Bioenergetics	4	0	0	4	30	20	50
3	BSDB1009	Hormones: Biochemistry and Function	4	0	0	4	30	20	50

4	BSDB1011	Concept of Immunology	4	0	0	4	30	20	50
5	BSBC1013	Biochemistry Lab-II	0	0	6	3	50		50
6	Xxxx	BEC-B2				3			
7	xxxx	***Two week social internship (during summer)							
			Total			22			

Semester III

Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB2001	Fundamentals of Molecular Biology	4	0	0	4	30	20	50
2	BSDB2002	Bioinstrumentation-II	4	0	0	4	30	20	50
3	BSDB2003	Fundamentals of Microbiology	4	0	0	4	30	20	50
4	BSDB2004	Metabolism of Biomolecules-I	4	0	0	4	30	20	50
5	BSBC2014	Biochemistry Lab-III	0	0	6	3	50	-	50
6	BSBC2015	Biochemistry Lab-IV	0	0	6	3	50	-	50
7	BSDB2006	Web based Course/Seminar-I	0	0	0	2	50		50
			Total			24			

Semester IV

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCSE1021	Programming in C and Python	4	0	0	4	30	20	50
2	BSDB2010	Biotechnology	4	0	0	4	30	20	50
3	BSDB2009	Medical Biochemistry	4	0	0	4	30	20	50
4	BSBC2008	Metabolism of Biomolecules-II	4	0	0	4	30	20	50

5	BSDBxxxx	Elective (Group-I, GE)	4	0	0	4	30	20	50
6	BSBC2017	Biochemistry Lab -V	0	0	6	3	50		50
7	BCSE1031	Programming in C and Python Laboratory	0	0	6	3	50		50
8	Xxxx	IPR				0.5			
9	xxxx	Foreign Language				0.5			
10	XXXX	Waste Management			2	1	50		50
11	BBSO9P2411	Research methodology and Statistics	2			2	30	20	50
			Total			30			

Semester V

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSBC3001	Minor Project*	0	0	0	3	50		50
2	BSDB3003	Inheritance Biology	4	0	0	4	30	20	50
3	BSBC3004	Plant Biochemistry	4	0	0	4	30	20	50
4	BSBC3005	Food and Nutrition	4	0	0	4	30	20	50
5	BSDBxxxx	Elective (Group-II, DSE)	4	0	0	4	30	20	50
6	BSBC3010	Biochemistry Lab-VI	0	0	6	3	50	-	50
7	BSBC3011	Biochemistry Lab-VII	0	0	6	3	50	-	50
8	xxxx	Campus to corporate				2			
			Total			27			

Semester VI

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSBC9997	Dissertation	0	0	0	12	50		50

2	BSDB3010	Web based Course/Seminar-II	0	0	0	2	50		50
					Total	14			
				Total		144			

List of Electives

Group I (Semester IV)

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB2011	Bioinformatics	4	0	0	4	30	20	50
2	BSDB2012	Biostatistics	4	0	0	4	30	20	50
3	BSDB2013	Biophysics	4	0	0	4	30	20	50
4	BSDB2014	Organic Farming	4	0	0	4	30	20	50
5	BSDB2015	Biofertilizers and Pesticides	4	0	0	4	30	20	50

Group II (Semester V)

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB3011	Nanobiotechnology	4	0	0	4	30	20	50
2	BSDB3012	Bioresource Management	4	0	0	4	30	20	50
3	BSDB3013	Biosafety and IPR	4	0	0	4	30	20	50
4	BSDB3015	Mushroom Culture Technology	4	0	0	4	30	20	50
5	BSDB3016	Parasitology	4	0	0	4	30	20	50

Name of The Course	**CHEMISTRY**				
Course Code	**BSDB1001**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of atomic structure, thermodynamics, chemical bonding, stereochemistry and ionic equilibria.

Course Outcomes

CO1	**Understand atomic structure with various Bohrs, Aufbau, Pauli's principles.**
CO2	**Describe chemical thermodynamics, law of thermodynamics.**
CO3	**Identify chemical bonding and molecular forces.**
CO4	**Express the knowledge stereochemistry.**
CO5	**Interpret the ionic equilibria.**
CO6	**Evaluate the recent advancement in chemistry.**

Text Book (s)

3. J.D. Lee : A New Concise Inorganic Chemistry, E.L.B.S.
4. P.W. Atkins : Physical Chemistry, Oxford University Press
5. R.T. Morrison & R.N. Boyd : Organic Chemistry, Prentice Hall

Reference Book (s)

1. P.W. Atkins : Physical Chemistry, Oxford University Press
2. R.T. Morrison & R.N. Boyd : Organic Chemistry, Prentice Hall
3. J.E. Huheeyetl.: Inorganic Chemistry : Principles of Structure and reactivity

Unit-1 ATOMIC STRUCTURE12 hour **Recapitulation of Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Quantum numbers and their significance.Shapes of s, p, d and f orbitals. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms).Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.**
Unit-2 CHEMICAL THERMODYNAMICS 10 hour **Introduction of thermodynamics, state of system, state variables, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes.Laws of Thermodynamics.**

Unit-3CHEMICAL BONDING AND MOLECULAR FORCES 09 hours **Introduction to ionic interactions and covalent bond, inter-molecular and intra-molecular forces, types of intermolecular forces and their characteristics: ion-dipole, dipole-dipole, dipole-induced dipole and dispersion (London) forces, hydrogen bond (intra-molecular and inter-molecular), effect of inter/intra-molecular forces on structure of different biomolecules.**
Unit-4 STEREOCHEMISTRY 08 hours **Optical isomerism: Optical activity, specific rotation, enantiomerism, D and L designation, racemic modification, R and S sequence rules, diasteroisomers. Conformational isomers: conformation of ethane and butane, interconversion of projection formula, cyclohexane (mono- and di-substituted), resolution, optical purity, Walden inversion, enantiotopic and diastereotopichydrogens and prochiralcenters. Geometrical isomerism: Definition, nomenclature– E and Z.**
Unit-5IONIC EQUILIBRIA 08 hours **Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionizationconstant and ionic product of water. Ionization of weak acids and base, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.Buffer solutions. Qualitative treatment of acid base titration curves. Theory of acid – base indicators.**
Unit-6 Recent Advancement in Chemistry 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**FUNDAMENTAL OF CELL BIOLOGY**				
Course Code	**BSDB1002**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of cell types, membranes, cellular communication, cellular transport, aging and their death.

Course Outcomes

CO1	**Identify cell types, structure, functions and differentiate between various cell organelles.**
CO2	**Interpret the membrane biochemistry and transport of ions across the membrane.**
CO3	**Summarize the different types Cell-Cell Interaction and cellular communication.**
CO4	**Demonstrate protein sorting and transport.**
CO5	**Express the knowledge cell aging and death.**
CO6	**Evaluate the significance of Cytology.**

Text Book (s)

3. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN: 978-0-87893-300-6.
4. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN: 13:978-1- 4641-0981-2 / ISBN:10: 1-4641-0981-8.
5. Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4 / ISBN:0-8153-1620-8.

Reference Book (s)

1. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN: 978-0-87893-300-6.
2. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN: 13:978-1- 4641-0981-2 / ISBN:10: 1-4641-0981-8.
3. Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4 / ISBN:0-8153-1620-8.

Unit-1 STRUCTURE OF CELL 07 hours **Introduction to the cell, its chemical composition, Cell types - organization of prokaryotic and eukaryotic cells, Plant and animal cells: variation in structure and function, cell theory. Structure and functions of cell organelles – Nucleus, mitochondria, chloroplast, ribosome, lysosomes.**
Unit-2 MEMBRANE BIOCHEMISTRY 07 hours **Membrane: chemical composition and its structural plan; molecular model of cell membrane - fluid mosaic model and membrane fluidity; Overview of types of transport systems and macromolecule transport: Exocytosis; Endocytosis; Pinocytosis and phagocytosis.**
Unit-3CELLULAR COMMUNICATION 10 hours **Cell Wall: Eukaryotic cell wall, Extracellular matrix and cell matrix interactions, Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata. Cytoskeleton: Structure and organization of actin filaments,**

association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules.
Unit-4PROTEIN SORTING AND TRANSPORT 12 hours **Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus.**
Unit-5CELL CYCLE AND CELL DEATH 10 hours **Cell cycle - phases of cell cycle; cell division - mitosis and meiosis; Cell cycle regulation; Cell aging and death - necrosis and apoptosis; Stem cells. Types: Embryonic stem cell, induced pluripotent stem cells.**
Unit-6 Recent Advancement in cytology 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BIOLOGICAL MACROMOLECULES				
Course Code	BSBC1004				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have the basic knowledge of biochemistry.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to express the knowledge about structure and function of biological macromolecules.

CO1	Elucidate the importance of water in biological system
CO2	Describe various classes of carbohydrates.
CO3	Explain the crucial role of lipids in biological system
CO4	Explain the different types Aminoacids and their properties.
CO5	Deduce the structure and classification of DNA and RNA .
CO6	Evaluate the recent development in the field of biological macromolecules.

Text Book (s)

6. **The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893-300-6.**
7. **Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN:13:978-1-4641-0981-2 / ISBN:10: 1-4641-0981-8.**

Reference Book

1. **Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4 / ISBN:0-8153-1620-8**

Unit-1 : I The foundations of biochemistry (08 hours)
Cellular and chemical foundations of life, Unique properties of water, weak interactions in aqueous systems, ionization of water, water as a reactant and fitness of the aqueous environment.
Unit-2 Carbohydrates and glycobiology (12 lectures)
Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and nonreducing disaccharides. Polysaccharides – homo- and heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lipopolysaccharides). Carbohydrates as informational molecules, working with
Unit-3 Lipid (10 hours)
Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids - triacyl glycerol and waxes. Structural lipids in membranes – glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Plant steroids. Lipids as signals, cofactors and pigments
Unit-4 : Amino acids (10 hours)
Structure and classification, physical, chemical and optical properties of amino acids. Organization of protein structure into primary, secondary, tertiary and quaternary structures. Nterminal and C-terminal amino acid analysis
Unit-5 : Nucleic acids (12 hours)
Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA. Structure of major species of RNA - mRNA, tRNA and rRNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers.
Unit-6 Recent Advancement in biological macromolecule 04hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Enzyme

Course Code	**BSBC1005**				
Prerequisite	**Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have the basic knowledge of enzymology**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to express the knowledge about structure, function and working mechanism of enzyme.

CO1	**Elucidate the basic concept of enzymology.**
CO2	**Illustrate the different parameters of enzyme kinetics.**
CO3	**Discuss about the various types of enzyme inhibition mechanism.**
CO4	**Explain the different mode of enzyme activity regulation..**
CO5	**Describe the application of enzyme in diagnostics**
CO6	**Evaluate recent development in field of enzyme biology.**

Text Book (s)

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292- 3414-8.

2. Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York), ISBN:0 19 850229 X

Reference Book

1. **Biochemistry (2011) 4th ed., Donald, V. and Judith G.V., John Wiley & Sons Asia Pvt. Ltd. (New Jersey), ISBN:978-1180-25024.**

Unit-1 : Introduction to enzymes (08 hours)
Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme. IUBMB classification of enzymes. Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory, catalysis, Catalytic power and specificity of enzymes (concept of active site), Fischer's lock and key hypothesis, Koshland's induced fit hypothesis.
Unit-2 Enzyme kinetics and Bisubstrate reaction (12 hours)
Relationship between initial velocity and substrate concentration, steady state kinetics, equilibrium constant - monosubstrate reactions. Michaelis-Menten equation, LineweaverBurk plot, Eadie-Hofstee and Hanes plot. Km and Vmax, Kcat and turnover number. Effect of pH, temperature and metal ions on the activity of enzyme. Types of bi bi reactions (sequential – ordered and random, ping pong reactions). Differentiating bi substrate mechanisms (diagnostic plots, isotope exchange).
Unit-3 Mechanism of action of enzymes and Enzyme inhibition (10 hours)
General features - proximity and orientation, strain and distortion, acid base and covalent catalysis (chymotrypsin, lysozyme). Metal activated enzymes and metalloenzymes, transition state analogues. Reversible inhibition (competitive,

uncompetitive, non-competitive, mixed and substrate) Mechanism based inhibitors - antibiotics as inhibitors
Unit-4 : Regulation of enzyme activity (12 hours)
Control of activities of single enzymes (end product inhibition) and metabolic pathways, feedback inhibition (aspartate transcarbomoylase), reversible covalent modification phosphorylation (glycogen phosphorylase). Proteolytic cleavage-zymogen. Multienzyme complex as regulatory enzymes. Occurrence and isolation, phylogenetic distribution and properties (pyruvate dehydrogenase).
Unit-5 : Applications of enzymes (08 hours)
Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes.
Unit-6 Recent Advancement in Enzyme 04hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Hands on Workshop on Basic Analytical Techniques and Measurements				
Course Code	BSBA1061				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		0	0	4	2

Course Objectives:

- To provide the knowledge of the scientific instruments in life sciences and biotechnology along with the applications.
- This will enable the students to understand all the subjects of biological sciences as these tools and techniques will be used therein.
- Also acquire the basic knowledge of the microbiological techniques to be applied in the laboratory.
- To know the general microbiological techniques for isolation of pure cultures of microorganisms.

Course Outcomes

CO1	Demonstration of principle and application of different types of microscope

CO2	**Analysis of explosive and preparation of nano-particles**
CO3	Preparation of solution and calculation of molarity, normality and surface tension of given solution
CO4	**Soldering and assembling of electric circuits**
CO5	**Demonstration of measurement with Vernier calipers, Screw, spherometer and oscilloscope**
CO6	Lab report

Referred Books:

5. Georg Stehli **,The Microscope And How to Use It,** English edition, 1970.

6. M.Sayer and A. Mansingh, PHI Learning. Measurement, Instrumentation and Experiment Design in Physics & Engineering, 2005.

7. Aliofkhazraei, Mahmood, Handbook of Nanoparticles, Springer, 2016

8. Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. Inorganic Chemistry:Principles of Structure and Reactivity, Pearson Education India, 2006.

11. Different types of microscopes and its applications.
12. Direct analysis of nanoparticles
13. Preparation of nano- particles.
14. Preparation of solution and molarity and normality calculation.
15. Measurement of surface tension and viscosity of given liquid.
16. Soldering of electrical circuits
17. Measurement with Vernier calipers, Screw gauge and spherometer
18. Operation of oscilloscope
19. Familiarization with linear, logarithmic and polar graphs for plotting of experimental data
20. Assembling of elementary electric circuits using breadboard.

Continuous Assessment Pattern

Internal Assessment Lab (IA)	**Mid Term Lab (MTE)**	**End Term Lab (ETE)**	**Total Marks**
50		**50**	**100**

Name of The Course	BIOCHEMISTRY LAB I				
Course Code	BSBC1012				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		0	0	6	3

Course Objectives:

- Supporting or strengthening theoretical knowledge.
- Experiencing the pleasure of discovery and development of their psycho-motor skills.
- Teaching how scientific knowledge may be used in daily life.
- Increasing creative thinking skills.
- Gains in scientific working methods and higher order thinking skills.
- Developing manual dexterity by using tools and equipment and allowing students to apply skills instead of memorizing.

Course Outcomes

CO1	Demonstrate the basic principle and applications of important instruments
CO2	Handle and maintenance of glassware
CO3	Preparation of microbiological media
CO4	Qualitative analysis of biomolecules
CO5	Demonstration of different cell cycle
CO6	Lab report

Text Books

4. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson
5. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGrawHill International.
6. Atlas RM. (1997). Principles of Microbiology. 2nd edition. M.T.BrownPublishers.Education Limited.

S.N.	Name of Practicals

1.	Study of the life history of the following scientists and their contributions with the help of their photographs: Anton von Leeuwenhoek, Linus Pauling, KaryMullis, Robert Hooke and Alexander Fleming.
2.	To study the principle and applications of important instruments (Microscope, Spectrophotometer, autoclave, Centrifuge) used in the microbiology laboratory.
3.	Qualitative analysis of carbohydrates present in the given solution.
4.	Qualitative analysis of amino acid and protein present in the given solution.
5.	Qualitative analysis of lipid present in the given solution.
6.	To understand the principle of Osmosis and Diffusion
7.	Demonstration of different stages of mitosis.
8.	Demonstration the different stages of meiosis.

Continuous Assessment Pattern

Internal Assessment Lab (IA)	Mid Term Lab (MTE)	End Term Lab (ETE)	Total Marks
50		50	100

SEMESTER – II

Name of The Course	BIOINSTRUMENTATION-I				
Course Code	BSDB1007				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have the basic knowledge of chemistry and environmental science.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives:

The objective of the course is to introduce various techniques to the students, which are used in biological research as well as to provide them with an understanding of the underlying principles of these techniques and experimental skills in the form of practical exercises so that students can apply this knowledge to improve their understanding of the subject and better execution of these techniques.

S.No	Course Outcome

CO1	**Describe various mode of protein precipitation and principle of Lyophilization and dialysis.**
CO2	**Explain different methods of sterilization and basic requirement for cell culture like types of media.**
CO3	**Describe different types of microscopes for the study of cell, identification of cellular changes within organs**
CO4	**Explain various kind centrifugation techniques for study of separation of different cells and cellular organs**
CO5	**Explains absorbance based techniques like Visible and UV spectroscopy.**

Text Book (s)

3. **Principles and Techniques of Practical Biochemistry Wilson, K., Walker, J. (eds.); Cambridge University Press, Cambridge, 2000, 784 pp., ISBN 0-521-65873.**

4. **An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.**

Reference Book

2. **Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.**
2. **Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.**

Unit-1 : Separation techniques (08hours)
Different methods of protein precipitation: Precipitation using inorganic salts (salting out) and organic solvents, isoelectric precipitation, Dialysis, Ultrafilteration, Lyophilization
Unit-2 MICROBIAL TECHNIQUES (8 hours)
Buffer, Principle and working of pH meter, Laminar-air flow. Decontamination, sterilisation and disinfection techniques, media preparation technique, Culture of Human, Plant & Animal cells. Preparation of microbial, animal and plant samples for microscopy.
Unit-3 MICROSCOPY (10 hours)
Basic principles and applications of - Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM, Confocal Laser microscopy, Radio Microscopy.
Unit-4 : CENTRIFUGATION (10 hours)
Basic Principle of Centrifugation, Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation, density gradient methods and their applications
Unit-5 : COLORIMETRY AND SPECTROSCOPY (10 hours)

Simple theory of the absorption of light by molecules, Beer-Lambert law, Principle and use of study of absorption spectra of biomolecules.Visible and UV spectroscopy.Colorimetry, turbidometry, Spectrofluorimetry, nephelometry and luminometry.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	MEMBRANE BIOLOGY AND BIOENERGETICS				
Course Code	BSBC1008				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have the basic knowledge of membrane biology				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the fundamental aspects of composition, structure and functioning of biological membranes and energy transformation in living organisms.

CO1	Describe the composition of prokaryotic and eukaryotic biomembrane
CO2	Explain the characterstics of different membrane form.
CO3	Describe the techniques used to detect the change in membrane dynamics.
CO4	Discuss about the different mode of membrane transport.
CO5	Explain the concept of energy production in cell.
CO6	Evaluate the recent development in membrane biochemistry and bioenergetics.

Text Book (s)

Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (NewYork), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962-1.

2. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.

3. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

Reference Book

1. **The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300- 6.**

Unit-1 : Introduction to Biomembranes (08 hours)
Composition of biomembranes - prokaryotic, eukaryotic, neuronal and subcellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems.
Unit-2 Membrane structures (10 hours)
Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes. Membrane skeleton, lipid rafts, caveolae and tight junctions. RBC membrane architecture
Unit-3 Membrane dynamics (10 hours)
Lateral, transverse and rotational motion of lipids and proteins. Techniques used to study membrane dynamics - FRAP, TNBS labeling etc. Transition studies of lipid bilayer, transition temperature. Membrane fluidity, factors affecting membrane fluidity.
Unit-4 : Membrane transport (12 hours)
Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport -glucose transporter, anion transporter and porins. Primary active transporters - P type ATPases, V type ATPases, F type ATPases. Secondary active transporters - lactose permease, Na+-glucose symporter. ABC family of transporters - MDR, CFTR. Group translocation. Ion channels - voltage-gated ion channels (Na+/K+ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores - valinomycin, gramicidin. Types of vesicle transport and their function - clathrin, COP I and COP II coated vesicles. Molecular mechanism of vesicular transport. Membrane fusion. Receptor mediated endocytosis of transferring
Unit-5 : Introduction to bioenergetics (10 hours)
Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. High energy compounds: PEP, Thiol esters, Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.
Unit-6 Recent Advancement in membrane biochemistry and bioenergetics 04hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**

30	20	50	100

Name of The Course	HORMONE : BIOCHEMISTRY AND FUNCTION				
Course Code	BSDB1009				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have the basic knowledge of types of hormones and its function.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to determine the function of various hormones and their mode of action.

CO1	Explain the concept of endocrinology.
CO2	Illustrate the basic concepts of hormones and their mechanism of action.
CO3	Explain the importance of pituitary gland hormone.
CO4	Demonstrate the role of thyroid and parathyroid gland in body metabolism.
CO5	Discuss about the importance of pancreatic, adrenal gland hormone.
CO6	Evaluate the recent development in endrocrinology.

Text Book (s)

Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (NewYork), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962-1.

2. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.

3. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

Reference Book

1. **The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300- 6.**

Unit-1 : Introduction to endocrinology (08 hours)
Functions of hormones and their regulation. Chemical signaling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone therapy. General introduction to Endocrine methodology.

Unit-2 Hormone mediated signaling and Growth Factors (12 Lecture)
Hormone receptors - extracellular and intracellular. Receptor - hormone binding, Scatchard analysis. G protein coupled receptors, G proteins, second messengers - cAMP, cGMP, IP3, DAG, Ca2+, NO. Effector systems - adenyl cyclase, guanyl cyclase, PDE, PLC. Protein kinases (PKA, PKB, PKC, PKG). Receptor tyrosine kinases - EGF, insulin, erythropoietin receptor; ras -MAP kinase cascade, JAK - STAT pathway. Steroid hormone/ thyroid hormone receptor mediated gene regulation. Receptor regulation and cross talk. PDGF, EGF, IGF-II, and erythropoietin.
Unit-3 Hypothalamic, pituitary and Reproductive hormones (10 hours)
Hypothalamic - pituitary axis. Study the physiological and biochemical actions of hypothalamic hormones, pituitary hormones - GH, prolactin, TSH, LH, FSH, POMC peptide family, oxytocin and vasopressin, feedback regulation cycle. Endocrine disorders - gigantism, acromegaly, dwarfs, pigmies and diabetes insipidus. Male and female sex hormones. Interplay of hormones during reproductive cycle, pregnancy, parturition and lactation. Hormone based contraception
Unit-4 : Thyroid and Parathyroid hormone (10 hours)
Thyroid gland. Biosynthesis of thyroid hormone and its regulation; its physiological and biochemical action. Pathophysiology - Goiter, Graves disease, cretinism, myxedema, Hashimato's disease. PTH, Vitamin D and calcitonin. Mechanism of Ca2+ regulation and pathways involving bone, skin, liver, gut and kidneys. Pathophysiology - rickets, osteomalacia, osteoporosis.
Unit-5 : Pancreatic, Adrenal and GI tract hormones (10 hours)
Regulation of release of insulin, glucagon, gastrin, secretin, CCK, GIP, adipolectin, leptin and ghrelin. Summary of hormone metabolite control of GI function. Physiological and biochemical action. Pathophysiology - diabetes type I and type II. Aldosterone, renin angiotensin system, cortisol, epinephrine and norepinephrine. Fight or flight response, stress response. Pathophysiology – Addison's disease, Conn's syndrome, Cushing Syndrome
Unit-6 Recent Advancement in membrane biochemistry and bioenergetics 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**CONCEPTS OF IMMUNOLOGY**				
Course Code	**BSDB1011**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

- To provide students with a foundation in immunological processes
- To provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiolog

Course Outcome:

CO1	**Describe the basic concept of immunology**
CO2	**It describeshow immuneresponse work in our body and explain defense mechanisms by CTL and NK cells**
CO3	**Demonstrate complementary system, organ transplantation, Antigen processing and presentation by MHC complex**
CO4	**Elucidate immunological disorders autoimmunity, hypersensitivity and immunodeficiency.**
CO5	**Evaluate vaccine production, Immunization, immunotherapy**
CO6	**Evaluation of latest research and application of immunology against various diseases**

Text Book (s)

4. Immunology, 6th edition, (2006), J. Kuby et al, W.H. Freeman and Company, New York. ISBN-13: 978-1429202114.
5. Roitt‟s Essential Immunology, 12th edition, (2011), Wiley-Blackwell Science. ISBN-13: 978-1405196833.
6. Cellular and Molecular Immunology, 7th edition, (2011). Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. Saunders. ISBN-13: 978-1437715286.

Reference Book (s):

5. Murphy K, Travers P, Walport M. (2008). Janeway'sImmunobiology. 7th edition Garland Science Publishers, New York.
6. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill
7. Livingstone Publishers, Edinberg.

8. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

Unit -1: INTRODUCTION TO IMMUNE SYSTEM 10 hours **Types of immunity; organs and cells involved in immune system; Antigen, haptens, adjuvants, antigenicity, antigenic determinants and epitopes; Antibody structure and functions; Theories of antibody formation; Antibody diversity.**
Unit -2: IMMUNE RESPONSE 8 hours **Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance.**
Unit -3: COMPLEMENT SYSTEM AND MAJOR HISTOCOMPATIBILITY COMPLEX10 hours **Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation. MHC - Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways).Transplantation - types, genetics of transplantation, graft versus host reactions.**
Unit -4: IMMUNOLOGICAL DISORDERS 12 hours **Types of AutoimmUnity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens, causes and therapy for cancers.**
Unit -5: VACCINES AND IMMUNOLOGICAL TECHNIQUES. 10 hours **Vaccines - Types and their characteristics; Immunization practices-immunoprophylaxis and immunotherapy.Immunological techniques -Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy.**
Unit-6 Recent Advancement in immunology 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOCHEMISTRY LAB II**
Course Code	**BSBC1013**

Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives: Students are able to prepare the microbial medium, describe the principle of pH meter, centrifugation and microscopy.

CO1	**Construct the different type of media for bacterial culture useful in bacterial research in laboratory**
CO2	**Illustrate Isolation of microorganisms by various methods, like streak plate method, spread plate method and serial dilution technique**
CO3	**Understand principle of light microscope and prepare of onion cell slide to evaluate cell morphology**
CO4	**Determine the pH of 0.1 M NaOH and tap water using pH meter**
CO5	**Explain the principle of centrifugation.**

Text Books

5. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
6. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
7. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
8. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. BlackwellScience, Oxford.

Reference Book (s)

5. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
6. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
7. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
8. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hallof India Pvt. Ltd., New Delhi.

S.N.	**Name of Practicals**
1.	**Preparation of nutrient broth for the routine cultivation of bacteria.**
2.	**Preparation of nutrient agar for the routine cultivation of bacteria.**
3.	**Isolation of microorganisms by streak plate method.**
4.	**To isolate the microorganisms by spread plate method.**
5.	**To isolate the microorganisms by serial dilution technique (or viable plate count method).**

6.	Understanding the different components and working principle of light microscope using pre-prepared slide.
7.	Preparation of onion cell slide to study cell morphology using light microscope.
8.	To perform the isoelectric precipitation of casein present in milk.
9.	To determine the pH of 0.1 M NaOH and tap water using pH meter.
10.	Demonstrating the basic principle of centrifugation and calculating the relation tween RCF and RPM during centrifugation.

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

SEMESTER-III

Name of The Course	FUNDAMENTALS OF MOLECULAR BIOLOGY				
Course Code	BSDB2001				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have the basic knowledge about structure and function of nuclei acids.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to determine the process and regulation of replication, translation and transcription.

CO1	Explain the functional and structural organization of genetic material
CO2	Illustrate the different stages of DNA replication and type of DNA repair
CO3	Explain detail process of transcription and its regulation
CO4	Elucidate the mechanism of translation and posttranslational modification
CO5	Summarize the basic concept of gene regulation in pro and eukaryotes
CO6	Evaluate the application of Molecular biology

Text Book (s)

5. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.
6. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.

Reference Book

2. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300- 6.

Unit-1 : NUCLEIC ACID STRUCTURE AND ORGANIZATION (08 hours)
DNA and RNA as genetic material, chemical structure, base composition and types of nucleic acids, supercoiling of DNA, DNA reassociation kinetics (cot curve analysis), DNA organization into chromatin, bacterial and eukaryotic genomic organization.
Unit-2 : DNA REPLICATION AND REPAIR (8 hours)
Enzymes and proteins of DNA replication, prokaryotic and eukaryotic replication mechanism, replication in phages and retroviruses, Mutagenesis, DNA damage and repair mechanisms.
Unit-3 TRANSCRIPTION (10 hours)
Transcription in prokaryotes and eukaryotes.Mechanism of transcription, enzymes and transcription factors. Post-transcriptional modifications in mRNA, rRNA andtRNA.
Unit-4 : TRANSLATION (12 hours)
Genetic code - properties of the genetic code, deciphering of the genetic code.Translation in prokaryotes and eukaryotes; Translational mechanism in prokaryotes and eukaryotes, post translational modification and transport of proteins.
Unit-5 : REGULATION OF GENE EXPRESSION (10 hours)
Regulation of gene expression in prokaryotes - The operon concept, lac &tryp operons.Transcriptional control. Post translational control. Regulation in eukaryotes - Control by promoter, enhancer and silencers.Cis-trans elements.DNA methylation & gene expression.
Unit-6 Recent Advancement in Molecular biology 04hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOINSTRUMENTATION-II**
Course Code	**BSDB2002**
Prerequisite	**Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the**

	cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: : Students are able to determine the principle of advanced spectroscopy, chromatographic techniques

CO1	**Describe different types of electrophoretic techniques for separation and isolation of biomolecules.**
CO2	**Explain various kinds of Spectroscopic techniques to characterize and detect structural changes in biomolecules.**
CO3	**Describe the principle and applications of various chromatographic techniques.**
CO4	**Explain the different types of radioactive detection techniques.**
CO5	**Demonstrate the principle of Sanger and Maxam Gilbert method of Nucleotide sequencing.**
CO6	**Evaluate recent advancement in bio analytical techniques.**

Text Book (s)

7. **Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.**
8. **Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.**

Reference Book

3. **The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300- 6.**

Unit-1 : ELECTROPHORESIS (10 hours)
Principle and applications of native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis
Unit-2 : ADVANCED SPECTROSCOPY (10 hours)
Basic concepts - Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD), Fluorescence spectroscopy, Infrared spectroscopy, FTIR, NMR spectroscopy. Mass spectroscopy- MALDI-TOF, Nano-SIMS (10L) .
Unit-3 CHROMATOGRAPHY (10 hours)
Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel

filtration chromatography, ionexchange chromatography and affinity chromatography, GLC, HPLC.
Unit-4 : RADIOGRAPHY (10 hours)
Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Autoradiography, FISH-MAR, Pulse chase experiment, Liquid scintillation counting, Phosphor imaging, IRMA, Dosimetry. .
Unit-5 : ADVANCED TECHNIQUES (08 hours)
Chemical synthesis of nucleotides and peptides, Sequencing of proteins and nucleic acids, Enzyme purification and assay techniques.
Unit-6 Recent Advancement in Bio analytical techniques 04hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	FUNDAMENTALS OF MICROBIOLOGY			
Course Code	BSDB2003			
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.			
Corequisite	Students should have the basic knowledge about microbes and their structure.			
Antirequisite				
	L	T	P	C
	4	0	0	4

Course Objectives:

- Students are able to describe history, scope and application of microbiology.
- Students are able to explain microbial growth curve, microbial pathogenecity.

CO1	Discuss abouthistory, diversity and scope of microbiology.
CO2	Explain microbial nutrition, growth and control of microorganism.
CO3	Describemicrobial molecular biology and genetics.
CO4	Demonstrate viruses and microbial pathogenicity.
CO5	Interpret various applications of food and industrial microbiology.
CO6	Evaluate recent development in area of microbiology.

Text Book (s)

9. **Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.**
10. **Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.**

Reference Book

4. **The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300- 6.**

Unit-1 : History, Diversity And Scope Of Microbiology (10 hours)
Discovery of microorganisms, spontaneous generation, germ theory of disease, members of the microbial world, scope and relevance of microbiology, Microbial taxonomy and phylogeny, Archaea, Bacteria, fungi, slime molds, water molds, algae, protozoa, helminths, the future of microbiology.
Unit-2 : Bacteria (10 hours)
An account of typical eubacteria, chlamydiae & rickettsiae (obligate intracellular parasites), mycoplasma, and Archaea. Applications of bacteria and Archaea in industry, environment and food.
Unit-3 Viruses, viroids and prions (10 hours)
An introduction to viruses with special reference to the structure and replication of the following: Poxvirus, Poliovirus, HIV, T4 and λ phage, lytic and lysogenic cycles.
Unit-4 : Algae (10 hours)
History of phycology; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food.
Unit-5 : 5 Fungi and Protozoan (12 hours)
Historical developments in the field of Mycology, significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins, General characteristics with special
Unit-6 Recent Advancement in Microbiology 04hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	METABOLISM OF BIOMOLECULES-I			
Course Code	BSBC2004			
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.			
Corequisite	Students should have the basic knowledge about biomolecules			
Antirequisite				
	L	T	P	C
	4	0	0	4

Course Objectives: Students are able to explain the metabolism of biomolecules particularly carbohydrates and lipid.

CO1	Analyze the concept of energy production in the living cell.
CO2	Explain the fundamentals of carbohydrate metabolism.
CO3	Discuss about TCA cycle and its regulation.
CO4	Explain the process of synthesis and degradation of lipids.Demonstrate the metabolism of essential and non-essential aminoacids.
CO5	Illustrate strave-fed cycle. the metabolism of nucleotides.

Text Book (s)

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414- 8.

Reference Book

1. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.

Unit-1 : Basic design of metabolism (10 hours)
Autotrophs, heterotrophs, metabolic pathways, catabolism, anabolism
Unit-2 : Carbohydate Metabolism (10 hours)
Glycolysis - a universal pathway, reactions of glycolysis, fermentation, fates of pyruvate, feeder pathways for glycolysis, galactosemia, Synthesis of glucose from non-carbohydrate sources, reciprocal regulation of glycolysis and gluconeogenesis, pentose phosphate pathway and its importance, Glycogen metabolism

Unit-3 Citric acid cycle (10 hours)
Production of acetyl CoA, reactions of citric acid cycle, anaplerotic reactions, amphibolic role,regulation of citric acid cycle, glyoxalate pathway, coordinated regulation of glyoxalate andcitric acid pathways.
Unit-4 : Lipid metabolism (10 hours)
Synthesis and degradation of triacylglycerols, phospholipids, glycolipids, eicosanoids; Biosynthesis of fatty acids; Oxidation of fatty acids; Ketone bodies; Metabolism of cholesterol - biosynthesis, catabolism and regulation; general metabolism of lipoproteins.   **.**
Unit-5 : 5 Starve-feed cycle (12 hours)
Well-fed state, early fasting state, fasting state, early re-fed state, energy requirements, reserves and caloric homeostasis, five phases of glucose homeostasis.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BIOCHEMISTRY LAB-III				
Course Code	BSBC2014				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have the basic knowledge about lab instruments.				
Antirequisite					
		L	T	P	C
		0	0	6	3

Course Objectives:

Students are able to describe the procedure to isolate, estimate the amount of DNA and RNA, perform planar chromatography.

CO1	Isolate DNA and RNA for research and development
CO2	Demonstrate the recording brain temperature through thermocouple wire and perform further research in thermoregulatory area

CO3	**Demonstrate the principle of paper chromatography.**
CO4	**Demonstrate the principle of Thin layer Chromatography.**

Text Books

9. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
10. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
11. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
12. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. BlackwellScience, Oxford.

Reference Book (s)

9. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
10. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
11. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
12. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hallof India Pvt. Ltd., New Delhi.

S.N.	**Name of Practicals**
1.	**Isolation of DNA.**
2.	**Estimation of DNA.**
3.	**Isolation of RNA**
4.	**Estimation of RNA.**
5.	**Demonstrate the different modes of qualitative and quantitative measurement of RNA and DNA.**
6.	. Demonstrate the different modes of qualitative and quantitative measurement of protein.
7.	**Demonstration of brain temperature through thermocouple wire.**
8.	**Understand the working principle and application of Paper chromatography**
9.	**Understand the working principle and application of Thin layer chromatography.**
10.	**Estimation of RNA.**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
50		**50**	**100**

Name of The Course	BIOCHEMISTRY LAB-IV			
Course Code	BSBC2015			
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.			
Corequisite	Students should have the basic knowledge about lab instruments.			
Antirequisite				
	L	T	P	C
	0	0	6	3

Course Objectives:

Students are able to describe the procedure to isolate, estimate the amount of DNA and RNA, perform planar chromatography.

CO1	Demonstrate the principle of blood glucose and Cholesterol estimation
CO2	Illustrate the procedure of assay of Salivary amylase
CO3	Demonstrate the principle of Cholesterol estimation
CO4	Demonstrate the principle and application of Thin layer Chromatography.

Text Books

13. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
14. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
15. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
16. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. BlackwellScience, Oxford.

Reference Book (s)

13. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
14. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
15. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
16. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hallof India Pvt. Ltd., New Delhi.

S.N.	Name of Practicals
1.	Estimation of blood glucose.
2.	Sugar fermentation by microorganisms.
3.	Assay of salivary amylase.
4.	Isolation of lipids from egg yolk and separation by TLC.
5.	Cholesterol estimation.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	Web based course/seminar				
Course Code	BSDB2006				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology.				
Antirequisite					
		L	T	P	C
		0	0	0	2

Course Objectives:

- **Students are** directly engage and learn particular subject of their interest. This strengthens the fundamentals of the student in the course.
- It gives the students the opportunities to explore new areas of interest . Also gives students the opportunity to learn in greater depth the subjects they wish to master.
- Promotes the self-learning initiative of the students – where their own motivation is what drives them to complete the course. This fosters the habit of keeping oneself updated always by means of self-study.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	ETE	Total Marks
50		50	100

SEMESTER – IV

Name of The Course	Programming in C and Python
Course Code	BCSE1021
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.

Corequisite	**Students should have the basic knowledge about computer science**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

This course explores concepts underlying the definition, implementation, and use of programming languages. The goal is to provide you with an understanding of (and a vocabulary for) common language features, including how they are implemented, how other language-design choices affect them, and how they can be used effectively in program development.

CO1	**Understand and explain the basics of computer and its components-**
CO2	**Explain the data input and out put, control systems and function-**
CO3	**Explain the arrays, structure and union-**
CO4	**Explain the use of pointer and interpret the file**
CO5	**Apply the Classes in C++**
CO6	**Evaluate the recent development in programming languages.**

Text Book (s)

15. P Kanetkar Yashvant, Let us C, BPB Publications, New Delhi, Seventh Edition.

16. E. Balagurusami, Programming in ANSI C, Tata McGraw Hill, Fourth Edition.

17. Schaum Outline Series,Programming in C.

Reference book:

1. Herbtz Schildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill.
2. **John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.**

Unit-1 INTRODUCTION TO COMPUTERS 10 hours **Introduction to computers:** Units of computers, Block Diagram, Generation of Computers, Characteristics of Computers, Phases of Computers, Different types of Memory, Input and Output Devices. **Logic Development and Program Development Tools:** Data Representation, Flowcharts, Problem Analysis, Decision Trees/Tables, Pseudo Code and Algorithms, Program Debugging, Compilation and Execution. **Fundamentals:** Character Set, Identifiers and Key Words, Data Types, Constants, Variables, Expressions, Statements, Symbolic Constants. **Operations and Expressions:** Arithmetic Operators, Unary Operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Library functions.
Unit-2 DATA INPUT AND OUTPUT 10 hours

Data Input and Output: Single Character Input, Single Character Output, Entering Input Data, More About Scan Functions, Writing Output Data, More About Print Functions, Gets and Puts Functions, Interactive Programming. **Control Structures:** Introduction, Decision Making with If – Statement, If Else and Nested If, While And Do-While, For Loop. Jump Statements: Break, Continue, Goto, Switch Statement. **Functions:** Introduction To Functions, Function Declaration, Function Categories, Standard Functions, Parameters And Parameter Passing, Pass – By Value/Reference, Recursion, Global and Local Variables, Storage Classes.
Unit-3ARRAYS 10 hours **Arrays:** Introduction to Arrays, Array Declaration, Single and Multidimensional, Array, Memory Representation, Matrices, Strings, String Handling Functions. **Structure and Union:** Declaration of Structure, Accessing Structure Members, Structure Initialization, Arrays of Structure, Nested Structures, Unions.
Unit-4POINTERS 10 hours **Pointers:** Introduction To Pointers, Address Operator And Pointers, Declaring and Initializing Pointers, Assignment through Pointers, Pointers and Arrays. **Files:** Introduction, Creating a Data File, Opening and Closing a Data File, Processing a Data File.
Unit-5USING CLASSES IN C++ 10 hours Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors, Overview of Template classes and their use. Introduction to Inheritance and Polymorphism
Unit-6 Recent Advancement in in programming languages. 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOTECHNOLOGY**
Course Code	**BSDB2010**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**

Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objective:

Students will understand the molecular methods and applications of recombinant DNA technology and gene transfer techniques.

Course Outcome:

CO1	**Brief account of plant tissue culture and advantages of somatic hybridization**
CO2	**Explain the basic techniques of cell culture**
CO3	**Describe the different methods of DNA sequencing**
CO4	**Describe the type and process of genetic exchange**
CO5	**Explain the various categories of transposable element**
CO6	**Evaluate the application of Biotechnology in research and deployment**

Text Book (s)

5. Principles of Gene Manipulations 1994 by Old and Primrose Blackwell Scientific Publications.
6. DNA Cloning: A Practical Approach by D.M. Glower and B.D. Hames, IRL Press, Oxford. 1995.
7. Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers, Oxford. 1994.
8. Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford 1998.

References Book (s)

5. PCR Technology - Principles and Applications for DNA Amplification by Henry A. Erlich (Ed.) Stockton Press. 1989.
6. Biotechnology: A Guide to Genetic Engineering by Peters.
7. Genetic Engineering – 2000 by Nicholl.
8. Recombinant DNA and Biotechnology: Guide for Teachers. 2nd Edition by Helen Kreuz. 2001. ASM Publications.

Unit -1: INTRODUCTION TO PLANT BIOTECHNOLOGY 8 hours **Basic introduction to animal and plant biotechnology; types of plant tissue culture, Somatic hybridization**
Unit -2: INTRODUCTION TO ANIMAL BIOTECHNOLOGY 8 hours **Animal Biotechnology - organ culture; cell culture and initiation of cell culture; evolution of continuous cell lines.**

Unit -3: CONSTRUCTION OF DNA LIBRARIES	**10 hours**
Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA), Quantification and storage of nucleic acids, Construction of cDNA library, Construction of Genomic library, Screening and preservation of DNA libraries, DNA Sequencing and cloning strategies.	
Unit -4: GENE TRANSFER TECHNIQUES	**10 hours**
Gene transfer techniques: biological methods; chemical methods; physical or mechanical methods.	
Unit -5: TRANSGENICS	**10 hours**
Plant Genetic Engineering: Restriction enzymes; Transformation of plant cells; different type of vectors including viral vectors and their benefits; Screening and selection of transformants, PCR and hybridization methods; Application of transgenic science in plant and animal improvement.	
Unit-6 Recent Advancement in biotechnology	**04hours**
Research article/ Review paper/ MOOC	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**MEDICAL BIOCHEMISTRY**				
Course Code	**BSDB2009**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules and their disorder**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the metabolism of biomolecules and their related disorders.

Course Outcomes

CO1	**Illustrate the various disorders of Metabolism.**
CO2	**Interpret the Distribution of enzymes and diagnostic significance**

CO3	Evaluate the significance of vitamins and hormones as well as disease associated with it .
CO4	Evaluate the biochemistry of cancer.
CO5	Analyze the molecular diagnostics.
CO6	Evaluate the recent development in medical biochemistry

Text Book (s)

1. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.
2. Textbook of Biochemistry for Medical Students. D.M. Vasudevan, Sreekumari. S, Kannan Vaidyanathan. JPB.

REFERENCES Books:

1. Textbook of Medical Biochemistry, 7thedition (2007), Chatterjea&Shinde, Jaypee Publications, ISBN: 81-8448-134-9.
2. Tietz Fundamentals of Clinical Chemistry, 6th edition (2007), Carl A. Burtis, Edward R. Ashwood, and David E. Bruns;WB Saunders Co, ISBN-13: 978-0721638652

Unit-1 DISORDERS OF METABOLISM 12 hours
Disorders of Carbohydrate Metabolism; Lipids, Lipoproteins and Apolipoproteins; Inborn Errors of Metabolism; Disorders of Electrolytes, Blood Gases and Acid Base Balance; Disorders of Mineral Metabolism; Hormonal Disorders - Adrenocortical steroids, Reproductive endocrinology, Thyroid function; Biochemical Aspects of Hematology - Disorders of erythrocyte metabolism, hemoglobinopathies, thalassemia, and anemias. Prostaglandins- classification, biosynthesis, role of COX-1, COX-2, NSAIDS in synthesis;
Unit 2: Enzymes: Distribution and diagnostic significance 10 hrs
Properties of enzymes used in diagnosis of metabolic disorders, clinical significance of diagnostically important enzymes: creatine kinase, lactate dehydrogenase, alanine- and aspartate aminotransferases, A detailed account on: isoenzymes, their tissue distribution and clinical significance.
Unit-3 VITAMIN AND HORMONES 10 hours
Vitamins and classification, requirement and recommended allowances, resource of vitamins, Diseases due to deficiency of water-soluble and fat-soluble vitamins. Role of leptin, ghrelin and other hormones in regulation of Obesity, Classification with special reference to epinephrine and thyroid hormones (T3 and T4); functions.
Unit-4 BIOCHEMISTRY OF CANCER 10 hours
Etiology - Chemical carcinogens, Oncogenic viruses; Molecular basis of cancer - Oncogenes, Antioncogenes, Oncosuppressor genes, Apoptosis, Growth factors;Tumour

kinetics - Doubling time, Contact inhibition, Anchorage dependence; Oncofetal antigens; Tumor markers; Cancer therapy - Anticancer drugs, Drug resistance. .
Unit-5 MOLECULAR DIAGNOSTICS 10 hours **Hybridization and blotting techniques; DNA finger printing; Restriction fragment length polymorphism (RFLP); Polymerase chain reaction (PCR); Hybridoma technology;Transgenesis; DNA sequencing; Mutation detection techniques – single strand conformation polymorphism, heteroduplex analysis, conformation sensitive gel electrophoresis, protein truncation test, denaturation high performance liquid chromatography.**
Unit-6 Recent Advancement in medical biochemistry **04hours** **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**METABOLISM OF BIOMOLECULES-II**				
Course Code	**BSBC2008**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules and their disorder**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the metabolism of biomolecule.
Course Outcomes

CO1	**Illustrate the basic component and inhibitors of electron transport chain.**
CO2	**Explain the fundamentals of aminoacid metabolism.**
CO3	**Explain the denovo pathway of nucleotide metabolism.**
CO4	**Discuss the metabolism of heme.**
CO5	**Illustrate the process of metabolism integration.**
CO6	**Evaluate the recent advancement in biochemistry of basic metabolic pathway.**

Text Book (s)

1. **Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.**

2. Textbook of Biochemistry for Medical Students. D.M. Vasudevan, Sreekumari. S, Kannan Vaidyanathan. JPB.

TEXT & REFERENCES:

1. Textbook of Medical Biochemistry, 7thedition (2007), Chatterjea&Shinde, Jaypee Publications, ISBN: 81-8448-134-9.
2. Tietz Fundamentals of Clinical Chemistry, 6th edition (2007), Carl A. Burtis, Edward R. Ashwood, and David E. Bruns;WB Saunders Co, ISBN-13: 978-0721638652

Unit-1 ELECTRON TRANSPORT CHAIN AND OXIDATIVE PHOSPHORYLATION 12 hours Electron transport chain - Components, organization and inhibitors of electron transport chain; Oxidative phosphorylation – mechanism, Chemi-osmotic theory, ATP synthase, Inhibitors of oxidative phosphorylation.;
Unit 2: AMINO ACID METABOLISM 10 hrs
Properties of enzymes used in diagnosis of metabolic disorders, clinical significance of diagnostically important enzymes: creatine kinase, lactate dehydrogenase, alanine- and aspartate aminotransferases, A detailed account on: isoenzymes, their tissue distribution and clinical significance.
Unit-3 NUCLEOTIDE METABOLISM 10 hours Purine metabolism – biosynthesis (de novo and salvage pathways), degradation, regulation and disorders of purine metabolism; Pyrimidine metabolism - biosynthesis (de novo and salvage pathways), degradation, regulation and disorders of pyrimidine metabolism.
Unit-4 HEME SYNTHESIS AND DEGRADATION 10 hours Porphyrins – structure and functions; Biosynthesis of heme – steps and regulation; Porphyrias – hepatic and erythropoieticporphyrias; degradation of heme – bilirubin metabolism and its disorders. .
Unit-5 Integration Of Metabolism 10 hours Integration of metabolic pathways (carbohydrate, lipid and amino acid metabolic pathways), tissue specific metabolism (brain, muscle, and liver).
Unit-6 Recent Advancement in basic metabolic pathways 04hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Research Methodology and Statistics**				
Course Code	**BBS09T2411**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream**				
Corequisite	**Students should have fundamental knowledge of subjects like mathematics, physics and chemistry**				
Antirequisite	**-**				
		L	**T**	**P**	**C**
		2	**-**	**-**	**2**

Course Objective: The objective of the course is to impart research based knowledge to the students. They would be taught the various ways of data collection, research methodologies adopted in different settings, and statistical methods.

Course Outcome:

CO1	**Students will get separately familiar with terms research and methodology, respectively.**
CO2	**Identifying different type of research sampling and research design.**
CO2	**Students will understand raw data, primary data, secondary data and their different methods of collection.**
CO4	**Students will appraise the application of sampling through statistics.**
CO5	**Students will get familiar with different descriptors of statistics to analyse data both quantitatively and qualitatively.**
CO6	**Students will develop the statistical analysis indulges in modern research for drug designing.**

Course Contents:

Module I: Introduction to Research Methodology 6-Lectures

Definition, concept and research in science; Introduction to Research Methodology, Research methodology in science.
Module II: Research in Scientific and Social Settings 5-Lectures
Research Design: Research Sampling, rationale for using a particular sampling procedure, Probability.
Module III: Tools of Data Collection 5-Lectures
Data and its types, Methods for Collecting Data, Observation method, Questionnaire, Other Methods
Module IV: Introduction to Statistics 4-Lectures
Introduction to statistics (Biostatistics); Sample and Population, parametric and non parametric statistics.
Module V: Descriptive Statistics 5-Lectures
Measures of central tendency; Measures of dispersion and deviation; graphical representation of the data. Correlation and Regression
Unit 6: Recent research advances 3 hrs
Descriptors, Quantitative structure-activity relationship (QSAR) , Quantitative structure-property relationship(QSPR), Drug designing.

Text & References:

- **Broota, K. D., Experimental designs in psychological research, Wiley eastern, New York, 1992.**
- **Guilford, Statistics in Psychology and Education, McGraw Hill, New York, 1986.**
- **J T Walker, Statistics in Criminology and Criminal Justice analysis and Interpretation**
- Leo, A., & Hoekman, D. H. (1995). *Exploring QSAR*. American Chemical Society.
- **Chanin Nantasenamat, Chartchalerm Isarankura-Na-Ayudhya, Thanakorn Naenna, Virapong Prachayasittikul, A Practical Overview of Quantitative Structure- Activity Relationship. EXCLI Journal 2009;8:74-88.**
- **Wiktor Pronobis, Alexandre Tkatchenko, and Klaus-Robert Muller, J. Chem. Theory Comput. 2018, 14, 2991−3003**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOCHEMISTRY LAB-V**				
Course Code	**BSBC2017**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives: Students are able to explain the principle and application of gel electrophoresis, procedure of Southern Blotting, Northern Blotting and Western Blotting techniques.

CO1	**Demonstrate and perform of agarose gel electrophoresis**
CO2	**Illustrate principle and applications of SDS PAGEwhich is useful for research**
CO3	**Demonstrate activity of restriction endonuclease enzyme**
CO4	Evaluate qualitative analysis ethanol production through microorganism
CO5	**Understand the Southern Blotting, Northern Blotting and Western Blotting techniques**

Text Books

17. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
18. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.
19. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
20. Lucas JA. (1998). Plant Pathology and Plant Pathogens. 3rd edition. BlackwellScience, Oxford.

Reference Book (s)

17. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.
18. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
19. Mehrotra RS. (1994). Plant Pathology. Tata McGraw-Hill Limited.
20. Rangaswami G. (2005). Diseases of Crop Plants in India. 4th edition. Prentice Hallof India Pvt. Ltd., New Delhi.

S.N.	**Name of Practicals**
1.	**Demonstration of agarose gel electrophoresis**

2.	Demonstration of SDS PAGE.
3.	Demonstration of native PAGE.
4.	Demonstration of activity of restriction endonuclease enzyme.
5.	Demonstration of ethanol production through microorganism.
6.	To study following techniques through photographs a. Southern Blotting b. Northern Blotting c. Western Blotting
7.	Demonstration of agarose gel electrophoresis
8.	Demonstration of SDS PAGE.
9.	Demonstration of native PAGE.
10.	Demonstration of activity of restriction endonuclease enzyme.

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	PROGRAMMING IN C AND PYTHON LABORATORY				
Course Code	BCSE1031				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding and a basic knowledge of the computing				
Antirequisite					
		L	T	P	C
		0	0	4	2

Course Objective:

Students are able to understand the basic data structures used in programming (such as arrays and array lists).

Text / References Books:

5. E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.
6. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011.
7. John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.
8. Harry, H. Chaudhary, "Head First C++ Programming: The Definitive Beginner's Guide", First Create space Inc, O-D Publishing, LLC USA.

10. Write a program to find greatest of three numbers.
11. Write a program to find gross salary of a person
12. Write a program to find grade of a student given his marks.

13. Write a program to find divisor or factorial of a given number.
14. Write a program to print first ten natural numbers.
15. Write a program to print first ten even and odd numbers.
16. Write a program to find grade of a list of students given their marks.
17. Create Matrix class. Write a menu-driven program to perform following Matrix operations (2-D array implementation): 18. Sum b) Difference c) Product d) Transpose

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

SEMESTER-V

Name of The Course	**Summer Training**				
Course Code	**BSBC3001**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**0**	**3**

Course Objectives:

- By taking summer internships students will be able to:
- Get hands-on experience about real world problems in a field relevant to their major of studies.
- Acquire confidence for employment after graduation.
- Acquire skills important for time management, discipline, self-learning, effective communication and so on.
- Learn practically about team-work, collaboration, and leadership.

Course Outcomes

CO1	**Demonstrate the use of knowledge of basic and applied sciences in project based learning.**
CO2	**Organizes experiments and researches, perform analysis and interpret data for the designed project.**
CO3	**Cooperate effectively as an individual and as a member in the research team.**

CO4	Systematize the articulated ideas, comprehend and write effective reports, documentation and to communicate effectively.
CO5	Demonstrate knowledge and understanding of research problems and related principles to manage projects in multidisciplinary research areas.

COURSE CONTENTS:

Summer Training is considered as a special course involving application of knowledge in solving / analysing /exploring a real life situation / difficult problem. Summer training work may be given in lieu of a discipline specific elective paper/Biochemistry.This should be done in consultation with the faculty supervisor and agency supervisor under whom he / she is getting trained. The project report should be around 40 pages and chaptered as follows:

Chapter I: Introduction
Chapter II: Review of Literature
Chapter III: Methodology
Chapter IV: Results
Chapter V: Discussion
Chapter VI: Summary and Conclusion

The following weightage is assigned at each stage of Student Project evaluation.

Activity	Remarks
Zeroth Review	Project scopes and Proposal
1st Review	Methods of project Implementation
2nd Review	Technical Achievement
3rd Review (Final)	Innovation and contribution
Submission of Project Report to the Department	Two weeks before the viva-voce exam

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	INHERITANCE BIOLOGY				
Course Code	BSDB3003				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives:

The aim of the course is to provide an understanding of both classical and modern concepts in the areas of transmission, molecular and population Genetics. Practicals are well correlated with the theory topics and designed to support skill• oriented learning outcomes.

Course Outcomes

CO1	**Understand Introduction of genetics and Mendelian principles**
CO2	**Interpret extensions of Mendelian principles**
CO3	**Demonstrate Extra chromosomal inheritance**
CO4	**Illustratethe Microbial genetics**
CO5	**Illustrate the Mutation.**
CO6	**Evaluate the application of Genetics in improvement of animal, plant and human races development and treatment of various disease**

Text Book (s)

- Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley and Sons Inc.
- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
- Benjamin A. Pierce. 2003. Genetics: A Conceptual Approach. W.H, Freeman and Company, New York.

Reference Book (s)

- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.
- Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.

Unit-1 INTRODUCTION OF GENETICS AND MENDELIAN PRINCIPLES 08 hours **Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests, genotype, phenotype. Mendelian principles; Dominance, segregation, independent assortment.**
Unit-2 EXTENSIONS OF MENDELIAN PRINCIPLES 08 hours **Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.**
Unit-3EXTRA CHROMOSOMAL INHERITANCE 08hours **Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.**

Unit-4MICROBIAL GENETICS 10 hours **Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.**
Unit-5MUTATION 12hours **Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Homologous and non-homologous recombination.**
Unit-6 Recent Advancement in inheritance biology 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	PLANT BIOCHEMISTRY			
Course Code	BSBC3004			
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.			
Corequisite	Students should have understanding of general biology, including a basic knowledge of the plant physiology and their interaction with the environment, and evolution.			
Antirequisite				
	L	T	P	C
	0	0	0	12

Course Objectives: Students are able to understand the basic concept of plant biochemistry

Course Outcomes

CO1	Describe the structure and cell organelle of plant cell.
CO2	Explain the mechanism of photophospholyration.
CO3	Discuss about the mitochondrial shuttle system.
CO4	Explain the significance of nitrogen metabolism.
CO5	Describe the effect of plant hormone and plant growth.
CO6	Evaluate the recent advancement in plant biochemistry

Text Book (s)

1) Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

2) Nutrition for health, fitness and sport (2013) ; Williams.M.H,Anderson,D.E, Rawson,E.S. McGraw Hill international edition. ISBN-978-0-07-131816-7.

Reference Book (s)

1) **Krause's Food and Nutrition Care process.(2012); Mahan, L.K Strings,S.E, Raymond,J. Elsevier's Publications. ISBN- 978-1-4377-2233-8.**
2) **The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7.**

Unit-1I Introduction to Plant cell structure 10 hours **Plasma membrane, Vacuole and tonoplast membrane, cell wall, plastids and peroxisomes.**
Unit-2 Photosynthesis and Carbon assimilation 10 hours **Pigments of photosynthesis; Role of carotenoids; Photosystems I and II; Hill reaction; Photosynthetic electron transport and generation of NADPH & ATP; Cyclic and non-cyclic photophosphorylations; Complexes associated with thylakoid membranes; Light harvesting complexes; Path of carbon in photosynthesis – C3 and C4 pathway of carbon reduction and its regulation; Photorespiration**
Unit- 3 Respiration 10 hours **Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis,** **Translocation of metabolites across mitochondrial membrane, TCA cycle, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration.**
Unit- Nitrogen metabolism 10 hours **Biological Nitrogen fixation by free living and in symbiotic association, structure and function of enzyme Nitrogenase. Nitrate assimilation: Nitrate and Nitrite reductase. Primary** **and secondary ammonia assimilation in plants; ammonia assimilation by Glutamine synthetase-glutamine oxoglutarate amino transferase (GS-GOGAT) pathway. Seed storage** **proteins in legumes and cereals.**
Unit-5 Regulation of plant growth and secondary Metabolites 05hours **Introduction to plant hormones and their effect on plant growth and development, Regulation**

of plant morphogenetic processes by light. Representatives alkaloid group and their amino acid precursors, function of alkaloids, Examples of major phenolic groups; simple phenylpropanoids, Coumarins, Benzoic acidderivatives, flavonoids, tannins and lignin, biological role of plant phenolics, Classification of terpenoids and representative examples from each class, biological functions of terpenoids
Unit-6 Recent Advancement in plant biochemistry 04hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	FOOD AND NUTRITION				
Course Code	BSBC3005				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of food and nutrition.

Course Outcomes

CO1	Illustrate the basic concepts of energy metabolism.
CO2	Interpret the function of carbohydrate in living system.
CO3	Evaluate the classification, source and function of lipid.
CO4	Evaluate the role of protein in body.
CO5	Analyze the structure and functions of vitamins and minerals.
CO6	Evaluate the recent development in field of food and nutrition

Text Book (s)

1) Textbook of Biochemistry with Clinical Correlations (2011) Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 978-0-4710-28173-4.

2) Nutrition for health, fitness and sport (2013) ; Williams.M.H,Anderson,D.E, Rawson,E.S. McGraw Hill international edition. ISBN-978-0-07-131816-7.

3) Krause's Food and Nutrition Care process.(2012); Mahan, L.K Strings,S.E, Raymond,J. Elsevier's Publications. ISBN- 978-1-4377-2233-8.

Reference Book (s)

1.The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications. ISBN-13- 978-0-12- 183493-7

Unit-1 Introduction to Nutrition and Energy Metabolism (15 hours) **Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff., Physiological energy value of foods, SDA. Measurement of energy expenditure. Direct and Indirect Calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and Resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance Energy expenditure in man. Estimating energy requirements, BMR factors Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups. Anthropometric measurements; Z scores, BMI, skinfold, circumference ratios. Biochemical assessment; Basal metabolic panel, Comprehensive metabolic panel, CBC, Urine Analysis, Assessment of Anemia, ROS assessment, GTT and glycosylated Hb, Differential diagnosis of B12 and folate.**
Unit-2 Dietary carbohydrates and health (05 hours) **Review functions of carbohydrates. Digestion, absorption ,utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fiber, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions.**
Unit- 3 Dietary lipid and health (10 hours) **Review of classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids. Dietary implications of fats and oils, Combination ratios of n6 and n3, MUFA, PUFA and SFA.**
Unit-4 Dietary Proteins and health (05 hours) **Review of functions of proteins in the body, Digestion and absorption. Essential and Nonessential amino acids. Amino Acid Availability Antagonism, Toxicity and Imbalance, Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances for different age group. Amino acid pool. NPU, Biological Value , Nitrogen balance. PEM and Kwashiorkor**
Unit-5 Vitamins and Minerals (15 hours) **Classification and nutritional aspects of the vitamins and minerals, Vitamin A, C, E,K and D Dietary sources, RDA, Adsorption, Distribution, Metabolism and**

excretion(ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone physiology. Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Niacin- Metabolic interrelation between tryptophan, Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role Biochemical basis for deficiency symptoms. **and extinction.**
Unit-6 Recent Advancement in food and nutrition 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOCHEMISTRY LAB-VI**				
Course Code	**BSBC3010**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general lab instruments.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives: Students are able to understand the basic concept and working principle of colorimetry, different chromatographic techniques. .

Course Outcomes

CO1	**Understand the Principles of Colorimetry**
CO2	**Illustrate principle and applications of of Beer-Lambert's law**
CO3	**Determination of molar extinction coefficient of NADH**
CO4	Separate of Plant pigments/lipids/sugars by different chromatographic techniques
CO5	**Separation and amplify DNA using electrophoresis and chromatography**

S.N.	Name of Practicals
1.	**Principles of Colorimetry**
2.	**Verification of Beer-Lambert's law – Protein quantification by Biuret's method.**

3.	Determination of molar extinction coefficient of NADH.
4.	Demonstrate the principle of HPLC
5.	Separation of Plant pigments/lipids/sugars by Thin layer chromatography.
6.	Gel Electrophoresis of DNA.
7.	Gas chromatography
8	To amplify DNA using PCR.
9	Restriction digestion of DNA
10	Western blotting of proteins from SDS-PAGE.
11	Separation of proteins by isoelectric focusing.
12	To perform immuno-diffusion by Ouchterlony/ Mancini method.
13	To perform ELISA experiment.
14	Grouping of blood and Rh typing.
15	To perform Agglutination inhibition Assay

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	BIOCHEMISTRY LAB-VII				
Course Code	BSBC3011				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general lab instruments.				
Antirequisite					
		L	T	P	C
		0	0	6	3

Course Objectives:
The students will be able to apply the principles of transmission and inheritance in real life situations.

Course Outcomes

CO1	Explain the characteristic features of polytene chromosome.
CO2	Illustrate concept of chromosomal abbreviations
CO3	Elucidate the concept of autosomal and sex linked inheritance.
CO4	To calculate the allelic and genotype frequencies in population.
CO5	Illustrate the concept of pedigree analysis.

S.N.	Name of Practicals
1.	Squash preparation of salivary glands of Dipteran larva to observe polytene chromosome
2.	Induction of polyploidy in onion roots.
3.	Smear technique to demonstrate sex chromatin in buccal epithelial cells.

4.	Monohybrid crosses in Drosophila for studying autosomal and sex linked inheritance.
5.	PTC testing in a population and calculation of allelic and genotype frequencies.
6.	Study of abnormal human karyotype and pedigrees (dry lab)

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

SEMESTER VI

Name of The Course	Dissertation				
Course Code	BSBC9997				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		0	0	0	12

Course Objectives:

The aim is to develop an understanding of the processes and skills required to undertake a supervised research project at masters level of study. The objectives are

- To develop research skills commensurate with the accomplishment of a masters degree.
- To develop skills in independent inquiry.
- To produce a coherent and logically argued piece of writing that demonstrates competence in research and the ability to operate independently.
- To address issues of research design, methodology, ethics and theoretical arguments, and apply these to your own research.

Course Outcomes

CO1	Demonstrate the use of knowledge of basic and applied sciences in project based learning.
CO2	Organizes experiments and researches, perform analysis and interpret data for the designed project.
CO3	Cooperate effectively as an individual and as a member in the research team.
CO4	Systematize the articulated ideas, comprehend and write effective reports, documentation and to communicate effectively.
CO5	Demonstrate knowledge and understanding of research problems and related principles to manage projects in multidisciplinary research areas.

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work may be given in lieu of a discipline specific elective paper/Biochemistry.This should be done in consultation with the faculty supervisor and agency supervisor under whom he / she is getting trained. The project report should be around 100 pages and chaptered as follows:

Chapter I: Introduction
Chapter II: Review of Literature
Chapter III: Methodology
Chapter IV: Results
Chapter V: Discussion
Chapter VI: Summary and Conclusion

The research should be original and should be action oriented in that the results should be able to throw light on some of the important unexplored areas that would be of practical use to the forensic experts.

Students are expected to decide on the specific project area and title, and carry out substantial portion of the literature survey during the end of their 3rd semester.After the end of their 3rdsemester ETEs, each student will be asked to make presentation about the project including literature available, objective sought and work plan including methodologiesto the Student Project Monitoring Committee constituted by the Division Chair. The Project Work may be a work based on theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, etc. or a combination of these. The final project report will be evaluated by a panel of examiners consisting of Dean,DC, PC,supervisor and Co-supervisor (wherever applicable) and an External Examiner. Viva-voce examination for the same will be conducted.
The following weightage is assigned at each stage of Student Project evaluation.

Activity	Remarks
Zeroth Review	Project scopes and Proposal
1st Review	Methods of project Implementation
2nd Review	Technical Achievement
3rd Review (Final)	Innovation and contribution
Submission of Project Report to the Department	Two weeks before the viva-voce exam

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	Web based course/seminar				
Course Code	BSDB3010				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology.				
Antirequisite					
		L	T	P	C
		0	0	0	2

Course Objectives:

- **Students are** directly engage and learn particular subject of their interest. This strengthens the fundamentals of the student in the course.
- It gives the students the opportunities to explore new areas of interest . Also gives students the opportunity to learn in greater depth the subjects they wish to master.
- Promotes the self-learning initiative of the students – where their own motivation is what drives them to complete the course. This fosters the habit of keeping oneself updated always by means of self-study.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	ETE	Total Marks
50		50	100

ELECTIVES
GROUP-I

Name of The Course	BIOINFORMATICS				
Course Code	BSDB2011				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the computer science.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of bioinformatics.
Course Outcomes

CO1	Describe the Introduction of Computer Fundamentals
CO2	It Interpret the Introduction of Bioinformatics and Biological Databases

CO3	**Demonstrate Sequence Alignments, Phylogeny and Phylogenetic trees**
CO4	**Evaluate Genome organization and analysis**
CO5	**Evaluate Protein Structure Predictions**
CO6	**Eloborate the recent advancement in bioinformatics.**

Text Book (s)

1. **Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House**
2. **Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications**
3. **Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student** Edition
4. **Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications,** genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. **Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell**

Reference Book (s)

1. **Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House**
2. **Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications**
3. **Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student** Edition
4. **Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications,** genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. **Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell**

Unit-1 INTRODUCTION TO COMPUTER FUNDAMENTALS12 hours **RDBMS - Definition of relational database, Mode of data transfer (FTP, SFTP, SCP), advantage of encrypted data transfer.**
Unit-2 INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES 10hours **Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB.**
Unit-3SEQUENCE ALIGNMENTS, PHYLOGENY AND PHYLOGENETIC TREES09hours **Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices. Types of phylogenetic trees, Different approaches of phylogenetic tree construction -UPGMA, Neighbour joining, Maximum Parsomony, Maximum likelihood.**
Unit-4GENOME ORGANIZATION AND ANALYSIS 08 hours

Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes; Genome, transcriptome, proteome, 2-D gel electrophoresis, Maldi Toff spectroscopy; Major features of completed genomes: *E.coli, S.cerevisiae, Arabidopsis*, Human.
Unit-5PROTEIN STRUCTURE PREDICTIONS 08 hours **Hierarchy of protein structure - primary, secondary and tertiary structures, modelling; Structural Classes, Motifs, Folds and Domains; Protein structure prediction in presence and absence of structure template; Energy minimizations and evaluation by Ramachandran plot** **Protein structure and rational drug design.**
Unit-6 RECENT ADVANCEMENT IN BIOINFORMATICS **04hours** **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	**BIOSTATISTICS**				
Course Code	**BSDB2012**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the statistics.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biostatistics.

Course Outcomes

CO1	**Understand Measures of central tendency, Correlation and Regression**
CO2	**Interpret Mean and Variance, namely Binomial, Poisson**
CO3	**Demonstrate parametric and non-parametric statistics.**
CO4	Illustratethe Sampling Distributions, Standard Error, Testing of Hypothesis
CO5	**Illustratethe Large Sample Test based and Small sample test**
CO6	**Eloborate the recent development in field of biostatistics**

Text Book (s)

3. Edmondson and D. Druce : Advanced Biology Statistics, Oxford University Press; 1996.
4. W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004

Reference Book (s)

3. Edmondson and D. Druce : Advanced Biology Statistics, Oxford University Press; 1996.

4. W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004

Unit-1 INTRODUCTION TO COMPUTER FUNDAMENTALS 12 hours Measures of central tendency, Measures of dispersion; skewness, kurtosis; Elementary Probability and basic laws; Discrete and Continuous Random variable, Mathematical Expectation; Curve Fitting; Correlation and Regression. Emphasis on examples from Biological Sciences.
Unit-2 INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES 10 hours Mean and Variance of Discrete and Continuous Distributions namely Binomial, Poisson, Geometric, Weibull, Logistic and Normal distribution. Fitting of Distributions.
Unit-3SEQUENCE ALIGNMENTS, PHYLOGENY AND PHYLOGENETIC TREES09 hours Statistical methods: Scope of statistics: utility and misuse. Principles of statistical analysis of biological data. Sampling parameters. Difference between sample and Population, Sampling Errors, Censoring, difference between parametric and non-parametric statistics.
Unit-4GENOME ORGANIZATION AND ANALYSIS 08hours **Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom.**
Unit-5PROTEIN STRUCTURE PREDICTIONS 08hours Large Sample Test based on Normal Distribution, Small sample test based on t-test, Z- test and F test; Confidence Interval; Distribution-free test - Chi-square test. Basic introduction to Multivariate statistics, etc.
Unit-6 RECENT ADVANCEMENT IN BIOSTATICS **04hours** **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOPHYSICS**				
Course Code	**BSDB2013**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the physics.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biophysics.

Course Outcomes

CO1	**Understand numerical models with non-linear algebraic equations, numerical integration.**
CO2	**Describe the principle and working of crystallography.**
CO3	**Interpret the applications of numerical methods in biological systems.**
CO4	**Demonstrate the use of quantum biology.**
CO5	**understand the theoretical modeling of biomolecules.**
CO6	**Elucidate the recent advancement in field of biophysics.**

Text Book (s)

6. A Textbook of Biophysics: For Medical Science and Biological Science Students by RN Roy
7. Introduction to Biophysics by Pranab Kumar Banerjee
8. An Introduction to Biophysics by David Burns
9. Fundamentals and Techniques of Biophysics and Molecular Biology by Pranav Kumar
10. Biological Physics: Energy, Information, Life by Philip Nelson

Reference Book (s)

6. A Textbook of Biophysics: For Medical Science and Biological Science Students by RN Roy
7. Introduction to Biophysics by Pranab Kumar Banerjee
8. An Introduction to Biophysics by David Burns
9. Fundamentals and Techniques of Biophysics and Molecular Biology by Pranav Kumar
10. Biological Physics: Energy, Information, Life by Philip Nelson

Unit-1 NUMERICAL METHODS 12 hours **Introduction to numerical methods, solutions to non-linear algebraic equations by the method of iteration and Newton aphson method, numerical integration by trapezoidal rule and simpson's rule, numerical solution of ordinary differential equations by picard's method of successive approximation, Euler's method and Runge-Kutta method.**
Unit-2 ELEMENTARY CRYSTALLOGRAPHY 10 hours

Introduction, symmetry in crystals, lattices and unit cells, crystal systems, Bravais lattices, elements of symmetry- rotation axis, mirror planes and center of inversion, point group symmetry- monoaxial point groups, polyaxial point groups, translational symmetry- screw axis and glide planes, space group, equivalent points, X-ray diffraction and Bragg equation.
Unit-3MATHEMATICAL METHODS AND THEIR APPLICATIONS IN BIOLOGICAL SYSTEMS 09hours
Ordinary differential equations of the first degree and first order (variable separable method, linear equation), linear differential equations of the second order with constant coefficients, the Laplace Transform, Inverse Laplace transform, application of Laplace transform to solutions of differential equations, Fourier series and their applications.
Unit-4QUANTUM BIOLOGY AND ITS USES 08hours
Classical mechanics, Newton, Lagrange and Hamilton's equations, Schrodinger's equation and its complete solution for S.H.O, central force and angular momentum.
Unit-5THEORETICAL MODELING OF BIOMOLECULAR SYSTEMS 08hours
Basic principles of modeling, modeling by energy minimization technique, concept of rotation about bonds, energy minimization by basic technique for small molecules, Ramachandran plot, torsional space minimization, energy minimization in cartesian space, molecular mechanics-basic principle, molecular dynamics basic principles.
Unit-6 RECENT ADVANCEMENT IN BIOPHYSICS 04hours   **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**ORGANIC FARMING**				
Course Code	**BSDB2014**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: To provide a broad foundation in organic farming.

Course Outcomes

CO1	**To understand the basic concept of organic farming.**
CO2	**To describe the concept of green manuring.**
CO3	**To identify the different methods of organic plant protection**
CO4	**To explain various types of organic crop production methods.**
CO5	**To understand the basic concept of farm economy.**
C06	**To evaluate the recent development if field of organic farming.**

Text Book (s)

4. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
5. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
6. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay -Publication, New Delhi.

Reference Book (s)

4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic _Farming Akta Prakashan, Nadiad

Unit-1 INTRODUCTION TO ORGANIC FARMING 08 hour **Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.**
Unit-2 ORGANIC PLANT NUTRIENT MANAGEMENT 10 hour **Organic farming systems, soil tillage, land preparation and mulching,Choice of varieties. Propagation-seed, planting materials and seed treatments, water management Green manuring, composting- principles, stages, types and factors, composting methods, Vermi composting, Bulky organic manures, concentrated organic manures, organic preparations, organic amendments and sludges**
Unit-3 ORGANIC PLANT PROTECTION 09 hours **Plant protection- cultural, mechanical, botanical pesticides, control agents, Weed management, Standards for organic inputs- plant protection.**
Unit-4 ORGANIC CROP PRODUCTION PRACTICES **10 hours** **Organic crop production methods- rice, coconut. Organic crop production methods- vegetables- okra, amaranthus, cucurbits. Livestock component in organic farming. Sustainable Agriculture-Apiculture, Mushroom cultivation.**
Unit-5 ORGANIC CERTIFICATION 08 hours **Farm economy: Basic concept of economics- demand &supply, economic viability of a farm. Basic production principles, reducing expenses, ways to increase returns, cost of production system. Benefit/ cost ratio, marketing, imports and exports. Policies and incentives of organic production. Farm inspection and certification. Terrace farming.**
Unit-6 RECENT ADVANCEMENT IN ORGANIC FARMIMG **04hours**

Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOFERTILIZERS AND PESTICIDES**				
Course Code	**BSDB2015**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: To provide basic understanding of biofertilizer and pesticides.Course Outcomes

CO1	**To understand the basic concept of biofertilizer.**
CO2	**To identify the role of azospirillium as biofertilizer .**
CO3	**To explain the process of nitrogen fixation.**
CO4	**To explain various types of mycorrhizal association.**
CO5	**To elucidate the basic concept of pest and pest management.**
CO6	**To elaborate the recent development in field of biofertilizers and pesticides**

Text Book (s)

1.Palaniappan SP &Anandurai K. 1999. Organic Farming–Theory and Practice. Scientific Publishers, Jodhpur

2. Joshi, M. 2014. New Vistas of Organic Farming 2nd Ed. Scientific Publishers, Jodhpur.

3. Farming system : Theory and Practice - S.A.Solaimalai

Reference Book (s)

3. Organic Farming: Theory and Practice- S.P.Palaniappan and K.A. Annadurai
4. A hand book of Organic Farming by A.K.Sharma

Unit-1 INTRODUCTION TO BIOFERTILIZERS 08 hour **General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.**
Unit-2 AZOSPIRILLUM 10 hour

Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication
Unit-3 CYANOBACTERIA 09 hours **Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.**
Unit-4 MYCORRHIZAL ASSOCIATION **10 hours** **Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.**
Unit-5 PEST & PEST MANAGEMENT 08 hours **Classification of pesticides on chemical nature and according to target species, mode of action, Methods of pest controls – Classification: Natural & applied control [Physical, mechanical, cultural, biological, genetic, regulatory, chemical controls] Integrated pest management..**
Unit-6 RECENT ADVANCEMENT IN BIOFERTILIZERS AND PESTICIDES **04hours** **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

GROUP-II

Name of The Course	NANOBIOTECHNOLOGY				
Course Code	BSDB3011				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of nanotechnology.
Course Outcomes

CO1	Understand the fundamentals of nanotechnology
CO2	Demonstrate the physical and chemical methods of synthesis of nanomaterials

CO3	**Demonstrate the biological methods of synthesis of nanomaterials**
CO4	**Generalize the use of nanomaterials in biotechnology**
CO5	**Illustrate the applications of nanobiotechnology**
CO6	**Evaluate the recent advancement in field of nanotechnology.**

Text Book (s)

5. 1. Nanobiotechnology: Concepts,Applications and Perspectives (2004), ChristofM.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
6. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
7. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd., 2012.
8. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.

Reference Book (s)

5. 1. Nanobiotechnology: Concepts,Applications and Perspectives (2004), ChristofM.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
6. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
7. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd., 2012.
8. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.

Unit-1 INTRODUCTION TO NANOTECHNOLOGY 10 hours **Historical perspectives, Existence of nanostructures in nature, Nanoscale Properties (Electrical, Optical, Chemical) Nanomaterials - Quantum Dots,Wells and Wires, nanotubes, graphene, nanogold, nanosilver and metal oxides, Nanopolymers.**
Unit-2 SYNTHESIS OF NANOMATERIALS 10hours **Physical Methods: Ball Milling, Electrodeposition, DC/RF Magnetron Sputtering, Molecular Beam Epitaxy (MBE).Chemical Methods: Metal Nanocrystals by Reduction, Solvothermal Synthesis, Photochemical Synthesis, Chemical Vapor Deposition (CVD), Metal Oxide - Chemical Vapor Deposition (MOCVD).**
Unit-3BIOLOGICAL SYNTHESIS OF NANOMATERIALS10 hours **Synthesis using Microorganisms, Synthesis using Biological templates, synthesis using plants and plant extracts.**
Unit-4 NANOMATERIAL IN BIOTECHNOLOGY 08 hours **Biological nanomaterials and Biomimetic synthesis of nanomaterials – magnetosomes, spider milk, bone, shell. Device based on assemblies of nanoparticles and biomaterials – Bioelectronic devices, nanocircuitry, nanomechanical devices, computational devices.**
Unit-5 APPLICATIONS OF NANOBIOTECHNOLOGY 08 hours

Nanobiosensors, molecular imaging using nanoparticles, targeted drug delivery. Applications in health and disease - infectious and chronic. Nanobiotechnological applications in Environment and food - detection and mitigation.
Unit-6 RECENT ADVANCEMENT IN NANOTECHNOLOGY 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIORESOURCE MANAGEMENT**				
Course Code	**BSDB3012**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of bioresource management.

Course Outcomes

CO1	**Illustrate the different types of aquaculture**
CO2	**Summarize the purpose of culturing economically important organisms**
CO3	**Illustrate the importance of vermiculture**
CO4	**Describe the origin and importance of cultivated plants**
CO5	**Generalize the economic uses of various plant products**
CO6	**Evaluate the recent development in field of bio resource management.**

Text Book (s)

3. ManjuYadav, Economic Zoology- Discovery publishing house, New Delhi
4. Lee R E,. Phycology 1999

Reference Book (s)

3. ManjuYadav, Economic Zoology- Discovery publishing house, New Delhi
4. Lee R E,. Phycology 1999

Unit-1 AQUACULTURE 10 hours **Introduction to aquaculture; Prawn culture, Methods of prawn fishing, Preservation and processing of prawn; Pearl culture and status of pearl culture in India; Economically important fishes of India. Setting up of a fish farm, Monoculture and composite fish culture, Bundh breeding, Induced breeding, methods of fishing, Fish**

preservation and processing; Identification of fish diseases and their control; Snakes and snake venoms.
Unit-2 ECONOMIC ZOOLOGY 08 hours **Overview of Sericulture, Apiculture, Lac culture, Poultry culture, Dairy industry.**
Unit-3 VERMICULTURE 08hours **Introduction and scope, Species of earthworm, Characteristics features ofearthworm. Overview of methods of vermicomposting, Role of earthworm in solid waste management. Vermiwash- its importance, Vermicompost as bio-fertilizer.**
Unit-4CULTIVATED PLANTS 10 hours **Cultivated Plants: origin and importance with particular reference to the works of A. de Candolle and Vavilov (especially centers of diversity, primary and secondary centers, multiple origin); a brief account of Harlan and Hawkes theories; examples of major introductions; practices of floriculture, agroforestry, sericulture. BT crops (brief account).**
Unit-5ECONOMIC USE OF PLANT PRODUCTS 10 hours **Definition, Classification, Names, Morphology and economic uses of important cereals, legumes (pulses and fodders), fruits and vegetables, spices and condiments, beverages, oils and fats, essential oils, medicinal plants, hallucinogens (psychotropic drugs), timber plants, fibre plants, natural rubber, resins, raw materials for paper. A brief account of crop improvement technologies, biosafety considerations, natural products.**
Unit-6 RECENT ADVANCEMENT IN BIO RESOURCE MANAGEMENT 04hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS**				
Course Code	**BSDB3013**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biosafety and intellectual property rights

Course Outcomes

CO1	**Understand the fundamentals of biosafety**
CO2	**Summarize the guidelines of biosafety**
CO3	**Understand the concepts of intellectual property**
CO4	**Describe the grant of patents, agreements and treaties**
CO5	**Evaluate the recent advancement in field of biosafety and intellectual property rights**

Text Book (s)

1. **Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt.Ltd., New Delhi.**
2. **Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.**
3. **Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.**
4. **Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.**
5. **Goel D &Prashar S (2013). IPR, Biosafety and Bioethics. Pearson**
6. **Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.**

Reference Book (s)

1. **Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt.Ltd., New Delhi.**
2. **Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.**
3. **Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.**
4. **Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.**
5. **Goel D &Prashar S (2013). IPR, Biosafety and Bioethics. Pearson**
6. **Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.**

Unit-1 INTRODCUTION TO BIOSAFETY 07 hours

Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms.
Unit-2 BIOSAFETY GUIDELINES 10hours **Biosafety Guidelines: Biosafety guidelines and regulations (National and International);GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol. Guidelines for using radioisotopes in laboratories and precautions.**
Unit-3INTRODUCTION TO INTELLECTUAL PROPERTY10hours **Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR –patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).**
Unit-4GRANT OF PATENT, AGREEMENTS AND TREATIES10 hours **Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional,Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing andagreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patentowner. Agreements and Treaties: GATT, TRIPS, WIPO, Budapest Treaty on international recognition of the deposit of microorganisms etc.**
Unit-6 RECENT ADVANCEMENT IN BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS 04HOURS **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**MUSHROOM CULTIVATION TECHNOLOGY**
Course Code	**BSDB3015**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the**

	cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of mushroom cultivation technology.

Course Outcomes

CO1	**Understand the values of mushroom.**
CO2	**Describe the technology used for cultivation of mushroom**
CO3	**Demonstrate the concepts of mushroom bed preparation.**
CO4	**Demonstrate the process of storage and its nutritional value.**
CO5	**Understand the concepts of types of foods prepared from mushroom.**
CO6	**Elucidate the recent development in field of mushroom culture technology.**

Text Book (s)

5. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
6. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
7. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
8. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Reference Book (s)

5. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
6. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
7. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
8. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Unit-1 INTRODUCTION TO MUSHROOM CULTIVATION 06 hours **Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - Volvariellavolvacea, Pleurotuscitrinopileatus, Agaricusbisporus.**
Unit-2 CULTIVATION TECHNOLOGY - I 08 hours **Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication.**
Unit-3CULTIVATION TECHNOLOGY-II 08hours

Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.
Unit-4 STORAGE AND NUTRITION 10 hours Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.
Unit-5FOOD PREPARATION 08 hours Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.
Unit-6 Recent Advancement in mushroom technology 04hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	PARASITOLOGY				
Course Code	BSDB3016				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of parasitology

Course Outcomes

CO1	Describe the basic concept Parasitology
CO2	Interpret about the Parasitic Protists and disease caused by it
CO3	Interpret Parasitic Platyhelminthes
CO4	Elucidate Parasitic Nematodes
CO5	Illustrate Parasitic Arthropoda and Parasitic Vertebrates
CO6	Evaluate the recent advancement in parasite biology.

Text Book (s)

9. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors

10. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger
11. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group
12. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
13. Rattan LalIchhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
14. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
15. Thomas C. Cheng (1986). General Parasitology, II Edition, Academic Press Inc
16. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd. DSE

Reference Book (s)

9. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
10. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger
11. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group
12. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
13. Rattan LalIchhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
14. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
15. Thomas C. Cheng (1986). General Parasitology, II Edition, Academic Press Inc
16. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd. DSE

Unit-1 INTRODUCTION TO PARASITOLOGY 04 hours **Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship.**
Unit-2 PARASITIC PROTISTS 12hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoebahistolytica, Giardia intestinalis, Trypanosomagambiense, Leishmaniadonovani, Plasmodium vivax.**
Unit-3PARASITIC PLATYHELMINTHES08hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsisbuski, Schistosomahaematobium,Taeniasolium and Hymenolepis nana.**

Unit-4PARASITIC NEMATODES 12 hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Ascarislumbricoides, Ancylostomaduodenale, Wuchereriabancrofti and Trichinellaspiralis. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylencus (lesion nematode).**
Unit-5PARASITIC ARTHROPODA AND PARASITIC VERTEBRATES **08 hours** **Biology, importance and control of ticks, mites, Pediculushumanus (head and body louse), Xenopsyllacheopis and Cimexlectularius, A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat.**
Unit-6 RECENT ADVANCEMENT IN PARASITE BIOLOGY **04hours** **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

Program: B.Sc (H) Forensic Science

Scheme: 2020-2021

Vision

To be recognized globally as a center of excellence in imparting value-based education in Basic and Applied Sciences by creating innovation in fundamental and multidisciplinary research.

Mission

M1. To excel in imparting contemporary knowledge and skills by developing an educational ecosystem with diverse interests and talents.
M2. To perform cutting edge research leading to innovation in sciences through national and international collaborations.
M3. To develop solutions for the emerging challenges in Basic and Applied Science to cater the needs of society.
M4. To attract best quality faculty to facilitate knowledge and develop confidence in our graduates to succeed in the world.

Program Educational Objectives

PEO1:The graduates shall be successful professionals in Academia, Industry, Government and Entrepreneurship.

PEO2:The graduates shall pursue higher education/research at institute of national and international repute.

PEO3:The graduate shall effectively address the challenges of the society and undertake the projects for bridging the gap between industry and societal needs.

Program Specific Objectives

The students shall be able to

PSO1: Exhibit technical skills required for examination of questioned documents and toxicological evidences.

PSO2:Acquire industrial exposure and scientific knowledge through industry internship and research based learning in State and Central forensic labs.

Program Outcomes

PO1: Apply knowledge of basic sciences to the dscipline and to provide the solution in the the area of forensic sciences

PO2: Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of complex forensic problems.

PO3: Create a awareness for intricate forensic issues and propagate knowledge for public health and safety, along with the cultural, societal, and environmental considerations.

PO4: Demonstrate the knowledge of forensic science for sustainable development of man, society and environment and provide assistance to the Criminal Justice System and the consequent responsibilities relevant to the society

PO5: Apply ethical principles and commit to professional ethics and responsibilities and norms of the forensic lab professionals or Work proficiently as a member of crime investigating teams

PO6: Proficiently communicate with the forensic community and being able to understand and write effective reports, documentation and make effective presentations.

PO7: Demonstrate knowledge and understanding of the forensic skills and apply these to one’s own work, or as a member in a team, to manage projects.

PO8: Develop the ability to critically evaluate theories, methods, principles, and applications of pure and applied science in multidisciplinary domain.

Curriculum

Semester 1									
Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BBS08T1101	Introduction to Forensic Science and Criminal Law	3	0	0	3	30	20	50
2	BBS08T1102	Inorganic Chemistry	3	0	0	3	30	20	50
3	BBS08T1103	Basic of Digital and Cyber Forensics	3	0	0	3	30	20	50
4	BSCF 1003	Biology I	3	0	0	3	30	20	50
5	BSCF1004	Practicals – Biology I			2	1	50		50
6	BBS08T1104	Elements of Basic Physics	3	0	0	3	30	20	50
7	BBS08P1101	Physics Lab I			2	1	50		50
8	xxx	Soft Skill				0			
9	xxx	Computer awareness				0			
10	xxx	Liberal Art				0.5			
11	xxx	BEC-B1				3			
12	xxx	Environmental Science	0	0	0	0.5			
13	xxx	AI and Machine learning				2			
		Total				23			
Semester II									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BBS08T1105	Crime Scene Investigation	3	0	0	3	30	20	50
2	BBS08P1102	Practicals – Crime Scene Investigation			2	1	50		50
3	BBS08T1106	Forensic Photography	2	0	0	2	30	20	50
4	BBS08P1103	Practicals – Forensic Photography			2	1	50		50
5	BBS08T1107	Physical Chemistry	3	0	0	3	30	20	50
6	BBS08T1108	Advanced of Digital and Cyber Forensics	2	0	0	2	30	20	50
7	BBS08P1104	Cyber Lab			2	1	50		50
8	BBS08P1104	Practicals – Inorganic and Physical Chemistry			2	1	50		50
9	BBS08T5109	Biology II	3	0	0	3	30	20	50
10	BBS08P5104	Practicals – Biology II			2	1	50		50
11	BBS08T5110	APPLIED OPTICS	3	0	0	3	30	20	50
12	BBS08P5105	Physics Lab II			2	1	50		50
13	xxx	BEC-B2				3	30	20	50
14	xxx	***Two week social internship (during summer)				0			
		Total				25			
Semester III									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
	BSCF2001	Fingerprints	3	0	0	3	30	20	50
	BBS08P2106	Practicals – Fingerprints			2	1	50		50
	BBS08T2111	Forensic Toxicology	3	0	0	3	30	20	50
	BBS08P2107	Practicals – Forensic toxicology			4	2	50		50
	BBS08T2112	Basics of Forensic Psychology	3	0	0	3	30	20	50

	BBS08T2113	Introduction to Criminology	3	0	0	3	30	20	50
	BBS08T2114	Organic Chemistry	3	0	0	3	30	20	50
	BBS08P2108	Practicals- Organic Chemistry			2	1	50		50
	BBS08T5115	Applied Biology-1	3	0	0	3	30	20	50
	BBS08T5116	Atomic Spectra and Applications	3	0	0	3	30	20	50
		Total				25			
Semester IV									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BBS08T2117	Forensic Ballistics	3	0	0	3	30	20	50
2	BBS08P2109	Practicals – Forensic Ballistics			2	1	50		50
3	BBS08T2118	Recent Advancement of Forensic Science	3	0	0	3	30	20	50
4	BBS08T2119	Basic concept of spectroscopy	3	0	0	3	30	20	50
5	BBS08T2120	Analytical Chemistry	3	0	0	3	30	20	50
6	BBS08T5121	Applied Biology-II	2	0	0	2	30	20	50
7	BBS08P5107	Practicals – Forensic anthropology and odontology			2	1	50		50
8	BBS08T5122	Electronic Circuits and Transducers	2	0	0	2	30	20	50
9	BBS08P5108	Physics Lab III			2	1	50		50
10	BBS09P2411	Research Methodology				2			
11	xxx	IPR				0.5			
12	xxx	Foreign Language				0.5			
13	xxx	waste management			2	1	50		50
		Total				23			
Semester V									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BBS08T3123	Forensic Medicine	3	0	0	3	30	20	50
2	BBS08T3124	Explosives	2	0	0	2	30	20	50
3	BBS08P3109	Practicals - Explosives	0	0	2	1	50		50
4	BBS08T3125	Introduction to Questioned Documents	3	0	0	3	30	20	50
5	BBS08P3110	Practicals – Questioned Documents			2	1	50		50
6	BBS08T3126	Applied Chemistry-I	3	0	0	3	30	20	50
7	BBS08P3111	Practicals – Applied Chemistry I	0	0	2	1	50		50
8	BBS08T5127	Applied Serology	3	0	0	3	30	20	50
9	BBS08P5112	Practical's - Serology			2	1	50		50
10	BBS08T5128	Applied Physics I	3	0	0	3	30	20	50
11	BBS08P5113	Practicals –Applied Physics I			2	1	50		50
12	xxx	Campus to corporate				2			
		Total				24			
Semester VI									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BBS08T3129	Applied Chemistry-II	3	0	0	3	30	20	50

2	BBS08P3114	Practicals – Applied Chemistry II			2	1	50		50
3	BBS08T5130	DNA Profiling	3	0	0	3	30	20	50
4	BBS08P5115	Practical's – DNA and Amino acid			2	1	50		50
5	BBS08T5131	Applied Physics II	3	0	0	3	30	20	50
6	BBS08P5116	Practicals –Aapplied Physics II			2	1	50		50
7	BBS08R5117	Project				12			
		Total				24			

List of Electives

Elective-1

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BBS08T5109	Biology II	3	0	0	3	30	20	50
2	BBS08P5104	Practicals – Biology II			2	1	50		50
3	BBS08T5115	Applied Biology-1	3	0	0	3	30	20	50
4	BBS08T5121	Applied Biology-II	2	0	0	2	30	20	50
5	BBS08P5107	Practicals – Forensic anthropology and odontology			2	1	50		50

Elective-2

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BBS08T5110	APPLIED OPTICS	3	0	0	3	30	20	50
2	BBS08P5105	Physics Lab II			2	1	50		50
3	BBS08T5116	Atomic Spectra and Applications	3	0	0	3	30	20	50
4	BBS08T5122	Electronic Circuits and Transducers	2	0	0	2	30	20	50
5	BBS08P5108	Physics Lab III			2	1	50		50

B.Sc. Forensic Science (H)

Semester 1

Name of The Course	Introduction to Forensic Science and Criminal Law				
Course Code	**BBS08T1101**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective: To introduce students with the field of forensic science its importance in criminal justice system and how forensic science has evolved.
Course Outcomes:

CO1	To understand about the history & development of forensic science
CO2	To gain knowledge about the development of forensic science laboratories and it various divisions.
CO3	To understand about the various procedures for collection,& preservation of various types of evidences .

CO4	To gain knowledge about law of evidence ,different laws related to interrogation
CO5	To understand about the criminal justice system and various sections under IPC ,CrPc and Indian Evidence Act
CO6	To study about various important case studies in forensic science

Text Book (s) & Reference Book (s)

1. Bodziak, W., Footwear Impression Evidence (2ndEdn.) CRC Press, Boca Raton, Florida, 2000.
2. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; an Introduction to Criminalitics, McGraw Hill, New York, 1983.
3. Fisher, B., Techniques of Crime Scene Investigation (6thEdn.) CRC Press, Boca Raton, Florida, 2000.
4. James, S. H. And Nordby, J. J. (Eds), Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
5. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2ndEdn) CRC Press, Boca Raton, Florida, 1999.
6. Saferstein, Richard, Criminalistics, An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.
7. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rdEdn) Universal Law Publishing Co. Ltd. New Delhi, 2001

Unit I: Development and growth of forensic science
Introduction to Forensic science –Definition, nature, need and function; Laws and Principles, basics of Forensic Science; Historical development and scope of Forensic Science in India. Branches of Forensic Science, its utilization at the scene of crime and in the courts
Unit II: Forensic Science Laboratory
Forensic Science Laboratory – Growth of Forensic Science Laboratories in India – Central and State level laboratories, Services and functionalities provided by various FSLs, Various divisions in the FSL – Ballistics, Biology, Chemistry Documents, Physics,Psychology, Serology, Toxicology; Mobile forensic science laboratory: its functions and utility, Introduction of BPRD,NICFS,CCMB,IITR,CDTS,NCRB)
Unit III: Collection & Preservation of various evidences
Collection &Preservation of Biological evidences, Toxicological evidences, in Fire & Arson cases, Explosives, Questioned documents ,Electronic Evidences ,Trace Evidences,Projectiles & Bullets.
Unit IV: Law of Evidence
The law of evidence, testimonial and real evidence and admissibility of scientific evidence in the court of Law; Law related to interrogation and interviewing of the criminals; First Information Report, types of cognizable and non-cognizable offences ; mental disorder and acceptance of evidence in court; child witness and acceptance of evidence in the court.
Unit V: Criminal Justice System:
Introduction to Criminal Justice System; Different agencies involved in crime detection: Police, Medico-legal expert, Judicial officers. Introduction to IPC (Indian Penal Code) and Cr.P.C – sections 291, 292 and 293.Indian Evidence Act – Introduction and Sections 32, 45, 46, 47, 57, 58, 60, 73, 135, 136, 137, 159. Court Testimony- admissibility of expert testimony, Court Procedure: Examination in

chief, Cross Examination and Re-examination; Ethics in Forensic Science. International Justice System – an overview.
Unit VI: Case studies
Famous Criminal Cases Beverly Allitt,Robert Donald Auker,Alain Baxter,Al Capone,Lindy Chamberlain,Malcolm Fairley,John Wayne Gacy,Onel de Guzman,Gordon Hay(any other relevant case studies)

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Inorganic Chemistry				
Course Code	**BBS08T1102**				
Perquisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Co requisite	Students should have fundamental knowledge of Inorganic Chemistry				
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

The course introduces about the inorganic chemistry and students would be acquainted with the basics of bonding fundamentals for both ionic and covalent, predicting geometries of simple molecules, the fundamentals of the chemistry of the s and p group elements, metal complexes and metal-ligand bonding and their applications in various fields of inorganic chemistry. This course will further help to carry out a career in the field of research and development in the core areas of Inorganic chemistry.

Course Outcomes:

The students would be able to describe and understand the basic structure of atoms, characteristics of the periodic table. They also understand the basic concepts in nuclear chemistry as well as basic terminologies of analytical chemistry.

CO1	Explain the conceptual understanding of the various laws and principles of atomic chemistry and determine the properties and shape of molecules by various theories of chemical bonding. (K2)

CO2	Analyze the modern periodic table which stands the backbone in understanding Chemistry and the periodic properties like Atomic and Ionic size Ionization Energy Electron Affinity Electronegativity and S and P Block elements in depth. (K4)
CO3	Simplify nuclear reactions and apply nuclear chemistry to calculate age of samples. (K4)
CO4	Apply the knowledge to understanding the fundamentals of coordination chemistry, including modern rules of writing formulae and generating names of coordination compounds, comparing bonding theories of coordination compounds, their geometry, isomerism and some properties. (K3)
CO5	Explain the concept of analytical techniques and enhance the instrumentation skills. (K2)
CO6	Elaborate the knowledge of recent advancement in the field of Inorganic Chemistry. (K6)

Text Book (s) & Reference Book (s)

1. Inorganic Chemistry by C. Housecroft and A. Sharpe
2. Miessler Inorganic Chemistry
3. Cotton-Wilkinson Advanced Inorganic Chemistry
4. Weller Inorganic Chemistry (Former Atkins)
5. Lee Concise Inorganic Chemistry
6. Chemistry: A Molecular Approach
7. Principles of Analytical Chemistry, A Textbook, Authors: Valcarcel, Miguel
8. Reference Book of Inorganic Chemistry (Latimer, Wendell M.; Hildebrand, Joel H.)
9. “Inorganic Chemistry” by Duward Shriver
10. “Inorganic Chemistry” by Shriver and Atkins
11. “Inorganic Chemistry” by Gary Wulfsberg
12. “Advanced Inorganic Chemistry” by Cotton and Wilkinson
13. “Inorganic chemistry: Principles of Structure and Reactivity” by Huheey

14. “Fundamental Concepts of Inorganic Chemistry, Vol.2” by Asim K Das

15. “Advanced Inorganic Chemistry – Vol. 2” by Prakash Satya

16. “Advanced Inorganic Chemistry-Vol.-II” by Gurdeep Raj

17. Principles of Analytical Chemistry” by F W Fifield and D Kealey

18. Inorganic Chemistry, James E House, 2008, Elsevier.

Unit-1:Atomic Structure and Chemical Bonding
Heisenberg uncertainty principle, de Broglie relationship, Concept of shells, sub-shell and orbitals, shapes of s, p and d orbitals, quantum numbers, Rules for filling electrons in orbitals-Aufbau principle, Pauli exclusion principle and Hund’s rule,Chemical Bonding- Definition, Types of bonds (Ionic Bond, Covalent Bond; sigma and pi bond, Coordinate bond) Hybridization and types of Hybridization, Limitations of Valence Bond Theory, Molecular Orbital theory- Postulates, Homo and Hetero-diatomic molecule (N_2, O_2, NO), Band theory of solids.
Uni-2: Introduction of periodic table
Study of Modern Periodic Table, Long form of Periodic Table, periodic properties, atomic radiation, ionization potential, electron affinity, electronegativity, metallic characters, Non- metallic characters and magnetic properties, Comparative study of S and P block elements.
Unit-3: Nuclear Chemistry
Radioactivity, Types of Radiations, Properties of radiations, Detection and measurement of radioactivity, Radioactive Decay and its types, The Group Displacement Law, Radioactive disintegration series, Rate of radioactive decay, half-life, Nuclear Reactions (Fission and fusion reactions), Mass defect, Carbon dating.
Unit- 4:Basic concepts of co-ordination
Classification of ligands, chelation, co-ordination number, stereochemistry and nomenclature of co-ordination compounds, polynuclear or bridged complexes, inner-metallic complexes, Werner’s theory, EAN concept
Unit-5:Titrimetric Analysis
Gravimetric analysis, Principle and estimation of gravimetric analysis, volumetric analysis, Principle and classification of volumetric analysis, Acid base theories- Arrhenius, Bronsted-Lowry and Lewis Theory, Theory of indicators- Ostwald’s theory.
Unit-6:Recent advancement in inorganic chemistry Water treatment materials, Toxic chemicals in wastewater

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Basic of Digital and Cyber Forensics				
Course Code	**BBS08T1103**				
Perquisite	**Basic of computers**				
Co requisite	**Cyber security**				
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective: The objective is to impart students the basic knowledge of computers and its application in forensic science and the different types of computer based crimes encountered in the society.

Course Outcomes:

CO1	Understand the basics of computers
CO2	Classify the different types of operating systems
CO3	Appraise the different file systems
CO4	Practice the internet for research

CO5	Compile different types of cyber crimes
CO6	Evaluate the cyber crime based on case studies

Text Book (s) & Reference Book (s)

1. Leshin, C.B., Internet Investigation in Criminalistics, Prentice Hall, New Jersey, 1997.
2. Tessarolo, A.A. and Marignani, A., Forenisc Science and the Internet. The Canadian Society of Forensic Science Journal, Vol. 29, 1996.
3. BernadJahne: Digital Image processing, Springer Verlag (1993)
4. Incident Response and Computer Forensic by *Kelvin Mandia*, TMH Publication.
5. Digital Forensics: Digital Evidence in Criminal Investigations by *Angus McKenzie Marshall*
6. Cyber Forensic A Field Manual for Collecting, Examining and Preserving Evidence of Computer Crimes by *Albert J Menendez.* Auerbach Publications.
7. First Responder's Guide to Computer Forensics by *Richard Nolanetal*. - Carnegi Mellon, 2005.
8. Cyber Forensic by *Marecella Menendez.*
9. Computer Forensic by *Newman*.
10. Cyber Crime Investigation Field Guide, by *B Middleton*.
11. John. R.Vacca, 2005, Computer Forensics: Computer Crime Scene Investigation, Cengage Learning

Unit-1: Basics of computers and Data representations
Computer organization, components of computers – input output device, CPU, memory-RAM, ROM and external storage devices. Data representations: integers, real, binary, octal hexadecimal & their conversions logic gates – Negation, OR, AND, X OR etc.
Uni-2: Introduction to operating system
Basics of operating system, memory structure, concurrency, scheduling, synchronization and memory management examples of operating systems-Windows and Linux.
Unit-3: File system and networking
Introduction to file system, FAT12, FAT16, FAT32, NTFS, EXT2, EXT3, HFS, Basics of networking-types of topologies, LAN, MAN,WAN
Unit- 4: Introduction to internet
World wide web, E-mails, chat, search engines, networking protocols, network security threats, vulnerabilities, Access control, virus, Trojans etc, security plan and policies.

Unit-5: Cyber crime and digital evidence
What is cyber crime, types of cyber crimes, digital evidence, Digital Vs Physical Evidence, Nature of Digital Evidence, Precautions, while dealing with Digital Evidence.
Unit VI: CASE STUDIES: Gary McKinnon, A Byte Out of History: $10 Million Hack, Melissa Virus, Operation Innocent Images

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Biology I				
Course Code	**BSCF 1003**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective: To make the student aware about the basics of biology. It includes the study of cells, study of the human anatomy and physiology, aspect of Genetics. These modules have been worked out with an aim to introduce the students to the fundamental functioning of the human body and the basic of the chemical changes that are important for Forensic biology. The students will learn about the laws of genetics, organization of chromosomes, cell division, various types of mutations and various genetic disorders.

Course Outcomes:

CO1	To understand about basic concepts of biology mainly cell,its various types,and various stages of cell division
CO2	They would be able to understand about basic concepts of genetics
CO3	To gain knowledge about human physiology various system like respiratory,circulatory system,skeletal system.
CO4	To gain knowledge about human physiology ,various system like Digestive system, Excretory system, Nervous system.
CO5	Students will learn about the key concepts of biomolecules, significance of various micro & macro nutrients in human body.
CO6	Students will become familiar about recent advancements in field of biology

Text Book (s) & Reference Book (s)· M. A. Miller, L.C. Leavell, &Kimber Grey's Stackpole's Anatomy & Physiology. 16th Edition.

1. R.L. Dravce, K.L. Vogl, & AWM Mitchell Grey's Anatomy for students 2005, Elsevier. Inc.
2. I.E. Celis Cell biology Academic Press 2nd Edition.
3. Robertis&Robertis Cell & Microbiology 8th Edition.
4. M.S. Leffel, A.D. Donnenberg& N.R. Rose Handbook of Human Immunology CRC press, 1997
5. Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.
6. Human Genetics: Concepts and Applications by Lewis R (2001) McGraw Hill; Boston.
7. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) Rastogi Publications, Meerut.
8. Mendelian inheritance in Man: Catalogs of Autosomal recessive, and x-linked phenotypes.[12teditions – 1998] by McKusick, V.A. Johns Hopkins university press, Baltimore.
9. Principles and Practive of Medical Genetics, by Emery, A.E.H and D.L. Rimoin (Eds_ (1990-2nd edition) Churchill Livingstone, Edinburgh.

10. Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (Eds0 McGraw Hill, New York.

11. Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.

12. Genetics in Medicine by M.W. Thompson et al, 5th Edition, W.B. Sounders Company, London

13. Genetic basis of common diseases by R. A. King et al, Oxford University Press.

14. Mendelian inheritance in Man by Mc. Kusick V.A. (1998), 12th Edition, John Hopsins University Press, Baltilmore.

Unit-1: The Cell
History of cell, Cell theory, Cell Structure, Function and Organization of Prokaryotes and Eukaryotes. Unicellular and Multicellular organisms, Structure of DNA and RNA. Cell cycle-mitosis and meiosis.
Uni-2: Genetics
Genetic Materials - Structural organization and functions Mendelian Principles, Mendels Laws and Ratio Sex linked inheritance, sex determination and crossing over - Karyotyping analysis, Chromosomal mapping, DNA and RNA structural types.
Unit-3: Human Physiology – I
Inte Integumentary System- components, structure and function of integumentary system, Respiratory System-respiratory organs and Mechanism of breathing Disorders of respiratory system, Cardiovascular System-Blood, elements of blood, Blood group, Coagulation of Blood, Lymph, organs of circulator system and Circulatory pathway Musculoskeletal System-types of muscles, structure of contractile Protein, skeletal system, types of bones, bones of Skull, vertebral column, ribs and ribs cage, types of joints.
Unit- 4: Human Physiology – II
Digestive system-alimentary canal and associated glands, digestion and absorbtion of food Excretory System-organs of human excretory system, Urine formation, Nature, composition and Properties of urine. Nervous System-types and components of human neural system, Neuron-its structure and function Endocrine System-endocrine glands and hormones, of human endocrine system and mechanism of hormone action , Reproductive System-male and female reproductive system, gametogenesis, structure of sperm
Unit-5: Biochemistry

Nutrition - BMR, Calorie value, Types of micronutrients and macronutrients in the body. Balanced diet, obesity Proteins - structure, properties and functions. Carbohydrates - structure, properties and functions. Lipids – structure, properties and functions.
Unit VI:Recent advancements
Various advancements in field of Intravitro fertilization, in field of genetics, field of immunology ,field of biotechnology

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	PRACTICALS – Biology I				
Course Code	**BSCF 1004**				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:The objective is to give exposure to students in different practicals

Aspects of biology.

Course Outcomes

CO1	Studenst should properly able to handle microscope and use it for experimenatl purpose , for differentiating animal cell(cheek cell) and plant cell(onion peel)

CO2	Students able to examine the blood components by preparing smear ,study the different types of pollen grains,aquatic organisms.
CO3	Student able to study the sex linked disease, also able to identify different microorganisms by given speciemen
CO4	Students able to estimate heamoglobin by haematometer, also able to handle basic laboratory equipments.

Text Book (s)&Reference Book (s)· M. A. Miller, L.C. Leavell, &Kimber Grey's Stackpole's Anatomy & Physiology. 16th Edition.

- **R.L. Dravce, K.L. Vogl, & AWM Mitchell Grey's Anatomy for students 2005, Elsevier. Inc.**
- **I.E. Celis Cell biology Academic Press 2nd Edition.**
- **Robertis&Robertis Cell & Microbiology 8th Edition.**
- **M.S. Leffel, A.D. Donnenberg& N.R. Rose Handbook of Human Immunology CRC press, 1997**
- **Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.**
- **Human Genetics: Concepts and Applications by Lewis R (2001) McGraw Hill; Boston.**
- **Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) Rastogi Publications, Meerut.**
- **Mendelian inheritance in Man: Catalogs of Autosomal recessive, and x-linked phenotypes.[12teditions – 1998] by McKusick, V.A. Johns Hopkins university press, Baltimore.**
- **Principles and Practive of Medical Genetics, by Emery, A.E.H and D.L. Rimoin (Eds_ (1990-2nd edition) Churchill Livingstone, Edinburgh.**
- **Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (Eds0 McGraw Hill, New York.**
- **Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.**

- **Genetics in Medicine by M.W. Thompson et al, 5th Edition, W.B. Sounders Company, London**
- **Genetic basis of common diseases by R. A. King et al, Oxford University Press.**
- **Mendelian inheritance in Man by Mc. Kusick V.A. (1998), 12th Edition, John Hopsins University Press, Baltilmore.**

List of Experiments
1. Study of construction & working of compound/s microscope 2. To study the structure of cheek cells 3. To study the structure of plant cells 4. Blood smear preparation & study of RBCs & WBC 5. Study of morphology of pollen grains 6. Study of morphology of aquatic organisms 7. Study of sex linked inheritance (hemophilia, color blindness, sickle cell anemia) with slides/charts./models/photographs 8. To study given speciemen of Algae, fungi ,lichen, bryophyte, pteridophte, gymnosperm ,angiosperm plant 9. To Identify given specimen of porifera,protozoa,coelentrata, helmenthies,Annelida,Arthropoda,mollusca,Amphibians,reptiles,Aves 10. To estimate the amount of haemoglobin by haematometer. 11. Study of instruments Hot air oven ,pH meter, incubator, colorimeter, centrifuge

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**Elements of Basic Physics**				
Course Code	**BBS08T1104**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective: This course is designed to impart the basics knowledge of the physics which includes Newtonian Mechanics, wave mechanics and its characteristics, optical fibre and radioactivity.

Course Outcomes:

CO1	**Interpret & utilize the Newton's law of Motion along with other physical entities such as elasticity.**
CO2	**Explain the energy and rotational dynamics of mechanical systems.**
CO3	**Explain type of waves and their velocities for different mediums.**
CO4	**Discuss the production and application of Ultrasonic waves.**
CO5	**Describe the radio activity and its application in forensic**
CO6	**Predicts the applications of diffraction tomography in the field of science and technology.**

Text Book (s) & Reference Book (s)

Text Books

4. **Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw- Hill.**
5. **Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill**
6. **The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.**
7. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill).

8. Principles of Optics, Max Born and Emil Wolf, 7 th Edn., 1999, Pergamon Press.

Research Articles

9. https://www.sciencedirect.com/science/article/pii/B9780121860301500072

Reference Books

5. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
6. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications. Principles of Optics, Max Born and Emil Wolf, 7thEdn., 1999, Pergamon Press.
7. Optics, AjoyGhatak, 2008, Tata McGraw Hill

Unit-1: Newton's Law of Motion and Elasticity	**10 h**
Definition of motion, position and displacement, average velocity, average speed, acceleration, acceleration of freely falling body, projectile motion, uniform circular motion, relative motion in one dimension and two dimension; Interpretation and applications of Newton's laws of motion, elastic properties of matter, elastic constants and their interrelations	
Unit II: Kinetic Energy and Rotation	**10h**
Energy, kinetic energy, work, work done by gravitational force, work done by spring force, power, work and potential energy, work done on system by external force, conservation of energy. Rotation: The rotational variable, rotation with constant angular acceleration, relating linear and angular variables, kinetic energy of rotation	
Unit III: Waves and optical fibre	**8h**
Wave Motion: transverse and longitudinal waves, wavelength and frequency, speed of travelling wave, the wave equation, particle and wave velocities, Intensity of Wave. Fibre Optics: Snell's Law, Total Internal reflection, graded index, Optical fibres and their properties, Principle of light propagation through a fibre, Numerical aperture, Attenuation in optical fibre	
Unit-IV: Sound Wave	**10h**
Sound waves, speed of sound, intensity and sound level, the Doppler effect, shock waves, noise and sound intensity measurement, echo, reverberation, Sabine's Formula, absorption coefficient, acoustics of buildings and factors affecting acoustics of buildings. Sound distribution in an auditorium, Ultrasonic: production of ultrasonic waves, applications of ultrasonic.	
Unit-V: Radio Activity	**8h**
Review of nuclear composition, nuclear properties and half-life, Radioactive decay Schemes, Applications of Radio Isotopes, Radiometric dating. Application of radioactive material in Forensic science.	
Unit VI: Application of Elements of Basics Physics	**4h**

Recent development in Elements of Basics Physics : X-ray Diffraction measurements, Principle and theory of Diffraction Tomography.

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**PHYSICS LAB -I**				
Course Code	BBS08P1101				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives: This lab is designed to make the students familiar with optics related experiments. Students will get the skill to operate the instruments to determine the results with acceptable accuracy.

Course Outcomes:

CO1	Operate and handle the physics instruments effectively and safely in the laboratory
CO2	Perform the experiments applying the physics principles and analyze the results with maximum accuracy
CO3	Apply the skill to measure the physical constants in the lab

Text Book (s) &Reference Book (s)

Text Book (s)

3. **Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, Asia Publishing House**
4. M.Sayer and A. Mansingh, Measurement, Instrumentation and Experiment Design in Physics & Engineering, PHI Learning.
5. **A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11thEdn, 2011,Kitab Mahal**

Reference Book (s)

a. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, Heinemann Educational Publishers

List of Experiments

1. Measurement with Vernier calipers, Screw gauge and spherometer
2. To determine the density of given liquid and solid using Pycnometer
3. To determine therefractive index of glass using Abbe's Refractometer
4. To determine the refractive index of liquidusing Abbe's Refractometer
5. To determine the angle of prism using spectrometer
6. To determine the Refractive Index of the Material of a Prism using Sodium Light
7. To determine the wavelength of monochromatic light by using spectrometer
8. To determine wavelength of He-Ne laser using plane diffraction grating
9. To determine wavelength of sodium light using Newton's Rings
10. Polarisation of light and Brewster's law

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Semester II

Name of The Course	Crime Scene Investigation				
Course Code	**BBS08T1105**				
Perquisite	**Forensic Science**				
Co requisite	**Forensic Photography**				
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective: This course would introduce the students to Forensic Science and its role in the investigative system. The students would be appraised about the crime scene management using which they can successfully evaluate a crime scene.

Course Outcomes:

CO1	Understand the basis of crime scene management
CO2	Infer the role of first responders and forensic scientist.
CO3	Reconstruct the case by generating the hypothesis based on research knowledge followed by experimental techniques and interpreting the acquired results.
CO4	Practice the gained knowledge in handling of different physical evidences found at the crime scene and generalized the cause of conduct based on type of crime scene and pattern of physical evidences found at scene of crime.
CO5	Interpret the result acquired from advanced techniques such as narcoanalysis, brain mapping or lie detection to know whether a person is lying or telling truth.
CO6	Appreciate the recent tools and techniques of criminal profiling

Text Book (s) & Reference Book (s)

1. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.

2. Fisher, B., Techniques of Crime Scene Investigation (6thEdn.) CRC Press, Boca Raton, Florida, 2000.
3. James, S. H. And Nordby, J. J. (Eds) Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
4. B.R. Sharma, Forensic Science in Criminal Investigation and trials - Universal Law Publishing Company, 2003, ISBN 817534332X, 9788175343320
5. Crime Scene Investigation Procedural Guide 1st Edition by Michael S. Maloney, Donald Housman, Ross M. Gardner
6. Fundamentals of Forensic Science 3rd Edition 2015 Max M. Houck and Jay A. Siegel
7. The Encyclopedia of Crime Scene Investigation (Facts on File Crime Library) 1st Edition by Michael Newton

Unit-1:Crime Scene10 hours
Defining a crime scene, Importance, location and processing of crime scene.Types of Crime Scene:Indoor and outdoor,Primary and secondary and crime scenes based on size of evidence.
Uni-2: Crime Scene Procedures 10h
Crime scene Management – initial response, role of first responding officer, dutymanagement; Role and qualities of an Investigating officer, Role of forensic scientists, forensic doctors, fire brigade and judiciary
Unit-3:Securing and Recording the Crime Scene 8h
Protecting a scene of crime – various steps involved, contamination issues.Recording a crime scene: Crime Scene Survey, Forensic Photography, sketching, field notes, handling clues, modern aids.Crime Scene Reconstruction and its utility, case studies for reconstructing a crime scene with physical evidences; chain of custody.
Unit- 4:Types of Physical Evidences10h
Definition, importance and types of physical evidences;Search, Collection and preservation of physical evidences, packing and forwarding of evidences to the Forensic Laboratory in crimes like murder, theft, extortion, explosion etc
Unit-5:Recent Tools and techniques in Forensic Science8 h
Recent techniques provided in forensic Science laboratories, introduction to digital and cyber-crime detection and analysis, portrait parley, Basics of Narco analysis, Brain Mapping and Lie Detection.
Unit VI: Recent methods for criminal profiling: graphology, linguistic analysis

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Practicals – Crime Scene Investigation					
Course Code	BBS08P1102					
Prerequisite	Forensic Science					
Corequisite	Forensic Photography					
Antirequisite						
			L	**T**	**P**	**C**
			0	0	2	1

Course Objectives: The objective of this course is to give practical exposure to the students in the different aspects of Forensic Courses.

Course Outcomes

CO1	Understand the basis of crime scene management
CO2	appraise the role of sketching in crime scene management

CO3	appreciate the process of search for physical evidence.
CO4	Practice the gained knowledge in handling of different physical evidences found at the crime scene.
CO5	reconstruct the crime scene using the knowledge gained

Text Book (s)&Reference Book (s)

1. Bodziak, W., Footwear Impression Evidence (2ndEdn.) CRC Press, Boca Raton, Florida, 2000.
2. DeForest, P., Gaensslen, R., and Lee, H., Forensic Science; An Introduction to Criminalitics, McGraw Hill, New York, 1983.
3. Fisher, B., Techniques of Crime Scene Investigation (6thEdn.) CRC Press, Boca Raton, Florida, 2000.
4. James, S. H. And Nordby, J. J. (Eds) Forensic Science - An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
5. James, S., and Eskerc, W., Interpretation of Blood Stain Evidence at Crime Scenes, (2ndEdn) CRC Press, Boca Raton, Florida, 1999.

List of Experiments

1. To perform protection and documentation of indoor crime scene.
2. To perform protection and documentation of outdoor crime scene.
3. To perform sketching of indoor crime scene using baseline method
4. To perform sketching of outdoor crime scene using baseline method
5. To perform sketching of indoor crime scene using triangulation method
6. To perform sketching of outdoor crime scene using triangulationmethod
7. To perform search, collection and packing of physical evidences.
8. To write forwarding letter by investigating officer
9. To perform evidence collection in cybercrime case
10. To perform evidence collection in hit and run case
11. Tools for forensic animation for crime scene reconstruction

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	Forensic Photography
Course Code	**BBS08T1106**

Perquisite	**Forensic science, optics**				
Co requisite	**Crime scene management**				
Anti requisite					
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course Objective: This course will impart the knowledge regarding the photographic methods and techniques. Also it aims to appraise the importance of photography in Forensic science .

Course Outcomes:

CO1	Outline the history and development of photography science.
CO2	Understand the basis of working of a camera.
CO3	Appraise the use of black-white and coloured photography
CO4	Assess the value of digital photography
CO5	Design the photography evidence presentation in the court of law.
CO6	Appraise the use of 3D laser scanners for crime scene reconstruction

Text Book (s) & Reference Book (s)

1. Redsicker, D. R., The Practical methodology of Forensic Photography, CRC Presss, London, 1994.
2. Criminalistics, An Introduction to Forensic Science: Richard Saferstein, 10th Edition, Pearson Education International.
3. Forensic Science An Introduction to Scientific and Investigative Techniques : Stuart H. James and Jon J. Nordby., 3rd Edition CRC Press, Taylor & Francis Group.
4. Edward M Robinson, Crime Scene Photography
5. Herbert L Blitzer, Forensic Digital Imaging and Photography
6. Tom Ang, Digital Photography, 1999
7. Forensic Digital Image Processing: Optimization of Impression Evidence 1st Edition by Brian Dalrymple, Jill Smith
8. The Practical Methodology of Forensic Photography (Practical Aspects of Criminal and Forensic Investigations) by David R. Redsicker
9. Fundamentals of Forensic Photography: Practical Techniques for Evidence Documentation on Location and in the Laboratory (Applications in Scientific Photography) 1st Edition, by Keith Mancini , John Sidoriak

10. Forensic Photography: Importance of Accuracy 1st Edition, by Sanford L. Weiss

Unit-1:Introduction and History of photography10 hours
Introduction, History and Development of Photography. Photographic instruments, fundamentals of light and vision, light source, geometry and photometry of image formation.
Unit-2: Camera 10h
Types of Cameras and their working, attachments of camera, types of camera lenses Image sensors, spectral sensitivity of photographic materials, reproduction of colors- photographic processing, Exposing, Camera exposure determination, Working of Camera, F-Number, Depth of field, ISO, Exposure Index, angle, scale, ambient light, color, temperature, flash/ strobe. Developing and Printing. Optical filters.
Unit-3:Black & white and Coloured photography 8h
Basic principles and techniques of black & white and colour photography, cameras andlenses, exposing, developments and printing, Different kinds of developers and fixers, modern developmentsin photography, linkage of cameras and film negatives
Unit- 4: Digital Photography10h
Introduction,Digitalcamera - SLR, DSLR; How digital camera works andbasics of digital imaging. Videography/high speed videography, High-speed photography,Surveillance photography and Aerial photography, Photo imaging evidence.
Unit-5: Forensic Photography 8 h
Introduction,crime scene and laboratory photography- Photography in indoor and outdoor scene of crime, close-up, midrange and bird-eye view photography, trick photography, contact photography. Significance Photography in Forensic Science.legal aspects of visual evidence - juxtapose charts and demonstrative photographs, photographs as secondary evidence
Unit VI: Recent photography methods
using 3-D laser scanners for crime scene reconstruction

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks

30	**20**	**50**	**100**

Name of The Course	Practicals – Forensic Photography				
Course Code	BBS08P1103				
Prerequisite	Optics				
Corequisite	Forensic science, crime scene management				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives: The objective of this course is to give practical exposure to the students in the different aspects of Forensic Photography.

Course Outcomes

CO1	Understand the working of camera
CO2	Infer the importance of focussed photographs.
CO3	Practice the different types of photography techniques.

CO4	Appraise the significance of sequential photography
CO5	Reconstruct the scene of crime using photography evidence.

Text Book (s)&Reference Book (s)

1. Redsicker, D. R., The Practical methodology of Forensic Photography, CRC Presss, London, 1994.
2. Criminalistics, An Introduction to Forensic Science: Richard Saferstein, 10th Edition, Pearson Education International.
3. Forensic Science An Introduction to Scientific and Investigative Techniques : Stuart H. James and Jon J. Nordby., 3rd Edition CRC Press, Taylor & Francis Group.
4. Edward M Robinson, Crime Scene Photography
5. Herbert L Blitzer, Forensic Digital Imaging and Photography
6. Tom Ang, Digital Photography, 1999
7. Forensic Digital Image Processing: Optimization of Impression Evidence 1st Edition by Brian Dalrymple, Jill Smith
8. The Practical Methodology of Forensic Photography (Practical Aspects of Criminal and Forensic Investigations) by David R. Redsicker
9. Fundamentals of Forensic Photography: Practical Techniques for Evidence Documentation on Location and in the Laboratory (Applications in Scientific Photography) 1st Edition, by Keith Mancini , John Sidoriak
10. Forensic Photography: Importance of Accuracy 1st Edition, by Sanford L. Weiss

List of Experiments

1. To understand the working of analog camera
2. To understand the working of digital camera
3. To perform photography in different light conditions
4. To perform black and white photography
5. To perform landscape photography
6. To perform photography of live individuals
7. To perform sequential photography (preparation of chart)
8. To take photograph of exhibits placed under microscope
9. To perform photography of indoor crime scene (evidence presentation)
10. To perform photography of outdoor crime scene (evidence presentation)
11. Using CAD/CAM software

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	Physical Chemistry				
Course Code	**BBS08T1107**				
Perquisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Co requisite	Students should have fundamental knowledge of physical chemistry				
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

The course intends to impart basic knowledge of physical chemistry.

Course Outcomes:

On completion of this course, the students would be able to learn about the fundamentals of physical chemistry.

CO1	Develop skills to demonstrate the concepts of chemical thermodynamics. (K3)
CO2	Analyze the concept of electrochemical cells and determination of potential of cells. **(K4)**
CO3	Apply the principles of kinetics to describe chemical reaction. **(K3)**
CO4	Explain the physical parameters of liquids and utilize the knowledge in practical based learnings. **(K2)**
CO5	Explain the basic concept of phase rule of homo and hetrosystems (K2)
CO6	Elaborate the knowledge of recent advancement in the field of physical chemistry. (K6)

Text Book (s) & Reference Book (s)

1. Principles of Physical Chemistry and Puri, Sharma and Pathania
2. Essentials of Physical Chemistry, Arun Bahl, B.S.Bahl, G.D.Tuli

3. Instrumental Analysis by Skoog, Holler and Crouch

Unit-1: Chemical Thermodynamics	**10 hours**
Concepts of system, types of systems, surroundings, extensive and intensive properties, state functions work, heat, First law of thermodynamics – internal energy and enthalpy, heat capacity and specific heat, measurement of ΔU and ΔH, Hess's law of constant heat summation, entropy, second law of thermodynamics, Gibbs energy change for spontaneous and non-spontaneous process, criteria for equilibrium, carnot cycle, derivation of entropy for carnot cycle.	
Uni-2: Electrochemistry	**10h**
Introduction, Electrochemical cells, Cell Potential, calculating the emf of a cell, relation between emf and free energy, Determination of emf of a half cell, The Nernst Equation, calculation of equilibrium constant for the cell reaction, Hydrogen electrode, Calomel and Glass Electrode, Battery-lead Acid Battery.	
Unit-3: Chemical Kinetics	**8h**
Chemical Kinetics, Reaction Rate, Units of Rate, Rate law, Units of rate constant, Molecularity and Order of a Reaction, Zero order reaction, first order reaction, second order reaction, pseudo order reactions, Half-life of a reaction, Collision Theory of Reaction Rates, Effect of Increase of Temperature on Reaction Rate.	
Unit- 4: Liquid State	**10h**
Intermolecular forces in liquids, Free volume of liquid and density measurement, physical properties of liquid, Vapour pressure, Surface tension, viscosity, Measurement of Viscosity - The Ostwald Method, Colligative properties – freezing point depression, boiling point elevation, vapor pressure lowering, and osmotic pressure.	
Unit-5: Phase Equilibria or Phase Rule	**8 h**
Explanation of terms such as phase, component, degree of freedom. Thermodynamic derivation of phase rule, application of phase rule to one component system- phase diagrams of water and sulphur systems – general discussion of simple eutectic – lead – silver system.	
Unit 6: Recent advancement in Physical chemistry	
Solar Cells, Water treatment, Photochemistry	

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks

30	**20**	**50**	**100**

Name of The Course	**Advanced of Digital and Cyber Forensics**				
Course Code	**BBS08T1108**				
Perquisite	**Basic of computers**				
Co requisite	**Cyber security**				
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective: The objective is to impart students the basic knowledge of computers and its application in forensic science and the different types of computer based crimes encountered in the society.

Course Outcomes:

CO1	Understand the basics of computers
CO2	Classify the different types of operating systems
CO3	Appraise the different file systems
CO4	Practice the internet for research
CO5	Compile different types of cyber crimes
CO6	Evaluate the cyber crime based on case studies

Text Book (s) & Reference Book (s)

Text Book (s) & Reference Book (s)

1. Leshin, C.B., Internet Investigation in Criminalistics, Prentice Hall, New Jersey, 1997.
2. Tessarolo, A.A. and Marignani, A., Forenisc Science and the Internet. The Canadian Society of Forensic Science Journal, Vol. 29, 1996.
3. BernadJahne: Digital Image processing, Springer Verlag (1993)
4. Incident Response and Computer Forensic by *Kelvin Mandia*, TMH Publication.
5. Digital Forensics: Digital Evidence in Criminal Investigations by *Angus McKenzie Marshall*
6. Cyber Forensic A Field Manual for Collecting, Examining and Preserving Evidence of Computer Crimes by *Albert J Menendez.* Auerbach Publications.
7. First Responder's Guide to Computer Forensics by *Richard Nolanetal*. - Carnegi Mellon, 2005.
8. Cyber Forensic by *Marecella Menendez.*
9. Computer Forensic by *Newman*.
10. Cyber Crime Investigation Field Guide, by *B Middleton*.
11. John. R.Vacca, 2005, Computer Forensics: Computer Crime Scene Investigation, Cengage Learning

Unit-1: Computer Forensic:	**10 hours**
Introduction to Computer/Cyber Forensic, Cyber Forensic Steps (Identification, Seizure, Acquisition, Authentication, Presentation, Preservation), Who is Computer Forensic Expert, Cyber Forensic Investigation Process, The Goal of the Forensic Investigation, Why Investigate (Internet usage exceeds norm, Using email inappropriately, Use of Internet, email, or PC in a non−work−related manner, Theft of information, Violation of security policies or procedures, Intellectual property infractions, Electronic tampering), Establishing a Basis or Justification to Investigate, Determine the Impact of Incident, Auditing V/s Cyber Forensic Investigations.	
Uni-2: Incident Response	**10h**
Introduction to Incident Response Process(What is Computer Security Incident, What are the goals of Incident Response, Who is involved in Incident Response Process, Incident Response Methodology, Formulate a Response Strategy, Investigate the Incident.),Preparing For Incident Response, Overview of Preincident Preparation, Identifying Risk, After Detection of an Incident.	
Unit-3: Cyber Forensic Tools and Utilities	**8h**
Introduction, Examining a Breadth of Products, Cyber Forensic Tools Good, Better, Best: What's the Right Incident Response Tool for Your Organization? , Tool Review Forensic Toolkit, EnCase, Cyber check suites, what is disk Imaging etc. Specifications for Forensic tools Tested.	
Unit- 4:Evidence Collection and Analysis Tools	**10h**
Volatile and Non volatile Evidences collection (Safeback, Gettime, FileList,Filecvt and Excel, Getfree, Swapfiles and Getswap ,GetSlack, Temporary Files), Detailed Procedures for Obtaining a bit stream backup of hard drive, File System (Details of File system, Data Structure Of File System, Data Recovery in Different file system.	
Unit-5 Concealment Techniques	**8 h**

Introduction to Cryptography, Types of Cryptographic Algorithms(Secret Key Cryptography, Public Key Cryptography, Hash Function),Electronic Signature, Stenography, Reversing the Stenographic Process, Cloaking Techniques(Data Hide and Seek),Renaming Files, Manipulating File System, Data Hiding on NTFS with Alternate data Stream
Unit VI: Recent cyber case studies:
Gary McKinnon, A Byte Out of History: $10 Million Hack, Melissa Virus, Operation Innocent Images

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Cyber Lab				
Course Code	BBS08P1104				
Prerequisite	Basics of computer functioning				
Corequisite	Cyber security				
Antirequisite					
		L	**T**	**P**	**C**

		0	0	2	1

Course Objectives: The objective is to impart students the basic knowledge of computers and its application in forensic science and the different types of computer based crimes encountered in the society.

Course Outcomes

CO1	Appraise the functioning Logic gates
CO2	Understand the working of windows and linux
CO3	Demonstrate the usage of internet for safe searching
CO4	Appraise the tools for tracing the emails

Text Book (s)&Reference Book (s)

1. Leshin, C.B., Internet Investigation in Criminalistics, Prentice Hall, New Jersey, 1997.
2. Tessarolo, A.A. and Marignani, A., Forensic Science and the Internet. The Canadian Society of Forensic Science Journal, Vol. 29, 1996.
3. Incident Response and Computer Forensic by Kelvin Mandia, TMH Publication.
4. Digital Forensics: Digital Evidence in Criminal Investigations by Angus McKenzie Marshall
5. Cyber Forensic A Field Manual for Collecting, Examining and Preserving Evidence of Computer Crimes by Albert J Menendez. Auerbach Publications.
6. First Responder’s Guide to Computer Forensics by Richard Nolanetal. - Carnegi Mellon, 2005.
7. Cyber Forensic by Marecella Menendez.
8. Computer Forensic by Newman.
9. Cyber Crime Investigation Field Guide, by B Middleton.

10. John. R.Vacca, 2005, Computer Forensics: Computer Crime Scene Investigation, Cengage Learning

List of Experiments
1. Finding results of different logic gates and their combinations 2. Working with windows file (creation, modification, deletion, attributes) folder (creation, nesting, attributes) 3. Working with Linux- file (Creation, modification, deletion, attributes), folder (creation, nesting attributes). 4. Working with external storage devices using windows- Reading and writing data on floppy, CD,DVD, USB thumb drive 5. Working with external storage devices using Linux-reading writing data on floppy, CD, DVD, USB, thumb drive. 6. Understanding LAN-client/server, user creation, password protection. 7. Use of internet- visiting websites with given URL, searching in formation using search engine. 8. Use of E-mail, creating e-mail, sending and receiving e-mails with attachments. 9. Networking commands- like ping, IP config. etc, with various switches. 10. Tracing E-mail, finding senders IP address, of received email, tracing route of email received using tool available on internet, e.g. Visual Trace Route etc.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	Practicals – Inorganic and Physical Chemistry				
Course Code	BBS08P1104				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Laboratory				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:

Course Outcomes

CO1	Develop skills to utilize the volumetric titrations techniques used in chemistry laboratories for analysis. (K3)

CO2	Analyze the strength of a given acid solution *p*H metrically and identify the viscosity and density of the given liquid. (K4)
CO3	Analyse the carbohydrate and protein in the given organic compound. (K4)
CO4	Identify the anions and cations in the given inorganic compound. (K3)

Text Book (s)& Reference Book (s)

R1. Vogel's Textbook of Quantitative Chemical Analysis, Revised by G.H. Jeffery, J. Bassett, J. Mendham and R.C. Denney.

R2. Applied Chemistry: Theory and Practice by O.P. Vermani and A.K. Narula.

R3. Laboratory Manual on Engg. Chemistry by S. K. Bhasin and Sudha Rani.

List of Experiments

1. Introduction to Chemistry laboratory apparatus and instruments.

2. To estimate the total permanent Hardness of the given hard water sample. An approximately 0.01M solution of EDTA are provided.

3. To Determine the Alkalinity of a given Water Sample.

4. To find out the amount of dissolved oxygen in the given sample of water.

5. To find out the viscosity of a given liquid using Ostwald's viscometer.

6. Qualitative analysis of carbohydrates, lipids and proteins.

7. To determine the density of given liquid

8. To determine the strength of a given Hydrochloric acid solution by titrating against Sodium hydroxide solution by using *p*H meter.

9. To determine the percentage of available chlorine in the given sample of bleaching powder.

10. Qualitative inorganic analysis-

Anions: Carbonate, sulphate, chloride, bromide, acetate, nitrate, borate, phosphate.

Cations: Lead, copper, iron, aluminum, zinc, manganese, calcium, strontium, barium, potassium and ammonium.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	Biology II				
Course Code	**BBS08T5109**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

The given course has been formulated with an objective to make the student aware about some of the important aspects of biology. It includes the study of genetics, a part of which was covered in the first semester, study of the plant anatomy and physiology,
introduction to the immune system and some introduction in to microbiology and Biotechnology.
These modules have been worked out with an aim to introduce the students to the fundamental functioning of the plant physiology,
The classification system of the various plants and micro-organisms. The students will also learn about the organization of chromosomes, cell division, various types of mutations and various genetic disorders

Course outcomes:

CO1	The students would be able to understand the human genetics
CO2	The students would be able to understand immunological aspects of human functioning

CO3	The students would be able to understand the concept of plant morphology
CO4	To present a complete comprehensive knowledge about the anatomy of plant and its various parts
CO5	To understand the concept of microbiology and biotechnology.
CO6	To acquire the knowledge about recent advancement in the field of biology.

Text Book (s) & Reference Book (s)

1. M. A. Miller, L.C. Leavell, &Kimber Grey's Stackpole's Anatomy & Physiology. 16th Edition.
2. R.L. Dravce, K.L. Vogl, & AWM Mitchell Grey's Anatomy for students 2005, Elsevier. Inc.
3. I.E. Celis Cell biology Academic Press 2nd Edition.
4. Robertis&Robertis Cell & Microbiology 8th Edition.
5. M.S. Leffel, A.D. Donnenberg& N.R. Rose Handbook of Human Immunology CRC press, 1997
6. Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.
7. Human Genetics: Concepts and Applications by Lewis R (2001) McGraw Hill; Boston.
8. Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) Rastogi Publications, Meerut.
9. Mendelian inheritance in Man: Catalogs of Autosomal recessive, and x-linked phenotypes.[12teditions – 1998] by McKusick, V.A. Johns Hopkins university press, Baltimore.
10. Principles and Practive of Medical Genetics, by Emery, A.E.H and D.L. Rimoin (Eds_ (1990-2nd edition) Churchill Livingstone, Edinburgh.
11. Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (Eds0 McGraw Hill, New York.
12. Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.
13. Genetics in Medicine by M.W. Thompson et al, 5th Edition, W.B. Sounders Company, London

14. Genetic basis of common diseases by R. A. King et al, Oxford University Press.

15. Mendelian inheritance in Man by Mc. Kusick V.A. (1998), 12th Edition, John Hopsins University Press, Baltilmore

Unit-1: Genetics	**10 hours**
Chromosomes: Discovery, morphology and structural Organization. Special types of chromosomes; Salivary gland and Lampbrush chromosomes. Mutations and Mutagens: Definition and Types of mutations.	
Uni-2: Immunology	**10h**
Introduction to Immunology-Immune response: Innate and Acquired Immunity Immunoglobulin: Types functions ,physico-chemical properties of immunoglobulin's, interaction of antigens and antibody -, raising of Antisera ,lectins and their forensic significance .	
Unit-3: Plant Morphology and Anatomy-I	**8h**
Principles of Taxonomy and systems of classification of angiosperms (Bentham and Hooker) and Gymnosperms (Chamberlain), Mechanical and conducting tissue systems in plants-Meristematic and permanent tissue, types and structure of Meristematic and permanent tissue	
Unit-4: Plant Morphology and Anatomy-II	**10h**
Morphology of root, leaf, stem, flowers and their modifications. Anatomy of mono and dicot roots, leaves and stems, secondary growth, growth rings, calculation of life of wood.	
Unit-5: Microbiology and Biotechnology	**8 h**
Basics of Microbiology and Broad classification of micro-organisms, concepts of pure culture techniques. Recombinant DNA technology and its application in Heath and Diseases, Western, and Southern Blot techniques and their forensic importance in criminal investigations.	

Unit VI:Recent advancement in Biology
Recent techniques used for the culturing of microorganism, recent methods for the antigen and antibodies interaction. Development of different vaccines based on recombinant DNA

Continuous Assessment Pattern

Internal Assessment (IA)	**Midterm (MTE)**	**End term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	PRACTICALS–Biology II				
Course Code	BBS08P5104				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:The objective of this course is to give practical exposure to the students in the different aspects of Biology-II

Course Outcomes

CO1	To able to examine difference between dicot plant & monocot plant
CO2	Students able to perform extraction of DNA
CO3	Students able to perform different staining techniques
CO4	Students able to do qualitative analysis for proteins,carbohydrates,nucleic acids.

Text Book (s)&Reference Book (s)·   R.L. Dravce, K.L. Vogl, & AWM Mitchell Grey's Anatomy for students 2005, Elsevier. Inc.

- **I.E. Celis Cell biology Academic Press 2nd Edition.**
- **Robertis&Robertis Cell & Microbiology 8th Edition.**
- **M.S. Leffel, A.D. Donnenberg& N.R. Rose Handbook of Human Immunology CRC press, 1997**
- **Essentials of Human Genetics by S.M. Bhatnagaretal (1999) IV edition. Orient Longman.**
- **Human Genetics: Concepts and Applications by Lewis R (2001) McGraw Hill; Boston.**
- **Basic Human Genetics by E.J. Manage and A.P. Manage (1997 India Reprint) Rastogi Publications, Meerut.**
- **Mendelian inheritance in Man: Catalogs of Autosomal recessive, and x-linked phenotypes.[12teditions – 1998] by McKusick, V.A. Johns Hopkins university press, Baltimore.**

- **Principles and Practive of Medical Genetics, by Emery, A.E.H and D.L. Rimoin (Eds_ (1990-2nd edition) Churchill Livingstone, Edinburgh.**
- **Molecular Basis of Inherited Diseases, (6th Edition-1989) by Scriver, C.R. A.L. Beudit, W.S. Styabnd D. Valle (Eds0 McGraw Hill, New York.**
- **Human Genetics by S.D. Gangane (2nd edition-Reprint 2001), B.L Churchill Livingstone Pvt. Ltd., New Delhi.**
- **Genetics in Medicine by M.W. Thompson et al, 5th Edition, W.B. Sounders Company, London**
- **Genetic basis of common diseases by R. A. King et al, Oxford University Press.**
- **Mendelian inheritance in Man by Mc. Kusick V.A. (1998), 12th Edition, John Hopsins University Press, Baltilmore.**

List of Experiments
1. Study the morphology of different plant parts roots, stem 2. Study the morphology of different plant parts leaf , flower 3. Studying the modifications of different plant parts: root, stem 4. Studying the modifications of different plant parts : leaf and flower 5. Study of monocot root 6. Study of Dicot root 7. Study of Dicot leaves 8. Study of monocot leaves 9. Extraction & Isolation of DNA 10. Staining techniques ,simple ,negative ,gram staining 11. Qualitative analysis of proteins, sugars, nucleic acids,

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**Applied Optics**				
Course Code	**BBS08T5110**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective: Students will be familiar with different types of lenses, image formation mechanism and the aberration in the images. Also, understand the interference and diffraction phenomenon in the light waves. They get the understanding how to get the polarized light and the different optical instruments. This course also provide the knowledge about basic principles and applications of photography in forensic science

Course Outcomes:

CO1	**Discuss various types of lenses and associated entities.**
CO2	**Describe the various aberrations in the image formed by the lenses and methods to remove these aberrations**
CO3	**Interpret phenomenon of interference & diffraction and explain the various optical phenomenon based on it.**
CO4	**Illustrate the polarization of light and explain the methods to produce polarized light**
CO5	**Explain the basic principles and applications of photography in forensic science.**
CO6	Propose for the recent advancement in Metasurface eyepiece for the better resolution in image.

Text Book (s) & Reference Book (s)

Text Books:

4. A textbook of Optics: N. Subrahmanyam, Brijlal and M. N.Avadhanulu.

5. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981,McGraw-Hill
6. D.R. Redsicker, The Practical Methodology of Forensic Photography, 2nd Edition, CRC Press, Boca Raton (2000).
7. Lee, G., Hong, J., Hwang, S. *et al.* Metasurface eyepiece for augmented reality. *Nat Commun* **9,** 4562 (2018). https://doi.org/10.1038/s41467-018-07011-5

Reference Books:

3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optical Physics, A. Lipson, S.G. Lipson, H. Lipson, 4thEdn., 1996, Cambridge Univ. Press
5. Optics, Ajoy Ghatak, 2008, Tata Mc GrawHill

Unit-1: Lenses and image formation	**8h**
Lenses: Transverse Magnification of a Spherically Refracting Surface. Cardinal Points of a Coaxial Optical System. Deviation produced by a Thin Lens. Equivalent Focal Length of Two Thin Lenses separated by a distance. Thick Lenses. Focal Length of a Thick Lens. Variation of Focal Length of a Convex Lens with Thickness. Telephoto lenses.	
Unit II: Aberration in image	**10h**
Aberration in images: Chromatic aberrations; achromatic combination of lenses in contact and separated lenses, Monochromatic aberration and their reduction, oil immersion objectives. Overview on Image Forensics: Assessment of the history and credibility of a digital image, Digital image life cycle, Image Acquisition, Image Coding and Editing, Image Antiforensics, Exposing Digital Forgeries Through Chromatic Aberration	
Unit III: Interference and Diffraction	**8h**
Interference - Division of Amplitude and Division of Wave front. Young’s double slit Experiment. Interference in Thin Films: Newton’s Rings. Bleach interference in forensic luminol tests on porous surfaces. Fresnel Diffraction and Fraunhofer diffraction: Diffraction due to a Single Slit and a Plane Transmission Grating. Rayleigh’s criterion of resolution. Resolving Power and Dispersive Power of a Plane Diffraction Grating.	
Unit VI: Polarization of light	**10h**

Recent advancement in Applied Optics: Metasurfaces, Metasurface eyepiece for augmented reality
Polarisation of light, Brewster's law, Malus law, phenomenon of double refraction, Geometry of Calcite crystal, optic axis, principal section, ordinary and extraordinary rays; Nicol prism, circularly and elliptically polarized light, retardation plate. Optical activity, Polarized Light Microscope.
Unit V:Optical Instruments and Photography 10h
Entrance and exit pupils, need for a multiple lens eyepiece, common types of Eyepieces and their working and applications (Ramsden Eyepiece).Forensic light source. Basic principles and applications of photography in forensic science. 3D photography. Photographic evidence. Infrared and ultraviolet photography. Digital photography. Videography. Crime scene and laboratory photography
Unit VI: Application of Applied Optics

Continuous Assessment Pattern

Internal Assessment (IA)	**Midterm (MTE)**	**End term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	**PHYSICS LAB -II**				
Course Code	BBS08P5105				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives: This lab is provided for students to measure the various characteristics such as resolving power, dispersive power, susceptibility etc. The students will learn the measuring skills using microscope. Also, they can perform the experiments based on electrical circuits.

Course Outcomes

CO1	Demonstrate the skill to handle the instruments effectively and obtain the accurate results
CO2	Utilise the optical instruments to determine its ability and calculate the material properties.
CO3	Apply the fundamental knowledge of physics and perform the experiments to determine the various physical constants and the parameters of the materials.

Text Book (s)&Reference Book (s)

Text Book (s)

1. B.Sc. Practical Physics by C.L Arora , S. Chand Limited.
2. B.Sc. Practical Physics by Harnam Singh, S. Chand Limited

3. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.
4. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, Asia Publishing House

Reference Book (s)

a. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, Heinemann Educational Publishers
b. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed.,KitabMahal

List of Experiments
1. To determine Dispersive Power of the Material of a Prism using Mercury Light 2. To determine the Resolving Power of telescope 3. Determine the Cauchy Constants of material of prism 4. To determine the Resolving Power of a Prism 5. Verification of Stefan's law by electrical method. 6. To determine the Planck's constant using LEDs of at least 4 different colours 7. To determine the wavelength of diode laser source using diffraction of single slit 8. To determine an unknown Low Resistance using Potentiometer 9. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method) 10. To study the BH curve of iron using a Solenoid and determine the energy loss

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Semester III

Name of The Course	Fingerprints				
Course Code	**BSCF2001**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

The objective of the courseis to impart knowledge of fingerprints as an important physical evidence at the scene of crime. The students would be able to study the manner in which it is developed, identified, classified, collected, packed and forwarded to the Fingerprint Bureau.

Course Outcomes:

On completion of this course, the students would acquire knowledge regarding fingerprint patterns, the different types of fingerprint classification, the various methods of fingerprint development and their recording.they'll get the knowledge of latest trends occurring for fingerprint development

CO1	To explain the history and developments of fingerprints with its importance as evidence.
CO2	To explain the formation of friction ridges, basic fingerprint pattern types and its interpretation. Different individual characteristics of ridges.
CO3	To explain the Ridge counting and tracing. Method for making an inked specimen of fingerprint and Taking of fingerprint from living and dead person.
CO4	To describe the Classification of fingerprints -Henry system, single digit classification and function of fingerprint Bureau.

CO5	To explain the Latent fingerprint and Chance Fingerprints in criminal investigation, and describe the various methods of development of fingerprints: physical and chemical methods, fluorescent method, laser method, lifting of latent fingerprints. Photography of latent traces and presentation of fingerprint evidence in court.
CO6	To gain the knowledge of recent developed methods for latent fingerprint development and other relevant studies.

Text Book (s) & Reference Book (s)

Text Books

1. J. A., Sukoo, R. J, and Knupfer (2000), "Encyclopedia of Forensic Science", Siegel, Academic Press.

2. Champod, C., Lennard, C. J., Margot, P., & Stoilovic, M. (2017). Fingerprints and other ridge skin impressions. CRC press.

3. Henry C. Lee and R. E.Gaensslen, "Advances in Fingerprint Technology", Second Edition.

4. Fingerprint Manual, Division of Health Improvement.

5. Edward Hueske, "Firearms and Fingerprints", Viva Books Private limited

6. "Crime Scene Investigation", Aric W. Dutelle, Jones and Bartlett learning, Second Edition.

7. J.E. Cowger, Friction Ridge Skin, CRC Press, Boca Raton (1983).

8. D.A. Ashbaugh (2000), Quantitative-Qualitative Friction Ridge Analysis, CRC Press, BocaRaton.

9. Criminalistics, An Introduction to Forensic Science: Richard Saferstein, 10th Edition, Pearson Education International.

10. Forensic Science An Introduction to Scientific and Investigative Techniques: Stuart H. James and Jon J. Nordby., 3rd Edition CRC Press, Taylor & Francis Group.

11. C. Champod, C. Lennard (2004), P. Margot an M. Stoilovic, Fingerprints and other Ridge Skin Impressions, CRC Press, Boca Raton.

12. Lee and Gaensleen's, Advances in Fingerprint Technology, 3rd Edition, R.S.

13. Ramotowski (2013), CRC Press, Boca Raton.

14. Encyclopedia of Forensic Science, Volume 1-3: Jay A Siegel, Pekka J Saukko, GeofferyKnupfer. Academic Press.

Reference Books

1. Encyclopedia of Forensic Science, Volume 1-3: Jay A Siegel, Pekka J Saukko, GeofferyKnupfer. Academic Press.

2. Criminalistics, An Introduction to Forensic Science: Richard Saferstein, 10th Edition, Pearson Education International.

3. Champod, C., Lennard, C. J., Margot, P., & Stoilovic, M. (2017). Fingerprints and other ridge skin impressions. CRC press.

4. Ashbaugh, D. R. (1999). Quantitative-qualitative friction ridge analysis: an introduction to basic and advanced ridgeology. CRC press.

Unit-1History of Fingerprinting	**8 hours**
History and Development of fingerprints; important figures in the field of fingerprint, Principles of Fingerprints, Importance, nature and location, Fingerprints as evidence: Its recognition, Collection and Preservation.	
Unit-2Introduction to Fingerprints and its pattern	**8 hours**
Biological Development of fingerprints, Biological significance of skin pattern, Ridge formation, Composition of Sweat, Theory pattern formation, Basic fingerprint patterns (Arch, loop, whorl and composite), Composites, accidental patterns, pattern area, delta and core (ridge characters) Ridge counting, Ridge tracing, General and Individual characteristics of fingerprints;	
Unit- 3 Classification of fingerprints	**10 Hours**
Classification of Fingerprints for Comparison purposes: Pattern area, Core, Delta, Type lines, Poroscopy, edgeoscopy, ridge characteristics, etc. Classification of fingerprints -Henry system of classification and FBI extension, single digit (battle), damage fingers, Ivan Vucetich, Purkinje, Francis Galton, Establishment and function of fingerprint Bureau.	
Unit-4 Recording and Examination of fingerprints	**12 hour**

Ridge counting and tracing, filling and searching .Method for making an inked specimen of fingerprint. Taking of fingerprint from living and dead person, Post-mortem fingerprinting (Fresh corpus, Rigor mortis, Mutilated, Decomposed, Drowned, Burn). Comparison Protocols: Class and individual characteristics (Galton's details), different ridge characteristics.
Unit-5 Latent Fingerprints and development 12 hours
Latent fingerprint and Chance Fingerprints in criminal investigation, investigating latent fingerprints, various methods of development of fingerprints: physical (Black and grey, fluorescent and magnetic powder method), Fingerprint powders metallic (Magnetic, Fine Lead, and Metal Evaporation) and chemical methods, fuming methods, laser method Iodine Fuming, Iodine Solution method, Cyanoacrylate, Super glue, Ninhydrin method, DFO Method, Silver nitrate method) Instrumental (Laser). lifting of latent fingerprints. Photography of latent traces Fingerprint as forensic Evidence, Visible Fingermarks, Latent Fingermarks and presentation of fingerprint evidence and testimony in court.
Unit VI: Recent Advancements in fingerprints
New developed methods, use of nanoparticles for the development of latent fingerprints, modification of SPR method.

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	PRACTICAL- FINGERPRINTS
Course Code	BBS08P2106

Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:

Course Outcomes

CO1	To understand the information about the plain and rolled fingerprints, identification of patterns. (K4,K3.K2)
CO2	To analyse and perform the ridge counting and tracing, for individual characterization. (K3,K2,K4)
CO3	To develop and lift the latent fingerprints using powder and chemical methods present at crime scenes by applying the knowledge. (K3)
CO4	To implement and update the ability of skill and knowledge in forensic science analysis /examination among students so that the future within forensic science discipline will continue to flourish. (K4, K5)

Text Book (s)&Reference Book (s)

List of Experiments

1. To take rolled and plain fingerprints.
2. To prepare a fingerprint card and identify the pattern.
3. To Develop a fingerprint using powder method(black).
4. To Develop a fingerprint using powder method(grey).
5. To Perform a ridge tracing in the given pattern.
6. To Perform a ridge counting in the given pattern.
7. To Identify the individual characters from the fingerprint sample.
8. To Develop a latent fingerprint using chemical method (iodine fuming).
9. To Develop a latent fingerprint using chemical method (Ninhydrin method).
10. To develop a latent fingerprint using chemical methods on different surfaces.
11. To develop a latent fingerprint by SPR method.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	Forensic Toxicology				
Course Code	**BBS08T2111**				
Perquisite	**Chemistry**				
Co requisite	**Analytical Chemistry**				
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

The objective of the course is to impart students' knowledge regarding the types of poisons and their toxic effects, characteristics and causes of poisoning, the legal aspects involving hit and run cases. Extraction and analytical techniques used for extraction of Volatile and Non-volatile poison.

Course Outcomes

CO1	Understand the basic concepts and terminologies of Forensic toxicology and identify the type of poison responsible for ill effects on the basis of signs and symptoms in fatal and survival cases.
CO2	Ascertain about the cause of poisoning on the basis of pattern of their toxicity (specific nature) caused.
CO3	Systematize the cause of toxicity based on characteristic features of poisoning followed by appropriate extraction methods and analytical techniques.

CO4	Evaluate the level of liquor in breath in field test as well as blood alcohol concentration in drunk and driving cases along with hit and run cases.
CO5	Practice their knowledge to identify the substance responsible for harmful effects based on the type of effects for example corrosive, irritant, asphyxiant, cardiac, spinal poison etc.
CO6	Overview of the recent advancement in the field of Forensic Toxicology

Text Book (s) & Reference Book (s)

1. Poklis, Forensic toxicology in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert CRC Press, Boca Raton (1997).

2. Professor K.S. Narayan Reddy the Essentials Of Forensic Medicine And Toxicology, jaypee

Brothers Medical Publishers, 33rd Edition, 2014

3. Professor V.V. Pillay Textbook Of Forensic Medicine And Toxicology, Paras Medical Publisher,

18th edition (2017)

4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC

Press, Boca Raton 8th Edition (2013).

5. Principles of Forensic Toxicology Barry Levine ,Amer. Assoc. for Clinical Chemistry,4th Edition

2014

6. Moffat, A. C.: Osselton, D. M. Widdop, B; Clake's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material, 3rd ed., Pharmaceutical Press 2004.

7. Modi, Jaisingh, P.; Textbook of Medical Jurisprudence & Toxicology, M. M. Tripathi Publication (2001).

8. Eckert: An Introduction to Forensic Science, CRC Press.

9. Pilay, V. V.: Handbook of Forensic Medicine and Toxicology, Paras Pub., 2001.

10. Curry, A. S.: Poison Detection in Human Organs.

11. Levine B.: Principles of Forensic Toxicology, 2nd Edn., (2006).

12 Handgeon E.: A textbook of Modern Toxicology, 3rd Edn., (2004).

Unit-1: Introduction to Forensic Toxicology: 10 h
Basics of Toxicology – History, scope, classification and principles of Toxicology. Poison – Definition, Classification of Poison, Types of Poisoning, Toxicokinetic and toxicodynamic of Poison. Types of toxicity; LD 50, LC 50, Lethal dose, lethal period, Fatal period and its forensic significance. Role of forensic toxicologist. Collection and Preservation of toxicological exhibits in fatal and survival cases, medico-legal aspects.
Uni-2: Pesticides 10h
Classification of Pesticides - Organophosphorus compounds, Organochloro Compounds and Carbamates- Nature, administration, symptoms, post-mortem findings, detection, and medico-legal aspects.
Unit-3: Metallic & Industrial poisons 8h
Metallic Poison: Arsenic, Mercury, Lead, Cadmium, Mineral Acids: HCl, H_2SO_4, HNO_3; Alkalies: hydrates and carbonates of Sodium and Potassium, NaOH, KOH - Nature, administration, symptoms, postmortem findings, Detection and medicolegal aspects.
Unit- 4: Toxicology of Volatile Poison 10h
Methyl alcohol, Chloroform, Ethyl alcohol, Acetone; Nature, administration, symptoms, post-mortem findings, detection and medico-legal aspects, Introduction, definition of alcohol and illicit liquor, Proof spirit, absorption, de-toxification and excretion of alcohol, Breath test instruments, field sobriety testing, analysis of blood for alcohol. Analytical techniques in the analysis of alcohol cases of drunken driving.
Unit-5: Animal and Vegetable Poisons: 8 h

Animal poisons: Snake, scorpions and Cantharides; Vegetable Poisons: Dhatura, Oleander, Madar, Abrus precatrious, Castor, Cannabis, Nux vomica, cyanide, etc. Nature, administration, symptoms, post-mortem findings, detection and medico-legal aspects.
Unit VI: Recent Advancement in Forensic Toxicology
Development of Toxicoinformatics, Recent advancement in Analytical toxicology for drug analysis(LC-MS-MS,), Case study - Vizag gas leak.

Continuous Assessment Pattern

Internal Assessment (IA)	**Midterm (MTE)**	**End term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	**PRACTICALS – Forensic Toxicology**				
Course Code	BBS08P2107				
Prerequisite	General Toxicology				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**

		0	0	2	1

Course Objectives: Students will be able to examine various poison and apply the knowledge extraction methods, perform qualitative and quantitative analysis in forensic investigations for identification of toxic compounds.

Course Outcomes

CO1	Detect metallic poison in given biological matrix
CO2	Identify Volatile and non- volatile poison in given sample
CO3	Develop TLC for the identification of Insecticides and pesticides
CO4	Perform Instrumental analysis (UV Vis - Spectrophotometry) for various poison.

Text Book (s) & Reference Book (s)

- Moffat, A. C.: Osselton, D. M. Widdop, B; Clake's Analysis of Drugs and Poisons in Pharmaceuticals, body fluids and postmortem material, 3rd ed., Pharmaceutical Press 2004.
- Forensic Laboratory Handbook procedure and practice, Ashraf Mozayani, 2011
- Laboratory procedure Manual, Forensic Toxicology: DFS, 2005.
- Forensic Science Experiments, Manteshwer, 2011
- Lab Manual Criminalistics An introduction to Forensic Science, Richard Saferstein (2007) Ninth Edition.

List of Experiments

1. Preparation of TLC plates.
2. Detection of metallic poisons (Arsenic ,Mercury, Lead and Copper)
3. Analysis of alcohol and other volatile poisons.(Ethyl alcohol, Methyl alcohol, Chloroform, Acetone, Phenol)
4. Analysis of non-volatile poisons.(Chlorate, Sulphate, Nitrate, Nitrites, Carbonates, Phosphate)
5. Analysis of vegetable poisons.(Calotropis, Oleander, Nicotine)
6. Spot test of iron, Aluminum, cadmium, zinc.
7. Analysis of phenolphthalein (Qualitative) in bribe trap cases.
8. Analysis of corrosive poisons. (Hydrochloric acid, Sulphuric acid, Nitric acid)
9. Calibration of UV-Vis spectrophotometer.
10. Instrumental analysis of toxic substances using UV-Vis spectrophotometer.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	Fundamental of Forensic Psychology				
Course Code	**BBS08T2112**				
Perquisite	**Basic of Psychology**				
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

This course is designed to introduce students to the interface of psychology and the law, with a specific focus on forensic psychology. Critical issues, such as Not Guilty By Reason of Insanity pleas, will be addressed. Students will be introduced to the roles and responsibilities of a forensic psychologist including psychological assessments, expert testimony, offender treatment, and correctional psychology.

Course Outcomes:

CO1	Describe the major areas of interests shared by psychology and forensic psychology
CO2	explore human cognition and discover the mistakes brains can make
CO3	Explore the behavior of the person in different personality disorder (BPD)
CO4	Understand the many ways psychology contributes to the investigation of crime
CO5	Describe the types of forensic evaluations conducted in criminal and civil cases
CO6	Describe the landmark legal cases of child sexual abuse and police psychology

Text Book (s) & Reference Book (s) 1. Graham J.Towel & David A. Crighton,Forensic Psychology,BPS BLACKWELL Cochrane, R.

E., Tett, R. P., Vandecreek, L. (2003). Psychological testing and the selection of police officers: A National Survey. *Criminal Justice and Behavior, 30*(5), 511-537.
2. Kocsis, R. N. (2003). Criminal psychological profiling: Validities and abilities. *International Journal of Offender Therapy and Comparative Criminology, 47*(2), 126-144.
3. Indian Penal Code 1860
4. Mental Health Act 1987.
5. Juvenile Justice Act 1986
6. Prof. Paranjape N. V., Criminology and Penology, Central Law Publication, Allahbad.
7. Barlow & Durand. V. M. (2005) Abnormal Psychology, 6th Ed. New Jercy
8. Seligman, Systems & Skill, 6th Ed. New Jercy
9. Serial Crime, Theoretical & Practical issues in behavioural profiling, Petherick, Woodworth Publications.

Unit-1: Basic of Forensic Psychology 10 hours
History of Forensic Psychology, Defining Forensic Psychology, Importance of Forensic Psychology, Concepts of psychology, Professional and ethical issues in Forensic psychology, Services provided by Forensic Psychologists., types of psychological professionals
Uni-2: Consciousness and learning and memory 10h
Consciousness, Altered states of consciousness, attention and awareness, sensation and perception, problems in Attention and perception, assessment attention and perception. Learning process, Types of learning, models of memory, stages of memory, encoding, retention and retrieval, forgetting, brain and memory, problem in learning and memory. Thinking, decision making and problem solving intelligence and language.
Unit-3: Motivation and Personality Disorders 8h
Motivation: Types of approaches Emotion, stress and coping. Understanding personality, type and Trait, theories of personality, psychoanalytic model, behavioristic model social cognitive model, Humanistic model, Biological model assessment of personality Definition and Diagnosing of Personality Disorders. Types of personality disorders
Unit- 4: Assessment and Evaluation in Forensic Psychology (Psychological Testing): 10h
What is Psychological Tests? , Types of Tests. Characteristics of good test.Tests that are used in Forensic Psychology Assessment, Intelligence Tests, Achievement Tests ,Personality Tests, MMPI Test.
Unit-5: Legal Aspects of Forensic Psychology: 8h

Introduction. Historical Background Survey into Psychological evidence in court. Ethical and Professional Issues, Application of Forensic Psychology in civil cases, criminal cases and Proceedings. Mental Health Act, 1987. **Mc Naughten rule insanity** – Nature of Insanity, Insanity Assessment, *Competency to* stand trial, Criminal responsibility and insanity defence
Unit VI: Recent trends in Forensic Psycholog 4H
Child custody assessments Assessment of child sexual abuse, Police psychology

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Introduction to Criminology				
Course Code	**BBS08T2113**				
Perquisite	**Human behaviour**				
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective: To introduce to the students the concepts of crime, criminology and the factors or causes of criminal behavior,The different types of crime committed in the society. The students would also acquire good knowledge regarding Police administration and the Indian Laws associated with different types of offences.

Course Outcomes:

CO1	To gain knowledge about basic concepts of criminology ,its development ,various types of crimes .
CO2	To understand about current scenario of crime in India and various theories given .
CO3	To understand about different forms of crime and concept of punishment .
CO4	To gain knowledge about the juvenile delinquency, various factors responsible for criminal tendency in youth.
CO5	To understand how Indian police system functions
CO6	To gain knowledge about recent advancements in field of criminology

Text Book (s) & Reference Book (s)·

- Ellis, L. and Walsh, Anthony, Criminology – A Global Perspective, Allyn and Bacon, Boston, 2000.

2. Morris, E. K., and Braukman,, C. J.(Eds.), Behavioural Approaches to Crime and Delinquency- A Hand book of Application, Research and Concepts, Plennum Press, New York, 1987.
3. Abaadinsky, H., Organised Crime (2ndEdn.), Nelson – Hall, Chicago, 1998.
4. Adler, F., Mueller, G. O. W. and Laufer, W. S., Criminology, McGraw – Hill, Boston, 1991.
5. Maguire, M.: Morgan, R and Reiner, R., TheOxford Handbook of Criminology (3rdEdn.), OxfordUniversity Press, Oxford, 2002.
6. Ahuja, R., Criminology, Rawat Publications, ND, 2000.
7. Bajpai, G. S., Development without Disorders. Vishwavidyala, Prakashan, Sagar (M. P.), 2002.

8. Ghosh&Rustamji, Encyclopedia of Police in India 1997 Vol, 3

9. VimalaVeeraraghavan, Handbook of Forensic Science

10. B S Nabar, Forensic Science in Crime Investigation

11. VimalaVeeraraghavan, Handbook of Forensic Psychology

Unit-1: Criminology and Criminal Behaviour	8h
Definition, description, and historical perspectives. Crime, Criminal and Criminology; Criminology as Science and Art, The field and scope of Criminology; Methods and Techniques in Criminology; Concept of Criminal Behaviour: Concept of a criminal, classification of criminals, Modus Operandi,Crime& Deviance	
Uni-2: Crime scenario in India	10h
Sociological aspects of crime and criminals in society, criminal inheritance and factors responsible, Criminal behaviour theories.	
Unit-3: Crime Types and punishment	10h
Organized crime; White – collar crimes; Sex offences; Murders, Terrorism; Serial Crime; Crime against women and children; Concept of punishment, humanitarian approach to concept of punishment, capital punishment in India	
Unit- 4: Juvenile Delinquency	10h
Nature and incidence; Characteristics; Types of Juvenile Delinquents; Classification of Juvenile Delinquents; Factors in Juvenile Delinquency, Custody of juvenile delinquents; Juvenile Court procedure; Residential treatment, Counseling of Juvenile Delinquents,behaviour modification techniques; Preventive Programmes	
Unit-5: Police Administration	10 h
Indian Police System – State & Central level,(introduction to ParaMilitary Forces(BSF, CISF,CRPF,ITBP,Assam Rifles,SSB,NSG etc) The Police Act of 1861, Role of police in regard to criminals; Police role in the society as protectors of citizens and their property; Custodial crimes.	
Unit VI: Recent advancements in criminology	
Advancements in field of criminology , Important crime statistics fromNCBI(National crime record Bureau site),	

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Organic Chemistry				
Course Code	**BBS08T2114**				
Perquisite	**Basic inorganic and physical chemistry, Periodic properties of elements**				
Co requisite	**Analytical chemistry**				
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

To impart knowledge of organic chemistry used in the analysis of different substances encountered during a criminal investigation and their Forensic application

Course Outcomes:

On completion of this course the students will have a thorough knowledge of the basic organic chemistry required in the analysis of different substances encountered during a criminal investigation They would be able to understand the effect of different functional groups on the activity of organic compounds used/found in Forensic investigations.

CO1	Enable students to understand the fundamental of organic chemistry **(K2)**
CO2	Enable students to apply the knowledge of stereochemistry of organic molecules to analyze their stereoselectivity and stereospecificity **(K3/K4)**
CO3	Enable students to understand the chemical reactions of Aliphatic hydrocarbons and their industrial applications **(K2/K3)**
CO4	Enable students to understand the phenolic and alcoholic compounds on the basis of their chemical reactions and applications **(K2/K3)**
CO5	Enable students to understand the carboxylic acids and amines on the basis of their chemical reactions and applications **(K2/K3)**
CO6	Utilization of CO2 to create valuable carbonyl-containing compounds as an advance approach **(K6)**

Text Book (s) & Reference Book (s)

1. Rakesh K. Parashar, V.K. Ahluwalia , Textbook of Organic Chemistry, Viva Books Private Limited
2. Rancis A. Carey, Richard A. Sundberg , Advanced Organic Chemistry, 2007

3. Michael B. Smith, Jerry March, March's Advanced Organic Chemistry. Reactions, Mechanisms, and Structure, Wiley

4. George S. Zweifel, Michael H. Nantz, Modern Organic Paula Y. Bruice,Synthesis - An Introduction, 2007

5. Paula Y. Bruice, Organic Chemistry, 2010
6. Organic Chemistry, Book by Robert Boyd, Robert Neilson Boyd, and Robert Thornton Morrison
7. Jonathan Clayden, Nick Greeves, Stuart Warren,Organic Chemistry: Second Edition, 2014
8. Michael B. Smith, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure 7ed (2015)

9. Ivandini, T. A., Honda, K., Rao, T. N., Fujishima, A., & Einaga, Y. (2007). Simultaneous detection of purine and pyrimidine at highly boron-doped diamond electrodes by using liquid chromatography. Talanta, 71(2), 648-655.

10. Song, L., Jiang, Y. X., Zhang, Z., Gui, Y. Y., Zhou, X. Y., & Yu, D. G. (2020). CO 2= CO+[O]: recent advances in carbonylation of C–H bonds with CO 2. Chemical Communications.

Unit-1: Fundamentals of Organic Chemistry	8h
Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis, Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals, Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.	
Uni-2: Stereochemistry	10h
Conformations with respect to ethane, butane and cyclohexane.Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations.Concept of chirality (upto two carbon atoms).Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis - trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).	
Unit-3: Aliphatic Hydrocarbons	12h
Aliphatic Hydrocarbons:Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. **Alkanes:** (Upto 5 Carbons).Preparation*:*Catalytic hydrogenation, Wurtzreaction,Kolbe's synthesis, from Grignard reagent. Reactions*:* Free radical Substitution: Halogenation. **Alkenes:** (Upto 5 Carbons)Preparation*:*Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction).Reactions*:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, Hydroboration-oxidation. **Alkynes**: (Upto 5 Carbons)Preparation*:*Acetylene from $CaC_2$and conversion intohigher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides, Reactions*:* addition of bromine and alkaline $KMnO_4$,ozonolysis and oxidation with hot alkaline $KMnO_4$.	
Unit- 4: Alcohols and Phenols 10h	
Alcohols: Preparation: Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions*:* With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3).Oppeneauer oxidation Diols*:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement. Phenols: (Phenol case) Preparation*:* Cumenehydroperoxide method, from diazonium salts. Reactions*:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction	
Unit-5: Carboxylic acids and amines	10 h
Carboxylic acids: Carboxylic acids (aliphatic and aromatic), Preparation*:* Acidic and Alkaline hydrolysis of esters.Reactions*:* Hell – Vohlard- Zelinsky Reaction. **Amines and Diazonium Salts:** Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation**:** from alkyl halides, Gabriel's Phthalimide synthesis, HofmannBromamide reaction. **Reactions*:*** Hofmann vs. Saytzeff elimination, Carbylamine test.Electrophilic substitution (case aniline): nitration, bromination, sulphonation.	
Unit VI: Recent advances in carbonylation of C–H bonds with CO2	

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**PRACTICALS – Organic Chemistry**				
Course Code	BBS08P2108				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:

Students will be able to separate and identify the mixture of organic compounds and apply this knowledge purification, identification of compounds in preliminary forensic investigations.

Course Outcomes

Students will be able to identify the organic compounds on the basis of their melting points, boiling points and functional groups activity. They will also be able to separate and identify the mixture of organic dyes and amino acids mixture using basic chromatographic techniques.

CO1	Enable students to identify organic compounds on the basis of their melting and boiling points
CO2	Enable students to identify organic compounds on the basis of their functional group tests
CO3	Enable students to separate and identify the mixture of dyes using paper chromatography
CO4	Enable students to separate and identify the mixture of amino acids using thin layer chromatography

Text Book (s)&Reference Book (s)

1. Vogels Textbook Of Practical Organic Chemistry 5th Edition by FURNISS and BRIAN S and HANNAFORD and ANTONY J, PEARSON INDIA
2. Practical Organic Chemistry 4th Edition by MANN and FG and saunders, PEARSON INDIA
3. A Text-Book of Practical Organic Chemistry by J. W. COOK
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

List of Experiments

1: To determine the Melting and boiling point of pure organic compound/s s 2: Identification of functional group/s in organic compound/s (Carboxylic acids). 3: Identification of functional group/s in organic compound/s (Phenols). 4: Identification of functional group/s in organic compound/s (Aldehye/Ketones). 5: Identification of functional group/s in organic compound/s (Alcohols). 6: Identification of functional group/s in organic compound/s (Amines). 7: Separation of dyes by Paper Chromatographic technique 8: Separation and identification of Amino acids (Rf Calculation)

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	Applied Biology-1				
Course Code	**BBS08T5115**				
Perquisite	**Basic of Biology**				
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

The students would learn the different aspects of Forensic Biology and some very specific areas such as Forensic Botany, wild life forensics, Palynology, and Forensic Entomology. The students will also study in detail the forensic examination of hair samples

Course Outcomes:

CO1	To understand the various aspects of forensic botany & its various types of botanical evidences
CO2	To present comprehensive knowledge of pollens, fungi and spores
CO3	To present complete knowledge to the student Diatoms and importance of diatoms in drowning cases
CO4	Classify the various wild life crimes and identification of wild life evidences.
CO5	Interpret the time since death by using insects as a evidence from the decomposed body and evaluate its forensic importance.
CO6	To apply the knowledge of forensic biology in the field of forensic science and to elaborate the knowledge of recent advancement in the field of forensic biology .

Text Book (s) & Reference Book (s)

1. James, S. H. And Nordby, J. J. (Eds), Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.

2. Saferstein, Richard, Criminalistics - An Introduction to Forensic Science, 6th Ed. Prentice-Hall, New Jersey, 1998.

3. Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rd Ed) Universal Law Publishing Co. Ltd. New Delhi, 2001.

4. Bryant, V.M. Jr, Mildenhall, D.C. and Jones, J.G., Forensic Polynology in the United States of America Polynology. 1990, 14.PP.193-208

5. Faegri, K. Iverson, J. and Krzywinski, K. Textbook of Pollen Analysis 4th Edition. John Wiley & Sons, New York 1989.

6. Microbial forensics By Roger Breeze, Bruce Budowle, Steven E. Schutzer. Elsevier Academic Press

7. The Forensic Laboratory Handbook Procedures and Practice By Ashraf Mozayani, Carla

8. Noziglia. 2nd edition. 2011. Human Press.

9. Forensic Science in Wildlife Investigations. Adrian Linacre Taylor and Francis, 2009

10. Forensic Entomology: The Utility of Arthropods in Legal Investigations Jason H. Byrd, James L. Castner Taylor and Francis, 2009

11. Forensic entomology: an introduction By Dorothy E. Gennard Wiley.

12. Forensic palynology Dallas Mildenhall, Patricia Wiltshire, Vaughn Bryant Elsevier, 2006

13. Forensic palynology: An in-depth look at its indispensable value National University, San Diego, 2002

Unit-1: Forensic Botany
Introduction, Scope and Significance, Various types of evidences related to forensic botany like Wood: types of wood and anatomy, methods of identification and comparison. Leaves: Identification of various types of leaves and their anatomy, methods of comparison. Seeds : identification and analysis .Documentation of botanical evidences.
Uni-2: Forensic Palynology
Pollens: Structure, function, methods of identification and comparison. spores: structure and formation in fungi, gymnosperm and angiosperm. Forensic Importance of pollen and spores
Unit-3: Forensic Diatomology
Diatoms: Nature, classification, location, structure, life cycle, extraction from various body tissues including bone marrow, preparation of slides, methods of identification and comparison, forensic significance.
Unit- 4: Wild Life Forensic
Importance of Wildlife (Protection) Act, its Schedules in the protection of endangered species of flora and fauna. Identification of wild life materials such as skin, fur, bones, nails, horn, teeth, plants, plant parts and products by conventional and modern methods, Identification of Pug marks of various animals, DNA techniques in wildlife investigations.
Unit-5: Forensic Entomology
Forensic Entomology: General entomology and arthropod biology, insects of forensic importance, collection of entomological evidence during death investigations. the role of aquatic insects in forensic investigations, insect succession on carrion and its relationship to determine time since death, factors influencing insect succession on carrion, its application to forensic entomology.
Unit VI: Current trends in Applied Biology
Recent advancement in estimating time since death from the human body, microbial forensics , 3D forensic facial reconstruction.

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Atomic Spectra and Applications			
Course Code	BBS08T5116			
Perquisite				
Co requisite				
Anti requisite				
	L	T	P	C
	3	0	0	3

Course Objective: This course is designed to provide the knowledge in the field of atomic spectra. The students will understand the characteristics of the atoms in the presence of external field and different types of emission of radiations. They will explain the mechanism and working principle of different spectroscopy, laser phenomenon and Photoluminescence.

Course Outcomes:

CO1	**Explain atomic spectra and apply the concept of selection rules.**
CO2	**Interpret the impact of external fields such as electric and magnetic fields on the atomic spectra.**
CO3	**Compare the rotational spectra of diatomic and polyatomic molecules and apply the concepts of IR technology in Forensic science field.**
CO4	**Differentiate between the Stoke's and Anti-Stoke's Raman lines.**
CO5	**Compare the behaviour of three & four level lasers and its application in Civil & Bio-medical field..**
CO6	Predict the applications of Infrared spectroscopy and spectroscopic imaging in forensic science

Text Book (s) & Reference Book (s)

Text Books

1. G M Barrow, Introduction to molecular spectroscopy, Tata McGraw Hill,Japan, 1962.

2. Arthur Beiser, Concepts of Modern Physics, 6thed.,McGraw Hill, New Delhi, 2008.

3.Harvey Elliott White, Introduction to Atomic Spectra, McGraw Hill, 1963.

4. J.W. Robinson, Undergraduate Instrumental Analysis, 5th Edition, Marcel Dekker, Inc., New York (1995).

5. Andrew V. Ewing and Sergei G. Kazarian, 'Infrared spectroscopy and spectroscopic imaging in forensic science,' Analyst, 2017, 142, 257-272 , https://doi.org/10.1039/C6AN02244H

Reference Books

1. ManasChanda, Atomic Structure and Chemical Bond, 2nd ed., Tata McGraw Hill, New Delhi,1979.

2. G .Aruldhas, Molecular Structure and Spectroscopy, 2nd ed., Prentice Hall of India Ltd, New Delhi, 2007.

3. B. H. Bransden and C. J. Joachain,Physics of Atoms and Molecules,2nd Edition, Wiley, Hong Kong,1990.

Unit-1 Atomic Spectra	**8h**
Isotopes and Isobars, Origin of atomic spectra, Explanation of different series in hydrogen spectra, Correspondence principle, Bohr and Sommerfeld model, Stern-Gerlach experiment, Electron spin; Spin Orbit interaction; Lande interval rule; Two electron systems; LS – JJ coupling Schemes; Spectroscopic terms and selection rules	
Unit II: Atoms in External Fields	**8h**
Zeeman and Paschen Back Effect of one and two electron systems; Stark effect; X-ray – Auger transitions; Compton Effect; NMR – Principles and description; Magnetic dipole coupling; Chemical shift; ESR – Basic principles; X-Rays: Bragg's law for X-ray diffraction, Bragg's X-ray spectrometer. Debye and Scherrer method. Continuous X-ray and Bremsstrahlung process. Characteristic X-ray spectra, Mosley's law.	
Unit III: IR and Ultraviolet Spectroscopy	**10h**
Rotational spectra of diatomic molecules; Rotation spectra of polyatomic molecules; Linear, symmetric top and asymmetric top molecules; Diatomic vibrating rotator; Analysis by infrared techniques. Usage of Infrared-Based Technologies in Forensic Sciences, Ultraviolet and Visible Spectroscopy: electronic transitions, radiative processes, energy diagram, forensic applications of Ultraviolet-visible spectroscopy	
Unit VI: Raman Spectroscopy	**8h**
Raman Effect: Stoke's and Anti-Stoke's Lines, Quantum Theory of Raman Effect. Complimentary Character of Raman and infrared Spectra, Electronic, rotational, vibrational and Raman spectra of diatomic molecules; Experimental techniques**.**	
Unit V: Laser and Luminescence	**10h**
Lasers: Spontaneous and Stimulated emissions, Einstein's A and B coefficients, Metastable states, Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers, Ruby Laser, He-Ne Laser and Semiconductor laser; Laser applications in Civil; Bio-medical applications of lasers Light Reactions in Forensics: Incandescence, Luminescence: Types of Luminescence, Types of Photoluminescence- Fluorescence and Phosphorescence, Phosphors – use in evidence collections.	
Unit VI: Application of Atomic Spectra	**4h**
Recent advancement in atomic spectra: Infrared spectroscopy and spectroscopic imaging in forensic science	

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Forensic Ballistics				
Course Code	**BBS08T2117**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

The objective of the course is to impart students knowledge regarding the types of firearms and ammunition, characteristics of identification, determination of range of firing and introduction to exterior ballistics.The legal aspects involving firearms cases.

Course Outcomes:

CO1	Explain the history and development of the firearm and describe the various types of firearms and their mode of operation.
CO2	Identify the types of propellant, primer and their composition and examine the fired cartridge case and bullet to correlate it with the firearm used in gunshot case.
CO3	Interpret the velocity of the bullet, recoil force, barrel pressure, ballistic coefficient, angle of elevation of the barrel when a bullet is fired.
CO4	Predict the range by which a bullet is fired and to Reconstruct the sequence of events in a shooting case.

CO5	Assess the nature of the injury inflicted to the body from various ranges.
CO6	Elaborate the knowledge of recent advancement in the field of forensic ballistics.

Text Book (s) & Reference Book (s)

Text Book (s) & Reference Book (s)

1. Sharma, B.R.; "Firearms in Criminal Investigation & Trials", Universal Law Publishing Co Pvt Ltd, New Delhi, 4th Edition, 2011.

2. Hatcher, Jury and Weller; "Firearms Investigation, Identification and Evidence", Stackpole Books, Harrisburg, Pa, 1997.

3. Heard, B.J; "Handbook of Firearms and Ballistics", John Wiley, England, 1997.

4. Jauhari M; "Identification of Firearms, Ammunition, & Firearms Injuries", BPR&D, New Delhi.

5. Hogg, I.V; "The Cartridge guide – A Smallarms Ammunition Identification Manual", The Stackpole publishing Co., Harrisburg, Pa, 1982.

6. Janes, T.J.G; "Infantry Weapons", Janes Information Group, Sentinal House, Surrey, U.K. (2004-05)

7. Burrard; "The Identification of Firearms and Forensic Ballistics", Herbert Jenkins, London, 1956.

8. Gunther and Gunther; "The Identification of Firearms", New York, 1935.

9. Wilber; "Ballistic Science for the Law Enforcement Officer", Charles C. Thomas, USA, 1977.

10.Hayes, T.J; "Elements of Ordnance", John Wiley & Sons, Inc, London, 2013.

11.Smith and Smith; "Book of Rifles", Stackpole Books, Harrisburg, Pa, 1972.

12.Smith and Smith; "Book of Pistols and Revolvers", Stackpole Books, Harrisburg, Pa, 1968.

Unit-1Fire Arms and Ammunitions	**8 hours**
History and development of fire arms and ammunitions, Classification of firearms, weapon types and their operations, proof marks.Types of ballistics, ammunitioncomponents, types of primers and propellants with their compositions.	
Unit-2Internal and External Ballistics	**8 hours**
Internal ballistics – Definition, Combustion of propellants, lock time, ignition time, barrel time, factors affecting the internal ballistics, External Ballistics – Vacuum trajectory, bullet drop, spin, drift, yaw, ricochet, trajectory computation, ballistics coefficient, Theory of recoil, barrel pressure measurement. Factors affecting trajectory.	

Unit-3Firearms-Ammunition Linkage	**8 hours**
Class and Individual characteristics, Cartridge case and Bullet Examination, Test exhibits, Comparison Microscope, NIBIN System, The Arms Act 1959.	
Unit-4Range of fire, GSR and Reconstruction of events	**8 hours**
Muzzle pattern, scorching, blackening, tattooing, wad distribution, pellet patterns, GSR analysis, Reconstruction of the sequence of events in a shooting case. Presentation of evidence in the court.	
Unit-5Wound /Terminal ballistics	**8 hours**
Introduction, Injuries and the quantity of energy of projectiles, Shock wave and cavitation effect, Elements of wound Ballistics; Nature of target, Velocity of projectile, Constructional features, Range, Penetration of shots in different regions of the body.	
Unit VI: Recent advancement in Ballistics	
Recent trends in gunshot residue analysis: luminescent marker, Fully automatic method for comparing cartridges case images. Recent Amendments in Arms Act,2019.	

Name of The Course	**Practicals– Forensic Ballistics**				
Course Code	BBS08P2109				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives: The objective of this course is to give practical exposure to the students in the different aspects of Ballistics regarding examination of cartridge cases, comparison of bullets, various parts of firearms, chemical analysis of Gunshot residues and firearm injury evaluation.

Course Outcomes

CO1	Discriminate between different types of firearms and their operation.
CO2	Demonstrate and practice the various methods of identification of firearms, fired bullets/cartridge cases.
CO3	Select the analysis methods for the explosive residues and evidences.
CO4	Assess the nature of the firearm injury inflicted to the body from various ranges.

Text Book (s)&Reference Book (s)

- Forensic Laboratory Handbook procedure and practice, Ashraf Mozayani, 2011
- Ballistics DFS Manual, 2005
- Forensic Science Experiments, Manteshwer, 2011
- Brain J. Heard; Hand book of Firearms and Ballistics; John Willey, England; (1997)
- Lab Manual Criminalistics An introduction to Forensic Science, Richard Saferstein (2007) Ninth Edition.

List of Experiments
· To describe, with the aid of diagrams, the different parts of firearms and classification of firearms and their firing mechanism. · To study the characteristic features of the firearm- caliber, choke and proof marks. · To study the different components of shotgun cartridges · To study the different components of Metallic cartridges · To examinefiredcartridgescasesfor Individual and Class characteristics. · To carry out the comparison of fired bullets. · To carry out the comparison of fired cartridge cases. · To collect the GSR from hands and cloths. · To examine the organic and inorganic components of Gunshot Residues. · To differentiate, with the aid of diagram, contact wounds, close range wounds and distantwounds. · Visit for Autopsy in Firearms cases.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	Recent Advancement of Forensic Science				
Course Code	**BBS08T2118**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

The students would be able to understand the principle of various types of biometric recognition techniques and working of advanced techniques for the detection of truth and other forensic tools for investigation. They would also know the application of nanotechnology in various domains of forensic science along with legal considerations of environmental regulatory statutes.

Course Outcomes:

CO1	Understand concept of principle of various types biometric techniques, their acceptance, advantages and disadvantages in the field of forensic investigation. K6.
CO2	Interpret the result acquired from advanced techniques such as narcoanalysis, brain mapping, lie detection to know whether a person is lying or telling truth with other advanced assisting techniques such as remote personal assessment, super imposition technique etc. K2
CO3	To make students understand the application of nanotechnology in in fingerprint development, Military investigation, DNA, Narcotics and Drugs testing. K4.
CO4	Understand hazards and risks of exposure of various environmental contamination to our ecology and how to evaluate such toxicant in environment by various detection techniques such as atmospheric tracer along with illegal considerations of regulatory bodies. **K3.**
CO5	Understand the concept of thanotomicrobiome, to know the cause of death due to microbial pathogens and to carryout outbreak investigation K2.
CO6	Understand and apply the concept and application of alternative light photography, LA-ICP-MS, Digital surveillance for gaming equipment and develop the research aptitude K6.

Text Book (s) & Reference Book (s)

1. Hand book of biometric, Edt., Anil K. Jain, Patrick Flynn, Arun A. Ross, Springer Pubisher, 2008.
2. Biometrics: Theory, Methods, and Applications, N. V. Boulgouris, Konstantinos N. Plataniotis, Evangelia Micheli-Tzanakou, 2010.
3. New perspective of nanotechnology: role in preventive forensic Alok Pandya1 and Ritesh K Shukla, Egyptian Journal of Forensic Sciences, 1-11, (2018) 8:57
4. Introduction of Forensic Nanotechnology as Future Armour in Nanotechnology Science and Technology, Nova Publisher, Edi., Ritesh Kumar Shukla, Alok Pandya, September 2019.
5. Forensic Microbiology, Editor(s): David O. Carter, Jeffery K. Tomberlin, M. Eric Benbow, Jessica L. Metcalf, 3 April 2017, Publishre; John Wiley & Sons Ltd., Wiley online library.
6. **Forensic Microbiology, David O. Carter, Jeffery K. Tomberlin, M. Eric Benbow, Jessica L. Metcalf, John Wiley & Sons, 30-May-2017, Wiley Publisher**

7. **Forensic Microbiology in Forensic Science in Focus) Hardcover – 21 April 2017, by David O. Carter (Editor), Jeffery K. Tomberlin (Editor), M. Eric Benbow (Editor), & Jessica L. Metcalf.**
8. **Introduction to Environmental Forensics, Book, 2nd Edtion, 200, Brain L., Murphy Robert D. Morrison, 2007, pp.776.**

Unit-1Biometrics: 8 hours
Definition, Scope,Pattern Recognition & Biometrics - Face, Iris & retinal imaging, Voice recognition, finger print, palm print recognition, Computer simulation, Image processing - Image capturing, Image restoration & enhancement. Image editing, Compression Technique, Proactive Forensic science. Biometrics Applications, Advantage of Biometric Database (Fingerprints, iris, face, etc.).
Unit-2Recent & advanced tools and techniques utilize in Forensic Science8 hours
Portrait parley method, Narco-analysis, Brain Mapping, Polygraphy, Ballistic Fingerprinting, Binocular for identifying dangerous gases, Remote personal assessment, super imposition technique, Fire technology, 3D Scanner, High speed ballistics photography, Forensic carbon-14 Dating.
Unit-3Forensic Nanotechnology 8 hours
Forensic Nanotechnology: Introduction and application of nanotechnology in forensic science such as in fingerprint development, in Military such asexplosives detection,GSR analysis,DNA, Narcotics and Drugs testing.
Unit-4 Environmental Forensic 8 hours
Sources identification, effect on human health and ecological effects of environmental contamination in air, water, soil, sediments and biota, chemicals, atmospheric tracers and concentration evaluations, Vapour Intrusion, Illegal mining of fossil fuels, minerals & metals, Legal Considerations including regulatory statutes and actions.
Unit-5-Forensic microbiology 10 hours
Investigation of thanotomicrobiome, Cause of death: Due to bacterial and viral pathogens, Outbreak investigation: Biological warfare, Animal pathogen, Food born outbreak, Agro-terrorism.Location based information of a person, Detection of Chain of infection. Agent, elucidate the source and provide these results as evidence in court.
Unit VI: Application of advanced technology in forensic investigation 4 hours
Definition, Concept and application of Alternative light photography, LA-ICP-MS, Digital surveillance for gaming equipment in forensic investigation.

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Basic concept of spectroscopy				
Course Code	**BBS08T2119**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

To impart knowledge of the various technique used in the analysis of different substances encountered during a criminal investigation and their Forensic application

Course Outcomes: On completion of this course the students will have a thorough knowledge of the various techniques used in the analysis of different substances encountered during a criminal investigation They would be able to understand the various types of principles, and their Forensic applications.

CO1	Explain the fundamentals of electromagnetic spectra. (K2)
CO2	Explain the conceptual understanding of the various laws, principles and applications of UV- Visible and IR Spectroscopy. (K2)
CO3	Analyse the basic principles and structural analyses and applications in Raman Spectroscopy (K4)
CO4	Apply the basic concepts of Principles, structural analyses, application of X- rays spectroscopy and instrumental knowledge of Mass spectroscopy. (K3)

CO5	Explain the basic principles, mechanism and applications of flame photometry and be able to calculate the NMR signal in the given molecule. (K2)
CO6	Elaborate the knowledge of recent advancement in the field of Instrumentation (K6)

Text Book (s) & Reference Book (s)

1. Stout G.H., & Jensten, L.H., X-ray Structure Determination – A practical Guide, 2nd Ed., Wiley, New York, 1989.
2. Gchristian, Gray D and Fredric J. Feldman, Atomic Absorption Spectroscopy; Wiley-Interscience, London, 1970.
3. Willard, H.H. et al, Instrumental Methods of Analysis, CBS Publishers and Distributors, Delhi 1986.
4. Bassett, J., et al,Vogel's Text Book of Quantitative Inorganic Analysis including Elementary Instrumental Analysis (Fourth Ed.), Long man Essex, 1978.
5. Sneddon, J., Advances in Atomic Spectroscopy, Vol. I & II, JNI Press 1992 & 1994.
6. Lin – Vien, D & Other – Infrared & Raman Characteristics frequencies of organic molecules; San Diego Acad, Press 1991.
11. Maclaffrty, F.W. & F. Turecek, Interpretation of Mass spectra, 4thedMillValley, C A Univ Science Books, 1993.
12. R.M. Silverstein, Baster, G.C. &Morsill, T. C., Spectrometric identification of Organic Compounds, 4thEdn., Wiley, New York, 1981.
13. S.J. Haswell, Atomic Absorption spectrometry, Elsevier, Amsterdam, 1992.
14. Senders, I & Hunter B., Modern Spectroscopy- A center for Chemists; 2nd ed. Oxford Univ. Press, UK, 1993.
15. https://www.sciencedirect.com/topics/chemistry/physico-chemical-analysis-method
16. https://www.sciencedirect.com/topics/chemistry/ir-spectroscopy

UNIT-I Electronic spectroscopy:	**8 hours**
Interaction of electromagnetic radiation with molecules and types of molecular spectra. Energy levels of molecular orbitals (σ, π, n). Selection rules for electronic spectra. Types of electronic transitions in molecules effect conjugation.	
Unit-2 UV-Visible &Infra-Red Spectroscopy	**8 hours**
Introduction, Lamberts Beer's law, Electronic transition, Chromophore,Auxochrome, Types of Band Shifts, Applications of U.V.Spectroscopy, Introduction,Fundamental modes of vibrations Types of vibrations, (Stretching, bending)Function group region, Fingerprint region and Applications of IR-Spectroscopy	
Unit-3 Raman Spectroscopy	**8 hours**
Scattering of light, Elastic and Inelastic collisions, Stoke's, Anti-stoke's and Rayleigh lines, polarization measurements of water and carbon-dioxide molecules	
Unit-4 X-ray and Mass Spectroscopy	**6 hours**

Introduction, Methods of generation of X-rays, General principle, Instrumentation working of Mass Spectroscopy and its applications.
Unit-5 Flame Photometryand NMR spectroscopy 10 hours
Introduction, Principle of Flame photometer, Parts of Flame photometer, Mechanism and Applications. Introduction of NMR, Basic Principle, Calculations for number of signals, shielding and de-shielding effect, chemical shift and applications of NMR.
Unit 6: Elaborate the knowledge of recent advancement in the field of Instrumentation.
Physico Chemical Analysis Methods, Advanced instrumental techniques, Medical Science applications etc

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Analytical Chemistry				
Course Code	**BBS08T2120**				
Perquisite	**Basic concepts of analytical chemistry**				
Co requisite	**Spectroscopy**				
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

To impart knowledge of the various analytical techniques in the analysis of different substances encountered during a criminal investigation and their Forensic application, understand the principles and instrumentation of these methods in analysis of samples/mixtures

Course Outcomes:

On completion of this course the students will have a thorough knowledge of the various instruments used in the analysis of different substances encountered during a criminal investigation. They would be able to understand the principles of various types of instrumentation, their Forensic application, their methods of sample analysis.

CO1	Enable students to understand and apply the knowledge of centrifugation in the separation of biomolecules/complex mixtures **(K2/K3)**
CO2	Enable students to understand the enzymatic kinetics and to compare it with chemical kinetics **(K5)**
CO3	Enable students to analyze different immunochemical interactions **(K4)**
CO4	Enable students to analyze the complex mixtures after chromatographic separation **(K4)**
CO5	Enable students to apply the principles of microscopy to analyze smaller (microsize) evidences **(K3/K4)**
CO6	Enable students to elaborate the knowledge of recent advancement in the field of Instrumentation physical chemistry **(K6)**

Text Book (s) & Reference Book (s)

1. Wilson And Walkers, Principles And Techniques Of Biochemistry And Molecular Biology 8th South Asia Edition 2018 by HOFMANN A, CAMBRIDGE UNIVERSITY PRESS
2. James M. Miller, Chromatography: Concepts and Contrasts, 2nd Edition
3. R J Mayer and J H Walker., Immunochemical Methods in Cell and Molecular Biology Academic Press, London. 1987.
4. Douglas B. Murphy and Michael W. Davidson, Fundamentals of Light Microscopy and Electronic

Introduction of gravimetric analysis and volumetric analysis, Acid base concept, indicators Theory, Introduction, Principles and theories of Column chromatography, Paper chromatography, TLC, Gas chromatography, HPLC, HPTLC

Imaging, Second Edition, First published:13 September 2012
5. Reiner WestermeierElectrophoresis in Practice: A Guide to Methods and Applications of DNA and Protein Separations, Fourth Edition,,First published:25 October 20046
6. Lewandowski, J., Meinikmann, K., & Krause, S. (2020). Groundwater–Surface Water Interactions: Recent Advances and Interdisciplinary Challenges
7. Vagi, M. C., & Petsas, A. S. (2020). Recent advances on the removal of priority organochlorine and organophosphorus biorecalcitrant pesticides defined by Directive 2013/39/EU from environmental matrices by using advanced oxidation processes: An overview (2007–2018). *Journal of Environmental Chemical Engineering*, *8*(1), 102940.

UNIT-I Centrifugation Techniques:	**8 hours**
Basic principles of sedimentation, various types of centrifuges, Density gradient centrifugation, Preparative centrifugation, Cell fractionation, Analysis of sub-cellular fractions, Ultracentrifuge-Refrigerated Centrifuges	
Unit-2 Enzyme Techniques	**10 hours**
Enzyme kinetics, Purification and protein estimation, Enzyme assay technique, Visible & ultraviolet Spectrophotometric methods - Instrumentation, Automated enzyme analysis, Immobilized enzymes.	
Unit-3 Immuno-chemical Techniques	**10 hours**
Gel immuno-diffusion, Immuno-electrophoresis, Radio Immuno Assay (RIA), ELISA, Fluorescence immuno assay.	
Unit-4 Chromatographic Techniques	**8 hours**
Unit- 5 Microscopy	**8 hours**

Definition and theory of microscopy, Different types of microscopes (Optical microscope - .Instrumentation and working of simple, compound microscope and stereomicroscope) and Electron microscope (Instrumentation and working of SEM and TEM)
Unit 6: Recent advancements in Analytical Chemistry for sustainable air/water remediation
Groundwater Surface Water Interactions: **Recent Advances** and Interdisciplinary Challenges

Continuous Assessment Pattern

Internal Assessment (IA)	**Midterm (MTE)**	**End term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	Applied Biology-II				
Course Code	**BBS08T5121**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course Objective:The objective of this course is to impart complete and thorough knowledge to the students regarding the various aspects of forensic biology, especially blood, its properties, its various methods of analysis and laboratory examination

Course Outcomes:

CO1	To Understand the types of bones in human skeletal system and establish identity on basis of skeletal remains
CO2	To Establish personal identity by using forensic facial reconstruction techniques
CO3	To assess the identity from various odontological evidences
CO4	To apply recent techniques to establish the identity from skeletal remains

Text Book (s) & Reference Book (s)

- James, S. H. And Nordby, J. J. (Eds), Forensic Science; An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
- Saferstein, Richard, Criminalistics - An Introduction to Forensic Science, 6^{th} Ed. Prentice-Hall, New Jersey, 1998.
- Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3^{rd} Ed) Universal Law Publishing Co. Ltd. New Delhi, 2001.

UNIT-I Forensic Anthropology	**8 hours**
Introduction, General Definition, Scope and Significance, Types of bones, Anatomy and physiology of major bones like pelvis, limb bones, skull, clavicle and sternum. Determination of sex, age, race and stature through bones, Skull, Pelvis, and long bones.	
Unit-2 Forensic anthropometry / Osteametry	**10 hours**
Determination of personal identity, superimposition technique, video image analysis, facial reconstruction from skeletal remains.Identification of burnt bones, recovery and identification of skeletal remains in accident crimes and mass disasters.	
Unit-3 Forensic Odontology and Bite marks Introduction, General Definition, Scope and Significance. Dentition,pattern, types and structure to teeth, age determination and identity of person from dental remains. Bite marks, Photography, lifting and preservation of bite marks, Forensic Significance of bite marks.	
Unit 4:Recent Advancement in forensic anthropology and odontology	
Recent advances in sex and age identification of human skeletal remains.Insight into Recent Advances of Forensic Odontology	

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Practicals– Forensic odontology and anthropology**
Course Code	BBS08P5107
Prerequisite	

Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives: Students will be able to identify different types of bones and determine age, sex and stature from skull, longbones, pelvis and mandible.

Course Outcomes

CO1	To study the identification and description of different types of bones.
CO2	To determine the sex from the human skull and pelvis
CO3	To determine age from the human skull and mandible.
CO4	To preserve and analyse bite marks from different surfaces

Text Book (s)&Reference Book (s)

- **Forensic Laboratory Handbook procedure and practice, Ashraf Mozayani, 2011**
- **Christensen AM, Passalacqua NV, Bartelink EJ. Forensic anthropology: current methods and practice. Academic Press; 2019 Jul 19.**

List of Experiments
1. To study identification and description of long bones bones. 2. To study identification and description of flat bones. 3. To study identification and description of pelvic girdle. 4. Estimation of stature using upper limb long bones. 5. Estimation of stature using Lower limb long bones. 6. Determination of age from skull . 7. Determination of age from mandible. 8. Determination of sex from skull. 9. Determination of sex from Pelvis. 10. Preparation of Dental chart 11. To analyze and preserve bite marks.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	**Electronic Circuits and Transducers**
Course Code	**BBS08T5122**
Perquisite	
Co requisite	

Anti requisite					
		L	T	P	C
		2	0	0	2

erence Books:

Course Objective: The students will be familiar with the various electronic components and their functioning in the analog and digital circuits. Also, they will learn the working of different types of transducers and measuring devices and their applications.

Course Outcomes

CO1	**Explain the basic components of electronics and design the circuits for various applications (K3)**
CO2	**Discuss the different types of transducers (K4)**
CO3	**Illustrate the basic principles and the working of different mechanical , electrical and other measuring devices (K4)**
CO4	**Propose the applications of transducers for energy harvesting (K6)**

Text Book (s) & Reference Book (s)

Text Book:
3. Integrated Electronics, J. Millman and C.C. Halkias , Tata Mc-Graw Hill.
4. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn., PHI Learning
5. Sensors and Transducers, D. Patranabis, PHI, 2nd edition.
6. Principles of Industrial Instrumentation, 2nd Edition , D.Patranabis, Tata McGraw Hill Publishing Co., New Delhi.
7. Priya, S. Advances in energy harvesting using low profile piezoelectric transducers. *J Electroceram* **19,** 167–184 (2007). https://doi.org/10.1007/s10832-007-9043-4
4. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw hill
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, Prentice Hall
6. Process Measurement and Analysis, 4th Edition (1995), Liptak B. G., Chilton Book Company, Pennsylvania.
7. Introduction to Measurements and Instrumentation, Arun K. Ghosh, PHI, 4th edition

Unit-I Electronics components and circuits	**8h**
Passive component; resisters, capacitors and inductors, transformers and its types. Active component; diodes and its identifications, Zener diode, transistors, Basics of LR, CR, LCR Circuits, Rectifier circuits, Wave Shaping Circuits, photo-sensors. Diode and transistors as logic gates and application of logic gates.	
Unit- II Transducers:	**8 h**

Recent advancement in Electronic Circuits and Transducers: Advances in energy harvesting by low profile piezoelectric transducers

Transducers –electrical transducers, strain gauge, resistance thermometer, thermistors and its applications.
Uses of Linear Variable Differential Transformer (LVDT), capacitive transducers, piezo-electric transducers, photo-electric transducers.

Unit III: Measuring Devices	**6h**
Mechanical flow meter. anemometer, power and watt meters, TDS meters, spectrophotometer, rain gauge, metal detector, breath analyzer, pH meters.	
Unit IV: Application of Electronic Circuits and Transducers	**2 h**

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**PHYSICS LAB –III (Electronic devices)**				
Course Code	BBS08P5108				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives: This lab is designed to make the students to learn the experiments based on passive elements, diodes, transistors, ICs and operational amplifies. From this lab students will acquire the knowledge of applying the resisters, capacitors, inductors, diodes and transistors in the electronic circuits

Course Outcomes

CO1	Interpret the basic principles of the experiments and analyse the results
CO2	Explain the characteristics of different diodes and transistors and their applications
CO3	Employ the understanding of logic gates using transistors and diodes to design switches, AND, OR, NOT, XOR gates

Text Book (s)&Reference Book (s)

Text Book (s)

1. B.Sc. Practical Physics by C.L Arora , S. Chand Limited.
2. B.Sc. Practical Physics by Harnam Singh, S. Chand Limited

3. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGrawHill.
4. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-GrawHill.

Reference Book (s)

a. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, Heinemann Educational Publishers
b. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, PrenticeHall.
c. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
d. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, Vani Publication.
e. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Edn., 2011, KitabMahal

List of Experiments

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses
2. To study the characteristics of a series RC Circuit
3. To measure the resistivity of a semiconductor (Ge) crystal with temperature by four-probe method (room temperature to 150 ^{o}C) and to determine its band gap
4. To study V-I characteristics of PN junction diode
5. Study of Tunnel diode characteristics
6. To study the V-I characteristics of a Zener diode and its use as voltage regulator
7. Study the characteristics of Transistors
8. To design a switch (NOT gate) using a transistor
9. To verify and design AND,OR,NOT and XOR gates using NAND gates.
10. Operational Amplifiers and its applications

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	Research Methodology and Statistics				
Course Code	BBS09T2411				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite	-				
		L	T	P	C
		2	-	-	2

Course Objective: The objective of the course is to impart research based knowledge to the students. They would be taught the various ways of data collection, research methodologies adopted in different settings, and statistical methods.

Course Outcome:

CO1	Students will get separately familiar with terms research and methodology, respectively.
CO2	Identifying different type of research sampling and research design.
CO2	Students will understand raw data, primary data, secondary data and their different methods of collection.
CO4	Students will appraise the application of sampling through statistics.
CO5	Students will get familiar with different descriptors of statistics to analyse data both quantitatively and qualitatively.
CO6	Students will develop the statistical analysis indulges in modern research for drug designing.

Course Contents:

Module I: Introduction to Research Methodology	6-Lectures
Definition, concept and research in science; Introduction to Research Methodology, Research methodology in science.	
Module II: Research in Scientific and Social Settings	5-Lectures
Research Design: Research Sampling, rationale for using a particular sampling procedure, Probability.	
Module III: Tools of Data Collection	5-Lectures
Data and its types, Methods for Collecting Data, Observation method, Questionnaire, Other Methods	
Module IV: Introduction to Statistics	4-Lectures
Introduction to statistics (Biostatistics); Sample and Population, parametric and non parametric statistics.	
Module V: Descriptive Statistics	5-Lectures
Measures of central tendency; Measures of dispersion and deviation; graphical representation of the data. Correlation and Regression	
Unit 6: Recent research advances	3 hrs
Descriptors, Quantitative structure-activity relationship (QSAR) , Quantitative structure-property relationship(QSPR), Drug designing.	

Text & References:

- Broota, K. D., Experimental designs in psychological research, Wiley eastern, New York, 1992.
- Guilford, Statistics in Psychology and Education, McGraw Hill, New York, 1986.
- J T Walker, Statistics in Criminology and Criminal Justice analysis and Interpretation
- Leo, A., & Hoekman, D. H. (1995). *Exploring QSAR*. American Chemical Society.
- Chanin Nantasenamat, Chartchalerm Isarankura-Na-Ayudhya, Thanakorn Naenna, Virapong Prachayasittikul, A Practical Overview of Quantitative Structure- Activity Relationship. EXCLI Journal 2009;8:74-88.
- Wiktor Pronobis, Alexandre Tkatchenko, and Klaus-Robert Muller, J. Chem. Theory Comput. 2018, 14, 2991−3003

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Semester V

Name of The Course	Forensic Medicine				
Course Code	**BBS08T3123**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective: Course Objective:To study the different types of injuries sustained by a person, examination of such wounds and their medico legal aspects. To understand the cause, dimensions and age of the injury. To study the causes of death, and post mortem examination, and identification of unknown bodies through various means.

Course Outcomes:

CO1	To understand the legal procedure and Medical Jurisprudence
CO2	To present a complete knowledge about the medicolegal aspect of death and post mortem examination
CO3	To learn about the cause, mechanism and the types of asphyxial deaths.
CO4	To understand the different types of injuries sustained by a person, examination wounds and their medico legal aspects
CO5	To acquire good knowledge regarding the personal identification of unknown bodies through various means.
CO6	To elaborate the knowledge regarding the non invasive techniques for autopsy

Text Book (s) & Reference Book (s)

Sharma, B.R., Forensic Science in Criminal Investigation and Trials (3rd Edn.) Universal Law Publishing Co. Ltd. New Delhi

- Modi, Jaishing P, Textbook of Medical Jurisprudence & Toxicology, M.M. Tripathi Pub. 2001.
- Parikh, Textbook of Medical Jurisprudence & Toxicology, 2001.
  - Delafield F. A hand-book of post-mortem examinations and of morbid anatomy. W. Wood & Company; 1872.

Unit-1 Introduction	**8 hours**
Medical Jurisprudence, Legal Procedure in India: -Police inquest, Magistrate's inquest, Coroner's inquest, Oath and affirmation. Documentary evidence: -Medical certificates, medical reports, dying declaration. Understanding laws and ethics of medical practice.	
Unit-2 Medico legal aspects of death	
Diagnosis of death-somatic & molecular, early and intermediate changes following death, late changes after death-putrefaction, autolysis, bacterial action, factors affecting these changes. Determination of time since death. Post-mortem examinations; external examination; internal examination. collection, preservation and packaging of viscera.	
Unit-3 Asphyxial deaths	
Definition, violent asphyxial deaths- hanging, ligature strangulation, throttling, suffocation, Drowning.	

Unit-4 Wounds and their medicological aspect
Introduction to wounds; definition, types of injures: Abrasions, grazes, lacérations, Bruises, contusion, Punctured wounds, incised wounds and identification ante – mortem, post – mortem injuries. Medico – legal aspects of wounds; Determining the age of the injury, Identifying,difference between suicidal, homicidal and accidental wounds.
Unit-5 Personal Identification
Importance and need for personal identification, Documents proof, scars, professional marks, personal articles, Finger printing, dentures, Portrait Parley and photographs, skeletal remains, ; identification in mass disasters, mutilated remains and decomposed bodies.
Unit 6:Current trend in the field of forensic medicine
Collection and Submission of Postmortem Specimens from Deceased Persons with Known or Suspected COVID-19 , Non invasive techniques for the autopsy

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Explosives				
Course Code	**BBS08T3124**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course Objective: To learn the kinetics and thermochemistry of explosives.To gain knowledge of the explosion effects and manufacturing of different explosives.To understand analysis of various explosive residues.

Course Outcomes:

CO1	To learn the kinetics and thermochemistry of explosives and also about classification of different types of explosives .
CO2	To gain knowledge of the explosion effects and manufacturing & development of different explosives
CO3	To understand about how to locate and collect explosive residues
CO4	To Examine and analyze explosive residues by different techniques.
CO5	To understand about different acts related to Explosives.
CO6	Elaborate the recent advancement in the field of forensic science for explosive residue analysis

Text Book (s) & Reference Book (s)

Text Book:

1. Nabar B S, ”Forensic Science in Crime Investigation”, Asia Law House, 2nd Edition, 2010.

2. Saferestein Richard, ”Criminalistics”, Pearson Prentice Hall, 13th Edition 2015.

Reference Book

1. Boudreau, JE et al – Arson & Arson Investigation, Surevey & Assessment National Institute of Law Enforcement, U.S Dept of Justice, US Govt. Printing Press (1977)
2. D.A. Skoog, D.M. West and F.J. Holler; Analytical Chemistry: An Introduction; Saunders College Publishing, Philadephia, USA, (1994)
3. Dettean, J D; Kirk’s Fire Investigation, 5thed, Prentice Hall, Eaglewood Cliffs, N.J (2002)
4. Working Procedure Manual: Chemistry, Explosives and Narcotics, BPR&D Pub (2000)
5. Y. Lyalikov; Physiochemical Analysis; Mir, Moscow, USSR, (1968)

Unit-1 Introduction and Classification of Explosives 8 hours

Definition of explosive and their physical and chemical properties, Classification of explosives: Primary explosives: lead azide, lead styphnate, mercury fulminate, tetrazene. Secondary explosives: TNT, RDX, PETN, Tetrayl, Gelatines, powders, ANFO, emulsion slurries, explosive high explosive mixtures
Unit 2- Detonators and fuses 4 hours
Introduction, plain and electric detonators, non electric detonators, delay detonators, detonating and safety fuse, visco fuse, Igniter Safety Fuse Electric, flying fish fuse, spolette, quick match, black match, slow match
Unit-3:Location, Collection of explosives residues 4 hours
Location and collection of fireworks, home-made bombs, traps bombs and letter bombs. Disposal of an explosive device, dispatch of explosive device and exploded material.
Unit-4Examination of Explosive Residue 5 hours
Chemical examination, Chromatographic techniques: TLC, HPLC, Vapor detection method: adsorption and concentration of explosive vapors, X-ray imaging. .
Unit-5 Legal Aspects of explosives 4 hours
Explosives Act 1884, (Definition, Powers of Central Govt. and Licensing Authority, Offencesand Penalties) and Section 286 of IPC, 1860, (Negligent conduct with respect to explosive substance), Explosive Substances Act 1908, (Definition, Offences and Penalties). Explosives (Amendments) Rules ,2018
Unit VI: Recent Advancement
Emerging techniques for the detection of pyrotechnic residues from seized postal packages containing fireworks, Fluorescent sensors for explosive detection, Detection of explosives in real liquid effluents like wastewater and landfill leachates.

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Explosives Lab**				
Course Code	BBS08P3109				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives: The objective of this course is to give practical exposure to the students about different types of explosives and examination of explosive remains and to gain the knowledge of different accelerants and its reaction in arson scenes, chemical examination of such accelerants, investigation of Arson scene and Pre &Post explosive bomb scene management.

Course Outcomes

CO1	Discriminate between different types of explosives, based on performance and structure.
CO2	Demonstrate and Practice the various methods of identification of explosive devices and techniques of locating hidden explosives and bomb scene management.
CO3	Construct a relational method for searching, collecting, preserving and analysing arson evidence.

CO4	Assess the methods of analysing trace amounts of petroleum products in crime scene evidence.

Text Book (s) & Reference Book (s)

Text Books:

1. S. Ballou, M. Houck, J.A. Siegel, C.A. Crouse, J.J. Lentini and S. Palenik in Forensic Science, D.H. Ubelaker (Ed.), Wiley-Blackwell, Chichester (2013).
2. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013).

References:

1. J.D. DeHaan, Kirk's Fire Investigation, 3rd Edition, Prentice Hall, New Jersey (1991).
2. A.A. Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, Scientific Evidence in Civil and Criminal Cases, 4th Edition, The Foundation Press, Inc., New York (1995).
3. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
4. Forensic Laboratory Handbook procedure and practice, Ashraf Mozayani, 2011
5. Explosives DFS Manual, 2005
6. Lab Manual Criminalistics An introduction to Forensic Science, Richard Saferstein (2007) Ninth Edition.

List of Experiments
· To describe, with the aid of diagrams, the different parts of Explosives devices and classification of Explosives. · To separate explosive substances using thin layer chromatography. · To perform qualitative analysis of explosives and explosive residue by colour test, microscopic examination and TLC/HPTLC and HPLC · To test the presence of inorganic anions and cations in explosive residues. · To prepare a case report on bomb scene management. · To carry out analysis of gasoline. · To carry out analysis of diesel. · To carry out analysis of kerosene oil. · To analyse arson accelerators. · To prepare a case report on a case involving arson.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	Introduction to Questioned Documents				
Course Code	**BBS08T3125**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

To know the different types of questioned documents, the types of forgery generally encountered. To learn the methods of their detection and examination and handwriting identification. To identify and do analysis of typewritten documents.

Course Outcome:

On completion of this course, the students would be able to know the different types of questioned documents, the types of forgery generally encountered, methods of their detection and examination, handwriting and typewriting identification.

CO1	Students will be able to delineate the basics of questioned documents and the sections dealing with expert testimony in IPC, IEA,Cr.PC. (K2)
CO2	Students will be able to handle, preserve and manage the questioned documents found at the scene of crime.(K4)
CO3	Students will be able to distinguish between the counterfeit and genuine currencies, passports , cheques ,credit and debit cards. (K3)
CO4	Students will be able to examine, analyze and differentiate various inks, papers and pens used in preparing a document. (K4)
CO5	Students will be able to identify class and individual characteristics, compare and form an opinion about the authorship of handwriting and signatures. (K6)

CO6	

Text Book (s) & Reference Book (s)

- Albert, S. Osborn, Questioned Documents, Second Ed., Universal Law Publishing, Delhi, 1998.
- Albert, S. Osborn, The Problem of Proof, Second Ed., Universal Law Publishing, Delhi, 1998.
- Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois, USA, 1971.
- Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA, 1971.
- Hard less, H.R., Disputed Documents, handwriting and thumbs – print identification: profusely illustrated, Low Book Co., Allahabad, 1988.
- Kurtz, Sheila, Grapholypes a new plant on handwriting analysis, Crown Publishers Inc., USA, 1983.
- Lerinson, Jay, Questioned Documents, Acad Press, London, 2001.
- Morris, Ron, N., Forensic handwriting identification, Acad Press, London, 2001.
- Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED., Elsevier, New York, 1982.
- Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997.

Unit-1Questioned Documents Types	**8 hours**
Definition of documents, questioned documents and the type of cases encountered; Importance, nature and problems of documents, Location, collection, handling and preservation of documents, adequacy of exemplars and standards.	
Unit-2 Handwriting & Signature Identification	**10 hours**
Principle of handwriting, individual and class handwriting characteristics. Identification, External, internal and physical characteristics affecting the handwriting of a person. Signatures: Authentic signatures, forged signatures, disguised signatures, traced signatures and their characteristics. Factors affecting the signature of individuals.	
Unit-3 Paper analysis	**8 hours**

Physical characteristics, water mark examination, fiber analysis, chemical and trace elemental analysis; Equipments required: Camera, Microscope, Reference standards, TLC and HPLC.
Unit-4 Examination of documents 10 hours
Examination of alterations, erasures, overwriting, additions and obliterations.examination, Determination of age of the documents, Instruments and equipments used for examination of fraudulent documents; Identification and comparison of typescripts, study of electronic printing and Photostat documents.
Unit-5 Methods of Detection 12 hours
Detection and deciphering of indented writing, charred documents, invisible/secret writing; Ink Examination, Composition of major types of writing inks (carbon ink, fountain pen ink, ballpoint pen ink, rolling ball marker inks, fiber or porous tips pen ink, analysis of writing inks and ink dating, Pencil lead examination
Unit 6: Recent trends in questioned documents research
Forensic document examination methods: Infrared absorption - fluorescence inspection is applied to altered and faded documents for identification. Electrostatic detection apparatus (ESDA), Personality identification through handwriting

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**PRACTICALS - Questioned Document**				
Course Code	BBS08P3110				
Prerequisite	Forensic Science, Forensic Photography, Crime scene management				
Corequisite	Instrumentation-Physical, Chemical				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives: The objective of this course is to give practical exposure to the students in the different aspects of Document Examination, Various characteristics of handwriting, analysis of ink samples, and use of some instruments for qualitative and quantitative estimation.

Course Outcomes

CO1	compare the class and individual characteristics of two samples of handwritings to find out the authorship of the writings. **(K6)**
CO2	Demonstrate various methods used to decipher invisible writings and indented writings found at the scene of crime.**(K2)**
CO3	Analyse various inks used to execute a document. **(K4)**
CO4	Plan various ranges of Photography of the questioned document found at the scene of crime helpful in documenting the evidence **(K3)**
CO5	Appraise the science of graphology

Text Book (s)

T1 Albert, S. Osborn, Questioned Documents, Second Ed., Universal Law Publishing, Delhi, 1998.

T2 Wilson, R., Harrison, Suspect Documents – Their Scientific Examination; Universal Law Publishing, Delhi, 1997.

T3 Charles C. Thomas, Typewriting Identification I.S.Q.D.; Billy Prior Bates; Springfield, Illinois, USA, 1971.

Reference Book (s)

R1 Charles, C. Thomas, I.S.Q.D. Identification System for Questioned Documents, Billy Prior Bates, Springfield, Illinois, USA, 1971.

R2 Lerinson, Jay, Questioned Documents, Acad Press, London, 2001.

R3 Morris, Ron, N., Forensic handwriting identification, Acad Press, London, 2001.

R4 Ordway Hilton, Scientific Examination of Questioned Documents, Rev. ED., Elsevier, New York, 1982.

List of Experiments	
	Photography of documents – area photography of evidence
	TLC of different ink samples – area ink analysis
	Identification of Invisible writing - area invisible writing (INK – ANIMAL)
	Identification of Invisible writing - area invisible writing (INK –PLANT)
	Identification of Invisible writing - area invisible writing (INK – CHEMICAL)
	Identification of Invisible writing - area invisible writing (INK – MISCELLANEOUS)
	Identification of security features in currency notes. – area security documents

	Identification of Indented writing – area indented writing
	Examinations of alterations and additions in documents. – area fraudulent document
	Examinations of obliterations in documents. – area fraudulent document
	Identification of class characteristics in handwriting. – area handwriting examination
	Identification of individual characteristics in handwriting. – area handwriting examination
	To compare the questioned handwriting with the standard handwriting and opine regarding their origin Interpretation of personality of writer using graphology

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	Applied Chemistry-I				
Course Code	**BBS08T3126**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

To impart the knowledge of the various subdivisions in forensic chemistry encountered in investigation such as narcotic drugs,oils and fats, material used in food adulteration and its analysis

Course Outcomes:

CO1	To get the knowledge of forensic chemistry, exhibits dealing and the analysis of inorganic compounds.
CO2	To explain and deliver the knowledge for the different classified drugs and their abuse and its forensic examination.
CO3	To describe the adulteration products added in different foods, and how to analyse them. With a knowledge of food adulteration act.
CO4	To understand the classification, characterization and analysis of various oils and fats.
CO5	To understand the legal provisions and act deals with the variant drugs and psychotropic substances.
CO6	To understand the new development in the field of forensic chemistry

Text Book (s) & Reference Book (s)

- A. Stolemen, Progress in Chemical Toxicology: Acad. Press, New York, 1963.
- Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986.
- Connors. , A test book of Pharmaceuticals analysis, Interscience, New York, 1975.
  - Tandon, T., & Collective, L. (2015). Drug policy in India. *IDPC briefing paper, February*.
- Cravey, R.H., Baselt, R.C., Introduction to Forensic Toxicology, Biochemical publications, Davis C A, 1981.
- Curry A.S., Analytical Methods in Human Toxicology, Part-II, 1986.,
- Curry, A.S., Poison Detection in Human Organs, C. Thomas Springfield, Illinois USA, 1963.
  - Smith, F. (2004). *Handbook of forensic drug analysis*. Elsevier.
- Modi, Jaishing P., Textbook of Medical Jurisprudence & Toxicology, M.M. Tripathi Pub., 2001.
- Mule, S.J. et al., Immunoassays for Drugs subjects to ab, CRC Press USA, 1974.
- Sunshine, I., Guidelines for Analytical Toxicology Programme, Vol. I, CRC Press, USA,1950.
  - India, & Malik, V. (2014). *Law Relating to Drugs and Cosmetics: Containing Drugs & Cosmetics Act, 1940, Drugs and Cosmetics Rules, 1945 Along with Drugs (Prices Control) Order, 2013, National Pharmaceuticals Pricing Policy, 2012 (NPPP-2012), Pharmacy Act, 1948, Poisons Act, 1919, Drugs and Magic Remedies (Objectionable Advertisements) Act, 1954 and Other Allied Acts, Rules Etc. with Information on Herbal Formulations, Cosmetics and Extracts, Etc*. Eastern book company.
- Sunshine, Methods of Analytical Toxicology, CRC Press USA, 1975.
- Working Procedure Manual – Toxicology, BPR&D Publication, 2000.
  - Wang, X., Cui, J., Zhuo, Y., Shen, B., Zhang, S., Liu, W., ... & Xiang, P. (2020). A Retrospective of Prevalence of Drugs of Abuse by Hair Analysis in Shanghai using LC–MS-MS. *Journal of Analytical Toxicology*.
  - Manousi, N., & Samanidou, V. F. (2020). Recent Advances in the HPLC Analysis of Tricyclic Antidepressants in Bio-Samples. *Mini Reviews in Medicinal Chemistry*, *20*(1), 24-38.

Unit-1 Forensic chemistry 8 Hours
Introduction, types of cases/exhibits, preliminary screening, presumptive test (colour and spot test), inorganic analysis, micro-chemical methods of analysis, Examination procedures involving standard methods and instrumental techniques.
Unit-2 Drugs of Abuse 8 Hours
Drugs of abuse: introduction, classification of drugs of abuse: Sedatives, Narcotics, Stimulants and Hallucinogens: their administration, symptoms, postmortem findings and medico-legal aspects; drugs of abuse in sports, narcotics drugs and psychotropic substances, designers drugs and their forensic examination. The identification of an addict, tolerance, signs and symptoms of addiction.
Unit-3 Food adulteration 8 Hours
Introduction, Examination of adulterations in different milk products (Khoya, Paneer, Milk, Butter etc) and spices (Red Chilli, Turmeric Powder, Coriander powder etc.) in Prevention of food adulteration, Analytical techniques for analysis of exhibits involved in food. Prevention of Food Adulteration Act 1954 (Definition, Power of Food Inspector, Offences and Penalties)

Unit-4 Oils and fats:
Definition and classification of oils and fats. Analysis and characterization of various oils and fats by physical, and chemical methods – Colour, Density, Specific gravity, Smoke point, Acid value, Peroxide value, Iodine value, Saponification value, self-stability value. Examination of adulteration in oils. Determination and significance of these aspects in quality control.
Unit-5 Legal Provisions 8 Hours
Narcotic Drugs & Psychotropic Substances Act 1985 (Definition, Licit Opium Cultivation, Minimum and Commercial Quantity in Narcotic Drugs, Offences and Penalties), Prevention of Illicit Trafficking in NDPS Act 1985 (Detention of a Person Under the Act), Drugs Control Act 1950(Definition, Power of Chief Commissioner Under the Act), Drugs & Cosmetics Act 1940 (Definition, Adulterated, Misbranded, Spurious Drugs and Cosmetics, Offenses and Penalties.)
Unit 6: Recent advancements
A Retrospective of prevalence of drugs of abuse by hair analysis using LC-MS-MS, **Recent advancement in HPLC analysis of antidepressants.**

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Practical applied chemistry-I**				
Course Code	BBS08P3111				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:

Students would be able to examine various categories of narcotics drugs and psychotropic substances along with drugs of abuse. They would also be able to identify adulterants in edible products along with the analysis of various oils and fats by chemical methods.

Course Outcomes

CO1	Examine various categories of drugs such as sedative, stimulants and hallucinogenic drugs.
CO2	Identify Narcotic drugs and psychotropic substances along with the drugs of abuse
CO3	Analyze adulterants in milk and spices
CO4	Examine various oils and fats along with analysis of adulterants in them .

Text Book (s)&Reference Book (s)

N K Rao, Textbook of Forensic Medicine and Toxicology, Chapter 21, p. 369, Irritant Poioson, 2nd edi., (JP Brothers Medical Pulisher P. LTD, 2006)

2. K. S. N. Reddy and O.P. Murty, The Essential of Forensic Science and Toxicology, Edi. (2006).

3. R. N. Karmakar, Forensic Science and Toxicology, p. 471, 3rd edi., (Academic Publisher, 2010).

4. K Vij , Textbook of Forensic Medicine and Toxicology: Principles and Practice, Chapter 43 p. 531, Agro-chemical Poisoning, 5th edn., (Elsevier, 2011).

5. https://www.scribd.com/doc/310201137/Toxicology-Manual, Laboratory procedure manual forensic toxicology, Directorate of Forensic Science, MHA, Govt. of India

6. Laboratory procedure manual of Forensic chemistry, Directorate of Forensic Science, MHA, Govt. of India

7. G. Sarathchandra, A. Albert, A.T. Venugopalan, Manual on Analytical Toxicology, Tamilnadu Veterinary & Animal Sciences University. Toxicology Unit, Central University Laboratory, Centre for Animal health Studies, Madhavram Milk Colony, Madras.

8. Toxicological Chemistry, LVIV–2009, Universitatis Medici Leopoliensis Sigillum. AD 1784.

9. C. Moffat, M. D. Osselton, B. Widdop, S. Jickells and A. Negrusz, Clarke's Analytical Forensic Toxicology, Introduction to Forensic Toxicology, Chapter 1, p. 1, 2nd edi., Editor: Adam negrusz, Gail A A Cooper, (Pharmaceutical Press, 2013).

List of Experiments
1. Examination of Sedatives drugs. 2. Analysis of stimulating drugs. 3. Detection of hallucinogenic drugs. 4. Analysis of Narcotic drugs. 5. Identification of psychotropic substances. 6. Analysis of drugs of abuse commonly encountered in sports. 7. Identification of adulterants in Milk products

8. Identification of adulterants in spices.

9. Analysis of various oils and fats by chemical methods

10. Identification of adulterants in oils.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**

Name of The Course	Applied Serology				
Course Code	**BBS08T5127**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:The objective of this course is to impart complete and thorough knowledge to the students regarding the various aspects of forensic biology, especially blood, its properties, its various methods of analysis and laboratory examination

Course Outcomes:

CO1	To Understand the nature of Blood and its various components
CO2	To present comprehensive knowledge of the various methods of analysis and laboratory examination of blood stains.
CO3	To determine the species of origin using various immunological methods
CO4	To assess the nature of the body fluid found at the crime scene and to present comprehensive knowledge of the various methods of analysis and laboratory examination of different types of body fluids
CO5	To understand the basic principle of bloodstain pattern analysis
CO6	To apply recent techniques for identification of various biological fluids

Text Book (s) & Reference Book (s)

- Eckert, W.G., & James S.H., Interpretation of bloodstain evidence at crime scene, CRC Press, Florida, 1989.
- James, S.H. and Nordby, J.J. (Eds.), Forensic Science - An introduction to Scientific and investigative Techniques, CRC Press, London, 2003.
- Kirk, P.L., Introduction in crime investigation (2^{nd}), John Willey and, New York, 1974.
- Saferstein, R. (1998).Criminalistics, An Introduction to Forensic Science, 6^{th} Ed. 6^{th} Ed. Prentice –Hall. New Jersey.
- M K Bhasin, A Laboratory Manual for Human Blood Analysis
- Richard Li, Forensic Biology: Identification and DNA Analysis
- Tom Bevel, Bloodstain Pattern Analysis with and Introduction to Crime Scene Reconstruction

Unit-1 Blood and its Properties	**8 hours**
The nature of blood, Components of blood- Cellular part & plasma part, study of blood composition and its functions, identification of blood cells by microscopic methods.	
Unit-2 Analysis of blood	
Collection, preservation & packing of blood evidence. Presumptive examination-Catalytic test (Phenolphthalein, Benzedine tests), Confirmatory test- crystal tests (Teichmann test, Takayama test and Wagenaar test). ABO system, Rh system and MN system; Techniques for the determination of blood groups from bloodstains: Absorption –inhibition, mixed-agglutination, Absorption-elution method	
Unit-3 Analysis of blood: Instrumental technique	
Spectrophotometric method, Electrophoresis methods: Cellulose Acetate Electrophoresis, Immuno-electrophoresis; chromatographic methods and immunological methods, Determination of species of blood: precipitin test (Ring test, immune-diffusion, Crossed-Over electrophoresis and others methods.	
Unit-4 Analysis of Biological Fluids	
Composition and examination of Biological Fluids such as Saliva, semen, Vaginal Fluid, Urine and sweat, Protection of Biological Evidences, collection, Packaging, preservation & transportation of Biological Evidences	
Unit-5 Blood Pattern Analysis	

History and evolution of Bloodstain Pattern analysis, target surface considerations, Size, Shape and Directionality of bloodstains, Basic tenets of bloodstain pattern analysis Bloodstain pattern on clothing and footwear, Documentation and Photography for Bloodstain Pattern Analysis. Preservation of blood evidence; procedures and precautions thereof.
Unit 6:Recent advancement in applied serology
Recent techniques for the identification of blood , semen, saliva, urine, vaginal fluid and sweat.

Continuous Assessment Pattern

Internal Assessment (IA)	**Midterm (MTE)**	**End term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	**Practical's - Serology**				
Course Code	BBS08P5112				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:The objective of this course is to give practical exposure to the students in the different aspects of Advanced Biology-1

Course Outcomes

CO1	Students will gain hand on experience in handling of Biological evidences, and their serological examination.
CO2	Students will able to identify unknown stain as blood.
CO3	Students will be able to identify unknown stain /sample as urine stain .
CO4	Students will able to identify unknown stain /sample as saliva stains

Text Book (s)&Reference Book (s)

Biology lab manual ·

Eckert, W.G., & James S.H., Interpretation of bloodstain evidence at crime scene, CRC Press, Florida, 1989.

- **James, S.H. and Nordby, J.J. (Eds.), Forensic Science - An introduction to Scientific and investigative Techniques, CRC Press, London, 2003.**
- **Kirk, P.L., Introduction in crime investigation (2nd), John Willey and, New York, 1974.**
- **Saferstein, R. (1998).Criminalistics, An Introduction to Forensic Science, 6th Ed. 6th Ed. Prentice –Hall. New Jersey.**
- **M K Bhasin, A Laboratory Manual for Human Blood Analysis**
- **Richard Li, Forensic Biology: Identification and DNA Analysis**
- **Tom Bevel, Bloodstain Pattern Analysis with and Introduction to Crime Scene Reconstruction**

List of Experiments
1. Examination of blood group/s from fresh blood 2. Examination of blood group/s from old blood stains 3. Preliminary Examination of blood by phenolphthalein test 4. Preliminary examination of blood by Benzidine test 5. Confirmatory Examination of blood by Takayama crystal test 6. Confirmatory Examination of blood by Teichmann crystal test 7. Examination of biological fluids (semen) 8. Examination of biological fluids(saliva) 9. Examination of biological fluid Urine by Jaffe's color test 10. Examination of body fluid urine by Urea Nitrate crystal test 11. Examination of blood stain pattern 12. To perform precipitin test for species of origin determination

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**Applied Physics I**				
Course Code	**BBS08T5128**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

On completion of this course, the students would be able to understand the physics of speech which is important in speaker identification, paint, soil tool marks another aspect that will be covered in this paper.

Course Outcomes:

CO1	Discuss the human vocal cord anatomy, production of voice and
CO2	Discuss the speaker identification and authentication and its forensic significance
CO3	Appraise the forensic importance of tool marks

CO4	Construct a relational comparison method for the forensic examination of soil and its legal aspects.
CO5	Estimate the forensic importance of paint and its legal aspects.
CO6	Handle various new techniques in the field of forensic physics.

Text Book (s) & Reference Book (s)

B. Caddy, Forensic Examination of glass and paints analysis and interpretation, ISBN 078405749 2001.

- Bengold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons, USA, 1999.
- C.E. O ‘Hara and J.W. Osterburg, An Introduction to Criminalistic, Indiana University Press, Blomington, 1972.
- Denis Shaw, Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.
- Carper, K. (ed.), Forensic Engineering, 2nd Edn. CRC Press, Bocarida, Florida, 2001.
- Field, J., and Carper, K., Construction Failure, 2nd Edn. John Wiley and Sons, New York, 1996.
- James, S.H. and Nordby, J.J. Eds., Forensic Science An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
- Nickolls, L.C., Scientific Investigation of Crime, Bulterwest, London, 1956.
- Philip Rose, Forensic Speaker Identification, Taylor & Francis Forensic Science series, London 2001.
- R. Saferstein, Forensic Science Handbook, Vols. I, II, (Ed), Prentice Hall, Eaglewood Cliffs, NJ; 1988.
- Raymond C Murray and John C.F Tendrew, Forensic Geology, Prentice Hall, New Jersey, 1991.
- Working Procedure Manual: Physics BPR&D Publication, 2000.

Unit -1: Physics of Speech	
Introduction, the generation of sound, amplitude vibration, simple motion, addition of sine waves, physical properties of vibrating propagation of sound waves, standing waves, modes of vibration.	
Unit-2 Speaker Identification	**8 hours**
Human Vocal cord anatomy, Production of voice, Basic factors of sound in speech, Speaker identification and authentication, various approaches in forensic speaker identification, application in automatic speaker identification and verification system. Voice analysis and their Forensic Significance.	
Unit-3 Tool Marks	**7 hours**
Types of tool marks: compression marks, striated marks, combination of compression and striated marks, repeated marks: class characteristics and individual characteristics, tracing and lifting of marks, Photographic examination of tool marks. Restoration of Erased / Obliterated Marks***:*** Methods of making-cast, punch, engrave; methods of obliteration, methods of restoration- etching (etchings for different metals), magnetic, electrolytic etc., recording of restored marks.	
Unit -4 Forensic Examination of Paint	

Types of paint and their composition, macroscopic and microscopic studies, pigment distribution, micro-chemical analysis- solubility test, pyrolysis chromatographic techniques, TLC, colorimetry, IR spectroscopy and X-ray diffraction, elemental analysis, interpretation of paint evidence.
Unit-5 Forensic Examination of Soil 12 hours
Classification and composition of soil, Variations in soil, Collection and preservation of soil evidence. Forensic analysis and examination of soil – Colour, density, molecular particle size distribution, turbidity test, pH measurements, microscopic examination, density gradient analysis, ignition-loss test, mineral analysis and chemical analysis of soil, the significance of soil evidence.
Unit 6: Recent research in applied physics
Gem Stones: Analysis of crystalline substances.

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Practicals –Applied Forensic physics I**				
Course Code	BBS08P5113				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:

The objective of the course is to impart knowledge and give hands on training for the analysis of various physical evidence.

Course Outcomes

On completion of this course, the students must be able to perform the analysis in the lab of various physical evidence such as paint, tool marks, soil.

CO1	To analyse the paint sample under microscope and by chemical methods.
CO2	To understand and examine the tool marks present at crime scenes using different techniques.
CO3	To develop and restore the obliterated tool marks by chemical methods.
CO4	To analyse the soil samples, present at crime scenes using different techniques.

Text Book (s)&Reference Book (s)

- **DFS Physics lab Manual**

List of Experiments

1. To perform chemical analysis of given paint samples.
2. To perform TLC of given paint samples.
3. Comparison of paint chips under microscope.
4. Refractive index of liquids by using abbey refractometer.
5. Examination of Tool marks.
6. Restoration of obliterated marks by chemical etching method.
7. Density gradient analysis of soil samples.
8. Particle size distribution of soil.
9. Examination of identification marks.
10. Restoration of obliterated marks on steel surfaces by chemical method.
11. Physical examination of soil sample.
12. Examination of soil sample using soil analysis kit.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Semester VI

Name of The Course	**Applied Chemistry-II**				
Course Code	**BBS08T3129**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:

To impart the knowledge of various petroleum products, beverages, arson, alkaloids and fertilizers and their analysis, importance in forensic investigation.

Course Outcomes:

CO1	Understand the usage and analysis of various petroleum products encountered in an investigation
CO2	To understand the difference in arson and fire , the collection and its importance in forensic investigation.
CO3	Examination of types of beverages and their medico legal aspects with the reference of cases.
CO4	To get the knowledge of different alkaloids substances and their analysis methods.

CO5	Analyse various types of fertilizers and other miscellaneous compounds handled in different cases.
CO6	Elaborate the knowledge of recent advancement in the field of forensic chemistry.

Text Book (s) & Reference Book (s)

- A. Stolemen, Progress in Chemical Toxicology: Acad. Press, New York, 1963.
- Clark, E.G.C., Isolation and identification of Drugs, Vol. I and Vol. II, Academic Press, 1986.
- Connors. , A test book of Pharmaceuticals analysis, Interscience, New York, 1975.
- Cravey, R.H., Baselt, R.C., Introduction to Forensic Toxicology, Biochemical publications, Davis C A, 1981.
- Curry A.S., Analytical Methods in Human Toxicology, Part-II, 1986.,
  - Fattorusso, E., & Taglialatela-Scafati, O. (Eds.). (2008). *Modern alkaloids: structure, isolation, synthesis, and biology*. John Wiley & Sons.
- Curry, A.S., Poison Detection in Human Organs, C. Thomas Springfield, Illinois USA, 1963.
- Mule, S.J. et al., Immunoassays for Drugs subjects to ab, CRC Press USA, 1974.
- Sunshine, I., Guidelines for Analytical Toxicology Programme, Vol. I, CRC Press, USA,1950.
- Sunshine, I., Guidelines for Analytical Toxicology, CRC Press USA, 1975.
- Sunshine, Methods of Analytical Toxicology, CRC Press USA, 1975.
  - Speight, J. G. (2015). *Handbook of petroleum product analysis*. John Wiley & Sons.
  - Popl, M., Fahnrich, J., & Tatar, V. (1990). *Chromatographic analysis of alkaloids*. M. Dekker.
  - Saleh, T. A. (2020). Characterization, determination and elimination technologies for sulfur from petroleum: Toward cleaner fuel and a safe environment. *Trends in Environmental Analytical Chemistry*, *25*, e00080.

Unit -1: Petroleum and Petroleum Products	
Petroleum and Petroleum Products- Commercial uses of different petroleum fractions. Analysis of traces of various Petroleum Products like Petrol, Kerosene, Diesel, Aviation Turbine Fuel (ATF-Kerosene) Lubricating oil, Furnace oil, etc. in forensic exhibits. Examination of adulteration in petroleum products like Diesel, Petrol, Kerosene etc	
Unit-2 Arson:	**8 hours**
Chemistry of fire, difference between Arson, cause of fire, origin of fire and collection of evidence, evaluation of clue material, Management of Arson cases, forensic Investigation of fire and arson cases.	
Unit-3 Study of Analysis of Beverages	**7 hours**
Introduction, Classification of beverages, Definition of alcohol and illicit liquor, Alcoholic and non-alcoholic beverages and their composition, Proof spirit, absorption, detoxication and excretion of alcohol, problems in alcohol cases and difficulties in diagnosis, Alcohol and prohibition, Consequences of drunken driving, and their medicololegal aspects and case studies	

Unit -4 Analysis of alkaloids
Alkaloids:-Introduction, Isolation, Classification. Structure determination, preparation, properties and applications of Cocaine, Piperine, Nicotine, isolation and properties of Quinine, Atropine, Ephedrine. Extraction and analysis of caffeine and catechine.
Unit-5 Miscellaneous: 12 hours
Characteristics, examination and legal aspects of gold, silver, sugar, salts, fertilizers, Detective dyes- cases and importance in trap cases. Fertilizers: Introduction, classification and analysis of fertilizers, Urea, ammonium nitrate, calcium phosphate.
Unit VI: Recent Advancements
Characterization, determination and elimination technologies for sulfur from petroleum: Toward cleaner fuel and a safe environment.

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Practical applied chemistry-II
Course Code	BBS08P3114
Prerequisite	
Corequisite	
Antirequisite	

	L	T	P	C
	0	0	2	1

Course Objectives:

Students would be able to examine adulterants in petroleum products and to distinguish among the various fractions of petroleum products. They would also be able to examine alcoholic beverages, extract the alkaloids, isolation of caffeine and catechine. They would be able to carry out trap analysis and examination of fertilizers.

Course Outcomes

CO1	Examine adulterants in petroleum products and to distinguish among the various fractions of petroleum products i.e. diesel, kerosene and petrol.
CO2	Examine various alcoholic beverages, extract the alkaloids and isolation of caffeine and catechine.
CO3	Carry out trap case analysis such as bribe case
CO4	Examine various categories of fertilizers

Text Book (s)&Reference Book (s)

1. N K Rao, Textbook of Forensic Medicine and Toxicology, Chapter 21, p. 369, Irritant Poioson, 2nd edi., (JP Brothers Medical Pulisher P. LTD, 2006)

2. K. S. N. Reddy and O.P. Murty, The Essential of Forensic Science and Toxicology, Edi. (2006).

3. R. N. Karmakar, Forensic Science and Toxicology, p. 471, 3rd edi., (Academic Publisher, 2010).

4. K Vij , Textbook of Forensic Medicine and Toxicology: Principles and Practice, Chapter 43 p. 531, Agro-chemical Poisoning, 5th edn., (Elsevier, 2011).

5. https://www.scribd.com/doc/310201137/Toxicology-Manual, Laboratory procedure manual forensic toxicology, Directorate of Forensic Science, MHA, Govt. of India

6. Laboratory procedure manual of Forensic chemistry, Directorate of Forensic Science, MHA, Govt. of India

7. G. Sarathchandra, A. Albert, A.T. Venugopalan, Manual on Analytical Toxicology, Tamilnadu Veterinary & Animal Sciences University. Toxicology Unit, Central University Laboratory, Centre for Animal health Studies, Madhavram Milk Colony, Madras.

8. Toxicological Chemistry, LVIV–2009, Universitatis Medici Leopoliensis Sigillum. AD 1784.

9. C. Moffat, M. D. Osselton, B. Widdop, S. Jickells and A. Negrusz, Clarke's Analytical Forensic Toxicology, Introduction to Forensic Toxicology, Chapter 1, p. 1, 2nd edi., Editor: Adam negrusz, Gail A A Cooper, (Pharmaceutical Press, 2013).

List of Experiments
1. Examination of adulterants in diesel. 2. Identification of adulterants in petrol. 3. Analysis of adulterants in kerosene. 4. To differentiate among diesel, petrol and kerosene 5. Examination of alcoholic beverages. 6. Extraction method of alkaloids. 7. Extraction and Isolation of caffeine and catechine. 8. Detection of caffeine and catechine in samples. 9. Analysis of Trap cases 10. Examination of fertilizers

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**DNA Profiling**				
Course Code	**BBS08T5130**				
Perquisite					
Co requisite					
Anti requisite					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objective:To understand the genetic basis of DNA typing, types and techniques of DNA typing , Polymerase Chain Reaction technique and the practical applications and forensic importance of DNA Fingerprinting. To know the types of evidences that are collected for conducting DNA typing

Course Outcomes:

CO1	To understand the basic concepts of genetics, heredity and DNA fingerprinting
CO2	To present comprehensive knowledge of the various methods of DNA profiling
CO3	To classify the various methods of DNA polymorphism and their use in disputed paternity and missing person cases .

CO4	To assess the various methods for the isolation and staining of DNA
CO5	To understand the application of DNA fingerprinting for personal and criminal identity.
CO6	To apply recent techniques for identification and isolation of genetic material

Text Book (s) & Reference Book (s)

- Norah Rudin and Keith Inman, (2nd Ed): An Introduction to Forensic DNA Analysis, CRC Press, New York, 2002.
- Sharma, B. R., Forensic Science in Criminal Investigation and Trials (3rdEdn) Universal Law Publishing Co. Ltd. New Delhi, 2001.
- John M. Butler, Forensic DNA Typing

Unit -1: Introduction
History of DNA fingerprinting, Human genetics – Heredity, Alleles, Mutations & Population. Definition, importance of DNA and RNA in Forensic Science; types of evidences & crime cases for DNA fingerprinting, collection, packing and preservation of evidences containing DNA
Unit-2 DNA profiling **8 hours**
Double helical structure of DNA, alternate forms of DNA double helix, replication, denaturation and renaturation of DNA, DNA binding proteins, factors affecting DNA stability, types and structure of RNA. Chemical nature of DNA and RNA. Nature and structure of human genome and its diversity.mt-DNA, nuclear DNA, Y-Chromosomes and the peopling, migration, of modern humans, Forensic DNA profiling and its application in criminal and civil investigations.
Unit-3 DNA polymorphism **7 hours**

Concept of gene – Conventional and modern views. Concept of sequence variation - VNTRs, STRs, Mini STRs , SNPs. Detection techniques - RFLP, PCR amplifications, Amp-RFLP, sequence polymorphism, Y-STR, Mitochondrial DNA. Disputed paternity cases.Missing person identity, population genetics and legal admissibility of DNA evidence.Concepts of length and sequence DNA polymorphism, DNA markers (VNTRs, Stars, SNPs, Y-STRs, mt DNA)- their importance and detection
Unit 4 - DNA Isolation techniques
Quantification and Quality assessment methods. PCR amplification – PCR process, components, controls, advantages and disadvantages, types of PCR, principle of PCR. PCR inhibitors, optimization and solution to PCR inhibition. Stochastic effect. PCR Primer designing. RT-PCR, process and Principle. DNA separation methods: Slab gel and Capillary Electrophoresis. Capillary electrophoresis-Principle and Instrumentation. DNA detection methods: Fluorescent Dyes and Silver–staining.
Unit-5 Miscellaneous: Forensic application of DNA Fingerprinting 12 hours
Paternity and maternity testing, personal identification, criminal identification and Forensic importance; Kinship testing and lineage markers DNA databanks, limitations of DNA Fingerprinting, legality of DNA Fingerprinting in India.
Unit 6:

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks

30	**20**	**50**	**100**

Name of The Course	**Practicals– DNA and Amino acid**				
Course Code	BBS08P5115				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives: To understand the procedure of extraction of amino acids and DNA from different tissue samples and hand on experience of PCR

Course Outcomes

CO1	To present a hand on experience of extraction of amino acid from different samples
CO2	To carry out the extraction of DNA from different tissue samples
CO3	To understand the procedure of DNA fragment separation using electrophoresis
CO4	To present a hand on experience of polymerase chain reaction.

Text Book (s)&Reference Book (s)

- Laboratory procedure manual of DNA, Directorate of Forensic Science, MHA, Govt. of India
- M K Bhasin, A Laboratory Manual for Human Blood Analysis
- · Richard Li, Forensic Biology: Identification and DNA Analysis

List of Experiments
1. To carry out the separation of amino acids by thin layer chromatography. 2. To carry out extraction of DNA from blood 3. To carry out extraction of DNA from Hair roots. 4. To carry out extraction of DNA from skin 5. To carry out extraction of DNA from plant tissue. 6. To preparation of gel plates for electrophoresis. 7. To carry out electrophoresis for separation of DNA fragments. 8. Quantification of DNA 9. PCR for DNA samples 10. To prepare a report on the role of DNA typing in solving paternity disputes.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	Applied Physics II				
Course Code	BBS08T5131				
Perquisite					
Co requisite					
Anti requisite					
		L	T	P	C
		3	0	0	3

Course Objective:

On completion of this course, the students would be able to understand the physics of Causes and investigation of vehicular accidents, and its legal implications. Analysis of glass fiber and cement used in the investigation of crime will be covered in this course.

Course Outcomes:

CO1	Demonstrate the tire and other marks identification, importance of eye witness and know how to investigate the vehicular accidents
CO2	To understand the application of legal aspects of vehicular accidents
CO3	Estimate the forensic importance of glass evidence
CO4	To apply recent techniques for identification of cement and concrete
CO5	To assess the various methods for the examination of Fibre
CO6	To apply recent techniques for identification in the field of forensic physics.

Text Book (s) & Reference Book (s)

B. Caddy, Forensic Examination of glass and paints analysis and interpretation, ISBN 078405749 2001.

- Bengold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons, USA, 1999.
- C.E. O ‘Hara and J.W. Osterburg, An Introduction to Criminalistic, Indiana University Press, Blomington, 1972.
- Denis Shaw, Physics in the Prevention and Detection of Crime, Contem Phys. Vol.17, 1976.
- Carper, K. (ed.), Forensic Engineering, 2nd Edn. CRC Press, Bocarida, Florida, 2001.
- Field, J., and Carper, K., Construction Failure, 2nd Edn. John Wiley and Sons, New York, 1996.
- James, S.H. and Nordby, J.J. Eds., Forensic Science An Introduction to Scientific and Investigative Techniques, CRC Press, London, 2003.
- Nickolls, L.C., Scientific Investigation of Crime, Bulterwest, London, 1956.
- Philip Rose, Forensic Speaker Identification, Taylor & Francis Forensic Science series, London 2001.
- R. Saferstein, Forensic Science Handbook, Vols. I, II, (Ed), Prentice Hall, Eaglewood Cliffs, NJ; 1988.
- Raymond C Murray and John C.F Tendrew, Forensic Geology, Prentice Hall, New Jersey, 1991.
- Working Procedure Manual: Physics BPR&D Publication, 2000.

Unit-1: Causes and Investigation of Vehicular Accidents-an overview 12 hours
Automobile accidents-Introduction, sources of information: eye witnesses, Tire and other mark, Pedestrian impacts and vehicle speed, vehicle condition, vehicle speed and damage, curved scuffmarks, Time and distance, reaction time, Vehicular Accident Photography. Rail Accidents- Investigation of rail crash: criminal and safety investigation, Investigation principles, Best Practices: rail company tests, inspection of driving cab, examination of electrical/electronic/technological system and their failure. Necessary equipments required for forensic examination.
Unit-2 Legal Aspects of Vehicular accidents 8 Hours
Relevant Provisions of Motor Vehicle Act, 1988 (Offenses and Penalties); Relevant Provisions of Indian Penal Code, 1860, (Sections 337 (causing hurt), 304 A (causing death due to negligence) and 279 (rash and negligent driving), Relevant Provisions of Motor Vehicle Act, 1939 (Offenses and Penalties). Relevant Provisions of Railway Act, 1989, (Offenses and Penalties).
Unit-3 Forensic Examination of Glass 11 hours

Classification and Types of glass, Composition of glass, Glass fractures- rib marks, hackle marks, cone fracture, wavy, backward fragmentation, concentric and radial fractures., Collection and preservation of glass evidence, Comparison of glass fragments, Examinations of glass fractures- Colour, fluorescence, physical measurements, refractive index, density gradient, becke-line, specific gravity examination and elemental analysis of glass evidences
Unit-4 Analysis of cement and concrete
Cement and Concrete-Cement- chemical composition of cement, mortar and concrete Detection and estimation of the constituents of cement, mortar and concrete in crime cases, bromoform test, fineness test, ignition-loss test. Identification of adulterated cement. Mortar and concrete analysis.
Unit-5 Examination of Fibre
Fibre Types of fibres, forensic aspects of fibre examination- fluorescence, optical properties, refractive index, birefringence, dye analysis. Physical fit and chemical testing. TLC, IR-micro spectroscopy. Difference between natural and man-made fibres. Fibre comparison of dye Component.
Unit 6: Physics of Bloodstain Pattern Analysis (BPA):
Introduction, Determination of Point of Convergence and Point of Origin. Impact spatter and mechanisms.

Continuous Assessment Pattern

Internal Assessment (IA)	Midterm (MTE)	End term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Practical –Applied Forensic physics II				
Course Code	BBS08P5116				
Prerequisite					
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives:

The objective of the course is to impart knowledge and give hands on training to the students for the analysis of various physical evidence found at crime scenes.

Course Outcomes

On completion of this course, the students must be able to perform the analysis in the lab of various physical evidence such as glass, cement, fibres.

CO1	To provide the information about the glass evidence, how to analyse the glass fracture and identification of fractures and sequence.
CO2	**To be able** to analyse/examine the glass pieces by density analysis technique.

CO3	To understand the adulteration in cement samples and analysing the adulteration present in samples using different techniques.
CO4	To examine the different fibres, present at crime scene and differentiate between them using different analysis techniques.

Text Book (s)&Reference Book (s)

DFS PHYSICS LAB MANUAL

List of Experiments
1. To study physical matching of broken glass pieces. 2. Determination of sequence of impact in glass fractures. 3. Study of glass fractures due to impacts and heat. 4. Examination of small glass pieces by flotation method. 5. To detect adulteration in cement samples. 6. To identify the nature of adulterants used in cement samples. 7. To check the quality of cement samples. 8. Physical examination of fibers. 9. Microscopic examination of fibers. 10. To perform burning test for fibers examination. 11. Determination of refractive index of glass.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	Projects				
Course Code	**BBS08R5117**				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Basic and Applied Sciences
Department of Life Sciences
Division of Biological Science

Programme: B.Sc. (Hons.) Biological Science

Scheme: 2020 – 2023

Vision

"To be known globally for value-based education, research, creativity and innovation"

Mission

9. **Establish state-of-the-art facilities for world class education and research.**
10. **Collaborate with industry and society to align the curriculum,**
11. **Involve in societal outreach programs to identify concerns and provide sustainable ethical solutions.**
12. **Encourage life-long learning and team-based problem solving through an enabling environment.**

School of Basic and Applied Sciences

Vision:

To be recognized globally as a center of excellence in imparting value-based education in Basic and Applied Sciences by creating innovation in fundamental and multidisciplinary research.

Mission

M1. To excel in imparting contemporary knowledge and skills by developing an educational ecosystem with diverse interests and talents.

M2. To perform cutting edge research leading to innovation in sciences through national and international collaborations.

M3. To develop solutions for the emerging challenges in Basic and Applied Science to cater the needs of society.

M4. To attract best quality faculty to facilitate knowledge and develop confidence in our graduates to succeed in the world.

Preamble

B. Sc. (Hons.) Biological Science is an undergraduate versatile course to teach biology as one of the integrating natural science domains. Biology is the science of life forms and living processes. Over centuries, biological knowledge has led to many technologies benefiting humans, be it in food security, health sector or national security. The applicants of the program study about the subjects like System physiology, Ecology, biochemistry Basic Microscopy & Instrumentation, Principles of Transmission Genetics, Principles of Immunology, evolutionary Biology, etc. Various elective courses are available that widens the horizons of the discipline of biological sciences. The duration of the course is three years and the complete syllabus of the program is divided into six semesters.

Scope of the Proposed Programme

The B.Sc., programme of three years is designed to help all the students to get good quality education in the field of Microbiology so that they can pursue Post Graduation or find employment. The ultimate aim is to enable the students to develop an integrated approach for understanding the various life science problems at the molecular level. In addition, the present curriculum gives scope for the students entering different modules to update their knowledge depending upon the employment opportunities in each area. Various practical courses have been designed not only to enable the students to appreciate scientific basis of various life processes but also to train them for self-employment.

There is a greater demand globally for trained manpower in the area of life science. After completion of the course candidate can work as Ecologist, Biochemist, Geneticist and Microbiologist, Weed Scientist, Science Adviser, Research Development, in Multinational Companies, Public Sectors, Quality Control Labs, Biopharmaceuticals companies as well as in Universities.

The course will provide solid foundation for all the students regardless of background and will gain a comprehensive understanding of the various processes concerning with life and allied areas, including clinical and research aspects and with the special attention to current development in the discipline.

Eligibility

Candidate for admission to the first year of B.Sc. Degree Course in Microbiology shall be required to have passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology

or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.

Programme Objectives

- To ignite young minds, from different backgrounds, to understand the principles which govern the biological system through application based learning.
- To provide high quality teaching to the students through traditional classroom teaching as well as varied exposure to audio-visual aids and hands on training on various aspects of Biological Science and allied biological subjects. More emphasis is given on understanding the subject rather than rote learning.
- Develop skills as a self-directed learner, recognize continuing educational needs.
- To equip the students to occupy important positions in Research, Industries and related organizations.
- To inspire the students to apply their knowledge gained for the development of society in general.

Program Educational Objectives (PEO)

PEO1: The graduates shall be successful professionals in Academia, Industry, Government and Entrepreneurship.

PEO2: The graduates shall pursue higher education/research at institute of national and international repute.

PEO3: The graduate shall effectively address the challenges of the society and undertake the projects for bridging the gap between industry and societal needs.

Programme Outcomes (POs)

PO1: Apply the principles and conceptual knowledge of basic and applied science to understand and solve the complex biological problems.

PO2: Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of biological reactions.

PO3: Create, select and apply appropriate techniques, resources and modern science and research tools within a defined specification that meet specified needs with appropriate consideration for public health and safety.

PO4: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal issues and the consequent responsibilities relevant to the professional biologist.

PO5: Understand the impact of professional life sciences solutions in communal and environmental contexts and demonstrate knowledge and need for sustainable development.

PO6: Articulate ideas, comprehend and write effective reports, documentation and to communicate effectively with the basic and applied sciences community and with society at large, professionally and ethically.

PO7: Demonstrate knowledge and understanding of science and technical principles to manage projects in multidisciplinary research areas and function effectively as an individual, and as a member or leader in diverse resource teams.

PO8: Seeking stimulation and to exploring numerous opportunities to engage in independent and life-long learning in the broadest context of technological change.

PSO1	Igniting young minds, from different backgrounds to understand the life processes in the biological system through application based learning.
PSO2	Equip students with analytical and technical skills to practice evidence based biological science for industrial and scientific applications.

Programme Specific Outcome (PSOs):

Curriculum

Sl. No	Course Code	Name of the Course					Assessment Pattern		
Semester 1									
			L	T	P	C	IA	MTE	ETE
1	BSDB1001	Chemistry	4	0	0	4	30	20	50
2	BSDB1002	Fundamentals of Cell Biology	4	0	0	4	30	20	50
3	BSBC1004	Light and Life	4	0	0	4	30	20	50
4	BSBC1003	Biochemistry	4	0	0	4	30	20	50
5	BSBA1061	Hands on Workshop on Basic Analytical Techniques and Measurements	0	0	4	2	50		50
6	BSBS1012	Biochemistry Lab-I	0	0	6	3	50		50
7	xxxx	Liberal Art				0.5			
8	xxxx	Soft Skill				0			
9	xxxx	Environmental Science		-	-	0.5			
10	xxxx	AI and Machine learning				2			
11	xxxx	BEC- B1				3			
12	xxxx	Computer awareness				0			
			Total			27			
Semester II									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSBD1007	Bioinstrumentation-I	4	0	0	4	30	20	50
2	BSDB1008	Ecology	4	0	0	4	30	20	50
3	BSDB1009	Hormones: Biochemistry and Function	4	0	0	4	30	20	50
4	BSDB1011	Concept of immunology	4	0	0	4	30	20	50
5	BSBC1013	Biological Science Lab-II	0	0	6	3	50		50
6	xxxx	BEC- B2				3			
7	xxxx	***Two week social internship (during summer)							
			Total			22			
Semester III									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB2001	Fundamentals of Molecular Biology	4	0	0	4	30	20	50
2	BSDB2002	Bioinstrumentation-II	4	0	0	4	30	20	50
3	BSBC2003	Fundamentals of Microbiology	4	0	0	4	30	20	50
4	BSBS2004	Biochemistry of Metabolism	4	0	0	4	30	20	50
5	BSBS2014	Biological Science Lab-III	0	0	6	3	50		50
6	BSBS2015	Biological Science Lab-IV	0	0	6	3	50		50

7	BSDB2006	Web based Course/Seminar -I				2			
			Total			24			
Semester IV									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCSE1020	Programming language in C and Python	4	0	0	4	30	20	50
2	BSDB2010	Biotechnology	4	0	0	4	30	20	50
3	BSBS2007	System Physiology	4	0	0	4	30	20	50
4	BSBS2008	Protein and Enzymes	4	0	0	2	50		50
5		Elective (Group-I, GE)	4	0	0	4	30	20	50
6	BSBS2017	Biological Science Lab-V	0	0	6	3	50		50
7	BCSE1031	Programming language in C and Python	0	0	6	3	50		50
8	Xxxx	IPR				1			
9	xxxx	Foreign Language				1			
10	BBS09T2411	Research Methodology and Statistics				2			
			Total			28			
Semester V									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSBC3001	Minor Project*	0	0	0	3	50		50
2	BSDB3003	Inheritance Biology	4	0	0	4	30	20	50
3	BSBS3004	Growth and Reproduction	4	0	0	4	30	20	50
4	BSDB3005	Evolutionary Biology	4	0	0	4	30	20	50
5	BSDBXXXX	Elective (Group-II, DSE)	4	0	0	4	30	20	50
6	BSBS3010	Biological Sciences Lab-VI	0	0	6	3	50		50
7	BSBS3011	Biological Sciences Lab-VII	0	0	6	3	50		50
8	XXXX	Campus to corporate				2			
			Total			27			
Semester VI									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSBS9997	Dissertation	0	0	0	12	50		50
2	BSDB3010	Web based Course/Seminar-I	0	0	0	2	50		50
					Total	14			

Group I

List of Electives									
Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB2011	Bioinformatics	4	0	0	4	30	20	50
2	BSDB2012	Biostatistics	4	0	0	4	30	20	50

3	BSDB2013	Biophysics	4	0	0	4	30	20	50
4	BSDB2014	Organic Farming	4	0	0	4	30	20	50
5	BSDB2015	Biofertilizers and Pesticides	4	0	0	4	30	20	50

Group II

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB3011	Nanobiotechnology	4	0	0	4	30	20	50
2	BSDB3012	Bioresource Management	4	0	0	4	30	20	50
3	BSDB3013	Biosafety and IPR	4	0	0	4	30	20	50
4	BSDB3015	Mushroom Culture Technology	4	0	0	4	30	20	50
5	BSDB3016	Parasitology	4	0	0	4	30	20	50

SEMESTER-I

Name of The Course	**CHEMISTRY**				
Course Code	**BSDB1001**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.

Course Outcomes

CO1	**Understand atomic structure with various Bohrs, Aufbau, Pauli's principles.**
CO2	**Describe chemical thermodynamics, law of thermodynamics.**
CO3	**Identify chemical bonding and molecular forces.**
CO4	**Express the knowledge stereochemistry.**
CO5	**Interpret the ionic equilibria.**
CO6	**Evaluate the applications of advancement of chemistry**

Text Book (s)

- J.D. Lee: A New Concise Inorganic Chemistry, E.L.B.S.
- P.W. Atkins : Physical Chemistry, Oxford University Press
- R.T. Morrison & R.N. Boyd : Organic Chemistry, Prentice Hall

Reference Book (s)

- P.W. Atkins : Physical Chemistry, Oxford University Press
- R.T. Morrison & R.N. Boyd : Organic Chemistry, Prentice Hall
- J.E. Huheeyetl.: Inorganic Chemistry : Principles of Structure and reactivity

Unit-1 ATOMIC STRUCTURE 12 hour **Recapitulation of Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Quantum numbers and their significance. Shapes of s, p, d and f orbitals. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms).Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.**
Unit-2 CHEMICAL THERMODYNAMICS 10 hour **Introduction of thermodynamics, state of system, state variables, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes. Laws of Thermodynamics.**
Unit-3 CHEMICAL BONDING AND MOLECULAR FORCES 09 hours **Introduction to ionic interactions and covalent bond, inter-molecular and intra-molecular forces, types of intermolecular forces and their characteristics: ion-dipole, dipole-dipole,**

dipole-induced dipole and dispersion (London) forces, hydrogen bond (intra-molecular and inter-molecular), effect of inter/intra-molecular forces on structure of different biomolecules.
Unit-4 STEREOCHEMISTRY 08 hours Optical isomerism: Optical activity, specific rotation, enantiomerism, D and L designation, racemic modification, R and S sequence rules, diasteroisomers. Conformational isomers: conformation of ethane and butane, interconversion of projection formula, cyclohexane (mono- and di-substituted), resolution, optical purity, Walden inversion, enantiotopic and diastereotopic hydrogens and prochiralcenters. Geometrical isomerism: Definition, nomenclature– E and Z.
Unit-5 IONIC EQUILIBRIA 08 hours Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and base, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Qualitative treatment of acid base titration curves. Theory of acid – base indicators.
Unit-6 RECENT ADVANCES IN CHEMISTRY 04 hours Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	FUNDAMENTAL OF CELL BIOLOGY				
Course Code	BSDB1002				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives:

1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
2. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

Course Outcomes

CO1	**Identify cell types, structure, functions and differentiate between various cell organelles.**
CO2	**Interpret the membrane biochemistry and transport of ions across the membrane.**
CO3	**Summarize the different types Cell-Cell Interaction and cellular communication.**
CO4	**Demonstrate protein sorting and transport.**
CO5	**Express the knowledge cell aging and death.**
CO6	**Evaluate the applications of advancement of fundamental of cell biology**

Text Book (s)

- The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN: 978-0-87893-300-6.
- Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN: 13:978-1- 4641-0981-2 / ISBN:10: 1-4641-0981-8.
- Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson, A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4.

Reference Book (s)

- Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN: 10:1-4292-3414- 8.
- Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson, A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN: 0-8153-1619-4.

Unit-1 STRUCTURE OF CELL 07 hours **Introduction to the cell, its chemical composition, Cell types - organization of prokaryotic and eukaryotic cells, Plant and animal cells: variation in structure and function, cell theory. Structure and functions of cell organelles – Nucleus, mitochondria, chloroplast, ribosome, lysosomes.**
Unit-2 MEMBRANE BIOCHEMISTRY 07 hours **Membrane: chemical composition and its structural plan; molecular model of cell membrane - fluid mosaic model and membrane fluidity; Overview of types of transport systems and macromolecule transport: Exocytosis; Endocytosis; Pinocytosis and phagocytosis.**
Unit-3 CELLULAR COMMUNICATION 10 hours **Cell Wall: Eukaryotic cell wall, Extracellular matrix and cell matrix interactions, Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata. Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules.**
Unit-4 PROTEIN SORTING AND TRANSPORT 12 hours **Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus.**
Unit-5 CELL CYCLE AND CELL DEATH 10 hours

Cell cycle - phases of cell cycle; cell division - mitosis and meiosis; Cell cycle regulation; Cell aging and death - necrosis and apoptosis; Stem cells. Types: Embryonic stem cell, induced pluripotent stem cells.
Unit-6 RECENT ADVANCES IN FUNDAMENTALS OF CELL BIOLOGY 04 hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**LIFE AND LIGHT**				
Course Code	**BSDB1004**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of light in biological system.

Course Outcomes

CO1	**Discuss the importance of light in biological system**
CO2	**Interpret the effect of light on plant morphology and physiology**
CO3	**Explain the basic mechanism of photosynthesis**
CO4	**Demonstrate the process of bioluminescence.**
CO5	**Describe the phenomena of circadian rhythms.**
CO6	**Evaluate the applications of advancement of life and light**

Text Book (s)

- Hawes C & Satiat-Jeunemaitre – 2001 Plant Cell Biology : Practical approach
- Buchanan B, Gruissem G & Jones R – 2000 – Biochemistry and Molecular Biology of Plants.

Reference Book (s)

- Hawes C & Satiat-Jeunemaitre – 2001 Plant Cell Biology : Practical approach
- Buchanan B, Gruissem G & Jones R – 2000 – Biochemistry and Molecular Biology of Plants.

Unit-1 LIGHT AND ITS ROLE IN BIOLOGICAL SYSTEM 12 hours **Nature of light, spectrum of light which is useful/ harmful (ionizing radiation) for various biological processes in life of plants and animals. Unit of light energy (Photon, quantum), the different Photo Biological reactions. Measurement of light (Lux, Foot Candle). Comparative account of chemistry and functional roles of pigments associated with harvesting light energy: pigments/receptors of light, chlorophylls, careteniods, phycobilinoproteins,**

bacteriochlorophylls, phytochromes rhodopsin etc. Photoreception in animals, evolution of eye and visual processing in vertebrate retina.
Unit-2 INTRODUCTION TO PHOTOBIOLOGY 12 hours **Definition of Photobiology, General account of effect of light on morphology and physiology (stomatal opening and closing, transpiration, respiration, growth and differentiation) Phytochrome mediated photomorphogenesis phenomena - seed germination etc. Photoperiodism: LDP, SDP, DNP plants, vernalization, vernalin, etiolation and deetiolation. Light as an ecological factor affecting distribution of plants and animals (Phyto and Zoo geography), in terrestrial and aquatic ecosystems: Morphological, Anatomical, Physiological and Behavioural adaptations to extreme light conditions by organisms. Changes during fruit ripening process as affected by light.**
Unit-3 PHOTOSYNTHESIS 12 hours **Photosynthesis: History, Photosynthetic equation, Light and dark reactions, mechanism of photolysis of water and oxygen evolution, Q cycle, O2 evolving complex; C3, C4, CAM plants, spectrum of photoautotrophs, photoautotroph vsphotoheterotrophs; Photoautotroph vs. chemoautotroph, structure of chloroplast and quantasome, Anoxygenic and oxygenic photosynthesis, reaction centers. Bacterial Photosynthesis.**
Unit-4 BIOLUMINESCENCE 06 hours **Bioluminescence: definition, discovery, diversity of organisms (plants and animals), photoreceptors - distribution, mechanism.**
Unit-5 BIOLOGICAL CLOCK 06 hours **Behavioural aspects of ecology and physiology: circadian rhythms, jetlag, rhythm of heart beat, melanocytes and skin colour, chromatophores and colour changes in animals.. Light as an inducer for biosynthesis of enzymes, hormones and other biomolecules.**
Unit-6 RECENT ADVANCES IN LIFE AND LIGHT 04 hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOCHEMISTRY**
Course Code	**BSDB1003**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**

Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: The course objectives are as following -

- **Demonstrate knowledge and understanding of the molecular machinery of living cells;**
- **Demonstrate knowledge and understanding of the principles that govern the structures of macromolecules and their participation in molecular recognition.**

Course Outcomes

CO1	Understand Chemical and physical foundations of biomolecules like carbohydrates.
CO2	Identify major classes of storage and structural lipids.
CO3	Understand the properties of amino acids, proteins and nucleic acids
CO4	Interpret basic concepts in enzymology and Vitamins function.
CO5	Express the knowledge in the area Bioenergetics.
CO6	Evaluate the applications of advancement of biochemistry

Text Book (s)

- Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
- Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
- Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
- Campbell, MKJ (2012) Biochemistry, 7th ed., Published by Cengage Learning

Reference Book (s)

- Berg, J. M., Tymoczko, J. L. and Stryer, L. Biochemistry. Freeman, 7th edition, 2011.
- Mathews, C. K. & Van Holde, K. E. & Ahern, K. G. Biochemistry. Addison Wesley, 4th edition, 2012.

Unit-1 CARBOHYDRATES	**07 hours**
Chemical and physical foundations of biomolecules, Carbohydrates: structure of sugars, classification, properties, chemical reactions, stereoisomerism and optical isomers of sugars, carbohydrate derivatives.	
Unit-2 LIPIDS	**07 hours**
Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids, Lipids with specific biological functions, micelles and liposomes.	
Unit-3 AMINO ACIDS, PROTEINS AND NUCELIC ACIDS	**12 hours**
Amino acids; classification, chemical reactions and physical properties; biosynthesis and catabolism; Nucleotides; biosynthesis and catabolism.	
Unit-4 ENZYMES AND VITAMINS	**12 hours**
Basic concepts in enzymology, enzyme classification, Enzyme kinetics, Enzyme inhibition: competitive, noncompetitive and uncompetitive inhibition, allosteric enzymes, Vitamins and cofactors: structure, distribution and biological properties.	
Unit-5 BIOENERGETICS	**08 hours**

First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy and Entropy and mathematical relationship among them, Standard free energy change and equilibrium constant, Coupled reactions and additive nature of standard free energy change, Energy rich compounds: Phosphoenolpyruvate, 1,3- Bisphosphoglycerate, Thioesters, ATP.
Unit-6 RECENT ADVANCES IN BIOCHEMISTRY 04 hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Hands on Workshop on Basic Analytical Techniques and Measurements**				
Course Code	**BSBA1061**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**2**

Course Objectives:

- To provide the knowledge of the scientific instruments in life sciences and biotechnology along with the applications.
- This will enable the students to understand all the subjects of biological sciences as these tools and techniques will be used therein.
- Also acquire the basic knowledge of the microbiological techniques to be applied in the laboratory.
- To know the general microbiological techniques for isolation of pure cultures of microorganisms.

Course Outcomes

CO1	**Demonstrate the basic principles, working and applications of different microscopic techniques.**
CO2	**Demonstrate the principle and applications of centrifugation technique.**
CO3	**Illustrate the principle and functioning of electrophoresis and chromatography.**
CO4	**Evaluate the different types of spectroscopic techniques**
CO5	**Deduce fundamental concept of radioactivity and radioisotopic techniques**
CO6	**Evaluate the applications of advancement of hands on Workshop on Basic analytical techniques and measurements**

Text Book (s)

- Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
- Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.
- An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

Reference Book (s)

- Principles and techniques of biochemistry and molecular biology. 6th ed. Wilson, Keith, Walker, John M Cambridge; New York : Cambridge. ISBN-10: 9780521178747.
- An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0

S.N.	Name of Practicals
1.	Different types of microscopes and its applications.
2.	Direct analysis of nanoparticle.
3.	Preparation of nano- particles.
4.	Preparation of solution and molarity and normality calculation.
5.	Measurement of surface tension and viscosity of given liquid.
6.	Soldering of electrical circuits
7.	Measurement with Verniercalipers, Screw gauge and spherometer
8.	Operation of oscilloscope
	Familiarization with linear, logarithmic and polar graphs for plotting of experimental data
	Assembling of elementary electric circuits using breadboard.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	BIOLOGICAL SCIENCE LAB I			
Course Code	BSBS1012			
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.			
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.			
Antirequisite				
	L	T	P	C
	0	0	6	3

Course Objectives:

- Supporting or strengthening theoretical knowledge.
- Experiencing the pleasure of discovery and development of their psycho-motor skills.

- Teaching how scientific knowledge may be used in daily life.
- Increasing creative thinking skills.
- Gains in scientific working methods and higher order thinking skills.
- Developing manual dexterity by using tools and equipment and allowing students to apply skills instead of memorizing.

Course Outcomes

CO1	**Display the various GLP with basic concentration problems**
CO2	**Demonstrate the basic principle and applications of important instruments**
CO3	**Handle extraction of enzymes using different sources**
CO4	**Measures the various factors affecting enzyme activity.**
CO5	**Perform the analysis of carbohydrates, Lipids and protein**
CO6	**Evaluate the applications of advancement of biological science laboratory experiments**

Text Book (s)

- G.Stehli**,** The Microscope And How to Use It, English edition, 1970.
- M.Sayer and A. Mansingh, PHI Learning. Measurement, Instrumentation and Experiment Design in Physics & Engineering, 2005.
- Aliofkhazraei, Mahmood, Handbook of Nanoparticles, Springer, 2016
- Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
- Aneja KR. Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai. 2005
- Horold J Benson. Microbiological Applications. Laboratory Manual in General Microbiology. 7th International Edition, WCB McGraw – Hill, Boston. 1998
- Dubey RC and Maheswari DK. Practical Microbiology 1st Edition, S. Chand & Company Ltd., New Delhi. 2004

Reference Book (s)

- Aliofkhazraei, Mahmood, Handbook of Nanoparticles, Springer, 2016
- Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
- Kannan N. Handbook of Laboratory Culture Media, Reagents, Stains and Buffers. Panima Publishing Corporation, New Delhi. 2003
- Kalaichelvan PT. Microbiology and Biotechnology – A Laboratory Manual 1st Edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai. 2005.
- ChellamRajamanicam – Experiments Protocols in Basic Molecularbiology. Osho Scientific Publications, Madurai.

S.N.	**Name of Practicals**
1.	**Study of the life history of the following scientists and their contributions with the help of their photographs: Anton von Leeuwenhoek, Linus Pauling, Kary Mullis, Robert Hoooke and Alexander Fleming.**
2.	**To study the principle and applications of important instruments (Microscope, Spectrophotometer, autoclave, Centrifuge) used in the microbiology laboratory.**
3.	**Qualitative analysis of carbohydrates present in the given solution.**
4.	**Qualitative analysis of amino acid and protein present in the given solution.**
5.	**Qualitative analysis of lipid present in the given solution.**
6.	**To understand the principle of Osmosis and Diffusion**

7.	Demonstration of different stages of mitosis.
8.	Demonstration the different stages of meiosis.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

SEMESTER-II

Name of The Course	BIOINSTRUMENTATION-I				
Course Code	BSDB1007				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have the basic knowledge of chemistry and environmental science.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students will understand the principle and application of basic instruments and the fundamental concept of microscopy, spectroscopy and radioisotopic techniques.

Course Outcomes:

CO1	Describe different types of microscopes for the study of cell, identification of cellular changes within organs
CO2	Explain various kind centrifugation techniques for study of separation of different cells and cellular organs
CO3	Describe the Principles and applications of chromatography, separation techniques based on chromatography, types of chromatography and application in industry
CO4	Explains absorbance based techniques like Visible and UV spectroscopy, Basic concepts and applications of MS and NMR.
CO5	Explain basic concepts of crystallography and its application
CO6	Evaluate the applications of advancement of bioinstrumentation I

Text Book (s)

5. Principles and Techniques of Practical Biochemistry Wilson, K., Walker, J. (eds.); Cambridge University Press, Cambridge, 2000, 784 pp., ISBN 0-521-65873.

6. An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.

Reference Book

3. Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.

Unit-1 SEPARATION TECHNIQUES (08hours)
Different methods of protein precipitation: Precipitation using inorganic salts (salting out) and organic solvents, isoelectric precipitation, Dialysis, Ultrafilteration, Lyophilization.
Unit-2 MICROBIAL TECHNIQUES (8 hours)
Buffer, Principle and working of pH meter, Laminar-air flow. Decontamination, sterilisation and disinfection techniques, media preparation technique, Culture of Human, Plant & Animal cells. Preparation of microbial, animal and plant samples for microscopy.
Unit-3 MICROSCOPY (10 hours)
Basic principles and applications of - Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM, Confocal Laser microscopy, Radio Microscopy.
Unit-4 CENTRIFUGATION (10 hours)
Basic Principle of Centrifugation, Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation, density gradient methods and their applications
Unit-5 COLORIMETRY AND SPECTROSCOPY (10 hours)
Simple theory of the absorption of light by molecules, Beer-Lambert law, Principle and use of study of absorption spectra of biomolecules. Visible and UV spectroscopy.Colorimetry, turbidometry, Spectrofluorimetry, nephelometry and luminometry.
Unit-6 RECENT ADVANCES IN BIOINSTRUMENTATION (04 hours) Research article/ Review paper/ MOOC.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	ECOLOGY
Course Code	BSDB1008
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.
Antirequisite	

	L	T	P	C
	4	0	0	4

Course Objectives: Ecology is "the scientific study of the distribution and abundance of organisms and the interactions that determine distribution and abundance". It is a tremendously diverse field of study, reflecting the incredible diversity of life, as well as the many types and levels of interactions that influence organisms.

Course Outcomes

CO1	**Describe the environment, habitat and Niche.**
CO2	**Analyze Ecosystem, Biome, Biosphere and Ecosphere**
CO3	**Interpret about Population ecology**
CO4	**Demonstrate Community and Ecosystem Ecology**
CO5	**Understand Species Interactions and Biogeography**
CO6	**Evaluate the applications of advancement of ecology**

Text Book (s)

- Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
- Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
- Odum, E.P. (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
- Ricklefs, R.E. (2000). Ecology. V Edition. Chiron Press

Reference Book (s)

- Basic Ecology: E. P. Odum, Indian Edition. Brooks/Cole
- P. D. Sharma Ecology and Environment, Rastogi publications, india.
- R. H. Whittaker, Communities and Ecosystems, New York and London: Macmillan Publishing Co. Inc., 1975. Second edition. Octavo, pp xx, 385.

Unit-1 THE ENVIRONMENT, HABITAT AND NICHE — 08 hours

Relevance of studying ecology, its history, autecology, synecology. Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Unit-2 ECOSYSTEM, BIOME, BIOSPHERE AND ECOSPHERE — 10 hours

Physical environment; biotic environment; biotic and abiotic interactions. Abiotic Factors: Laws of limiting factors- Liebig's law of minimum and Shelford's law of tolerance. A brief account of light and temperature as limiting factors, soil types and soil erosion.

Unit-3 POPULATION ECOLOGY — 10 hours

Population density, natality, mortality, life tables, fecundity tables, survivorship curves, Exponential/Malthusian and Sigmoid growth patterns, Verhulst-Pearl growth equation, 'r' and 'k' strategies. Population Growth regulation; Intrinsic mechanism- Density dependent fluctuations and oscillations, Extrinsic mechanism- Density independent, environmental and climatic factors, population interactions- types in a tabular form with examples. Niche concept, Gause's principle of competitive exclusion with laboratory and field examples, LotkaVolterra Equation for prey predator interaction, functional and numerical responses of prey and predator.

Unit-4 COMMUNITY AND ECOSYSTEM ECOLOGY — 10 hours

Nature of communities; community structure and attributes, community stratification, ecotone/edge effect, succession, stages of primary succession, climax community. Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).
Unit-5 SPECIES INTERACTIONS AND BIOGEOGRAPHY 08 hours **Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.**
Unit-6 RECENT ADVANCES IN ECOLOGY 04 hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	HORMONE : BIOCHEMISTRY AND FUNCTION				
Course Code	BSDB1009				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of endocrinology, hormones, mechanism of action and their functions.

Course Outcomes

CO1	Explain the concept of endocrinology.
CO2	Illustrate the basic concepts of hormones and their mechanism of action.
CO3	Explain the importance of pituitary gland hormone.
CO4	Demonstrate the role of thyroid and parathyroid gland in body metabolism.
CO5	Discuss about the importance of pancreatic, adrenal gland hormone.
CO6	Evaluate the applications of advancement of hormone: biochemistry and function

Text Book (s)

- Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962-1.
- Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
- Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

Reference Book (s)

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10-14641-0962-1.
2. Vander's Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
3. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.

Unit-1 INTRODUCTION TO ENDOCRINOLOGY 08 hours **Functions of hormones and their regulation. Chemical signaling - endocrine, paracrine, autocrine, intracrine and neuroendocrine mechanisms. Chemical classification of hormones, transport of hormones in the circulation and their half-lives. Hormone therapy. General introduction to Endocrine methodology.**
Unit-2 HORMONE MEDIATED SIGNALING AND GROWTH FACTORS 10 hours **Hormone receptors - extracellular and intracellular. Receptor - hormone binding, Scatchard analysis. G protein coupled receptors, G proteins, second messengers - cAMP, cGMP, IP3, DAG, Ca2+, NO. Effector systems - adenylcyclase, guanylcyclase, PDE, PLC. Protein kinases (PKA, PKB, PKC, PKG). Receptor tyrosine kinases - EGF, insulin, erythropoietin receptor; ras -MAP kinase cascade, JAK - STAT pathway. Steroid hormone/ thyroid hormone receptormediated gene regulation. Receptor regulation and cross talk. PDGF, EGF, IGF-II, and erythropoietin.**
Unit-3 HYPOTHALAMIC, PITUITARY AND REPRODUCTIVE HORMONE 12 hours **Hypothalamic - pituitary axis. Study the physiological and biochemical actions of hypothalamic hormones, pituitary hormones - GH, prolactin, TSH, LH, FSH, POMC peptide family, oxytocin and vasopressin, feedback regulation cycle. Endocrine disorders - gigantism, acromegaly, dwarfs, pigmies and diabetes insipidus. Male and female sex hormones. Interplay of hormones during reproductive cycle, pregnancy, parturition and lactation. Hormone based contraception.**
Unit-4 THYROID AND PARATHYROID HORMONE 12 hours **Thyroid gland. Biosynthesis of thyroid hormone and its regulation; its physiological and biochemical action. Pathophysiology - Goiter, Graves disease, cretinism, myxedema, Hashimato's disease. PTH, Vitamin D and calcitonin. Mechanism of Ca2+ regulation and pathways involving bone, skin, liver, gut and kidneys. Pathophysiology - rickets, osteomalacia, osteoporosis.**
Unit-5 PANCREATIC, ADRENAL AND GI TRACT HORMONES 10 hours **Regulation of release of insulin, glucagon, gastrin, secretin, CCK, GIP, adipolectin, leptin and ghrelin. Summary of hormone metabolite control of GI function. Physiological and biochemical action. Pathophysiology - diabetes type I and type II. Aldosterone, renin angiotensin system, cortisol, epinephrine and norepinephrine. Fight or flight response, stress response. Pathophysiology – Addison's disease, Conn's syndrome, Cushing syndrome.**
Unit-6 RECENT ADVANCES IN HORMONE : BIOCHEMISTRY AND FUNCTION 04 hours

Research article/ Review paper/ MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**CONCEPT OF IMMUNOLOGY**				
Course Code	**BSDB1011**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

- The students will be able to identify the cellular and molecular basis of immune responsiveness.
- The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.
- The students will be able to describe immunological response and how it is triggered and regulated.

Course Outcomes

CO1	**Describe the basic concept of immunology**
CO2	**It describes how immune response work in our body and explain defense mechanisms by CTL and NK cells**
CO3	**Demonstrate complementary system, organ transplantation, Antigen processing and presentation by MHC complex**
CO4	**Elucidate immunological disorders autoimmunity, hypersensitivity and immunodeficiency.**
CO5	**Evaluate vaccine production, Immunization, immunotherapy**
CO6	**Evaluate the applications of advancement of immunology**

Text Book (s)

- Immunology, 6th edition, (2006), J. Kuby et al, W.H. Freeman and Company, New York. ISBN-13: 978-1429202114.
- Roitt"s Essential Immunology, 12th edition, (2011), Wiley-Blackwell Science. ISBN-13: 978-1405196833.
- Cellular and Molecular Immunology, 7th edition, (2011). Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. Saunders. ISBN-13: 978-1437715286.

Reference Book (s)

- Immunology, 6th edition, (2006), J. Kuby et al, W.H. Freeman and Company, New York. ISBN-13: 978-1429202114.

- Cellular and Molecular Immunology, 7th edition, (2011). Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. Saunders. ISBN-13: 978-1437715286.

Unit-1 INTRODUCTION TO IMMUNE SYSTEM 10 hours **Types of immunity; organs and cells involved in immune system; Antigen, haptens, adjuvants, antigenicity, antigenic determinants and epitopes; Antibody structure and functions; Theories of antibody formation; Antibody diversity.**
Unit-2 IMMUNE RESPONSE 08 hours **Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance.**
Unit-3 COMPLEMENT SYSTEM AND MAJOR HISTOCOMPATIBILITY COMPLEX 10 hours **Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation. MHC - Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways).Transplantation - types, genetics of transplantation, graft versus host reactions.**
Unit-4 IMMUNOLOGICAL DISORDERS 12 hours **Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens, causes and therapy for cancers.**
Unit-5 VACCINES AND IMMUNOLOGICAL TECHNIQUES 10 hours **Vaccines - Types and their characteristics; Immunization practices-immunoprophylaxis and immunotherapy.Immunological techniques -Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy.**
Unit-6 RECENT ADVANCES IN CONCEPT OF IMMUNOLOGY 04 hours **Research article/ Review paper/ MOOC.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOLOGICAL SCIENCE LAB II**
Course Code	**BSBS1013**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry**

	from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives:

- This will enable the students to understand all the subjects of biological sciences as these tools and techniques will be used therein.
- Also acquire the basic knowledge of the microbiological techniques to be applied in the laboratory.
- To know the general microbiological techniques for isolation of pure cultures of microorganisms.

Course Outcomes

CO1	**Display the various methods of sterilization.**
CO2	**Construct various culture media.**
CO3	**Handle pure culture techniques.**
CO4	**Perform the isolation and estimation of DNA, RNA.**
CO5	**Perform the blood grouping, agglutination inhibition Assay.**
CO6	**Demonstrate the knowledge of laboratory practices in molecular biology, immunology and microbiology.**

Text Book (s)

- Aneja KR. Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai. 2005.
- Horold J Benson. Microbiological Applications. Laboratory Manual in General Microbiology. 7th International Edition, WCB McGraw – Hill, Boston. 1998.
- James G Cappuccino & Natalie Sherman Microbiology: A Laboratory manual. 6th Edition, Published by Pearson Education. 2004.
- Dubey RC and Maheswari DK. Practical Microbiology 1st Edition, S. Chand & Company Ltd., New Delhi. 2004

Reference Book (s)

- James G Cappuccino & Natalie Sherman Microbiology: A Laboratory manual. 6th Edition, Published by Pearson Education. 2004.
- Dubey RC and Maheswari DK. Practical Microbiology 1st Edition, S. Chand & Company Ltd., New Delhi. 2004.

S.N.	**Name of Practicals**
1.	**Preparation of nutrient broth for the routine cultivation of bacteria.**
2.	**Preparation of nutrient agar for the routine cultivation of bacteria.**
3.	**Isolation of microorganisms by streak plate method.**
4.	**To isolate the microorganisms by spread plate method.**
5.	**To isolate the microorganisms by serial dilution technique (or viable plate count method).**

6.	**Understanding the different components and working principle of light microscope using pre-prepared slide.**
7.	**Preparation of onion cell slide to study cell morphology using light microscope.**
8.	**To perform the isoelectric precipitation of casein present in milk.**
9.	**To determine the pH of 0.1 M NaOH and tap water using pH meter.**
10.	**Demonstrating the basic principle of centrifugation and calculating the relation tween RCF and RPM during centrifugation.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

SEMESTER-III

Name of The Course	FUNDAMENTALS OF MOLECULAR BIOLOGY				
Course Code	BSDB2001				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Molecular biology deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development. It is a large and ever-changing discipline. This course will emphasize the molecular mechanisms of DNA replication, repair, protein synthesis etc.

Course Outcomes

CO1	Explain the functional and structural organization of genetic material
CO2	Illustrate the different stages of DNA replication and type of DNA repair
CO3	Explain detail process of transcription and its regulation
CO4	Elucidate the mechanism of translation and posttranslational modification
CO5	Summarize the basic concept of gene regulation in pro and eukaryotes
CO6	Evaluate the applications of advancement of fundamentals of molecular biology

Text Book (s)

- Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414- 8.
- Molecular biology of the gene, (4thed)J D Watson, Benjamin/Cummings publ. Co Inc.
- Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN:13:978-1- 4641-0981-2 / ISBN:10: 1-4641-0981-8.

- Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4 / ISBN:0-8153-1620-8.

Reference Book (s)

- **Alberts B, Bray D, Johnson A et al. (1997) Essential Cell Biology. London: Garland Publishing.**
- **Darwin C (1859) On the Origin of Species. London: Murray.**
- **Graur D & Li W-H (1999) Fundamentals of Molecular Evolution, 2nd edn. Sunderland, MA: Sinauer Associates.**

Unit-1 NUCLEIC ACID STRUCTURE AND ORGANIZATION 08 hours **DNA and RNA as genetic material, chemical structure, base composition and types of nucleic acids, supercoiling of DNA, DNA reassociation kinetics (cot curve analysis), DNA organization into chromatin, bacterial and eukaryotic genomic organization.**
Unit-2 DNA REPLICATION AND REPAIR 08 hours **Enzymes and proteins of DNA replication, prokaryotic and eukaryotic replication mechanism, replication in phages and retroviruses, Mutagenesis, DNA damage and repair mechanisms.**
Unit-3 TRANSCRIPTION 08 hours **Transcription in prokaryotes and eukaryotes. Mechanism of transcription, enzymes and transcription factors. Post-transcriptional modifications in mRNA, rRNA and tRNA.**
Unit-4 TRANSLATION 12 hours **Genetic code - properties of the genetic code, deciphering of the genetic code. Translation in prokaryotes and eukaryotes; Translational mechanism in prokaryotes and eukaryotes, post translational modification and transport of proteins.**
Unit-5 REGULATION OF GENE EXPRESSION 10 hours **Regulation of gene expression in prokaryotes - The operon concept, lac &tryp operons. Transcriptional control. Post translational control. Regulation in eukaryotes - Control by promoter, enhancer and silencers. Cis-trans elements. DNA methylation & gene expression.**
Unit-6 RECENT ADVANCES IN FUNDAMENTALS OF MOLECULAR BIOLOGY 04 hours **Research article/ Review paper/ MOOC.**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	**BIOINSTRUMENTATION-II**
Course Code	**BSDB2002**
Prerequisite	**Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary**

	Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**
Antirequisite	

	L	T	P	C
	4	0	0	4

Course Objectives: Students are able to determine the principle of advanced spectroscopy, chromatographic techniques

Course Outcome:

CO1	**Describe different types of electrophoretic techniques for separation and isolation of biomolecules.**
CO2	**Explain various kinds of Spectroscopic techniques to characterize and detect structural changes in biomolecules.**
CO3	**Describe the principle and applications of various chromatographic techniques.**
CO4	**Explain the different types of radioactive detection techniques.**
CO5	**Demonstrate the principle of Sanger and Maxam Gilbert method of Nucleotide sequencing.**
CO6	**Evaluate the applications of advancement of bioinstrumentaion II**

Text Book (s)

11. **Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.**
12. **Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.**

Reference Book

5. **The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300- 6.**

Unit-1 ELECTROPHORESIS (10 hours)
Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.
Unit-2 ADVANCED SPECTROSCOPY (10 hours)
Basic concepts - Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD), Fluorescence spectroscopy, Infrared spectroscopy, FTIR, NMR spectroscopy. Mass spectroscopy- MALDI-TOF, Nano-SIMS (10L).
Unit-3 CHROMATOGRAPHY (10 hours)
Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ionexchange chromatography and affinity chromatography, GLC, HPLC.
Unit-4 RADIOGRAPHY (10 hours)
Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional

chamber, Autoradiography, FISH-MAR, Pulse chase experiment, Liquid scintillation counting, Phosphor imaging, IRMA, Dosimetry.	
Unit-5 ADVANCED TECHNIQUES	**(08 hours)**
Chemical synthesis of nucleotides and peptides, Sequencing of proteins and nucleic acids, Enzyme purification and assay techniques.	
Unit-6 RECENT ADVANCES IN BIOINSTRUMENTATION	**(04 hours)**
Research article/ Review paper/ MOOC.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**FUNDAMENTALS OF MICROBIOLOGY**				
Course Code	**BSDB2003**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

- Knowledge on Landmark discoveries in Microbiology and different domains classification of living organisms.
- Familiarity with general characters of prokaryotic and Eukaryotic microorganisms for conventional and molecular characterization using modern methods.
- Knowledge of cellular organization, life cycle and economic importance of prokaryotic (Eubacteria, Archaea, Cyanobacteria) and Eukaryotic (Algae, Fungi and protozoans).

Course Outcomes

CO1	**Discuss about history, diversity and scope of microbiology.**
CO2	**Explain microbial nutrition, growth and control of microorganism.**
CO3	**Describe microbial molecular biology and genetics.**
CO4	**Demonstrate viruses and microbial pathogenicity.**
CO5	**Interpret various applications of food and industrial microbiology.**
CO6	**Evaluate the applications of advancement of fundamentals of microbiology**

Text Book (s)

- Prescott & Dunn's Industrial Microbiology. Ed. E.G. Reed (1987). CBS Publishers, New Delhi.
- Biotechnology: A Text book of Induxctrial Microbiology 2nd Edition. Crueger, W. and Cruger, A. (2000) Panima Publishing Corporation, New Delhi.

- Manual of Industrial Microbiology and Biotechnology 2nd Edition. Ed. Arnold L. Demain and Julian E. Davies (1999) ASM Press Washington D.C.
- Microbiology, Pelczar Jr. M.J.: Chan E.C.S. and Krieg, N. R. (1993) Tata Mc. Graw Hill, New Delhi.

Reference Book (s)

- Prescott & Dunn's Industrial Microbiology. Ed. E.G. Reed (1987). CBS Publishers, New Delhi.
- Biotechnology: A Text book of Induxctrial Microbiology 2nd Edition. Crueger, W. and Cruger, A. (2000) Panima Publishing Corporation, New Delhi.

Unit-1 HISTORY, DIVERSITY AND SCOPE OF MICROBIOLOGY 12 hours **Discovery of microorganisms, spontaneous generation, germ theory of disease, members of the microbial world, scope and relevance of microbiology, Microbial taxonomy and phylogeny, Archaea, Bacteria, fungi, slime molds, water molds, algae, protozoa, helminths, the future of microbiology.**
Unit-2 BACTERIA 10 hours **An account of typical eubacteria, chlamydiae&rickettsiae (obligate intracellular parasites), mycoplasma, and Archaea. Applications of bacteria and Archaea in industry, environment and food.**
Unit-3 VIRUSES, VIROIDS AND PRIONS 09 hours **An introduction to viruses with special reference to the structure and replication of the following: Poxvirus, Poliovirus, HIV, T4 and λ phage, lytic and lysogenic cycles.**
Unit-4 ALGAE 09 hours **History of phycology; General characteristics of algae including occurrence, thallus organization, algae cell ultrastructure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food.**
Unit-5 FUNGI AND PROTOZOAN 08 hours **Historical developments in the field of Mycology, significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins, General characteristics with special reference to Amoeba.**
Unit-6 RECENT ADVANCES IN FUNDAMENTALS OF MICROBIOLOGY 04 hours **Research article/ Review paper/ MOOC.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOCHEMISTRY OF METABOLISM**				
Course Code	**BSBS2004**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students will understand the fundamental concept of biochemistry. It is a large and major inter disciplinary course. It will enhance the knowledge of chemistry within the living organisms. The course will emphasize the metabolism of carbohydrates, lipids, proteins and nucleotides.

Course Outcomes

CO1	**Explain the concept of energy production in the living cell.**
CO2	**Explain the fundamentals of carbohydrate metabolism.**
CO3	**Illustrate the process of synthesis and degradation of lipids.**
CO4	**Describe the metabolism of essential and non-essential amino acids.**
CO5	**Evaluate the metabolism of nucleotides.**
CO6	**Evaluate the applications of advancement of biochemistry of metabolism**

Text Book (s)

- Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414- 8.
- Biochemistry, 5th edition Jeremy M Berg, John L Tymoczko, and Lubert Stryer. New York: W H Freeman; 2002. ISBN-10: 0-7167-3051-0.

Reference Book (s)

- Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414- 8.
- Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN: 978-0-470-28173-4.
- Biochemistry, 5th edition Jeremy M Berg, John L Tymoczko, and Lubert Stryer. New York: W H Freeman; 2002. ISBN-10: 0-7167-3051-0.

Unit-1 BIOENERGETICS **10 hours** **Gibbs free energy, Entropy, Enthalpy, relationship among Gibbs free energy, Entropy and Enthalpy, Laws of thermodynamics, exergonic and endergonic reactions, coupled reactions. High energy compounds - ATP, synthesis of ATP, ATP-ADP cycle, storage of high energy phosphates.**
Unit-2 CARBOHYDRATES METABOLISM **08 hours** **Glycolysis, Krebs cycle, Glycogenesis, glycogenolysis, Gluconeogenesis, Pentose phosphate pathway, uronic acid pathway, Glycogen metabolism and glycogen storage diseases.**

Unit-3 LIPID METABOLISM	**08 hours**
Synthesis and degradation of triacylglycerols, phospholipids, glycolipids, eicosanoids; Biosynthesis of fatty acids; Oxidation of fatty acids; Ketone bodies; Metabolism of cholesterol - biosynthesis, lipoproteins synthesis and significance.	
Unit-4 AMINO ACID METABOLISM	**08 hours**
Structure and classification of aminoacids; Disorders associated with amino acid metabolism. Urea cycle– steps, regulation and disorders; Biosynthesis of polyamines– putrescine, spermidine and spermine.	
Unit-5 NUCLEOTIDE METABOLISM	**08 hours**
Purine metabolism – biosynthesis (de novo and salvage pathways), degradation, regulation and disorders of purine metabolism; Pyrimidine metabolism - biosynthesis (de novo and salvage pathways), degradation, regulation and disorders of pyrimidine metabolism.	
Unit-6 RECENT ADVANCES IN BIOCHEMISTRY OF METABOLISM	**04 hours**
Research article/ Review paper/ MOOC.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOLOGICAL SCIENCE- LAB-III**				
Course Code	**BSBS2014**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives:

- Supporting or strengthening theoretical knowledge.
- Experiencing the pleasure of discovery and development of their psycho-motor skills.
- Teaching how scientific knowledge may be used in daily life.
- Increasing creative thinking skills.
- Gains in scientific working methods and higher order thinking skills.
- Developing manual dexterity by using tools and equipment and allowing students to apply skills instead of memorizing.

Course Outcomes

CO1	**Perform the analysis of DNA and RNA**
CO2	**Perform the isolation, purification and cultivation of virus.**
CO3	**Demonstrate the recent techniques of the isolation and analysis protocol**

Text Book (s)

- Aneja KR. Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai. 2005
- Horold J Benson. Microbiological Applications. Laboratory Manual in General Microbiology. 7th International Edition, WCB McGraw – Hill, Boston. 1998
- James G Cappuccino & Natalie Sherman Microbiology : A Laboratory manual. 6th Edition, Published by Pearson Education. 2004
- Dubey RC and Maheswari DK. Practical Microbiology 1st Edition, S. Chand & Company Ltd., New Delhi. 2004
- Myer's and Koshi's Manual of Diagnostic Procedures in Medical Microbiology and Immunology / Serology. Published by Department of Clinical Microbiology, CMC and Hospital, Vellore, Tamil Nadu. 2001
- Sundararaj T. Microbiology – Laboratory Manual. Revised and Published by AswathySundararaj, No.5. 1st Cross Street, Thirumalai Nagar, Perundgudi, Chennai.
- Kannan N Laboratory Manual in General Microbiology. 1st Edition, Palani Paramount Publications, Palani, Tamilnadu. 1996

Reference Book (s)

- ChellamRajamanicam – Experiments Protocols in Basic Molecularbiology. Osho Scientific Publications, Madurai.
- Kannan N. Handbook of Laboratory Culture Media, Reagents, Stains and Buffers. Panima Publishing Corporation, New Delhi. 2003
- Kalaichelvan PT. Microbiology and Biotechnology – A Laboratory Manual 1st Edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai. 2005.

S.N.	Name of Practicals
1.	Isolation of DNA.
2.	Estimation of DNA.
3.	Isolation of RNA.
4.	Estimation of RNA.
5.	Demonstration of isolation of viruses.
6.	Demonstration of purification of viruses.
7.	Demonstration of cultivation of viruses.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOLOGICAL SCIENCE- LAB-IV**				
Course Code	**BSBS2015**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives:

- Supporting or strengthening theoretical knowledge.
- Experiencing the pleasure of discovery and development of their psycho-motor skills.
- Teaching how scientific knowledge may be used in daily life.
- Increasing creative thinking skills.
- Gains in scientific working methods and higher order thinking skills.
- Developing manual dexterity by using tools and equipment and allowing students to apply skills instead of memorizing.

Course Outcomes

CO1	**Understand the principle component of an ecosystem and its interactions.**
CO2	**Describe various soil testing methods.**
CO3	**Determination and estimation of biomolecules.**
CO4	**Determination and estimation of enzyme activity.**
CO6	**Demonstrate the different recent techniques**

Text Book (s)

- Myer's and Koshi's Manual of Diagnostic Procedures in Medical Microbiology and Immunology / Serology. Published by Department of Clinical Microbiology, CMC and Hospital, Vellore, Tamil Nadu. 2001.
- Kalaichelvan PT. Microbiology and Biotechnology – A Laboratory Manual 1st Edition, MJP Publishers, A Unit of Tamil Nadu Book House, Chennai. 2005.

Reference Book (s)

- ChellamRajamanicam – Experiments Protocols in Basic Molecular biology. Osho Scientific Publications, Madurai.
- Teresa Thiel, Shirley Bissen&Eilence M Lyons. Biotechnology – DNA & Protein – A laboratory project in Molecularbiology. International edition, published by Tata Mc. Graw – Hill publishing company, 2002.

S.N.	**Name of Practicals**
1.	**Study of all the biotic and abiotic components of any simple ecosystem- natural pond or terrestrial ecosystem or human modified ecosystem.**
2.	**Determination of population density in a terrestrial community or hypothetical community by quadrate method and calculation of the Simpson's and Shannon-Weiner diversity index for the same community.**

3.	**Principle of GPS (Global Positioning System).**
4.	**Study of the life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data.**
5.	**Study of the types of soil, their texture by sieve method and rapid tests for –pH, chlorides, nitrates, carbonates and organic carbon**
6.	**Study any five endangered/ threatened species- one from each class.**
7.	**Preparation of buffers**
8.	**Determination of PKa value for acetic acid**
9.	**Estimation of proteins by Biuret method**
10.	**Estimation of proteins by Lowry's method**
11.	**Separation of sugars by Thin Layer chromatography**
12.	**Assay of the enzyme acid phosphatase from germinated mungdal or β-amylase from**
13.	**Sweet potato beams**
14.	**Effect of pH on the activity of an enzyme**
15.	**Progress curve of an enzyme**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	**Web based course/seminar-I**				
Course Code	**BSDB2006**				
Prerequisite	**Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**0**	**2**

Course Objectives:

- **Students are** directly engage and learn particular subject of their interest. This strengthens the fundamentals of the student in the course.
- It gives the students the opportunities to explore new areas of interest. Also gives students the opportunity to learn in greater depth the subjects they wish to master.
- Promotes the self-learning initiative of the students – where their own motivation is what drives them to complete the course. This fosters the habit of keeping oneself updated always by means of self-study.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	ETE	Total Marks
50		50	100

SEMESTER-IV

Name of The Course	**PROGRAMMING LANGUAGE IN C AND PYTHON**				
Course Code	**BCSE1020**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: High-throughput technologies produce massive amounts of data, much too large to analyze by hand. The objectives are -

- To know how to convert a biological question into a computational problem that can be solved using computers.
- To know how to read and understand solutions to computational problems, which will be formalized as a series of tasks (an algorithm).
- To learn about general approaches for solving computational problems, and you will be able to apply these approaches to new problems you encounter.
- To know how implement the algorithms by writing computer programs in Python, which can be run and understood by others.

Course Outcomes

CO1	**Understand and explain the basics of computer and its components**
CO2	**Explain the data input and output, control systems and function**
CO3	**Explain the arrays, structure and union**
CO4	**Explain the use of pointer and interpret the file**
CO5	**Apply the Classes in C++**
CO6	**Evaluate the applications of programming languages**

Text Book (s)

- P Kanetkar Yashvant, Let us C, BPB Publications, New Delhi, Seventh Edition.
- E. Balagurusami, Programming in ANSI C, Tata McGraw Hill, Fourth Edition.
- Schaum Outline Series, Programming in C.
- Herbtz Schildt, "C++: The Complete Reference", Fourth Edition, McGrawHill.
- John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition,2000.
- Programming in ANSI C (4th Ed.) by E. Balagurusamy. Tata McGrawHill Publishing Company Limited. 2007
- Object Oriented Programming using C++ (4th Ed.) by Lafore, R. Sams Publishers. 2002
- Beginning PERL for Bioinformatics by James Tisdall. O'Reilly publications.2001.

Reference Book (s)

- P.K. Yashvant, Let us C, BPB Publications, New Delhi, Seventh Edition.
- E. Balagurusami, Programming in ANSI C, Tata McGraw Hill, Fourth Edition.

- Schaum Outline Series, Programming in C.
- H. Schildt, "C++: The Complete Reference", Fourth Edition, McGrawHill.
- J.R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.

Unit-1 INTRODUCTION TO COMPUTERS 10 hours **Introduction to computers:** Units of computers, Block Diagram, Generation of Computers, Characteristics of Computers, Phases of Computers, Different types of Memory, Input and Output Devices. **Logic Development and Program Development Tools:** Data Representation, Flowcharts, Problem Analysis, Decision Trees/Tables, Pseudo Code and Algorithms, Program Debugging, Compilation and Execution. **Fundamentals:** Character Set, Identifiers and Key Words, Data Types, Constants, Variables, Expressions, Statements, Symbolic Constants. **Operations and Expressions:** Arithmetic Operators, Unary Operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Library functions.
Unit-2 DATA INPUT AND OUTPUT 10 hours **Data Input and Output:** Single Character Input, Single Character Output, Entering Input Data, More About Scan Functions, Writing Output Data, More About Print Functions, Gets and Puts Functions, Interactive Programming. **Control Structures:** Introduction, Decision Making with If – Statement, If Else and Nested If, While And Do-While, For Loop. Jump Statements: Break, Continue, Goto, Switch Statement. **Functions:** Introduction To Functions, Function Declaration, Function Categories, Standard Functions, Parameters And Parameter Passing, Pass – By Value/Reference, Recursion, Global and Local Variables, Storage Classes.
Unit-3 ARRAYS 10 hours **Arrays:** Introduction to Arrays, Array Declaration, Single and Multidimensional, Array, Memory Representation, Matrices, Strings, String Handling Functions. **Structure and Union:** Declaration of Structure, Accessing Structure Members, Structure Initialization, Arrays of Structure, Nested Structures, Unions.
Unit-4 POINTERS 10 hours **Pointers:** Introduction To Pointers, Address Operator And Pointers, Declaring and Initializing Pointers, Assignment through Pointers, Pointers and Arrays. **Files:** Introduction, Creating a Data File, Opening and Closing a Data File, Processing a Data File.
Unit-5 USING CLASSES IN C^{++} 10 hours Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors, Overview of Template classes and their use. Introduction to Inheritance and Polymorphism.
Unit-6 RECENT ADVANCES IN PROGRAMMING LANGUAGE IN C AND PYTHON 04 hours **Research article/ Review paper/ MOOC.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BIOTECHNOLOGY				
Course Code	BSDB2010				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: The objective of the course is to familiarize the students with the basic concepts in biotechnology; to acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology; and to appraise them about applications genetic engineering.

Course Outcomes

CO1	Brief account of plant tissue culture and advantages of somatic hybridization
CO2	Interpret the basic techniques of cell culture
CO3	Demonstrate the different methods of DNA sequencing
CO4	Describe the type and process of genetic exchange
CO5	Evaluate the various categories of transposable element
CO6	Evaluate the applications of advancement of biotechnology

Text Book (s)

- Principles of Gene Manipulations 1994 by Old and Primrose Blackwell Scientific Publications.
- DNA Cloning: A Practical Approach by D.M. Glower and B.D. Hames, IRL Press, Oxford. 1995.
- Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers, Oxford. 1994.
- Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford 1998.
- PCR Technology - Principles and Applications for DNA Amplification by Henry A. Erlich (Ed.) Stockton Press. 1989.

Reference Book (s)

- Biotechnology: A Guide to Genetic Engineering by Peters.
- Genetic Engineering – 2000 by Nicholl.
- Recombinant DNA and Biotechnology: Guide for Teachers. 2nd Edition by Helen Kreuz. 2001. ASM Publications.
- Molecular Biotechnology: Principles and Applications of Recombinant DNA. 2 nd Edition. 1998 by Bernard R. Glick and Jack J. Pastemak, ASM Publications.

Unit-1 INTRODUCTION TO PLANT BIOTECHNOLOGY	**08 hours**
Basic introduction to animal and plant biotechnology; types of plant tissue culture, Somatic hybridization	

Unit-2 INTRODUCTION TO ANIMAL BIOTECHNOLOGY 08 hours **Animal Biotechnology - organ culture; cell culture and initiation of cell culture; evolution of continuous cell lines.**
Unit-3 CONSTRUCTION OF DNA LIBRARIES 10 hours **Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA), Quantification and storage of nucleic acids, Construction of cDNA library, Construction of Genomic library, Screening and preservation of DNA libraries, DNA Sequencing and cloning strategies.**
Unit-4 GENE TRANSFER TECHNIQUES 10 hours **Gene transfer techniques: biological methods; chemical methods; physical or mechanical methods.**
Unit-5 TRANSGENICS 10 hours **Plant Genetic Engineering: Restriction enzymes; Transformation of plant cells; different type of vectors including viral vectors and their benefits; Screening and selection of transformants, PCR and hybridization methods; Application of transgenic science in plant and animal improvement.**
Unit-6 RECENT ADVANCES IN BIOTECHNOLOGY 04 hours **Research article/ Review paper/ MOOC.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**SYSTEM PHYSIOLOGY**				
Course Code	**BSBS2007**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

- The major aims of this course are to provide students with a basic understanding of the fundamental processes and mechanisms that serve and control the various functions of the body.

- It should be noted that, although introductory, this course in System Physiology is comprehensive in scope. Areas treated in detail include both relatively simple cellular mechanisms as well as more complex interactions between whole organ systems.
- The major areas of study include excitable tissues, muscle, blood, the cardiovascular system and neurophysiology.
- To learn to properly and safely use animals and modern laboratory equipment to conduct research.

Course Outcomes

CO1	**Understand the cellular movement and transportation of nutrients**
CO2	**Explain the gaseous exchange and generation and utilization of energy**
CO3	**Demonstrate the regulatory physiology in plants and animals**
CO4	**Explain the sensory physiology in plant and animals**
CO5	**Understand the role of plant hormones and their effect**
CO6	**Evaluate the applications of advancement of system physiology**

Text Book (s)

- Knut Schmidt-Nielsen, Animal Physiology, Cambridge University Press.
- David Randall, Eckert's Animal Physiology, W.H. Freeman and Co.
- Philips Withers; Comparative Animal Physiology. Books Cole Publishers

Reference Book (s)

- Reddy, P. (2015). Dr.P.B. Reddy's Text Book of Animal Physiology. 10.13140/RG.2.1.4807.9441.
- P.S. Verma, V.K. Agarwal and B.S. Tyagi (2000). Anima Physiology by S. Chand Publication, India.

Unit-1 MOVEMENTS AND BULK TRANSPORT 12 hours **Cellular movements, ciliary and flagellar structure and function; Introduction to musculo skeletal system; Terrestrial, aquatic and aerial locomotion; Locomotory cost; Long distance transport of water and nutrients in plants (xylem and phloem transport); General plan and physiology of circulatory system in vertebrates and invertebrates.**
Unit-2 GAS EXCHANGE IN ORGANISM; GENERATION AND UTILIZATION OF ENERGY 15 hours **Exchange in unicellular organisms and plants; Respiratory organs in aquatic and terrestrial systems ; Physiology of aquatic breathing and aerial breathing; Feeding patterns, digestive tract systems; Digestion of food.**
Unit-3 REGULATORY PHYSIOLOGY 15 hours **Mechanism of opening and closing of stomata. Regulation of water and solutes in aquatic and terrestrial animals; Osmoregulatory organs. Transpiration in plants; Excretion of nitrogenous wastes in animals; Patterns of Thermoregulation: Ectotherms and Endotherms; Structural and functional adaptation to stress.**
Unit-4 SENSORY PHYSIOLOGY 10 hours **An overview of neuronal structure and function; Sensory physiology -mechano, chemo, thermo, photo and electro receptors.**

Unit-5 INTEGRATIVE PHYSIOLOGY	**08 hours**
Endocrine systems in animals and their physiological effects; Plant hormones and their physiological effects; Regulation of metabolism and response to environmental cues.	
Unit-6 RECENT ADVANCES IN SYSTEM PHYSIOLOGY	**04 hours**
Research article/ Review paper/ MOOC.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**PROTEIN AND ENZYMES**				
Course Code	**BSBS2008**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

The students should be able to demonstrate advanced knowledge and understanding in the following core areas-

- The principles of globular protein structure, as well as the techniques used for elucidation of structures and approaches to their prediction from sequence.
- Intermediates in enzyme.
- Identification/quantitation of polypeptide similarity. Identification of polypeptide families & superfamilies. Large scale sequencing projects, data analysis including comparative analysis.
- Protein synthesis mechanisms, especially with respect to ribosome structure-function and accuracy of translation, considered mainly in prokaryotes.

Course Outcomes

CO1	**Understand about the biomolecules and its distributions**
CO2	**Explain the structure and function of proteins**
CO3	**Demonstrate the classification of characteristic of enzymes**
CO4	**Explain the isolation of enzymes**
CO5	**Understand the role of metal in life**
CO6	**Evaluate the applications of advancement of protein and enzymes**

Text Book (s)

- Nelson, D. L. and Cox, M.M. (2008**).** Lehninger, Principles of Biochemistry, 5th Edition, W.H. Freeman and Company, N.Y., USA.
- Voet, D. and Voet, J.G. (2004). Biochemistry, 3rd Edition, John Wiley & Sons, Inc. USA.

Reference Book (s)

- Berg, J. M., Tymoczko, J. L. and Stryer, L. Biochemistry. Freeman, 7th edition, 2011.
- Mathews, C. K. & Van Holde, K. E. & Ahern, K. G. Biochemistry. Addison Wesley, 4th edition, 2012.
- Wilson, K. & Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. CUP, 7th edition.

Unit-1 BIOMOLECULES: DIVERSITY AND DISTRIBUTION 15 hours **Lipids: Role of lipids in cellular architecture and functions. Definition and classification of lipids. Structure and function of fatty acids, triacylglycerols, phospholipids and sterols. Carbohydrates: Biological roles of carbohydrates. Structure of monosacharides- Hexoses and pentoses. Disacharides-Sucrose, lactose, maltose. Storage and structural polysacharides-Glycogen, starch and cellulose. Nucleic acids: Role of nucleic acids in living system. Composition of nucleic acids-the purine and pyrimidine bases.**
Unit-2 PROTEINS 15 hours **Classification of proteins on the basis of composition, conformation and function-functional diversity of proteins. The amino acid building blocks-classification, structure and physical properties of the standard amino acids. Proteinaceous and non-proteinaceous, essential and non-essential amino acids. Primary, secondary, tertiary and qua ternary structure of proteins. Structure of myoglobin and hemoglobin. Molecular physiology of myoglobin and hemoglobin, Bohr effect, Hill's coefficient. Concerted and sequential models for allosteric proteins.**
Unit-3 ENZYMES 15 hours **Enzymes as biological catalysts. Enzyme classification and nomenclature. Chemical nature of enzymes, ribozymes. Concept of active site, specificity. Coenzymes, cofactors and prosthetic groups. Kinetics of enzyme catalyzed reactions – Michaelis Menten equation. Determination of Km and Vmax. Factors influencing the rate of enzyme catalyzed reactions. Enzyme inhibitions-competitive, non-competitive and uncompetitive inhibitions. Catalytic mechanism of lysozyme or chymotrypsin. Regulation of enzyme activity allosteric enzymes, feedback inhibition with ATcase as an example.**
Unit-4 ISOLATION AND PURIFICATION OF ENZYMES 10 hours **Methods of enzyme isolation and purification. Introduction to enzyme immobilization.**
Unit-5 ROLE OF METAL IONS IN BIOLOGY 10 hours **Metalloprotein, Metalloenzymes, metal base drug interaction and inhibition; metallo porphyrins, Redox. Carriers in mitochondrial electron transport chain.**
Unit-6 RECENT ADVANCES IN PROTEIN AND ENZYMES 04 hours **Research article/ Review paper/ MOOC.**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	BIOLOGICAL SCIENCE- LAB-V				
Course Code	BSBS2017				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		0	0	6	3

Course Objectives:

- This will enable the students to understand all the subjects of biological sciences as these tools and techniques will be used therein.
- Also acquire the basic knowledge of the developmental biology and immunological techniques to be applied in the laboratory.

Course Outcomes

CO1	Demonstrate the knowledge of laboratory practices in developmental biology
CO2	Demonstrate the knowledge of laboratory practices in molecular biology and immunology.
CO3	Demonstrate the advanced techniques in the biological science lab V

Text Book (s)

- Aneja KR. Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai. 2005.
- Horold J Benson. Microbiological Applications. Laboratory Manual in General Microbiology. 7th International Edition, WCB McGraw – Hill, Boston. 1998.
- James G Cappuccino & Natalie Sherman Microbiology: A Laboratory manual. 6th Edition, Published by Pearson Education. 2004.
- Dubey RC and Maheswari DK. Practical Microbiology 1st Edition, S. Chand & Company Ltd., New Delhi. 2004

Reference Book (s)

- James G Cappuccino & Natalie Sherman Microbiology: A Laboratory manual. 6th Edition, Published by Pearson Education. 2004 .
- Dubey RC and Maheswari DK. Practical Microbiology 1st Edition, S. Chand & Company Ltd., New Delhi. 2004

S.N.	Name of Practicals
1.	Study of whole mounts of frog and chick- early developmental stages
2.	Study of chick development from live eggs (window viewing)
3.	Study of section of chick embryo through selective developmental stages
4.	Videos showing selective embryonic events like cleavage; gastrulation.
5.	To perform ELISA experiment.

6.	**Grouping of blood and Rh typing.**
7.	**To perform Agglutination inhibition Assay.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	**PROGRAMMING LANGUAGES IN C AND PYTHON**				
Course Code	**BCSE1031**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding and a basic knowledge of the computing**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objective:

Students are able to understand the basic data structures used in programming (such as arrays and array lists).

Text / References Books:

9. **E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.**
10. **Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011.**
11. **John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.**
12. **Harry, H. Chaudhary, "Head First C++ Programming: The Definitive Beginner's Guide", First Create space Inc, O-D Publishing, LLC USA.**

19. Write a program to find greatest of three numbers.
20. Write a program to find gross salary of a person
21. Write a program to find grade of a student given his marks.
22. Write a program to find divisor or factorial of a given number.
23. Write a program to print first ten natural numbers.
24. Write a program to print first ten even and odd numbers.
25. Write a program to find grade of a list of students given their marks.
26. Create Matrix class. Write a menu-driven program to perform following Matrix operations (2-D array implementation): a) Sum b) Difference c) Product d) Transpose

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	Research Methodology and Statistics				
Course Code	BBS09T2411				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and chemistry				
Antirequisite	-				
		L	T	P	C
		2	-	-	2

Course Objective: The objective of the course is to impart research based knowledge to the students. They would be taught the various ways of data collection, research methodologies adopted in different settings, and statistical methods.

Course Outcome:

CO1	Students will get separately familiar with terms research and methodology, respectively.
CO2	Identifying different type of research sampling and research design.
CO2	Students will understand raw data, primary data, secondary data and their different methods of collection.
CO4	Students will appraise the application of sampling through statistics.
CO5	Students will get familiar with different descriptors of statistics to analyse data both quantitatively and qualitatively.
CO6	Students will develop the statistical analysis indulges in modern research for drug designing.

Course Contents:

Module I: Introduction to Research Methodology 6-Lectures
Definition, concept and research in science; Introduction to Research Methodology, Research methodology in science.
Module II: Research in Scientific and Social Settings 5-Lectures
Research Design: Research Sampling, rationale for using a particular sampling procedure, Probability.
Module III: Tools of Data Collection 5-Lectures
Data and its types, Methods for Collecting Data, Observation method, Questionnaire, Other Methods

Module IV: Introduction to Statistics 4-Lectures
Introduction to statistics (Biostatistics); Sample and Population, parametric and non parametric statistics.
Module V: Descriptive Statistics 5-Lectures
Measures of central tendency; Measures of dispersion and deviation; graphical representation of the data. Correlation and Regression
Unit 6: Recent research advances 3 hrs
Descriptors, Quantitative structure-activity relationship (QSAR) , Quantitative structure-property relationship(QSPR), Drug designing.

Text & References:

- **Broota, K. D., Experimental designs in psychological research, Wiley eastern, New York, 1992.**
- **Guilford, Statistics in Psychology and Education, McGraw Hill, New York, 1986.**
- **J T Walker, Statistics in Criminology and Criminal Justice analysis and Interpretation**
- Leo, A., & Hoekman, D. H. (1995). *Exploring QSAR*. American Chemical Society.
- **Chanin Nantasenamat, Chartchalerm Isarankura-Na-Ayudhya, Thanakorn Naenna, Virapong Prachayasittikul, A Practical Overview of Quantitative Structure- Activity Relationship. EXCLI Journal 2009;8:74-88.**
- **Wiktor Pronobis, Alexandre Tkatchenko, and Klaus-Robert Muller, J. Chem. Theory Comput. 2018, 14, 2991−3003**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

SEMESTER-V

Name of The Course	**MINOR PROJECT**				
Course Code	**BSBS3001**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**0**	**3**

COURSE CONTENTS:

Minor Project is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. The duration of Minor project is 1 month (4-6 weeks). A Minor Project may be given in lieu of a discipline specific elective paper/Biological Science.This should be done in consultation with the faculty supervisor and agency supervisor under whom he / she is getting trained. The project report should be around 20 pages and chaptered as follows:

Chapter I: Introduction
Chapter II: Review of Literature
Chapter -3: Methodology
Chapter IV: Results&Discussion
Chapter V: Summary and Conclusion

The research should be original and should be action oriented in that the results should be able to throw light on some of the important unexplored areas that would be of practical use to the microbiologists.

Students are expected to decide on the specific project area and title, and carry out substantial portion of the literature survey during the end of their 4th semester.After the end of their 4thsemester ETEs, each student will be asked to make presentation about the project including literature available, objective sought and work plan including methodologiesto the Student Project Monitoring Committee constituted by the HOD.

The Project Work may be a work based on theoretical analysis, modeling& simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, etc. or a combination of these. The final project report will be evaluated by a panel of examiners consisting of HOD, Guide and Co-guide (wherever applicable) and an External Examiner. Viva-voce examination for the same will be conducted.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	INHERITANCE BIOLOGY				
Course Code	BSDB3003				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept ofinheritance and genetics.
Course Outcomes

CO1	**Understand Introduction of genetics and Mendelian principles**
CO2	**Interpret extensions of Mendelian principles**
CO3	**Demonstrate Extra chromosomal inheritance**
CO4	**Illustrate the Microbial genetics**
CO5	**Illustrate the Mutation**
CO6	**Evaluate the applications of advancement of inheritance biology**

Text Book (s)

- Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley and Sons Inc.
- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
- Benjamin A. Pierce. 2003. Genetics: A Conceptual Approach. W.H, Freeman and Company, New York.

Reference Book (s)

- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.
- Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co**.**

Unit-1 INTRODUCTION OF GENETICS AND MENDELIAN PRINCIPLES 08 hours **Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests, genotype, phenotype. Mendelian principles; Dominance, segregation, independent assortment.**
Unit-2 EXTENSIONS OF MENDELIAN PRINCIPLES 08 hours **Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.**
Unit-3 EXTRA CHROMOSOMAL INHERITANCE 08 hours **Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.**
Unit-4 MICROBIAL GENETICS 10 hours **Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.**
Unit-5 MUTATION 12 hours **Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Homologous and non-homologous recombination.**
Unit-6 RECENT ADVANCES IN INHERITANCE BIOLOGY 04 hours **Research article/ Review paper/ MOOC.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	GROWTH AND REPRODUCTION				
Course Code	BSBS3004				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		0	0	0	4

Course Objectives: Students are able to understand the basic concept of animal and plant growth and reproduction.

Course Outcomes

CO1	Understand the growth pattern of plant and animals
CO2	Interpret growth kinetics and kinematics of plant
CO3	Explain Pre Fertilization Changes
CO4	Illustrate the post fertilization events
CO5	Explain cell differentiation
CO6	Evaluate the applications of advancement of growth and reproduction

Text Book (s)

1. Gilbert S: Developmental Biology 9th Ed.
2. Carlson B.M. Patterns; Foundations of Embryology.

Reference Book (s)

1. Gilbert S: Developmental Biology 9th Ed.
2. Carlson B.M. Patterns; Foundations of Embryology.

Unit-1 INTRODUCTION 10 hours General growth patterns in animals and plants: the plant cell as a model of growing system; biophysical basis of plant cell growth; the role of cell wall in cell growth; extension growth of multicellular organs in plants. Juvenile, vegetative and reproductive phases in growth:
Unit-2 PLANT GROWTH AND AGEING 10 hours Primary meristem: concept of stem cell; shoot apical meristem- dynamics of shoot apical meristem; homeobox genes and meristem identity; root apical meristem as an organized structure; Post - embryonic meristems in plants with special reference to Arabidopsis embryogenesis. Analysis of plant growth: kinetics and kinematics. Senescence, ageing, abscission and programmed cell death: a general account, with special reference to hyperplasia and hypertrophy in animals and tumours in plants.
Unit-3 PRE FERTILIZATION CHANGES 10 hours

Alternation of generations and reproductive patterns in animals and plants; Asexual and sexual reproduction- an overview (regeneration, archegonium, heterospory, siphonogamy, apogamy, apospory, apomixis etc.). Pre- fertilization events- gametogenesis- spermatogenesis and oogenesis, types of eggs in animals; relative sexuality in plants and heterothallism in fungi.
Unit-4 POST FERTILIZATION CHANGES AND EARLY DEVELOPMENT 15 hours **Post Fertilization Events; Types of Cleavages; Blastula; Fate Maps, Morphogenetic movements during gastrulation; Gastrulation in frog and chick and humans; Fate of Germ layers; Neural tube formation, brief account on embryonic induction, Extra Embryonic membranes in chick and mammal, Placenta: Functions and types.**
Unit-5 DIFFERENTIATION 05 hours **Organogenesis: Formation of CNS, Organogenesis of secondary girth.**
Unit-6 RECENT ADVANCES IN GROWTH AND REPRODUCTION 04 hours **Research article/ Review paper/ MOOC.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**EVOLUTIONARY BIOLOGY**				
Course Code	**BSDB3005**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

- To define genotype, allele, phenotype, biological (Darwinian) fitness.
- To define and explain the connections between mutations, variation, genotype, phenotype, environment, survival, reproduction, allele frequencies, individuals, population and fitness.
- To explain why selection works on individuals, but evolution works on populations. To explain what it means if two different genotypes differ in relative fitness.
- To explain how natural selection results in altered allele frequencies in subsequent generations.

Course Outcomes

CO1	**Understand introduction genotype, allele, phenotype, biological (Darwinian) fitness.**

CO2	**Interpret the connections between mutations, variation, genotype, phenotype, environment, survival, reproduction, allele frequencies, individuals, population and fitness**
CO3	**Demonstrate selection works on individuals, but evolution works on populations.**
CO4	**Illustrate the role of genotypes in relative fitness.**
CO5	**Illustrate the role of natural selection in determining the allele frequencies in subsequent generations.**
CO6	**Evaluate the applications of advancement in evolutionary biology**

Text Book (s)

- Ridley, M. (2004) Evolution. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D.E.G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring
- Pevsner, J. (2009) Bioinformatics and functional genomics. II Edition. Wiley-Blackwell
- Rastogi, V.B. organic evolution.

Reference Book (s)

- Barton, N. H., Briggs, D.E.G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring
- Harbour Laboratory Press.

Unit-1 THEORIES OF ORGANIC EVOLUTION	**10 hours**
Lamarckism, Darwinism, Development and concept of synthetic theory, Natural selection in action (industrial melanism, antibiotic and DDT resistance), type of natural selection; Stabilizing selection, Directional selection, Diversifying selection, cyclic selection, k selection and r selection, selection pressure.	
Unit-2 EVIDENCE OF ORGANIC EVOLUTION	**10 hours**
Evidence of Organic evolution from morphology and comparative anatomy (tectology); Homology and homologous organs, types of homology; phylogenetic homology, sexual homology, serial homology. Analogy and analogous organs, Divergent evolution, Convergent evolution, vestigial organs, Evidence of evolution from Comparative embryology, recapitulation theory, Evidence from Palaeontology, Evidence from Biochemistry and physiology, Evidence from Zoogeography.	
Unit-3 POPULATION GENETICS AND GENETIC DRIFT	**10 hours**
Concept of Deme, gene pool, gene frequency, genotype frequency, genetic equilibrium and Hardy weinbergs law of equilibrium, genetic load and genetic death, mutational and segregation load, silent feature of Genetic drift, Sewall wright effect, Bottle neck phenomenon, founder effect, concept of polymorphism, balanced polymorphism, transient polymorphism.	
Unit-4 PRODUCTS OF EVOLUTIONARY CHANGE	**10 hours**
Species concept, speciation, phyletic speciation, quantum speciation, gradual speciation, allopatric speciation, sympatric speciation, parapatric speciation, Isolating mechanisms and modes of speciation. Adaptation and evolution: Structural adaptation,coadaptation,r-adaptation, k adaptation, Divergent evolution (adaptive radiation) adaptive radiation in finches, parallel evolution (convergent evolution).	
Unit-5 GEOLOGICAL TIME SCALE	**08 hours**

The Eras, Azoic era, archeozoic era, Proterozoic area, 493alaeozoic era, Mesozoic era, Cenozoic era, Different periods and its characteristics, Ordovician period, Silurian period, Devonian period, Dinasaurs and its type distribution and extinction.
Unit-6 RECENT ADVANCES IN EVOLUTIONARY BIOLOGY 04 hours **Research article/ Review paper/ MOOC.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

SEMESTER-VI

Name of The Course	**DISSERTATION**				
Course Code	**BSBS9997**				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**0**	**12**

Course Objectives:To gainknowledge and understanding of research problems and related principles to manage projects in multidisciplinary research areas.

Course Outcome

CO1	Demonstrate the use of knowledge of basic and applied sciences in project based learning.
CO2	Organizes experiments and researches, perform analysis and interpret data for the designed project.
CO3	Cooperate effectively as an individual and as a member in the research team.
CO4	Systematize the articulated ideas, comprehend and write effective reports, documentation and to communicate effectively.
CO5	**Demonstrate knowledge and understanding of research problems and related principles to manage projects in multidisciplinary research areas.**
CO6	**Study the applications of advancement in the field of biological science**

COURSE CONTENTS:

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. The duration of the Project work/Dissertation is 6 months. A Project/Dissertation work may be given in lieu of a discipline specific elective

paper/Biological Science.This should be done in consultation with the faculty supervisor and agency supervisor under whom he / she is getting trained. The project report should be around 100 pages and chaptered as follows:

Chapter I: Introduction

Chapter II: Review of Literature

Chapter -3: Methodology

Chapter IV: Data Analysis and Results

Chapter V: Discussion of Results

Chapter VI: Summary and Conclusion

The research should be original and should be action oriented in that the results should be able to throw light on some of the important unexplored areas that would be of practical use to the forensic experts.

Students are expected to decide on the specific project area and title, and carry out substantial portion of the literature survey during the end of their 5th semester.After the end of their 5th semester ETEs, each student will be asked to make presentation about the project including literature available, objective sought and work plan including methodologiesto the Student Project Monitoring Committee constituted by the HOD. The Project Work may be a work based on theoretical analysis, modeling& simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, etc. or a combination of these. The final project report will be evaluated by a panel of examiners consisting of HOD, Guide and Co-guide (wherever applicable) and an External Examiner. Viva-voce examination for the same will be conducted.

The following weightage is assigned at each stage of Student Project evaluation.

Reference Book (s)	Reference Book (s)
Zeroth Review	Project scopes and Proposal
Review I	Methods of project Implementation
Review II	Technical Achievement
Review -3:	Innovation and contribution
Final Evaluation	Overall achievement
(External evaluation)	Project Report Evaluation

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	Web based course/seminar-II				
Course Code	BSDB3010				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology.				
Antirequisite					
		L	T	P	C

	0	0	0	2

Course Objectives:

- **Students are** directly engage and learn particular subject of their interest. This strengthens the fundamentals of the student in the course.
- It gives the students the opportunities to explore new areas of interest . Also gives students the opportunity to learn in greater depth the subjects they wish to master.
- Promotes the self-learning initiative of the students – where their own motivation is what drives them to complete the course. This fosters the habit of keeping oneself updated always by means of self-study.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	ETE	Total Marks
50		50	100

ELECTIVES
GROUP-I

Name of The Course	BIOINFORMATICS				
Course Code	BSDB2011				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the computer science.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of bioinformatics.
Course Outcomes

CO1	Describe the Introduction of Computer Fundamentals
CO2	It Interpret the Introduction of Bioinformatics and Biological Databases
CO3	Demonstrate Sequence Alignments, Phylogeny and Phylogenetic trees
CO4	Evaluate Genome organization and analysis
CO5	Evaluate Protein Structure Predictions
CO6	Evaluate the applications of advancement of bioinformatics

Text Book (s)

- Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House
- Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications
- Lesk M.A. (2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student Edition
- Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
- Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell

Reference Book (s)

- Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House
- Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications
- Lesk M.A. (2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student Edition
- Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
- Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell

Unit-1 INTRODUCTION TO COMPUTER FUNDAMENTALS 12 hours **RDBMS - Definition of relational database, Mode of data transfer (FTP, SFTP, SCP), advantage of encrypted data transfer.**
Unit-2 INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES 10 hours **Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB.**
Unit-3 SEQUENCE ALIGNMENTS, PHYLOGENY AND PHYLOGENETIC TREES 09 hours **Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices. Types of phylogenetic trees, Different approaches of phylogenetic tree construction -UPGMA, Neighbour joining, Maximum Parsomony, Maximum likelihood.**
Unit-4 GENOME ORGANIZATION AND ANALYSIS 08 hours **Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes; Genome, transcriptome, proteome, 2-D gel electrophoresis, Maldi Toff spectroscopy; Major features of completed genomes: *E.coli, S.cerevisiae, Arabidopsis,* Human.**
Unit-5 PROTEIN STRUCTURE PREDICTIONS 08 hours **Hierarchy of protein structure - primary, secondary and tertiary structures, modelling; Structural Classes, Motifs, Folds and Domains; Protein structure prediction in presence and absence of structure template; Energy minimizations and evaluation by Ramachandran plot Protein structure and rational drug design.**
Unit-6 RECENT ADVANCES IN BIOINFORMATICS 04 hours **Research article/ Review paper/ MOOC.**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	**BIOSTATISTICS**				
Course Code	**BSDB2012**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the statistics.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biostatistics.
Course Outcomes

CO1	**Understand Measures of central tendency, Correlation and Regression**
CO2	**Interpret Mean and Variance, namely Binomial, Poisson**
CO3	**Demonstrate parametric and non-parametric statistics.**
CO4	Illustrate the Sampling Distributions, Standard Error, Testing of Hypothesis
CO5	**Illustrate the Large Sample Test based and Small sample test**
CO6	**Evaluate the applications of advancement of biostatistics**

Text Book (s)

5. Edmondson and D. Druce: Advanced Biology Statistics, Oxford University Press; 1996.
6. W. Danial : Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004

Reference Book (s)

1. Edmondson and D. Druce: Advanced Biology Statistics, Oxford University Press; 1996.
2. W. Danial : Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004

Unit-1 **12 hours**
Measures of central tendency, Measures of dispersion; skewness, kurtosis; Elementary Probability and basic laws; Discrete and Continuous Random variable, Mathematical Expectation; Curve Fitting; Correlation and Regression. Emphasis on examples from Biological Sciences.
Unit-2 **10 hours**
Mean and Variance of Discrete and Continuous Distributions namely Binomial, Poisson, Geometric, Weibull, Logistic and Normal distribution. Fitting of Distributions.
Unit-3 **09 hours**
Statistical methods: Scope of statistics: utility and misuse. Principles of statistical analysis of biological data. Sampling parameters. Difference between sample and Population, Sampling Errors, Censoring, difference between parametric and non-parametric statistics.
Unit-4 **08 hours**
Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom.

Unit-5	**08 hours**
Large Sample Test based on Normal Distribution, Small sample test based on t-test, Z- test and F test; Confidence Interval; Distribution-free test - Chi-square test. Basic introduction to Multivariate statistics, etc.	
Unit-6 RECENT ADVANCES IN BIOSTATISTICS	**04 hours**
Research article/ Review paper/ MOOC.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOPHYSICS**				
Course Code	**BSDB2013**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the physics.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biophysics.

Course Outcomes

CO1	**Understand numerical models with non-linear algebraic equations, numerical integration.**
CO2	**Describe the principle and working of crystallography.**
CO3	**Interpret the applications of numerical methods in biological systems.**
CO4	**Demonstrate the use of quantum biology.**
CO5	**Understand the theoretical modeling of biomolecules.**
CO6	**Evaluate the applications of advancement of biophysics**

Text Book (s)

11. A Textbook of Biophysics: For Medical Science and Biological Science Students by RN Roy
12. Introduction to Biophysics by Pranab Kumar Banerjee
13. An Introduction to Biophysics by David Burns
14. Fundamentals and Techniques of Biophysics and Molecular Biology by Pranav Kumar
15. Biological Physics: Energy, Information, Life by Philip Nelson

Reference Book (s)

11. A Textbook of Biophysics: For Medical Science and Biological Science Students by RN Roy
12. Introduction to Biophysics by Pranab Kumar Banerjee
13. An Introduction to Biophysics by David Burns
14. Fundamentals and Techniques of Biophysics and Molecular Biology by Pranav Kumar
15. Biological Physics: Energy, Information, Life by Philip Nelson
16.

Unit-1 NUMERICAL METHODS	**12 hours**
Introduction to numerical methods, solutions to non-linear algebraic equations by the method of iteration and Newton aphson method, numerical integration by trapezoidal rule and simpson's rule, numerical solution of ordinary differential equations by picard's method of successive approximation, Euler's method and Runge-Kutta method.	
Unit-2 ELEMENTARY CRYSTALLOGRAPHY	**10 hours**
Introduction, symmetry in crystals, lattices and unit cells, crystal systems, Bravais lattices, elements of symmetry- rotation axis, mirror planes and center of inversion, point group symmetry- monoaxial point groups, polyaxial point groups, translational symmetry- screw axis and glide planes, space group, equivalent points, X-ray diffraction and Bragg equation.	
Unit-3 MATHEMATICAL METHODS AND THEIR APPLICATIONS IN BIOLOGICAL SYSTEMS	**09 hours**
Ordinary differential equations of the first degree and first order (variable separable method, linear equation), linear differential equations of the second order with constant coefficients, the Laplace Transform, Inverse Laplace transform, application of Laplace transform to solutions of differential equations, Fourier series and their applications.	
Unit-4 QUANTUM BIOLOGY AND ITS USES	**08 hours**
Classical mechanics, Newton, Lagrange and Hamilton's equations, Schrodinger's equation and its complete solution for S.H.O, central force and angular momentum.	
Unit-5 THEORETICAL MODELING OF BIOMOLECULAR SYSTEMS	**08 hours**
Basic principles of modeling, modeling by energy minimization technique, concept of rotation about bonds, energy minimization by basic technique for small molecules, Ramachandran plot, torsional space minimization, energy minimization in cartesian space, molecular mechanics-basic principle, molecular dynamics basic principles.	
Unit-6 RECENT ADVANCES IN BIOPHYSICS	**04 hours**
Research article/ Review paper/ MOOC.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**ORGANIC FARMING**
Course Code	**BSDB2014**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**

Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: To provide a broad foundation in organic farming.

Course Outcomes

CO1	To understand the basic concept of organic farming.
CO2	To describe the concept of green manuring.
CO3	To identify the different methods of organic plant protection
CO4	To explain various types of organic crop production methods.
CO5	To understand the basic concept of farm economy.
CO6	Evaluate the applications of advancement of organic farming

Text Book (s)

7. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
8. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
9. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay -Publication, New Delhi.

Reference Book (s)

7. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
8. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.
9. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic _Farming Akta Prakashan, Nadiad

Unit-1 INTRODUCTION TO ORGANIC FARMING 08 hour
Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.
Unit-2 ORGANIC PLANT NUTRIENT MANAGEMENT 10 hour
Organic farming systems, soil tillage, land preparation and mulching,Choice of varieties. Propagation-seed, planting materials and seed treatments, water management Green manuring, composting- principles, stages, types and factors, composting methods, Vermi composting, Bulky organic manures, concentrated organic manures, organic preparations, organic amendments and sludges
Unit-3 ORGANIC PLANT PROTECTION 09 hours
Plant protection- cultural, mechanical, botanical pesticides, control agents, Weed management, Standards for organic inputs- plant protection.
Unit-4 ORGANIC CROP PRODUCTION PRACTICES 10 hours
Organic crop production methods- rice, coconut. Organic crop production methods- vegetables- okra, amaranthus, cucurbits. Livestock component in organic farming. Sustainable Agriculture-Apiculture, Mushroom cultivation.
Unit-5 ORGANIC CERTIFICATION 08 hours
Farm economy: Basic concept of economics- demand &supply, economic viability of a farm. Basic production principles, reducing expenses, ways to increase returns, cost of production

system. Benefit/ cost ratio, marketing, imports and exports. Policies and incentives of organic production. Farm inspection and certification. Terrace farming.
Unit-6 RECENT ADVANCES IN ORGANIC FARMING 04 hours Research article/ Review paper/ MOOC.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

ame of The Course	BIOFERTILIZERS AND PESTICIDES				
Course Code	BSDB2015				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: To provide a broad foundation to .
Course Outcomes

CO1	To understand the basic concept of biofertilizer.
CO2	To identify the role of azospirillium as biofertilizer.
CO3	To explain the process of nitrogen fixation.
CO4	To explain various types of mycorrhizal association.
CO5	To elucidate the basic concept of pest and pest management.
CO6	Evaluate the applications of advancement of biofertilizers and pesticides

Text Book (s)
1. Palaniappan SP &Anandurai K. 1999. Organic Farming–Theory and Practice. Scientific Publishers, Jodhpur
2. Joshi, M. 2014. New Vistas of Organic Farming 2nd Ed. Scientific Publishers, Jodhpur.
3. Farming system: Theory and Practice - S.A.Solaimalai
Reference Book (s)

5. Organic Farming: Theory and Practice- S.P.Palaniappan and K.A. Annadurai
6. A hand book of Organic Farming by A.K.Sharma

Unit-1 INTRODUCTION TO BIOFERTILIZERS 08 hour General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.
Unit-2 AZOSPIRILLUM 10 hour Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication

Unit-3 CYANOBACTERIA	**09 hours**
Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.	
Unit-4 MYCORRHIZAL ASSOCIATION	**10 hours**
Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.	
Unit-5 PEST & PEST MANAGEMENT	**08 hours**
Classification of pesticides on chemical nature and according to target species, mode of action, Methods of pest controls – Classification: Natural & applied control [Physical, mechanical, cultural, biological, genetic, regulatory, chemical controls] Integrated pest management.	
Unit-6 RECENT ADVANCES IN BIOFERTILIZERS AND PESTICIDES	**04 hours**
Research article/ Review paper/ MOOC.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

GROUP-II

Name of The Course	**NANOBIOTECHNOLOGY**				
Course Code	**BSDB3011**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of nanotechnology.

Course Outcomes

CO1	**Understand the fundamentals of nanotechnology**
CO2	**Demonstrate the physical and chemical methods of synthesis of nanomaterials**
CO3	**Demonstrate the biological methods of synthesis of nanomaterials**
CO4	**Generalize the use of nanomaterials in biotechnology**
CO5	**Illustrate the applications of nanobiotechnology**
CO6	**Evaluate the applications of advancement of nanotechnology**

Text Book (s)

9. Nanobiotechnology: Concepts,Applications and Perspectives (2004), Christ of M.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
10. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
11. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd., 2012.
12. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.

Reference Book (s)

9. Nanobiotechnology: Concepts,Applications and Perspectives (2004), Christ of M.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
10. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
11. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd., 2012.
12. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.

Unit-1 INTRODUCTION TO NANOTECHNOLOGY 10 hours **Historical perspectives, Existence of nanostructures in nature, Nanoscale Properties (Electrical, Optical, Chemical) Nanomaterials - Quantum Dots,Wells and Wires, nanotubes, graphene, nanogold, nanosilver and metal oxides, Nanopolymers.**
Unit-2 SYNTHESIS OF NANOMATERIALS 10 hours **Physical Methods: Ball Milling, Electrodeposition, DC/RF Magnetron Sputtering, Molecular Beam Epitaxy (MBE).Chemical Methods: Metal Nanocrystals by Reduction, Solvothermal Synthesis, Photochemical Synthesis, Chemical Vapor Deposition (CVD), Metal Oxide - Chemical Vapor Deposition (MOCVD).**
Unit-3 BIOLOGICAL SYNTHESIS OF NANOMATERIALS 10 hours **Synthesis using Microorganisms, Synthesis using Biological templates, synthesis using plants and plant extracts.**
Unit-4 NANOMATERIAL IN BIOTECHNOLOGY 08 hours **Biological nanomaterials and Biomimetic synthesis of nanomaterials – magnetosomes, spider milk, bone, shell. Device based on assemblies of nanoparticles and biomaterials – Bioelectronic devices, nanocircuitry, nanomechanical devices, computational devices.**
Unit-5 APPLICATIONS OF NANOBIOTECHNOLOGY 08 hours **Nanobiosensors, molecular imaging using nanoparticles, targeted drug delivery. Applications in health and disease - infectious and chronic. Nanobiotechnological applications in Environment and food - detection and mitigation.**
Unit-6 RECENT ADVANCES IN NANOBIOTECHNOLOGY 04 hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BIORESOURCE MANAGEMENT			
Course Code	BSDB3012			
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.			
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.			
Antirequisite				
	L	T	P	C
	4	0	0	4

Course Objectives: Students are able to understand the basic concept of bioresource management.
Course Outcomes

CO1	Illustrate the different types of aquaculture
CO2	Summarize the purpose of culturing economically important organisms
CO3	Illustrate the importance of vermiculture
CO4	Describe the origin and importance of cultivated plants
CO5	Generalize the economic uses of various plant products
CO6	Evaluate the applications of advancement of bioresource management

Text Book (s)

5. ManjuYadav, Economic Zoology- Discovery publishing house, New Delhi
6. Lee R E,. Phycology 1999

Reference Book (s)

5. ManjuYadav, Economic Zoology- Discovery publishing house, New Delhi
6. Lee R E,. Phycology 1999

Unit-1 AQUACULTURE	10 hours
Introduction to aquaculture; Prawn culture, Methods of prawn fishing, Preservation and processing of prawn; Pearl culture and status of pearl culture in India; Economically important fishes of India. Setting up of a fish farm, Monoculture and composite fish culture, Bundh breeding, Induced breeding, methods of fishing, Fish preservation and processing; Identification of fish diseases and their control; Snakes and snake venoms.	
Unit-2 ECONOMIC ZOOLOGY	08 hours
Overview of Sericulture, Apiculture, Lac culture, Poultry culture, Dairy industry.	
Unit-3 VERMICULTURE	08 hours

Introduction and scope, Species of earthworm, Characteristics features ofearthworm. Overview of methods of vermicomposting, Role of earthworm in solid waste management. Vermiwash- its importance, Vermicompost as bio-fertilizer.
Unit-4 CULTIVATED PLANTS 10 hours **Cultivated Plants: origin and importance with particular reference to the works of A. de Candolle and Vavilov (especially centers of diversity, primary and secondary centers, multiple origin); a brief account of Harlan and Hawkes theories; examples of major introductions; practices of floriculture, agroforestry, sericulture. BT crops (brief account).**
Unit-5 ECONOMIC USE OF PLANT PRODUCTS 10 hours **Definition, Classification, Names, Morphology and economic uses of important cereals, legumes (pulses and fodders), fruits and vegetables, spices and condiments, beverages, oils and fats, essential oils, medicinal plants, hallucinogens (psychotropic drugs), timber plants, fibre plants, natural rubber, resins, raw materials for paper. A brief account of crop improvement technologies, biosafety considerations, natural products.**
Unit-6 RECENT ADVANCES IN BIORESOURCE MANAGEMENT 04 hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS**				
Course Code	**BSDB3013**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biosafety and intellectual property rights

Course Outcomes

CO1	**Understand the fundamentals of biosafety**
CO2	**Summarize the guidelines of biosafety**
CO3	**Understand the concepts of intellectual property**
CO4	**Describe the grant of patents, agreements and treaties**
CO5	**Evaluate the applications of advancement of biosafety and IPR**

Text Book (s)

1. **Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt.Ltd., New Delhi.**
2. **Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.**
3. **Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.**
4. **Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.**
5. **Goel D &Prashar S (2013). IPR, Biosafety and Bioethics. Pearson**
6. **Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.**

Reference Book (s)

1. **Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt.Ltd., New Delhi.**
2. **Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.**
3. **Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.**
4. **Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.**
5. **Goel D &Prashar S (2013). IPR, Biosafety and Bioethics. Pearson**
6. **Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.**

Unit-1 INTRODCUTION TO BIOSAFETY	**07 hours**
Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms.	
Unit-2 BIOSAFETY GUIDELINES	**10 hours**
Biosafety Guidelines: Biosafety guidelines and regulations (National and International);GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol. Guidelines for using radioisotopes in laboratories and precautions.	
Unit-3 INTRODUCTION TO INTELLECTUAL PROPERTY	**10 hours**
Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR –patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).	
Unit-4 GRANT OF PATENT, AGREEMENTS AND TREATIES	**10 hours**
Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional,Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing andagreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patentowner. Agreements and Treaties: GATT, TRIPS, WIPO, Budapest Treaty on international recognition of the deposit of microorganisms etc.	

Unit-5 RECENT ADVANCES IN BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS 04 hours **Research article/ Review paper/ MOOC**	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**MUSHROOM CULTIVATION TECHNOLOGY**				
Course Code	**BSDB3015**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of mushroom cultivation technology.

Course Outcomes

CO1	**Understand the values of mushroom.**
CO2	**Describe the technology used for cultivation of mushroom**
CO3	**Demonstrate the concepts of mushroom bed preparation.**
CO4	**Demonstrate the process of storage and its nutritional value.**
CO5	**Understand the concepts of types of foods prepared from mushroom.**
CO6	**Evaluate the applications of advancement of mushroom cultivation technology**

Text Book (s)

9. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
10. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
11. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
12. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Reference Book (s)

9. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
10. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
11. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
12. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Unit-1 INTRODUCTION TO MUSHROOM CULTIVATION	**06 hours**
Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - Volvariellavolvacea, Pleurotuscitrinopileatus, Agaricusbisporus.	
Unit-2 CULTIVATION TECHNOLOGY – I	**08 hours**
Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication.	
Unit-3 CULTIVATION TECHNOLOGY-II	**08hours**
Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.	
Unit-4 STORAGE AND NUTRITION	**10 hours**
Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.	
Unit-5 FOOD PREPARATION	**08 hours**
Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.	
Unit-6 RECENT ADVANCES IN MUSHROOM CULTIVATION TECHNOLOGY 04 hours	
Research article/ Review paper/ MOOC	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**PARASITOLOGY**				
Course Code	**BSDB3016**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**

	4	0	0	4

Course Objectives: Students are able to understand the basic concept of parasitology

Course Outcomes

CO1	**Describe the basic concept Parasitology**
CO2	**Interpret about the Parasitic Protists and disease caused by it**
CO3	**Interpret Parasitic Platyhelminthes**
CO4	**Elucidate Parasitic Nematodes**
CO5	**Illustrate Parasitic Arthropoda and Parasitic Vertebrates**
CO6	**Evaluate the applications of advancement of parasitology**

Text Book (s)

17. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
18. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger
19. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group
20. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
21. Rattan LalIchhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
22. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
23. Thomas C. Cheng (1986). General Parasitology, II Edition, Academic Press Inc
24. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd. DSE

Reference Book (s)

17. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
18. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger
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24. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd. DSE

Unit-1 INTRODUCTION TO PARASITOLOGY 04 hours **Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship.**
Unit-2 PARASITIC PROTISTS 12 hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoebahistolytica, Giardia intestinalis, Trypanosomagambiense, Leishmaniadonovani, Plasmodium vivax.**
Unit-3 PARASITIC PLATYHELMINTHES 08 hours

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsisbuski, Schistosomahaematobium,Taeniasolium and Hymenolepis nana.
Unit-4 PARASITIC NEMATODES 12 hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Ascarislumbricoides, Ancylostomaduodenale, Wuchereriabancrofti and Trichinellaspiralis. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylencus (lesion nematode).**
Unit-5 PARASITIC ARTHROPODA AND PARASITIC VERTEBRATES 08 hours **Biology, importance and control of ticks, mites, Pediculushumanus (head and body louse), Xenopsyllacheopis and Cimexlectularius, A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat.**
Unit-6 RECENT ADVANCES IN PARASITOLOGY 04 hours **Research article/ Review paper/ MOOC**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

School of Basic and Applied Sciences
Department of Life Sciences
Division of Biomedical Science

Program: B.Sc. (Hons.) Biomedical Science

Scheme: 2020 – 2022

Vision

"To be known globally for value-based education, research, creativity and innovation"

Mission

13. **Establish state-of-the-art facilities for world class education and research.**
14. **Collaborate with industry and society to align the curriculum,**
15. **Involve in societal outreach programs to identify concerns and provide sustainable ethical solutions.**
16. **Encourage life-long learning and team-based problem solving through an enabling environment.**

School of Basic and Applied Sciences

Vision:

To be recognized globally as a center of excellence in imparting value-based education in Basic and Applied Sciences by creating innovation in fundamental and multidisciplinary research.

Mission

M1: To excel in imparting contemporary knowledge and skills by developing an educational ecosystem with diverse interests and talents.

M2: To perform cutting edge research leading to innovation in sciences through national and international collaborations.

M3: To develop solutions for the emerging challenges in Basic and Applied Science to cater the needs of society.

M4: To attract best quality faculty to facilitate knowledge and develop confidence in our graduates to succeed in the world.

Salient features of Biomedical Sciences

B.Sc. Biomedical Sciences is a undergraduate course. The duration of B.Sc. Biomedical Sciences programme is of three years duration and is divided into six parts, Part I to part II and part III. Each part has two Semesters. Biomedical Sciences is the branch of the science that deals with the study of biological sciences and medical sciences. This is basically application of biological science in medical sciences. The purpose of the biomedical sciences to develop drug designing and discovery of drug. Pharmacology, Medicinal chemistry, Medical microbiology, and Physiology subjects are core subjects and backbone of biomedical sciences but biochemistry, molecular biology and immunology, bioinstrumentation are also necessary to fulfill the purpose of biomedical sciences.

Aim of the programme:

The programme aims:

1. To help the student to develop the knowledge, skills, attitude and ethical values required providing patient-centred care and working safely and effectively in the NHS as a biomedical scientist.

2. To apply scientific principles and theories underpinning biomedical science to patient care.

3. To enable students to carry out competently diagnostic investigations relevant to the role of a biomedical scientist.

4. To develop the student's ability to apply scientific methods and approaches to research, development and innovation.

5. To help the student develop a range of transferable academic skills required for effective life-long learning, communication, team working and leadership.

6. To give the student an opportunity to gain work experience in a biomedical laboratory.

7. To prepare the student for employment in a biomedical science laboratory.

8.To provide the student with the skills required for postgraduate studies in biomedical and health sciences.

Eligibility

Candidate for admission to the first year of B.Sc. Biomedical Sciences shall be required to have 10+2 in any Biology stream, or an equivalent in a science stream with a minimum of 50 % marks in aggregate from a recognized board.

Scope of the Proposed Programme

The B.Sc. Programme of three years is designed to assist all students to get good quality education in the field of Biomedical sciences so that they can pursue higher education and find employment in India and abroad. The purpose of biomedical sciences education is to develop biomedical scientist in various research institute and universities. They can research in various fields of life science in hospitals and R&D in Biopharmaceuticals multinational company. After completing B.Sc. in biomedical sciences student can join M.Sc. in Biomedical sciences and after M.Sc. students may pursue M. Tech in Biomedical engineering also and serve as Biomedical Engineer. Students may also work as technical officer and EEG technician/ technical officer in various neuroscience research institutes like NIMHANCE and Brain Research Center, Gurgaon.

The ultimate aim is to enable the students to develop an integrated approach for understanding the various life science problems at the molecular level. In addition, the present curriculum gives scope for the students entering different modules to update their knowledge depending upon the employment opportunities in each area. Various practical courses have been designed not only to enable the students to appreciate scientific basis of various life processes but also to train them for self-employment.

There is a greater demand for Biomedical researcher in the area of life sciences. After completion of the course candidate may work as Biochemist, Geneticist, and Medical Microbiologist, in Multinational Companies, Public Sectors, Quality Control Labs, Biopharmaceuticals companies. The course will provide solid foundation for all the students

regardless of background and will gain a comprehensive understanding of the Biomedical tools & techniques and allied areas, including clinical and research aspects with the special attention to current development in the discipline.

Program Educational Objectives (PEO)

PEO1: The graduates shall be successful professionals in Academia, Industry, Government and Entrepreneurship.

PEO2: The graduates shall pursue higher education/research at institute of national and international repute.

PEO3: The graduate shall effectively address the challenges of the society and undertake the projects for bridging the gap between industry and societal needs.

Programme Outcomes (POs)

PO1: **Apply the principles and conceptual knowledge of basic and applied science to understand and solve the complex biological problems.**

PO2: **Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of biological reactions.**

PO3: **Create, select and apply appropriate techniques, resources and modern science and research tools within a defined specification that meet specified needs with appropriate consideration for public health and safety.**

PO4: **Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal issues and the consequent responsibilities relevant to the professional biologist.**

PO5: **Understand the impact of professional life sciences solutions in communal and environmental contexts and demonstrate knowledge and need for sustainable development.**

PO6: Articulate ideas, comprehend and write effective reports, documentation and to communicate effectively with the basic and applied sciences community and with society at large, professionally and ethically.

PO7: Demonstrate knowledge and understanding of science and technical principles to manage projects in multidisciplinary research areas and function effectively as an individual, and as a member or leader in diverse resource teams.

PO8: Seeking stimulation and to exploring numerous opportunities to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcome (PSO)

PSO1: Igniting young minds, from different backgrounds to understand the science of biomedicine through application-based learning.

PSO2: Equip students with analytical and technical skills to practice evidence based biomedical science for industrial applications.

Curriculum

Semester I

Sl. No	Course Code	Name of the Course	L	T	P	C	IA	MTE	ETE
							Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB1001	Chemistry	4	0	0	4	30	20	50
2	BSDB1002	Fundamentals of Cell Biology	4	0	0	4	30	20	50
3	BSDB1003	Biochemistry	4	0	0	4	30	20	50
4	BSBM1004	Human Physiology- I	4	0	0	4	30	20	50
5	BSBA1061	Hands on Workshop on Basic Analytical Techniques and Measurements	0	0	4	2	50		50
6	BSBM1012	Biomedical Science Lab-I	0	0	6	3	50		50
7	xxxx	Liberal Art				0.5			
8	xxxx	Soft Skill				0			
9	xxxx	Environmental Science		-	-	0.5			
10	xxxx	AI and Machine learning				2			
11	xxxx	BEC- B1				3			
12	xxxx	Computer awareness				0			
				Total		27			

Semester II									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSBD1007	Bioinstrumentation-I	4	0	0	4	30	20	50
2	BSBM 1008	Human Physiology -II	4	0	0	4	30	20	50
3	BSBM 1009	Toxicology and Pharmacology	4	0	0	4	30	20	50
4	BSDB1011	Concept of immunology	4	0	0	4	30	20	50
5	BSBM1013	Biomedical Science Lab-II	0	0	6	3	50		50
6	Xxxx	BEC-B2				3			
7	xxxx	***Two week social internship (during summer)							
				Total		22			

Semester III									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB2001	Fundamentals of Molecular Biology	4	0	0	4	30	20	50
2	BSDB2002	Bioinstrumentation-II	4	0	0	4	30	20	50
3	BSBC2003	Fundamentals of Microbiology	4	0	0	4	30	20	50
4	BSBC2004	Metabolism of Biomolecules-I	4	0	0	4	30		50
5	BSBM2005	Biomedical Science Lab-III	0	0	6	3	50		50
6	BSBM2007	Biomedical Science Lab-IV	0	0	6	3	50	-	50

Semester V									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSBC3001	Minor Project*	0	-	-	3	50		50
2	BSDB3003	Inheritance Biology	4	-	-	4	30	20	50
3	BSDB3004	Medical Microbiology	4	-	-	4	30	20	50
4	BSDB 3005	Evolutionary Biology	4	-	0	4	30	20	50
5	BSDBxxxx	Elective (Group-II, DSE)	4		-	4	50	20	50
6	BSBM3010	Biomedical Science Lab-VI	0	0	6	3	50		50
7	BSBM3011	Biomedical Science Lab-VII	0	0	6	3	50	-	50
8	xxxx	Campus to corporate				2			
			Total			27			
7	BSDB2006	Web based Course/Seminar-I	0	0	0	2	50		50
			Total			24			

Semester IV									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCSE1020	Programming Language C and Python	4	0	0	4	30	20	50
2	BSDB2010	Biotechnology	4	0	0	4	30	20	50
3	BSDB2009	Medical Biochemistry	4	0	0	4	30	20	50
4	BSBM2007	Medicinal Chemistry	4	0	0	4	30	20	50
5		Elective (Group-I, GE)	4	0	0	4	30	20	50
6	BSBM2016	Biomedical Science Lab -IV	0	0	6	3	50		50
7	BCSE1031	Programming Languages C and Python Laboratory	0	0	6	3	50		50
8	Xxxx	IPR				0.5			
9	xxxx	Foreign Language				0.5			
10	XXXXX	Waste Manaement			2	1	50		50
	XXXX	Research methodology		2				2	
				Total credit		30			

Semester VI									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSBC9999	Dissertation	0	0	0	12	50		50
2	BSDB3010	Web based Course/Seminar-I	0	0	0	2	50		50
					Total	14			
				Total credit		142			

		List of Electives							
Group I									
Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB2011	Bioinformatics	4	0	0	4	30	20	50
2	BSDB2012	Biostatistics	4	0	0	4	30	20	50
3	BSDB2013	Biophysics	4	0	0	4	30	20	50
4	BSDB2014	Organic Farming	4	0	0	4	30	20	50
5	BSDB2015	Biofertilizers and Pesticides	4	0	0	4	30	20	50
Group II									
Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSDB3011	Nanobiotechnology	4	0	0	4	30	20	50
2	BSDB3012	Bioresource Management	4	0	0	4	30	20	50
3	BSDB3013	Biosafety and IPR	4	0	0	4	30	20	50
4	BSDB3015	Mushroom Culture Technology	4	0	0	4	30	20	50
5	BSDB3016	Parasitology	4	0	0	4	30	20	50

SEMESTER-I

Name of The Course	**CHEMISTRY**				
Course Code	**BSDB1001**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: To provide a broad foundation in chemistry that stresses scientific reasoning and analytical problem solving with a molecular perspective.

Course Outcomes

CO1	**Understand atomic structure with various Bohrs, Aufbau, Pauli's principles.**
CO2	**Demonstrate chemical thermodynamics, law of thermodynamics.**
CO3	**Interpret chemical bonding and molecular forces.**
CO4	Express the knowledge Stereochemistry.
CO5	**Interpret the ionic equilibria.**
CO6	**Evaluate the significance of Chemistry**

Text Book (s)

6. J.D. Lee : A New Concise Inorganic Chemistry, E.L.B.S.
7. P.W. Atkins : Physical Chemistry, Oxford University Press

Reference Book (s)

3. R.T. Morrison &R.N.Boyd : Organic Chemistry, Prentice Hall
4. James E.Huheeyetl. : Inorganic Chemistry : Principles of Structure and reactivity

Unit-1: ATOMIC STRUCTURE	**10 hours**
Recapitulation of Bohr's theory and its limitations, dual behavior of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Quantum numbers and their significance. Shapes of s, p, d and f orbitals. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Pauli's exclusion principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.	
Unit-2: CHEMICAL THERMODYNAMICS	**10 hours**
Introduction of thermodynamics, state of system, state variables, thermodynamic equilibrium, thermodynamic properties, various types of systems and processes.Laws of Thermodynamics.	

Unit-3: CHEMICAL BONDING AND MOLECULAR FORCES	**09 hours**
Introduction to ionic interactions and covalent bond, inter-molecular and intra-molecular forces, types of intermolecular forces and their characteristics: ion-dipole, dipole-dipole, dipole-induced dipole and dispersion (London) forces, hydrogen bond (intra-molecular and inter-molecular), effect of inter/intra-molecular forces on structure of different biomolecules.	
Unit-4: STEREOCHEMISTRY	**08 hours**
Optical isomerism: Optical activity, specific rotation, enantiomerism, D and L designation, racemic modification, R and S sequence rules, diasteroisomers. Conformational isomers: conformation of ethane and butane, interconversion of projection formula, cyclohexane (mono- and di-substituted), resolution, optical purity, Walden inversion, enantiotopic and diastereotopichydrogens and prochiral centers. Geometrical isomerism: Definition, nomenclature– E and Z.	
Unit-5: IONIC EQUILIBRIA	**08 hours**
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionizationconstant and ionic product of water. Ionization of weak acids and base, pH scale, common ion effect, Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts.Buffer solutions. Qualitative treatment of acid base titration curves. Theory of acid – base indicators.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	FUNDAMENTAL OF CELL BIOLOGY				
Course Code	BSDB1002				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives:

1. Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.
2. These can include responses to environmental or physiological changes, or alterations of cell function brought about by mutation.

Course Outcomes

CO1	**Identify cell types, structure, functions and differentiate between various cell organelles.**
CO2	**Interpret the membrane biochemistry and transport of ions across the membrane.**
CO3	**Summarize the different types Cell-Cell Interaction and cellular communication.**
CO4	**Demonstrate protein sorting and transport.**
CO5	**Express the knowledge cell aging and death.**
CO6	**Evaluate the significance of fundamental of Cell biology**

Text Book(s)

8. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893-300-6.
9. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN:13:978-1- 4641-0981-2 / ISBN:10: 1-4641-0981-8.

Reference Book (s)

2. Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson,A., Lewis, J., and Enlarge, M., Garland Science (Princeton), ISBN:0-8153-1619-4.

Unit-2:STRUCTURE OF CELL 7 hours
Introduction to the cell, its chemical composition, Cell types - organization of prokaryotic and eukaryotic cells, Plant and animal cells: variation in structure and function, cell theory. Structure and functions of cell organelles – Nucleus, mitochondria, chloroplast, ribosome, lysosomes.
Unit-2:MEMBRANE BIOCHEMISTRY 7 hours
Membrane: chemical composition and its structural plan; molecular model of cell membrane - fluid mosaic model and membrane fluidity; Overview of types of transport systems and macromolecule transport: Exocytosis; Endocytosis; Pinocytosis and phagocytosis.
Unit-3:CELLULAR COMMUNICATION 7 hours
Cell Wall: Eukaryotic cell wall, Extracellular matrix and cell matrix interactions, Cell-Cell Interactions - adhesion junctions, tight junctions, gap junctions, and plasmodesmata. Cytoskeleton: Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules.
Unit-4:PROTEIN SORTING AND TRANSPORT 12 hours
Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids Golgi Apparatus – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus.
Unit-5:CELL CYCLE AND CELL DEATH 10 hours
Cell cycle - phases of cell cycle; cell division - mitosis and meiosis; Cell cycle regulation; Cell aging and death - necrosis and apoptosis; Stem cells. Types: Embryonic stem cell, induced pluripotent stem cells.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BIOCHEMISTRY				
Course Code	BSDB1003				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: The course objectives are as following -

- Demonstrate knowledge and understanding of the molecular machinery of living cells;
- Demonstrate knowledge and understanding of the principles that govern the structures of macromolecules and their participation in molecular recognition.

Course Outcomes

CO1	Understand Chemical and physical foundations of biomolecules like carbohydrates.
CO2	Identify major classes of storage and structural lipids.
CO3	Understand the properties of amino acids, proteins and nucleic acids
CO4	Interpret basic concepts in enzymology and Vitamins function.
CO5	Express the knowledge in the area Bioenergetics.
CO6	Evaluate the application and significance of biochemistry

Text Book (s)

3. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
4. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone

Reference Book (s)

3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company

Unit-1:CARBOHYDRATES	**07 hours**
Chemical and physical foundations of biomolecules, Carbohydrates: structure of sugars, classification, properties, chemical reactions, stereoisomerism and optical isomers of sugars, carbohydrate derivatives.	
Unit-2: LIPIDS	**07 hours**
Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids, Lipids with specific biological functions, micelles and liposomes	
Unit-3: AMINO ACIDS, PROTEINS AND NUCELIC ACIDS	**12 hours**
Amino acids; classification, chemical reactions and physical properties; biosynthesis and catabolism; Nucleotides; biosynthesis and catabolism.	

Unit-4: ENZYMES AND VITAMINS	**10 hours**
Basic concepts in enzymology, enzyme classification, Enzyme kinetics, Enzyme inhibition: competitive, noncompetitive and uncompetitive inhibition, allosteric enzymes, Vitamins and cofactors: structure, distribution and biological properties	
Unit-5: BIOENERGETICS	**08 hours**
First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy and Entropy and mathematical relationship among them, Standard free energy change and equilibrium constant, Coupled reactions and additive nature of standard free energy change, Energy rich compounds: Phosphoenolpyruvate, 1,3- Bisphosphoglycerate, Thioesters, ATP	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Human Physiology-I**				
Course Code	**BSBM1008**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate**				
Corequisite	**Basic knowledge of physiology.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of Physiology and they can apply the knowledge ofphysiology in understanding the various diseases and keeping the body in healthy state.

Course Outcomes

CO1	**Understand and interpret the Digestive system.**
CO2	**Interpret the about composition of blood and its function circulatory system of human**
CO3	**Interpret the about circulatory system in human**
CO4	**Evaluate the respiratory system**
CO5	**Understand and Analyze the excretory system.**
CO6	**Evaluate the significance of human physiology**

Text Book (s)

1. Guyton A.C, Hall J.E, Textbook of Medical Physiology, 11th Ed., Saunders Company, 2005.
2. Widmaier E. P, Raff H, Strang K. T. Vander's, Human Physiology : The mechanism of Body Function, 9th Ed. Mc. Graw Hill, 2003.
3. Ganong W. E, Review of Medical Physiology, 21st Ed., Mc. Graw Hill, 2003.

Reference Book (s)

1. Guyton A.C, Hall J.E, Textbook of Medical Physiology, 11th Ed., Saunders

Company, 2005.
2. Widmaier E. P, Raff H, Strang K. T. Vander's, Human Physiology : The mechanism of Body Function, 9th Ed. Mc. Graw Hill, 2003

UNIT I
Digestive system – Homeostasis, structure of stomach and intestine, Digestive gland and Hormones, Digestion of food in different parts of alimentary canal, absorption and assimilation.
Unit-2
Blood and circulation - Blood corpuscles, hemopoieses and formed elements, plasma function, blood volume, WBC and platelets function. Anemia, thalassemia, Leukemia, Polycythemia, Hemostasis and blood coagulation mechanism, blood groups and blood banking. hematocrits value
Unit-3
Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation.
Unit-4
Respiratory system – structure of lungs and surfactant function, Mechanism of breathing, anatomical considerations, alveolar ventilation, vital capacity of lungs, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.
Unit-5
Excretory system - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

Name of The Course	**Hands on Workshop on Basic Analytical Techniques and Measurements**				
Course Code	**BSBA1061**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**

Course Objectives:

- To provide the knowledge of the scientific instruments in life sciences and biotechnology along with the applications.
- This will enable the students to understand all the subjects of biological sciences as these tools and techniques will be used therein.
- Also acquire the basic knowledge of the microbiological techniques to be applied in the laboratory.
- To know the general microbiological techniques for isolation of pure cultures of microorganisms.

Course Outcomes

CO1	**Demonstration of principle and application of different types of microscope**
CO2	**Analysis and preparation of nano-particles**
CO3	Preparation of solution and calculation of molarity, normality and surface tension of given solution
CO4	**Soldering and assembling of electric circuits**
CO5	**Demonstration of measurement with Vernier calipers, Screw, spherometer and oscilloscope**
CO6	Lab report

Referred Books:

9. Georg Stehli **,The Microscope And How to Use It,** English edition, 1970.

10. M.Sayer and A. Mansingh, PHI Learning. Measurement, Instrumentation and Experiment Design in Physics & Engineering, 2005.

11. Aliofkhazraei, Mahmood, Handbook of Nanoparticles, Springer, 2016

12. Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. Inorganic Chemistry:Principles of Structure and Reactivity, Pearson Education India, 2006.

21. Different types of microscopes and its applications.
22. Direct analysis of nanoparticles.
23. Preparation of nano- particles.

24. Preparation of solution and molarity and normality calculation.
25. Measurement of surface tension and viscosity of given liquid.
26. Soldering of electrical circuits
27. Measurement with Vernier calipers, Screw gauge and spherometer
28. Operation of oscilloscope
29. Familiarization with linear, logarithmic and polar graphs for plotting of experimental data
30. Assembling of elementary electric circuits using breadboard.

Continuous Assessment Pattern

Internal Assessment Lab (IA)	Mid Term Lab (MTE)	End Term Lab (ETE)	Total Marks
50		50	100

Name of The Course	**BIOMEDICAL SCIENCE LAB I**				
Course Code	**BSBM1012**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives:

- Supporting or strengthening theoretical knowledge.
- Experiencing the pleasure of discovery and development of their psycho-motor skills.
- Teaching how scientific knowledge may be used in daily life.
- Increasing creative thinking skills.
- Gains in scientific working methods and higher order thinking skills.
- Developing manual dexterity by using tools and equipment and allowing students to apply skills instead of memorizing.

Course Outcomes

CO1	**Demonstrate the basic principle and applications of important instruments**
CO2	**Handle and maintenance of glassware**
CO3	**Preparation of microbiological media**
CO4	Qualitative analysis of biomolecules
CO5	**Demonstration of different cell cycle**

CO6	Evaluation in research advances in laboratory experiments

Text Books

7. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson
8. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGrawHill International.
9. Atlas RM. (1997). Principles of Microbiology. 2nd edition. M.T.BrownPublishers.Education Limited.

S.N.	**\Name of Practicals**
1.	**Study of the life history of the following scientists and their contributions with the help of their photographs: Anton von Leeuwenhoek, Linus Pauling, KaryMullis, Robert Hooke and Alexander Fleming.**
2.	**To study the principle and applications of important instruments (Microscope, Spectrophotometer, autoclave, Centrifuge) used in the microbiology laboratory.**
3.	**Qualitative analysis of carbohydrates present in the given solution.**
4.	**Qualitative analysis of amino acid and protein present in the given solution.**
5.	**Qualitative analysis of lipid present in the given solution.**
6.	**To understand the principle of Osmosis and Diffusion**
7.	**Demonstration of different stages of mitosis.**
8.	**Demonstration the different stages of meiosis.**

Continuous Assessment Pattern

Internal Assessment Lab (IA)	**Mid Term Lab (MTE)**	**End Term Lab (ETE)**	**Total Marks**
50		**50**	**100**

ame of The Course	**BIOINSTRUMENTATION-I**				
Course Code	**BSDB1007**				
Prerequisite	**Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have the basic knowledge of chemistry and environmental science.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students will understand the principle and application of basic instruments and the fundamental concept of microscopy, spectroscopy and radioisotopic techniques.

CO1	**Describe different types of microscopes for the study of cell, identification of cellular changes within organs**
CO2	**Explain various kind centrifugation techniques for study of separation of different cells and cellular organs**
CO3	**Describe the Principles and applications of chromatography, separation techniques based on chromatography, types of chromatography and application in industry**
CO4	**Explains absorbance based techniques like Visible and UV spectroscopy, Basic concepts and applications of MS and NMR.**
CO5	**Explain basic concepts of crystallography and its application**

CO6	Evaluate the application of Bioinstrumentation in various aspects like analysis of sample and research and development

Text Book (s)

7. **Principles and Techniques of Practical Biochemistry Wilson, K., Walker, J. (eds.); Cambridge University Press, Cambridge, 2000, 784 pp., ISBN 0-521-65873.**

8. **An Introduction to Practical Biochemistry (1998) 3rd ed., Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN:13: 978-0-07-099487-4 / ISBN:10: 0-07-099487-0.**

Reference Book

4. **Physical Biochemistry: Principles and Applications (2010) 2nd ed., Sheehan, D., Wiley Blackwell (West Sussex), ISBN:978-0-470-85602-4 / ISBN:978-0-470-85603-1.**
4. **Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2nd ed., Freifelder, D., W.H. Freeman and Company (New York), ISBN:0-7167-1315-2 / ISBN:0-7167-1444-2.**

Unit-1 : Separation techniques (08hours)
Different methods of protein precipitation: Precipitation using inorganic salts (salting out) and organic solvents, isoelectric precipitation, Dialysis, Ultrafilteration, Lyophilization
Unit-2 MICROBIAL TECHNIQUES (8 hours)
Buffer, Principle and working of pH meter, Laminar-air flow. Decontamination, sterilisation and disinfection techniques, media preparation technique, Culture of Human, Plant & Animal cells. Preparation of microbial, animal and plant samples for microscopy.
Unit-3 MICROSCOPY (10 hours)
Basic principles and applications of - Light microscopy, Bright & Dark Field microscopy, Fluorescence microscopy, Phase Contrast microscopy, TEM, SEM, Confocal Laser microscopy, Radio Microscopy.
Unit-4 : CENTRIFUGATION (10 hours)
Basic Principle of Centrifugation, Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, Factors affecting Sedimentation velocity, Standard Sedimentation Coefficient, Centrifugation of associating systems, Rate-Zonal centrifugation, sedimentation equilibrium Centrifugation, density gradient methods and their applications
Unit-5 : COLORIMETRY AND SPECTROSCOPY (10 hours)
Simple theory of the absorption of light by molecules, Beer-Lambert law, Principle and use of study of absorption spectra of biomolecules.Visible and UV spectroscopy.Colorimetry, turbidometry, Spectrofluorimetry, nephelometry and luminometry.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The	**HUMAN PHYSIOLOGY-II**				
Course Code	**BSBM1008**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Basic knowledge of human physiology**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:Students are able to understand the basic concept of Physiology and they can apply the knowledge of physiology in understanding the various diseases and keeping the body in healthy state.

Text Books

1. Guyton A.C, Hall J.E, Textbook of Medical Physiology, 11th Ed., Saunders Company, 2005.
2. Widmaier E. P, Raff H, Strang K. T. Vander's, Human Physiology : The mechanism of Body Function, 9th Ed. Mc. Graw Hill, 2003.
3. Ganong W. E, Review of Medical Physiology, 21st Ed., Mc. Graw Hill, 2003.

Reference Books

Guyton A.C, Hall J.E, Textbook of Medical Physiology, 11th Ed., Saunders Company, 2005.
2. Widmaier E. P, Raff H, Strang K. T. Vander's, Human Physiology : The mechanism of Body Function, 9th Ed. Mc. Graw Hill, 2003.

Course Outcomes

Students are able to

CO1	**Describe Structure of Neurons, action potential, Neurotransmitter**
CO2	**Explain Mechanism of Muscle contraction in skeletal tissue**
CO3	**Describe Structure and functional anatomy of eye and ear**
CO4	**Explains Endocrinology including hormones and their action**
CO5	**Explain Reproductive processes**
CO6	**Evaluate the application of exercise physiology in treatment of various disease**

Unit-1 Nervous system (12 hours)
Nervous system: Structure of Neurons, action potential, Neurotransmitter, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, Structure of cerebrum and function of different area of cerebral cortex, memory and cognition, Thermoregulation, mechanism of thermo sensation pathways.
Unit-2 Muscle physiology (6 hours)
Muscle physiology: Mechanism of Muscle contraction in skeletal tissue, structural and function difference between skeletal muscle and cardiac muscle. Structure of actin and myosin filament, Tetany, muscular dystrophy.
Unit-3 Sensory system (10 hours)
Sensory system: Functional anatomy of eye, Structure and functional anatomy of retina, Structure of rod and cone cells and their pigments, Molecular mechanism of rhodopsin,

mechanism of Vision, hyperpolarization of rod receptor potential, Functional anatomy of ear; structure and function of organ of corti, Inner hair cells (IHC) and outer hair cells (OHC) stereocilia, mechanism of Hearing. Common disorders of the following sensations: Vision, Hearing, Taste, Smell and Touch
Unit-4 Endocrinology (10 hours)
Endocrinology: Endocrine glands: Pituitary gland and hormone, thyroid gland and its hormone, adrenal gland and its hormone function, basic mechanism of hormone action, hormones and diseases.
Unit-5 Reproductive system (8 hours)
Reproductive system: Reproductive processes, gametogenesis, ovulation, neuroendocrine regulation, Menstrual cycle, Hormones related to ovulation and reproductive cycle.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**TOXICOLOGY AND PHARMACOLOGY**				
Course Code	**BSBM1009**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate**				
Corequisite	**Basic knowledge of chemistry and biology**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:Students are able to apply knowledge of toxicology and pharmacologyin drug designing and application of knowledge of drug action can be used in research analysis and drug development.

Course Outcomes

CO1	Analyze Toxic agents and Evaluation of toxicity
CO2	**Explain the basic concepts xenobiotics**
CO3	**Illustrate the evaluation of toxicology**
CO4	**Interpret Pharmacokinetics and Pharmacodynamics of drugs**
CO5	**Discuss the Classification of drugs and its mechanism.**
CO6	**Evaluate the application of Toxicology and Pharmacology in drug development and toxicology research**

Text Book (s)

1. Essentials of Medical Pharmacology, 7th edition (2010), K.D. Tripathi, Jaypee Brothers, ISBN: 9788184480856.
2. Pharmacology, 7th edition (2011), H.P. Rang, M.M. Dale, J.M. Ritter and P.K. Moore, Churchill Livingstone. ISBN: 9780702045042.

3. Hand book of Experimental Pharmacology, 4th edition (2012), S.K. Kulkarni, VallabhPrakashan, 2012. ISBN 13: 9788185731124.
4. Introduction to Toxicology, 3rd edition (2001), John Timbrell, Taylor and Francis Publishers. ISBN-13: 978-0415247627.
5. Cassarett and Doull"s "Essentials of Toxicology", 2nd edition (2010), Klaassen and Whatkins, McGraw Hill Publisher. ISBN-13: 978-0071622400.
6. Principles of Toxicology, 2nd edition (2006), Stine Karen and Thomas M Brown, CRC Press.ISBN-13: 978-0849328565.

Reference Book (s)

1. Introduction to Toxicology, 3rd edition (2001), John Timbrell, Taylor and Francis Publishers. ISBN-13: 978-0415247627.
2. Cassarett and Doull"s "Essentials of Toxicology", 2nd edition (2010), Klaassen and Whatkins, McGraw Hill Publisher. ISBN-13: 978-0071622400.
3. Principles of Toxicology, 2nd edition (2006), Stine Karen and Thomas M Brown, CRC Press.ISBN-13: 978-0849328565.

UNIT-I Introduction to Toxicology (6 hours)
History and Scope of toxicology; Modern Toxicology; Terminologies in toxicology; Toxic exposure and response - Effect of duration, frequency, route and site of exposure of xenobiotics on its toxicity; Characteristic and types of toxic response; Tolerance and addiction; Types of toxicity.
Unit II: Xenobiotics and eco-toxicology 12 hours)
Xenobiotic compounds, Metabolism of xenobiotics (biotransformation, Phase- I reactions including oxidations, hydrolysis, reductions and phase II conjugation reactions), Mechanism of action and toxic effects of – Metals (lead, arsenic, mercury), Pesticides (organophosphates, carbamates, organochlorine, bipyridyl compound pesticides). Eco-toxicology - bioaccumulation, biomagnification, acid rain and its effect on ecosystems, concept of BOD and COD.
Unit III: Evaluation of toxicity and Organ toxicity (8hours)
Evaluation of toxicity - Dose response relationships and its types, Concept of LD50, LC50, TD50 and therapeutic index. WHO and OECD guidelines for evaluation of acute and chronic toxicity. **Organ toxicity - Toxic responses of blood, liver, respiratory system and nervous system.**
Unit IV: Introduction to Pharmacology (8 hours)
History and scope of pharmacology; Nature and Source of drugs; Routes of drug administration and their advantages; Pharmacokinetics - Membrane transport, Absorption, Distribution, Metabolism and Excretion (ADME) of drugs, bioavailability; Pharmacodynamics - Mechanism of drug action, Factors affecting drug action, receptors and receptors subtypes, Drug-drug interactions.
Unit-5: Classification of drugs (10 hours)
Introduction and classification of drugs acting on - Central and autonomic nervous system, cardiovascular system, Kidney. Introduction and classification of drugs - Anti-inflammatory and analgesic drugs and their related toxicity, Endocrine drugs, Antimicrobial chemotherapeutic drugs

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BASIC CONCEPTS IN IMMUNOLOGY				
Course Code	BSDB1011				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives:
- To provide students with a foundation in immunological processes
- To provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology

Course Outcome:

CO1	Describe the basic concept of immunology
CO2	It describeshow immuneresponse work in our body and explain defense mechanisms by CTL and NK cells
CO3	Demonstrate complementary system, organ transplantation, Antigen processing and presentation by MHC complex
CO4	Elucidate immunological disorders autoimmunity, hypersensitivity and immunodeficiency.
CO5	Evaluate vaccine production, Immunization, immunotherapy
CO6	Evaluate the application and significance of Immunology

Text Book (s)

7. Immunology, 6th edition, (2006), J. Kuby et al, W.H. Freeman and Company, New York. ISBN-13: 978-1429202114.
8. Roitt‟s Essential Immunology, 12th edition, (2011), Wiley-Blackwell Science. ISBN-13: 978-1405196833.
9. Cellular and Molecular Immunology, 7th edition, (2011). Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. Saunders. ISBN-13: 978-1437715286.

Reference Book (s):

9. Murphy K, Travers P, Walport M. (2008). Janeway'sImmunobiology. 7th edition Garland Science Publishers, New York.

10. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill
11. Livingstone Publishers, Edinberg.
12. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

Unit -1: INTRODUCTION TO IMMUNE SYSTEM 10 hours

Types of immunity; organs and cells involved in immune system; Antigen, haptens, adjuvants, antigenicity, antigenic determinants and epitopes; Antibody structure and functions; Theories of antibody formation; Antibody diversity.

Unit -2: IMMUNE RESPONSE 8 hours

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance.

Unit -3: COMPLEMENT SYSTEM AND MAJOR HISTOCOMPATIBILITY COMPLEX10 hours

Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation. MHC - Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways).Transplantation - types, genetics of transplantation, graft versus host reactions.

Unit -4: IMMUNOLOGICAL DISORDERS 12 hours

Types of AutoimmUnity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumors, tumor Antigens, causes and therapy for cancers.

Unit -5: VACCINES AND IMMUNOLOGICAL TECHNIQUES. 10 hours

Vaccines - Types and their characteristics; Immunization practices-immunoprophylaxis and immunotherapy.Immunological techniques -Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, Western blotting, Immunofluoresence, Flow cytometry, Immunoelectron microscopy.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOMEDICAL SCIENCE LAB II**
Course Code	**BSBM1013**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**

Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objective:Students are able to prepare the microbial medium, describe the principle of pH meter, centrifugation and microscopy.

Course Outcome

CO1	**Preparation of pure culture by different methods**
CO2	**Understanding and usage of different component of compound microscope**
CO3	**Understanding and usage of different component of centrifuge**
CO4	Understanding and usage of different component of pH meter and determination of pH of milk and different water
CO5	**Preparation of gram's staining and mobility for bacteria**
CO6	Evaluation in research advances in laboratory experiments

1. Isolation of microorganisms by streak plate method.
2. To isolate the microorganisms by spread plate method.
3. Estimation of CFU count by spread plate method/pour plate method.
4. Understanding the different components and working principle of light microscope using pre-prepared slide.
5. Preparation of onion cell slide to study cell morphology using light microscope.
6. To perform the isoelectric precipitation of casein present in milk.
7. To determine the pH of 0.1 M NaOH and tap water using pH meter.
8. Demonstrating the basic principle of centrifugation and calculating the relation between RCF and RPM during centrifugation.
9. To perform gram staining of given sample.
10. Motility by hanging drop method.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
50	**0**	**50**	**100**

SEMESTER -III

Name of The Course	**MOLECULAR BIOLOGY**
Course Code	**BSDB2001**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**
Antirequisite	

	L	T	P	C
	4	0	0	4

Course Objectives:Students are able to determine the process and regulation of replication, translation and transcription.

Course Outcome:

CO1	**Explain the functional and structural organization of genetic material**
CO2	**Illustrate the different stages of DNA replication and type of DNA repair**
CO3	**Explain detail process of transcription and its regulation**
CO4	**Elucidate the mechanism of translation and posttranslational modification**
CO5	**Summarize the basic concept of gene regulation in pro and eukaryotes**
CO6	**Evaluate the application of Molecular biology**

Text Book (s)

13. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.
14. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.

References Book (s)

3. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), ISBN:13:978-1- 4641-0981-2 / ISBN:10: 1-4641-0981-8.
4. Molecular biology of the gene, (4thed)J D Watson, Benjamin/Cummings publ. Co Inc.

Unit - 1: NUCLEIC ACID STRUCTURE AND ORGANIZATION 8 hours
DNA and RNA as genetic material, chemical structure, base composition and types of nucleic acids, supercoiling of DNA, DNA reassociation kinetics (cot curve analysis), DNA organization into chromatin, bacterial and eukaryotic genomic organization.
Unit - 2: DNA REPLICATION AND REPAIR 8 hours
Enzymes and proteins of DNA replication, prokaryotic and eukaryotic replication mechanism, replication in phages and retroviruses, Mutagenesis, DNA damage and repair mechanisms
Unit - 3: TRANSCRIPTION 10 hours
Transcription in prokaryotes and eukaryotes.Mechanism of transcription, enzymes and transcription factors. Post-transcriptional modifications in mRNA, rRNA andtRNA.
Unit - 4: TRANSLATION (12 hours)
Genetic code - properties of the genetic code, deciphering of the genetic code.Translation in prokaryotes and eukaryotes; Translational mechanism in prokaryotes and eukaryotes, post translational modification and transport of proteins.
Unit - 5: REGULATION OF GENE EXPRESSION 10 hours
Regulation of gene expression in prokaryotes - The operon concept, lac &tryp operons.Transcriptional control. Post translational control. Regulation in eukaryotes - Control by promoter, enhancer and silencers.Cis-trans elements.DNA methylation & gene expression.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BIOINSTRUMENTATION-II				
Course Code	BSDB2002				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: : Students are able to determine the principle of advanced spectroscopy, chromatographic techniques

CO1	Describe different types of electrophoretic techniques for separation and isolation of biomolecules.
CO2	Explain various kinds of Spectroscopic techniques to characterize and detect structural changes in biomolecules.
CO3	Describe the principle and applications of various chromatographic techniques.
CO4	Explain the different types of radioactive detection techniques.
CO5	Demonstrate the principle of Sanger and Maxam Gilbert method of Nucleotide sequencing.
CO6	Evaluate the application of Bioinstrumentation in various aspects like analysis of sample and research and development

Text Book (s)

15. Molecular Biology of the Gene (2008) 6th ed., Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R., Cold Spring Harbor Laboratory Press, Cold spring Harbor (New York), ISBN:0-321-50781 / ISBN:978-0-321-50781-5.
16. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W. H. Freeman & Company (New York), ISBN:13: 978-1-4292-3414-6 / ISBN:10-14641-0962-1.

Reference Book

6. The Cell: A Molecular Approach (2009) 5th Ed. Cooper, G.M. and Hausman, R.E. ASM Press & Sunderland, (Washington DC), Sinauer Associates. (MA). ISBN:978-0-87893-300- 6.

Unit-1 : ELECTROPHORESIS (10 hours)
Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis

Unit-2 : ADVANCED SPECTROSCOPY (10 hours)
Basic concepts - Circular Dichroism (CD) and Optical Rotatory Dispersion (ORD), Fluorescence spectroscopy, Infrared spectroscopy, FTIR, NMR spectroscopy. Mass spectroscopy- MALDI-TOF, Nano-SIMS (10L) .
Unit-3 CHROMATOGRAPHY (10 hours)
Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ionexchange chromatography and affinity chromatography, GLC, HPLC.
Unit-4 : RADIOGRAPHY (10 hours)
Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Autoradiography, FISH-MAR, Pulse chase experiment, Liquid scintillation counting, Phosphor imaging, IRMA, Dosimetry. .
Unit-5 : ADVANCED TECHNIQUES (08 hours)
Chemical synthesis of nucleotides and peptides, Sequencing of proteins and nucleic acids, Enzyme purification and assay techniques.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	FUNDAMENTALS OF MICROBIOLOGY				
Course Code	BSDB2003				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives:

- Knowledge on Landmark discoveries in Microbiology and different domains classification of living organisms.
- Familiarity with general characters of prokaryotic and Eukaryotic microorganisms for conventional and molecular characterization using modern methods.
- Knowledge of cellular organization, life cycle and economic importance of prokaryotic (Eubacteria, Archaea, Cyanobacteria) and Eukaryotic (Algae, Fungi and protozoans).

Course Outcomes

CO1	Discuss about history, diversity and scope of microbiology.
CO2	Explain microbial nutrition, growth and control of microorganism.
CO3	Describe microbial molecular biology and genetics.
CO4	Demonstrate viruses and microbial pathogenicity.

CO5	**Interpret various applications of food and industrial microbiology.**
CO6	**Evaluate the application of Fundamental of microbiology**

Text Book (s)

- Prescott & Dunn's Industrial Microbiology. Ed. E.G. Reed (1987). CBS Publishers, New Delhi.
- Biotechnology: A Text book of Induxctrial Microbiology 2nd Edition. Crueger, W. and Cruger, A. (2000) Panima Publishing Corporation, New Delhi.
- Manual of Industrial Microbiology and Biotechnology 2nd Edition. Ed. Arnold L. Demain and Julian E. Davies (1999) ASM Press Washington D.C.
- Microbiology, Pelczar Jr. M.J.: Chan E.C.S. and Krieg, N. R. (1993) Tata Mc. Graw Hill, New Delhi.

Reference Book (s)

- Prescott & Dunn's Industrial Microbiology. Ed. E.G. Reed (1987). CBS Publishers, New Delhi.
- Biotechnology: A Text book of Induxctrial Microbiology 2nd Edition. Crueger, W. and Cruger, A. (2000) Panima Publishing Corporation, New Delhi.

Unit-1 HISTORY, DIVERSITY AND SCOPE OF MICROBIOLOGY12 hours **Discovery of microorganisms, spontaneous generation, germ theory of disease, members of the microbial world, scope and relevance of microbiology, Microbial taxonomy and phylogeny, Archaea, Bacteria, fungi, slime molds, water molds, algae, protozoa, helminths, the future of microbiology.**
Unit-2 BACTERIA 10hours **An account of typical eubacteria, chlamydiae&rickettsiae (obligate intracellular parasites), mycoplasma, and Archaea. Applications of bacteria and Archaea in industry, environment and food.**
Unit-3VIRUSES, VIROIDS AND PRIONS 09hours **An introduction to viruses with special reference to the structure and replication of the following: Poxvirus, Poliovirus, HIV, T4 and λ phage, lytic and lysogenic cycles.**
Unit-4ALGAE 09hours **History of phycology; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food.**
Unit-5FUNGI AND PROTOZOAN 08hours **Historical developments in the field of Mycology, significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasexual mechanism. Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins, General characteristics with special reference to Amoeba.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	METABOLISM OF BIOMOLECULES-I			
Course Code	BSDB2004			
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.			
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.			
Antirequisite				
	L	T	P	C
	4	0	0	4

Course Objectives: Students will understand the fundamental concept of biochemistry. It is a large and major inter disciplinary course. It will enhance the knowledge of chemistry within the living organisms. The course will emphasize the metabolism of carbohydrates, lipids, proteins and nucleotides.

Course Outcomes

CO1	Explain the concept of energy production in the living cell.
CO2	Explain the fundamentals of carbohydrate metabolism.
CO3	Illustrate the process of synthesis and degradation of lipids.
CO4	Describe the metabolism of essential and non-essential amino acids.
CO5	Evaluate the metabolism of nucleotides.
CO6	Evaluate the application of Biochemistry of metabolism

Text Book (s)

- Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414- 8.
- Biochemistry, 5th edition Jeremy M Berg, John L Tymoczko, and LubertStryer.New York: W H Freeman; 2002. ISBN-10: 0-7167-3051-0.

Reference Book (s)

- Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414- 8.
- Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN: 978-0-470-28173-4.
- Biochemistry, 5th edition Jeremy M Berg, John L Tymoczko, and LubertStryer.New York: W H Freeman; 2002. ISBN-10: 0-7167-3051-0.

Unit-1 BIOENERGETICS 10 hours **Gibbs free energy, Entropy, Enthalpy, relationship amongGibbs free energy, Entropy and Enthalpy, Laws of thermodynamics, exergonic and endergonic reactions, coupled reactions. High energy compounds - ATP, synthesis of ATP, ATP-ADP cycle, storage of high energy phosphates.**
Unit-2 CARBOHYDRATES METABOLISM 08 hours

3. Biochemistry, 5th edition Jeremy M Berg, John L Tymoczko, and LubertStryer.

Glycolysis, Krebs cycle, Glycogenesis, glycogenolysis, Gluconeogenesis, Pentose phosphate pathway, uronic acid pathway, Glycogen metabolism and glycogen storage diseases.
Unit-3LIPID METABOLISM 08 hours **Synthesis and degradation of triacylglycerols, phospholipids, glycolipids, eicosanoids; Biosynthesis of fatty acids; Oxidation of fatty acids; Ketone bodies; Metabolism of cholesterol - biosynthesis, lipoproteins synthesis and significance.**
Unit-4AMINO ACID METABOLISM 08 hours **Structure and classification of aminoacids; Disorders associated with amino acid metabolism. Urea cycle– steps, regulation and disorders; Biosynthesis of polyamines– putrescine, spermidine and spermine.**
Unit-5NUCLEOTIDE METABOLISM 08 hours **Purine metabolism – biosynthesis (de novo and salvage pathways), degradation, regulation and disorders of purine metabolism; Pyrimidine metabolism - biosynthesis (de novo and salvage pathways), degradation, regulation and disorders of pyrimidine metabolism.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of Thecourse	**BIOMEDICAL SCIENCE LAB-III**				
Course Code	**BSBM2014**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate**				
Corequisite	**Basic knowledge of biology**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives:Students can gain experience of hand on experiments and will be helpful for future research.

Text Book (s)

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414- 8.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.
   New York: W H Freeman; 2002. ISBN-10: 0-7167-3051-0.

3. Biochemistry, 5th edition Jeremy M Berg, John L Tymoczko, and LubertStryer. **Reference Book (s)**

1. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN:13: 978-1-4641-0962-1 / ISBN:10:1-4292-3414- 8.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.
   New York: W H Freeman; 2002. ISBN-10: 0-7167-3051-0.

CO1	**Isolate DNA and RNA for research and development**
CO2	**Evaluate DNA and RNA in diagnostic laboratory and hospitals for treatment of disease**
CO3	**Demonstrate the principle of Stereotaxic instrument which is useful for advanced neuroscience research**
CO4	**Demonstrate the recording brain temperature through thermocouple wire and perform further research in thermoregulatory area**
CO5	**Understand principle of GPS (Global Positioning System).**
CO6	**Evaluation in research advances in laboratory experiments**

Practical's

2. Isolation and Estimation of DNA.
3. Isolation and estimation of of RNA.
4. Demonstration the principle of Stereotaxic instrument.
5. Demonstration of brain temperature through thermocouple wire.
6. Study of all the biotic and abiotic components of any simple ecosystem- natural pond or terrestrial ecosystem or human modified ecosystem.
7. Determination of population density in a terrestrial community or hypothetical community by quadrate method and calculation of the Simpson's and Shannon- Weiner diversity index for the same community.
8. Principle of GPS (Global Positioning System).
9. Study of the life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data.
10. Study of the types of soil, their texture by sieve method and rapid tests for –pH, chlorides, nitrates, carbonates and organic carbon
11. Study any five endangered/ threatened species- one from each class.

Name of The Course	**Biomedical Science LAB-IV**				
Course Code	**BSBM2015**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**BSBM2002 and BSBM2003**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objective:

Student will learntostudy microbial growth and metabolic processes. They will gain knowledge the about techniques used for study and characterization of cellular DNA and proteins. Study structure of viruses and their characterization.

Course Outcome:

CO1	**Demonstration of human brain.**
CO2	**Identification of colour-blindness in humans**
CO3	Virtual recording of EPSP and IPSP
CO4	**Alcoholic fermentation**
CO5	**Preparation of isolation, purification and cultivation of viruses**
CO6	Lab report

Text Book (s)

9. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
10. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition.
11. Blackwell Publishing, Oxford, U.K.
12. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons

Reference Book (s):

7. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
8. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
9. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA.

10. Demonstration of human brain and identification of different areas
11. Identification of colour-blindness in humans
12. Virtual recording of EPSP and IPSP
13. Demonstration of stereotaxic instrument and its application
14. Demonstration of alcoholic fermentation.
15. Study the morphological structures of viruses (DNA and RNA) and their important characters using electron micrographs.
16. Demonstration of isolation of viruses.
17. Demonstration of purification of viruses.
18. Demonstration of cultivation of viruses.

Continuous Assessment Pattern

Internal Assessment (IA) Lab	Mid Term Test (MTE)	End Term Test Lab (ETE)	Total Marks
50	0	50	100

Name of The Course	**Web based course/seminar**
Course Code	**BSDB2006**
Prerequisite	**Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.**

Corequisite	**Students should have understanding of general biology.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**0**	**2**

Course Objectives:

- **Students are** directly engage and learn particular subject of their interest. This strengthens the fundamentals of the student in the course.
- It gives the students the opportunities to explore new areas of interest . Also gives students the opportunity to learn in greater depth the subjects they wish to master.
- Promotes the self-learning initiative of the students – where their own motivation is what drives them to complete the course. This fosters the habit of keeping oneself updated always by means of self-study.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	ETE	Total Marks
50		50	100

SEMESTER – IV

Name of The Course	**Programming Language C and Python**				
Course Code	**BCSE1020**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of and basic knowledge of the computers.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:

Course Outcome:

CO1	**Understand about the computers, Logic Development and Program Development Tools,Operations and Expressions.**
CO2	Identify Data Input and Output,Interactive Programming. Control Structures and functions.
CO3	Interpret Arrays, Structure and Union.
CO4	Interpret theapplications of Pointers, Initializing Pointers, Creating the data files.
CO5	**Express the knowledge in the area of C++.**
CO6	**Evaluation in research advances in PROGRAMMING LANGUAGES**

Text Book (s)

18. P KanetkarYashvant, Let us C, BPB Publications, New Delhi, Seventh Edition.

19. E. Balagurusami, Programming in ANSI C, Tata McGraw Hill, Fourth Edition.

Reference Book (s)

4. Schaum Outline Series,Programming in C.
5. HerbtzSchildt, "C++: The Complete Reference", Fourth Edition, McGrawHill.
6. John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition,2000.

Unit-I	**10 hours**
Introduction to computers: Units of computers, Block Diagram, Generation of Computers, Characteristics of Computers, Phases of Computers, Different types of Memory, Input and Output Devices. **Logic Development and Program Development Tools:** Data Representation, Flowcharts, Problem Analysis, Decision Trees/Tables, Pseudo Code and Algorithms, ProgramDebugging, Compilation and Execution. **Fundamentals:** Character Set, Identifiers and Key Words, Data Types, Constants, Variables, Expressions, Statements, Symbolic Constants. **Operations and Expressions:** Arithmetic Operators, Unary Operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Library functions.	
Unit-2:	**10 hours**
Data Input and Output: Single Character Input, Single Character Output, Entering Input Data, More About Scan Functions, Writing Output Data, More About Print Functions, Gets and Puts Functions, Interactive Programming. **Control Structures:** Introduction, Decision Making with If – Statement, If Else and Nested If, While And Do-While, For Loop. Jump Statements: Break, Continue, Goto, Switch Statement. **Functions:** Introduction To Functions, Function Declaration, Function Categories, Standard Functions, Parameters And Parameter Passing, Pass – By Value/Reference, Recursion, Global and Local Variables, Storage Classes.	
Unit-3:	**10 hours**
Arrays: Introduction to Arrays, Array Declaration, Single and Multidimensional, Array, Memory Representation, Matrices, Strings, String Handling Functions. **Structure and Union:** Declaration of Structure, Accessing Structure Members, Structure Initialization, Arrays of Structure, Nested Structures, Unions.	
Unit-4:	**10 hours**
Pointers: Introduction To Pointers, Address Operator And Pointers, Declaring and Initializing Pointers, Assignment through Pointers, Pointers and Arrays. **Files:** Introduction, Creating a Data File, Opening and Closing a Data File, Processing a Data File.	
Unit-5:	**10 hours**
Using Classes in C^{++}: Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors, Overview of Template classes and their use.Introduction to Inheritance and Polymorphism	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks

30	**20**	**50**	**100**

Name of The Course	**BIOTECHNOLOGY**				
Course Code	**BSDB2010**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objective:

Students will understand the molecular methods and applications of recombinant DNA technology and gene transfer techniques.

Course Outcome:

CO1	**Brief account of plant tissue culture and advantages of somatic hybridization**
CO2	**Explain the basic techniques of cell culture**
CO3	**Describe the different methods of DNA sequencing**
CO4	**Describe the type and process of genetic exchange**
CO5	**Explain the various categories of transposable element**
CO6	**Evaluate the application of Biotechnology and genetic engineering in research and deployment**

Text Book (s)

9. Principles of Gene Manipulations 1994 by Old and Primrose Blackwell Scientific Publications.
10. DNA Cloning: A Practical Approach by D.M. Glower and B.D. Hames, IRL Press, Oxford. 1995.
11. Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers, Oxford. 1994.
12. Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford 1998.

References Book (s)

9. PCR Technology - Principles and Applications for DNA Amplification by Henry A. Erlich (Ed.) Stockton Press. 1989.
10. Biotechnology: A Guide to Genetic Engineering by Peters.
11. Genetic Engineering – 2000 by Nicholl.
12. Recombinant DNA and Biotechnology: Guide for Teachers. 2nd Edition by Helen Kreuz. 2001. ASM Publications.

Unit -1: INTRODUCTION TO PLANT BIOTECHNOLOGY	**8 hours**
Basic introduction to animal and plant biotechnology; types of plant tissue culture, Somatic hybridization	
Unit -2: INTRODUCTION TO ANIMAL BIOTECHNOLOGY	**8 hours**
Animal Biotechnology - organ culture; cell culture and initiation of cell culture; evolution of continuous cell lines.	
Unit -3: CONSTRUCTION OF DNA LIBRARIES	**10 hours**
Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA), Quantification and storage of nucleic acids, Construction of cDNA library, Construction of Genomic library, Screening and preservation of DNA libraries, DNA Sequencing and cloning strategies.	
Unit -4: GENE TRANSFER TECHNIQUES	**10 hours**
Gene transfer techniques: biological methods; chemical methods; physical or mechanical methods.	
Unit -5: TRANSGENICS	**10 hours**
Plant Genetic Engineering: Restriction enzymes; Transformation of plant cells; different type of vectors including viral vectors and their benefits; Screening and selection of transformants, PCR and hybridization methods; Application of transgenic science in plant and animal improvement.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**MEDICAL BIOCHEMISTRY**				
Course Code	**BSDB2009**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules and their disorder**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the metabolism of biomolecules and their related disorders.

Course Outcomes

CO1	**Illustrate the various disorders of Metabolism.**
CO2	**Interpret the Distribution of enzymes and diagnostic significance**
CO3	**Evaluate the significance of vitamins and hormones as well as disease associated with it .**

CO4	Evaluate the biochemistry of cancer.
CO5	Analyze the molecular diagnostics.
CO6	Evaluate the application of Medical biochemistry in research

Text Book (s)

3. Textbook of Biochemistry with Clinical Correlations (2011) 7th ed., Devlin, T.M., John Wiley & Sons, Inc. (New York), ISBN:978-0-470-28173-4.
4. Textbook of Biochemistry for Medical Students. D.M. Vasudevan, Sreekumari. S, Kannan Vaidyanathan. JPB.

REFERENCES Books:

1. Textbook of Medical Biochemistry, 7thedition (2007), Chatterjea&Shinde, Jaypee Publications, ISBN: 81-8448-134-9.
2. Tietz Fundamentals of Clinical Chemistry, 6th edition (2007), Carl A. Burtis, Edward R. Ashwood, and David E. Bruns;WB Saunders Co, ISBN-13: 978-0721638652

Unit-1 DISORDERS OF METABOLISM	**12 hours**
Disorders of Carbohydrate Metabolism; Lipids, Lipoproteins and Apolipoproteins; Inborn Errors of Metabolism; Disorders of Electrolytes, Blood Gases and Acid Base Balance; Disorders of Mineral Metabolism; Hormonal Disorders - Adrenocortical steroids, Reproductive endocrinology, Thyroid function; Biochemical Aspects of Hematology - Disorders of erythrocyte metabolism, hemoglobinopathies, thalassemia, and anemias. Prostaglandins- classification, biosynthesis, role of COX-1, COX-2, NSAIDS in synthesis;	
Unit 2: Enzymes: Distribution and diagnostic significance	**10 hrs**
Properties of enzymes used in diagnosis of metabolic disorders, clinical significance of diagnostically important enzymes: creatine kinase, lactate dehydrogenase, alanine- and aspartate aminotransferases, A detailed account on: isoenzymes, their tissue distribution and clinical significance.	
Unit-3 VITAMIN AND HORMONES	**10 hours**
Vitamins and classification, requirement and recommended allowances, resource of vitamins, Diseases due to deficiency of water-soluble and fat-soluble vitamins. Role of leptin, ghrelin and other hormones in regulation of Obesity, Classification with special reference to epinephrine and thyroid hormones (T3 and T4); functions.	
Unit-4 BIOCHEMISTRY OF CANCER	**10 hours**
Etiology - Chemical carcinogens, Oncogenic viruses; Molecular basis of cancer - Oncogenes, Antioncogenes, Oncosuppressor genes, Apoptosis, Growth factors;Tumour kinetics - Doubling time, Contact inhibition, Anchorage dependence; Oncofetal antigens; Tumor markers; Cancer therapy - Anticancer drugs, Drug resistance. .	
Unit-5 MOLECULAR DIAGNOSTICS	**10 hours**

Hybridization and blotting techniques; DNA finger printing; Restriction fragment length polymorphism (RFLP); Polymerase chain reaction (PCR); Hybridoma technology;Transgenesis; DNA sequencing; Mutation detection techniques – single strand conformation polymorphism, heteroduplex analysis, conformation sensitive gel electrophoresis, protein truncation test, denaturation high performance liquid chromatography.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of Thecourse	**MEDICINAL CHEMISTRY**				
Course Code	**BSBM 2007**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate**				
Corequisite	**Basic knowledge of Chemistry and Biochemistry**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:Students are able to understand the composition of drug and its binding affinity with receptor will be helpful to develop new medicine in research laboratories and industries.

Course Outcomes

CO1	**Interpret the classification of drug targets.**
CO2	**Explain the Physiochemical properties of drug action.**
CO3	**Illustrate the Drug receptor interactions.**
CO4	**Demonstrate the principles of drug designing.**
CO5	**Analyze the drug discovery and pharmainformatics.**
CO6	**Evaluate the application of Medicinal chemistry in research drug development**

Text Book (s)

1. Introduction to Medicinal Chemistry, 4th edition (2009), Graham l. Patrick, Oxford University Press. ISBN-13: 978-0199234479.
2. The Organic Chemistry of Drug Design and Drug Action, 2nd edition (2004), Richard B. Silvermann, Elsevier, Academic Press. ISBN-13: 978-0126437324.
3. Medicinal Chemistry: A Molecular and Biochemical Approach, 3rd edition (2005), Thomas Nogrady and Donal F. Weaver, Oxford University Press. ISBN-13: 978-0195104561.DIGITAL BOOKS:
4. Introduction to Medicinal Chemistry, 4th edition (2009), Graham l. Patrick, Oxford University Press. ISBN-13: 978-0199234479.
5. The Organic Chemistry of Drug Design and Drug Action, 2nd edition (2004), Richard B. Silvermann, Elsevier, Academic Press. ISBN-13: 978-0126437324

Reference Book (s)

1. Introduction to Medicinal Chemistry, 4th edition (2009), Graham l. Patrick, Oxford University Press. ISBN-13: 978-0199234479.

UNIT I
DRUG TARGET CLASSIFICATION **Definition and scope of drug design. Proteins as drug targets: Receptors - receptor role, ion channels, membrane bound enzyme activation, agonist and antagonists, concept of inverse agonist, desensitization and sensitization of receptors, affinity, efficacy and potency. Enzymes - Enzyme inhibitors (competitive, non-competitive, suicide inhibitors), medicinal use of enzyme inhibitors. Nucleic acids as drug targets: Classes of drugs that interact with DNA: DNA intercalators and DNA alkylators.**
Unit-2
PHYSICOCHEMICAL PRINCIPLES OF DRUG ACTION **Partition coefficient, drug dissolution, acid-base properties, surface activity, bioavailability, stereochemical aspects of drug action.**
Unit-3
DRUG RECEPTOR INTERACTIONS **Kinetic analysis of ligand receptor interactions using scatchard plot, double reciprocal plot, Hill plot, forces involved, relationship between dose and effect (graded and quantal response).**
Unit-4
PRINCIPLES OF DRUG DESIGN **Introduction to SAR, strategies in the search for new lead compounds, analogue synthesis versus rational drug design, concept of prodrugs.**
Unit-5
DRUG DISCOVERY AND PHARMAINFORMATICS **Drug discovery pipeline, drug target identification and validation for microbial pathogen, selection of gene unique to the pathogen, screening for its presence in other microbes and human host, Drug Databases, PubChem, Calculating drug-like properties, introduction to rational drug design methods, optimization of lead compounds, protein 3D structure and binding site analysis, similarity based virtual screening using online tools.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of Thecourse	**BIOMEDICAL SCIENCES LAB-IV**				
Course Code	**BSBM 2017**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate**				
Corequisite	**Basic knowledge of Biology**				
Antirequisite					
		L	**T**	**P**	**C**

	0	0	6	3

Course Objectives:Students are able to perform research in the field of life science.

Course Outcomes

CO1	**Demonstrate and perform of agarose gel electrophoresis**
CO2	**Illustrate principle and applications of SDS PAGE which is useful for research**
CO3	**Demonstrate activity of restriction endonuclease enzyme**
CO4	**Evaluate qualitative analysis ethanol production through microorganism**
CO5	**Understand the Southern Blotting, Northern Blotting and Western Blotting techniques**
CO6	**Evaluation in research advances in laboratory experiments**

Text Book (s)

1. PRACTICALS AND VIVA IN MEDICAL BIOCHEMISTRY, DANDEKAR , S. P. Ist edition
2. Wilson and Walker, Cambridge press.
3. PRACTICAL BIOCHEMISTRY Gupta ARC 5th edition

Reference Book (s)

1. PRACTICALS AND VIVA IN MEDICAL BIOCHEMISTRY, DANDEKAR , S. P. Ist edition
2. Wilson and Walker, Cambridge press.
3. PRACTICAL BIOCHEMISTRY Gupta ARC 5th edition

Practical's

1. Demonstration of agarose gel electrophoresis
2. Demonstration of SDS PAGE.
3. Demonstration of native PAGE.
4. Demonstration of activity of restriction endonuclease enzyme.
5. Demonstration of ethanol production through microorganism.
6. To study following techniques through photographs a. Southern Blotting b. Northern Blotting c. Western Blotting
7. Demonstration of cardiac perfusion and isolation of rat heart through video.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	**Programming Languages C and Python Laboratory**
Course Code	**BCSE1031**
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**
Corequisite	**Students should have understanding and a basic knowledge of the computing**
Antirequisite	

	L	T	P	C
	0	**0**	**6**	**3**

Course Objective:

Students are able to understand the basic data structures used in programming (such as arrays and array lists).

Text / References Books:

13. **E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.**
14. **Paul Deitel, Harvey Deitel, "C++ How to Program", 8^{th} Edition, Prentice Hall, 2011.**
15. **John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.**
16. **Harry, H. Chaudhary, "Head First C++ Programming: The Definitive Beginner's Guide", First Create space Inc, O-D Publishing, LLC USA.**

27. Write a program to find greatest of three numbers.
28. Write a program to find gross salary of a person
29. Write a program to find grade of a student given his marks.
30. Write a program to find divisor or factorial of a given number.
31. Write a program to print first ten natural numbers.
32. Write a program to print first ten even and odd numbers.
33. Write a program to find grade of a list of students given their marks.
34. Create Matrix class. Write a menu-driven program to perform following Matrix operations (2-D array implementation): 35. Sum b) Difference c) Product d) Transpose

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
50		**50**	**100**

Name of The Course	**Research Methodology and Statistics**
Course Code	**BBS09T2411**

Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream**				
Corequisite	**Students should have fundamental knowledge of subjects like mathematics, physics and chemistry**				
Antirequisite	**-**				
		L	**T**	**P**	**C**
		2	**-**	**-**	**2**

Course Objective: The objective of the course is to impart research based knowledge to the students. They would be taught the various ways of data collection, research methodologies adopted in different settings, and statistical methods.

Course Outcome:

CO1	**Students will get separately familiar with terms research and methodology, respectively.**
CO2	**Identifying different type of research sampling and research design.**
CO2	**Students will understand raw data, primary data, secondary data and their different methods of collection.**
CO4	**Students will appraise the application of sampling through statistics.**
CO5	**Students will get familiar with different descriptors of statistics to analyse data both quantitatively and qualitatively.**
CO6	**Students will develop the statistical analysis indulges in modern research for drug designing.**

Course Contents:

Module I: Introduction to Research Methodology	**6-Lectures**
Definition, concept and research in science; Introduction to Research Methodology, Research methodology in science.	
Module II: Research in Scientific and Social Settings	**5-Lectures**
Research Design: Research Sampling, rationale for using a particular sampling procedure, Probability.	
Module III: Tools of Data Collection	**5-Lectures**
Data and its types, Methods for Collecting Data, Observation method, Questionnaire, Other Methods	
Module IV: Introduction to Statistics	**4-Lectures**
Introduction to statistics (Biostatistics); Sample and Population, parametric and non parametric statistics.	
Module V: Descriptive Statistics	**5-Lectures**
Measures of central tendency; Measures of dispersion and deviation; graphical representation of the data. Correlation and Regression	
Unit 6: Recent research advances	3 hrs
Descriptors, Quantitative structure-activity relationship (QSAR) , Quantitative structure-property relationship(QSPR), Drug designing.	

Text & References:

- **Broota, K. D., Experimental designs in psychological research, Wiley eastern, New York, 1992.**
- **Guilford, Statistics in Psychology and Education, McGraw Hill, New York, 1986.**
- **J T Walker, Statistics in Criminology and Criminal Justice analysis and Interpretation**

- Leo, A., & Hoekman, D. H. (1995). *Exploring QSAR*. American Chemical Society.
- **Chanin Nantasenamat, Chartchalerm Isarankura-Na-Ayudhya, Thanakorn Naenna, Virapong Prachayasittikul, A Practical Overview of Quantitative Structure- Activity Relationship. EXCLI Journal 2009;8:74-88.**
- **Wiktor Pronobis, Alexandre Tkatchenko, and Klaus-Robert Muller, J. Chem. Theory Comput. 2018, 14, 2991−3003**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

SEMESTER - V

Name of The Course	**MINOR PROJECT**				
Course Code	**BSMB3001**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

COURSE CONTENTS:

Minor Project is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. The duration of Minor project is 1 month (4-6 weeks). A Minor Project may be given in lieu of a discipline specific elective paper/Microbiology.This should be done in consultation with the faculty supervisor and agency supervisor under whom he / she is getting trained. The project report should be around 20 pages and chaptered as follows:

Chapter I: Introduction

Chapter II: Review of Literature

Chapter -3:: Methodology

Chapter IV: Results&Discussion

Chapter V: Summary and Conclusion

The research should be original and should be action oriented in that the results should be able to throw light on some of the important unexplored areas that would be of practical use to the microbiologists.

Students are expected to decide on the specific project area and title, and carry out substantial portion of the literature survey during the end of their 4th semester.After the end of their 4thsemester ETEs, each student will be asked to make presentation about the project including literature available, objective sought and work plan including methodologiesto the Student Project Monitoring Committee constituted by the HOD. The Project Work may be a work based on theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of

data, etc. or a combination of these. The final project report will be evaluated by a panel of examiners consisting of HOD, Guide and Co-guide (wherever applicable) and an External Examiner. Viva-voce examination for the same will be conducted.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50		50	100

Name of The Course	INHERITANCE BIOLOGY				
Course Code	BSDB3003				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept ofinheritance and genetics.

Course Outcomes

CO1	Understand Introduction of genetics and Mendelian principles
CO2	Interpret extensions of Mendelian principles
CO3	Demonstrate Extra chromosomal inheritance
CO4	Illustratethe Microbial genetics
CO5	Illustrate the Mutation
CO6	Evaluate the application of inheritance biology

Text Book (s)

- Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley and Sons Inc.
- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
- Benjamin A. Pierce. 2003. Genetics: A Conceptual Approach. W.H, Freeman and Company, New York.

Reference Book (s)

- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.
- Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.

Unit-1 INTRODUCTION OF GENETICS AND MENDELIAN PRINCIPLES **08 hours**

Concept of gene: Allele, multiple alleles, pseudoallele, complementation tests, genotype, phenotype. Mendelian principles; Dominance, segregation, independent assortment.
Unit-2 EXTENSIONS OF MENDELIAN PRINCIPLES 08 hours **Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.**
Unit-3EXTRA CHROMOSOMAL INHERITANCE 08hours **Inheritance of Mitochondrial and chloroplast genes, maternal inheritance. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.**
Unit-4MICROBIAL GENETICS 10 hours **Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.**
Unit-5MUTATION 12hours **Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Recombination: Homologous and non-homologous recombination.**
Unit 6 Research advances in inheritance biology
Research article/review/MOOC

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**MEDICAL MICROBIOLOGY**				
Course Code	**BSDB3004**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate**				
Corequisite	**Basic knowledge of Microbiology**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives::Students are able to understand the concept of medical microbiology and work in hospital and research laboratory. Students are able to research in microorganism and help for treatment.

Course Outcomes

CO1	**Overview of microorganism, routes of transmission, pathogenesis and treatment**

CO2	**Demonstrate molecular diagnosis of microbial diseases, study of diagnostic techniques PCR, ELISA**
CO3	**Describe Characteristics, diagnosis, treatment, prevention and control of bacterial disease, gastrointestinal and viral disease**
CO4	**Evaluate about protozoans infection, route of infection and treatment, types of fungus and causative agents of fungal disease**
CO5	**Principle of antibiotics and its application for treatments of various kinds of disease**
CO6	**Evaluate the application and significance of medical microbiology**

Text Book (s)

3. Chaechter M. Medoff G. and Eisenstein BC. (1993) Mechanism of Microbial Diseases 2nd edition. Williams and Wilkins, Baltimore.
4. Collee, JG. Duguid JP, Fraser AG, Marimon BP. (1989) Mackie and Mc Cartney Practical Medical Microbiology, 13th Edition. Churchill Livingstone.
5. Pharmaceutical Microbiology – Edit. ByW.B.Hugo&A.D.Russell Sixth edition. Blackwell scientific Publications.
6. Analytical Microbiology–Edit by Frederick Kavanagh Volume I & II.Academic Press New York.

Reference Book (s)

1. Pharmaceutical Microbiology – Edit. ByW.B.Hugo&A.D.Russell Sixth edition. Blackwell scientific Publications.
2. Analytical Microbiology–Edit by Frederick Kavanagh Volume I & II.Academic Press New York.

UNIT I
BASICS IN MEDICAL MICROBIOLOGY **Infectious diseases overview. Medically important microbes. Microbial diseases - sources, route of transmission. Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity Pathogenesis, Microbial virulence and virulence factors - Signs and symptoms of microbial diseases. Treatment, Prevention and control of microbial infections. Immunity of microbial diseases.**
Unit-2
DIAGNOSIS OF MICROBIAL DISEASES **Collection, transport and preliminary processing of clinical pathogens. Clinical, microbiological, immunological and molecular diagnosis of microbial diseases. Modern methods of microbial diagnosis. Principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).**
Unit-3
BACTERIAL DISEASES AND VIRAL DISEASES Characteristics, diagnosis, treatment, prevention and control of diseases caused by Bacteria, **The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control** **Respiratory Diseases: *Streptococcus pyogenes, Haemophilusinfluenzae, Mycobacterium tuberculosis*** **Gastrointestinal Diseases: *Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori* Others: *Staphylococcus aureus, Bacillus anthracis, Clostridium tetani, Treponema pallidum, Clostridium difficie.*** **List of viral diseases of various organ systems and their causative agents.**

Symptoms, mode of transmission, prophylaxis and control of Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis
Unit-4
PROTOZOAN AND FUNGAL DISEASES **List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar. Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention Cutaneous mycoses: Tinea pedis (Athlete's foot),Systemic mycoses: Histoplasmosis, Opportunistic mycoses: Candidiasis**
Unit-5
ANTIBIOTICS, SYNTHETIC ANTIMICROBIAL AGENTS AND ACTION MECHANISM OF ANTIBIOTICS **Antibiotics and synthetic antimicrobial agents, Antifungal antibiotics, antitumor substances. Peptide antibiotics, Chloramphenicol, Sulphonamides and Quinolinone antimicrobial agents. Chemical disinfectants, antiseptics and preservatives, Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis). Bacterial resistance to antibiotics, Penetrating defenses – How the antimicrobial agents reach the targets (cellular permeability barrier, cellular transport system and drug diffusion).**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**EVOLUTIONARY BIOLOGY**				
Course Code	**BSDB3005**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Basic knowledge of evolution**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives:Students are able to understand the significance of evolution and can work in geography laboratory, engage in research.

Course Outcomes

CO1	**Explain the theories of organic evolution**
CO2	Analyze Evidence of Organic evolution
CO3	**Illustrate the basic concept Population genetics and Genetic drift**
CO4	**Interpret Products of evolutionary change**
CO5	**Illustrate the Geological time scale.**
CO6	**Evaluate the application and significance of Evolution Biology**

Text Book (s)

1. Ridley, M. (2004) Evolution. III Edition. Blackwell Publishing
2. Barton, N. H., Briggs, D.E.G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring Harbour Laboratory Press.
3. Hall, B.K. and Hallgrimsson, B. (2008) Evolution. IV Edition. Jones and Bartlett Publishers
4. Pevsner, J. (2009) Bioinformatics and functional genomics. II Edition. Wiley-Blackwell
5. Rastogi, V.B. organic evolution.

Reference Book (s)

1. Ridley, M. (2004) Evolution. III Edition. Blackwell Publishing
2. Barton, N. H., Briggs, D.E.G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring Harbour Laboratory Press.
3. Rastogi, V.B. organic evolution.

Unit- I
Theories of organic evolution **Lamarckism, Darwinism, Development and concept of synthetic theory, Natural selection in action (industrial melanism, antibiotic and DDT resistance), type of natural selection; Stabilizing selection, Directional selection, Diversifying selection, cyclic selection, k selection and r selection, selection pressure.**
Unit-2
Evidence of Organic evolution **Evidence of Organic evolution from morphology and comparative anatomy(tectology); Homology and homologous organs, types of homology; phylogenetic homology, sexual homology, serial homology. Analogy and analogous organs, Divergent evolution, Convergent evolution, vestigial organs, Evidence of evolution fromComparative embryology, recapitulation theory, Evidence from Palaeontology, Evidence from Biochemistry and physiology, Evidence fromZoogeography.**
Unit-3
Population genetics and Genetic drift **Concept of Deme, gene pool, gene frequency, genotype frequency, genetic equilibrium and Hardy Weinberg's law of equilibrium, genetic load and genetic death, mutational and segregation load, silent feature of Genetic drift, Sewall wright effect, Bottle neck phenomenon, founder effect, concept of polymorphism, balanced polymorphism, transient polymorphism.**
Unit-4
Products of evolutionary change **Species concept, speciation, phyletic speciation, quantum speciation, gradual speciation, allopatric speciation, sympatric speciation, parapatric speciation, Isolating mechanisms and modes of speciation. Adaptation and evolution: Structural adaptation, coadaptation-adaptation, k adaptation, Divergent evolution (adaptive radiation) adaptive radiation in finches, parallel evolution (convergent evolution)**
Unit-5
Geological time scale **The Eras, Azoic era, Archaeozoic era, Proterozoic area, Paleozoic era, Mesozoic era, Cenozoic era, Different periods and its characteristics, Ordovician period, Silurian period, Devonian period, Dinosaurs and its type distribution and extinction.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	30	50	100

Name of Thecourse	**BIOMEDICAL SCIENCES Lab V**				
Course Code	**BSBM3010**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate**				
Corequisite	**Basic knowledge of Biology**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives:Students are able to expose in research and gain experience.

Course Outcomes

CO1	**Understand the Principles of Colorimetry**
CO2	**Illustrate principle and applications of of Beer-Lambert's law**
CO3	**Determination of molar extinction coefficient of NADH**
CO4	**Separate of Plant pigments/lipids/sugars by different chromatographic techniques**
CO5	**Separation and amplify DNA using electrophoresis and chromatography**
CO6	**Evaluation in research advances in laboratory experiments**

Text Book (s)

COMPREHENSIBLE VIVA & PRACTICAL BIOCHEMISTRY

Reference Book (s)

COMPREHENSIBLE VIVA & PRACTICAL BIOCHEMISTRY

Practicals

1. Principles of Colorimetry
2. Verification of Beer-Lambert's law – Protein quantification by Biuret's method.
3. Determination of molar extinction coefficient of NADH.
4. Identification of amino acids by Paper chromatography.
5. Separation of Plant pigments/lipids/sugars by Thin layer chromatography.
6. Gel Electrophoresis of DNA.
7. To amplify DNA using PCR through video
8. Restriction digestion of DNA
9. Separation of proteins by isoelectric focusing.
10. To perform ELISA experiment.
11. Grouping of blood and Rh typing.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Biomedical sciences LAB-VII**				
Course Code	**BSB3M011**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		0	**0**	**6**	**3**

Course Objectives:Students are able to understand the basic techniques of medical microbiology and immunology

Course Outcome :

CO1	**Understand the preparation of master and replica plates.**
CO2	**Demonstrate the effect of chemicals and radiation on bacterial cells**
CO3	Demonstration of conjugation and Ames test
CO4	**Demonstration of different types of fermenters.**
CO5	**Visit report**
CO6	Lab report

Text and Reference Book (s)

11. Aneja KR. Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai. 2005
12. Horold J Benson. Microbiological Applications. Laboratory Manual in General Microbiology. 7th International Edition, WCB McGraw – Hill, Boston. 1998
13. James G Cappuccino & Natalie Sherman Microbiology : A Laboratory manual. 6th Edition, Published by Pearson Education. 2004
14. 5. Dubey RC and Maheswari DK. Practical Microbiology 1st Edition, S. Chand & Company Ltd., New Delhi. 2004
15. Myer’s and Koshi’s Manual of Diagnostic Procedures in Medical Microbiology and Immunology / Serology. Published by Department of Clinical Microbiology, CMC and Hospital, Vellore, Tamil Nadu. 2001

8. Preparation of Master and Replica Plates.
9. Study the effect of chemical (HNO2) and physical (UV) mutagens on bacterial cells
10. Study survival curve of bacteria after exposure to ultraviolet (UV) light.
11. Demonstration of Bacterial Conjugation.
12. Demonstration of Ames test.
13. Study different parts of fermenter.
14. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

SEMESTER: VI

Name of The Course	Dissertation				
Course Code	BSBC9998				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		0	0	0	14

Course Objectives:

The aim is to develop an understanding of the processes and skills required to undertake a supervised research project at masters level of study. The objectives are

- **To develop research skills commensurate with the accomplishment of a masters degree.**
- **To develop skills in independent inquiry.**
- **To produce a coherent and logically argued piece of writing that demonstrates competence in research and the ability to operate independently.**
- **To address issues of research design, methodology, ethics and theoretical arguments, and apply these to your own research.**

Course Outcomes

CO1	Demonstrate the use of knowledge of basic and applied sciences in project based learning.
CO2	Organizes experiments and researches, perform analysis and interpret data for the designed project.
CO3	Cooperate effectively as an individual and as a member in the research team.
CO4	Systematize the articulated ideas, comprehend and write effective reports, documentation and to communicate effectively.
CO5	Demonstrate knowledge and understanding of research problems and related principles to manage projects in multidisciplinary research areas.
CO6	Evaluate the research advances in research project

Project work/Dissertation is considered as a special course involving application of knowledge in solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertation work may be given in lieu of a discipline specific elective paper/Biochemistry.This should be done in consultation with the faculty supervisor and agency supervisor under whom he / she is getting trained. The project report should be around 100 pages and chaptered as follows:

Chapter I: Introduction
Chapter II: Review of Literature
Chapter III: Methodology
Chapter IV: Results
Chapter V: Discussion
Chapter VI: Summary and Conclusion

The research should be original and should be action oriented in that the results should be able to throw light on some of the important unexplored areas that would be of practical use to the forensic experts.

Students are expected to decide on the specific project area and title, and carry out substantial portion of the literature survey during the end of their 3rd semester.After the end of their 3rdsemester ETEs, each student will be asked to make presentation about the project including literature available, objective sought and work plan including methodologiesto the Student Project Monitoring Committee constituted by the Division Chair. The Project Work may be a work based on theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, etc. or a combination of these. The final project report will be evaluated by a panel of examiners consisting of Dean,DC, PC,supervisor and Co-supervisor (wherever applicable) and an External Examiner. Viva-voce examination for the same will be conducted.

The following weightage is assigned at each stage of Student Project evaluation.

Activity	Remarks
Zeroth Review	Project scopes and Proposal
1st Review	Methods of project Implementation
2nd Review	Technical Achievement
3rd Review (Final)	Innovation and contribution
Submission of Project Report to the Department	Two weeks before the viva-voce exam

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	0	50	100

Name of The Course	Web based course/seminar-II				
Course Code	BSDB3010				
Prerequisite	Candidate for admission to the first year of B.Sc. Degree Course in Biochemistry should passed the Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology.				
Antirequisite					
		L	T	P	C
		0	0	0	2

Course Objectives:

- **Students are** directly engage and learn particular subject of their interest. This strengthens the fundamentals of the student in the course.
- It gives the students the opportunities to explore new areas of interest. Also gives students the opportunity to learn in greater depth the subjects they wish to master.
- Promotes the self-learning initiative of the students – where their own motivation is what drives them to complete the course. This fosters the habit of keeping oneself updated always by means of self-study.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	ETE	Total Marks
50		50	100

ELECTIVES
GROUP-I

Name of The Course	**BIOINFORMATICS**				
Course Code	**BSDB2011**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the computer science.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of bioinformatics.
Course Outcomes

CO1	**Describe the Introduction of Computer Fundamentals**
CO2	**It Interpret the Introduction of Bioinformatics and Biological Databases**
CO3	**Demonstrate Sequence Alignments, Phylogeny and Phylogenetic trees**
CO4	**Evaluate Genome organization and analysis**
CO5	**Evaluate Protein Structure Predictions**
CO6	**Evaluate the significance of bioinformatis**

Text Book (s)

1. **Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House**
2. **Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications**
3. **Lesk M.A. (2008) Introduction to Bioinformatics. Oxford Publication, 3rd International Student** Edition
4. **Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications,** genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. **Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell**

Reference Book (s)

1. **Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House**
2. **Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications**
3. **Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student** Edition
4. **Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications,** genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
5. **Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell**

Unit-1 INTRODUCTION TO COMPUTER FUNDAMENTALS12 hours **RDBMS - Definition of relational database, Mode of data transfer (FTP, SFTP, SCP), advantage of encrypted data transfer.**
Unit-2 INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES 10hours **Biological databases - nucleic acid, genome, protein sequence and structure, gene expression databases, Database of metabolic pathways, Mode of data storage - File formats - FASTA, Genbank and Uniprot, Data submission & retrieval from NCBI, EMBL, DDBJ, Uniprot, PDB.**

Unit-3 SEQUENCE ALIGNMENTS, PHYLOGENY AND PHYLOGENETIC TREES09hours **Local and Global Sequence alignment, pairwise and multiple sequence alignment. Scoring an alignment, scoring matrices, PAM & BLOSUM series of matrices. Types of phylogenetic trees, Different approaches of phylogenetic tree construction -UPGMA, Neighbour joining, Maximum Parsomony, Maximum likelihood.**
Unit-4 GENOME ORGANIZATION AND ANALYSIS 08 hours **Diversity of Genomes: Viral, prokaryotic & eukaryotic genomes; Genome, transcriptome, proteome, 2-D gel electrophoresis, Maldi Toff spectroscopy; Major features of completed genomes: *E.coli, S.cerevisiae, Arabidopsis*, Human.**
Unit-5 PROTEIN STRUCTURE PREDICTIONS 08 hours **Hierarchy of protein structure - primary, secondary and tertiary structures, modelling; Structural Classes, Motifs, Folds and Domains; Protein structure prediction in presence and absence of structure template; Energy minimizations and evaluation by Ramachandran plot Protein structure and rational drug design.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOSTATISTICS**				
Course Code	**BSDB2012**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the statistics.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biostatistics.

Course Outcomes

CO1	**Understand Measures of central tendency, Correlation and Regression**
CO2	**Interpret Mean and Variance, namely Binomial, Poisson**
CO3	**Demonstrate parametric and non-parametric statistics.**
CO4	Illustrate the Sampling Distributions, Standard Error, Testing of Hypothesis
CO5	**Illustrate the Large Sample Test based and Small sample test**
CO6	**Evaluate the application of Biostatistics**

Text Book (s)

7. Edmondson and D. Druce: Advanced Biology Statistics, Oxford University Press; 1996.
8. W. Danial: Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004

Reference Book (s)

5. Edmondson and D. Druce: Advanced Biology Statistics, Oxford University Press; 1996.
6. W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004

Unit-1	**12 hours**
Measures of central tendency, Measures of dispersion; skewness, kurtosis; Elementary Probability and basic laws; Discrete and Continuous Random variable, Mathematical Expectation; Curve Fitting; Correlation and Regression. Emphasis on examples from Biological Sciences.	
Unit-2	**10 hours**
Mean and Variance of Discrete and Continuous Distributions namely Binomial, Poisson, Geometric, Weibull, Logistic and Normal distribution. Fitting of Distributions.	
Unit-3	**09 hours**
Statistical methods: Scope of statistics: utility and misuse. Principles of statistical analysis of biological data. Sampling parameters. Difference between sample and Population, Sampling Errors, Censoring, difference between parametric and non-parametric statistics.	
Unit-4	**08hours**
Sampling Distributions, Standard Error, Testing of Hypothesis, Level of Significance and Degree of Freedom.	
Unit-5	**08hours**
Large Sample Test based on Normal Distribution, Small sample test based on t-test, Z- test and F test; Confidence Interval; Distribution-free test - Chi-square test. Basic introduction to Multivariate statistics, etc.	
Unit 6: Research Advances in Biostatistics: Research article, Review, MOOC	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOPHYSICS**				
Course Code	**BSDB2013**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the physics.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biophysics.

Course Outcomes

CO1	**Understand numerical models with non-linear algebraic equations, numerical integration.**
CO2	**Describe the principle and working of crystallography.**
CO3	**Interpret the applications of numerical methods in biological systems.**
CO4	**Demonstrate the use of quantum biology.**
CO5	**understand the theoretical modelling of biomolecules.**
CO6	**Evaluate the significance of Biophysics**

Text Book (s)

16. A Textbook of Biophysics: For Medical Science and Biological Science Students by RN Roy
17. Introduction to Biophysics by Pranab Kumar Banerjee
18. An Introduction to Biophysics by David Burns
19. Fundamentals and Techniques of Biophysics and Molecular Biology by Pranav Kumar
20. Biological Physics: Energy, Information, Life by Philip Nelson

Reference Book (s)

17. A Textbook of Biophysics: For Medical Science and Biological Science Students by RN Roy
18. Introduction to Biophysics by Pranab Kumar Banerjee
19. An Introduction to Biophysics by David Burns
20. Fundamentals and Techniques of Biophysics and Molecular Biology by Pranav Kumar
21. Biological Physics: Energy, Information, Life by Philip Nelson

Unit-1 NUMERICAL METHODS 12 hours **Introduction to numerical methods, solutions to non-linear algebraic equations by the method of iteration and Newton aphson method, numerical integration by trapezoidal rule and simpson's rule, numerical solution of ordinary differential equations by picard's method of successive approximation, Euler's method and Runge-Kutta method.**
Unit-2 ELEMENTARY CRYSTALLOGRAPHY 10 hours **Introduction, symmetry in crystals, lattices and unit cells, crystal systems, Bravais lattices, elements of symmetry- rotation axis, mirror planes and center of inversion, point group symmetry- monoaxial point groups, polyaxial point groups, translational symmetry- screw axis and glide planes, space group, equivalent points, X-ray diffraction and Bragg equation.**
Unit-3MATHEMATICAL METHODS AND THEIR APPLICATIONS IN BIOLOGICAL SYSTEMS 09hours **Ordinary differential equations of the first degree and first order (variable separable method, linear equation), linear differential equations of the second order with constant coefficients, the Laplace Transform, Inverse Laplace transform, application of Laplace transform to solutions of differential equations, Fourier series and their applications.**
Unit-4 QUANTUM BIOLOGY AND ITS USES 08hours **Classical mechanics, Newton, Lagrange and Hamilton's equations, Schrodinger's equation and its complete solution for S.H.O, central force and angular momentum.**
Unit-5THEORETICAL MODELING OF BIOMOLECULAR SYSTEMS 08hours **Basic principles of modeling, modeling by energy minimization technique, concept of rotation about bonds, energy minimization by basic technique for small molecules, Ramachandran plot,**

torsional space minimization, energy minimization in cartesian space, molecular mechanics-basic principle, molecular dynamics basic principles.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	BIOFERTILIZERS AND PESTICIDES				
Course Code	BSDB2015				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: To provide basic understanding of biofertilizer and pesticides.
Course Outcomes

CO1	To understand the basic concept of biofertilizer.
CO2	To identify the role of azospirillium as biofertilizer .
CO3	To explain the process of nitrogen fixation.
CO4	To explain various types of mycorrhizal association.
CO5	To elucidate the basic concept of pest and pest management.
CO6	To evaluate the application of Biofertilizer and pesticide

Text Book (s)
1.Palaniappan SP &Anandurai K. 1999. Organic Farming–Theory and Practice. Scientific Publishers, Jodhpur
2. Joshi, M. 2014. New Vistas of Organic Farming 2nd Ed. Scientific Publishers, Jodhpur.
3. Farming system : Theory and Practice - S.A.Solaimalai
Reference Book (s)

7. Organic Farming: Theory and Practice- S.P.Palaniappan and K.A. Annadurai
8. A hand book of Organic Farming by A.K.Sharma

Unit-1 INTRODUCTION TO BIOFERTILIZERS 08 hour **General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.**
Unit-2 AZOSPIRILLUM 10 hour **Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms.Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication**
Unit-3 CYANOBACTERIA 09 hours

Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.
Unit-4 MYCORRHIZAL ASSOCIATION **10 hours** **Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.**
Unit-5 PEST & PEST MANAGEMENT 08 hours **Classification of pesticides on chemical nature and according to target species, mode of action, Methods of pest controls – Classification: Natural & applied control [Physical, mechanical, cultural, biological, genetic, regulatory, chemical controls] Integrated pest management..**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**ORGANIC FARMING**				
Course Code	**BSDB2014**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: To provide a broad foundation in organic farming.

Course Outcomes

CO1	**To understand the basic concept of organic farming.**
CO2	**To describe the concept of green manuring.**
CO3	**To identify the different methods of organic plant protection**
CO4	**To explain various types of organic crop production methods.**
CO5	**To understand the basic concept of farm economy.**
CO6	**To Evaluate the application organic farmingin treatment of toxic molecules**

Text Book (s)

10. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
11. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
12. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay -Publication, New Delhi.

Reference Book (s)

10. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
11. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.
12. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic _Farming Akta Prakashan, Nadiad

Unit-1 INTRODUCTION TO ORGANIC FARMING 08 hour **Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.**
Unit-2 ORGANIC PLANT NUTRIENT MANAGEMENT 10 hour **Organic farming systems, soil tillage, land preparation and mulching,Choice of varieties. Propagation-seed, planting materials and seed treatments, water management Green manuring, composting- principles, stages, types and factors, composting methods, Vermi composting, Bulky organic manures, concentrated organic manures, organic preparations, organic amendments and sludges**
Unit-3 ORGANIC PLANT PROTECTION 09 hours **Plant protection- cultural, mechanical, botanical pesticides, control agents, Weed management, Standards for organic inputs- plant protection.**
Unit-4 ORGANIC CROP PRODUCTION PRACTICES 10 hours **Organic crop production methods- rice, coconut. Organic crop production methods- vegetables- okra, amaranthus, cucurbits. Livestock component in organic farming. Sustainable Agriculture-Apiculture, Mushroom cultivation.**
Unit-5 ORGANIC CERTIFICATION 08 hours **Farm economy: Basic concept of economics- demand &supply, economic viability of a farm. Basic production principles, reducing expenses, ways to increase returns, cost of production system. Benefit/ cost ratio, marketing, imports and exports. Policies and incentives of organic production. Farm inspection and certification. Terrace farming.**

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	**20**	**50**	**100**

GROUP-II

Name of The Course	**NANOBIOTECHNOLOGY**				
Course Code	**BSDB3011**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of nanotechnology.
Course Outcomes

CO1	**Understand the fundamentals of nanotechnology**
CO2	**Demonstrate the physical and chemical methods of synthesis of nanomaterials**
CO3	**Demonstrate the biological methods of synthesis of nanomaterials**
CO4	**Generalize the use of nanomaterials in biotechnology**
CO5	**Illustrate the applications of nanobiotechnology**
CO6	**Evaluate the research advance in nanotechnology**

Text Book (s)

13. 1. Nanobiotechnology: Concepts,Applications and Perspectives (2004), ChristofM.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
14. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
15. Pradeep T., “A Textbook of Nanoscience and Nanotechnology”, Tata McGraw Hill Education Pvt. Ltd., 2012.
16. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002.

Reference Book (s)

13. 1. Nanobiotechnology: Concepts,Applications and Perspectives (2004), ChristofM.Niemeyer (Editor), Chad A. Mirkin (Editor), Wiley VCH.
14. Nanobiotechnology - II more concepts and applications. (2007) - Chad A Mirkin and Christof M. Niemeyer (Eds), Wiley VCH.
15. Pradeep T., “A Textbook of Nanoscience and Nanotechnology”, Tata McGraw Hill Education Pvt. Ltd., 2012.
16. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, 2002.

Unit-1 INTRODUCTION TO NANOTECHNOLOGY 10 hours **Historical perspectives, Existence of nanostructures in nature, Nanoscale Properties (Electrical, Optical, Chemical) Nanomaterials - Quantum Dots,Wells and Wires, nanotubes, graphene, nanogold, nanosilver and metal oxides, Nanopolymers.**
Unit-2 SYNTHESIS OF NANOMATERIALS 10hours **Physical Methods: Ball Milling, Electrodeposition, DC/RF Magnetron Sputtering, Molecular Beam Epitaxy (MBE).Chemical Methods: Metal Nanocrystals by Reduction, Solvothermal**

Synthesis, Photochemical Synthesis, Chemical Vapor Deposition (CVD), Metal Oxide - Chemical Vapor Deposition (MOCVD).
Unit-3BIOLOGICAL SYNTHESIS OF NANOMATERIALS10 hours **Synthesis using Microorganisms, Synthesis using Biological templates, synthesis using plants and plant extracts.**
Unit-4 NANOMATERIAL IN BIOTECHNOLOGY 08 hours **Biological nanomaterials and Biomimetic synthesis of nanomaterials – magnetosomes, spider milk, bone, shell. Device based on assemblies of nanoparticles and biomaterials – Bioelectronic devices, nanocircuitry, nanomechanical devices, computational devices.**
Unit-5 APPLICATIONS OF NANOBIOTECHNOLOGY 08 hours **Nanobiosensors, molecular imaging using nanoparticles, targeted drug delivery. Applications in health and disease - infectious and chronic. Nanobiotechnological applications in Environment and food - detection and mitigation.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIORESOURCE MANAGEMENT**				
Course Code	**BSDB3012**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of bioresource management.

Course Outcomes

CO1	Illustrate the different types of aquaculture
CO2	Summarize the purpose of culturing economically important organisms
CO3	Illustrate the importance of vermiculture
CO4	Describe the origin and importance of cultivated plants
CO5	Generalize the economic uses of various plant products
CO6	Evaluate the application of Bioresource management

Text Book (s)

7. ManjuYadav, Economic Zoology- Discovery publishing house, New Delhi
8. Lee R E,. Phycology 1999

Reference Book (s)

7. ManjuYadav, Economic Zoology- Discovery publishing house, New Delhi
8. Lee R E,. Phycology 1999

Unit-1 AQUACULTURE 10 hours **Introduction to aquaculture; Prawn culture, Methods of prawn fishing, Preservation and processing of prawn; Pearl culture and status of pearl culture in India; Economically important fishes of India. Setting up of a fish farm, Monoculture and composite fish culture, Bundh breeding, Induced breeding, methods of fishing, Fish preservation and processing; Identification of fish diseases and their control; Snakes and snake venoms.**
Unit-2 ECONOMIC ZOOLOGY 08 hours **Overview of Sericulture, Apiculture, Lac culture, Poultry culture, Dairy industry.**
Unit-3 VERMICULTURE 08hours **Introduction and scope, Species of earthworm, Characteristics features ofearthworm. Overview of methods of vermicomposting, Role of earthworm in solid waste management. Vermiwash- its importance, Vermicompost as bio-fertilizer.**
Unit-4CULTIVATED PLANTS 10 hours **Cultivated Plants: origin and importance with particular reference to the works of A. de Candolle and Vavilov (especially centers of diversity, primary and secondary centers, multiple origin); a brief account of Harlan and Hawkes theories; examples of major introductions; practices of floriculture, agroforestry, sericulture. BT crops (brief account).**
Unit-5ECONOMIC USE OF PLANT PRODUCTS 10 hours **Definition, Classification, Names, Morphology and economic uses of important cereals, legumes (pulses and fodders), fruits and vegetables, spices and condiments, beverages, oils and fats, essential oils, medicinal plants, hallucinogens (psychotropic drugs), timber plants, fibre plants, natural rubber, resins, raw materials for paper. A brief account of crop improvement technologies, biosafety considerations, natural products.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**BIOSAFETY AND INTELLECTUAL PROPERTY RIGHTS**				
Course Code	**BSDB3013**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of biosafety and intellectual property rights

Course Outcomes

CO1	**Understand the fundamentals of biosafety**
CO2	**Summarize the guidelines of biosafety**
CO3	**Understand the concepts of intellectual property**
CO4	**Describe the grant of patents, agreements and treaties**
CO5	**Illustrate the concept of biosafety**
CO6	**Evaluate the significance of Biosafety and intellectual property rights**

Text Book (s)

1. **Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt.Ltd., New Delhi.**
2. **Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.**
3. **Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.**
4. **Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.**
5. **Goel D &Prashar S (2013). IPR, Biosafety and Bioethics. Pearson**
6. **Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.**

Reference Book (s)

1. **Bare Act, 2007.Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt.Ltd., New Delhi.**
2. **Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.**
3. **Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.**
4. **Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Impliocations, Springer India.**
5. **Goel D &Prashar S (2013). IPR, Biosafety and Bioethics. Pearson**
6. **Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.**

Unit-1 INTRODCUTION TO BIOSAFETY 07 hours

Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms.
Unit-2 BIOSAFETY GUIDELINES 10hours **Biosafety Guidelines: Biosafety guidelines and regulations (National and International);GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of International Agreements - Cartagena Protocol. Guidelines for using radioisotopes in laboratories and precautions.**
Unit-3INTRODUCTION TO INTELLECTUAL PROPERTY10hours **Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR –patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).**
Unit-4GRANT OF PATENT, AGREEMENTS AND TREATIES10 hours **Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional,Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing andagreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patentowner. Agreements and Treaties: GATT, TRIPS, WIPO, Budapest Treaty on international recognition of the deposit of microorganisms etc.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**MUSHROOM CULTIVATION TECHNOLOGY**				
Course Code	**BSDB3015**				
Prerequisite	**Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.**				
Corequisite	**Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.**				
Antirequisite					
		L	**T**	**P**	**C**
		4	**0**	**0**	**4**

Course Objectives: Students are able to understand the basic concept of mushroom cultivation technology.

Course Outcomes

CO1	**Understand the values of mushroom.**
CO2	**Describe the technology used for cultivation of mushroom**

CO3	**Demonstrate the concepts of mushroom bed preparation.**
CO4	**Demonstrate the process of storage and its nutritional value.**
CO5	**Understand the concepts of types of foods prepared from mushroom.**
CO6	**Evaluate the application of Mashroom cultivation technology**

Text Book (s)

13. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
14. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
15. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
16. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Reference Book (s)

13. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
14. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
15. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
16. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Unit-1 INTRODUCTION TO MUSHROOM CULTIVATION 06 hours **Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - Volvariellavolvacea, Pleurotuscitrinopileatus, Agaricusbisporus.**
Unit-2 CULTIVATION TECHNOLOGY - I 08 hours **Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication.**
Unit-3CULTIVATION TECHNOLOGY-II 08hours **Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.**
Unit-4 STORAGE AND NUTRITION 10 hours **Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.**
Unit-5 FOOD PREPARATION 08 hours **Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	PARASITOLOGY				
Course Code	BSDB3016				
Prerequisite	Higher Secondary Examination with Chemistry and Biology or Chemistry, Botany and Zoology or Biochemistry and Chemistry from a recognized Board in science stream with a minimum of 50 % marks in aggregate.				
Corequisite	Students should have understanding of general biology, including a basic knowledge of the biological molecules, the cell, genetics, regulation, structure/function, interaction with the environment, and evolution.				
Antirequisite					
		L	T	P	C
		4	0	0	4

Course Objectives: Students are able to understand the basic concept of parasitology

Course Outcomes

CO1	Describe the basic concept Parasitology
CO2	Interpret about the Parasitic Protists and disease caused by it
CO3	Interpret Parasitic Platyhelminthes
CO4	Elucidate Parasitic Nematodes
CO5	Illustrate Parasitic Arthropoda and Parasitic Vertebrates
CO6	Evaluate the application of parasitology

Text Book (s)

25. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
26. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger
27. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group
28. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
29. Rattan LalIchhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
30. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
31. Thomas C. Cheng (1986). General Parasitology, II Edition, Academic Press Inc
32. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd. DSE

Reference Book (s)

25. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
26. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger
27. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group
28. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
29. Rattan LalIchhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
30. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers

31. Thomas C. Cheng (1986). General Parasitology, II Edition, Academic Press Inc
32. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd. DSE

Unit-1 INTRODUCTION TO PARASITOLOGY 04 hours **Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship.**
Unit-2 PARASITIC PROTISTS 12hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoebahistolytica, Giardia intestinalis, Trypanosomagambiense, Leishmaniadonovani, Plasmodium vivax.**
Unit-3PARASITIC PLATYHELMINTHES08hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Fasciolopsisbuski, Schistosomahaematobium,Taeniasolium and Hymenolepis nana.**
Unit-4PARASITIC NEMATODES 12 hours **Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Ascarislumbricoides, Ancylostomaduodenale, Wuchereriabancrofti and Trichinellaspiralis. Study of structure, life cycle and importance of Meloidogyne (root knot nematode), Pratylencus (lesion nematode).**
Unit-5PARASITIC ARTHROPODA AND PARASITIC VERTEBRATES08 hours **Biology, importance and control of ticks, mites, Pediculushumanus (head and body louse), Xenopsyllacheopis and Cimexlectularius, A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

SCHOOL OF BASIC AND APPLIED SCIENCES

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

Program: B.Sc (Hons) in Mathematics

Scheme: 2020-2021

Vision

To be recognized globally as a center of excellence in imparting value-based education in Basic and Applied Sciences by creating innovation in fundamental and multidisciplinary research.

Mission

M1. To excel in imparting contemporary knowledge and skills by developing an educational ecosystem with diverse interests and talents.
M2. To perform cutting edge research leading to innovation in sciences through national and international collaborations.
M3. To develop solutions for the emerging challenges in Basic and Applied Science to cater the needs of society.
M4. To attract best quality faculty to facilitate knowledge and develop confidence in our graduates to succeed in the world.

Program Educational Objectives

PEO1: The graduates shall be successful professionals in Academia, Industry, Government and Entrepreneurship.
PEO2: The graduates shall pursue higher education/research at institute of national and international repute.
PEO3: The graduate shall effectively address the challenges of the society and undertake the projects for bridging the gap between industry and societal needs.

Program Specific Objectives

The students shall be able to
PSO1: Apply appropriate knowledge of Mathematics used for Data Science and Artificial Intelligence to solve problems.
PSO2: Apply Advanced Statistical Methods and Tools for forecasting the impact in financial sectors.

Program Outcomes

PO1: Data Science & Artificial Intelligence: Apply knowledge of Mathematics, Computer Sciences and Modern software tools to provide effective solutions in area of enormous applications of Data Science and Artificial Intelligence.

PO2: Finance & Banking: Demonstrate knowledge of Mathematics, Optimization Techniques, Statistics and Computing tools for providing solution in the domain of economics, finance and banking.

PO3: Critical Thinking: Develop the ability to critically evaluate theories, methods, principles, and applications of pure and applied science.

PO4: Modelling & Simulation: Ability to identify and apply mathematical knowledge to model and simulate various complex problems of our society through experiments, analysis and interpretation of data.

PO5: Modern Tool Usage: Develop professional skills required for industry through learning of demandable programming languages and software tools

PO6: Communication: Communicate effectively with the scientific community and with society at large. Be able to comprehend, write and communicate effective reports/ documentation.

PO7: Society and Teamwork: Perform professionally with social, cultural and ethical responsibility as an individual as well as in multifaceted teams with positive attitude

PO8: Lifelong Learning: Capable of adapting to new methodologies and Constantly upgrading their skills with an attitude towards independent and lifelong learning

Curriculum

Semester 1									
Sl. No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BSCM101	Calculus- I	3	1	0	4	30	20	50
2	BSCM102	Algebra and Number Theory	3	1	0	4	30	20	50
3	BSCM103	Fundamentals of Computer and C-programming	3	0	0	3	30	20	50
4	BSCM111	C-programming Lab	0	0	2	1	50	-	50
5	BSCM202	Analytical Geometry	3	1	0	4	30	20	50
6	BBS14T1001	Elements of Physics	3	1	0	4	30	20	50
7	BBS14P1002	Elements of Physics Lab	0	0	2	1	50	-	50
8		**Cambridge university program, BEC(B1)**	**3**	**0**	**0**	**3**			
9		**Environmental Science**			**1**	**0.5**			
10		**Liberal Arts**				**0.5**			
11		**Soft Skills**	**0**	**0**	**0**	**0**			
12		**Computational Awareness**				**0**			
		Total				**25**			
Semester II									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BSCM201	Calculus –II	3	1	0	4	30	20	50
2	BSCM211	Calculus –II Lab using Scilab	0	0	2	1	50	-	50
3	BBS14T1003	General Chemistry	3	1	0	4	30	20	50
4	BBS14P1004	General Chemistry Lab	0	0	2	1	50	-	50
5	BSCM203	Abstract Algebra	3	1	0	4	30	20	50
6	BSCM304	Programming using Python	3	0	0	3	30	20	50
7	BSCM311	Python Lab	0	0	2	1	50	-	50
8	BSCM302	Ordinary Differential Equations	3	1	0	4	30	20	50
9		Cambridge university program, BEC(B2)	3	0	0	3			
10		Two weeks Social Internship (During Summer Vacation)	0	0	0	0			
		Total				**25**			
Semester III									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BSCM301	Real Analysis –I	3	1	0	4	30	20	50
2	BSCM401	Partial Differential Equations	3	1	0	4	30	20	50
3	BSCM303	Linear Algebra	3	1	0	4	30	20	50
4	BBS14P1005	Linear Algebra using Python	0	0	2	1	50	-	50
5	BSCM205	Discrete Structure	3	1	0	4	30	20	50
6	BSCM104	Probability and Statistics	3	1	0	4	30	20	50
7	BSCM112	Probability and Statistics Lab in R	0	0	2	1	50	-	50
8	BSCM503	Numerical Methods	3	1	0	4	30	20	50
9	BSCM512	Numerical Methods Lab	0	0	2	1	50	-	50
		Total				**27**			
Semester IV									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BSCM403	Transforms and their applications	3	1	0	4	30	20	50

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2	BSCM404	Econometrics	3	1	0	4	30	20	50
3	BSCM524	Differential Geometry and Tensor	3	1	0	4	30	20	50
4	BBS14T1006	Complex Analysis	3	1	0	4	30	20	50
5	BBS14T1007	Real Analysis –II	3	1	0	4	30	20	50
6	BSCM423	Ring and Module Theory	3	1	0	4	30	20	50
7		IPR				0.5			
8		Foreign Language				0.5			
		Total				**25**			
Semester V									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BSCM601	Fuzzy Mathematics	3	1	0	4	30	20	50
2	BSCM502	Operations Research	3	1	0	4	30	20	50
3	BSCM511	Operations Research Lab	0	0	2	1	50	-	50
4	BBS14T1008	Special Functions and Difference Equations	3	1	0	4	30	20	50
5	BBS14T1009	General Mechanics	3	1	0	4	30	20	50
6		Discipline Elective- I	3	1	0	4	30	20	50
7		Campus to Corporate	2	0	0	2			
		Total				**23**			
Semester VI									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BBS14T1010	Classical Mechanics	3	1	0	4	30	20	50
2		Discipline Elective II	3	0	0	3	30	20	50
3	BSCM612	Project	0	0	0	12			
		Total				**19**			

List of Electives

Elective-1

Sl No	**Course Code**	**Name of the Electives**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BSCM522	Dynamical Systems	3	1	0	4	30	20	50
2	BSCM523	Financial Mathematics	3	1	0	4	30	20	50
3	BSCM421	Graph Theory	3	1	0	4	30	20	50
4	BBS14T5011	Measure Theory	3	1	0	4	30	20	50
5	BSCM422	Bio-Mathematics	3	1	0	4	30	20	50
6	BBS14T5012	Special Theory of Relativity	3	1	0	4	30	20	50
7	BBS14T5013	Numerical solution of ODE	3	1	0	4	30	20	50
8	BBS14T5014	Information Theory and Coding	3	1	0	4	30	20	50
9	BBS14T5015	Mechanics of solids	3	1	0	4	30	20	50

Elective-2

Sl No	Course Code	Name of the Elective	L	T	P	C	Assessment Pattern IA	MTE	ETE
1	BSCM621	Mathematical Modelling & Simulation	3	1	0	4	30	20	50
2	BSCM622	Optimization Techniques	3	1	0	4	30	20	50
3	BSCM623	Cryptography and Network Security	3	1	0	4	30	20	50
4	BBS14T5016	Time Series Analysis	3	1	0	4	30	20	50
5	BSCM624	Applications of Algebra	3	1	0	4	30	20	50
6	BBS14T5017	Introduction to Actuarial Science	3	1	0	4	30	20	50
7	BBS14T5018	Approximation Theory	3	1	0	4	30	20	50
8	BBS14T5019	General Theory of Relativity and Cosmology	3	1	0	4	30	20	50
9	BBS14T5020	Numerical solution of PDE	3	1	0	4	30	20	50

Semester-I

Name of The Course	Calculus-I				
Course Code	**BSCM101**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

In this course we provide an introduction to calculus. Emphasis is on an understanding of the basic concepts and techniques, and on developing the practical, computational skills to solve problems from a wide range of application areas.

Course Outcomes:

After learning the course, the students should be able to:

CO1	**Explain the basic concept of differential calculus, expansion of functions as series and concavity & curvature of a curve.**
CO2	**Plan the tracing of curves in Cartesian and polar co-ordinates and find the limits using L'Hospital's rule**
CO3	**Develop the reduction formulae and use of integral calculus to find volume and surface areas of different types of curves**
CO4	**Explain the concept of vector calculus and its use in finding tangent and normal components of acceleration**
CO5	**Design optimization problems, curvilinear & planetary motion, modelling ballistics and applications of calculus in business.**
CO6	**Translate the conics vertically or horizontally in a plane.**

Text Book (s)

1. Thomas, G. B., and R. L. Finney, Calculus and Analytic Geometry, 9th ed., Addison Wesley Publishing Company,1995.
2. Strauss, M. J., G.L Bradley and K.J Smith, Calculus, 3rd ed., Dorling Kindersley (India) Pvt Ltd. (Pearson Education), Delhi,2007.
3. Anton, H., I. Bivens and S. Davis, Calculus, 7th ed., John Wiley and Sons (Asia)Pvt. Ltd., Singapore,2002.
4. Courant, R. and F. John, Introduction to Calculus and Analysis (Vol I and II), Springer Verlag, New York, 1989.

Reference Book (s)

1. Narayan, S., Differential Calculus, 10th ed, S. Chand and Company, New Delhi, 1962.
2. Narayan, S., Integral Calculus, S. Chand and Company, New Delhi, 2005.
3. Iyengar, S.R.K. and R.K. Jain, Advanced Engineering Mathematics, 4th ed., Alpha Science International, Ltd, 2014

Unit-1	11 Hours
Hyperbolic functions, Higher order derivatives, Leibniz rule and its application to problems of the type $e^{ax+b}sinx$, $e^{ax+b}\ cosx$, $(ax+b)^n sinx$, $(ax+b)^n cosx$, Taylor's series, Maclaurin series, Roll's theorem, Mean Value theorem, convexity and concavity of a curve, inflection points, curvature.	
Unit-2	8 Hours

Asymptotes, Curve tracing in Cartesian and polar coordinates, Tracing of standard polar curves, L'Hospital's rule.	
Unit-3	11 Hours
Reduction formulae, derivation and illustration of reduction formulae of the type $\int sinnxdx, \int cosnxdx, \int tannxdx, \int secnxdx, \int (logx)^n dx, \int sin^n x\, sin^m xdx$, Volume by slicing, disks and washers methods, quadrature, volume by cylindrical shells, parametric equations, Parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.	
Unit-4	9 Hours
Vector Triple product, introduction to vector functions, operations with vector valued functions, Differentiation and integration of vector valued functions, Tangent and normal component of acceleration.	
Unit-5	9 Hours
Optimization problems, curvilinear motion, Modeling ballistics and planetary motion, Kepler's second law, business applications (cost function, the average cost, the revenue function, the marginal revenue).	
Unit-6	7 Hours
Translations of conics: Equations of conics that have been shifted vertically or horizontally in the plane, graph of conics that have been shifted vertically or horizontally in the plane.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Algebra and Number Theory			
Course Code	**BSCM102**			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	1	0	4

Course Objectives:

The objective of this course is to provide a first approach to the subject of algebra, which is one of the basic pillars of modern mathematics and to examine the key questions in the theory of numbers whose solutions led to the development of modern abstract algebra. Abstract algebra gives student a good mathematical maturity and enables to build mathematical thinking and skill while conjectures in number theory have stimulated major advances in other fields.

Course Outcomes:

After learning the course, the students should be able to:

CO1	**Discuss the anatomy of Polynomials of one variable.**
CO2	**Work out quadratic and higher degree polynomials and equations having complex variables.**
CO3	**Explain the properties and applications of gcd of two integers and study of primes**
CO4	**Apply the test of divisibility of two integers via congruency and solvability of linear congruence.**

CO5	**Apply the test for Quadratic congruence and determining the approximations of rational and irrational numbers.**
CO6	**Analyze the real life applications.**

Text Book (s)

1. Burton, D. M., Elementary Number Theory, 6th ed., Tata McGraw-Hill, Indian reprint, 2007.
2. Robinns, N., Beginning Number Theory, 2nd ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007.
3. Lipschutz, S., Set Theory and related topics, 2nd ed., McGraw-Hill Education, New York, 1998.
4. **Chandrasekharan,** K., Introduction to Analytic Number Theory, Springer-Verlag, New York, 1968

Reference Book (s)

1. Hunter, J., Number Theory, Oliver & Boyd, Edinburgh and London, 1964.
2. Rao, V. V. , B.V.S.S. Sarma, N. Krishnamurthy, S. Anjaneya Sastry & S. Ranganatham, A Textbook of B.Sc. Mathematics Volume-I, S. Chand Publishing, 2019.

Unit-1	10 Hours
Polynomials in one variable and the division algorithm. Synthetic division. Fundamental theorem of algebra. Relations between the roots and the coefficients. Transformation of equations. Descartes rule of signs.	
Unit-2	8 Hours
De Moivre's theorem for integral indices, De Moivre's theorem for fractional indices, solution of equations of complex variable, Solution of cubic and biquadratic (quartic) equations	
Unit-3	9 Hours
Primes, Divisibility and the Fundamental Theorem of Arithmetic, Greatest common divisor, Euclidean algorithm.	
Unit-4	9 Hours
Congruences, Chinese Remainder Theorem, Hensel's Lemma, Euler's phi function, Fermat's, Euler's and Wilson's theorems	
Unit-5	12 Hours
Quadratic residues, Legendre and Jacobi symbols Law of quadratic reciprocity, Finite continued fractions, recurrence relation, Euler's rule, Convergent, infinite continued fractions, representation of irrational numbers, Periodic continued fractions and quadratic irrationals.	
Unit-6	4 Hours
Applications of abstract algebra in real life and higher mathematics like coding theory, Applications of number theory in cryptography.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Fundamentals of Computer and C-programming				
Course Code	BSCM103				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

1. **Basic understanding of computers, the concept of algorithm and creating the ability to analyze a problem, develop an algorithm to solve it.**
2. **Write the program on a computer, edit, compile, debug, correct, recompile and run it.**
3. **The program coding techniques for the implementation of various real-life problems.**

Course Outcomes:

After successful completion of this course the students will be able to:

CO1	**Define the basic concepts of Computer and acquire various problem-solving techniques such as algorithms and flowchart.**
CO2	**Explain the basic terminology used in programming and able to write, compile and debug programs in 'C' programming language and to develop program logics using decision structures and loop structures.**
CO3	**Develop program logics using the concept of arrays and arrays of characters.**
CO4	**Explain the modular techniques such as functions and difference between call by value and call by reference methods.**
CO5	**Develop and implement the small projects using the concept Structures in C programming language.**
CO6	**Knowledge of macro and pre-processor for code optimization**

Text Book (s)

1. Kerninghan, B.W. & Ritchie D.M.,The C Programming Language, 2nd ed.,Prentice Hall, Englewood Cliffs, , 1988.
2. Gottfried, S.,Programming with C,McGraw-Hill, 2nd ed., New York,1990.

Reference Book (s)

1. **Rajaraman, V., Fundamental of Computers,Prentice-Hall of India, 6th Edition,1985**

Unit-1	10 Hours
Introduction to Computers, Characteristics of Computers, Generations of Computer, Block Diagram of a Computer, Functions of the Different Units - Input unit, Output unit, Memory unit, CPU (Control Unit , ALU). Data vs Information, Hardware vs Software, flowcharts, algorithms	
Unit-2	10 Hours
Number Systems: Introduction, Types of Number System: Binary, Octal, Decimal, Hexadecimal, Conversions from One Base to Another, r's complement, (r-1)'s complement, Addition and Subtraction operations in different number system, Binary-coded Decimals (BCD), Gray Code.	
Unit-3	8 Hours
The C character set identifiers and keywords, data type & sizes, variable names, declaration, statement and blocks, scanf, fscanf , printf, fprintf,if-else, switch, Loops - while, for do while, break and continue, go to and labels	
Unit-4	10 Hours
Fundamentals and Program Structures : Basic of functions, Function prototypes, function types, functions returning values, functions not returning values, Call by value and call by	

address, recursion, Storage Class: auto, external, static and register variables, scope rules, C preprocessor, command line arguments.	
Unit-5	10 Hours
One dimensional arrays, Pointers and functions, Character array and string, array of strings, Passing a string to a function, String related functions, Arrays and Pointers :Multidimensional arrays cont. Dynamic Memory Allocation, basic of structures, structures and functions, Arrays of structures, bit fields, structures and pointers, Structures and functions	
Unit- 6	3 hrs
Pre-processor –What is preprocessing?, Macro expansions, File inclusions, Conditional compilation, The stringification(#)and token passing operator	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	C-programming Lab				
Course Code	BSCM111				
Prerequisite	**Good mathematical background and programming skills sufficient enough to learn new languages and software are required.**				
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives:

1. To develop practical data analysis skills, which can be applied to practical problems.

2. To develop fundamental knowledge of concepts of C language

3. To develop practical skills needed in modern analytics.

4. To explain how math and information sciences can contribute to building better algorithms and software.

5. To develop applied experience with data science software, programming, applications and processes.

Course Outcomes:

After successful completion of this course the students will be able to:

CO1	**Explain the different data type and variables in C language.**
CO2	**Demonstrate the mathematical expression or problem in C language platform.**
CO3	**Apply C code in different type of series expansion.**
CO4	**Utilize Call By Value & Call By Reference in recursion or non recursion program.**
CO5	**Apply C code to write a character, string and structure.**

Text Book (s)

1. Problem Solving and Program Design in C, 4th edition, by jeri R. Hanly and Elli B .Koffman.
2. Brain W .Kernighan & Dennis Ritchie, C Programming Language, 2nd edition, PHI.
3. A first book of ANSI C by Gray J. Brosin 3rd edition Cengagedelmer Learning.

Reference Book (s)

1. E. Balaguruswamy, Programming in ANSI C 5th Edition McGraw-Hill.

List of Experiments:

Lab 1.

(a) Write a Program to print different data types in 'C' and their ranges.

(b) Write a Program to initialize, assignment & printing variables of different data types.

(c) Write a Program to read radius value from the keyboard and calculate the area of circle and print the result in both floating and exponential notation.

Lab 2.

(a) Write a program for computing the volume of sphere, cone and cylinder assume that dimensions are integer's use type casting where ever necessary.

(b) Write a Program to read marks of a student in six subjects and print whether pass or fail (using if-else).

Lab 3.

(a) Write a Program to calculate roots of quadratic equation (using if-else).

(b) Write a Program to calculate electricity bill. Read starting and ending meter reading.

The charges are as follows.

No. of Units Consumed	**Rate in(Rs)**
1-100	**1.50 per unit**
101-300	**2.00 per unit for excess of 100 units**
301-500	**2.50 per unit for excess of 300 units**
501-above	**3.25 per unit for excess of 500 units**

Lab 4.

(a) Write a Program to display colors using switch case (VIBGYOR).

(b) Write a program to display multiplication tables from 1 to 10 except 3 and 5.

Lab 5.

(a) Write a program to print the Fibonacci series for given 'N' value.

(b) Write a program to read 2 numbers x and n then compute the sum of the Geometric Progression

$$\mathbf{1 + x + x^2 + \cdots + x^n}$$

Lab 6.

(a) Write a program to count no. of positive numbers, negative numbers and zeros in the array

(b) Write a program to perform matrix multiplication by checking the compatibility.

(c) Write a program to print the transpose of a matrix.

Lab 7.

(a) Write a program to print the given strings in ascending order.

(b) Write a program to verify the given string is palindrome or not (without built-in functions, with using built-in functions).

(c) Write a program to concatenate two strings using arrays

Lab 8.

(a) Write a program to find difference of two numbers using functions without arguments, with return type.

(b) Write a program to find sum of two numbers using functions with arguments &without return type.

(c) Write a program to find product of two numbers using functions with arguments, with return type

Lab 9.

(a) Write a program to swap two numbers using (i) Call By Value (ii) Call By Reference.

(b) Write a program to calculate factorial, gcd using recursion and non-recursion functions.

Lab 10.

(a) Write a program to create structure called traveler and members of structure are train no, coach no, seat no, source ,destination , gender, age, name and departure date.

(b) Write a program to illustrate passing an entire structure to a function.

Lab 11.

(a) Write a program which copies the contents of one file to another file using command line arguments.

(b) Write a program to reverse the first n characters in a file use command line arguments.

Lab 12**.**

(a) Write a C program that uses functions to perform the following operations:

(i) Reading a complex number
(ii) Writing a complex number
(iii) Addition and subtraction of two complex numbers
(iv) Multiplication of two complex numbers. Note: represent complex number using a structure.

(b) Create a union containing 6 strings: name, home_address, hostel_address, city, state and zip. Write a C program to display your present address.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	**-**	**50**	**100**

Name of The Course	**Analytical Geometry**				
Course Code	**BSCM202**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

The aim of this course **is to introduce the** geometry **of lines, surfaces and conics in the Euclidean plane. Students can develop** geometry **with a degree of confidence and will gain fluency in the basics of Euclidean** geometry**. In this** course**, foundational mathematical training is also pursued. This course deals with the concepts of analytic geometry. Some of the most important applications in physical sciences will be presented. However, emphasis is on the fundamentals of analytic geometry as a foundation for the study of calculus. Students may use this course for higher level prerequisite mathematics requirements. Topics include: transformation of rectangular axes, conic sections in Cartesian and polar coordinates, three dimensional surfaces including plane, sphere, cone and cylinder.**

Course Outcomes:

After successful completion of this course the students will be able to:

CO1	**Define the transformation of rectangular axes and 2D conic section, and discuss the tangent and normal properties of 2D conic section.**
CO2	**Demonstrate the geometrical properties of 2D conic section in polar coordinate.**
CO3	**Define the direction cosine and direction ratios of line and plane, and use it to find the angle and perpendicular distance between plane and line.**

CO4	**Apply method to find the tangent plane and angle of intersection of Sphere.**
CO5	**Discuss the geometrical properties and application of Cone and Cylinder.**
CO6	**Demonstrate the knowledge of Plane section of Conicoid**

Text Book (s)

1. Bell, R. J. T., Elementary Treatise on Coordinate Geometry of Three Dimensions, Macmillan India Ltd., 1994.
2. Loney, S. L., The elements of Coordinate Geometry, Michigan Historical Reprint Series, Macmillan & Co., New York, 2005.
3. Kishan, H. Coordinate Geometry of Two Dimensions, Atlantic Publishers & Distributors Pvt Ltd, New Delhi, 2006.
4. Thomas, G. B., and R. L. Finney, Calculus and Analytic Geometry, 9th ed., Addison Wesley Publishing Company,1995.

Reference Book (s)

1. Prasad, G. and H.C.Gupta, Text Book on Coordinate Geometry, Pothishala Pvt. Ltd., Allahabad, 1958.
2. Saran, N. and R.S. Gupta, Analytical Geometry of Three Dimensions, Pothishala Pvt. Ltd. Allahabad.

Unit-1	10 Hours
Transformation of rectangular axes. General equation of second degree and its reduction to normal form, Pair of lines, Parabola, Ellipse, Hyperbola, Tangent, Normal, Pole and Polar, Conjugate diameters	
Unit-2	10 Hours
Asymptotes, Polar equation of a conics, Polar equation of tangent, normal, polar and asymptotes, Tracing of parabola, Ellipse and hyperbola , Conjugate hyperbola and Rectangular hyperbola	
Unit-3	11 Hours
Line and Plane: Review of Co-ordinates in 3-space, Direction cosines and direction ratios, Equations of coordinate planes, Normal form of equation of a plane, Distance of a point from a plane, Distance between parallel planes, Systems of planes, Bisector planes, Equations of a line in various forms, Symmetric and asymmetric forms of the equations of a line, Line passing through two points, Angle between a line and a plane, Perpendicular distance of a point from a plane, Condition for two lines to be coplanar	
Unit-4	9 Hours
Sphere: **Equation of a sphere in different forms, plane section of a sphere, Equation of a circle. Sphere through a given circle, Intersection of a sphere and a line, Equation of tangent plane to standard sphere and general sphere, Angle of intersection of two sphere.**	
Unit-5	8 Hours
Cone: **Equation of a cone, Intersection of cone with a plane and a line, Enveloping cone, Right circular cone; Cylinder**: **Equation of cylinder, Enveloping and right circular cylinders**	
Unit 6	**6 hrs**
Plane section of Conicoid: Nature of ellipsoid, hyperboloid of one sheet and hyperboloid of two sheets, Intersection of a line and a central conicoid., Axes of central plane sections. Area of the section., Nature of plane section of paraboloids.	

Name of The Course	**Elements of Physics**				
Course Code	**BBS14T1001**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course

Objectives: **The objective of this course is:**

- To acquaint the students with elementary physics such as quantum mechanics, semiconductors, diodes, Laser, magnetic and superconducting materials.
- To acquire a general understanding of the theoretical and practical methods in these fields and make individual be able to apply this knowledge to solve the concrete problems.

Course Outcomes

CO1	**Explain the concept of duality of matter and wave, and solve Schrödinger wave equations for a given quantum system**
CO2	**Describe the fundamentals of intrinsic and extrinsic semiconductors.**
CO3	**Interpret the Junction theory of diode and describe the applications of diodes**
CO4	**Interpret interference, diffraction and describe the working of Laser and its applications**
CO5	**Explain the origin of magnetism in the material and describe the types of superconductors and their applications**
CO6	**Predict the new concept of achieving the superconductivity at high temperature for its feasible applications**

Text Book (s)

3. **Arthur Beiser, S RaiChoudhury, ShobhitMahajan, (2009), Concepts of Modern Physics, 6th Edition, Tata-McGraw Hill. ISBN- 9780070151550.**
4. **Neeraj Mehta, (2011), Applied Physics For Engineers, New Arrivals – PHI, ISBN-9788120342422.**
5. **Engineering Physics, B K Pandey, S Chaturvedi, Cengage Learning, ISBN: 137788131517611**
6. **Kanaankano , semiconductor devices , PHI, 2005**
7. **S.O. Pillai, Solid state physics , New Age International Pvt Ltd, 7th edition, 2015.**
8. **A. P. Drozdov, P. P. Kong, V. S. Minkov, S. P. Besedin, M. A. Kuzovnikov, S. Mozaffari, L. Balicas, F. F. Balakirev, D. E. Graf, V. B. Prakapenka, E. Greenberg, D. A. Knyazev, M. Tkacz, M. I. Eremets. Superconductivity at 250 K in lanthanum hydride under high pressures. *Nature*, 2019; 569 (7757): 528 DOI: 10.1038/s41586-019-1201-8**

Reference Book (s)

1. B.B. Laud, Lasers and Non-Linear Optics (2011), 3rd Edition, New Ages International.
2. William Silfvast (2002), Laser Fundamentals, Cambridge University Press.
3. D.A. Neamen , Semiconductor physics and devices .3rd edition , Mcgraw-Hill, 2003.
4. M.S .Tyagi , Introduction to semiconductor materials and devices , John Wiley & Sons, 2004

Unit-1 Quantum Mechanics	**(12 lecture hours)**

Failure of classical mechanics, dual nature of radiation, Photoelectric effect, Compton Effect, Wave-Particle duality, de-Broglie waves, Experimental verification of de-Broglie waves, Heisenberg Uncertainty Principle and its Applications, concept of wave function, Schrodinger's wave equations, Particle in a Box
Unit-2 Semiconductor Fundamentals (12 lecture hours)
Intrinsic and extrinsic semiconductors, elemental and compound semiconductor, carrier concentration and Fermi level of intrinsic and extrinsic semiconductor, thermal effects, conductivity and carrier mobility in semiconductors. Hall effect.
Unit-3 Junction Theory and Diodes (12 lecture hours)
PN junction , junction potential , biasing of PN junction , I-V characteristics , static and dynamics resistances , breakdown phenomena- avalanche and Zener process, Zener diode , solar cell.
Unit-4 Optics and LASER (12 lecture hours)
Interference: Interference of Light, displacement of fringes, interference in thin films, wedge shaped film, Newton's rings. Diffraction: Single and double slit, Diffraction grating, Grating spectra, missing orders in spectra. Interaction of radiation and matter, Einstein's coefficients, Population Inversion, Three level and four level laser, Laser characteristics, He-Ne laser and applications.
Unit-5 Magnetism and Superconductivity (12 lecture hours)
Origin of magnetization, Orbital and spin magnetic moment, Classification and properties of magnetic materials, Hysteresis curve, soft and hard magnetic materials. **Superconductors: types I and Type II super conductors, Meissner Effect, magnetic levitation, application of superconductors**
Unit VI: Application of Elements of Physics
Recent advancement in Elements of Physics: The superconductor at the highest temperature, latest approach and description of new superconductor

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Elements of Physics Lab**				
Course Code	**BBS14P1002**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	**0**	**2**	**1**

Course

Objectives:

- Directly observe phenomenon discussed in physics theory.
- Exploring relationship between measurable quantities,
- Collect and record experimental data. Gain skills that teach what data to record, when to record, and analyze the recorded data.
- Indulgence with the limited precision of measurements and the uncertainties involved in experimentation.

Course Outcomes

CO1	Operate and handle the instruments effectively and safely in the physics laboratory
CO2	Determine the Planck constant and Stefan’s constant
CO3	Calculate the wavelength of Laser and monochromatic light.
CO4	Calculate Hall coefficient and Hysteresis curve for a given material
CO5	Determine the characteristics of solar cell and AC frequency

Reference Books:

3. B.Sc. Practical Physics by C.L Arora ,S. Chand Limited, 2001.

2. B.Sc. Practical Physics by Harnam Singh,S. Chand Limited, 2000.

S. No.	List of Experiments
1.	To determine the wavelength of sodium light by Newton’s ring
2.	To Verify the Stefan's law by electrical method
3.	To determine Planck's constant using Light Emitting Diode (LED)
4.	To determine the wavelength of He-Ne laser source using Diffraction grating
5.	To draw the hysteresis curve (B-H curve) of a given sample of ferromagnetic material and to determine retentivity, coercivity and hysteresis loss
6.	To find the wavelength of monochromatic light with the help of a plane transmission diffraction grating and spectrometer
7.	To determine the frequency of alternating current (AC) mains using Sonometer
8.	To draw the characteristics of solar cell and to estimate Fill Factor (FF) of solar cell
9.	To determine the angle of prism and minimum deviation of solid prism Spectrometer
10.	To determine Hall coefficient and mobility of charge carriers
11.	Characteristics of PN junction diode

12	Zener diode characteristics in reverse bias and its application voltage regulator

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	**-**	**50**	**100**

Semester-II

Name of The Course	**Calculus -II**				
Course Code	**BSCM201**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

The course deals with differential calculus of multivariable functions. It begins with defining a function of two variables, its limit and continuity followed by defining its derivative (partial derivative) and applications of partial derivatives in the form of the problem of finding Maxima and Minima.
The course deals with methods to evaluate double and triple integrals and their applications in finding Plane areas and volumes of solids. We also introduce 2d polar coordinates and its changing in Cartesian coordinates.
The course gives the idea about the calculus of vector functions. In the differential calculus part we study three basic elements of vector calculus, namely, Gradient, Divergence and Curl and their properties. In the integral calculus part we first learn the techniques of evaluating line integrals and surface integrals followed by the three all important theorems, namely Green's, Stokes's and Gauss Divergence theorem using which we can easily evaluate line and surface integrals

The course describes how to develop linear programming models for simple problems and identify the special features of a model that make it a linear programming model. It will also give an overview of the kinds of problems linear programming has been used to solve.

Course Outcomes:

After successful completion of this course the students will be able to:

CO1	Apply methods to find limit, continuity, derivatives of multivariable scalar functions and relate derivatives to solve the problems of optimization
CO2	Apply methods to find integrals of multivariable scalar functions.
CO3	Explain the three elements of vector differential calculus, apply these elements for evaluation of integrals of vector valued functions and relate the three important theorems to evaluate the problems of integrations.
CO4	Find the area, volume and mass of multivariable scalar functions.
CO5	Find the optimized solution of linear programming problems
CO6	Applications of multivariable calculus.

Text Book (s)

1. Thomas, G. B., and R. L. Finney, Calculus and Analytic Geometry, 9th ed., Addison Wesley Publishing Company, 1995.
2. Strauss, M.J., G.L Bradley and K.J Smith, 3rd ed., Dorling Kindersley(India) Pvt Ltd.(Pearson Education), Delhi, 2007.
3. Marsden, E., A.J. Tromba and A. Weinstein, Basic Multivariable calculus, Springer(SIE), Indian Reprint,2005.
4. Stewart, J., Multivariable Calculus, Concepts and contexts, 2nd Ed, Brooks/Cole, Thomson Learning, USA, 2001.

Reference Book (s)

1. Narayan, S., Differential Calculus, 10thed, S. Chand and Company, New Delhi, 1962
2. Narayan, S., Integral Calculus, S. Chand and Company, New Delhi, 2005.
3. Iyengar, S.R.K. and R.K. Jain, Advanced Engineering Mathematics, 4th ed., Alpha Science International, Ltd, 2014.

Unit-1	11 Hours
Functions of several variables, Limits and continuity of function of two variables, Partial differentiation, Total differentiability, sufficient condition for differentiability, chain rule for one and two independent parameters, Taylor & Maclaurin series in two variables, Jacobian, Extrema of function of two variables, saddle points, Method of Lagrange Multipliers	
Unit-2	7 Hours
Mathematical Formulation and solution of constrained optimization problems	
Unit-3	10 Hours
Beta and Gamma functions, Double integration over rectangular regions, Double integration over non rectangular regions, Double integral in Polar coordinates, Change of order of integration, Triple integral over a parallelepiped and solid regions, Dirichlet's theorem, Cylinderical and spherical coordinates, Change of variables in double and triple integrals,	
Unit-4	12 Hours
Scalar and vector fields, Differentiation of Vector functions, Directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes Gradient, divergence, curl and their physical interpretations, line integrals, conservative vector fields, independence of path, Green's theorem, surface integrals, integral over parametrically defined surfaces, Stokes's theorem, Gauss's divergence theorem	
Unit-5	8 hours
Area and volume by double and triple integrations, Application of Line integral in Mass and work done.	
Unit-6	5 hours
Gradient descent: An analogy for understanding gradient descent, Solution of a linear system, Solution of a non-linear system.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**BSCM211**				
Course Code	Calculus Lab using SCILAB				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives:
The aim to this course is to provide the students a platform to solve the complicated problems of maxima and minima, multiple integral, vector calculus.
Course Outcomes:
After successful completion of this course the students will be able to:

CO1	Develop the SCILAB codes for solving mathematical problems and summarize different function loops (if else, while , for) in SCILAB platform
CO2	Apply SCILAB codes to perform various matrix operations to find inverse, transpose & Eigen values etc. of a matrix
CO3	Construct SCILAB codes for plotting various graphs in 2 and 3 dimension.
CO4	Apply SCILAB codes for computing double and triple integrals in Cartesian coordinates and select the critical points of 2-D and 3-D surfaces.
CO5	Utilize SCILAB codes for computing and plotting scalar and vector point functions in vector calculus
CO 6	Construct SCILAB code for solution of Linear programming Problems

Text Book (s)

1. Gilberto E. Urroz, Introduction to SCILAB, infocleainghouse.com.
2. Gilberto E. Urroz, Numerical integral using SCILAB, infocleainghouse.com.
3. Gilberto E. Urroz, Optimization techniques using SCILAB, infocleainghouse.com.

Reference Book (s)

1. Gilberto E. Urroz, Vector operation on SCILAB, infocleainghouse.com.

List of experiments:

1. Overview, Basic syntax, Mathematical Operators, Predefined constants, Built in functions at **SCILAB** platform.
2. Write a **SCILAB** code to find addition, subtraction, multiplication and division of two matrices, transpose of a matrix and inverse of a non singular matrix.
3. Write a **SCILAB** code for programming -Functions - Loops - Conditional statements - Handling .sci files.

4. Write a **SCILAB** code for 2-D : circle, parabola, ellipse and hyperbola.
5. Write a **SCILAB** code for 3-D surfaces: Planes, Sphere, Cylinder, Paraboloid, Ellipsoid, Hyperboloid, and cone.
6. Write a **SCILAB** code for identifying the critical points of 2-D and 3-D. surface.
7. Write a **SCILAB** code for computing double integrals in Cartesian coordinates.
8. Write a **SCILAB** code for computing triple integrals in Cartesian coordinates.
9. Write a **SCILAB** code for computing and plotting gradient of scalar point function.
10. Write a **SCILAB** code for computing and plotting divergence of vector point functions.
11. Write a **SCILAB** code for computing and plotting curl of Vector point functions.
12. Write a **SCILAB** code to optimize linear programming problem.
13. Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	**-**	**50**	**100**

Name of The Course	**General Chemistry**				
Course Code	**BBS14T1003**				
Prerequisite	**Students should qualify 10+2 or equivalent examination in Science stream with chemistry as a major subject**				
Corequisite	**Fundamental knowledge in Chemistry**				
Antirequisite	**-**				
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives:

The course reviews the structure of the atom, which is a necessary pre-requisite in understanding the nature of chemical bonding in compounds. It provides basic knowledge about ionic, covalent and metallic bonding and explains that chemical bonding is best regarded as a continuum between the three cases. The course is also infused with there capitulation of fundamentals of organic chemistry and the introduction of a new concept of visualizing the organic molecules in a three- dimensional space. The constitution of the course strongly aids in the paramount learning of the concepts and their applications.

Course Outcomes:

After the completion of this course, the students will be able to :

CO1	Describe the theoretical models to explain the structure of an atom and orbitals.
CO2	Determine ionic and covalent properties of compounds by various theories of chemical bonding and draw the MO digram of different molecules.
CO3	Describe the fundamental properties of Organic Compound.
CO4	Illustrate the geometry of organic molecules by applying the principles of stereochemistry.
CO5	Describe different reactions and their mechanisms of Aliphatic Hydrocarbons.
CO6	Elaborate the advantages of Green approach over conventional chemical approach.

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. &Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. &Dnyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
7. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
8. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
9. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
10. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
11. Bahl, A. &Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

UNIT-1: Atomic Structure	12 hours
Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenicwavefunctions (atomic orbitals) and their variations for 1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (*ms*). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.	
UNIT-2: Chemical Bonding and Molecular Structure	12 hours
Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment *Covalent bonding:* VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches.	
Unit-3: Fundamentals of Organic Chemistry	8 hours
Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance	

and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule	
Unit-4 Stereochemistry	8 hours
Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis – trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).	
Unit-5 Aliphatic Hydrocarbons	10 hours
Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Alkanes: (Upto 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation. Alkenes: (Upto 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation. Alkynes: (Upto 5 Carbons) *Preparation:* Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.	
Unit-6 Recent advancements in Chemistry for Society	4hrs
Green Chemistry, Principles of Green Chemistry, Advantages of Green synthesis methods over conventional methods	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**General Chemistry Lab**				
Course Code	**BBS14P1004**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with chemistry as a major subject				
Corequisite	Students should have fundamental knowledge of Titration, Concentration of solution.				
Antirequisite	-				
		L	T	P	C
		0	0	2	1

Course Objectives:

Understand and perform different types of volumetric titration.

Course Outcomes:

After the completion of this course, the students will be able to :

CO1	Perform volumetric titration to estimate the amount of a compound present in a mixture (K4).
CO2	**Estimate the no. of moles of water of crystallisation present in Mohr's saltby titration method.**
CO3	**Employ different volumetric titration techniques to estimate the amount of acids, salts and ions**
CO4	Measure the readings of experiments accurately
CO5	Handle the instruments and apparatus carefully

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

Inorganic Chemistry - *Volumetric Analysis*
1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. **2. Estimation of oxalic acid by titrating it with $KMnO_4$.** **3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.** **4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.** **5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	**-**	**50**	**100**

Name of The Course	**Abstract Algebra**				
Course Code	**BSCM203**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives: This course aims to provide a first approach to the subject of algebra, which is one of the basic pillars of modern mathematics. The focus of the course will be the study of certain structures called groups, rings, fields and some related structures.

Course Outcomes:

After successful completion of this course the students will be able to**:**

CO1	Define various algebraic structures (group, subgroup, centralizer, normalizer, center of a group) with their standard examples (permutation group, dihegral group) and show the theorem based on these.
CO2	Discuss the properties of cyclic groups, permutation group, and Lagrange's theorem and their consequences.
CO3	Define normal subgroups, factor groups, group homomorphism and show some theorem based on these structures.
CO4	Define various algebraic structures of two binary operations and their properties.
CO5	Define ring homomorphism and their properties and show some theorem related to homomorphism.
CO6	Apply group in various applications like Cryptography, ISBN codes, UPC symbols.

Text Book (s)

1. Fraleigh, J. B., A First Course in Abstract Algebra, 7th ed., Pearson, New Delhi, 2002.
2. Artin, M., Abstract Algebra, 2nd ed., Pearson, Upper Saddle River, NJ, 2011.
3. Gallian, J. A., Contemporary Abstract Algebra, 4th ed., Narosa Publishing House, New Delhi, 1999.
4. Rotman, J. J., An Introduction to the Theory of Groups, 4th ed., Springer Verlag, 1995.

Reference Book (s)

1. Herstein, I.N., Topics in Algebra, Wiley, New York, 1996.
2. Malik, D.S., J. N. Mordesonand M. K. Sen, Introduction to Abstract Algebra, : McGraw-Hill, New York, 2007.
3. Gallian, J. A. and Winters, S. "Modular Arithmetic in the Marketplace" The American Mathematical Monthly 95(1988): 548-51.

Unit-1	10 Hours
Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups. Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.	
Unit-2	10 Hours
Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.	
Unit-3	10 Hours
External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups. Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.	
Unit-4	10 Hours
Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideals, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals, definition of field and examples.	
Unit-5	08 Hours
Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients,	
Unit-6	5 Hours

UPC symbols, ISBN codes, Cryptography through group

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Programming using Python**				
Course Code	**BSCM304**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	0	0	3

Course Objectives:

The main objective of this course is to provide basic knowledge of Python programming. Students will also be able to apply concept of Decision Making and Functions.

Course Outcomes:

After successful completion of this course the students will be able to:

CO1	Apply Tokens & Data types supported in python
CO2	Apply Different program control structures available in python
CO3	Define and Use user defined Functions in Python
CO4	Utilize various string handling techniques available in python
CO5	Apply and Differentiate various data structures like Lists, tuples, and dictionaries available in python.
CO6	Under the area of latest development in Python

Text Book (s)

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher
2. Python Programming using problem solving Approach by ReemaThareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173
3. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1 st edition (6th February 2009)

Reference Book (s)

1. T. Budd, Exploring Python, TMH, 1st Ed, 2011
2. How to think like a computer scientist : learning with Python / Allen Downey, Jeffrey Elkner, Chris Meyers. 1st Edition – Freely available online.2012
3.

Unit-I: Basic Python	12 Hours
Python identifiers and reserved words, Lines and indentation, multi-line statements, Comments, Input/output with print and input functions, Command line arguments and	

processing command line Arguments, Standard data types - basic, none, Boolean (true & False), Numbers, Data type conversion, Python basic operators (Arithmetic, comparison, assignment, bitwise logical), Python membership operators (in & not in), Python identity operators (is & is not), Operator precedence, Control Statements, Python loops, Iterating by subsequence index, loop control statements (break continue, pass)	
Unit-II: String, Tuples & Lists	10 Hours
String - Concept, escape characters, String special operations, String formatting operator, Single quotes, Double quotes, Triple quotes, Raw String, Unicode strings, Built-in String methods Creating & deleting tuples, Accessing values in a tuple, Updating tuples, delete tuple elements, Indexing, slicing and Matrices, built- in tuple functions, Sets - Concept, operations, Python Lists - concept, creating and accessing elements, updating & deleting lists, basic list operations, built-in List functions Using Lists as stacks and Queues, List comprehensions.	
Unit-III: Files & Directories	8 Hours
Creating files, Operations on files (open, close, read, write), File object attributes, file positions, Listing Files in a directory, Testing File Types, Removing Files and Directories, Copying and Renaming Files, Splitting Pathnames, Creating and Moving to Directories, Traversing Directory Trees , built-in dictionary functions and methods	
Unit-IV: Functions	9 Hours
Defining a function, Calling a function, Function arguments - Pass by value, Keyword Arguments, default arguments, Scope of variable - basic rules, Documentation Strings, Variable Number of Arguments, Call by Reference, Order of arguments (positional, extra & keyword), Generators (functions and expressions) and iterators, list Anonymous functions, Recursion, Treatment of Input and Output Arguments, Unpacking argument lists.	
Unit-V: Classes & Objects	9 Hours
Object oriented programming and classes in Python - creating classes, instance objects, accessing members, Data hiding (the double underscore prefix), Built-in class attributes, Garbage collection : the constructor, Overloading methods and operators, Inheritance - implementing a subclass, overriding methods, recursive calls to methods, class variables, class methods, and static methods.	
UNIT- VI: Latest Development	6 Hours
Library Management System, Stock Prediction, Air Quality Prediction, Age Calculator in Python, Online Video Chat, Diabetes Prediction	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Python Lab**				
Course Code	**BCSM311**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives:

The main objective of this course is to provide basic knowledge of Python programming. Students will also be able to apply concept of Decision Making and Functions handling in Python. It also covers the Object Oriented Programming and Files Handling.

Course Outcomes:

After successful completion of this course the students will be able to:

CO1	Define the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python
CO2	Explain different Decision Making statements and Functions
CO3	Interpret Object oriented programming in Python
CO4	Summarize different File handling operation
CO5	

Text Book (s)

4. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher
5. Python Programming using problem solving Approach by ReemaThareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173
6. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1 st edition (6th February 2009)

Reference Book (s)

4. T. Budd, Exploring Python, TMH, 1st Ed, 2011
5. How to think like a computer scientist : learning with Python / Allen Downey, Jeffrey Elkner, Chris Meyers. 1st Edition – Freely available online.2012

List of experiments:

1. (a) Write a program in Python that uses class to store the name and marks of students.
   [Note: use list to store marks in 3 subjects]
   (b) Create two instances of this class and make use of instance method to display marks.
   (c) Write code in Python to show the use of the following built-in functions:
   Getattr(), setattr(), hasattr() and delattr()
2. (a) Write a program to define the same function area to compute the area of circle and rectangle depending upon the number of arguments passed. (Method overloading)
   Area (a, b=None)
   If b==None:
   Compute the area of circle
   Else

Compute the area of rectangle

(b) Write the Python code for method overriding:

Class Person: It has an instance method display (self)

Class Student: It also has an instance method display (self)

Create objects of each class and invoke the instance method display.

(c) Write Python code to show the usage of the built-in class attributes like __doc__,__dict__etc.

3. (a) Write a program in Python for the class Person using __init__(self) , the class constructor.

(b) Add the method: __del__(self) to the above definition. (Destructor)

(c) Add a class attribute- counter and object attributes- self.name and self.age. Increase counter by 1 in the constructor and initialize name and age in constructor.

4. (a) Write a code in Python to use single inheritance:

Base class: Person: name and age attributes

Derived class: Student (Person): mark-attribute

(b) Write Python code using multiple-inheritance.

(c) Write Python code using multi-level inheritance.

5. Write a Python code for database connectivity – database = student.db

b) Create a database table – marks with columns name and marks

c) Insert two records in the table

6. a) Write a Python code using 'select' statement and print the result of query.

b) Write Python code using update operation.

c) Write Python code using delete operation.

7. Write Python code using database connectivity:

a) Performing transactions

b) commit operation

c) Roll back operation

8. Write Python code using sockets and sockets module.

b) Use server socket methods

c) Use client socket methods

9. Write Python code using general socket methods.

b) Implement simple server

c) Implement simple client

10. Write Python code using Python Internet modules

b) Use socket modules

c) Use socket libraries

11. Write Python code using multi-threading

b) Use states of thread

c) Use starting a new thread

12. Write Python code using methods provided by thread class

b) Use threading module

c) Create a thread using threading module

13. Write Python code using multi-threading

b) Use synchronizing threads.

c) Implement multi-threaded priority queue.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	**-**	**50**	**100**

Name of The Course	**Ordinary Differential Equations**				
Course Code	**BSCM302**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives: **In this increasingly growing and developing complex world, mathematical understanding, thinking and skill is more important than ever. Differential equations will provide students with the working knowledge of advanced mathematical concepts and an awareness of their relationship to complex problems. It also provides a solid platform for further studies in mathematics, the basic sciences, and in engineering.**
The theory of elementary differential equations provides students with proficiency skills and broad view in 1^{st} order differential equations, higher order linear differential equations, the Laplace transform and a conceptual understanding of those topics, and the opportunity for an in depth understanding of elementary differential equations and the meaning of their solutions.

Course Outcomes: **After the completion of the course the students will be able to:**

CO1	**Classify ordinary differential equations(ode's) and solutions of 1^{st} order ode's.**
CO2	**Classify higher order ordinary differential equations(ode's) and solutions of 1^{st} order ode's.**
CO3	**Classify special kind of ordinary differential equation known as Cauchy-Euler differential equation and its method of solution**
CO4	**Change the higher order differential equation into system of 1^{st} order differential equations and their method of solutions**
CO5	**Model some certain type of differential equations**
CO6	**Demonstrate knowledge of numerical solution of ODE**

Text Book (s)
1. G.F. Simmon; Differential equations with applications and historical notes, McGraw- Hill, 1991.
2. F. Brauer and J. A. Nohel; Ordinary differential equations, W. A. Benjamin, Inc., New York, Amsterdam, 1967.
3. M. Braun; Differential equations and their applications, Springer-Verlag, New York Heidelberg, Berlin.

Reference Book (s)
1. W. T. Martain and E. Relssner; Elementary differential equations, Addison Wesley Publishing Company, inc., 1995.
2. E. A. Coddington; An introduction to ordinary differential equations, Prentice-Hall of India Private Ltd., New Delhi.
3. M. D. Rai Singhania; Ordinary and partial differential equations, S. Chand & comp. Ltd., New Delhi.

Unit-I	11 Hours

Introduction to Ordinary differential equation, Exact 1st and higher order differential equations, integrating factors for different cases, some important geometrical problems, Orthogonal trajectories and oblique trajectories.	
Unit-II	10 Hours
Second order differential equations, linear homogenous equations with constant coefficients, Linear non-homogenous equations, auxilary equations and complementary functions, general solutions of homogeneous equations and non-homogeneous equations, general and short methods for finding particular integrals, the method of undetermined coefficients, wronskian, method of variation of parameters.	
Unit-III	9 Hours
Cauchy-Euler differential equations, equations reducible to Cauchy-Euler form, simultaneous linear differential equations, equations of the form dx/P=dy/Q=dz/R, Equation of the form Pdx+Qdy+Rdz=0, Singularities in differential equations.	
Unit-IV	9 Hours
Introduction of systems of differential equations, systems of 1st order differential equations, linear homogeneous and non-homogenous systems, linear systems with constant coefficients, phase space in two dimensions.	
Unit-V	9 Hours
Introduction to compartmental model, exponential model, lake pollution model, drug assimilation into the blood (case of a single cold pill, case of a course of cold pills), limited growth of population, limited growth with harvesting.	
Unit-V I	2 hours
Numerical solutions of differential Equations: Euler's method and Runge-Kutta methods	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Semester-III

Name of The Course	**Real Analysis I**				
Course Code	BSCM301				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**-**	**4**

Course Objectives:

Demonstrate an understanding of sets, limits, continuity, differentiability, sequence, series and how they are used in real world problems.

Course Outcomes

CO1	**Understand sets and their properties**
CO2	**Understand sequences and their convergence**
CO3	**Understand series and their sum**
CO4	**Understand the limit, continuity and uniform continuity of functions**
CO5	**Understand the differentiability of a function and their application**
CO6	**Develop knowledge of sigma algebra**

Text Book (s)

1. R. G. Bartle and D. R. Sherbert, *Introduction to Real Analysis* (3rd Edition), John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.

2. **Gerald G. Bilodeau , Paul R. Thie and G.E. Keough,** ***An Introduction to Analysis,*** **Jones & Bartlett, Second Edition, 2010.**

3. **Brian S. Thomson, Andrew. M. Bruckner, and Judith B. Bruckner,** ***Elementary Real Analysis,*** **Prentice Hall, 2001.**

4. **S. C. Malik and Savita Arora:** ***Mathematical Analysis*****, New Age International (P) Ltd. Publishers, 1996.**

5. **K. A. Ross, Elementary Analysis:** ***The Theory of Calculus, Under graduate Texts in Mathematics*****, Springer (SIE), Indian reprint, 2004.**

6. **Sudhir R. Ghorpade and Balmohan V. Limaye,** ***A course in Calculus and Real Analysis, Undergraduate Text in Math*****., Springer (SIE). Indian reprint, 2004.**

7. **T.M. Apostol:** ***Mathematical Analysis*****, Addison-Wesley Series in Mathematics, 1974.**

Reference Book (s)

1. **A. Mattuck,** Introduction to Analysis, Prentice Hall (1999).
2. **S. R. Ghorpade & B. V. Limaye**, A Course in Calculus and Real Analysis – Springer (2006).

Unit I Lecture hours-14 **Bounded and unbounded sets, Infimum and supremum of a set, Order completeness property of R, Archimedian property of R, equivalence between order completeness property of R and Dedekind property. Neighbourhood, Open set, Limit point, Closed set, Derived set, closure of a set, Bolzano-Weierstrass theorem, Countable and uncountable sets.**
Unit II Lecture hours-10 **Sequence of real numbers, Monotone sequences, Bounded sequence, convergent and non-convergent sequences, limit points of a sequence, Cauchy's sequence, Cauchy's general principle of convergence, Subsequences, Monotone convergence Theorem, Bolzano Weierstrass Theorem for Sequences.**
Unit III Lecture hours-8 **Infinite series, convergence and divergence of infinite series, Test for convergence of positive term series, Integral test, Alternating series, Leibnitz test, Absolute and conditional convergence.**
Unit IV Lecture hours-8

Limits of functions (epsilon-delta approach), sequential criterion for limits, Continuous functions(epsilon-delta approach), sequential criterion for continuity & discontinuity. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.
Unit V Lecture hours-10 **Differentiability of a function at a point & in an interval, Carathéodory's theorem, Rolle's theorem, Mean value theorem, Darboux's theorem. Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder.**
Unit –VI 4 hours
Sigma algebra of sets, Binary operations, Absolutely continuous functions, Bounded variation, Introduction of uniform converge of functions

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Partial Differential Equations**				
Course Code	**BSCM401**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives: **Students will learn about the partial differential equations (pde's) and how they can serve to model many physical processes such as mechanical vibrations, transport phenomena including diffusion, heat transfer, advection and electrostatics etc. They will learn about heat and wave equations in 1D, 2D and 3D.**

More ever, students will master the use of flux laws in combination with the conservation principle, expressed as the continuity equation, to derive pde's associated with transport phenomena. They can also learn how we can solve the pde's under the boundary conditions on the spatial domain and initial conditions on time. They can easily solve the pde's by the technique of separation of variables to pde's and analyze the behaviour of solutions in terms of eigen functions expansions.

Course Outcomes: **After the completion of the course, students will be able to**

CO1	**Classify partial differential equations and solve linear partial differential equations of both first and second order**
CO2	**Classify and solve partial differential equations of second order with constants coefficients**
CO3	**Classify heat equations and its elementary solution**
CO4	**Classify wave equations and the Cauchy method to solve vibrating strings**
CO5	**Apply separation of variable method to heat and wave equations**
CO6	**Lean some special partial differential equations**

Text Book (s)

1. K. Sankara Rao; Introduction of partial differential equations, PHI Learning Pvt. Ltd, New Delhi.

2. *M. D. Rai Singhania; Ordinary and partial differential equations, S. Chand & co. Ltd, Edi. 12, New Delhi.*

3. F. John; Partial differential equations, 3rd Edition, Narosa publication co., New Delhi, 1979.

Reference Book (s)

1. **N. Sneddon ; Elements of partial differential equations, McGRaw Hill Book company, 1957.**
2. ***E.T. Copson; Partial differential equations, Cambridge university press, 1995*.**
3. *E. Di Benedetto; Partial differential equations, Birkhauser, Boston, 1995.*

Unit-1	10 Hours
Introduction of partial differential equations (PDE's) and its classification, formation and geometrical interpretation of first order partial differential equations, surfaces and normal's, basic definitions of general solution or integral, particular solution, complete integral and singular integral of first order partial differential equations, method of characteristic and general solution of first order partial differential equations by Lagrange's method, canonical form of first order PDE, method of separation of variables for first order PDE.	
Unit-2	9 Hours
Introduction of second order partial differential equations and its classification, homogeneous and non-homogeneous linear equations with constant coefficient, solutions of linear homogeneous and non-homogeneous equations with constant coefficient, short and general method of finding particular integral, equations reducible to linear equations with constant coefficients	
Unit-3	6 Hours
Conduction of heat in solids, gravitational potential, Laplace and heat equations, conservation laws and Burger's equations, reduction to canonical forms, elementary solution of heat equations	
Unit-4	9 Hours
Cauchy problem for second order partial differential equations, mathematical modelling of vibrating string, vibrating membrane, homogeneous wave equations, initial and boundary value problems, non-homogeneous boundary conditions, finite strings with fixed ends, non-homogeneous wave equations, Riemann problem, Goursat's problem, spherical and cylindrical wave equations.	
Unit-5	6 Hours
Method of separation of variables for second order PDE, vibrating string problem, existence and uniqueness of solution of vibrating string problem, existence and uniqueness of solution of heat conduction problem, Euler-Bernoulli Beam Equation.	
Unit-6	4 Hours
Klein–Gordon equation, Korteweg–de Vries equation, Modified KdV–Burgers equation, Maxwell's equations, Navier–Stokes equations	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Linear Algebra**				
Course Code	**BSCM303**				
Prerequisite					
Anti-requisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

Course Outcomes:

After the completion of the course, students will be able to:

CO1	Understand real vector spaces, subspaces ,basis & dimension and apply their properties.
CO2	Compute linear transformations, kernel and range, and inverse linear transformations, and find matrices of general linear transformations.
CO3	Compute inner products on a real vector space and compute angle and orthogonality in inner product spaces.
CO4	Find eigen values and eigen vectors . Diagonalize, and orthogonally diagonalize symmetric matrices•
CO5	To solve system of first order linear ordinary differential equations using Linear algebra.
CO6	Know various applications of linear algebra.

Text Book (s):

1. SERGE LANG : Introduction to Linear Algebra, Springer Verlag.

2. S. KUMARESAN : Linear Algebra A Geometric approach, Prentice Hall of India Private Limited

3- GARETH WILLIAMS : Linear Algebra with Applications, Narosa Publication

Reference Book (s):

1. M. ARTIN : Algebra, Prentice Hall of India Private Limited.

2. K. HOFFMAN and R. KUNZE : Linear Algebra, Tata McGraw Hill, New Delhi.

3. GILBERT STRANG : Linear Algebra and its applications, International Student Edition.

4. L. SMITH : Linear Algebra, Springer Verlag.

5. A. RAMACHANDRA RAO and P. BHIMA SANKARAN : Linear Algebra, Tata McGraw Hill, New Delhi.

6. T. BANCHOFF and J. WERMER : Linear Algebra through Geometry, Springer Verlag New York, 1984.

7. SHELDON AXLER : Linear Algebra done right, Springer Verlag, New York.

8. OTTO BRETCHER : Linear Algebra with Applications, Pearson Education.

Unit-I: Vector Spaces	10hrs
Definition examples and basic properties of a vector space, Subspaces, Linear Dependence Independence, Linear combinations and span, Basis and dimension, Sum and intersection of subspaces, Direct sum of subspaces, Dual spaces, invariant subspaces and Cyclic subspaces.	
Unit-II: Linear Transformations	8hrs

Definition and examples of linear transformations, Properties of linear transformations, Range and kernel, The rank and nullity of a linear transformation, Rank-Nullity Theorem and its consequence, The matrix representation of a linear transformation, Change of basis, Isomorphism theorems, invertibility and isomorphism, change of coordinate matrix.
Unit-III: Inner Product Spaces 8hrs **Scalar product in an Inner product spaces. Orthogonality in inner product Spaces, Normed linear spaces, Inner product on complex vector spaces, Orthogonal Complements, orthogonal sets and projections, Gram-Schmidt Orthogonalization process, Bessel's inequality.**
Unit-IV: Eigen Value & Eigen Vectors 8 hrs **Eigenvalues and eigenvectors, Eigenvectors and eigenvalues of linear transformations and matrices, Eigen Space, algebraic multiplicity, geometrical multiplicity, Cayley-Hamilton Theorem. Similar matrices and Diagonalization, Eigenvalues and eigenvectors of symmetric and Hermitian matrices, Orthogonal Diagonalization, Quadratic forms and conic sections.**
Unit-V: Applications 6hrs **Eigen Decomposition (Spectral Decomposition), Singular Value Decomposition, Dimension Reduction, Principal Component Analysis, Image Compression, Facial Recognition, Solving system of first order linear ordinary differential equations.**
Unit-VI: Advancement of Linear Algebra: 5hrs Zero-dilation index of a finite matrix ,Non existence of 5-class association scheme with 2-Q polynomial scheme. Line star set for Laplacian Eigen Values.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Linear Algebra Lab using Python**				
Course Code	**BBS14P1005**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives:

Students of the course should master properties of solving complex linear systems of equations, conversion of linear transformation into matrix, to find orthogonal and orthonormal basis by Gram Smith process and many other complicated real life problem of linear algebra by using Python lab

Course Outcomes:

After completion of the course the students will be able to:

CO1	Develop code to find the inverse of a matrix and solving a system of equations
CO2	Apply code for rank nullity theorem and Eigen value problems.
CO3	Find the matrix from a linear transformation
CO4	Develop code for Singular value decomposition and its applications
CO5	Solve system of first order linear ordinary differential equations

Text Book (s)

7. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher
8. Python Programming using problem solving Approach by ReemaThareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173
9. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1 st edition (6th February 2009)

Reference Book (s)

6. T. Budd, Exploring Python, TMH, 1st Ed, 2011
7. How to think like a computer scientist : learning with Python / Allen Downey, Jeffrey Elkner, Chris Meyers. 1st Edition – Freely available online.2012

List of experiments:

1. **Basic of python**
2. **Basic of python continued**
3. **Develop python code to find the Inverse of matrix by Jordan method**
4. **Develop python code to determine LI of vectors and determining solution of system of linear equations.**
5. **Develop python code to find the Kernel, range and verification of rank and nullity theorem.**
6. **Develop python code for Matrix representation of any linear transformation, and find inverse of a linear transformation.**
7. **Develop code to compute the Eigen Values and Vectors and check whether a given matrix is symmetric, skew-symmetric, and orthogonal.**
8. **Develop a code for Gram-Schmidt orthogonalization process.**
9. **Implement singular value decomposition in python**
10. **Implement Dimension Reduction in python**
11. **Develop code for image compression using SVD**
12. **Develop python code for solving system of first order linear ordinary differential equations.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	**-**	**50**	**100**

Name of The Course	**Discrete Structures**
Course Code	**BSCM205**

Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

Discrete structure is the study of mathematical structures that are fundamentally discrete rather than continuous. The objective of this course is to teach students how to think logically and mathematically. The course stresses on mathematical reasoning and describes different ways in which mathematical problems could be solved.

Course Outcomes:

After successful completion of this course the students will be able to:

CO1	**Apply the Rules of Inference in solving variety of problems including the validity of an argument.**
CO2	**Apply advance counting techniques to solve a variety of problems.**
CO3	**Apply the concepts of sets, relation and functions.**
CO4	**Apply laws of Boolean algebra.**
CO5	**Classify a structure as Graph, Trees and their various types.**
CO6	**Understand the concept of automated theorem proving.**

Text Book (s)

1. Rosen,K. H., Discrete Mathematics and Its Applications, 7th ed., McGraw-Hill, New York, 2007.
2. Liu, C. L. and Mohapatra, Elements of Discrete Mathematics: a computer oriented approach, 3rd ed., McGraw Hill, New Delhi, 2008.
3. Mano, M. M., Computer System Architecture, 3rd Edition, Prentice-Hall of India Pvt. Ltd, New Delhi, 1996.

Reference Book (s)

1. Sarkar, S. K., A textbook of Discrete Mathematics, S.Chand & Company Ltd., New Delhi, 2005.

Unit-1: Propositional Logic & Proof Techniques	10 Hours
Syntax, Semantics, Validity and Satisfiability, Basic connectives and Truth Tables, Logical Equivalance, ,the laws of logic, Logical implication, Rules of inference,Normal form(CNF,DNF), Predicate logic, Universal and Existantial quantifiers, skolemization. **Some terminologies, Proof methods and strategies, Forward proof, Proof by contradiction, Proof by contraposition, Proof of necessity and sufficiency.**	
Unit-2	08 Hours
Counting Techniques: Basic counting techniques, inclusion and exclusion, pigeon-hole principle, permutation and combination.	
Unit-3: Sets, Relation and Function & Principles of Mathematical Induction	10 Hours

Operations and laws of sets, Cartesian product, binary relation, partial order relation, Equivalence relation, Functions, Bijective function, inverse and composition of function, size of a set, countable and uncountable set, Cantor's diagonal argument and the power set theorem, Schroeder-Bernstein theorem. **The well -Ordering principle, Recursive definition, prime numbers, greatest common divisor, Euclidean algorithm, the fundamental theorem of arithmetic.**	
Unit-4: Boolean Algebra & Logic Circuits	10 Hours
Logical Addition(OR operation), Logical multiplication(AND operation), Boolean function, truth table, logic diagram, Boolean expression, DeMorgan's theorem, Complement of a function; Logic Gates: OR, AND, inverter, NAND, NOR, exclusive-OR; Karnaugh map(or K-map) simplification: minterm, adjacent squares, product-of-sums, NAND implementation, NOR implementation.	
Unit-5: Graphs	10 Hours
Graphs and their properties, degree, connectivity, path cycle, sub graphs, isomorphism, Eulerian and Hamiltonian walks, Graph coloring, coloring maps and planer graphs, coloring vertices and edges, list coloring, perfect graph. Trees: **Definitions, properties and examples, rooted trees, trees and sorting, weighted trees and prefix codes, bi-connected components and articulation points, shortest distances.**	
Unit-6	3 Hours
Automated theorem proving	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Probability and Statistics				
Course Code	BSCM104				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

The aim of this course is to identify the types of data (qualitative, quantitative, discrete, and continuous). Identify the types of sampling (random, stratified, systematic, cluster). Identify the misuses of statistics**. Student will use appropriate** statistical **methods to collect, organize, display, and analyze relevant data.**

Course Outcomes:

After successful completion of this course the students will be able to:

CO1	**Analyze statistical data graphically and by using measures of central tendency, dispersion and location.**
CO2	**Domestication and introduction to Probability and its Applications in real life situation.**
CO3	**Understand the concepts of a random variable, Expectation and a probability distribution.**
CO4	**Identify the characteristics and real life application of different discrete probability distributions.**
CO5	**Identify the characteristics and real life application of different continuous probability distributions.**
CO6	**Explain the various applications of statistics in current research.**

Text Book (s)

1. Walpole, R. E., R. H. Mayers, S. L. Mayers and K. Ye, Probability and Statistics for Engineers and Scientists, 8th ed.,Pearson Education, 2007.
2. Sheldon, M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, 4th ed, Academic Foundation, California, 2011.
3. Douglas, C. Montgomery, Applied Statistics and Probability for Engineers, 5th ed., Wiley India, 2012.
4. Spiegel,M. R., J. Schiller and R. A. Srinivasan, Probability & Statistics, 3rd ed., Tata-McGraw Hill, 2010.

Reference Book (s)

1. **Gupta, S.C., and V.K. Kapoor, Fundamentals of Mathematical Statistics (a Modern Approach), 10th ed., Sultan Chand & Sons, New Delhi, 2000.**

Unit-1: Descriptive Statistics	9 Hours
Concepts of a statistical population and sample from a population, Sources of data. Different types of scales - nominal, ordinal, ratio and interval. Presentation of Data, Diagrammatic and graphical representation of grouped data. Frequency distributions, cumulative frequency distributions and their graphical representation, histogram, frequency polygon and ogives .Univariate data - Concepts of central tendency or location, dispersion and relative dispersion, skewness and kurtosis, and their measures including those based on quantiles and moments. Sheppard's correction for grouped data (without derivation).	
Unit-2: Probability Theory	9 Hours
Random experiments: trial, sample point and sample space, event. Operations of events, concepts of mutually exclusive and exhaustive events. Definition of Probability: Classical and relative frequency approach. Discrete probability space, Axiomatic approach to probability for the discrete case only. Properties of probability. Independence of events in probability for two and three events. Conditional probability, total and compound probability rules, Baye's theorem and its applications.	
Unit-3: Random Variable and Expectation	8 Hours
Discrete and continuous random variables, Cumulative distribution function (cdf), Probability mass function(pmf) and probability density functions(pdf). Bivariate distribution, Marginal and conditional distributions. Expectation of a random variable and its properties. Independence of random variables. Moments, measures of location and dispersion of arv. Theorems on the expectation of sums of random variables and product of independent random	

variables, Conditonal expectations, Probability generating function(pgf) and moment generating function(mgf), their properties and uses.	
Unit-4 :Discrete Probability Distributions	9 Hour
Introduction to probability distribution, Mean, Variance, mgf and other characteristics of Bernoulli, Binomial, Negative Binomial, Poisson, Geometric, Hyper geometricdistriution. Multinomial distribution.	
Unit-5: Continuous Distributions	9 Hours
Uniform, Normal, Beta and Gamm , Exponential, Log-normal, Cauchy, Laplace, Pareto and Weibull distributions and their properties. Bivariate normal distribution and its properties. Chi-Square distribution and Exact Sampling distribution.	
Unit-6: Advancement in Probability and Statistics	4 Hour
Recent Developments in Modeling and Applications in Statistics, Migration and migrant population statistics, Statistical Model use in Child Mortality.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Probability and Statistics Lab in R				
Course Code	**BSCM112**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives: **The objective of this course is to familiarize the students with fundamental concepts of R Environment and develop programming skills using R Environment to effectively implement for difficult statistical problems like plotting of different types of chart, curve fitting of data, regression analysis, test of hypothesis, and interval estimations.**

Course Outcomes:

After successful completion of this course the students will be able to:

CO1	**Develop R-code for basic concepts of R**
CO2	**Design R-code various data inferences like: CSV files, Excel files, XML files, binary files.**
CO3	**Apply R-code to plot the different types of chart**
CO4	**Develop R-code for correlation and regression problems**
CO5	**Write R-code for mean, variance, moments, problems of different probability distributions, test of hypothesis and confidence interval.**

Text Book (s)

1. Garret Gorlemund and Dadley Wickham, R for Data Science, https://r4ds.had.co.nz/

2. *Roger D. Peng, R Programming for Data Science,* https://www.cs.upc.edu/~robert/teaching/estadistica/rprogramming.pdf

3. Hogg, R.V., Tanis, E.A. and Rao J.M., Probability and Statistical Inference, 2009 Seventh Ed, Pearson Education, New Delhi.

Reference Book (s)

1. Miller, Irwin and Miller, Marylees : John E. Freund's Mathematical Statistic with Applications, (7th Edn.), Pearson Education, Asia., 2006

2. Bhattacharjee D and Das D., Introduction to Probability Theory, Asian Books, New Delhi, 2010.

List of Experiments:

Lab 1. Basics of R – data type, variables, operators, loops, functions, string.
Lab 2. Basics of R Contd. – vector, list, matrices, array, packages.
Lab 3. R data interfaces - CSV files, Excel files, XML files, binary files.
Lab 4. R Charts & Graphs - Pie charts, Bar Charts, Boxplots, Histograms, Line Graphs, Scatterplots.
Lab 5. Problems based on combined mean and variance and coefficient of variation.
Lab 6. Problems based on moments and cumulants.
Lab 7. Problem based on Poisson distributions for given value of lambda.
Lab 8. Problem based on Normal distributions.
Lab 9. Fitting of polynomials and exponential curves.
Lab 10. Problem based on Karl Pearson's correlation coefficient.
Lab 11 Lines of regression, angle between two lines of regression and estimated values of variables.
Lab 12. Testing of significance and confidence intervals for mean and difference of mean proportions.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	**-**	**50**	**100**

Name of The Course	Numerical Methods				
Course Code	**BSCM503**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

The aim of this course is to learn various numerical methods for finding solutions of non linear equations and system of linear equations, problems of interpolation, numerical integration and differentiation and solution of ordinary differential equations.

Course Outcomes:

After the completion of the course, students will be able to:

CO1	Summarize the concept of errors and apply various numerical methods to find the roots of non linear equations.

CO2	Summarize the concept of errors and apply various numerical methods to find the solution of system of equations.
CO3	Apply interpolated formulas to find approximated polynomials and missing values.
CO4	Solve differentiation and integration for complex functions using numerical methods.
CO5	Solve Ordinary differential equations using different numerical methods.
CO6	Apply numerical methods to solve mechanical, thermal and dynamical problems

Text Book (s)

1. **M. K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, New Delhi, Sixth edition.**
2. **Melvin J. Maron, Numerical Analysis A Practical Approach, Macmillan Publishing Company Inc., New York, 1982.**
3. **S. S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited, New Delhi, 2010.**

Reference Book (s)

1. **C. F. Gerald, P. O. Wheatley, Applied Numerical Analysis, Pearson Education, 2009.**
2. **S. D. Conte, C de Boor, Elementary Numerical Analysis, McGraw-Hill, 1980.**
3. **C. E. Froberg, Introduction to Numerical Analysis, (Second Edition), Addition-Wesley, 1979.**

Unit-1	8 Hours
Introduction, error and error propagation. Solution of transcendental and polynomial equations by iteration, bisection, Regula-Falsi and Newton-Raphson methods. Convergence of these methods.	
Unit-2	10 Hours
Solution of system of linear equations by Gauss – Jordan method, LU decomposition, Gauss-Siedel. Convergence of iterative methods. Algebraic eigen value problems: Power method.	
Unit-3	8 Hours
Shift operator, Forward and backward difference operators and their relationships, Fundamental theorem of difference calculus, Interpolation, Newton-Gregory's forward and backward interpolation formulae. Approximation: Least square polynomial approximation.	
Unit-4	11 Hours
Divided differences, Newton's divided difference formula, Lagrange's formula, Central differences, Formulae based on central differences: Gauss, Striling's, Numerical differentiation.	
Unit-5	11 Hours
Numerical integration, General quadrature formula, Trapezoidal and Simpson's 1/3 and 3/8 rules, Numerical solution of first order differential equations: Euler's method, Picard's method, Runge-Kutta method.	
Unit-6	

Applications of Numerical Methods in domain related problems such as mechanical, thermal and dynamical problems etc.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Numerical Methods Lab				
Course Code	**BSCM512**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives:

The objective of this course is to familiarize the students with fundamental numerical methods and develop programming skills using Scilab to effectively implement numerical solutions for difficult engineering problems.

Course Outcomes:

After the completion of the course, students will be able to:

CO1	**Elaborate the Arithmetic Operations and Elementary Mathematical Built-in functions on SCILAB platform.**
CO2	**Design SCILAB codes to find the solution of non linear equations and system of equations.**
CO3	**Develop SCILAB codes for interpolating the value in the given range of data.**
CO4	**Apply SCILAB codes to find the Numerical Integration of complex functions**
CO5	**Apply SCILAB codes to find the solution of complex Ordinary differential equations with specific initial conditions.**

Text Book (s)

. Urroz, G E., Numerical and Statistical Methods with SCILAB for Science and Engineering **,Vol1 Book Surge Publishing, 2001, ISBN-13: 978-1588983046**

2. Software site: http://www.scilab.org, official scilab website

3. Wikipedia article: http://en.wikipedia.org/wiki/Scilab

Reference Book (s)

Lab 1**: Basics of Scilab (Refresher)**

(i) Scilab Basics

(ii) Arrays: Unlocking potential of Scilab

(iii) Scilab Files: script and function

Lab 2: **Experiment on following:**

(i) Numerical Limitations

(ii) Program output and plotting

(iv) Working with arrays and functions

(v) Loops and Execution control

Lab 3: **Developing code for Bisection method to find the roots of a non linear equation.**

Lab 4: **Developing code for Regula- Falsi method to find the roots of a non linear equation.**

Lab 5: **Developing code for Newton- Raphson method to find the roots of a non linear equation.**

Lab 6: **Developing a code for Naïve Gauss Elimination to find the solution of system of linear equations.**

Lab 7: **Developing a code for Gauss Seidel Method to find the solution of system of linear equations.**

. Lab 8: **Developing a code for Power Method to find Largest Eigen value and corresponding Eigen Vector.**

Lab 9: **Developing a code for Lagrange's Method to solve the problems of Interpolation.**

Lab 10: **Developing a code for numerical integration of complex function (Trapezoidal and Simpson 1/3rd Rule)**

Lab 11: **Develop a code to find the solution of ordinary differential equation by Euler Method..**

Lab 12: **Develop a code to find the solution of ordinary differential equation by Runge- Kutta Method.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	**-**	**50**	**100**

Semester IV

Name of The Course	**Transforms and their applications**			
Course Code	BSCM403			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	1	0	4

Course Objectives:

1. Mathematics fundamental necessary to formulate, solve and analyze engineering problems.

2. An understanding of Fourier and Laplace Transform to solve real world problems.

3. An understanding of Wavelet transforms.

4. An understanding of Z-transform & Affine transforms.

Course Outcomes:

After the completion of the course, students will be able to:

CO1	**Demonstrate the application of Laplace transform in mathematical problem & engineering problem.**
CO2	**Conclude the application of Fourier transform in real world problems.**
CO3	**Classify the Wavelet transform in different wave packets and apply in mathematical models.**
CO4	**Interpret the Z- transform in mathematics beside Laplace & Fourier transform.**
CO5	**Interpret the uses of Affine transform in mathematical problem.**
CO6	**Apply integral transform to solve differential equations.**

Text Book (s)

1. **Raguveer M. Rao and Ajit S. Bopardikar-Wavelet Transforms –Introduction and applications-Pearson Education, 2008**

2. **K.P Soman, K. I. Ramachandran –Insight into Wavelets from Theory to practice, PHI, 2006.**

3. **Jain R.K., Iyengar, S.R.K. Advanced Engineering Mathematics, Narosa Publishers, 2006.**

Reference Book (s)

4. **Johny R. Johnson, Introduction to Digital Signal Processing, PHI, 2006.**

Unit-1: Laplace Transform	10 Hours
The concept of transform, Integral transforms and kernel, Linearity property of transforms, Laplace transform, Properties of Laplace transform, Inverse Laplace transform, Convolution theorem, Applications of Laplace transform to solve ordinary differential equations.	
Unit-2:Fourier transforms	10 Hours
Fourier Transform (finite and infinite), Properties of Fourier transforms, Fourier integral, Convolution Theorem, Inverse of Fourier Transform, Applications of Fourier transform to boundary value problems. Discrete Fourier transform: Frequency domain sampling, Discrete Fourier transform (DFT): DFT pair, properties of DFT, circular convolution using DFT, Fast Fourier transform (FFT).	
Unit-3: Wavelet transform	10 Hours
Classification: continuous and discrete wavelet transforms, Developments in wavelet theory applications. Continuous Wavelet Transform: Introduction, Continuous time wavelets, CWT as an operator, Inverse CWT. Discrete Wavelet Transform and orthogonal Wavelet decomposition: Approximations of vectors in nested linear vector subspaces, Multi-resolution Analysis of L2 (R), Haar Scaling function, Haar wavelet, Haar wavelet decomposition, Haar wavelet packets and application.	
Unit-4: Z-Transform	9 Hours
Definition and properties of Z-transforms, inverse Z-transform of elementary functions, Initial and final value theorem for Z-transforms, Convolution theorem for Z- transforms, Formation of difference equations, Solution of difference equations. Applications of Z- transform.	
Unit-5: Affine Transform	9 Hours
Constant-functions. Definition of affine transformation. Linear spaces of affine transformations. The algebra of affine transformations. Bases for various function-spaces. Matrices and transformations. The dimension of the linear space of all affine transformations on a finite-dimensional Euclidean space.	
Unit-6: Applications of Integral Transforms to Fractional Differential Equations	7hours
Laplace Transforms of Fractional Integrals and Fractional Derivatives, Fractional Ordinary Differential Equations, Initial Value Problems for Fractional Differential Equations.	

Name of The Course	Econometrics				
Course Code	BSCM404				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

Econometrics is a set of research tools used to estimate and test economic relationships.The aim of this course is to provide you with the skills helpful in filling the gap between being "a student of economics" and being "a practicing economist." By taking this introduction to econometrics you will gain an overview of what econometrics is about, and develop some "intuition" about how things work.

Course Outcomes:

After the completion of the course, students will be able to:

CO1	**Apply statistical tests to solve the hypothesis testing problems.**
CO2	**Define Simple Linear Regression Model & its various methods**
CO3	**Define multiple Linear Regression Model &its various methods**
CO4	**Explain the violations of Classical Assumptions**
CO5	**Able to explain Specification Analysis Omission of a relevant variable, inclusion of irrelevant variable and tests of specification errors.**
CO6	**Understands the recent trends in econometrics.**

Text Book (s)

1. Jay L. Devore, *Probability and Statistics for Engineers,* Cengage Learning, 2010.
2. John E. Freund, *Mathematical Statistics*, Prentice Hall, 1992.

Reference Book (s)

1. Richard J. Larsen and Morris L. Marx, *An Introduction to Mathematical Statistics and its Applications,* Prentice Hall, 2011.
2. D. N. Gujarati and D.C. Porter, *Essentials of Econometrics*, McGraw Hill, 4th Ed., International Edition, 2009.
3. Christopher Dougherty, *Introduction to Econometrics,* Oxford University Press, 3rd Ed., Indian edition, 2007.

Unit-1	10 Hours
Fitting of the Curves by method of least square: Straight line, parabola and exponential curves. Correlation and Regression: Bivariate population, Meaning of correlation & regression. Coefficient of Correlation, rank correlation, lines of regression. Properties of regression coefficients, Partial and multiple correlation and their simple Properties.	
Unit-2	**9 Hours**
Simple Linear Regression Model: Two Variable Case Estimation of model by method of ordinary least squares; properties of estimators; goodness of fit; tests of hypotheses; scaling and units of measurement; confidence intervals; Gauss-Markov theorem; forecasting.	
Unit-3	**9 Hours**
Multiple Linear Regression Model Estimation of parameters; properties of OLS estimators; goodness of fit - R2 and adjusted R2 ; partial regression coefficients; testing hypotheses – individual and joint; functional forms of regression models; qualitative (dummy) independent variables.	
Unit-4	**8 Hours**
Violations of Classical Assumptions: Consequences, Detection and Remedies Multicollinearity; heteroscedasticity; serial correlation.	
Unit-5	**8 Hours**

Specification Analysis Omission of a relevant variable; inclusion of irrelevant variable; tests of specification errors.
Unit-6 4 Hour
Estimating derivatives of function-valued parameters in a class of moment condition models. Relevant parameter changes in structural break models.

Name of The Course	Differential Geometry & Tensor				
Course Code	**BSCM524**				
Prerequisite	Linear algebra, Calculus in several variables, Vector calculus.				
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives: **The aim of the course is to provide knowledge of the geometry of curves and surfaces. The course integrates concepts from different parts of mathematics, such as linear algebra, calculus and differential equations. It also provides intuitive examples for many concepts in linear algebra, calculus and differential equations. These examples are fundamental to physics and mechanics: they play a role in our understanding of the movements of particles and the theory of relativity.**

Course Outcomes:

After learning the course the students should be able to:

CO1	**Apply method to find the parametric representations and tangent, Evolute and Envolute of curve.**
CO2	**Apply methods of theory of surfaces**
CO3	**Explain the theory of Geodesics.**
CO4	**Find the tensor product of vector spaces and its associated vectors.**
CO5	**Elaborate the knowledge about tensor analysis and tensor differentiation.**
CO6	**Learn the basic theory of curvature tensor**

Recommended Books:

1. Tensor Calculus, Zafar Ahsan, Anamaya Publication, New Delhi.

2. Differential Geometry of manifolds, U.C.De&A.A.Shaikh, Narosa Publishing House Pvt. Ltd, 2007.

3. Schaum's Outlines of Tensor Calculus.

4. Tensor Calculus & Riemannian Geometry, D.C. Agarwal, Krishna Publications.

Reference Book (s):

1- J. A. Schouten, *Ricci-Calculus. An introduction to tensor analysis and its geometrical applications,* **2d ed. Berlin, Springer, 1954.**

2- Introduction to Tensor Calculus: Kees Dullemond & Kasper Peeters, Lecture Notes series.

Unit-1: Theory of Space Curves 9 Hours

Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.
Unit-2: Theory of Surfaces **11 Hours**
Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines. Developables: Developable associated with space curves and curves on surfaces, Minimal surfaces.
Unit-3 10 Hours
Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem. Surfaces of constant curvature. Conformal mapping. Geodesic mapping. Tissot's theorem.
Unit-4: Tensor algebra **08 Hours**
Vector spaces, the dual spaces, tensor product of vector spaces, transformation formulae, contraction, special tensor, inner product, associated tensor.
Unit-5: Tensor Analysis 10 Hours
Contravariant and covariant vectors and tensors, Mixed tensors, Symmetric and skew-symmetric tensors, Algebra of tensors, Contraction and inner product, Quotient theorem, Reciprocal tensors, Christoffel's symbols, Covariant differentiation, Gradient, divergence and curl in tensor notation.
Unit-6:Curvature tensor 4hours **Differential Manifold-examples, tangent vectors, connexions, Elements of general Riemannian geometry-Riemannian metric, the fundamental theorem of local Riemannian Geometry**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	Complex Analysis				
Course Code	**BBS14T1006**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives:

The objective of the course is to familiarize with techniques in calculus of complex variable functions It aims to enhance the problem solving skills using standard concepts and tools at an intermediate to advance level that will serve them well towards tackling more advanced level of Mathematics and application that they would find useful in their discipline.

Course Outcomes: **Students will able to**

CO1	**Explain analytic function and its properties.**
CO2	**Evaluate contour integral in complex plane.**
CO3	**Determine power series and zero of an analytic functions.**
CO4	**Construct conformal mappings between many kinds of domain.**
CO5	**Evaluate and Differentiate between the singularities and Residues.**
CO6	**Understand the concept of transformation in a complex space (linear and non-linear) and sketch their associated diagrams.**

Text Book (s)

1. **S. Ponnusamy and H. Silverman, Complex Variables, Birkhäuser, Inc., Boston, MA, 2006.**
2. **J. B. Conway, Functions of One Complex Variable, Narosa Publishing House, New Delhi, 2002.**

Reference Book (s)

1. **V. Ahlfors, Complex Analysis (Third Edition), McGraw-Hill, 1979.**
2. **S.Ponnusamy, Foundation of complex analysis, Narosa publication, 2003**

Unit-1	Contact hours: 9
Algebra of complex numbers, Limit, Continuity, Differentiability of complex function, Cauchy-Riemann equations(Cartesian & polar), analytic functions, harmonic functions, harmonic conjugates, analyticity of functions, the exponential, trigonometric, hyperbolic functions and their properties.	
Unit-2	Contact hours: 8
Line integral, basic properties of contour integration, M-L inequality, fundamental theorem of contour integration, Cauchy's integral theorem, Cauchy-Goursat theorem (statement only), Cauchy's integral formula, Cauchy's integral formula for higher derivatives,	
Unit-3	Contact hours: 9
Taylor's theorem, zeros of an analytic function, Laurent's theorem, the identity/uniqueness theorem for analytic functions, the identity theorem for power series, Maximum modulus theorem, Schwarz' lemma and its consequences, Cauchy's estimate, Liouville's theorem, A Generalized version of Liouville's theorem, the fundamental theorem of algebra.	
Unit-4	Contact hours: 9
Conformal mappings, Möbius transformations and its properties, the group of Möbius transformations, circles and lines under Möbius maps, cross ratio and its invariance property, Principle of symmetry (statement only), Conformal self maps of disks and half planes.	
Unit-5	Contact hours: 10

Singularities of functions, Non-isolated singularities: removable singularity, poles and essential singularities, Characterization of removable singularity, pole and essential singularity, Characterizing singularities via Laurent series expansion, isolated singularities at ∞, residues, Cauchy's residue theorem, evaluation of definite and improper integrals using contour integration,
Unit-6 Contact hours: 4
Introduction, Conformal Mapping, Some special transformations, Möbius transformations, Cross ratio, invariance of circles, symmetry and orientation principles (statement only), determination of Möbius transformations mapping real line onto itself, upper half plane onto itself, upper half plane onto open disc and an open disc onto an open disc.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Real Analysis II				
Course Code	**BBS14T1007**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives:

Demonstrate an understanding of Riemann integral, improper integrals , point wise and uniform convergence of sequences and series of functions , Fourier Series, Power series and their convergence, metric spaces and how they are used in real world problems.

Course Outcomes

CO1	**To understand the Riemann integral**
CO2	**To understand improper integrals and their convergence**
CO3	**To understand point wise and uniform convergence of sequences and series of functions**
CO4	**To understand Fourier Series, Power series and their convergence**
CO5	**To understand definition and examples of metric spaces**
CO6	**To Explain fundamental properties of the metric spaces that lead to the formal development of real analysis.**

Text Book (s)

1. R. G. Bartle and D.R. Sherbert, *Introduction to Real Analysis* (3rd Edition), John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2002.

2. S.C. Malik and Savita Arora: *Mathematical Analysis*, New Age International (P) Ltd. Publishers, 1996.

3. K. A. Ross, Elementary Analysis: *The Theory of Calculus, Under graduate Texts in Mathematics*, Springer (SIE), Indian reprint, 2004.

Reference Book (s)

1.Sudhir R Ghorpade and Balmohan V. Limaye, *a course in Calculus and Real Analysis, Undergraduate Text in Math.*, Springer (SIE). Indian reprint, 2004.

2. T.M. Apostol: *Mathematical Analysis*, Addison-Wesley Series in Mathematics, 1974.

Unit I	Lecture hours- 12
Introduction to Riemann integral, Riemann lower and upper sums, existence of Riemann integral, Darboux theorem, Condition of integrability, Riemann integrability for continuous functions, bounded functions, monotonic function and functions with finite or infinite number of discontinuities (with proof).	
Unit II	Lecture hours- 8
Definition of improper integrals, Kinds of improper integral with example, test for convergence of improper integrals: p-integral test, comparison test, Cauchy's test for convergence, absolute convergence, Abel's Test, Dirichlet's Test,	
Unit III	Lecture hours- 12
Definition of point wise and uniform convergence of sequences and series of functions, Cauchy's criterion for uniform convergence, Weierstrass M-test, Uniform convergence and continuity, Uniform convergence and differentiation, Uniform convergence and integration.	
Unit IV	Lecture hours- 12
Fourier Series, Power series, Radius of convergence, uniform and absolute convergence, Abel's Theorem, Uniqueness theorem for power series, Abel's and Tauber's theorems (with proof).	
Unit V	Lecture hours- 8
Definition and examples of metric spaces, open ball and closed ball, Neighbourhood of a point, Open sets, Limit points, Closed sets and closure of a set, Convergent and Cauchy sequences, Complete metric space.	
Unit VI	Lecture hours- 4
Equivalent metric spaces, Complete metric, Banach fixed point theorem, Dense subsets, Nowhere dense set, Perfect sets, Cantor Sets, Baire Category theorem, Separable, second countable and first countable spaces. Compactness, Sequential compactness, $\in -$Nets & Totally bounded sets. Finite intersection property. Lebesgue numbers for coves, Connectedness, Component of metric spaces and its property.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Ring and Module Theory**			
Course Code	**BSCM423**			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	1	0	4

Course Objectives: **Objective of this course is to introduce basic concepts of Ring, subring , their homomorphism and related properties.**

Course Outcomes:

After learning the course the students should be able to:

CO1	**Apply methods to find Ring Sub ring and Ideal.**
CO2	**Apply methods to find Homomorphism, Isomorphism and Kernel.**
CO3	**Explain the concept of Polynomial rings, Division algorithm and Factorization of polynomials.**
CO4	**Apply the concept of Principal Ideal Domain, Euclidean Domain, Unique Factorization Domain.**
CO5	**Explain Ring embedding and quotient field.**
CO6	**Introduce module theory over commutative rings.**

Text Book (s)

1. Surjeet Singh and QaziZameeruddin: *Modern Algebra*, Vikas Publication.

2. J.A. Gallian: *Contemporary Abstract Algebra*, Narosa Publication.

Reference Book (s)

1. I. N. Herstein: *Topics in Algebra*, Wiley Eastern Ltd., New Delhi.

2. N. Jacobson: *Basic Algebra*, Volume I and II. W. H. Freeman and Co.

Unit-1	10 Hours
Rings and their properties, Boolean Ring, Integral domain, Division ring and Field, Subrings, Ideals and their properties, Operations on ideals, Ideal generated by a subset of a ring, Quotient rings	
Unit-2	9 Hours
Homomorphism of rings and its properties, Kernel of a homomorphism, Natural homomorphism, Isomorphism and related theorems, Field of quotients	
Unit-3	10 Hours
Polynomial rings over commutative rings, Properties of R[X], Division algorithm and its consequences, Factorization of polynomials, Irreducibility test, Eisenstein's criterion for irreducibility	
Unit-4	11 Hours
Factorization in integral domains, prime and irreducible element, Principal Ideal Domain, Euclidean Domain, Unique Factorization Domain and its properties	
Unit-5	8 Hours
Ring embedding and quotient field, regular rings and their examples, properties of regular ring, ideals in regular rings	
Unit-6	6 Hours
Module over commutative rings, examples: vector spaces, Z-modules, commutative rings; submodules, quotient modules, homomorphism, isomorphism,	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Semester- V

Name of The Course	**Fuzzy Mathematics**
Course Code	**BSCM601**
Prerequisite	Set theory
Corequisite	
Antirequisite	

	L	T	P	C
	3	1	0	4

Course Objectives:

1. **Introduce the basic mathematical concepts of the theory of fuzzy sets.**
2. **Explain the differences and similarities between fuzzy sets and classical sets theories.**
3. **Provide an emphasis on the concepts of fuzzy logic, neural networks and genetic algorithms.**
4. **Enable students to define membership grades of sets extracted from the real life applications.**

Course Outcomes:

After the completion of the course, students will be able to:

CO1	**Explain the basics of fuzzy set theory and fuzzy equivalence relation.**
CO2	**Develop understanding and knowledge of fuzzy logic and its application.**
CO3	**Develop different membership functions corresponding to different sets in the fields like neural network, genetic algorithm and inductive reasoning.**
CO4	**Define the fundamental concepts of fuzzy arithmetic and its properties.**
CO5	**Discuss various application areas like control systems, industrial problems to name a few.**
CO6	**Introduce some extensions and application areas of fuzzy set theory.**

Text Book (s):

1. H.J. Zimmerman: *Fuzzy Set Theory and its Application*, 3rd Ed., Springer India Pvt. Ltd., 2006.
2. G. Klir and B. Yuan: *Fuzzy Set and Fuzzy Logic: Theory and Applications*, Prentice Hall of India Pvt. Ltd., 2002.

Reference Book (s):

1. T.J. Ross: *Fuzzy Logic with Engineering Applications*, 3rd Ed., Wiley India Pvt. Ltd., 2011.
2. G. Klir and T. Folger: *Fuzzy Sets, Uncertainty and Information*, Prentice Hall of India Pvt. Ltd., 2002.

Unit-1: Fuzzy Sets and Uncertainty	11 Hours
Uncertainty and information, fuzzy sets and membership functions, chance versus fuzziness, properties of fuzzy sets, fuzzy set operations. Cardinality, operations, properties, fuzzy Cartesian product and composition, fuzzy tolerance and equivalence relations, forms of composition operation.	
Unit-2: Fuzzy Logic and Fuzzy Systems	10 Hours
Classic and fuzzy logic, approximate reasoning, Natural language, linguistic hedges, fuzzy rule based systems, graphical technique of inference. fuzzification, de-fuzzification to crisp sets and scalars.	
Unit-3: Development of membership functions	9 Hours
Membership value assignments: intuition, inference, rank ordering, neural networks, genetic algorithms, inductive reasoning.	
Unit-4: Fuzzy Arithmetic and Extension Principle	8 Hours
Functions of fuzzy sets, extension principle, fuzzy mapping, interval analysis, vertex method and DSW algorithm.	

Unit-5: Fuzzy Control Systems	10 Hours
Fuzzy control system design problem, fuzzy engineering process control, fuzzy statistical process control, industrial applications.	
Unit-6: Extensions and Applications of fuzzy set theory	5 Hours
Extensions: Type-2 fuzzy sets and intuitionistic fuzzy sets **Applications: Fuzzy rough set, fuzzy time series analysis and fuzzy automata**	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Operations Research				
Course Code	**BSCM502**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

The course aims at building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints. This course introduce students to use quantitive methods and techniques for effective decisions–making; model formulation and applications that are used in solving decision problems. Topics covered will include linear programming, Duality, Assignment, and transportation programming, Game theory and Queueing theory. The course will discuss the underlying theory, but the emphasis will be on 632odelling and applications in various real world problems.

Course Outcomes:

After the completion of the course, students will be able to:

CO1	Construct linear integer programming models and discuss the solution techniques.
CO2	Design Dual problems and their relationship with primal with economic interpretation
CO3	Explain and formulate transportation, assignment problems and drive their optimal solution.
CO4	**Explain the various technique to solve zero-sum two- person games problems and game with mixed strategies.**
CO5	**Develop the model and solve various type of queueing system.**
CO6	**Explain the applications of Operations Research in real life problems.**

Text Book (s)

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, *Linear Programming and Network Flows*, 2nd Ed., John Wiley and Sons, India,2004.
2. HamdyA.Taha,*OperationsResearch,AnIntroduction*,8thEd.,Prentice-HallIndia,2006.
3. G. Hadley, *Linear Programming*, Narosa Publishing House, New Delhi,2002.

Reference Book (s)

1. F.S. Hillier and G.J. Lieberman, *Introduction to Operations Research*, 9th Ed., Tata McGraw Hill, Singapore,2009.

5.

Unit-1: Linear Programming	**10 Hours**
Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format.	
Unit-2 Duality	8 Hours
Duality, formulation of the dual problem, dual simplex method, primal-dual relationships, economic interpretation of the dual.	
Unit-3: Transportation & Assignment Problem	**10 Hours**
Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.	
Unit-4: Game Theory	**9 Hours**
Formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.	
Unit-5: Sequencing & Replacement Model	11 Hours
Sequencing and replacement model: Sequencing problem – processing through 2 machines, 3 machine – s jobs and k machines, Replacement of items that deteriorate gradually – with time, without time, that fails completely – individual replacement.	
Unit-6: Applications of OR	6 hours
Optimal Allocation and distribution of resources, Finance, Decision Making, Production and facilities planning, travelling salesman problem.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Operations Research Lab
Course Code	BSCM 511
Prerequisite	
Corequisite	

Antirequisite					
		L	T	P	C
		0	0	2	1

Course Objectives: Operations research Lab helps in solving peoblems in different conditions. The Analytic techniques and computer software will be used to solve problems various LPP, transportation Models, assignments models, Game theory, sequencing Model etc..

Course Outcomes:

After the completion of the course, students will be able to:

CO1	**Design simple models**
CO2	**Develop critical thinking and objective analysis of various problems.**
CO3	**To build and solve Transportation Models and Assignment Models.**
CO4	**To solve and model Game theory**
CO5	**To optimize the sequencing of job and replacement Model.**

Text Book (s)

1. G. Hadley: Linear Programming. Narosa, Reprint, 2002.

2. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 9th Edition, 2010.

Reference Book (s)

3. A. Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, 2005.

4. F.S. Hillier. G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata Mc-Graw Hill, 2010.

List of Experiments:

1. **Using SCILAB to solve Linear Programming Problem using Graphical Method.**
2. **Illustration of following special cases in LPP using Simplex method in SCILAB**
    a. **Unrestricted variables**
    b. **Unbounded solution**
    c. **Infeasible solution**
    d. **Alternative or multiple solutions**
3. **Developing Sci code for primal- dual relationship.**
4. **Solve Transportation problem for determination of starting basic solution by northwest-corner method using SCILAB**
5. **Solve Transportation problem for determination of starting basic solution by least cost method using SCILAB**
6. **Solve Transportation problem for determination of starting basic solution by Vogel approximation method using SCILAB**
7. **Developing Sci code for solving assignment problem by Hungarian method.**
8. **Developing Sci code for finding saddle point and solving two person zero sum games.**
9. **Developing Sci code for solving games with mixed strategies.**

10. **Developing Sci code for linear programming solution of games.**
11. **Developing Sci code for Sequencing problem – processing through s jobs and k machines.**
12. **Developing Sci code for Replacement of items that deteriorate gradually – with time, without time.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
50	**-**	**50**	**100**

Name of The Course	Special Functions and Difference equations			
Course Code	**BBS14T1008**			
Prerequisite	Ordinary Differential Equations			
Corequisite				
Antirequisite				
	L	T	P	C
	3	**1**	**0**	**4**

Course Objectives:

- The interplay between mathematical analysis and physical understanding.
- To investigate and derive the properties of special functions, inter-relations between such functions and their representations in various forms.
- Certain specific systems of orthogonal polynomials and their properties.
- To impart knowledge about various special functions and difference equations employed to study real world problems.
- This course further explains the analytic techniques in computing the solutions of various ordinary differential equations appearing in various fields of science and technology.

Course Outcomes

CO1	**Solve, expand and interpret solutions of many types of important differential equations by making use of special functions and orthogonal polynomials.**
CO2	**Derive the formulas and results of certain classical special functions and orthogonal polynomials by different methods.**
CO3	**Achieve the knowledge to analyse the problems using the methods of special functions and orthogonal polynomials.**
CO4	**Classify the problem related to difference equation.**
CO5	**Apply the difference equation technique in real world problem.**
CO6	**Apply special function and difference equation to mechanical, thermal and dynamical problems**

Text Book (s)

1. E. D. Rainville: Special Functions, Chelsea Publishing Co., Bronx, New York, Reprint, 1971.
2. Sneddon, I.N., *Special Functions of Mathematical Physics and Chemistry*. Edinburg: Oliver & Boyd, 1956.
3. Introductions to Difference Equations, SamuleGoldbarg. Dover Pulications.

4. Modelling with Differential and Difference equations, GleenFulford, Peter Forrester, Cambridge University press, 1997

Reference Book (s)

1. Bell. W.W. (1966) Special function for Scientific and Engineers; D. Van Nontrand Conv. Ltd. London.
2. *U.P. Singh: Special Function & Their Application, WISDOM PRESS, 2012.*
3. Advanced topics in Difference Equations, Ravi Agarwal and Praticia J. Y. Wang, Kluwar Academic Press
4. S.Elaydi, Difference equation, springer.

Unit-1:Gamma, Hypergeometric, Bessel and Neumann Functions 8 hours
Introduction; Gamma Function; Hypergeometric Functions: Definition and special cases, convergence, analyticity, integral representation, differentiation, transformations and summation theorems; Bessel Functions: Definition, connection with hypergeometric function, differential and pure recurrence relations, generating function, integral representation; Neumann polynomials, Neumann series and related results; Examples.
Unit-2: Legendre, Hermite and Laguerre Polynomials 10 Hours
Legendre polynomials: (i) Generating function (ii) Special values (iii) Pure and differential recurrence relations (iv) Differential equation (v) Series definition (vi) Rodrigues' formula (vii) Integral representation; Hermite polynomials: Results (i) to (vii) and expansion of x^n in terms of Hermite polynomials; Laguerre polynomials: Results (i) to (vii).
Unit-3: Orthogonal Polynomials 9 Hours
Simple sets of polynomials; Orthogonal polynomials: Equivalent condition for orthogonality; Zeros of orthogonal polynomials; Expansion of polynomials; Three-term recurrence relation; Christoffel-Darboux formula; Normalization and Bessel's inequality; Orthogonality of Legendre, Hermite and Laguerre polynomials; Ordinary and singular points of differential equations, Regular and irregular singular points of hypergeometric, Bessel, Legendre, Hermite and Laguerre differential equations; Examples.
Unit-4: Difference Equations-I 8 Hours
Difference equations: Introduction. Definition of difference equation. Solution of the difference equations. Various type of linear difference equation. Differential equation as limit of difference equations. Linearly independent functions. Homogenous difference equation with constant co-efficients. Homogenous linear difference equations with variable coefficients. Existence and uniqueness theorem.
Unit-5: Difference Equations-II 9 Hours
Linear difference equation with constant coefficient, method of undetermined coefficient and specialoperator method to find particular solution, Solution of linear difference equation with constant coefficient usingVariation of parameter, calculation of nth power of a matrix A, matrix method for the solution of system of lineardifference equation, generating function technique to solve linear difference equation, applications of difference equations.
Unit-6 8 hours
Use of Special Functions and Difference equations in the real life applications and research oriented problems such as mechanical, thermal and dynamical problems etc.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**General Mechanics**				
Course Code	**BBS14T1009**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives: **The aim of the course is to provide the basic knowledge of static objects like concepts of force, moment, and mechanical equilibrium. To understand forces and moments in two and three dimensions due to concentrated and distributed forces in various systems such as beams, frames and trusses. Also, to analyze the bodies which is in motion using the basics of kinetics and kinematics.**

Course Outcomes: After completing the course, the students will able to

CO1	**analyze force systems in plane and also in space.**
CO2	**to solve two and three dimensional rigid body static equilibrium problems.**
CO3	**to determine the centroid of planes, center of gravity of masses and evaluate their moments of inertia.**
CO4	**to evaluate velocity and acceleration of a particle in rectangular and cylindrical coordinate systems and angular velocity of rigid bodies that are in plane motion.**
CO5	**to solve the problem related to bodies in dynamic Equilibrium and bodies undergoing forced and free vibration using the laws of kinetics**
CO6	**Understand the basics of generalised coordinates and degree of freedom**

Text Book (s):

1. R.S. Verma - A Text Book on Statics, Pothishala Pvt. Ltd., Allahabad.
2. M. Ray and G. C. Sharma – A Text Book on Dynamics, S. Chand & Company, New Delhi, 2008
3. **Beer, F. P. and Johnston, E. R., "Vector Mechanics for Engineers- Statics and Dynamics", 8/e, McGraw Hill International Book Co., 2008.**
4. **Shames, I. H, "Engineering Mechanics – Statics and Dynamics", 4/e, Prentice–Hall of India Pvt. Ltd., 2003.**
5.

Reference Book (s) :

1. S.L. Loney - An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.
2. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.
3. **Hibbeler, R. C., "Engineering Mechanics', 12/e, Pearson Education Pvt. Ltd., 2007.**
4. **Meriam, J. L., "Dynamics", 5/e, John Wiley & sons, 2003.**
5. **K. L. Kumar, "Engineering Mechanics", 3/e, Tata McGraw Hill, 2003.**

Unit-1: Introduction of Statics	8 hours
Introduction to vector approach – free body diagrams –forces in plane – forces in space – concurrent forces - resolution of forces –equilibrium of particle, Virtual work.	

Unit-2: Principles of statics 8 hours **Statics of rigid bodies in two dimensions and three dimensions, Moment of a force about a point – moment of a force about an axis .**
Unit-3 : Applications of statics 8 hours **Friction – contact friction problems. Analysis of trusses –method of joints – method of sections. Properties of surfaces and solids - Centroid.**
Unit-4: Dynamics 8 hours **Rotation of a vector in a plane. Velocity and acceleration components in Cartesian, polar and intrinsic terms. Central orbit, Kepler's laws of motion.**
Unit-5: Dynamic Equilibrium and bodies 8 hours **Rectilinear simple harmonic motion. Vertical motion on circular and cycloidal curves. Motion with respect to linearly moving and rotating plane. Coriolis force and centrifugal force.**
Unit VI 4 hours **Generalised coordinates, Generalised forces, equation of equilibrium of a rigid body, degree of freedom for a system of rigid bodies**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Elective-I

Name of The Course	Dynamical System				
Course Code	BSCM522				
Prerequisite	Differential equations				
Corequisite	NA				
Antirequisite	NA				
		L	T	P	C
		3	1	0	4

Course Objectives: **The course objectives to introduce the main features of dynamical systems, particularly as they arise from systems of ordinary differential equations as models in applied mathematics. The topics presented will include phase space, fixed points and stability analysis, bifurcations, Hamiltonian systems and dissipative systems. Discrete dynamical systems will also be discussed briefly, leading to the idea of a 'chaotic' dynamical system.**

Course Outcomes:

After learning the course the students should be able to:

CO1	**Explain the main features of dynamical systems and their realisation as systems of ordinary differential equations**
CO2	**identify fixed points of simple dynamical systems, and study the local dynamics around these fixed points, in particular to discuss their stability and bifurcations**

CO3	**Make use of a range of specialised analytical techniques which are required in the study of dynamical systems**
CO4	**Explain and predict the occurrence and consequences of bifurcations**
CO5	**Find fixed points and period orbits of discrete dynamical systems, and find their stability**

Text Book (s)

1. **M. W. Hirsch & S. Smale – Differential Equations, Dynamical Systems and Linear Algebra (Academic Press 1974)**
2. **L. Perko – Differential Equations and Dynamical Systems (Springer – 1991)**

Reference Book (s)

3. **Lawrence Perko, Differential equations and dynamical systems, Springer-Verlag, 2001.**
4. **F. Verhulst, Non-linear Differential Equations and Dynamical Systems, Springer, 1990.**

Unit-1	10 Hours
An Introduction to Dynamical Systems: Background and examples, dynamical systems, attractors and invariant sets. Phase Portraits: Phase portraits in 1D, topological equivalence.	
Unit-2	10 Hours
linear systems, linear 2D systems, stability and linearization of non-linear systems, Lyapunov stability, drawing global phase portraits.	
Unit-3	9 Hours
Non-linear dynamical systems: solutions to initial value problem, existence and uniqueness ofsolutions, linearization, phase space, classification of critical points.	
Unit-4	10 Hours
Bifurcations: Introductions, Saddle-Node Bifurcations, Transcritical Bifurcation, Pitchfork Bifurcation, Imperfect Bifurcations and Catastrophes.	
Unit-5	9 Hours
Definition of a discrete dynamical system, graphical analysis of 1D discrete dynamical systems, stability of fixed points and periodic orbits, chaotic orbits – definition and examples.	
Unit-6	6 Hours
Higher-dimensional dynamical system: Lorenz and Rossler equations, chaos, strange attractors and fractals	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Financial Mathematics				
Course Code	**BSCM523**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

The key objectives of financial mathematics are also to understand how to construct the best investment strategies that minimizes risks in the real world.

Course Outcomes:

After learning the course, the students should be able to:

CO1	Summarize the concepts of time value of money using interest rates and discounting
CO2	Explain concepts related to complex rate functions and annuities.
CO3	Apply discounted cash flow techniques in different project appraisal
CO4	**Explain concepts of Internal rate of return and securities**
CO5	**Estimate the price of a future and forward contract**
CO6	**Applying hedging in the contract**

Text Book (s)

1. **Suresh Chandra, S. Dharmaraja, Aparna Mehra, R. Khemchandani, Financial Mathematics: An Introduction, Narosa Publication House, 2012.**

Reference Book (s)

1. **D.G. Luenberger, Investment Science, Oxford University Press, Oxford, 1998.**
2. **J.C. Hull, Options, Futures and Other Derivatives, 4th ed., Prentice-Hall, New York, 2000.**
3. **J.C. Cox and M. Rubinstein, Options Market, Englewood Cliffs, N.J.: Prentice Hall, 1985.**

Unit-1	10 Hours
Interest rates, Simple interest rates, Compound interest rates, Present value of a single future payment. Discount factors, effective and nominal interest rates.	
Unit-2	11 Hours
Relation between the time periods for compound interest rates and the discount factor. Compound interest functions. Annuities and perpetuities.	
Unit-3	10 Hours
loan schedule, Investment project appraisal, Cash flow, present value of a cash flow	
Unit-4	9 Hours
Equation of value, Internal rate of return, securities, fixed income securities, types of markets.	
Unit-5	8 hours
Forward and futures contracts, options, properties of stock option prices, trading strategies involving options	
Unit-6	6 hours
Hedging, Bonds, Equity, Property, Interest rate modelling, Financial networks	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Graph Theory				
Course Code	**BSCM421**				
Prerequisite	Discrete Structure				
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives: **This course is aimed to cover a variety of different problems in Graph Theory. In this course students will come across a number of theorems and proofs. Theorems will be stated and proved formally using various techniques. Various graphs algorithms will also be taught along with its analysis. After the course the student will have a strong background of graph theory which has diverse applications in the areas of computer science, biology, chemistry, physics, sociology, and engineering. Topics include: Basic concepts of graph theory, Trees, Bipartite graphs and matching, Connectivity, Eulerian circuits, Degree Sequences, Planarity.**

Course Outcomes: **After learning the course the students should be able to:**

CO1	**Define basic notions in graph theory including bi-partite graphs and matching, Network and flow, some basic algorithms for graphs and discuss travelling salesman's problem.**
CO2	**Discuss degree sequences including tree and path, then using it in some algorithms for graphs.**
CO3	**Explain the basic operations on Graphs and subgraphs, and determine whether graphs are Hamiltonian and/or Eulerian. Also, discuss the application of trees.**
CO4	**Solve problems involving Eulerian circuits, and found the matrix representation of graph.**
CO5	**Solve problems involving vertex and edge, connectivity, planarity and crossing numbers.**
CO6	**Understand the concept of vector space for graphs and its requirement.**

Text Book (s)

1. **N Deo – Graph theory with applications to Engineering and Computer Science, Prentice Hall of India, 1987.**
2. **K R Parthasarathy – Basic Graph theory, Tata McGraw-Hill, New Delhi, 1994.**
3. **Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory 2nd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2003.**
4. **Rudolf Lidl and Günter Pilz, Applied Abstract Algebra, 2nd Ed., Undergraduate Texts in Mathematics, Springer (SIE), Indian Sreprint, 2004.**

Reference Book (s)

1. **C.L. Liu – Elements of discrete mathematics, McGraw-Hill, 1986.**
2. **Kenneth H. Rosen – Discrete Mathematics and its applications, McGraw-Hill, 2002.**
3. **F Harary – Graph theory, Addison Wesley, Reading Mass, 1969.**
4. **J A Bondy and U S R Murthy – Graph theory with applications, Elsevier, 1976.**

Unit-1 Introduction	10 Hours
Definition, examples and basic properties of graphs, pseudographs, complete graphs, bi-partite graphs, isomorphism of graphs, paths and circuits, Eulerian circuits, Hamiltonian cycles, the adjacency matrix, weighted graph, travelling salesman's problem, shortest path, Dijkstra's algorithm, Floyd-Warshall algorithm.	
Unit-2	8 Hours

Degree Sequences – Graphic Sequences, Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.	
Unit-3	10 Hours
Basic Definitions, Isomorphism, Subgraphs, Operations on graphs, Walks, Paths, Circuits, Connected and disconnected graphs, Euler graphs, Hamiltonian graphs, Some Applications, Trees and Basic properties, Distance, Eccentricity, centre, Spanning trees, Minimal spanning tree.	
Unit-4	10 Hours
Eulerian circuits, Eulerian graph, semi-Eulerian graph, theorems, Hamiltonian cycles,theorems Representation of a graph by matrix, the adjacency matrix, incidence matrix, weighted graph.	
Unit-5	10 Hours
Cut- sets, Fundamental circuits; fundamental cut-sets, Connectivity, Separability, cutvertex, Network flows, 1- and 2- Isomorphisms. Planar and non planar graphs, Euler's formula, Detection of planarity. Matrix representation of Graphs – Adjacency matrix of a graph, Incidence matrix of a graph.	
Unit -6	3 Hours
Vector space of graphs, computer representation of graphs	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Measure Theory**				
Course Code	**BBS14T5011**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives: **Demonstrate an understanding of measure of sets and functions, also relation between Riemann integration and Lebesgue integration and how they are used in real world problems.**

Course Outcomes

Sudents are able

CO1	**To understand the sets and their cardinality**
CO2	**To learn about Lebesgue Measure of sets**
CO3	**To learn about algebra of Lebesgue Measurable functions**
CO4	**To understand relation between Riemann integration and Lebesgue integration**
CO5	**To understand General Lebesgue integral and its application**
CO6	**To extend the concept of analysis in General measurable space**

Text Books:

1. Royden, H.L. and Fitzpatrick, P. M., Real Analysis, 4th Edition, Pearson, 2010.
2. Barra, G. De. Measure Theory and Integration (New Age International(P) Ltd, Publishers, New Delhi 2003).
3.P. Billingsley, Probability and Measure, 3rd ed., John Wiley & Sons, New York, 1995

4.G. De Barra, Measure theory and Integration, New age international publishers, 2012

Reference Books:
1. Rana, I. K. An Introduction to Measure and Integration, 2nd edition, Narosa Publishing House India, 2000.
2. Halmos, P. R. Measure Theory, Springer-Verlag, 1974.
3. Jain, P. K. and Gupta, V. P. Lebesgue Measure and Integration, New Age International (P) Limited, New Delhi, 1986.
4.J. Rosenthal, A First Look at Rigorous Probability, World Scientific, Singapore, 2000.
5.A.N. Shiryayev, Probability, 2nd ed., Springer, New York, 1995.
6.K.L. Chung, A Course in Probability Theory, Academic Press, New York, 1974.

Unit I	Lecture hours- 10
Equivalent Set, Finite and Infinite set, Countable and Uncountable set, Cardinality of set, order relation in cardinal number, addition , multiplication and exponentiation of cardinal number, Cantor like sets, Continuum Hypothesis.	
Unit II	Lecture hours- 8
Length of sets, Outer measure, Lebesgue Measure, properties of measurable sets, Borel sets and their measure, σ algebra of Lebesgue Measurable set, Set of measure zero, Non Measurable Sets.	
Unit III	Lecture hours- 12
Measurable Function, Measurability of sum, difference, product and quotient of measurable functions. Measurability of Step function, characteristic function, Simple function, Sequence of function, Sequentional pointwise limits, Littlewood's Three Priciple, Egoroff's Theorem,	
Unit IV	Lecture hours- 12
Riemann integration and Lebesgue integration, Lebesgue integration of bounded and unbounded measurable, Lebesgue integration of non-negative measurable function.	
Unit V	Lecture hours- 8
General Lebesgue integral, Bounded Convergence Theorem, Monotone, Lebesgue Dominated Convergence Theorem, Fatou's Lemma.	
Unit VI	**Lecture hours- 4**
General measurable space, Signed measure, The Han and Jordon Decompositions Theorem, the Caratheodory Han Theorem, integration of non-negative measurable function and General measurable function, The Radon Nikodym Theorem, The Vitali Han Saks Theorem.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	Bio- Mathematics				
Course Code	BSCM422				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives: **The aim of the course is to describe the application of mathematical models to biological phenomena. A variety of contexts in human biology and diseases are considered, as well as problems typical of particular organisms and environments.**

Course Outcomes:

After learning the course the students should be able to:

CO1	**Discuss various Mathematical modeling process for Biological phenomena like bacterial growth in a Chemostat, harvesting a single natural population, Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC).**
CO2	**Find numerical and graphical solutions of continuous models like Insect Outbreak Model, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods etc**
CO3	**Demonstrate spatial models** for **spreading colonies of microorganisms, blood flow in circulatory system, Spread of genes in a population etc.**
CO4	**Discuss Discrete Models for Growth models, Decay models, Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting.**
CO5	**Discuss Case Studies for Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.**
CO6	**Discuss Turing Patterns and Reaction-Diffusion and Tumour Growth Models**

Text Book (s)

1. L.E. Keshet, Mathematical Models in Biology, SIAM, 1988.
2. J. D. Murray, Mathematical Biology, Springer, 1993.
3. Y.C. Fung, Biomechanics, Springer-Verlag, 1990.

Reference Book (s)

1. F. Brauer, P.V.D. Driessche and J. Wu, Mathematical Epidemiology, Springer, 2008.
2. M. Kot, Elements of Mathematical Ecology, Cambridge University Press, 2001.

Unit-1	11 Hours
Mathematical Biology and the modeling process: an overview. Continuous models: Malthus model, logistic growth, Allee effect, Gompertz growth, Michaelis-Menten Kinetics, Holling type growth, Bacterial growth in a Chemostat, Harvesting a single natural population, Prey predator systems and Lotka Volterra equations, Populations in competitions, Epidemic Models (SI, SIR, SIRS, SIC)	
Unit-2	11 Hours
Activator-Inhibitor system, Insect Outbreak Model: Spruce Budworm, Numerical solution of the models and its graphical representation. Qualitative analysis of continuous models: Steady state solutions, stability and linearization, multiple species communities and Routh-Hurwitz Criteria, Phase plane methods and qualitative solutions, bifurcations and limit cycles with examples in the context of biological scenario.	
Unit-3	08 Hours
Spatial Models: One species model with diffusion, Two species model with diffusion. Conditions for diffusive instability, Spreading colonies of microorganisms, Blood flow in circulatory system, Travelling wave solutions, Spread of genes in a population	
Unit-4	9 Hours
Discrete Models: Overview of difference equations, steady state solution and linear stability analysis. Introduction to Discrete Models, Linear Models, Growth models, Decay models,	

Drug Delivery Problem, Discrete Prey-Predator models, Density dependent growth models with harvesting.	
Unit-5	9 Hours
Host-Parasitoid systems (Nicholson-Bailey model), Numerical solution of the models and its graphical representation. Case Studies: Optimal Exploitation models, Models in Genetics, Stage Structure Models, Age Structure Models.	
Unit-6	6 Hours
Turing Patterns and Reaction-Diffusion Models for Pattern Formation: Animal Coat Patterns, Phyllotaxis, Min proteins and e. coli Cell Division, Tumour Growth Models	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Special Theory of Relativity**				
Course Code	**BBS14T5012**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives: **This** course **enables the students: To distinguish between Newtonian Mechanics and special theory of relativity and develop the relationship of length contraction, time dilation and Einstein energy mass relation and to apply the concepts of special theory of relativity in various field of physics and engineering.**

Course Outcomes

CO1	**Demonstrate an understanding of the basic principles of the special theory of relativity.**
CO2	**Perform basic calculations in relativistic kinematics and dynamics**
CO3	**Explain relativistic momentum and Einstein field equations.**
CO4	Explain Maxwell equations in electromagnetic field
CO5	**To explain Maxwell equations in tensor forms and apply its concepts in various fields of physics and engineering.**
CO6	**To apply the special theory of relativity in different field.**

Text Book (s):

1. C. Moller, The Theory of Relativity, Oxford Clarendon Press, 1952.

2. P.G. Bergmann, Introduction to the Theory of Relativity, Prentice Hall of India, 1969.

3. J.L. Anderson, Principles of Relativity Physics, Academic Press, 1967.

4. W. Rindler, Essential Relativity, Van Nostrand Reinhold Company, 1969.

Reference Book (s):

1. V. A. Ugarov, Special Theory of Relativity, Mir Publishers, 1979.

2. R. Resnick, Introduction to Special Relativity, Wiley Eastern Pvt. Ltd. 1972.

3. J.L. Synge, Relativity : The Special Theory, North-Holland Publishing Company, 1956.

4. W.G. Dixon, Special Relativity : The Foundation of Macroscopic Physics, Cambridge University Press, 1982.

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Unit-1 Introduction	9hours
Review of Newtonian mechanics: **Inertial frames. Speed of light and Galilean relativity. Michelson-Morley experiment. Lorentz-Fitzgerald contraction hypothesis. Relative character of space and time. Postulates of special theory of relativity. Lorentz transformation equations and its geometrical interpretation. Group properties of Lorentz transformations.**	
Unit-2	10hours
Relativistic kinematics**: Composition of parallel velocities. Length contraction. Time dilation. Transformation equations for components of velocity and acceleration of a particle and Lorentz contraction factor. Geometrical representation of space-time: Four dimensional Minkowskian space-time of special relativity. Time-like, light-like and space-like intervals. Null cone, Proper time. World line of a particle. Four vectors and tensors in Minkowiskian space-time**	
Unit-3	10hours
Relativistic mechanics **- Variation of mass with velocity. Equivalence of mass and energy. Transformation equations for mass momentum and energy. Energy-momentum four vector. Relativistic force and Transformation equations for its components. Relativistic Lagrangian and Hamiltonian. Relativistic equations of motion of a particle. Energy momentum tensor of a continuous material distribution.**	
Unit-4	10 hours
Electromagnetism – I. **Maxwell's equations in vacuum. Transformation equations for the densities of electric charge and current. Propagation of electric and magnetic field strengths. Transformation equations for electromagnetic four potential vectors.**	
Unit-5	6 hours
Electromagnetism – II. **Transformation equations for electric and magnetic field strengths. Gauge transformation. Lorentz invariance of Maxwell's equations. Maxwell's equations in tensor form. Lorentz force on a charged particle. Energy momentum tensor of an electromagnetic field.**	
Unit -06:	4 hours
Application of Special theory of Relativity: Superconducting currents and charge gradients in the octonion spaces, A New Lab for Measuring the Speed of Light, Modified electromagnetic transmission eigenvalues in inverse scattering theory,The Maxwell-Pauli Equations.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Numerical solution of ordinary differential equations**				
Course Code	**BBS14T5013**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives: **The aim of the course is develop an understanding of Numerical methods for ordinary differential equations. The students will explore his/her knowledge how to determine the stability criterion for a numerical scheme and apply the methods to solve problems.**

Course Outcomes: After completing the course, the students will able to

CO1	**apply the numerical methods for ordinary differential equations.**
CO2	**apply the different single and multi step methods**
CO3	**apply the methods to solve problems and stiff problems**
CO4	**determine the stability criterion for a numerical scheme .**
CO5	**Apply the different error analysis to ordinary differential equations**
CO6	**Learn the convergence of methods**

Text Book (s):

1. G.D.Smith,"Numerical Solution of Partial Differential Equations : Finite Difference Methods" (Oxford Applied Mathematics & Computing Science Series).
2. R K Jain ,"Numerical Methods for Scientific and Engineering Computations": M K Jain,S R K Iyengar.
3. John Wiley,"Finite Difference methods for partial Differential equations": Forsythe G.E.& Wasow, WR.
4. Gerald, C.F.& Wheatley P.O."Applied Numerical Analysis", Pearson Education Asia.

Reference Book (s) :

1. **Bradie B A, Friendly Introduction to Numerical Anaysis Pearson Education,2007**
2. **Burden RL, Faires J D Numerical Analysis Cengage Learning, 2007**
3. **Chapra SC, Canale, R P Numerical Methods for Engineers Tata McGraw Hill, 2003**
4. **Gerald C.F., Wheatley P O Applied Numerical analysis, Addison Wesley, 1998**

Unit-1: Solution of first order ordinary differential equations 8 hours
Single step methods: Euler method, Modified Euler Method, Convergence of Euler method, Improvement of error bound, stability, Higher order single step methods: Runge Kutta methods, Second Order methods, Fourth Order Runge Kutta methods, Higher Order Runge Kutta methods, error bound , Absolute stability
Unit-2: Multi step methods 8 hours
Multi step methods predictor corrector methods, Multi step methods Adams Basforth method, Multi step methods Adams Moulton method
Unit-3 : Systems of equation 8 hours

Systems of differential equations, higher order equations, stiff differential equations, general single step methods, convergence of general single step methods
Unit-4: Linear boundary value problems 8 hours **Finite difference methods: Dirichlet's type boundary condition, mixed boundary condition, shooting method, linear multistep methods for stiff systems**
Unit-5: Non-Linear boundary value problems 8 hours **Finite difference methods: Dirichlet's type boundary condition, mixed boundary condition, shooting method, analysis of difference system, analytic expression of the error**
Unit-6: Convergence of methods 4 hours **Convergence of Linear Multistep Methods, Necessary & Sufficient Conditions for Convergence, Absolute Stability and Relative Stability, General methods for finding intervals of absolute and relative stability**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	Information Theory and Coding				
Course Code	**BBS14T5014**				
Prerequisite	**Mathematical foundation**				
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

1. To define and apply the basic concepts of information theory (entropy, channel capacity etc.)
2. To learn the principles and applications of information theory in communication systems
3. To study various data compression methods and describe the most common such methods
4. To understand the theoretical framework upon which error-control codes are built

Course Outcomes

CO1	**Quantify the notion of information in a mathematically sound way.**
CO2	**Explain what is the significance of this quantitative measure of information in the communications systems.**
CO3	**Calculate entropy, joint entropy, relative entropy, conditional entropy, and channel capacity of a system.**
CO4	**Differentiate between lossy and lossless compression techniques.**
CO5	**Decide an efficient data compression scheme for a given information source.**
CO6	**Describe different codes of cryptography and time transform approach.**

Text Book (s)

1. T. M. Cover, J. A. Thomas, *Elements of Information Theory*, Wiley.

2. R. Togneri, C.J.S deSilva, *Fundamentals of Information Theory and Coding Design*, Taylor and Francis.

Reference Book (s)

1. The mathematics of coding theory, Garrate P. , Pearson
2. Error correcting coding theory-Rhee M.Y.,McGraw-Hill

Unit-1	10 Hours
Information theory: Concept of amount of information, information units Entropy: marginal, conditional, joint and relative entropies, relation among entropies Mutual information, information rate, channel capacity, redundancy and efficiency of channels Discrete channels – Symmetric channels, Binary Symmetric Channel, Binary Erasure Channel, Noise-Free Channel, Channel with independent I/O, Cascaded channels, repetition of symbols, Binary asymmetric channel, Shannon theorem	
Unit-2	10 Hours
Source coding – Encoding techniques, Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy, Source coding theorem. Construction of basic source codes – Shannon Fano coding, Shannon Fano Elias coding, Huffman coding, Minimum variance Huffman coding, Adaptive Huffman coding, Arithmetic coding, Dictionary coding – LZ77, LZ78, LZW, ZIP coding Channel coding, Channel coding theorem for DMC.	
Unit-3	10 Hours
Codes for error detection and correction – Parity check coding, Linear block codes, Error detecting and correcting capabilities, Generator and Parity check matrices, Standard array and Syndrome decoding, Hamming codes Cyclic codes – Generator polynomial, Generator and Parity check matrices, Encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, BCH codes, RS codes, Burst error correction	
Unit-4	7 Hours
Convolutional codes – Encoding and State, Tree and Trellis diagrams, Maximum likelihood decoding of convolutional codes -Viterbi algorithm, Sequential decoding -Stack algorithm.	
Unit-5	9 Hours
Interleaving techniques – Block and convolutional interleaving, Coding and interleaving applied to CD digital audio system - CIRC encoding and decoding, interpolation and muting. ARQ – Types of ARQ, Performance of ARQ, Probability of error and throughput.	
Unit-6	7 Hours
Golay codes, Shortened cyclic codes, Burst and Random Error correcting codes. Time domain approach. Transform domain approach	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
130	**20**	**50**	**100**

Name of The Course	Mechanics of solids
Course Code	**BBS14T5015**
Prerequisite	**Mathematical foundation**
Corequisite	

Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

The aim of this course is to introduce the basic theory of mechanics of solids. This course deals with the the laws of transformations and tensors, Mathematical theory of deformations, analysis of strain and analysis of stress in elastic solids, basic equations of elasticity. In this course, the students will be exposed to the mathematical theory of elasticity and other techniques which find applications in areas of civil and mechanical engineering and Earth and material sciences.

Course Outcomes: **After successful completion of this course the students will be able to:**

CO1	**Understand tensors and their properties.**
CO2	**Analyse various types of tensors.**
CO3	**Analyse geometrical and analytical interpretation of components of strain.**
CO4	**Analyse geometrical and analytical interpretation of components of stress.**
CO5	**Distinguish the equations of elasticity for isotropic and anisotropic elastic solid.**
CO6	**Apply applications of elasticity in various engineering branches.**

Text Book (s)

1. **I.S. Sokolnikoff, Mathematical Theory of Elasticity, Tata-McGraw Hill Publishing Company Ltd., New Delhi, 1977.**
2. **D.S. Chandrasekharaiah and L. Debnath, Continuum Mechanics, Academic Press, 1994.**

Reference Book (s)

1. A.E.H. Love, A Treatise on the Mathematical Theory of Elasticity Dover Publications, New York.
2. Y.C. Fung. Foundations of Solid Mechanics, Prentice Hall, New Delhi, 1965.
3. Shanti Narayan, Text Book of Cartesian Tensor, S. Chand & Co., 1950.
4. S. Timeshenko and N. Goodier. Theory of Elasticity, McGraw Hill, New York, 1970.

Unit-1	10 Hours
Tensor Algebra: Coordinate-transformation, Cartesian Tensor of different order. Properties of tensors.Isotropic tensors of different orders and relation between them. Symmetric and skew symmetric tensors. Tensor invariants. Eigen-values and eigen-vectors of a tensor.	
Unit-2	8 Hours
Tensor Analysis: Scalar, vector, tensor functions, Comma notation, Gradient, divergence and curl of a vector / tensor field.	
Unit-3	8 Hours
Analysis of Strain : Affine transformation, Infinitesimal affine deformation, Geometrical Interpretation of the components of strain. Strain quadric of Cauchy.	
Unit-4	10 Hours
Analysis of Stress : Stress Vector, Stress tensor, Equations of equilibrium, Transformation of coordinates.Stress quadric of Cauchy, Principal stress and invariants. Examples of stress. (Relevant portions of Chapter 1 & 2 of the book by I.S. Sokolnikoff).	
Unit-5	10 Hours

Equations of Elasticity :Generalised Hooks Law, Anisotropic symmetries, Homogeneous isotropic medium. Elasticity moduli for Isotropic media. Equilibrium and dynamic equations for an isotropic elastic solid.
Unit-6 8 Hours
Applications of mathematical theory of elasticity **“Application of hooks law in elasticity” R.Vishalashi, Indian journal of research, 6(11), 2017.** **“The Theory and Applications of Elasticity: A Study on Consumers in Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria” Adejumo Oluwabunmi Opeyemi, American Journal of Economics, 3(6), 313-321, 2013.**

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Semester VI

Name of The Course	**Classical Mechanics**				
Course Code	**BBS14T1010**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives:

1. Students should understand the drawbacks of Newtonian approach and necessity of new approaches to solve advanced problems involving the dynamic motion of classical mechanical systems.
2. The students will introduce about the forces, angular momentum and knowledge about the constraint.
3. The course provides the students about the knowledge of hollow cylinder and solid cylinder.
4. How to use differential equations and other advanced mathematics in the solution of the problems considered in item 2.
5. How to use conservation of energy and linear and angular momentum to solve dynamics problems.
6. How to represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulations of classical mechanics.
7. Students should understand the forces in non inertial systems.

Course Outcomes

CO1	**Understand the rigid body problem involving Euler dynamical and geometrical equations of motion.**
CO2	**Define and understand basic mechanical concepts related to advanced problems involving the dynamic motion of classical mechanical systems.**
CO3	**. Describe and understand the differential equations and other advanced mathematics in the solution of the problems of mechanical systems.**
CO4	**Describe and understand the motion of a mechanical system using Lagrange’s Hamilton formalism.**
CO5	**Describe and understand the motion of the forces in non inertial systems.**

CO6	**Apply the laws of classical mechanics .**

Text Book (s):

1- Classical Mechanics by P. V. Panat, Narosa Publishing Home, New Delhi.
2- Classical Mechanics by N. C. Rana and P. S. Joag, Tata Mc-Graw Hill Publishing Company Limited, New Delhi.
3- Introduction to Classical Mechanics by R. G. Takawale and P. S. Puranik, Tata Mc-Graw Hill Publishing Company Limited, New Delhi.

4- Classical Mechanics by J. C. Upadhyaya, Himalaya Publishing House. 7. Analytical Dynamics E. T. Whittaker, Cambridge University Press.

Reference Book (s):

1. Classical Mechanics by H. Goldstein, Narosa Publishing Home, New Delhi.
2. Classical Dynamics of Particles and Systems by Marion and Thomtron, Third Edition, Horoloma Book Jovanovich College Publisher.

Unit-1 Introduction 6hours Review of Vector Calculus(Questions will not set in examination), **Rotation of a vector in two and three dimensional fixed frame of reference. Kinetic energy and angular momentum of rigid body rotating about its fixed point. Euler dynamical and geometrical equations of motion.**
Unit-2 10hours Constrained motion and Lagrangian formulation**: Constraints and their types. Generalized coordinates, Lagrange's equations of motion, including velocity dependent potentials. Properties of kinetic energy function, theorem on total energy, generalized momenta, cyclic coordinates, integrals of motion, Jacobi integrals and energy conservation. Concept of symmetry, invariance under Galilean transformation.**
Unit-3 10hours Variational principle and Hamiltonian formulation**: Variational principle, Euler's equation, applications of variational principle, shortest distance problem, Brachistrochrone, Geodesics of a Sphere. Hamilton's function and Hamilton's equation of motion, configuration space, phase space and state space, Lagrangian and Hamiltonian of relativistic particles.** **.**
Unit-4 10 hours Canonical transformations and Poisson brackets**: Legendre transformations, Generating function, Conditions for canonical transformation and problem. Definition, Identities, Poisson theorem, Jacobi Poisson theorem, Jacobi identity, (statement only), invariance of Poisson Bracket under canonical transformation.**

Unit-5 6 hours
Non inertial frames of references, central force**: Rotating frames of reference, inertial forces in rotating frames, Larmour precession, electromagnetic analogy of inertial forces, effects of Coriolis force, Foucault's pendulum.**
Unit-06 Applications of Classical Mechanics: Power laws in wall and wake layers of a turbulent boundary layer , Generalized Lie Symmetries, Singular Lagrangians, and the Passage to Hamiltonian Mechanics, Modeling flywheel energy storage system charge and discharge dynamics.

Elective II

Name of The Course	Mathematical Modeling & Simulation				
Course Code	BSCM621				
Prerequisite	Linear algebra & Calculus				
Corequisite	NA				
Antirequisite	NA				
		L	T	P	C
		3	1	0	4

Course Objectives: **The overall objectives of this course is to enable students to build mathematical models of real-world systems, analyze them and make predictions about behaviour of these systems. Variety of modelling techniques will be discussed with examples taken from physics, biology, chemistry, economics and other fields. The focus of the course will be on seeking the connections between mathematics and physical systems, studying and applying various modelling techniques to creating mathematical description of these systems, and using this analysis to make predictions about the system's behavior.**
Course Outcomes: **Successful completion of the course assumes that a student is able to:**

CO1	**Assess and articulate what type of modelling techniques are appropriate for a given real world system**
CO2	**Construct a mathematical model of a given real world system and analyze it,**
CO3	**Discuss predictions of the behaviour of a given real world system based on the analysis of its mathematical model.**
CO4	**Demonstrate the power of mathematical modelling and analysis and be able to apply their understanding to their further studies.**
CO5	**Apply network modelling in some relevant situation**
CO6	**Demonstrate Role of time delay in various mathematical modeling.**

Text Books:

1. **Kapur , J.N.,"Mathematical Modelling",New Age international publisher, 1988.**
2. **Burghes D.N , "Modelling with differential equations", Ellis Horwood and John Wiley, 1991**

Reference Books:

1. **Burghes, D.N.," Mathematical Modelling in the Social Management and Life Science",Ellie Herwood and John Wiley.**
2. **Charlton, F.," Ordinary Differential and Difference Equations", Van Nostrand.**
3. **Brauer, Castillo-Chavez ,"Mathematical Models in Population Biology and Epidemiology".**

Unit-1	10 Hours
Introduction to compartmental models, lake pollution model, exponential growth of population, limited growth of population, limited growth with harvesting, discrete population growth , logistic equation with time lag.	
Unit-2	9 Hours
Linear homogeneous and non-homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters, application to projectile motion.	
Unit-3	9 Hours
Equilibrium points, interpretation of the phase plane, predator-prey model and its analysis, competing species and its analysis, epidemic model of influenza and its analysis, battle model and its analysis.	
Unit-4	10 Hours
Mathematical modeling of vibrating string, vibrating membrane, conduction of heat in solids, gravitational potential, conservation laws and Burger's equations, classification of second order PDE, reduction to canonical forms, equations with constant coefficients, general solution.	
Unit-5	10 Hours
Graphs, diagraphs, networks and subgraphs, vertex degree, paths and cycles, regular and bipartite graphs, four cube problem, social networks, exploring and traveling, Eulerian and Hamiltonian graphs, applications to dominoes, diagram tracing puzzles, Knight's tour problem, gray codes.	
Unit-6	**6 Hours**
Prey-predator model with infectious disease in any one of the species, Ecological models, Role of time delay in various mathematical modeling.	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Optimization Techniques				
Course Code	BSCM622				
Prerequisite	Operation Research-1				
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives: **To impart knowledge in concepts and tools of Operations Research .To understand mathematical modelsand numerical techniques in Operations Research .To apply these techniques constructively to make effective business decisions**

Course Outcomes:

After learning the course the students should be able to:

CO1	**Solve Non-linear and dynamic programming problems.**

CO2	**Explain networking analysis.**
CO3	**Interpret the simulation methods.**
CO4	**Interpret the Information theory.**
CO5	**Solve constrained and unconstrained optimization problems with numerical optimization techniques.**
CO6	**Determine optimization using calculus of function of multiple variables.**

Text Book (s)

1. M.S. Bazaraa, H.D. Sherali, C.M. Shetty, Nonlinear Programming, J. Wiley & Sons.
2. G. Hadley, Nonlinear and Dynamic Programming, Addison-Wesley, 1972.
3. I.C. Hu, Integer Programming and Network Flows, Addison-Wesley, 1970.

Reference Book (s)

1. Hillier, Lieberman, Introduction to Operations Research, McGraw Hill Book Company, 1989.
2. Mangasarian O.L., Non-linear Programming, McGraw Hill, New York

Unit-1: Nonlinear Programming & Dynamic Programming	9 Hours
Nonlinear programming, Karush-Kuhn-Tucker necessary and sufficient conditions of optimality, Quadratic programming , Wolfe's method, Beale's method. Dynamic programming, Bellman's principle of optimality, Recursive relations, System with more than one constraint, Solution of LPP using dynamic Programming.	
Unit-2: Network Analysis	12 Hours
Analysis of a project thorough network diagram, Network scheduling by CPM, PERT, Financial planning through network, Network crashing. Network flow problems, Max-flow-min-cut theorem, Integral flow theorem, Maximum flow algorithms, Linear programming interpretation of Max-flow-mincut theorem. The out-of-Kilter formulation of minimal cost network flow problem, Labeling procedure for the Out-of-Kilter algorithm, Insight into changes in Primal and Dual function values. Sequencing Problem.	
Unit-3: Simulation	8 Hours
Basic concepts, Monte Carlo method, Random number generation, Waiting the simulation model, New process planning through simulation, Capital budgeting through simulation	
Unit-4: Information Theory	9 Hours
Shannon theory, Measure of information, Entropy – the expected information, Entropy as a measure of uncertainty, Memoryless channel, Conditional entropies, Mutual information, Information process by a channel, Channel capacity, Encoding, Shannon-Fanno encoding procedure.	
Unit-5: Unconstrained Optimization	10 Hours
Search Methods-Fibonacci search, Golden section search. Gradient Methods- Method of steepest descent, Damped Newtown's Method, Davidson-Fletcher-Powell Method, Line search derivatives, Projection Methods. Constrained Optimization: Methods of feasible direction, Cutting hyperplane Method.	
Unit-6: Optimization using Calculus	10 Hours
Stationary points, Functions of single and two variables, Global Optimum, Convexity and concavity of functions of one and two variables, Optimization of function of one variable and multiple variables, Gradient vectors, Optimization of function of multiple variables subject to equality constraints, Lagrangian function	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	Cryptography and Network Security				
Course Code	BSCM623				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives: **This** Course **focuses towards the introduction of** network security **using various** cryptographic **algorithms. Underlying** network security **applications. It also focuses on the practical applications that have been implemented and are in use to provide email and web** security

Course Outcomes:

After learning the course the students should be able to:

CO1	**Explain the fundamentals of Cryptography and Network Security, including data and advanced encryption**
CO2	**Analyse about different types of attacks.**
CO3	**Develop security networks and its usages.**
CO4	**Improve the knowledge of standard algorithms that can be used to provide confidentiality, integrity and authentication of data.**
CO5	**Design firewall characteristics.**
CO6	**Describe computer-based Symmetric Key Cryptographic Algorithms.**

Text Book (s)

1.TCP/IPProtocolSuite,BehrouzA.Forouzan,*DataCommunicationandNetworking*,Tata McGraw Hill.

Reference Book (s)

2.W.Stallings,*CryptographyandNetworkSecurity,PrinciplesandPractice*,Pearson Education, 2000.

Unit-1 Introduction	11 Hours
Public Key Cryptography Principles & Applications, Algorithms: RSA, Message Authentication: One way Hash Functions: Message Digest, MD5, SHA1.Public Key Infrastructure: Digital Signatures, Digital Certificates, Certificate Authorities.	
Unit-2	10 Hours
NetworkAttacks:BufferOverflow,IPSpoofing,TCPSessionHijacking,SequenceGuessing, NetworkScanning:ICMP,TCPsweeps,BasicPortScans;DenialofServiceAttacks:SYN Flood, Teardrop attacks, land, Smurf Attacks	
Unit-3	9 Hours
IP security Architecture: Overview, Authentication header, Encapsulating Security Pay Load, combining Security Associations, Key Management. Virtual Private Network Technology: Tunneling using IPSEC	
Unit-4	9 Hours
Requirements, Secure Socket Layer, and Secure Electronic Transactions, Network Management Security: Overview of SNMP Architecture-SNMPV1, SNMPV3.	
Unit-5	9 Hours

Firewall Characteristics& Design Principles, Types of Firewalls: Packet Filtering Router, Application Level Gate way or Proxy, Content Filters, Bastion Host.
Unit-6 7 Hours
Computer-based Symmetric Key Cryptographic Algorithms: Algorithm Types and Modes, An overview of Symmetric Key Cryptography, DES, International Data Encryption Algorithm (IDEA), RC5, Blowfish, AES, Differential and Linear Cryptanalysis.

Name of The Course	Applications of Algebra				
Course Code	BSCM624				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives: **The objective of this course is to provide knowledge about applications of both abstract and linear algebra. The aim is to study about the codes that deal with error detection and correction in any technological devices that allows communication. Also, the course focus on the key concepts of image processing**.

Course Outcomes:

After learning the course the students should be able to:

CO1	**Construct of Balanced incomplete block designs (BIBD).**
CO2	**Define and illustrate main concepts and prove fundamental theorems concerning error-correcting codes**
CO3	**Understand the symmetry groups and coloring patterns.**
CO4	**Elobrate anatomy of special types of matrices and applications of image processing**
CO5	**Analyze the applications of Linear Transformations.**
CO6	**Analyze the application of computer algebra.**

Text Book (s)

1. **I. N. Herstein and D. J. Winter,** ***Primer on Linear Algebra*****, Macmillan Publishing Company, New York,1990.**
2. **S. R. Nagpaul and S. K. Jain,** ***Topics in Applied Abstract Algebra*****, Thomson Brooks and Cole, Belmont, 2005.**
3. **Richard E. Klima, Neil Sigmon, Ernest Stitzinger,** ***Applications of Abstract Algebra with Maple*****, CRC Press LLC, Boca Raton,2000.**

Reference Book (s)

1. **David C. Lay,** ***Linear Algebra and its Applications.*** **3rd Ed., Pearson Education Asia, Indian Reprint,2007.**
2. **Fuzhen Zhang,** ***Matrix theory*****, Springer-Verlag New York, Inc., New York,1999.**

Unit-1 10 Hours
Balanced incomplete block designs (BIBD): definitions and results, incidence matrix of a BIBD, construction of BIBD from difference sets, construction of BIBD using quadratic residues, difference set families, construction of BIBD from finite fields.

Unit-2	9 Hours
Coding Theory: introduction to error correcting codes, linear cods, generator and parity check matrices, minimum distance, Hamming Codes, decoding and cyclic codes.	
Unit-3	9 Hours
Symmetry groups and color patterns: review of permutation groups, groups of symmetry and action of a group on a set; colouring and colouring patterns, Polya theorem and pattern inventory, generating functions for non-isomorphic graphs.	
Unit-4	12 Hours
Special types of matrices: idempotent, nilpotent, involution, and projection tri diagonal matrices, circulant matrices, Vandermonde matrices, Hadamard matrices, permutation and doubly stochastic matrices, Frobenius- König theorem, Birkhoff theorem. Positive Semi-definite matrices: positive semi-definite matrices, square root of a positive semi-definite matrix, a pair of positive semi-definite matrices, and their simultaneous diagonalization. Symmetric matrices and quadratic forms: diagonalization of symmetric matrices, quadratic forms, constrained optimization, singular value decomposition, and applications to image processing and statistics.	
Unit-5	10 Hours
Applications of linear transformations: Fibonacci numbers, incidence models, and differential equations. Least squares methods: Approximate solutions of system of linear equations, approximate inverse of an m×n matrix, solving a matrix equation using its normal equation, finding functions that approximate data. Linear algorithms: LDU factorization, the row reduction algorithm and its inverse, backward and forward substitution, approximate inverse and projection algorithms.	
Unit-6	**5Hours**
Computer algebra and its application	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Time Series Analysis**				
Course Code	**BBS14T5016**				
Prerequisite	**Statistical Inference**				
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives:

This course is aimed at the reader who wishes to gain a working knowledge of time series and forecasting methods as applied in economics, engineering and the natural and social sciences.

Course Outcomes

CO1	**Understands the basic ideas of time series analysis and stochastic processes**

CO2	**Explain the concept of ARMA Processes.**
CO3	**Understand the concept Forecasting ARMA Processes**
CO4	**Understand the concept and application of Spectral Analysis.**
CO5	**Understand the concept of Modeling and Forecasting with ARMA Processes.**
CO6	**Understands the recent advancement in time series.**

Texts / References

1. P. Brockwell and R. Davis, Introduction to Time Series and Forecasting, Springer, Berlin, 2000.
2. G.E.P. Box, G. Jenkins and G. Reinsel, Time Series Analysis-Forecasting and Control, 3rd ed., Pearson Education, 1994.
3. C. Chatfield, The Analysis of Time Series – An Introduction, Chapman and Hall / CRC, 4 th ed., 2004.

Unit-1: Introduction to Time Series:	9 Hour
Examples of Time Series, Objectives of Time Series Analysis, Some Simple Time Series Models, Stationary Models and the Autocorrelation Function, The Sample Autocorrelation Function, A Model for the Lake Huron Data, Estimation and Elimination of Trend and Seasonal Components.	
Unit-2: Stationary processes	8 Hour
Basic Properties, Linear Processes, Introduction to ARMA Processes, Properties of the Sample Mean and Autocorrelation Function, Forecasting Stationary Time Series, The Durbin–Levinson Algorithm. The Wald decomposition Theorem.	
Unit-3: ARMA Models	8 Hour
ARMA(p, q) Processes, The ACF and PACF of an ARMA(p, q) Process, Calculation of the ACVF, The Autocorrelation Function, The Partial Autocorrelation Function, Forecasting ARMA Processes	
Unit-4: Spectral Analysis	8 Hour
Spectral Densities, The Periodogram, Time-Invariant Linear Filters, The Spectral Density of an ARMA Process.	
Unit 5: Modeling and Forecasting with ARMA Processes	8 Hour
Preliminary Estimation, Yule–Walker Estimation, Burg's Algorithm, The Innovations Algorithm, The Hannan–Rissanen Algorithm, Maximum Likelihood Estimation, The Sample ACF of the Residuals, Tests for Randomness of the Residuals, Forecasting.	
Unit-6: Recent trends in Time Series	4 Hour
Location Multiplicative Error Models with Quasi Maximum Likelihood Estimation. On the Stationary Marginal Distributions of Subclasses of Multivariate Setar Processes of Order One.	

Name of The Course	Introduction to Actuarial Science				
Course Code	**BBS14T5017**				
Prerequisite					
Corequisite					
Antirequisite					
		L	T	P	C
		3	1	0	4

Course Objectives:

The aim of the Actuarial science subject is to provide grounding in life insurance and risk management.

Course Outcomes

CO1	**Summarize the concepts of valuing cash flows**
CO2	**Able to calculate probability using the two-state model**
CO3	**Able to Calculate Probabilities using the Life Table**
CO4	**Summarize the concepts of valuing uncertain cash flows**
CO5	**Life Insurance Company Scenario**
CO6	**Introduce some life assurance and annuity contracts.**

Text Book (s)

1. Suresh Chandra, S. Dharmaraja, AparnaMehra, R. Khemchandani, Financial Mathematics: An Introduction, Narosa Publication House, 2012

Reference Book (s)

1. **D.G. Luenberger, Investment Science, Oxford University Press, Oxford, 1998.**
2. **J.C. Hull, Options, Futures and Other Derivatives, 4th ed., Prentice-Hall, New York, 2000.**
3. **J.C. Cox and M. Rubinstein, Options Market, Englewood Cliffs, N.J.: Prentice Hall, 1985.**

Unit-1	12 Hours
Valuing Cash Flows, Time Value of Money, Present Value, Accumulated Value, Valuing Multiple Regular Payments, Equations of Value, Annuity	
Unit-2	11 Hours
Introduction to State Transitions, Two-State Model, Calculating Probabilities using the Two-State Model	
Unit-3	9 Hours
Introduction to the Life Table, Calculating Probabilities using the Life Table	
Unit-4	8 Hours
Valuing Uncertain Cash Flows, Expected Present Value, Accumulated Value and Uncertainty	
Unit-5	8 Hours
Life Insurance Company Scenario and Reserves	
Unit-6	6 Hours
Life assurance contracts, Life annuity contracts, Evaluation of assurances and annuities, AI and Machine Learning Usage in Actuarial Science	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**Approximation Theory**				
Course Code	**BBS14T5018**				
Prerequisite	**Basic knowledge of Calculus, Real Analysis**				
Corequisite	**Numerical Analysis**				
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**3**

Course Objectives: The course is designed for B.Sc (H) mathematics students. Main objective of this course to lay the theoretical foundation for wider field of mathematical as well as research areas by using classical topics of Approximation theory. After studying this course, the students will be able to understand and master theoretical as well as practical topics that arise in approximation of functions by polynomials, trigonometric polynomials, splines and by rational functions.

Course Outcomes

CO1	**Understand basic concepts in approximation theory.**
CO2	**Apply different important techniques that are used.**
CO3	Use polynomial and trigonometric approximation.
CO4	Apply approximation methods to interpolation
CO5	**Implement some of the techniques to engineering problems**
CO6	**Know application of approximation theory in real life**

Text Book (s):

M.J.D.Powell, Approximation theory and Application: Cambridge University Press.

Reference Book (s)

(1)E. W. Cheney, Approximation theory.

(2) Lloyd N. Trefethen, Approximation theory and approximation practice.

Unit-1 Introduction	10 hours
Basic concepts, the best approximation, Linear approximation and projection, Degree of approximation, The Weierstrass theorems, Linear positive operators, Korovkin theorem.	
Unit-2 Existence, uniqueness, characterization of best approximations	8 hours
Existence and unicity of best approximation, Finite-dimensional subspaces. Strictly convex spaces, Examples of nonexistence.	
Unit-3 Polynomial and Trigonometric approximations	8 hours
Jacksons theorems, Best approximation in C(K), Kolmogorov criterion and Haar spaces, Chebyshev alternation theorem, Haarunicity theorem, Chebyshev polynomials.	
Unit-4 Polynomial Interpolation	6 hours
Estimates outside the interval, Application to the iterative methods, Lagrange interpolation, Polynomials with interlacing zeros	
Unit-5 Other Approximation	8 hours
Approximation to periodic functions, B-splines, Rational approximations.	

Unit 6	**4 Hours**
Applications in signal processing, Computer Simulation, Engineering and technology	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**General Theory of Relativity**				
Course Code	**BBS14T5019**				
Prerequisite	**Special Theory of Relativity, Classical Mechanics, Classical Electrodynamics, Tensor Calculus.**				
Corequisite					
Antirequisite					
		L	T	P	C
		3	**1**	**0**	**4**

Course Objectives: The primary objective is to teach the students the physical and mathematical basis of Einstein's relativistic theory of gravitation and application of General Relativity to Cosmology.

Course Outcomes

CO1	**Demonstrate an understanding of the basic principles of the General theory of Relativity, tensor analysis and tensor calculus.**
CO2	**Perform basic calculations in the formalism of general relativity (GR) and to obtain an exact solution of GR, namely, the Schwarzschild solution.**
CO3	**Explain Post Newtonian formalism and Mach Principle.**
CO4	Explain equation of motion for field equation and different laws for gravitational field.
CO5	**To study Cosmology based on general relativity will teach how to study the origin, composition and evolution of the universe.**
CO6	**To apply General theory of Relativity to electrical engineering , Astronomy & Astrophysics.**

Text Book (s):

1. ***C.E. Weatherburn: An Introduction to Riemannian Geometry and the tensor Calculus, Cambridge University Press, 1950.***
2. ***J.V. Narlikar :General Relativity and Cosmology, The Macmillan Company of India Ltd. 1978.***
3. ***B.F. Shutz: A first course in general relativity, Combridge University Press, 1990.***
4. ***A.S. Eddington:The Mathematical Theory of Relativity, Cambridge University Press, 1965.***
5. ***S. Weinberg Gravitation and Cosmology : Principle and applications of the general theory of relativity, John Wiley & Sons, Inc. 1972.***
6. ***J.V. Narlikar: Introduction to Cosmology, Cambridge University Press, 1993.***
7. **Misner, Thorne & Wheeler (MTW): Gravitation (Freeman 1973)**

8. **Lightman, Press, Price & Teukolsky (LPPT): Problem Book in Relativity & Gravitation (Princeton 1975)**
9. T. Padmanabhan :*Gravitation*, CAMBRIDGE UNIVERSITY PRESS

Reference Book (s):

1. Hartle (H): Gravity (Addison-Wesley 2003)
2. Schutz (S): First Course in General Relativity (Cambridge 1985)
3. **Rindler (R): Essential Relativity (Springer 1969)**
4. **Adler, Bazin & Schiffer (ABS): General Relativity (McGraw Hill 1965)**
5. **Einstein (E): The Meaning of Relativity (Princeton 2014) Weinberg (W): Gravitation & Cosmology (Wiley 1972)**
6. L. Ryder :Introduction to General Relativity, CAMBRIDGE UNIVERSITY PRESS 2009
7. **Landau & Lifshitz (LL): Classical Theory of Fields (Pergamon 1989)**
8. **Hans Stephani (HS): Relativity: An Introduction to Special and General Relativity (Cambridge Paperback, 2004)**

.

Unit-1 Introduction	10hours
Equality of gravitational and intertial masses, Equivalence principle, Principle of general covariance. covariant and contravariant tensors. Tensors of arbitrary rank. Metric tensor. Parallel transport and covariant differentiation. Affine connection and its relation to metric tensor. Curvature tensor and its symmetries. Bianchi identities. Weyl tensor and conformal invariance.	
Unit-2	11hours
Geodesics: Equation of motion of particles. Weak fields and Newtonian approximation. Time and distance in general theory, gravitational red and blue shifts, experimental verification, Einstein's field equation - Newtonian gravity as an approximation, Schwarzschild solution, Radial motion towards centre. Nature of singularities, black holes, even horizon, Kruskal co-ordinates.	
Unit-3	6hours
General orbits, constants of motion, deflection of light, precession of perihelion and radar echo. Standard, isotropic and harmonic coordinates. Parameterized post-Newtonian formalism and status of observational verification. Mach's principle.	
Unit-4	6 hours
Energy momentum tensor for a perfect fluid, equation of motion from field equation for equation for dust. Action principle for field equations. Conservation laws in curved space and pseudo energy tensor for gravitational field.	
Unit-5	12 hours
Cosmology**: Cosmological principle, maximally symmetric spaces, Killing vectors, Robertson- Walker metric. Red shift of galaxies and Hubble's law. Magnitude-red shift relation, Hubble's constant and deceleration parameter. Friedman equations and standard models. Closed, flat and open universes. Age of the universe, critical density.**	

Galaxy clusters and problem of missing mass or missing light, dark matter. Thermal history of early universe, helium formation, decoupling of matter and radiation, microwave background radiation. Cosmological constant and the late time acceleration.
Unit-06: Application of General theory of Relativity: General theory of Relativity for electrical engineering , Dark Energy and Modified Scale Covariant Theory of Gravitation, Gravitational Theory of Cosmology, Galaxies and Galaxy Clusters, Hamiltonian formulation of dust cloud collapse.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

Name of The Course	**Numerical solution of partial differential equations**			
Course Code	**BBS14T5020**			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	**1**	**0**	**4**

Course Objectives: **The aim of the course is develop an understanding of Numerical methods for partial differential equations. The students will explore his/her knowledge how to determine the stability criterion for a numerical scheme and apply the methods to solve problems.**

Course Outcomes: After completing the course, the students will able to

CO1	**apply the numerical methods for partial differential equations.**
CO2	**apply the different single and multi step methods**
CO3	**apply the methods to solve problems.**
CO4	**determine the stability criterion for a numerical scheme .**
CO5	**Apply the different error analysis to partial differential equations**
CO6	**Apply the Galerkin method to the partial differential equations**

Text Book (s):

6. A. R. Mitchell and D.F. Griffiths, The finite difference method in partial differential equations, J. Wiley & sons, New York
7. **K. W. Morton and D. F. Mayers, Numerical Solution of Partial Differential Equations, Cambridge University Press.**
8. **W F Ames, Numerical Methods for Partial Differential Equations, 3rd edn. Boston, Academic Press**

Reference Book (s) :

1. Courant, R. and Hilbert, D., Methods of Mathematical Physics, Vol2: Partial Differential Equations, New York, Wiley-Interscience.
2. A. R. Mitchell, Computational methods in partial differential equations, J. Wiley & sons, New York

Unit-1: Parabolic equations in one space variable	8 hours
Introduction, A model problem, Series approximation, An explicit scheme for the model problem, Difference notation and truncation error, Convergence of the explicit scheme.	
Unit-2: Single and Multi step methods	8hours
Fourier analysis of the error, An implicit method, The Thomas algorithm, The weighted average or θ-method, A maximum principle and convergence for $\mu(1-\theta) \leq 1$, A three-time-level scheme, 2-D and 3-D parabolic equations , The explicit method in a rectilinear box, An ADI method in two dimensions.	
Unit-3 : Hyperbolic equations in one space dimension	8hours
Characteristics, The CFL condition, Error analysis of the upwind scheme, Fourier analysis of the upwind scheme, The Lax–Wendroff scheme, The Lax–Wendroff method for conservation laws.	
Unit-4: Stability Criterion	8hours
Consistency, convergence and stability, Definition of the problems considered, The finite difference mesh and norms, Finite difference approximations, Consistency, order of accuracy and convergence, Stability and the Lax Equivalence Theorem, Calculating stability conditions .	
Unit-5: Linear second order elliptic equations in 2D	8hours
A model problem, Error analysis of the model problem, The general diffusion equation, Boundary conditions on a curved boundary, Error analysis using a maximum principle, Asymptotic error estimates	
Unit -6: The Galerkin method	4hours
Introduction, elliptic equations, two-point boundary value problems, the Galerkin method with different test and trial functions	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	**30**	**50**	**100**

SCHOOL OF BASIC AND APPLIED SCIENCES

GALGOTIAS UNIVERSITY

(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

Program: B.Sc. (Hons.) Chemistry

Scheme: 2020-2021

Vision:

To be recognized globally as a center of excellence in imparting value-based education in Basic and Applied Sciences by creating innovation in fundamental and multidisciplinary research

Mission:

M1. To excel in imparting contemporary knowledge and skills by developing an educational ecosystem with diverse interests and talents.

M2. To perform cutting edge research leading to innovation in sciences through national and international collaborations.

M3. To develop solutions for the emerging challenges in Basic and Applied Science to cater the needs of society.

M4. To attract best quality faculty to facilitate knowledge and develop confidence in our graduates to succeed in the world.

Program Educational Objectives:

PEO1:The graduates shall be successful professionals in Academia, Industry, Government and Entrepreneurship.

PEO2: The graduates shall pursue higher education/research at institute of national and international repute.

PEO3: The graduate shall effectively address the challenges of the society and undertake the projects for bridging the gap between industry and societal needs.

Program Specific Objectives

The students shall be able to

PSO1: Exhibit technical skills required for synthesis and structural characterization of Organic, Inorganic compounds and Nanomaterials.

PSO2: Acquire industrial exposure and scientific knowledge through industry internship and research based learning in R & D labs.

Program Outcomes:

PO1: Apply the knowledge of various areas of chemistry to solve complex chemical problems in industry and academia.

PO2: Develop the ability to evaluate theories, methods, principles and applications of pure and applied science.

PO3: Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.

PO4: Use modern techniques, decent equipments and Chemistry software's

PO5: Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.

PO6: Perform professionally with social, cultural and ethical responsibility as an individual as well as in multifaceted teams with positive attitude.

PO7: Communicate effectively with the scientific community and with society at large. Be able to comprehend, write and communicate effective reports/ documentation.

PO8: Capable of adapting to new methodologies and constantly upgrading their skills with an attitude towards independent and lifelong learning.

Semester I

Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCC1003	Inorganic Chemistry I	**4**	**0**	**0**	**4**	**30**	**20**	**50**
2	BSCC1051	Inorganic Chemistry-I Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
3	BMAT1041	Foundation Course in Mathematics	**5**	**1**	**0**	**6**	**30**	**20**	**50**
4	BBS05T1101	Programming in C and Python	**4**	**0**	**0**	**4**	**30**	**20**	**50**
5	BBS05P1102	Programming in C and Python Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
6	BBS09P1101	Hands on Basic Techniques and Measurments	**0**	**0**	**4**	**2**	**50**	**-**	**50**
7	Xxxx	Environmental Science	**0**	**0**	1	0.5			
8	Xxxx	AI and Machine learning				2			
9	Xxxx	Liberal Art				0.5			
10	Xxxx	BEC-B1				3			
11	Xxxx	Soft Skill							
12	Xxxx	Computer Awareness							
		Total	**13**	**1**	**13**	26			

Semester II

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCC1002	Physical Chemistry I	**4**	**0**	**0**	**4**	**30**	**20**	**50**
2	BSCC1052	Physical Chemistry-I Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
3	BSCG1001	Nanoscience and Nanotechnology	**4**	**0**	**0**	**4**	**30**	**20**	**50**
4	BSCG1051	Nanoscience and Nanotechnology lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
5	BSCP1043	General Physics	**4**	**0**	**0**	**4**	**30**	**20**	**50**
	BSCP1044	Physics Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
6	BBS05T5101	Elective (Analytical Methods in Chemistry)	**3**	**0**	**0**	**3**	**30**	**20**	**50**
7	BSCS1062	Analytical Techniques and Instrumentation Lab	**2**	**0**	**0**	**2**	**50**	**-**	**50**
8	Xxxx	BEC- B2				3			
9	Xxxx	***Two week social internship (during summer)							
		Total	**17**	**0**	**12**	26			

Semester III

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCC2001	Organic Chemistry I	**4**	**0**	**0**	**4**	**30**	**20**	**50**
2	BSCC2051	Organic Chemistry-I Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**

3	BSCC2002	Physical Chemistry II	**4**	**0**	**0**	**4**	**30**	**20**	**50**
4	BSCC2052	Physical Chemistry II Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
5	BSCC2003	Inorganic Chemistry II	**4**	**0**	**0**	**4**	**30**	**20**	**50**
6	BSCC2053	Inorganic Chemistry II Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
7	BSCC2004	Organic Chemistry II	**4**	**0**	**0**	**4**	**30**	**20**	**50**
8	BSCC2054	Organic Chemistry II lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
9	BBS05T5102	Industrial Chemistry	**3**	**0**	**0**	**3**	**30**	**20**	**50**
		Total	**19**		**16**	27			
Semester IV									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BBS05T2101	Physical Chemistry III	**4**	**0**	**0**	**4**	**30**	**20**	**50**
2	BBS05P2101	Physical Chemistry III Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
3	BSCC2006	Inorganic Chemistry III	**4**	**0**	**0**	**4**	**30**	**20**	**50**
4	BSCC2056	Inorganic Chemistry III Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
5	BSCC2007	Organic Chemistry III	**4**	**0**	**0**	**4**	**30**	**20**	**50**
6	BSCC2057	Organic Chemistry III Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
7	BSCC2101	Green Chemistry	**4**	**0**	**0**	**4**	**30**	**20**	**50**
8	Xxxx	Waste Management	**0**	**0**	**2**	**1**	**50**	**-**	**50**
9	BBS09T2411	Research Methodology and Statistics	**2**	**0**	**0**	**2**	**30**	**20**	**50**
10	Xxxx	IPR				**0.5**			
11	Xxxx	Foreign Language				**0.5**			
		Total	**18**	**0**	**14**	26			
Semester V									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BBS05T3101	Organic Chemistry IV	**4**	**0**	**0**	**4**	**30**	**20**	**50**
2	BBS05P3101	Organic Chemistry IV Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
3	BSCC3002	Physical Chemistry IV	**4**	**0**	**0**	**4**	**30**	**20**	**50**
4	BSCC3052	Physical Chemistry IV Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
5	BSCC3003	Inorganic Chemistry IV	**4**	**0**	**0**	**4**	**30**	**20**	**50**

6	BSCC3053	Inorganic Chemistry IV Lab	**0**	**0**	**4**	**2**	**50**	**-**	**50**
7	BBS05T3102	Organic Chemistry V	**4**	**0**	**0**	**4**	**30**	**20**	**50**
8	BBS05T5103	Battery Technology	**3**	**0**	**0**	**3**	**30**	**20**	**50**
9	Xxxx	Campus to corporate				2			
		Total	**19**	**0**	**12**	27			
Semester VI									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BSCC3151	**Project**	**-**	**-**	**-**	**12**	**50**	**-**	**50**
Total Credit=144									

urriculum

List of Electives:

Sl No	**Course Code**	**Name of the Electives**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BBS05T5101	Analytical Methods in Chemistry	3	0	0	3	30	20	50
2	BSCC2101	Green Chemistry	4	0	0	4	30	20	50
3	BSCC2102	COMPUTATIONAL CHEMISTRY	4	0	0	3	30	20	50
4	BBS05T5102	Industrial Chemistry	3	0	0	3	30	20	50
5	BSCC3102	NOVEL INORGANIC SOLIDS	4	0	0	3	30	20	50
6	BSCC3103	POLYMER CHEMISTRY	4	0	0	3	30	20	50
7	BSCC3104	MOLECULAR MODELLING & DRUG DESIGN	4	0	0	3	30	20	50
8	BBS05T5103	Battery Technology	3	0	0	3	30	20	50

Name of The Course	**INORGANICCHEMISTRY I**				
Course Code	BSCC1003				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Inorganic Chemistry.				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives: The course reviews the structure of the atom, which is a necessary pre-requisite in understanding the nature of Chemical Bonding in compounds. It provides basic knowledge about Ionic, Covalent and Metallic bonding and explains that Chemical Bonding is best regarded as a continuum between the three cases. It discusses the Periodicity in properties with reference to the *s*and *p* block, which is necessary in understanding their group chemistry.

Course Outcomes:

CO1	Describe the basic concept and principle of atomic structure (K2).
CO2	Discuss the periodic properties of s and p block element to locate their position in periodic table. (K2)
CO3	Determine the properties and shape of molecules by various theories of chemical bonding. (K3).
CO4	Understand the bonding in metals and various chemical forces, interactions and redox reaction (K2).
CO5	Apply the basic knowledge of inorganic chemistry for real applications (K3).
CO6	Elaborate the recent advancements in inorganic chemistry. (K6).

Text Book (s)

- Lee,J.D.*ConciseInorganicChemistry*ELBS,1991.
- Douglas, B.E. and McDaniel, D.H. *Concepts &Models of Inorganic Chemistry* Oxford,1970

Reference Book (s)

- Lee,J.D.*ConciseInorganicChemistry*ELBS,1991.
- Douglas, B.E. and McDaniel, D.H. *Concepts &Models of Inorganic Chemistry* Oxford,1970
- Atkins,P.W.&Paula,J.*PhysicalChemistry*,10thEd.,OxfordUniversityPress,2014.
- Day,M.C.andSelbin,J.*TheoreticalInorganicChemistry*,ACSPublications,1962.
- Rodger,G.E.*InorganicandSolidStateChemistry*,CengageLearningIndiaEdition,2002.

Unit-1: Atomic Structure	**10hrs**
Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of *s*, *p*, *d* and *f* orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau'sprinciple and its limitations.	
Unit-2: Periodicity of Elements	**12hrs**
Detailed discussion of the following properties of the elements, with reference to *s* and *p*-block. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.	
Unit-3: Chemical Bonding- (Ionic and Covalent bond)	**14hrs**
(i) *Ionic bond:* General characteristics, types of ions, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its applications, Solvation energy. (ii) *Covalent bond:* Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N2, O2, C2, B2, F2, CO, NO, and their ions; HCl (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths. Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.	
Unit-4: Chemical Bonding- (Metallic bond and Chemical Forces)	**8 hrs 8hrs**
(iii) *Metallic Bond:*Pool model of metallic bonding, Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. (iv) *Weak Chemical Forces:* van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points,	

Unit-5: Redox Reaction	**6hrs**
Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.	
Unit-6: Recent advancements of various inorganic chemistry concepts	**4hrs**
Recent Advancements in metal catalyzed redox chemistry, New elements discovered in Periodic table and their properties, Recent advancement in Chemical bonding.	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Name of The Course	**INORGANIC CHEMISTRYI LAB**				
Course Code	BSCC1051				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Titration, Concentration of solution.				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

Understand and perform different types of volumetric titration.

Course Outcomes

CO1	1. Understand the basics of titrimetric analysis and calibration of appratus (K2).
CO2	Prepare solutions of different Molarity/ Normality of titrants (K4).
CO3	3. Demonstrate and determine the strength of the given acid by acid-base titration (K3).
CO4	4. Gain hands on experience in the different aspects of oxidation-reduction titrimetry (K4).
CO5	5. Apply the basic knowledge of experiments in inorganic analysis (K3).

Text Book (s)

***Vogel's Textbook of Quantitative Chemical Analysis*, Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C., 5th Edn.,** Longman Scientific & Technical, England, *(John Wiley and Sons Inc, 605 Third Avenue, New York NY 10158).*

Reference Book (s)

Mendham,J.,A.I.Vogel's*QuantitativeChemicalAnalysis6thEd.*,Pearson,2009.

Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education, 2002.

Marr & Rockett *Practical Inorganic Chemistry*. John Wiley & Sons 1972.

Unit-1 Titrimetric Analysis (i) Calibration and use of apparatus (ii)Preparation of solutions of different Molarity/Normality of titrants
Unit-2 Acid-BaseTitrations
(i) Estimation of carbonate and hydroxide present together in mixture. (ii)Estimationofcarbonateandbicarbonatepresenttogetherinamixture. (iii) Estimation of free alkali present in different soaps/detergents
Unit-3 Oxidation-Reduction Titrimetry
Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution. Estimation of oxalic acid and sodium oxalate in a given mixture. Estimation of Fe(II) with K2Cr2O7 using internal indicator (diphenylamine,N-phenyl anthranilic acid).

Continuous Assessment Pattern

Practical IA	**Practical ETE**	**Total Marks**
50	50	100

Name of The Course	**Foundation Course in Mathematics**				
Course Code	BMAT1041				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.				
Antirequisite					
		L	**T**	**P**	**C**
		5	1	0	6

Course Objectives:

The objective of this course is to introduce the students to fundamental mathematical techniques and basic computer skills that will help them in solving chemistry problems. It aims to make the students understand the concept of uncertainty and error in experimental data. Learn the use of different software for data tabulation, calculation, graph plotting, data analysis and document preparation.

Course Outcomes:

CO1	Understand different functions and progressions and solve the problems based on it. (K3)
CO2	Explain the different types of matrices and solve the differential equations. (K3)
CO3	Understand the basics of differential calculus. (K2)
CO4	Evaluate the problems based on integral calulus. (K3)
CO5	Understand the basics of probability. (K2)
CO6	Analyse application of BCG Matrix to market growth.(K6)

Text Book (s)/Reference Book (s)

1. Calculus and Analytic Geometry : *G. B. Thomas*, *R. L. Finney*, Pearson Education, Asia.

2. Statistical Methods :*S.P. Gupta*, Sultan Chand and Sons

3. Engineering Mathematics : *B.S. Grewal*, Khanna Publishers.

Unit-1	**10hrs**
Algebra: Fundamentals, mathematical functions, logarithms, the exponential function, polynomial expressions, Factorization and division of Polynomials, Partial fractions, Binomial Expansion, Arithmetic Progression, Geometric Progression, Infinite Geometric Progression.	
Unit-2	**10hrs**

Matrices & Determinants: Types of matrices, basic operations of matrices, determinant of a matrix and it's properties, matrix inverse, elementary row and column operations, rank of a matrix, consistency of a linear system of equations, solution of a linear system by Gauss Elimination method.
Unit-3 **10hrs**
Differential Calculus: Differentiation of a function of a single variable, product rule, quotient rule, chain rule of differentiation, Taylor's series, Applications of derivatives: Rate of change, increasing/decreasing functions, tangents and normals, maxima and minima.
Unit-4 **10hrs**
Integral Calculus: Integral of elementary functions, standard results, Integration by substitutions, by parts and partial fraction methods, Definite integral, Even and odd functions, Properties of definite integral and application in finding the area.
Unit-5 **10hrs**
Probability: Basicconcepts of probability, Random variable and its probability distribution, Binomial, Poisson and Normal distributions
Unit-6 **4hrs** BCG matrix and its application to market sharing growth.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Name of The Course	**Programming in C and Python**				
Course Code	BBS05T1101				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream				
Co requisite	Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.				
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

The aim of the paper is to make the students of chemistry familiar with the working of computer, programming language, QBASIC and use of software as a tool to understand chemistry, and solve chemistry based problems.

Course Outcomes:

CO1	Understand and explain the basics of computer & its components, logic development and data input and output.
CO2	Explain the control systems and function.
CO3	Explain the arrays, structure, union and pointer.
CO4	Explain control flow structure and function in python.
CO5	Apply the Classes and objects in python.
CO6	Analyze the real world data using python libraries

Text Book (s)/Reference Book (s)

20. P Kanetkar Yashvant, Let us C, BPB Publications, New Delhi, Seventh Edition.
21. E. Balagurusami, Programming in ANSI C, Tata McGraw Hill, Fourth Edition.
22. Schaum Outline Series,Programming in C.
23. Mark Lutz ,"Learning Python", O Reily, 4th Edition, 2009, ISBN: 978-0-596-15806-4
24. Mark Lutz ,"Programming Python ", O Reily, 4th Edition, 2010, ISBN 9780596158118.
25. Tim Hall and J-P Stacey ,"Python 3 for Absolute Beginners" , 2009, SBN:9781430216322

Unit-1	**10hrs**
Introduction to computers: Units of computers, Block Diagram, Generation of Computers, Characteristics of Computers, Different types of Memory, Input and Output Devices. **Logic Development and Program Development Tools:** Data Representation, Flowcharts, Problem Analysis, Pseudo Code and Algorithms, Program Debugging, Compilation and Execution. **Fundamentals:** Character Set, Identifiers and Key Words, Data Types, Constants, Variables, Expressions, Statements **Operations and Expressions:** Arithmetic Operators, Unary Operators, Relational Operators, Logical Operators, Assignment and Conditional Operators, Library functions. **Data Input and Output:** Single Character Input, Single Character Output, Entering Input Data, More About Scan Functions, Writing Output Data, More About Print Functions, Gets and Puts Functions, Interactive Programming.	
Unit-2	**10hrs**

Control Structures: Introduction, Decision Making with If – Statement, If Else and Nested If, While And Do-While, For Loop. Jump Statements: Break, Continue, Goto, Switch Statement. **Functions:** Introduction To Functions, Function Declaration, Function Categories, Standard Functions, Parameters And Parameter Passing, Pass – By Value/Reference, Recursion, Global and Local Variables, Storage Classes.	
Unit-3	**10hrs**
Arrays: Introduction to Arrays, Array Declaration, Single and Multidimensional, Array, Memory Representation, Matrices, Strings, String Handling Functions. **Structure and Union:** Declaration of Structure, Accessing Structure Members, Structure Initialization, Arrays of Structure, Nested Structures, Unions. **Pointers:** Introduction To Pointers, Address Operator And Pointers, Declaring and Initializing Pointers, Assignment through Pointers, Pointers and Arrays.	
Unit-4	**10hrs**
CORE PYTHON : BASICS Introduction to Python, Python Interpreter and its working, Syntax and Semantics, Data Types, Assignments and Expressions, Control Flow Statements, Sequences and Dictionaries, Functions and lambda expressions	
Unit-5	**10hrs**
CORE PYTHON : ADVANCED FEATURES Iterations and Comprehensions, Handling text files, Modules, Classes and OOP	
Unit-6 Data Analysis (Python toolboxes/libraries)	**4hrs**
NumP, SciPy , Pandas, ChemPy	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Programming in C and Python Lab**				
Course Code	BBS05P1102				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry				
Co requisite	Students should have fundamental knowledge of Computer and it's application.				
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

The aim of the paper is to make the students of chemistry familiar with the working of computer programming language, QBASIC and use of software as a tool to understand chemistry, and solve chemistry based problems.

Course Outcomes

CO1	Understand the different codes to execute the program.
CO2	Write the program for numbers and mathematical calculations.
CO3	Write the print command to the given program.
CO4	Write the program for control structure in python.
CO5	Understand the concept of classes and objects in python.

1. Write a program in C to find greatest of three numbers.
2. Write a program in C to find gross salary of a person
3. Write a program in C to find grade of a student given his marks.
4. Write a program in C to find divisor or factorial of a given number.
5. Write a program in C to print first ten natural numbers.
6. Write a program in C to print first ten even and odd numbers.
7. Write a program in python to print n terms of Fibonacci series.
8. Write a program in python to find all prime numbers within a given range.
9. Write a program in python to demonstrate working of classes and objects

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	50	100

Name of The Course	**Hands on Basic Techniques and Measurements**				
Course Code	BBS09P1101				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of physics, chemistry and biology.				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

The main purpose of this laboratory is to provide the students an appreciation for basic techniques in applied sciences. It is also aimed to provide the students a degree of competence in the laboratory skills required for accurate and precise analysis. Therefore it is expected that the students will demonstrate proficiency in synthesizing some material in laboratory.

Course Outcomes

CO1	Explain and operate the microscope for measurements.(K2)
CO2	Prepare Soap and Resins and understand the mechanism of preparartion. (K5)
CO3	Preparation of biodiesel from Vegetable oil/ Waste cooking oil and characterize it. (K5)
CO4	Apply the skill to solder and connect the electronic components. (K3)
CO5	Understand the functioning of CRO and develop the ability to use the micrometers. (K2)

Text Book (s)/ Reference Book (s)

1. Georg Stehli , The Microscope And How to Use It, English edition, 1970.

2. M.Sayer and A. Mansingh, PHI Learning. Measurement, Instrumentation and Experiment Design in Physics & Engineering, 2005.

3. Stocchi, E.(1990),Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.

1. Different types of microscopes and its applications.

11. Preparation of Urea-formaldehyde Resin
12. Preparation of Soap
13. Preparation of Biodiesel from Vegetable oil/Waste cooking oil.
14. Characterization of biodiesel (TLC, Acid value and viscosity)
15. Soldering of electrical circuits
16. Measurement with Vernier calipers, Screw gauge and spherometer
17. Operation of oscilloscope
18. Familiarization with linear, logarithmic and polar graphs for plotting of experimental data
19. Assembling of elementary electric circuits using breadboard.

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	50	100

Name of The Course	**PHYSICALCHEMISTRY I**				
Course Code	**BSCC1002**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

1. Understand states of matter and interchange of states, intermolecular interactions.

2. Understand state of equilibrium, concept of pH, buffers, acids and bases indicators.

Course Outcomes

CO1	Describe the various models and behavior of ideal as well as real gases. (K2)
CO2	Describe the effect of various factors on the physical properties of a liquid. (K2)

CO3	Determine the various crystal structure and their properties. (K4)
CO4	Describe the properties of acids and bases. (K2)
CO5	Determine the pH scale, buffer action and applications of buffer solution. (K4)
CO6	Elaborate the recent advancement in different states of matter and analyse their utility. (K6)

Text Book (s)

2. Atkins, P. W. & Paula, J. de ***Atkin's Physical Chemistry***10th Ed., Oxford University Press (2014).

Reference Book (s)

3. Castellan, G. W. ***Physical Chemistry***4th Ed. Narosa (2004).

4. Engel, T. & Reid, P. ***Physical Chemistry***3rd Ed. Pearson (2013

Unit-1 Gaseous state	**12 hrs**
Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.Behaviour of real gases: Deviations from ideal gas behavior, compressibility factor, Z, and its variation with pressure for different gases; Causes of deviation from ideal behavior; Van der Waals equation of state, its derivation and application in explaining real gas behavior; Calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms	
Unit-2 Liquid state	**6 hrs**
Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapor pressure, surface tension and coefficient of viscosity, and their determination; Effect of addition of various solutes on surface tension and viscosity; Explanation of cleansing action of detergents; Temperature variation of viscosity of liquids and comparison with that of gases.	
Unit-3 Solid state	**14 hrs**
Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.	
Unit-4 Ionic Equilibria-I	**6 hrs**
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water; Ionization of weak acids and bases, pH scale, common ion effect; dissociation constants of mono-, di-and triprotic acids (exact treatment).	

Unit-5 Ionic Equilibria-II	**12 hrs**
Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions; derivation of Henderson equation and its applications; buffer capacity, buffer range, buffer action and applications of buffers in analytical chemistry and biochemical processes in the human body. Solubility and solubility product of sparingly soluble salts; applications of solubility product principle; Qualitative treatment of acid – base titration curves (calculation of pH at various stages).Theory of acid–base indicators; selection of indicators and their limitations.	
Unit-6 Future Trends in States of Matter	4hrs
Recent advancement in different states of matter, Liquid crystal, Application of Liquid crystal	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Name of The Course	**PHYSICALCHEMISTRY I Lab**				
Course Code	**BSCC1052**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

3. Determine the surface tension and viscosity of different solvent and solutions
4. Determine pH of buffer soutions and perform pH metric titrations.

Course Outcomes

CO1	Measure the surface tension of solutions by different techniques. (K4)
CO2	Operate Ostwald’s viscometer to measure viscosity of different solutions.(K3)
CO3	Prepare buffer solutions of different pH and study the effects on pH by addition of acid/base. (K4)
CO4	Perform pH metric titration of acid against base. (K3)
CO5	Determine dissociation constant of a acid. (K2)

Text Book (s)

- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R.Chand& Co.: New Delhi (2011).

Reference Book (s)

Athawale, V. D. &Mathur, P. *Experimental Physical Chemistry* New Age

1. **Surface tension measurements.** a. Determine the surface tension by (i) drop number (ii) drop weight method. b. Study the variation of surface tension of detergent solutions with concentration. 2. **Viscosity measurement using Ostwald's viscometer**. a. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature. b. Study the variation of viscosity of sucrose solution with the concentration of solute. **3. pH metry** a. Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures. b. Preparation of buffer solutions of different pH i. Sodium acetate-acetic acid ii. Ammonium chloride-ammonium hydroxide c. pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base. d. Determination of dissociation constant of a weak acid.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**Nanoscience and Nanotechnology**
Course Code	BSCG1001
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.
Antirequisite	

	L	T	P	C
	4	0	0	4

Course Objectives:

Students will understand the basics of Nanoscience and Nanotechnology and present a comprehensive introduction to importance of Nanoscience and Nanotechnology.

Course Outcomes

CO1	Describe the basic science behind the properties of materials at the nanometer scale. (K2)
CO2	Illustrate the concept of physical and chemical method, application and fabrication of nanostructures. (K3)
CO3	Generalize and introduce the methods of preparation, methods of purification and applications of carbon nano materials. (K3)
CO4	Apply the concepts of nano energy conversion materials.(K3)
CO5	Generalize the importance of nano-catalysis. (K2)
CO6	Formulate the rudimentary knowledge of photovoltaic devices and propose synthesis of quantum junction solar cells. (K6)

Text Book (s)

5. Introduction to Nanotechnology C P Poole, Frank J. Owens, John Wiley & Sons, 2011, ISBN 978-81-265-1099-3.

6. Introduction to Nanoscience and Nanotechnology, KK Chattopadhyay, A N Banerjee, Phi Learning Pvt Ltd., New Delhi, 2012, ISBN-978-81-203-3608-7.

7. Nanotechnology Science Innovation & Opportunity, Lynn E Foster, Pearson publication, 2008, ISBN-9788131711187.

8. The Chemistry of Nanomaterials C. N. R. Rao, A. Mu¨ller, A. K. Cheetham, Wiley-VCH Verlag GmbH & Co. KGaA, 2004 ISBN 3-527-30507-6

Reference Book (s)

6. The Evolution of Dip-pen nanolithography, D.Ginger ,H,Zang and C.A. Mirkin, Angw. Chem.. Int. Ed., 2004,43, 30-45.

7. Carbon Materials and Nanotechnology, Anke Krueger, Wiley –VCH Verlag GmbH & Co., 2010, ISBN-10: 3527318038.

8. Nanotechnology, J.F. Mongillo Greenwood Press London, 2008, ISBN–13: 978–0–313–33880–9.

9. Microfabricationa and naomanufacuing, M.J Jackson, CRC Press Taylor & Francis Group 2006

10. Jiang Tang et al., Quantum Junction Solar Cells, Nano Lett. 2012, 12, 4889−4894

Unit-1 Introduction to Nanoscience and Nanotechnology 10 hrs
Introduction to Nanoscience and Nanotechnology, materials vs nanomaterials, Nanoscale effects on properties, Surface energies, Melting point, Optical (SPR), Magnetic, and Electrical properties, Tools to explore nanomaterials, Fundamental of Nanospintronics, Nanomedicine, Nanostructured materials, Energy conversion processes.
Unit-2 Nanomaterials preparation 10 hrs
Classification of Nanomaterials, Different approaches in synthesis, Nanomaterials synthesis and processing, Physical and chemical methods of synthesis, Synthesis of nanowires and fabrication of nanostructures, Lithography, Dip-pen nanolithography.
Unit-3 Carbon Materials 10 hrs
General introduction to carbon materials, Fullerenes, preparation, properties and application of fullerenes Carbon Nanotubes, Functionalization of nanotubes, Graphene- Preparation, properties and applications.
Unit-4 Nanomaterials in Energy Conversion devices 10 hrs
Principles of photovoltaics and photo electrochemical cell, Optical properties of SC nanomaterials, Photovoltaics cell, Silicon- Extraction, Single crystal growth, TiO2 based cells, Dye sensitization, Photoelectrochemical cells.
Unit-5 Nanocatalysis and ethics in nanotechnology 10 hrs
Introduction to nanocatalysis, , Bulk vs nanoscale surfaces, Major properties, Applications of nanocatalysts, Societal concern of nanotechnology.
Unit- 6 Quantum Junction Solar Cells 4 hrs
Photovoltaic devices, Colloidal Quantum dot cells, Efficiency of solar cells

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	Nanoscience and Nanotechnology lab
Course Code	BSCG1051
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject
Corequisite	Chemistry as major or one of the subjects along with Physics, Mathematics and Biology/any branch of biosciences as minor subjects at 12th level.
Antirequisite	

	L	T	P	C
	0	0	4	2

Course Objectives:

Synthesis and characterization of different Nanoparticles.

Course Outcomes

CO1	Describe basics of nanoscience and nanotechnology. (K2)
CO2	Synthesis of nanoparticles by different materials. (K5)
CO3	Describe the general characteristics of nanosize materials. (K2)
CO4	Demonstrate the nanomaterials characterization by UV. (K3)
CO5	Correlate the nano-materials properties & identify appropriate applications as well as ethical aspects. (K4)

Text Book (s)

6. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.
7. Carbon Materials and Nanotechnology, Anke Krueger, Wiley –VCH Verlag GmbH & Co., 2010.
8. Nanotechnology, J.F. Mongillo Greenwood Press London, 2008.
9. Introduction to Nanotechnology C P Poole, Frank J. Owens, John Wiley & Sons, 2011.
10. Microfabricationa and naomanufacuing, M.J Jackson, CRC Press

Reference Book (s)

3. Carbon Materials and Nanotechnology, Anke Krueger, Wiley –VCH Verlag GmbH & Co., 2010, ISBN-10: 3527318038.
4. Nanotechnology, J.F. Mongillo Greenwood Press London, 2008, ISBN–13: 978–0–313–33880–9.

List of Experiments
23. Preparation of Ag nano particle and characterization. 24. Preparation and characterization of CaO nanoparticles. 25. Preparation and characterization of ZnO nanoparticles. 26. Synthesis of ZnS nanoparticles and Characterization of synthesized nanoparticles by different techniques. 27. Preparation of Cunanoparticles and Characterization by UV-Vis spectrophometer.

28. Synthesis of CdS nanoparticle UV-Vis and IR characterization.
29. Synthesis of MnO nanoparticles under optimized conditions using different Manganese salts (Manganese acetate and Manganese nitrate) and Characterization by UV-Vis spectrophometer and other characterization techniques.
30. Optimization and study of the size variation of Manganese oxide nanoparticles using time variation and temperature variation.
31. Synthesis of Nickel Oxide nanoparticles from Nickel Nitrate and optimization of conditions. Characterization by UV-Vis spectrophometer.
32. Synthesis of Copper nanoparticle from Copper Sulphate in presence of Ascorbic acid and optimization of conditions. UV-Visible and IR characterization.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**General Physics**				
Course Code	BSCP1043				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with physics as a major subject				
Corequisite	School level knowledge in Physics				
Antirequisite	-				
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

General Physics is designed to inculcate the basic knowledge of quantum physics in modern technology. Student will study the laser technology and its production. They will come to know about their application in various fields of life. Students will be familiar with Optics in Interference and diffraction of light and resolving power. They will learn about dielectric materials.

Course Outcomes:

After the completion of this course, the students will be able to :

CO1	Explain the concept of Material particle and De-Broglie hypothesis.
CO2	Interpret interference, diffraction and Laser with applications.
CO3	Describe the free electron theory and Fermi level.
CO4	Employ the idea of dielectric with applications.
CO5	Demonstrate the origin of magnetism and Hall effect .
CO6	Predict the new concept of achieving the superconductivity at high temperature for its feasible applications.

Text Book (s):

Arthur Beiser, S Rai Choudhury, Shobhit Mahajan, (2009), Concepts of Modern Physics, 6th Edition, Tata-McGraw Hill. ISBN- 9780070151550.

Neeraj Mehta, (2011), Applied Physics For Engineers, New Arrivals – PHI, ISBN-9788120342422.

Engineering Physics, B K Pandey, S Chaturvedi, Cengage Learning, ISBN: 137788131517611

Reference Book (s):

10. Robert Kolenkow, David Kleppner (2007), An Introduction to Mechanics, 1st Edition, Tata-McGraw Hill.
11. B.B. Laud, Lasers and Non-Linear Optics (2011), 3rd Edition, New Ages International.
12. William Silfvast (2002), Laser Fundamentals, Cambridge University Press.
13. David. J. Griffiths (2009), Introduction to Electrodynamics, 3rd Edition, PHI Learning.
14. Arthur Beiser (2003), Concepts of Modern Physics, 6th Edition, Tata-McGraw Hill.
15. Kittel (2001), Solid State Physics, 7th Edition, John Wiley & Sons.
16. Neil W Ashcroft and N David Mermin, (2003), Solid State Physics, Cengage Learning, ISBN-9788131500521.
17. Pillai S O, Solid State Physics,(2010), sixth edition, New Age International (P) Ltd. ISBN-9788122427264
18. A. P. Drozdov, P. P. Kong, V. S. Minkov, S. P. Besedin, M. A. Kuzovnikov, S. Mozaffari, L. Balicas, F. F. Balakirev, D. E. Graf, V. B. Prakapenka, E. Greenberg, D. A. Knyazev, M. Tkacz, M. I. Eremets. Superconductivity at 250 K in lanthanum hydride under high pressures. *Nature*, 2019; 569 (7757): 528 DOI: 10.1038/s41586-019-1201-8

Unit-1 Quantum Mechanics	**12 hours**
Wave-Particle duality, de-Broglie waves, Davisson & Germer Experiment (Experimental verification of de-Broglie waves), Heisenberg Uncertainty Principle and its Applications, Schrodinger's wave equations, Particle in a Box, Compton Effect.	
Unit-2 Optics and LASER	**12 hrs**

Interference: Interference of Light, Biprism experiment, displacement of fringes, interference sin thin films, wedge shaped film, Newton's rings. Diffraction: Single and double slit, Diffraction grating, Grating spectra, Rayleigh's criterion and resolving power of grating. Einstein's coefficients, Population Inversion,Three level and four level laser, Laser characteristics, He-Ne laser and applications.
Unit-3 Free electron theory 8 hrs
Lorentz classical free electron theory and its limitations, Drude theory of conduction, Thermal conductivity, Weidemann-Franz law, Quantum theory of free electron, Fermi level, Density of states, Fermi-Dirac distribution, Thermionic emission, Richardson equation.
Unit-4 Dielectric materials 8 hrs
Dielectrics introduction, Polarization and dielectric constant, Polarization mechanism: Ionic, Electronic, orientational and space charge polarization, Bound charges and their physical interpretation, Electric displacement vector, Equation of electric field inside dielectrics, Clausius–Mossotti relation, Dielectric losses, Dielectric breakdown and types, Applications of dielectric materials.
Unit-5 Magnetism 5 hrs
Origin of magnetization, Orbital and spin magnetic moment, Classification and properties of magnetic materials, Hall effect, Langevin's theory of diamagnetism, Hysteresis curve, soft and hard magnetic materials
Unit-6 Application of General Physics 4 hrs
Recent advancement in General Physics: The superconductor at the highest temperature, latest approach and description of new superconductor

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Name of The Course	**Physics Lab**				
Course Code	BSCP1044				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with physics as major subject				
Corequisite	Students should have fundamental knowledge of subjects like mathematics, physics and computer applications.				
Antirequisite					
		L	**T**	**P**	**C**

	0	0	4	2

Course Outcomes:

CO1	Operate and handle the instruments effectively and safely in the physics laboratory –K2
CO2	Determine the Planck constant and Stefan's constant–K3
CO3	Calculate the wavelength of Laser and monochromatic light. K3
CO4	Calculate Hall coefficient and Hysteresis curve for a given material-K3
CO5	Determine the characteristics of solar cell and AC frequency -K3

Text Book (s)/Reference Book (s)

4. **B.Sc. Practical Physics** by C.L Arora ,S. Chand Limited, 2001.

2. **B.Sc. Practical Physics** by Harnam Singh,S. Chand Limited, 2000.

5.

11. Spectrometer – angle of prism and minimum deviation of solid prism. 12. Spectrometer – Grating, Wavelength of different lines of mercury spectrum. 13. Newton's rings- Wave length of the mono-chromatic light. 14. Determination of Stefan's Constant 15. Determination of Planck's constant 16. Wavelength determination of He-Ne laser 17. B-H curve for magnetic material 18. Determination of Hall coefficient 19. Frequency of AC mains using sonometer 20. Characteristics of solar cell.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**ANALYTICAL METHODS IN CHEMISTRY**
Course Code	**BBS05T5101**
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry
Co-requisite	Students should have fundamental knowledge of Analytical Chemistry

Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. Concept of sampling, Accuracy, Precision, Statistical test data-F, Q,and t test.

2. The course exposes students to the laws of spectroscopy and selection rules governing the possibletransitions in the different regions of the electromagnetic spectra. Thermal and electroanalyticalmethods of analysis are also dealt with. Students are exposed to important separation methods likesolvent extraction and chromatography. The practicals expose students to latest instrumentation andthey learn to detect analytes in a mixture.

Course Outcomes

CO1	Develop the knowledge of statistical analysis and to perform experiment with accuracy and precision. (K2)
CO2	Understand basic principle of instrument like Flame Photometer,UV-VISIBLE and IR spectroscopy. (K2)
CO3	Ill Understand the basic principles of Thermogravimetric analysis. (K2)
CO4	IllUnderstand the principles and how to perform pH metric, potentiometric and conductometric titrations. (K2)
CO5	Il Illustrate different extraction and chromatographic techniques for analysis of reaction mixtures.(K3)
CO6	A Analyze the use of advance instruments for characterization of compounds. (K6)

Reference Books

 Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

 Willard, H.H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.

 Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

 Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.

 Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.

Unit I:Qualitative and quantitative aspects of analysis	**5 hrs**

Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.
Unit II:Optical methods of analysis 10 hrs
Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Infrared Spectrometry: Basic principles of instrumentation (choice of source, monochromator & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data.
Unit-3: Thermal methods of analysis: **5 hrs**
Theory of thermogravimetry (TG), basic principle of instrumentation.Techniques for quantitative estimation of Ca and Mg from their mixture
Unit-4: Electroanalytical methods 5 hrs
Classification of electroanalytical methods, basic principle of pH metric, potentiometric and conductometric titrations. Techniques used for the determination of equivalence points.
Unit-5: Separation techniques 15 hrs
Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation.Technique of extraction: batch, continuous and counter current extractions.Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and nonaqueous media. Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC. Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of Enantiomeric excess (ee)/ diastereomeric excess (de) ratios. reagents.
Unit-6 Recent Advancements in Analytical Chemistry 4 hrs
Advance Techniques in UV and IR, LC-MS and it's application, 2-D NMR and uses

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Analytical Techniques and Instrumentation**

Course Code	BSCS1062				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Basic analytical techniques				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

The main purpose of this laboratory is to provide the students an appreciation for basic instrumental technique. It is also aimed to provide the students a degree of competence in the laboratory skills required for accurate and precise analysis. Therefore it is expected that the students will demonstrate proficiency in the theory underlying analytical techniques.

Course Outcomes

CO1	Determine quantitatively the strength of different samples using redox, complexometric and iodometric titrations. (K4)
CO2	Employ the water and food product analysis. (K3)
CO3	Analyze different acid base mixtures by conductivity measurements. (K4)
CO4	Estimation of iron in different food products by spectrophotometric analysis. (K4)
CO5	Illustrate different chromatographic technique for analysis and separation of mixtures. (K3)

Text Book (s)

1.Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall, 1996.

2.Robinson, J.W. Undergraduate Instrumental Analysis 5th Ed., Marcel Dekker, Inc., New York (1995).

3. Dean, J. A. Analytical Chemistry Handbook, McGraw Hill, 2004.

4. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.

Reference Books

4. Willard, H.H., Merritt, L.L., Dean, J. &Settoe, F.A. Instrumental Methods of Analysis, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988. 2

5. Skoog, D.A., Holler, F.J. & Crouch, S. Principles of Instrumental Analysis, Cengage Learning India Edition, 2007.

6. Cooper, T.G. The Tools of Biochemistry, John Wiley & Sons, N.Y. USA. 16 (1977).

1. Redox Titration: To determine the strength of Ferrous ions in Mohr's Salt solution by titrating it against a known KMnO4 solution
2. Redox Titration:To determine the strength of Ferrous ions in Mohr's Salt solution by using the external indicator method
3. Complexometric Titration:Estimation of Calcium and Magnesium ions in Calcium carbonate sample by complexometric titration
4. Complexometric Titration:Estimation of Ni^{2+} ions in a given solution by the formation of Ni-DMG complex
5. Analysis of Water Sample: Estimation of total hardness in a given hard water sample.
6. Analysis of Water Sample: Determination of Dissolved Oxygen (DO) in a given water sample
7. Perform the following **Conductometric** titrations: v. Strong acid vs. strong base vi. Weak acid vs. strong base vii. Strong acid vs. weak base
8. Analysis of Food Products:Identification of adulterants in food items such as in Milk and Honey
9. Analysis of Food Products:Determining Vitamin C concentration in food products.
10. Chromatography: Paper chromatographic technique on separation of different mixtures.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks

50	50	100

Name of The Course	**ORGANIC CHEMISTRY I**				
Course Code	**BSCC2001**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Basic knowledge of Organic Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

The course develop a sound knowledge on Organic Chemistry.In this course to establish the applications of these concepts, the functional groups- alkanes, alkenes, alkynes and aromatic hydrocarbons- are introduced and the chemistry of these compounds will be explained with the help of various mechanism, reactions, energy diagrams and rules. The constitution of the course strongly aids in the paramount learning of the concepts and their applications.

Course Outcomes

CO1	Explain the basics of organic compounds and various reaction involved in organic chemistry (K2)
CO2	Develop skills to Illustrate various stereochemical processes, projections, optical isomerism and nomenclature. (K3)
CO3	Identify the chemistry and reactions of aliphatic hydrocarbons. (K3)
CO4	Apply the basic understanding in conformational analysis of alkanes and cyclohexane. (K3)
CO5	Simplify basic principles and different chemical reactions of aromatic compounds. (K4)
CO6	Elaborate the knowledge of recent advancement in the field of organic chemistry. (K6)

Reference Books:

7. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt.

Ltd. (Pearson Education).

8. Finar, I. L. *Organic Chemistry (Volume 1)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

9. Finar, I. L. *Organic Chemistry (Volume 2: Stereochemistry and the Chemistry ofNatural Products)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education.

10. Eliel, E. L. &Wilen, S. H. *Stereochemistry of Organic Compounds*, Wiley: London, 1994.

11. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*, New Age International, 2005.

12. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning IndiaEdition, 2013.

Unit-1: Basics of Organic Chemistry **10 hrs**

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. *Electronic Displacements:* Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes. Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Unit-2:Stereochemistry **10 hrs**

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Unit-3:Chemistry of Aliphatic Hydrocarbons-I **10 hrs**

B. Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

B. Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.

Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration- oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.

Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

Unit-4: Chemistry of Aliphatic Hydrocarbons-I **8 hrs**

Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Unit-5:Aromatic Hydrocarbon **8 hrs**

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

Unit-6: Recent Advancement in Organic Chemistry	**4 hrs**
Sustainable and Green Chemical reactions with applications	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**ORGANIC CHEMISTRY I LAB**				
Course Code	BSCC2051				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Organic chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

Perform crystallization and determine boiling point and melting point of organic compound**.**

Course Outcomes

CO1	Understand the basics of organic analysis and calibration of apparatus (K2).
CO2	Purification of organic compounds by crystallization method (K2).
CO3	Determination of boiling point and melting point of organic compounds (K2).
CO4	Separate the mixture of organic compounds by different chromatographic techniques (K3).
CO5	Measure the readings accurately and handle apparatus safely. K2

Text Book (s)

***Vogel's Textbook of Quantitative Chemical Analysis*, Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C., 5th Edn.,** Longman Scientific & Technical, England, *(John Wiley and Sons Inc, 605 Third Avenue, New York NY 10158).*

Reference Book (s)

- Mann,F.G.&Saunders,B.C.*PracticalOrganicChemistry*,PearsonEducation (2009).
- Furniss,B.S.;Hannaford,A.J.;Smith,P.W.G.;Tatchell,A.R.*PracticalOrganic Chemistry,5thEd.*,Pearson(2012)

Unit-1
1.Checkingthecalibrationofthethermometer 2.Purificationoforganiccompoundsbycrystallizationusingthefollowingsolvents: a. Water b. Alcohol c. Alcohol-Water
Unit-2
3. Determination of the melting points of above compounds and unknown organic compounds(meltingpointapparatus) 4. Effectofimpuritiesonthemeltingpoint–mixedmeltingpointof twounknownorganic compounds 5.Determinationofboilingpointofliquidcompounds.(boilingpointlowerthanandmore than100°Cbydistillationandcapillarymethod)
Unit-3
a. Separationofamixtureoftwoaminoacidsbyascendingandhorizontalpaper chromatography b. Separationofamixtureoftwosugarsbyascendingpaperchromatography c. Separation ofamixtureofo-andp-nitrophenol oro-andp-aminophenol by thinlayerchromatography(TLC).

Continuous Assessment Pattern

Practical IA	**Practical ETE**	**Total Marks**
50	50	100

Name of The Course	**PHYSICALCHEMISTRY II**				
Course Code	**BSCC2002**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Physical Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

1. The aim of this course is to make students understand the concepts of energy, heat, work, enthalpy, entropy, free energies and the relation between them.

2. To apply these processes, extend the thermodynamic properties to the system of variable compositions, equilibrium and colligative properties.

Course Outcomes

CO1	Demonstrate the concepts of thermodynamics. (K3)
CO2	Determine the enthalpy, its application and the factors affecting the enthalpy of the reaction. (K4)
CO3	Describe Partial molar quantities and thermodynamic functions. (K2)
CO4	Describe the different criteria of thermodynamic equilibrium and derive equilibrium constants. (K2)
CO5	Determine the factors affecting various colligative properties of the solution. (K4)
CO6	Elaborate the knowledge of recent advancement in the field of physical chemistry. (K6)

Text Books

2. Atkins, P. W. & Paula, J. de ***Atkin's Physical Chemistry***10th Ed., Oxford University Press (2014).

Reference Books

4. Castellan, G. W. ***Physical Chemistry***4th Ed. Narosa (2004).
5. Engel, T. & Reid, P. ***Physical Chemistry***3rd Ed. Pearson (2013).
6. Levine, I .N. ***Physical Chemistry***6th Ed., Tata Mc Graw Hill (2010).

Unit-1 Chemical Thermodynamics	**18 hrs**
Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. First law:Concept of heat, *q*, work, *w*, internal energy, *U*, and statement of first law; enthalpy, *H*, relation between heat capacities, calculations of *q*, *w*, *U* and *H* for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. Second Law:Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy; Calculation of entropy change for reversible and irreversible processes, Entropy changes for Ideal gas**.** Third Law:Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions:Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. . Isotherms of real gases and their comparison with van der Waals isotherms	
Unit-2Thermochemistry	**8 hrs**
Hess's Law, Heats of reactions: standard states; enthalpy of formation of molecules and ions and enthalpy of combustion and its applications; calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data, effect of temperature (Kirchhoff's Law and equations) and pressure on enthalpy of reactions. Adiabatic flame temperature, explosion temperature.	
Unit-3 Systems of Variable Composition	**8 hrs**

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs- Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.	
Unit-4 Chemical Equilibrium	**8 hrs**
Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of relations between the various equilibrium constants *Kp*, *Kc* and *Kx*. Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.	
Unit-5 Solutions and Colligative Properties	**8hrs**
Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.	
Unit 6 Recent advancement in Physical chemistry	**4 hrs**
Solar Cells, Water treatment, Photochemistry	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**PHYSICAL CHEMISTRY II LAB**				
Course Code	BSCC2052				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Physical Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

Students will able to operate calorimeter to determine heat capacity and enthalpy of ionization.

Course Outcomes

CO1	Determine the heat capacity using calorimetric technique. (K4)
CO2	Calculate the enthalpy of ionization of ethanoic acid. (K4)
CO3	Determine the enthalpy of hydration of copper sulphate. (K4)
CO4	Determine the basicity/proticity of polyprotic acid by thermochemical method. (K4)
CO5	Describe the solubility of benzoic acid and calculate the enthalpy value. (K2)

Text Books

2. Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R.Chand & Co.: New Delhi (2011).

Reference Books

2. Athawale, V. D. & Mathur, P. *Experimental Physical Chemistry* New Age.

8. Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
9. Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
10. Calculation of the enthalpy of ionization of ethanoic acid.
11. Determination of heat capacity of the calorimeter and integral enthalpy (endothermic andexothermic) solution of salts.
12. Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
13. Determination of enthalpy of hydration of copper sulphate.
14. Study of the solubility of benzoic acid in water and determination of ΔH.

Continuous Assessment Pattern

Practical IA	**Practical ETE**	**Total Marks**
50	50	100

Name of The Course	**INORGANIC CHEMISTRY II**
Course Code	BSCC2003

Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Basic knowledge of Inorganic Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

To make students aware about the basic knowledge of Inorganic Chemistry.

Course Outcomes

CO1	Illustrate the basic principles and processes of metallurgy. K2
CO2	Catergorize various classes of acids and bases adopting the basic concepts. K4
CO3	Interpret the properties and applications of s- and p- block elements. K2
CO4	Illustrate the structure, preparation and application of p-block elements.K2
CO5	Simplify the molecular shapes and properties of noble gas compounds.K4
CO6	Elaborate the recent development in the application of s and p block elements. K6

Reference Books:

Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.

 Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. Concepts & Models of

Inorganic Chemistry 3rd Ed., John Wiley Sons, N.Y. 1994.

 Greenwood, N.N. & Earnshaw. Chemistry of the Elements, ButterworthHeinemann.

1997.

 Cotton, F.A. & Wilkinson, G. Advanced Inorganic Chemistry, Wiley, VCH, 1999.

 Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4th Ed., Pearson, 2010. Atkin, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press

Unit-1: General Principles of Metallurgy	**8 hrs**
Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy, wet cyanide process for silver & gold. Methods of purification of metals: Electrolytic, van Arkel-de Boer process and Mond's process, Zone refining.	
Unit-2: Acids and Bases	**8 hrs**
Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids, types of acid-base reactions, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB).	
Unit-3: Chemistry of s and p block Elements	**12 hrs**

Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial.
Unit-4: Compounds p block Elements **12 hrs**
Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Borates, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, and basic properties of halogens
Unit-5: Noble Gases **10 hrs**
Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF_2, XeF_4 and XeF_6; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF2). Molecular shapes of noble gas compounds (VSEPR theory).
Unit-6: Application of s and p block elements and Noble gases **4 hrs**
Recent advancement and development in field of compounds of s and p block elements and Noble gases.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	INORGANIC CHEMISTRY II LAB			
Course Code	BSCC2053			
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject			
Corequisite	Students should have fundamental knowledge Inorganic Chemistry			
Antirequisite				
	L	**T**	**P**	**C**
	0	0	4	2

Course Objectives:

To introduce different experiments to test basic understanding of Inorganic Chemistry.

Course Outcomes

CO1	Estimate the strength of Copper using sodium thiosulphate solution.
CO2	Calculate the strength of Dissolved Oxygen in a given water sample.
CO3	Estimate the strength of available Chlorine in bleaching powder.

CO4	Estimate the amount of metals in a given sample complexometrically.
CO5	Synthesize various types of double salts.

Reference Book (s)

Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

(A) Iodometric Titrations

(i) Estimation of Cu(II) using sodium thiosulphate solution.

(ii) Estimation of dissolved oxygen in given sample of water.

(iii) Estimation of available chlorine in bleaching powder.

(B) Complexometric Titrations

(i) Estimation of calcium in a given sample.

(ii) Estimation of magnesium in a given sample.

(iii) Estimation of zinc using EDTA solution.

(C) Inorganic preparations

(i) Mohr Salt

(ii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2.12H_2O$ (Potash alum) or Chrome alum.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Name of The Course	**ORGANIC CHEMISTRY II**
Course Code	BSCC2004
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject
Corequisite	Basic Concepts of Organic Chemistry
Antirequisite	

	L	T	P	C
	4	0	0	4

Course Objectives: The objective is to study various mechanisms related to nucleophilic and electrophilic substitutions, structure, reactivity and preparation methods.

Course Outcomes

CO1	Identify and differentiate the mechanism of nucleophilic substitution reactions and eliminations reactions in alkyl halides and aryl halides along with the stereochemistry. (K3)
CO2	Explain the preparation and compare the properties and relative reactivity of 1°, 2°, 3° alcohols, phenols and ethers.(K2)
CO3	Discuss Structure, reactivity and preparation; of carbonyl compounds and differentiate the Nucleophilic additions, and Nucleophilic addition-elimination reactions along with related named reactions.(K6)
CO4	Analyze the preparation methods and properties of carboxylic acid derivatives. (K4)
CO5	Discuss the preparation methods and reactions of sulphur containing compounds. (K6)
CO6	Identify the role of different reaction mechanisms in recent development.(K3)

Text Book (s)

· Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt.

Ltd. (Pearson Education).

· Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd.

(Pearson Education).

Reference Book (s)

· Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc.

· McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India

Edition, 2013.

Unit-1 Chemistry of Halogenated Hydrocarbons:	**14hrs**
Alkyl halides: Methods of preparation, nucleophilic substitution reactions – S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent etc.; nucleophilic substitution vs. elimination.*Aryl halides*: Preparation, including preparation from diazonium salts. nucleophilic aromatic substitution; SNAr, Benzyne mechanism.Relative reactivity of alkyl and aryl halides towards nucleophilic substitution reactions.Organometallic compounds of Mg and Li – Use in synthesis of organic compounds.	
Unit-2 Alcohols, Phenols, Ethers and Epoxides:	**12 hrs**
Alcohols: preparation, properties and relative reactivity of 1°, 2°, 3° alcohols, Bouvaelt-Blanc Reduction; Preparation and properties of glycols: Oxidation by periodic acid and lead tetraacetate, Pinacol-Pinacolone rearrangement;*Phenols*: Preparation and properties; Acidity and factors effecting it, Ring substitution reactions, Reimer–Tiemann and Kolbe's–Schmidt Reactions, Fries and Claisen rearrangements with mechanism; *Ethers and Epoxides*: Preparation and reactions with acid.	
Unit-3 Carbonyl Compounds	**12 hrs**
Structure, reactivity and preparation; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann and Benzil-Benzilic acid rearrangements, haloform reaction and Baeyer Villiger oxidation, α-substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner, $LiAlH_4$, $NaBH_4$, Michael addition. Active methylene compounds: Keto-enol tautomerism. Preparation and synthetic applications of diethyl malonate and ethyl acetoacetate.	
Unit-4 Carboxylic Acids and their Derivatives8 hrs	
Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of maleic and fumaric acids;Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic sustitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmannbromamide degradation and Curtius rearrangement.	
Unit-5 Sulphur containing compounds	**4hrs**
Preparation and reactions of thiols, thioethers and sulphonic acids.	
Unit-6 Recent applications of organic reaction mechanism	**4 hrs**
Identify the role of different reaction mechanisms in recent development	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**ORGANIC CHEMISTRY-II Lab**				
Course Code	BSCC2054				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Basic analytical techniques				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives: The objective is to analyse the presence of extra elements and functional groups in organic compounds.

Course Outcomes

CO1	Analyze qualitatively the presence of extra elements (K4).
CO2	Perform the tests of functional groups in unknown organic compounds (K4).
CO3	Identify the functional groups in unknown organic compounds (K4).
CO4	Handle the apparatus and perform the tests accurately.

Text Book (s)

· Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education(2009)

· Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical OrganicChemistry, 5th Ed., Pearson (2012)

Reference Book (s)

· Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry:Preparation and Quantitative Analysis, University Press (2000).

· Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry:Qualitative Analysis, University Press (2000).

1. Detection of extra elements.
2. Functional group test for nitro, amine and amide groups.
3. Qualitative analysis of unknown organic compounds containing simple functional groups (alcohols, carboxylic acids, phenols and carbonyl compounds)

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	**Industrial Chemistry**				
Course Code	**BBS05T5102**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as a major subject.				
Co-requisite	Students should have fundamental knowledge of Inorganic compounds and uses				
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

The course introduces learners to the diverse roles of inorganic materials in the industry. It gives an insight into how these raw materials are converted into products used in day to day life. Students learn about silicates, fertilizers, surface coatings, batteries, engineering materials for mechanical construction as well as the emerging area of nano-sized materials. The course helps develop the interest of students in the frontier areas of inorganic and material chemistry.

Course Outcomes

CO1	Explain the composition and applications of the different kinds of glass.(K2)
CO2	State the composition of cement and discuss the mechanism of setting of cement. .(K3)
CO3	Explain the suitability of fertilizers for different kinds of crops and soil. (K2)

CO4	E Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings. (K2)
CO5	List and analyze the properties of engineering materials for mechanical construction used in day to day life. (K3)
CO6	Elaborate the recent advancements in Industrial Chemistry and analyze their fruitfulness for sustainable environment. (K6)

Reference Books

West, A. R., Solid State Chemistry and Its Application, Wiley

□□Smart, L. E., Moore, E. A., Solid State Chemistry An Introduction CRC Press Taylor & Francis.

□□Rao, C. N. R., Gopalakrishnan, J. New Direction of Solid State Chemistry, Cambridge University Press.

□□Felder, R. M. and Rousseau, R.W., Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi, 2005.

□□Atkins, Peter, and Tina Overton. Shriver and Atkins' inorganic chemistry. Oxford University Press, USA, 2010.

□□Kingery, W. D., Bowen H. K. and Uhlmann, D. R. Introduction to Ceramics, Wiley Publishers, New Delhi, 1976.

□□Kent, J. A. (ed) Riegel's Handbook of Industrial Chemistry, 9 th Ed., CBS Publishers, New Delhi, 1997

□□Jain, P. C. and Jain, M. Engineering Chemistry, Dhanpat Rai & Sons, Delhi 2015

□□Gopalan, R., Venkappayya, D. and Nagarajan, S. Engineering Chemistry, Vikas Publications, New Delhi, 2004.

□□Sharma, B. K. Engineering Chemistry, Goel Publishing House, Meerut, 2015

Unit 1: Silicate Industries	**5 hrs**
Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of glass wool and optical fibre.	
Unit 2: Ceramics and Cement	**5 hrs**
Ceramics: Brief introduction to types of ceramics. glazing of ceramics. ***Cement***: Manufacture of Portland cement and the setting process, Different types of cements: quick settingcements, eco-friendly cement (slag cement), pozzolana cement.	
Unit 3: Fertilizers	**5 hrs**

Different types of fertilizers (N, P and K). Importance of fertilizers, chemistry involved in the manufacture of the fertilizers, Biofertilizers and it's application
Unit-4: Surface Coatings: **15 hrs**
Brief introduction to and classification of surface coatings, paints and pigments: formulation, composition and related properties, pigment volume concentration (PVC)and critical pigment volume concentration (CPVC), fillers, thinners, enamels and emulsifying agents. Special paints: heat retardant, fire retardant, eco-friendly paints, plastic paints, water and oil paints. Preliminary methods for surface preparation, metallic coating (electrolytic and electroless with reference to chrome plating and nickel plating), metal spraying and anodizing, Lubricants and bioadditives.
Unit-5: Engineering materials for mechanical construction **10 hrs**
Classification, Composition, characteristics and applications of various types of irons, steels, thermoplastics, thermosets and composite materials and dendrimers.
Unit-6: Future Trends of Industrial Chemistry **4 hrs**
Biofuel and Bioenergy, Biodiesel and it's application, Advantages of Biolubricant, Biomass to Bioenergy.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**PHYSICAL CHEMISTRY-III**				
Course Code	**BBS05T2101**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject.				
Corequisite	Students should have fundamental knowledge of Physical Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

1. Understand concepts of phase, co-existence of phases, phase diagram, CST and distribution law.

2. Understand surface phenomenon, adsorption isotherms, BET Equation.

3. Apply and analyze the principles of Electrochemistry.

Course Outcomes

CO1	Understand the principles of phase equilibrium diagram for one and two component system with its applications. (K2)
CO2	Determine the theoretical and experimental methods of chemical kinetics. (K3)
CO3	Generalize different theories of adsorption and Illustrate different principles and mechanism of catalytic reactions. (K3)
CO4	Describe basic concepts of conductance and applications of conductance measurement (K2)
CO5	Solve the problems based on laws related to electrochemistry, solubility product and hydrolysis constant of salts and Calculate EMF of Cell (K3)
CO6	

Text Book (s)

- Peter Atkins & Julio De Paula, Physical Chemistry 10th Ed., Oxford University Press(2014)
- Castellan, G. W. Physical Chemistry, 4th Ed., Narosa (2004).
- McQuarrie, D. A. & Simon, J. D., Molecular Thermodynamics, Viva Books Pvt. Ltd.:New Delhi (2004).
- Engel, T. & Reid, P. Physical Chemistry 3rd Ed., Prentice-Hall (2012).
- · Mortimer, R. G. Physical Chemistry 3rd Ed., Elsevier: NOIDA, UP (2009).
- · Barrow, G. M., Physical Chemistry 5th Ed., Tata McGraw Hill: New Delhi (2006).

Unit-1 Phase Equilibria	**12 hrs**
Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid liquid, liquid-vapour and solid-vapour equilibria, phase diagram for one component systems, with applications. Phase diagrams for systems of solid-liquid equilibria, Binary solutions: Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids (ideal and nonideal), azeotropes.	
Unit-2 Chemical Kinetics	**12 hrs**
Order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential and integrated form of rate expressions up to second order reactions, experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only): (i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and steady-state approximation in reaction mechanisms (iv) chain reactions. Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates.	
Unit-3 Surface chemistry and Catalysis	**08 hrs**
Physical adsorption, chemisorption, adsorption isotherms, Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.	
Unit-4 Conductance	**14hrs**

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Debye-Hückel-Onsager equation.

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) Conductometric titrations, and (v) Hydrolysis constants of salts.

Unit-5 Electrochemistry **16 hrs**

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining (i) free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values, using hydrogen, quinone-hydroquinone, glass electrodes. Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transference numbers.

Unit-6 Recent Advancement in Electrochemistry **04 hrs**

Application of nanotubes and nanoparticles in electrochemistry towards biosensing, Electrochemistry towards Scanning Electron Microscopy

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	PHYSICAL CHEMISTRY -III LAB			
Course Code	BBS05P2101			
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry			
Corequisite	Students should have fundamental knowledge of Physical Chemistry.			
Antirequisite				
	L	T	P	C
	0	0	4	2

Course Objectives:

3. Measure critical temperature, distribution co-efficient and study the kinetics of reactions.
4. Study of Potentiometric titrations of a combination of different types of solutions.

Course Outcomes

CO1	Determine the composition and critical solution temperature for phenol-water system.(K4)
CO2	Estimate the distribution of acetic/benzoic acid between water and cyclohexane. (K3)
CO3	Determine the kinetics of different chemical reaction and Asses Freundlich and Langmuir isotherms for adsorption. (K4)
CO4	Measure equivalent conductance, degree of dissociation and dissociation constant of a weak acid conductometrically. (**K3**)
CO5	Perform various types of Potentiometric titrations. (**K4**)

Text Book (s)

 Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R.

Chand & Co.: New Delhi (2011).

 Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry

8th Ed.; McGraw-Hill: New York (2003).

 Halpern, A. M. & McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H.

Freeman & Co.: New York (2003).

I. Determination of critical solution temperature and composition of the phenol-water system and to study the effect of impurities on it. II. Distribution of acetic/ benzoic acid between water and cyclohexane. III. Study the kinetics of the following reactions.

a. Acid hydrolysis of methyl acetate with hydrochloric acid. b. Saponification of ethyl acetate. IV. Adsorption: Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal. V. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid. VI. Perform the following **Potentiometric** titrations: iv. Strong acid vs. strong base v. Weak acid vs. strong base vi. Dibasic acid vs. strong base viii. Potassium dichromate vs. Mohr's salt

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	50	100

Name of The Course	**INORGANIC CHEMISTRY-III**				
Course Code	**BSCC2006**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Inorganic Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

The course introduces the students to coordination compounds which find manifold applications in diverseareas like qualitative and quantitative analysis, metallurgy, as catalysts in industrial processes as medicines,paints and pigments as well as in life. The student is also familiarized with the d and f block elements and gets an idea about horizontal similarity in a period in addition to vertical similarity in a group.

Course Outcomes

CO1	Illustrate about basic concepts of various theories in Coordination chemistry (K2)
CO2	Analyze different properties of complex compounds on the basis theories of coordination chemistry. (K4)

CO3	Generalize the various properties and chemistry of some important transition metal compounds. (K3)
CO4	Describe the properties of Lanthanoids and Actinoids. (K2)
CO5	Determine the different reaction rates, kinetics and reaction mechanisms. (K4)
CO6	Elaborate the recent advancements in Coordination chemistry. (K6)

Text Book (s)

Huheey, J.E., Inorganic Chemistry, Prentice Hall, 1993.

Reference Book (s)

 Purcell, K.F & Kotz, J.C. Inorganic Chemistry W.B. Saunders Co, 1977.

 Lippard, S.J. & Berg, J.M. Principles of Bioinorganic Chemistry Panima Publishing

Company 1994.

 Cotton, F.A. & Wilkinson, G, Advanced Inorganic Chemistry Wiley-VCH, 1999

 Basolo, F, and Pearson, R.C. Mechanisms of Inorganic Chemistry, John Wiley &

Sons, NY, 1967.

 Greenwood, N.N. & Earnshaw A. Chemistry of the Elements, ButterworthHeinemann,

1997.

Unit-1 Coordination Chemistry I	**6 hrs**
Werner's theory, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding.	
Unit-2 Coordination Chemistry II	**10 hrs**
Crystal field theory, measurement of Δo. Calculation of CFSE in weak and strong fields, concept of pairing energies, factors affecting the magnitude of Δo. Evidences of CFT. Jahn-Teller theorem, octahedral, square planar geometry. Qualitative aspect of Ligand field and MO Theory.	
Unit-3 Transition Elements	**14 hrs**
General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states. Difference between the first, second and third transition series. Chemistry of Cr Mn, Fe and Co in various oxidation states (excluding their metallurgy). Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, $K_3[Fe(CN)_6]$, $Na_2[Fe(CN)_5NO]$, $Na_3[Co(NO_2)_6]$, $[Co(NH_3)_6]Cl_3$.	
Unit-4 Lanthanoids and Actinoids	**8 hrs**
Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanoide contraction, separation of lanthanoides (ion-exchange method only).	

Unit-5 Reaction Kinetics and Mechanism	**12hrs**
Introduction to inorganic reaction mechanisms, Substitution reactions in square planar complexes, Trans effect, theories of trans effect, Thermodynamic (Chelate, HSAB) and Kinetic stability (Labile and Inert), Kinetics of octahedral substitution, Ligand field effects and reaction rates.	
Unit-6 Recent Advancements in Coordination Chemistry	**4 hrs**
N-donor ligands in coordination chemistry, Heteroaromatic alcohol as Ligands, coordination clusters and coordination polymers	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Name of The Course	**INORGANIC CHEMISTRY III LAB**				
Course Code	**BSCC2056**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Inorganic Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

Students will able to perform gravimetric analysis and synthesize complex compounds.

Course Outcomes

CO1	Analyze the concept of gravimetric analysis. (K3)
CO2	Estimate the amount of different ions gravimetrically. (K5)
CO3	Synthesize different inorganic coordination complexes. (K6)
CO4	Analyze the principles involved in chromatographic separations. (K3)
CO5	Employ paper chromatographic technique for separation of metal ions. (K3)

Text Book (s)

Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.

9. Estimation of nickel (II) using Dimethylglyoxime (DMG).
10. Estimation of copper as CuSCN
11. Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
12. Preparations of Tetraamminecopper(II) sulphate, $[Cu(NH_3)_4]SO_4.H_2O$
13. Preparations of Cis and trans $K[Cr(C_2O_4)_2.(H_2O)_2]$ Potassium dioxalatodiaquachromate (III)
14. Preparations of Potassium tris(oxalato)ferrate(III)
15. Chromatographic separations by paper chromatographic separation of Ni (II) and Co (II)
16. Paper chromatographic separation of Cu (II) and Cd (II)

Continuous Assessment Pattern

Internal Assessment (IA)	**External Exam (ETE)**	**Total Marks**
50	50	100

Name of The Course	**ORGANIC CHEMISTRY III**				
Course Code	**BSCC2007**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Organic Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives: The objective is to study the preparation methods and chemical & medicinal properties of nitrogen containing compounds, polynuclear hydrocarbons, heterocyclic compounds, alkaloids & terpenes.

Course Outcomes

CO1	Illustrate preparation methods and chemical properties of nitrogen containing compounds. (K3)
CO2	Determine structure and preparation methods of polynuclear hydrocarbons. (K2)
CO3	Generalize classification, synthesis methods and reaction. mechanisms of heterocyclic compounds. (K3)

CO4	Determine structure, preparation methods, properties and medicinal importance of alkaloids**.(K3)**
CO5	Deduce the structures of various terpenes along with their synthetic methods**. (K3)**
CO6	Compile the recent therapeutic uses of Alkaloids and Terpenes. (K6)

Text Book (s)

· Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India)Pvt. Ltd. (Pearson Education).

· Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd.(Pearson

Education).

· Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry ofNatural Products),

Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).

· Acheson, R.M. Introduction to the Chemistry of Heterocyclic compounds, JohnWelly & Sons (1976).

Reference Book (s)

Graham Solomons, T.W. Organic Chemistry, John Wiley & Sons, Inc.

· McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage LearningIndia Edition, 2013.

· Kalsi, P. S. Textbook of Organic Chemistry 1st Ed., New Age International (P)Ltd. Pub.

· Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; Organic Chemistry, Oxford University Press.

· Singh, J.; Ali, S.M. & Singh, J. Natural Product Chemistry, Prajati Parakashan(2010).

Unit-1 Nitrogen Containing Functional Groups **16 hrs**
Preparation and important reactions of nitro and compounds, nitriles and isonitriles Amines: Effect of substituent and solvent on basicity; Preparation and properties: Gabriel phthalimide synthesis, carbylamine reaction, Mannich reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; Distinction between 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid. Diazonium Salts: Preparation and their synthetic applications.
Unit-2 Polynuclear Hydrocarbons **6 hrs**
Reactions of naphthalene, phenanthrene and anthracene Structure, Preparation and structure elucidation.
Unit-3 Heterocyclic Compounds **17 hrs**

Classification and nomenclature, Structure, aromaticity in 5-numbered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole (Paal-Knorr synthesis, Knorr pyrrole synthesis, Hantzsch synthesis), Thiophene, Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline, Skraup synthesis, Friedlander's synthesis, Knorr quinoline synthesis, DoebnerMiller synthesis. Derivatives of furan: Furfural
Unit-4 Alkaloids 5 hrs
Natural occurrence, General structural features, Isolation and their physiological action, Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of Nicotine. Medicinal importance of Nicotine, Quinine, Morphine, Cocaine, and Reserpine.
Unit-5 Terpenes 6 hrs
Occurrence, classification, isoprene rule; Elucidation of stucture and synthesis of Citral, Neral and α-terpineol.
Unit-6 Recent advancement in Natural Product Chemistry 4 hrs
Advance Therapeutic use of Alkaloids and Terpenes, Advance use of Heterocyclic compounds

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Name of The Course	**ORGANIC CHEMISTRY III Lab**
Course Code	BSCC2057
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject
Corequisite	Basic knowledge of Organic Chemistry
Antirequisite	

	L	T	P	C

	0	0	4	2

Course Objectives: The objective is to synthesize different organic compounds.

Course Outcomes

CO1	Prepare acetyl derivatives of amines both by conventional and green method.(K3)
CO2	Prepare acetyl derivatives of phenols both by conventional and green method.(K3)
CO3	Synthesize benzoyl derivatives of anilines and phenols.(K5)
CO4	Synthesize nitro derivative of salicylic acid both by conventional and green method**.**(K5)
CO5	Produce hydrolyzed derivative of ester or amide and semicarbazide derivatives of carbonyl compounds.(K3)

Text Book (s)/ Reference Books

 Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education

(2009)

 Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic

Chemistry, 5th Ed. Pearson (2012)

 Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry:

Preparation and Quantitative Analysis, University Press (2000).

 Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative

Analysis, University Press (2000).

Organic preparations: i. Acetylation of one of the following compounds: amines (aniline, o-, m-, p-toluidines and o-, m-, p-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method: a. Using conventional method. b. Using green approach ii. Benzolyation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine) and one of the following phenols (β-naphthol, resorcinol, pcresol) by Schotten-Baumann reaction.

iii. Nitration of any one of the following: a. Acetanilide/nitrobenzene by conventional method b. Salicylic acid by green approach (using ceric ammonium nitrate). iv. Hydrolysis of amides and esters. v. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde. The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	**Green Chemistry**				
Course Code	**BSCC 2101**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Co-requisite	Students should have the basic knowledge of various green chemistry principles and various other alternate methods that can be opted in place of the conventional methods.				
Anti-requisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

This course involves the basic understanding about various green chemistry principles, alternate routes, designing of green reactions and the future trends.

Course Outcomes

CO1	Identify the scope of environmental studies and its need in present day society. (K3)
CO2	Illustrate the 12 basic principles of Green Chemistry. (K2)

CO3	Explain the upcoming new trends in green chemistry synthesis and some real world experiences. (K2)
CO4	Identify the use of Microwaves and Ultrasonic waves in Green Chemistry. (K3)
CO5	Analyze the role of sustainable development in Green Chemistry. (K4)
CO6	Compile the various latest green technologies based on green chemistry principles. (K6)

Text Book (s)

- Ahluwalia, V.K. & Kidwai, M.R. *New Trends in Green Chemistry*, Anamalaya Publishers (2005).
- Anastas, P.T. & Warner, J.K.: *Green Chemistry - Theory and Practical*, Oxford University Press (1998).
- Matlack, A.S. *Introduction to Green Chemistry*, Marcel Dekker (2001).
- Cann, M.C. & Connely, M.E. *Real-World cases in Green Chemistry*, American Chemical Society, Washington (2000).

Reference Book (s)

- Ryan, M.A. & Tinnesand, M. *Introduction to Green Chemistry*, American Chemical Society, Washington (2002).
- Lancaster, M. *Green Chemistry: An Introductory Text* RSC Publishing, 2nd Edition, 2010.

Unit 1	**Introduction to Green Chemistry**	**6 hrs**
What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry.		
Unit 2	**Principles of Green Chemistry and Designing a Chemical synthesis**	**15 hrs**
Twelve principles of Green Chemistry with their explanations and examples and special emphasis on the following: • Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products , Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions. • Green solvents– supercritical fluids, water as a solvent for organic reactions, ionic liquids, fluorous biphasic solvent. • Energy requirements for reactions – alternative sources of energy: use of microwaves and ultrasonic energy. • Use of catalytic reagents, comparison of heterogeneous and homogeneous catalysis. • Prevention of chemical accidents designing greener processes, inherent safer design, principle of ISD, subdivision of ISD, minimization, simplification, substitution, moderation and limitation.		

- Strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.
Unit-3 Green Synthesis of Some compounds 5 hrs
Green Synthesis of the following compounds: adipic acid, catechol, disodium iminodiacetate (alternative to Strecker synthesis).
Unit-4: Green Reactions and some real world cases 10 hrs
4. Microwave assisted reactions in water: Hofmann Elimination, methyl benzoate to benzoic acid, oxidation of toluene and alcohols; Diels-Alder reaction and Decarboxylation reaction. 5. Ultrasound assisted reactions: Sonochemical Simmons-Smith Reaction (Ultrasonic alternative to Iodine) 6. Surfactants for carbon dioxide – replacing smog producing and ozone depleting solvents with CO2 for precision cleaning and dry cleaning of garments.
Unit-5 Sustainable development and future trends 8 hrs
Oxidation reagents and catalysts; Biomimetic, multifunctional reagents, Green chemistry in sustainable development and Zero Waste Technology, innovative products.
Unit-6 Latest advancements in Green chemistry and technology 6hrs
Negative effect of heavy metals on humans and environment**,** Future status of green chemistry, Green and sustainable future of science and technology, Green economy.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Course Code	**Course Name**	**L**	**T**	**P**	**C**
BBS09T2411	**RESEARCH METHODOLOGY AND STATISTICS**	**2**	**0**	**0**	**2**

Course Objective: The objective of the course is to impart research based knowledge to the students. They would be taught the various ways of data collection, research methodologies adopted in different settings, and statistical methods.

Course Outcome:

CO1	Students will get separately familiar with terms research and methodology, respectively.
CO2	Identifying different type of research sampling and research design.
CO2	Students will understand raw data, primary data, secondary data and their different methods of collection.

CO4	Students will appraise the application of sampling through statistics.
CO5	Students will get familiar with different descriptors of statistics to analyse data both quantitatively and qualitatively.
CO6	Students will develop the statistical analysis indulges in modern research for drug designing.

Text & References:

- Broota, K. D., Experimental designs in psychological research, Wiley eastern, New York, 1992.
- Guilford, Statistics in Psychology and Education**,** McGraw Hill, New York, 1986.
- J T Walker, Statistics in Criminology and Criminal Justice analysis and Interpretation
- Leo, A., & Hoekman, D. H. (1995). *Exploring QSAR*. American Chemical Society.
- Chanin Nantasenamat, Chartchalerm Isarankura-Na-Ayudhya, Thanakorn Naenna, Virapong Prachayasittikul, A Practical Overview of Quantitative Structure- Activity Relationship. EXCLI Journal 2009;8:74-88.
- Wiktor Pronobis, Alexandre Tkatchenko, and Klaus-Robert Muller, J. Chem. Theory Comput. 2018, 14, 2991−3003

Unit-1: Introduction to Research Methodology **6 hrs** Definition, concept and research in science; Introduction to Research Methodology, Research methodology in science.
Unit-2 : Research in Scientific and Social Settings **5hrs** Research Design: Research Sampling, rationale for using a particular sampling procedure, Probability.
Unit-3: Tools of Data Collection **5hrs** Data and its types, Methods for Collecting Data, Observation method, Questionnaire, Other Methods
Unit- 4: Introduction to Statics **4hrs** Introduction to statistics (Biostatistics); Sample and Population, parametric and non parametric statistics.
Unit- 5: Descriptive Statistics **5hrs** Measures of central tendency; Measures of dispersion and deviation; graphical representation of the data.Correlation and Regression
Unit 6: Recent research advances **3 hrs** Descriptors, Quantitative structure-activity relationship (QSAR) , Quantitative structure-property relationship(QSPR), Drug designing.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Organic Chemistry IV**				
Course Code	BBS05T3101				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Organic Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

The focus area of this course is on the chemistry of biomolecules i.e. amino acids, peptides, proteins, enzymes, carbohydrates and lipids. Through the study of energetics in biological systems, it aims to build the concept of metabolism for biological systems more lucid.

Course Outcomes

CO1	Describe the components structure and reaction of nucleic acid. (K2)
CO2	Illustrate the classification, synthesis, structure and properties of amino acids. (K3)
CO3	Determine the mechanism of enzyme action and role different factors. (K3)
CO4	Categorize the Carbohydrates and their biological importance (K2)
CO5	Illustrate the metabolism, formation and mechanism of ATP to understand the concept of energy in biosystems. (K3)
CO6	Compile the advance therapeutic uses of different biomolecules. (K6)

Reference Books:

6. Berg, J.M., Tymoczko, J.L. &Stryer, L. (2006) *Biochemistry*. 6th Ed. W.H. Freeman and Co.
7. Nelson, D.L., Cox, M.M. &Lehninger, A.L. (2009) *Principles of Biochemistry. IVEdition.* W.H. Freeman and Co.

8. Murray, R.K., Granner, D.K., Mayes, P.A. &Rodwell, V.W. (2009) *Harper'sIllustrated Biochemistry.* XXVIII edition. Lange Medical Books/ McGraw-Hill.

9. Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.

10. Arthur, I. V. *Quantitative Organic Analysis*, Pearson.

Unit 1 Nucleic Acids	**8 hrs**
Components of nucleic acids, Nucleosides and nucleotides;Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotides.	
Unit 2 Amino Acids, Peptides and Proteins	**12 hrs**
Amino acids, Peptides and their classification. α-Amino Acids - Synthesis, ionic properties and reactions. Zwitterions, p*K*a values, isoelectric point and electrophoresis; Study of peptides: determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups -Solid-phase synthesis.	
Unit3 Enzymes	**8 hrs**
Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes.Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).	
Unit 4 Carbohydrates	**10hrs**
Occurrence, classification and their biological importance.Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani- Fischer synthesis and Ruff degradation;Disaccharides – Structure elucidation of maltose, lactose and sucrose.Polysaccharides – Elementary treatment of starch, cellulose and glycogen.	
Unit 5 Lipids & Concept of Energy in Biosystems	**10hrs**
Introduction to oils and fats; common fatty acids present in oils and fats, Hydrogenntion of fats and oils, Saponification value, acid value, iodine number. Reversion and rancidity. Cells obtain energy by the oxidation of foodstuff (organic molecules). Introduction to metabolism (catabolism, anabolism). ATP: The universal currency of cellular energy, ATP hydrolysis and free energy change. Agents for transfer of electrons in biological redox systems: NAD^+, FAD.Conversion of food to energy: Outline of catabolic pathways of carbohydrate-glycolysis, fermentation, Krebs cycle. Overview of catabolic pathways of fat and protein. Interrelationship in the metabolic pathways of protein, fat and carbohydrate. Caloric value of food, standard caloric content of food types.	
Unit 6 Bio-medical Applications of Biomolecules	**4 hrs**
Recent advances in Biomolecules as therapeutic Agents	

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**ORGANIC CHEMISTRY -IV LAB**				
Course Code	**BBS05P3101**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Organic Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

Students will able to estimate amino acids and determine saponification value and Iodine number of an oil or a fat

Course Outcomes

CO1	Estimation and titration of gycine. (K4)
CO2	Analyze the action and effect of temperature of amylase. (K3)
CO3	Determine the saponification value and Iodine number of an oil or a fat. (K4)
CO4	Extract and characterize organic compounds from plant products (K5)
CO5	Prepare and Characterize different dyes. (K5)

Text Book (s)/ Reference Book (s)

- Manual of Biochemistry Workshop, 2012, Department of Chemistry, University of Delhi.
- Arthur, I. V. *Quantitative Organic Analysis*, Pearson

Experiment 1. Estimation of glycine by Sorenson's formalin method.
Experiment 2. Study of the titration curve of glycine.
Experiment 3. Study of the action of salivary amylase on starch at optimum conditions.
Experiment 4. Effect of temperature on the action of salivary amylase.
Experiment 5. Saponification value of an oil or a fat.
Experiment 6. Determination of Iodine number of an oil/ fat

Exp.7. Extraction of caffeine from tea leaves.
Exp.8. Preparation of sodium polyacrylate.
Exp.9. Preparation of methyl orange.

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	50	100

Name of The Course	**Physical Chemistry IV**				
Course Code	**BSCC3002**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Physical Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

1. The objective of this course is to identify the limitations of classical mechanics and the need of quantum chemistry.

2. To familiarize the students with postulates of quantum chemistry and apply them to derive

equations for various models and hydrogen atoms.

Course Outcomes

CO1	Describe fundamentals concepts of quantum mechanics and its applications. (K2)
CO2	Determine the properties and shape of molecules by various theories of chemical bonding. (K3)
CO3	Distinguish the electromagnetic radiation with molecules and various types of spectra. (K4)
CO4	Apply the method of various spectroscopic techniques for characterization and analysis. (K3)
CO5	Explain photochemical reactions with example. (K2)
CO6	Compile recent advancements in different field of physical chemistry(K6)

Text Book (s)/Reference Book (s)

6. Banwell, C. N. &McCash, E. M. *Fundamentals of Molecular Spectroscopy* 4^{th} Ed. Tata McGraw-Hill: New Delhi (2006).
7. Chandra, A. K. *Introductory Quantum Chemistry* Tata McGraw-Hill (2001).
8. House, J. E. *Fundamentals of Quantum Chemistry* 2^{nd} Ed. Elsevier: USA (2004).
9. Kakkar, R. *Atomic & Molecular Spectroscopy*: *Concepts & Applications*, Cambridge University Press (2015).
10. Lowe, J. P. & Peterson, K. *Quantum Chemistry*, Academic Press (2005).

Unit 1 Quantum Chemistry	**12 hrs**
Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy and Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Extension to two and three dimensional boxes, separation of variables, degeneracy.Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Vibrational energy of diatomic molecules and zero-point energy.Angular momentum: Commutation rules, quantization of square of total angular momentum and z-component. Rigid rotator model of rotation of diatomic molecule.Schrödinger equation, transformation to spherical polar coordinates.Separation of variables. Spherical harmonics. Discussion of solution .Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus. Setting up of Schrödinger equation for many-electron atoms (He, Li). Need for approximation methods. Statement of variation theorem and application to simple systems (particle-in-a-box, harmonic oscillator, hydrogen atom).	
Unit 2 Chemical bonding:	**10 hrs**
Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of $H2^+$. Bonding and antibonding orbitals.Qualitative extension to H2. Comparison of LCAO-MO and VB treatments of H2 (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB).Qualitative description of LCAO-MO treatment of homonuclear and heteronuclear diatomic molecules (HF, LiH).Localised and non-localised molecular orbitals treatment of triatomic (BeH2, H2O) molecules. Qualitative MO theory and its application to AH2 type molecules.	
Unit 3 Molecular Spectroscopy I:	**10 hrs**
Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation. Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.	

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies. Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.
Unit 4 Molecular Spectroscopy II: 10 hrs
Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion. Electronic spectroscopy: Franck-Condon principle, Morse potential energy curve for diatomic molecules, electronic transitions, singlet and triplet states, terms, symbols, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model, Walsh Diagrams. Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules. Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals.
Unit 5 Photochemistry 8 hrs
Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws, of photochemistry, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence.
Unit 6 Recent Advancement in Physical Chemistry 04 hrs
Comparative study of classical, statistical and quantum mechanics, applications of spectroscopic and photochemical techniques

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Name of The Course	**PHYSICAL CHEMISTRY -IV LAB**				
Course Code	**BSCC3052**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry				
Corequisite	Students should have fundamental knowledge of Physical Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

Students will able to operate UV spectrophotometer and Colorimeter.

Course Outcomes

CO1	Recognize basic laboratory rules and basic principles of lab safety. (K2)
CO2	Operate the UV/Visible spectroscopy and analyse, determine theparameter of solutions. (K4)
CO3	Estimate the 200-350 nm UV spectra of the given compounds in water. (K3)
CO4	Determine the concentrations, kinetics and dissociation constant by using Colourimetry. (K4)
CO5	Perform colorimetric analysis of compounds using UV spectrophotometer. (K4)

Text Book (s)/Reference Book (s)

- Khosla, B. D.; Garg, V. C. & Gulati, A., *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
- Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in PhysicalChemistry 8th Ed.;* McGraw-Hill: New York (2003).
- Halpern, A. M. &McBane, G. C. *Experimental Physical Chemistry 3rdEd.;* W.H. Freeman & Co.: New York (2003).

UV/Visible spectroscopy

Experiment 1. Study the 200-500 nm absorbance spectra of KMnO4 and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λmax values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).
Experiment 2. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.
Experiment 3. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.
Colourimetry
Experiment 4. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/ $K_2Cr_2O_7$ in a solution of unknown concentration
Experiment 5. Determine the concentrations of $KMnO_4$and $K_2Cr_2O_7$in a mixture.
Experiment 6. Study the kinetics of iodination of propanone in acidic medium.
Experiment 7. Determine the amount of iron present in a sample using 1,10- phenathroline.
Experiment 8. Determine the dissociation constant of an indicator (phenolphthalein).
Experiment 9. Study the kinetics of interaction of crystal violet/ phenolphthalein with sodium hydroxide.
Experiment 10. Analysis of the given vibration-rotation spectrum of HCl(g).

Continuous Assessment Pattern

Internal Assessment (IA)	**End Term Test (ETE)**	**Total Marks**
50	50	100

Name of The Course	**INORGANIC CHEMISTRY IV**				
Course Code	BSCC3003				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have the basic knowledge of Inorganic chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

3. To impart the knowledge of key concepts of Organometallic compounds

4. To present a comprehensive introduction to inorganic chemistry.

Course Outcomes

CO1	Analyze the inorganic cations , anions and solubility products. K4
CO2	Illustrate the structures of mononuclear and binuclear carbonyls and its MO diagram. K3
CO3	Correlate the basic reactions and concept of metal alkyls and ferrocene. K4
CO4	Determine the beneficiary and toxic role of ions in biological and medicinal system. K4
CO5	Illustrate the catalytic properties of Organometallic in industrial processes. K3
CO6	Discuss the recent development in field of organometallic compounds. K6

Text Book (s)

- Svehla, G. *Vogel's Qualitative Inorganic Analysis*, 7th Edition, Prentice Hall, 1996.
- Cotton, F.A.G.; Wilkinson & Gaus, P.L. *Basic Inorganic Chemistry 3rd Ed.;* Wiley India,
- Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.*, Harper Collins 1993, Pearson,2006.
- Sharpe, A.G. *Inorganic Chemistry*, 4th Indian Reprint (Pearson Education) 2005
- Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry3rd Ed.*, John Wiley and Sons, NY, 1994.
- Greenwood, N.N. & Earnshaw, A. *Chemistry of the Elements*, *Elsevier 2nd Ed*, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).

Reference Book (s)

- . Lee, J.D. *Concise Inorganic Chemistry 5th Ed.*, John Wiley and sons 2008.
- Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988.
- Shriver, D.D. & P. Atkins, *Inorganic Chemistry 2nd Ed.*, Oxford University Press, 1994.
- Basolo, F. & Pearson, R. *Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed.*, John Wiley & Sons Inc; NY.
- Purcell, K.F. & Kotz, J.C., *Inorganic Chemistry*, W.B. Saunders Co. 1977
- Miessler, G. L. & Tarr, D.A. *Inorganic Chemistry 4th Ed.*, Pearson, 2010.
- Collman, J. P. *et al. Principles and Applications of Organotransition Metal Chemistry*. Mill Valley, CA: University Science Books, 1987.
- Crabtree, R. H. *The Organometallic Chemistry of the Transition Metals*. *j* New York, NY: John Wiley, 2000.
- Spessard, G. O. & Miessler, G.L. *Organometallic Chemistry*. Upper Saddle River, NJ: Prentice-Hall, 1996.

Unit-1 :Theoretical Principles in Qualitative Analysis (H_2S Scheme) 14 hrs
Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principles involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II. Analysis of anions and cations.
Unit-2 Organometallic Compounds 10 hrs
Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. □-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.
Unit-3 Metal Alkyls and Aryls 8 hrs
Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Aromaticity. Comparison of aromaticity and reactivity with that of benzene.
Unit-4 Bioinorganic Chemistry 10 hrs
Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine.Iron and its applications in bio-systems, Haemoglobin; Storage and transfer of iron.
Unit-5 Catalysis by Organometallic Compounds 8 hrs
Study of the following industrial processes and their mechanism:1. Alkene hydrogenation (Wilkinsons Catalyst), 2. Hydroformylation (Co salts)3. Wacker Process, 4. Synthetic gasoline (Fischer Tropsch reaction)5. Synthesis gas by metal carbonyl complexes
Unit -6 Application of organometallic compounds 4 hrs
Recent Advancement and development in the field organometallic compounds and their uses.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	**20**	**50**	**100**

Name of The Course	**INORGANIC CHEMISTRY IV Lab**				
Course Code	BSCC3053				
Prerequisite	Students should have the knowledge of atoms, elements, anions and cations.				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	4	2

Course Objectives:

3. To impart the knowledge of key concepts of analysis of cations and anions.
4. To present a comprehensive introduction to inorganic chemistry.

Course Outcomes

CO1	Analyze qualitatively the mixtures containing anions and cations. K4
CO2	Evaluate the spot tests by spectrophotometric method. K5
CO3	Synthesis of inorganic complexes and its Ligand exchange reactions. K5
CO4	Test the spectrochemical series. K4
CO5	Synthesize Ammine complex of Ni(II) and its ligands. K5

Text Book (s)

- Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education, 2002.
- Marr & Rockett *Practical Inorganic Chemistry*. John Wiley & Sons 1972.

Reference Book (s)

- Vogel's *Qualitative Inorganic Analysis,* Revised by G. Svehla. Pearson Education, 2002.

Unit-1 :
Qualitative semi micro analysis of mixtures containing 3 anions and 3 cations. Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested: CO_3^{2-}, NO_2^-, S_2^-, SO_3^{2-},$S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-}, NH_4^+, K^+,Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+},Sr^{2+}, Ca^{2+}, Mg^{2+}

Unit-2
Mixtures should preferably contain one interfering anion, **or** insoluble component ($BaSO_4$, $SrSO_4$, $PbSO_4$, CaF_2 or Al_2O_3) **or** combination of anions e.g. $CO_3^{2-}$and SO_3^{2-}, NO^{2-} and NO^{3-}, Cl^- and Br^-, Cl^- and I^-, Br^- and I^-, NO^{3-} and Br^-, NO^{3-} and I^-. Spot tests should be done whenever possible.
Unit-3
Measurement of 10 Dq by spectrophotometric method
Unit-4
Verification of spectrochemical series
Unit-5
Synthesis of ammine complexes of Ni(II) and its ligand exchange reactions (e.g. bidentate ligands like acetylacetone, DMG, glycine) by substitution method.

Continuous Assessment Pattern

Practical IA	Practical ETE	Total Marks
50	**50**	**100**

Name of The Course	**ORGANIC CHEMISTRY V**				
Course Code	**BBS05T3102**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject				
Corequisite	Students should have fundamental knowledge of Organic Chemistry				
Antirequisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

The core course of Organic Chemistry V deals with some classes of organic compounds finding applications in everyday life namely; polymers, dyes, lipids and pharmaceutical compounds. The chemistry of these compounds in general will be explained through naturally occurring and synthetic compounds. The course also introduces the learner to various tools and techniques for identifying and characterizing the organic compounds through their interactions with electromagnetic radiation viz. IR, NMR and UV- Visible spectroscopy

Course Outcomes

CO1	1. Explain the concepts of UV,IR and NMR spectra of simple organic molecules. (K2)

CO2	Analyze and apply UV,IR and NMR spectroscopy for identification of organic compounds. (K4)
CO3	3. Generalize the Classification, structure and therapeutic uses of pharmaceutical compounds. (K2)
CO4	4. Compare synthetic and natural dyes with their structure elucidation. (K4)
CO5	5. Demonstrate different types of polymer and characterize them. (K2)
CO6	11. Elaborate Modern Spectroscopic techniques & its applications .(K6)

Text Book (s)/Reference Book (s)

- Kalsi, P. S. *Textbook of Organic Chemistry 1st Ed.*, New Age International (P) Ltd. Pub.
- Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
- Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
- Finar, I. L. *Organic Chemistry* (*Volume 2: Stereochemistry and the Chemistry of Natural Products*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Graham Solomons, T.W. *Organic Chemistry*, John Wiley & Sons, Inc.
- McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
- Clayden, J.; Greeves, N.; Warren, S.; Wothers, P.; *Organic Chemistry*, Oxford University Press.
- Singh, J.; Ali, S.M. & Singh, J. *Natural Product Chemistry*, Prajati Prakashan (2010). Kemp, W. *Organic Spectroscopy*, Palgrave.
- Pavia, D. L. *et al. Introduction to Spectroscopy* 5th Ed. Cengage Learning India Ed.2015

Unit-1 Organic Spectroscopy I	**12 hrs**
General principles Introduction to absorption and emission spectroscopy. *UV Spectroscopy:* Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λmax for the following systems: α,β unsaturated aldehydes, ketones,carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers. *IR Spectroscopy:* Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.	
Unit-2 Organic Spectroscopy II	**8 hrs**

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds. Applications of IR, UV and NMR for identification of simple organic molecules	
Unit-3 Pharmaceutical Compounds: Structure and Importance	**10 hrs**
Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).	
Unit-4 Dyes	**8 hrs**
Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing; Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigotin; Edible Dyes with examples.	
Unit-5 Polymers	**12 hrs**
Introduction and classification including di-block, tri-block and amphiphilic polymers; Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index. Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene); Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.	
Unit-6 Modern Spectroscopic techniques	**8hrs**
Raman Spectroscopy: Standard Raman Spectroscopy vs Resonance-enhanced Raman Spectroscopy , Mass Spectrometry-: Introduction of theory, ionization methods, molecule fragmentation & applications, Photoelectron spectroscopy: x-ray and Auger photoelectron spectroscopy & applications	

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Name of The Course	**Battery Technology**
Course Code	BBS05T5103
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with Chemistry as major subject

Corequisite	Basic knowledge of Thermodynamics, Chemical Kinetics and Electrochemistry.				
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

To impart knowledge of advanced electrochemistry and relevant analytical techniques

Course Outcomes

CO1	E Explain the basic physical concepts of thermodynamics and kinetics involved in electrochemical reactions (**K2**)
CO2	Ill Illustrate the characterization methods of batteries and interpret concepts describing battery performance (**K2**)
CO3	Interpret the recent developments battery systems. (**K3**)
CO4	Analyze the requirements of battery systems for automotive applications and understand the modelling of battery systems (**K4**)
CO5	Explain solar energy conversion in terms of nanotechnology (**K2**)
CO6	Compile the recent advanced technologies adopted by Battery Industry. (K6)

Reference Book (s)

8. T.Minami, M.Tatsumisago,M.Wakihara,C. Iwakura,S. Kohijiya, Solid state ionics for batteries, Springer Publication, 2009
9. Sandeep Dhameja, Electric Vehicle Battery Systems, Newnes publication, 2001
10. Bard, Allen J., and Larry R. Faulkner. Electrochemical Methods: Fundamentals and Applications. 2nd ed.,Wiley– VCH, Verlag, GmbH, 2000
11. Masataka Wakihara and Osamu Yamamoto, Lithium ion Batteries Fundamental and Performance,Wiley–VCH, Verlag GmbH, 1999
12. Robert A.Huggins, Advanced Batteries – Materials science aspects,Springer, 2009
13. Nanoscience and Nanotechnology: Fundamentals of Frontiers by M.S. Ramachandra Rao, Shubra Singh
14. Introduction to Nanotechnology By Charles P. Poole, Jr., Frank J. Owens.

Unit-1 Introduction to Electrochemical energy storage 8 hrs
Introduction to battery technologies, Electromotive force- Reversible cells- Relation between electrical energy and energy content of a cell-Free energy changes and electromotive force in cell- Current challenges in Energy storage Technologies.
Unit-2 Major Battery Chemistry Development and testing 10 hrs
Battery performance evaluation- Primary battery - Service time- Voltage data- Service life – ohmic load curve- Effect of operating temperature on service life. Secondary batteries- Discharge curves, Terminal voltages- Plateau voltage –Lead acid Batteries – Construction and application.
Unit-3 Recent Technologies 10 hrs
Recent development of electrode materials in lithium ion batteries- Recent development of solid electrolytes and their application to solid state batteries-Polymer solid electrolytes for lithium ion

conduction– Thin Film solid state Batteries: Fundamentals, Constriction and application – Super Capacitors: Fundamental, Construction and application.
Unit-4 Batteries for Automotives – Future prospects 8 hrs
Degrees of vehicle electrification - Battery size vs. application -USABC and DOE targets for vehicular energy storage systems - Analysis and Simulation of batteries - Equivalent circuit and life modeling – Environmental concerns in battery production – recycling of batteries
Unit-5 Improvements in solar energy conversion and storage 10 hrs
Better energy-efficient lighting; stronger and lighter materials that will improve energy transportation efficiency; Energy Storage: Fuel Cells, Carbon Nanotubes for energy storage, Hydrogen Storage in Carbon Nanotubes, Use of nanoscale catalysts to save energy and increase the productivity in industry, Rechargeable batteries based on Nanomaterials, Nanoscale optical, liquid crystal and magnetic devices
Unit-6 Future Trends of Battery Technology 4 hrs
Recent Advance technology adopted in Battery Industry

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

SEMESTER-VI

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	**BSCC3151**	**Project**	**-**	**-**	**-**	**12**	**50**		**50**

Course Objectives:

The major project will help the students to have a hand on experience and practical knowledge of the theory papers studied so far. It will enable them to tackle practical problems and expose them to industrial experience.

Course Outcomes

CO1	Survey literature for the topic of the project.(K4)
CO2	Correctly interpret the literature review before starting any individual experiment (K3)
CO3	Propose novel reaction routes and pathways for an chemical reaction(K6)
CO4	Interpret the results and data obtained from any experiment clearly, interpret the results and data obtained; records experiments orderly for future reference and draw clear and logical conclusions & assemble in presentations and reports.(K4)
CO5	Demonstrate leadership skills and effective teamwork while working and prepare themselves for their future career in industry or academics (K6)

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (ETE)	Total Marks
50	50	100

Name of The Course	**NOVEL INORGANIC SOLIDS**				
Course Code	**BSCC 3102**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry				
Co-requisite	Students should have fundamental knowledge of Inorganic chemistry				
Anti-requisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

Solid-state chemistry also referred as material chemistry currently has emerged with great focus on novelinorganic solids. It has found enormous applications in both industrial and research arenas and have helped toshape modern day recyclable adsorbents and catalysts. Novel inorganic-organic hybrid nanocomposites havereceived a lot of attention because of their abundance and cost-effective nature they can be utilized ascatalysts, as a nano reactor to host reactants for synthesis and for the controlled release of biomolecules.Materials such as semiconductors, metals, composites, nanomaterials, carbon or high-tech ceramics make lifeeasier in this era and are great sources of industrial growth and technological changes. Therefore, its exposureto the undergraduates with science backgrounds can groom them for future researches.

Course Outcomes

CO1	Understand the mechanism of solid-state synthesis and explain about the different characterization techniques and their principle
CO2	Understand the concept of nanomaterials, their synthesis and properties.
CO3	Ill Appreciate the existence of bioinorganic nanomaterials.
CO4	E Explain the importance of composites, conducting polymers and their applications
CO5	Understand the usage of solid materials in various instruments, batteries, etc. which help them toappreciate the real life importance of these materials
CO6	Compile recent advancements in Novel Inorganic Solids.

Reference Books

□ Shriver & Atkins. Inorganic Chemistry, Peter Alkins, Tina Overton, Jonathan Rourke, Mark Weller and Fraser Armstrong, 5th Edition, Oxford University Press (2011-2012)

□ Adam, D.M. Inorganic Solids: An introduction to concepts in solid-state structural chemistry. John Wiley & Sons, 1974.

□ Poole, C.P. & Owens, F.J. Introduction to Nanotechnology John Wiley & Sons, 2003.

□ Rodger, G.E. Inorganic and Solid State Chemistry, Cengage Learning India Edition, 2002.

Unit I: Synthesis and modification of inorganic solids and their Importance 16 hrs
Conventional heat and beat methods, Co-precipitation method, Sol-gel methods, Hydrothermal method, Ion-exchange and Intercalation methods. Solid electrolytes – Cationic, anionic, mixed Inorganic pigments – coloured solids, white and black pigments. Molecular material and fullerides, molecular materials & chemistry – one-dimensional metals, molecular magnets, inorganic liquid crystals.
Unit II: Nanomaterials 8 hrs
Overview of nanostructures and nanomaterials: classification. Preparation of gold and silver metallic nanoparticles, self-assembled nanostructures-control of nanoarchitecture-one dimensional control. Carbon nanotubes and inorganic nanowires. Bio-inorganic nanomaterials, DNA and nanomaterials, natural and antisical nanomaterials, bionano composites..
Unit-3: Introduction to engineering materials for mechanical construction: **8 hrs**
Composition, mechanical and fabricating characteristics and applications of various types of cast irons, plain carbon and alloy steels, copper, aluminum and their alloys like duralumin, brasses and bronzes cutting tool materials, super alloys thermoplastics, thermosets and composite materials.
Unit-4:Composite materials 8 hrs
Introduction, limitations of conventional engineering materials, role of matrix in composites, classification, matrix materials, reinforcements, metal-matrix composites, polymer-matrix composites, fibre-reinforced composites, environmental effects on composites, applications of composites.
Unit-5: Speciality polymers 10 hrs
Conducting polymers - Introduction, conduction mechanism, polyacetylene, polyparaphenylene and polypyrrole, applications of conducting polymers, Ion-exchange resins and their applications. Ceramic & Refractory: Introduction, classification, properties, raw materials, manufacturing and applications.
Unit-6: Recent Advancements in Novel Inorganic Solids 4 hrs
Recent trends and Application of Novel Inorganic Solids

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Name of The Course	**POLYMER CHEMISTRY**
Course Code	**BSCC 3103**

Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry				
Co-requisite	Students should have fundamental knowledge of Polymers				
Anti-requisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

The primary objective of this paper is to help the student to know about the synthesis, properties andapplications of polymers.

Course Outcomes

CO1	Understand about different mechanisms of polymerization and also polymerization techniques.
CO2	Evaluate kinetic chain length of polymers based on their mechanism and differentiate between polymers and copolymers
CO3	Ill Differentiate between glass transition temperature (Tg) and crystalline melting point (Tm)
CO4	K Develop knowledge about solid and solution properties of polymers
CO5	Learn properties and applications of various useful polymers in our daily life.
CO6	Compile recent advancement and technology adopted in the field of Polymer Chemistry.

Reference Books

□ R.B. Seymour & C.E. Carraher: Polymer Chemistry: An Introduction, Marcel Dekker, Inc. New York, 1981.□ G. Odian: Principles of Polymerization, 4th Ed. Wiley, 2004.

□ F.W. Billmeyer: Textbook of Polymer Science, 2nd Ed. Wiley Interscience, 1971.

□ P. Ghosh: Polymer Science & Technology, Tata McGraw-Hill Education, 1991.

□ R.W. Lenz: Organic Chemistry of Synthetic High Polymers. Interscience Publishers, New York, 1967.

Unit I:Introduction and history of polymeric materials 4 hrs
Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers.
Unit II:Functionality and its importance 6 hrs
Criteria for synthetic polymer formation, classification of polymerization processes, Relationships between functionality, extent of reaction and degree of polymerization.
Unit-3:Kinetics of Polymerization: 6 hrs

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.
Unit-4:Crystallization and crystallinity: 24 hrs
Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point. Determination of molecular weight of polymers (Mn, Mw, etc) by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index. Glass transition temperature (Tg) and determination of Tg, Factors affecting glass transition temperature (Tg). Polymer Solution – Criteria for polymer solubility, Solubility parameter, Thermodynamics of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymers solutions, Flory-Huggins theory, Lower and Upper critical solution temperatures.
Unit-5: Properties of Polymers (Physical, thermal, Flow & Mechanical Properties) 10 hrs
Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers,polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylene sulphide polypyrrole, polythiophene)].
Unit-6: Recent Trends in Polymer Chemistry **4 hrs**
Recent advancement in Polymers and their application

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100

Name of The Course	**MOLECULAR MODELLING & DRUG DESIGN**				
Course Code	**BSCC 3104**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry				
Co-requisite	Students should have fundamental knowledge of Drugs				
Anti-requisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

The primary objective of this paper is to help the student to know about molecular modeling, simulation and designing of drugs.

Course Outcomes

CO1	Understandthe concepts of molecular modeling.
CO2	Differentiate between bond stretching and bending vibrations.
CO3	Ill Develop the knowledge of computer simulation.
CO4	K Understand Molecular Dynamics & Monte Carlo Simulation
CO5	Learn how to predict structure and design of drugs.
CO6	Analyze recent trends going on in the field of Molecular modeling and drug design.

Reference Books

 A.R. Leach, Molecular Modelling Principles and Application, Longman, 2001.

 J.M. Haile, Molecular Dynamics Simulation Elementary Methods, John Wiley and Sons, 1997.

 Satya Prakash Gupta, QSAR and Molecular Modeling, Springer - Anamaya Publishers, 2008.

Unit I: Introduction to Molecular Modelling: **8 hrs**
Introduction. Useful Concepts in Molecular Modelling: Coordinate Systems. Potential Energy Surfaces. Molecular Graphics. Surfaces
Unit II: Force Fields: **10 hrs**
Fields. Bond Stretching. Angle Bending. Introduction to nonbonded interactions. Electrostatic interactions. van der Waals Interactions. Hydrogen bonding in Molecular Mechanics.
Unit-3: Energy Minimization and Computer Simulation **10 hrs**
Minimization and related methods for exploring the energy surface. Non-derivative method, First and second order minimization methods. Simple thermodynamic properties and Phase Space. Boundaries. Analyzing the results of a simulation and estimating Errors.
Unit-4:Molecular Dynamics & Monte Carlo Simulation **10hrs**
Molecular Dynamics Simulation Methods. Molecular Dynamics using simple models. Molecular Dynamics with continuous potentials. Molecular Dynamics at constant temperature and pressure. Metropolis method. Monte Carlo simulation of polymers.
Unit-5: Structure Prediction and Drug Design **12 hrs**
Structure prediction - Introduction to comparative Modeling. Sequence alignment. Constructing and evaluating a comparative model. Predicting protein structures by 'Threading', Molecular docking. Structure based de novo ligand design, Drug Discovery – Chemoinformatics – QSAR.
Unit-6: Recent Trends in Molecular Modeling and Drug Designing **4 hrs**

Advance technology adapted for modelling and Drug Design

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
30	20	50	100

Name of The Course	**Computational Chemistry**				
Course Code	**BSCC 2102**				
Prerequisite	Students should qualify 10+2 or equivalent examination in Science stream with a minimum of 50% marks secured in Chemistry				
Co-requisite	Students should have fundamental knowledge of Computer and Mathematics				
Anti-requisite					
		L	**T**	**P**	**C**
		4	0	0	4

Course Objectives:

The objective of this course is to introduce the students to fundamental mathematical techniques and basic computer skills that will help them in solving chemistry problems.

Course Outcomes

CO1	Explain most commonly used commands and library functions used in Computer BASIC programming. (K2)
CO2	Develop algorithm to solve problems and write corresponding programs in BASIC. (K3)
CO3	Design BASIC programs for performing calculations involved in labory experiments and research work. (K4)
CO4	Practice various spreadsheet software to perform calculations and plot graphs. (K3)
CO5	Eloborate recent advancements in Computational Chemistry. (K6)

Text Books

3. V. Rajaraman, *Fortran 90*, Prentice Hall (India), New Delhi (1997)
4. C. Xavier, Fortran 77 and Numerical Methods, New Age International Pvt. Ltd. Publishers, New Delhi (1994)

Reference Books

3. S. Lipschutz and A. Poe, Schaum's Outline Series - Theory and Problems of Programming with Fortran including structured Fortran, Mc Graw Hill Book Company, Singapore (1982)
4. K. V. Raman, *Computers in Chemistry*, Tata McGraw Hill (1993).

Unit I:Basics **14 hrs**
Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages.
Unit II: C Programming: **12 hrs**
Introduction; style of C language ,character and key words, variables and constants in C, arithmetic , relational , logical and bitwise operators in C, ternary, cast, & and * pointer operators, Size of operator input and output in C : content , conditional and switch statement in C; break and continue statement in loop. Storage classes in C functions array and pointers C, structure and unions, types of statement , preprocessor- define and includes simple programming in C.
Unit-3 Molecular Modelling **12 hrs**
Elementary ideas of molecular mechanics and practical MO methods. Computation of stable state energies and geometries of molecules; vibrational states and electron distribution; Potential energy surfaces.
Unit-4 Numerical methods **12 hrs**
Roots of equations: Numerical methods for roots of equations: Quadratic formula, iterative method. Differential calculus: Numerical differentiation. Integral calculus: Numerical integration (Trapezoidal and Simpson's rule), probability distributions and mean values. Simultaneous equations: Matrix manipulation: addition, multiplication. Handling of experimental data. **Unit-5 Recent Trends in Computational Chemistry** **4 hrs**
Recent Advancements in Computational Chemistry and Application

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Test (MTE)**	**End Term Test (ETE)**	**Total Marks**
30	20	50	100