GALGOTIAS UNIVERSITY

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

School of Electrical, Electronics and Communication Engineering

Program:B. Tech Electronics and communication engineering

Scheme: 2019 – 2023

Curriculum

Semester 1									
Sl. No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BMA101	Mathematics-I (Multivariable Calculus)	3	1	0	3	20	50	100
2	BMA151	Exploration with CAS-I	0	0	2	1	50	-	50
3	BHS101	Professional Communication	2	0	0	2	50	-	50
4	BCS101	Fundamentals of Computer Programming	3	0	0	3	20	50	100
5	BCS151	Fundamentals of Computer Programming Lab - 1	0	0	2	1	50	-	50
6	BPH101	Engineering Physics	3	0	0	3	20	50	100
7	BPH151	Engineering Physics Lab	0	0	2	1			
8	BME101	Elements of Mechanical Engineering	3	0	0	3	20	50	100
9	BME151	Workshop Practice	0	0	4	2	50	-	50
		Total	**14**	**1**	**10**	**19**			
Semester II									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BMA201	Mathematics-I (Matrices and Differential Equations)	3	1	0	3	20	50	100
2	BMA251	Exploration with CAS-II	0	0	2	1	50	-	50
3	BHS251	Professional Communication Lab	0	0	2	1	50	-	50
4	BCS251	Fundamentals of Computer Programming Lab - 2	0	0	2	1	50	-	50
5	BOC251	Engineering Clinic-1	0	0	2	1	50	-	50
6	BLE101	Psychology and Sociology	2	0	0	2	20	50	100
7	BCH101	Engineering Chemistry	3	0	0	3	20	50	100
8	BCH151	Engineering Chemistry Lab	0	0	2	1			
9	BEC101	Basic Electrical and Electronics Engineering	3	0	0	3	20	50	100
10	BEC151	Basic Electrical and Electronics Engineering Lab	0	0	2	1	50	-	50
		Total	**11**	**1**	**12**	**19**			
Semester III									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BMA201	Functions of complex variables and Transforms	3	0	0	3	20	50	100
2	BEC301	Electronic Devices and Circuits	3	0	0	3	20	50	100
3	BEC302	Signals and Systems	3	0	0	3	20	50	100
4	BEC303	Electronic Engineering Materials	3	0	0	3	20	50	100
5	BEC304	Digital System Design	3	0	0	3	20	50	100
6	BEC305	Network Analysis and Synthesis	3	0	0	3	20	50	100
7	BEC306	Design and Engineering	2	0	0	2	20	50	100
8	BEC351	Digital System Design Lab	0	0	2	1	50	-	50
9	BEC352	Electronics Circuits Design and PCB Lab	0	0	2	1	50	-	50
10	BOC351	Engineering Clinic-2	0	0	2	1	50	-	50
11	BLL351	Managerial Communication	0	0	2	1	50	-	50

		Effectiveness Lab							
12	BEN301	Environmental Science and Engineering (Mandatory Audit Course)	2	0	0	0	20	50	100
		Total	**22**	**0**	**8**	**24**			

Semester IV

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BMA402	Probability and Stochastic Processes	3	0	0	3	20	50	100
2	BEC407	Integrated Circuits	3	0	0	3	20	50	100
3	BEC408	Electromagnetic Field Theory	3	0	0	3	20	50	100
4	BEC409	Analog and Digital Communication	3	0	0	3	20	50	100
5	BEC410	Computer Architecture and Organization	3	0	0	3	20	50	100
6	BEC411	Microprocessors and Micro-Controllers	3	0	0	3	20	50	100
7	BOC451	Engineering Clinic-4	0	0	2	1	50	-	50
8	BEC455	Integrated Circuits Lab	0	0	2	1	50	-	50
9	BLL452	Logical and Critical Reasoning	0	0	2	1	50	-	50
10	BEC456	Microprocessor and Micro Controller Lab	0	0	2	1	50	-	50
		Total	**18**	**0**	**8**	**22**			

Semester V

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BEC501	Control Systems	3	0	0	3	20	50	100
2	BEC502	EM Waves	3	0	0	3	20	50	100
3	BEC503	Object Oriented Programming and Data Structures	3	0	0	3	20	50	100
4	BEC504	Digital Signal Processing	3	0	0	3	20	50	100
5		Program Elective-I	3	0	0	3	20	50	100
6	BSB501	Engineering Economics and Management	3	0	0	3	20	50	100
7	BOC551	Engineering Clinic-5	0	0	2	1	50	-	50
8	BLL551	Effective Leadership and Decision Making Skills	0	0	2	1	50	-	50
9	BEC551	Digital Signal Processing Lab	0	0	2	1	50	-	50
10	BEC552	Communication Engineering Lab	0	0	2	1	50	-	50
11	BEC553	Industrial Internship	0	0	0	1	50	-	50
		Total	**18**	**0**	**8**	**23**			

Semester VI

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BLL601	Campus to Corporate program	3	0	0	3	50	-	50
2	BEC602	Computer Networks	3	0	0	3	20	50	100
3	BEC603	VLSI Design	3	0	0	3	20	50	100
4	BHS601	Professional Ethics and Human Values	2	0	0	2	20	50	100
5		Program Elective-II	3	0	0	3	20	50	100
6		Program Elective-III	3	0	0	3	20	50	100
7		Open Elective -1	3	0	0	3	20	50	100
8	BEC654	Computer Network Lab	0	0	2	1	50	-	50
9	BEC655	Design and Innovation Project	0	0	2	1	50	-	50

10	BLE601/BLE602/BLE603	Foreign Language - 1 (German, Japanese, French) *Optional	0	0	2	0	50	-	50
		Total	**20**	**0**	**6**	**22**			

Semester VII

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BEC701	Embedded Systems	3	0	0	3	20	50	100
2		Program Elective-IV	3	0	0	3	20	50	100
3		Program Elective-V	3	0	0	3	20	50	100
4		Open Elective-2	3	0	0	3	20	50	100
5	BEC702	Advance Communication Systems	3	0	0	3	20	50	100
6	BEC751	VLSI and Embedded Systems Lab	0	0	2	1	50	-	50
7	BEC752	Industrial Internship	0	0	0	1	50	-	50
8	BEC753	Technical Seminar	0	0	2	1	50	-	50
9	BEC754	Capstone Design - I	0	0	10	5	50	-	50
10	BLE701 / BLE702 / BLE 703	Foreign Language - 2 (German, Japanese, French) *Optional	0	0	2	0	50	-	50
		Total	**15**	**0**	**16**	**23**			

Semester VIII

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BEC801	Capstone Design - II	0	0	18	9	50	-	50
		Total	0	0	18	9			

List of Electives

Basket-1

Sl No	**Course Code**	**Name of the Electives**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	EEC501	Automation and Robotics	3	0	0	3	20	50	100
2	EEC502	Satellite Communication	3	0	0	3	20	50	100
3	EEC503	MEMS	3	0	0	3	20	50	100
5	EEC504	Digital System Design using VHDL	3	0	0	3	20	50	100

Basket-2

Sl No	**Course Code**	**Name of the Elective**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	EEC505	Principles of Secure Communication	3	0	0	3	20	50	100
2	EEC506	Neural Networks and Fuzzy Control	3	0	0	3	20	50	100
3	EEC507	Wireless Sensor Networks	3	0	0	3	20	50	100
4	EEC508	Nano Science and Technology	3	0	0	3	20	50	100
5	EEC509	Mobile Ad Hoc Networks	3	0	0	3	20	50	100

Basket-3

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	EEC510	Digital Image Processing	3	0	0	3	20	50	100
2	EEC511	Information Theory and Coding	3	0	0	3	20	50	100
3	EEC512	Modern Digital Signal Processing	3	0	0	3	20	50	100
4	EEC513	ASIC Design and FPGA	3	0	0	3	20	50	100

Basket-4

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	EEC514	Soft Computing	3	0	0	3	20	50	100
2	EEC515	Mobile Computing	3	0	0	3	20	50	100
3	EEC516	Microwave Engineering	3	0	0	3	20	50	100
4	EEC517	Biomedical engineering	3	0	0	3	20	50	100
5	EEC518	Radar Guidance and Navigation	3	0	0	3	20	50	100

Basket-5

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	EEC520	Introduction to IoT and its Applications	3	0	0	3	20	50	100
2	EEC521	Optical Communication	3	0	0	3	20	50	100
3	EEC522	Mixed Signal Circuit Design	3	0	0	3	20	50	100
4	EEC523	Audio Visual Engineering	3	0	0	3	20	50	100
5	EEC524	PLC/SCADA	3	0	0	3	20	50	100

List of Open elective (Engineering courses) Proposed									
Basket 1									
Sl.No.	CourseCode	CourseTitle					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BOE601	Human Computer Interface	3	0	0	3	20	50	100
2	BOE602	Introduction to cyber Physical Systems	3	0	0	3	20	50	100
3	BOE603	Selected Topics in Signal Processing	3	0	0	3	20	50	100
4	BOE604	Selected Topics in Communication Engineering	3	0	0	3	20	50	100
5	BOE605	Autonomous Vehicles	3	0	0	3	20	50	100
6	BOE606	Data Science	3	0	0	3	20	50	100
7	BOE607	Computer Vision	3	0	0	3	20	50	100
8	BOE608	Artificial Intelligence	3	0	0	3	20	50	100
9	BOE609	Cyber Security	3	0	0	3	20	50	100
10	BOE610	Energy Management	3	0	0	3	20	50	100
11	BOE611	Estimation and Costing	3	0	0	3	20	50	100
12	BOE612	Data Envelopment Analysis	3	0	0	3	20	50	100
13	BOE613	Operation Management	3	0	0	3	20	50	100
14	BOE614	Construction Engineering	3	0	0	3	20	50	100

16	BOE615	Disaster Management	3	0	0	3	20	50	100
16	BOE616	Bioinformatics	3	0	0	3	20	50	100
Basket-2									
1	BOE701	Remote Sensing and GIS	3	0	0	3	20	50	100
2	BOE702	Automotive Electronics	3	0	0	3	20	50	100
3	BOE703	Sensors & Actuators	3	0	0	3	20	50	100
4	BOE704	IoT and Smart Cities	3	0	0	3	20	50	100
5	BOE705	Web Design and Management	3	0	0	3	20	50	100
6	BOE706	Principles of Telemedicine	3	0	0	3	20	50	100
7	BOE707	Mobile Application Development	3	0	0	3	20	50	100
8	BOE708	Business Analytics	3	0	0	3	20	50	100
9	BOE709	Cloud Computing	3	0	0	3	20	50	100
10	BOE710	Block Chain	3	0	0	3	20	50	100
11	BOE711	Augmented / Virtual Reality	3	0	0	3	20	50	100
12	BOE712	Digital Forensics	3	0	0	3	20	50	100
13	BOE713	Operations Research	3	0	0	3	20	50	100
14	BOE714	Renewable Energy	3	0	0	3	20	50	100
15	BOE715	Interior Design	3	0	0	3	20	50	100
16	BOE716	Landscaping	3	0	0	3	20	50	100
17	BOE717	Biology for Engineers	3	0	0	3	20	50	100

Detailed Syllabus

Name of The Course	Basic Electrical and Electronics Engineering				
Course Code	BEC101				
Prerequisite	Physics,Modern Physics				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices

Course Outcomes

CO1	Apply fundamental laws to analyze DC Circuits.
CO2	Outline the AC source and analyze the steady staeresponse of RL, RC and RLC phasors.
CO3	Summerize the Digital Number Systemand Boolean Algebra with small combinational circuit design.
CO4	Illustrate the operation and charecteristics of PN Junction Diode, BJT with application
CO5	Demonstrate the commonly used Sensors and Transducers and their applications

Text Books

1. D.P. Kothari and I.J. Nagrath , “Basic Electrical Engineering”, Tata McGraw-Hill
2. V.Mittle, ArvindMittle, “Basic Electrical Engineering”, McGraw Hill
3. Robert L.Boylestad, Louis Nashelsky, “Electronic Devices and Circuit Theory
4. A.P.Malvino, Donald Leach, “Digital Principles and Applications”, Tata McGraw- Hill
5. D.Patranabi, “Sensors and Transducers”, PHI

Reference Books

1. D.C.Kulshreshtha,”Basic Electrical Engineering”, Tata McGraw Hill
2. J. Edminister and M. Nahvi , “Electric Circuits”, 3rd Edition, Tata McGraw-Hill
3. Jacob Millman, Christos C.Halkias, SatyabrataJit, “Electronics Devices and Circuits”, Tata McGraw Hill
4. Morris Mano, “Digital Computer Design”, PHI

Course Content:

Unit I: Analysis of DC Circuit **8 Hours**
Ohm’s law, Series and Parallel Circuits, Current and Voltage division, Kirchoff’s Law (KCL&KVL), Star-Delta Transformation, Nodal Analysis.
Unit II: Analysis of AC Circuits **8 Hours**
Alternating signals, Derivation of Root Mean Square (RMS) value, Average value, Peak or crest factor, Form factor

Phasor representation of Pure Resistive, Pure Inductive, Pure Capacitive, R-L Series, R-C Series and R-L-C Series Circuits. Concept of lagging and leading power factor. Inductive and Capacitive reactance, CalculationofAC power.
Unit III: Digital Systems **9 Hours**
Number System : Decimal form, Binary form, Octal form, Hexadecimal form and their interconversions **Logic Gates** : Basic logic gates and Universal gates. Realization of basic gates using Universal gates. **Combinational logic circuitsdesign** :Boolean algebra, De-Morgan's law, SOP and POS form, Minimisationof logic circuits using Karnaugh Map. Design of Half adder and Full adder
Unit IV: Semiconductor Devices **8 Hours**
Semiconductor: Intrinsic & Extrinsic Semiconductors, PN Junction Diode – V-I Charecteristics of normal and ideal diode. Zener diode and its application as Voltage regulator, Avalanche and Zener breakdown **Diode Applications**:Half Wave& Full Wave rectifiers, Filters **Bipolar Junction Transistor (BJT):** Construction and working of BJT. Characteristics and uses of Common Emitter (CE) Configurations
Unit V: Transducers and Sensors **4 Hours**
Sensors and Transducers Definitions, Crieteria to choose a sensor, Basic requirements of a Sensor and Transducer, Classification of Sensors, Commonly used Sensors and Transducers, Analogue and Digital Sensors

Continuous Assessment Pattern

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

Name of The Course	Electronic Devices and Circuits				
Course Code	BEC301				
Prerequisite	Physics,Modern Physics				
Corequisite	Physics				
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives: To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices

Course Outcomes

CO1	Realize the transistor biasing methods and Design analog electronic circuits using discrete components
CO2	Design common amplifier circuits and analyze the amplitude and frequency responses
CO3	Design various analog circuits to analyze their responses
CO4	Understand the principle of operation of different Oscillator circuits.
CO5	Understand the principle of operation of various amplifier circuits

Text Book (s):

1. Jacob. Millman, Christos C.Halkias, 'Electronic Devices and Circuits', Tata McGraw Hill Publishing Limited, New Delhi, 2008, ISBN 0070634556, 9780070634558.
2. Jacob Millman and C. Halkias, 'Integrated Electronics – Analog and Digital Circuits and Systems', Tata Mc Graw Hill, 2001, ISBN 0074622455, 9780074622452
3. Electronic Devices & Circuits Theory – Robert Boylestad and Louis Nashelsky, 10th EditionPrentice Hall, 2009, ISBN 0135026490, 9780135026496

Reference Book (s):

1. Jacob Millman and Arvin Grabel, 'Microelectronics', McGraw Hill, 2001, ISBN 0074637363, 9780074637364.
2. Electronic Devices & Circuits – David. A. Bell, 3rd Edition, Prentice – Hall, 1986 ISBN 083591559X, 9780835915595

Course Content:

Unit-1 Introduction **8 hours**
BJT and BJT Biasing .Hybrid models of CE, CB, CC, configurations – Study of the effect of emitter by- pass condenser at low frequencies - Hybrid – π common emitter transistor model – hybrid π conductance and capacitance – CE short circuit current gain – current gain with resistive load – gain bandwidth product – Study of the effect of un bypassed emitter resister on amplifier performance, Cascode amplifier. HF & LF compensation of RC coupled amplifier. Multistage Amplifiers.
Unit-2FET and FET Biasing8 hours
FET and FET Biasing. FET Amplifiers: Common source, Common gate and Common drain Amplifiers – problems. Small signal analysis of FET Amplifiers. High Frequency analysis of FET Amplifiers, VMOS & CMOS Concepts.
Unit-3Feedback amplifiers **8 hours**
The feedback concept – Transfer gain with feedback – general characteristics and advantages of

negative feedback– analysis of voltage series, Voltage shunt, current series and current shunt feedback amplifiers – Study of the effect of Negative feedback on Gain, Bandwidth, Noise, Distortion, Input and Output impedances with the help of Block Schematic and Mathematical Expressions
Unit-4Oscillators 8 hours
Sinusoidal oscillators –phase shift oscillator – Wien bridge oscillator – Hartley oscillator – Colpits oscillator – frequency stability, inclusive of design, Crystal oscillators.
Unit-5Tuned amplifiers8 hours
Characteristics of Tuned amplifiers – Analysis of Single tuned, Doubled tuned and stagger tuned amplifiers, Gain – bandwidth product – High frequency effect – neutralization. Power Amplifiers: Classification of amplifiers – class A large signal amplifiers – second harmonic distortion – higher order harmonic generations – computation of Harmonic distortion – Transformer coupled audio power amplifier – efficiency – push - pull amplifier – class B amplifier – class AB operation – Push-Pull circuit with Transistors of Complimentary Symmetry.

Continuous Assessment Pattern

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

Name of The Course	Signals and Systems				
Course Code	BEC302				
Prerequisite	Engineering Mathematics				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives: To understand the basic properties of signal & systems • To know the methods of characterization of LTI systems in time domain • To analyze continuous time signals and system in the Fourier and Laplace domain • To analyze discrete time signals and system in the Fourier and Z transform domain

Course Outcomes

CO1	Understand various types of signals, classify, analyze and perform various operations on them.
CO2	Classify the systems and realize their responses
CO3	Analyze the response of continuous time systems using Fourier transforms
CO4	Use Laplace and Z transform techniques as tool for System analysis
CO5	Analyze the continuous and discrete time system functions

Text Book (s)

1. Signals and Systems, Robert, TMH
2. Signals and Systems by Oppenheim &Wilsky

Reference Book (s)

1. P. Ramakrishna Rao, `Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi
2. Linear Signals and Systems by B. P. Lathi

Course Content:

Unit-1 Introduction **8 hours**
Signals and systems as seen in everydaylife, and in various branches of engineering and science. Types of signals and their representations: continuous-time/discrete-time, periodic/non-periodic, even/odd, energy/power, deterministic/ random, one dimensional/ multidimensional; Basic Signals: unit impulse, unit step, unit ramp, exponential, rectangular pulse, sinusoidal; operations on continuous-time and discrete-time signals (including transformations of independent variables)
Unit-2 Classification of Systems **8 hours**
Classification, linearity, time-invariance and causality, impulse response, characterization of linear time-invariant (LTI) systems, unit sample response, convolution summation, step response of discrete time systems, stability, convolution integral, co-relations, signal energy and energy spectral density, signal power and power spectral density, properties of power spectral density.
Unit-3 Fourier Series and Transforms **8 hours**
Continuous-time Fourier series: Periodic signals and their properties, exponential and trigonometric FS representation of periodic signals, convergence, FS of standard periodic signals, salient properties of Fourier series, Definition, conditions of existence of FT, properties, magnitude and phase spectra, Parseval's theorem, Inverse FT, Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT.
Unit-4 Laplace Transforms and Z Transforms **8 hours**
One-sided LT of some common signals, important theorems and properties of LT, inverse LT,

solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC), One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s- to z-plane mapping
Unit-5 Analysis of LTI systems 8 hours
Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, system functions of CT systems, poles and zeros, block diagram representations; discrete-time system functions, block diagram representation, illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter

Continuous Assessment Pattern

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

Name of The Course	Electronic Engineering Materials				
Course Code	BEC303				
Prerequisite	Basic Physics				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

The purpose of this course is to develop comprehension of the rapidly changing technological scenario and the requisite expertise for appropriate selection of materials for specific engineering applications. To Understand electrical properties of materials, the properties and applications of semi conducting materials, general properties and applications of magnetic and dielectric materials, the behavior of materials on exposure to light, general properties and application of modern engineering and bio materials, and familiarized with the concepts of Nano Science and Technology.

Course Outcomes

The students will be able to

CO1	Understand the properties and applications of semi conducting materials
CO2	Explain general properties and applications of magnetic and dielectric materials
CO3	Explain the behavior of materials on exposure to light
CO4	To elucidate the properties and application of modern engineering and bio materials,
CO5	Demonstrate appropriate selection of materials for specific engineering applications.

TEXT BOOKS

1. Kasap, S. O. (2006). *Principles of electronic materials and devices*. Boston: McGraw-Hill.
2. Van, V. L. H. (2008). *Elements of materials science and engineering*. Pearson.
3. Vijaya, M. S., &Rangarajan, G. (2004). *Materials science*. New Delhi: Tata McGraw-Hill.

REFERENCE BOOKS

1. Hummel, R. E. (1992). *Electronic properties of materials*. Berlin: Springer-Verlag.
2. Raghavan, V. (2004). *Materials science and engineering: A first course*. New Delhi: Prentice-Hall of India.
3. Wadhwa, A. S., &Dhaliwal, H. S. (2008). *A textbook of engineering material and metallurgy*. New Delhi: University Science Press.
4. Bhat, S. V. (2002). *Biomaterials*. Boston, Mass. [u.a.: Kluwer Academic [u.a..
5. Wilson, M. (2004). *Nanotechnology: Basic science and emerging technologies*. Boca Raton: Chapman & Hall/CRC.

Unit-1 MECHANICAL PROPERTIES OF MATERIALS **8 hours**
Stress Strain diagram for different engineering materials – Ductile and brittle material – Tensile strength – Hardness – Impact strength – Fatigue – Creep – Fracture – Factors affecting mechanical properties.
Unit-2 ELECTRONIC AND PHOTONIC MATERIALS **8 hours**
Semiconductors- Intrinsic and Extrensic – Hall effect –Superconducting materials. Photonic materials: LED and LCD materials – Photo conducting materials – Nonlinear optical materials (elementary ideas) and their applications.

Unit-3 DIELECTRIC AND MODERN ENGINEERING MATERIALS	**8 hours**
Dielectric materials: Various polarization mechanisms in dielectrics (elementary ideas) and their frequency and temperature dependence – Dielectric loss – Piezo electric and ferro electric materials and their applications.	
Unit-4 MAGNETIC MATERIALS	**8 hours**
Magnetic materials: Ferrites– perovskites, dia, para, ferro, ferri, antiferro - Giant Magneto Resistance (GMR).	
Unit-5 BIO MATERIALS	**8 hours**
Classification of biomaterials – Comparison of properties of some common biomaterials – Effects of physiological fluid on the properties of biomaterials – Biological responses (extra and intra vascular system) – Metallic, Ceramic and Polymeric implant materials	

Continuous Assessment Pattern

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

Name of The Course	Digital System Design				
Course Code	BEC304				
Prerequisite	Number Systems				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

- To present the Digital fundamentals, Boolean algebra and its applications in digital systems
- To familiarize with the design of various combinational digital circuits using logic gates
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
- To explain the various semiconductor memories and related technology
- To introduce the electronic circuits involved in the making of logic gates

Course Outcomes

CO1	Design and analyze combinational logic circuits
CO2	Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
CO3	Understand Logic Families and Design memories
CO4	Design & analyze synchronous sequential logic circuits
CO5	Use HDL & appropriate EDA tools for digital logic design and simulation

Text Book

1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI, 2nd edition ,2006.
4. D.V. Hall, “Digital Circuits and Systems”, Tata McGraw Hill, 1989
5. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill 2nd edition 2012.

Course Content:

Unit-1 Introduction 8 hours
Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan’s Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.
Unit-2MSI devices8 hours
MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.
Unit-3Sequential Logic Design 8 hours
Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.
Unit-4Logic Families and Semiconductor Memories 8 hours

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.
Unit-5VLSI Design flow **8 hours**
VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

Continuous Assessment Pattern

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

Name of The Course	Network Analysis and Synthesis			
Course Code	BEC305			
Pre-requisite	Basic Electrical and Electronics Engineering			
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To learn the concepts of network analysis in electrical and electronics engineering.
2. To learn linear circuit analysis, graph theory and network theorems.
3. Analyze two port networks using Z, Y, ABCD and h parametersa

Course Outcomes:

CO1	Apply network theorems for the analysis of electrical circuits
CO2	Obtain the transient response of electrical circuits
CO3	Obtain the steady-state response of electrical circuits
CO4	Analyze circuits in the sinusoidal steady-state (single-phase and three-phase).
CO5	Analyze two port circuit behavior.

Text / Reference Books

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers,
1999.A.Chakrabarti, "Circuit Theory" DhanpatRai& Co

Course Content:

Unit I: Network Theorems8 Hours
Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.
Unit II: Solution of First and Second order networks 10 Hours
Solution of first and second order differential equations for Series and parallel R-L, R-C, RL-C circuits,initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.
Unit III: Sinusoidal steady state analysis **9 Hours**
Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits.Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.
Unit IV : Electrical Circuit Analysis Using Laplace Transforms**8 Hours**
Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs,convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances
Unit V: Two Port Network and Network Functions**9 Hours**
Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Continuous Assessment Pattern

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

Name of The Course	Design and Engineering				
Course Code	BEC306				
Prerequisite	Design and Innovation				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

1. To excite the student on creative design and its significance;
2. To make the student aware of the processes involved in design;
3. To make the student understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design;
4. To get an exposure as to how to engineer a design.

Course Outcomes

CO1	Able to appreciate the different elements involved in good designs and to apply them in practice when called for.
CO2	Aware of the product oriented and user oriented aspects that make the design a success.
CO3	Will be capable to think of innovative designs incorporating different segments of knowledge gained in the course;
CO4	Students will have a broader perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis.

Text Book (s)

1. Balmer, R. T., Keat, W. D., Wise, G., and Kosky, P., Exploring Engineering, Third Edition: An Introduction to Engineering and Design - [Part 3 - Chapters 17 to 27], ISBN-13: 978-0124158917 ISBN-10: 0124158919
2. Dym, C. L., Little, P. and Orwin, E. J., Engineering Design - A Project based introduction-Wiley, ISBN-978-1-118-32458-5
3. Eastman, C. M. (Ed.), Design for X Concurrent engineering imperatives, 1996, ISBN 978-94-011-3985-4 Springer

Reference Book (s)

1. Haik, Y. And Shahin, M. T., Engineering Design Process, Cengage Learning, ISBN-13:978-0-495-66816-9
2. Pahl, G., Beitz, W., Feldhusen, J. and Grote, K. H., Engineering Design: A Systematic46Approach, 3rd ed. 2007, XXI, 617p., ISBN 978-1-84628-319-2
3. Voland, G., Engineering by Design, ISBN 978-93-325-3505-3, Pearson India

Course Content:

Unit-1 Introduction **8 hours**
Design and its objectives; Design constraints, Design functions, Design means and Design from; Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. Design form, function and strength;
Unit-2Design process 8 hours
Design process- Different stages in design and their significance; Defining the design space; Analogies and "thinking outside of the box"; Quality function deployment-meeting what the customer wants; Evaluation and choosing of a design.
Unit-3Prototyping8 hours

Prototyping- rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis. Engineering the Design – from prototype to product; Planning, Scheduling, Supply chains, Inventory, handling, manufacturing/ construction operations; storage, packaging, shipping, marketing, feedback on design.
Unit-4 Design Attributes **8 hours**
Product Centered and User Centered design, Product centered attributes and user centered attributes; Value engineering, concurrent engineering and reverse engineering in design; Culture based Design.
Unit-5 Modular Design **8 hours**
Modular Design, design optimization, Intelligent and autonomous products, User interfaces, communication between products; autonomous products, internet of things; human psychology and the advanced products. IPR, product liability.

Continuous Assessment Pattern

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

Name of The Course	Electronic Circuits Design and PCB lab				
Course Code	BEC352				
Prerequisite	BEEE Lab				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives

- Study the Frequency response of CE, CB and CC Amplifier
- Learn the frequency response of CS Amplifiers
- Study the Transfer characteristics of differential amplifier
- Perform experiment to obtain the bandwidth of single stage and multistage amplifiers
- Perform SPICE simulation of Electronic Circuits

Course Outcomes

CO1	Design and Test rectifiers, filters and regulated power supplies
CO2	Design and Test BJT/JFET amplifiers.
CO3	Analyze the limitation in bandwidth of single stage and multi stage amplifier
CO4	Measure CMRR in differential amplifier
CO5	Simulate and analyze amplifier circuits using PSpice

List of Experiments

1. Design of Regulated Power supplies
2. Frequency Response of CE, CB, CC and CS amplifiers
3. Darlington Amplifier
4. Differential Amplifiers - Transfer characteristics, CMRR Measurement
5. Cascode and Cascade amplifiers
6. Determination of bandwidth of single stage and multistage amplifiers
7. Analysis of BJT with Fixed bias and Voltage divider bias using Spice
8. Analysis of FET, MOSFET with fixed bias, self-bias and voltage divider bias using simulation software like Spice
9. Analysis of Cascode and Cascade amplifiers using Spice
10. Analysis of Frequency Response of BJT and FET using Spice

Continuous Assessment Pattern

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

Name of The Course	Engineering Clinic 2				
Course Code	BOC351				
Prerequisite	Nil				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives

• To get hands on expertise of knowledge gained from the courses studied in class. Students will be introduced to the practice of engineering through application problems drawn from engineering disciplines chosen to amplify work drawn from supporting courses. It includes topics such as: technical communication formats; analytical tools; computer-based tools: introduction to design;engineering ethics; teamwork

Course Outcomes

CO1	Will be able to understand measurement, Design systems for various Engineering Applications, Develop Teamwork, Technical Problem Solving skills and ethics in Engineering design

1. Measurements
    - Apply appropriate sensors and instrumentation to make measurements of physical quantities
    - Collect, analyze, and interpret data; form and support conclusions
    - Know and apply measurement unit systems and conversions

2. Engineering Professions
    - Understand the function of the members of a technology team
    - Explain the functions of the Engineer
    - Describe the engineering disciplines

3. Teamwork
    - Work effectively in teams with individual and joint accountability
    - Assign roles, responsibilities and tasks
    - Monitor progress, meet deadlines, integrate individual contributions into a final deliverable

4. Problem Solving
    - Apply the Scientific Problem-Solving Method to solve engineering problems
    - Present the problem and its solution in standard engineering format
    - Demonstrate independent thought, creativity, critical thinking in real-world problem solving

5. Communication
    - Communicate effectively about laboratory work with a specific audience both orally and in writing – Technical reports, memos, laboratory notebooks – Graphical representation of data – Appropriate use of significant figures; estimations – Oral presentations
    - Demonstrate appropriate and effective business communication skills via e-mail and oral communications with faculty.

6. Design Process
    - Devise a system, component, or process using the Ten Step Design Process

7. Safety/ Professionalism /Ethics
    - Recognize health, safety, and environmental issues related to technological processes and

deal with them responsibly
• Demonstrate high ethical standards in all academic activities and assignments, including data collection and reporting, reports, exams, and homework assignments.

Continuous Assessment Pattern

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

Name of The Course	Integrated Circuits				
Course Code	BEC407				
Prerequisite	Analog electronics				
Corequisite	Analog electronics				
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives: To introduce the basic building blocks of linear integrated circuits • To learn the linear and non-linear applications of operational amplifiers • To introduce the theory and applications of analog multipliers and PLL • To learn the theory of ADC and DAC • To introduce the concepts of waveform generation and introduce some special function ICs

Course Outcomes

CO1	Illustrate the AC, DC characteristics and compensation techniques of Operational Amplifier
CO2	Realize the applications of Operational Amplifiers
CO3	Clarify and Analyze the working of Analog Multipliers and PLL
CO4	Classify and realize the working principle of various converter circuits using Op-Amps
CO5	Demonstrate the function of various signal generators and Waveform Shaping Circuits

Text Book (s)

1. Sergio Franco, " Design with operational amplifiers and analog integrated circuits ", McGraw Hill, 2002, ISBN 0070530440, 9780070530447
2. Ramakant A. Gayakwad, " OP - AMP and Linear IC's ", 4th Edition, Prentice Hall, 2000, ISBN 0132808684, 9780132808682

Reference Book (s)

1. Botkar K.R., " Integrated Circuits ", Khanna Publishers, 1996.
2. Taub and Schilling, " Digital Integrated Electronics ", Tata McGraw-Hill Education, 2004, ISBN 0070265089, 9780070265080
3. Millman J. and Halkias C.C., " Integrated Electronics ", McGraw Hill, 2001, ISBN 0074622455, 9780074622452Syllabus

Course Content:

Unit-1 Introduction **8 hours**
Analysis of difference amplifiers, Monolithic IC operational amplifiers, specifications, frequency response of op-amp,, slew rate and methods of improving slew rate, Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Non inverting Amplifiers.
Unit-2
Differentiator, Integrator, Voltage to Current convertor, Low pass, high pass, band pass filters, comparator, Multi-vibrator and Schmitt trigger, Triangle wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator, Sine wave Oscillators.
Unit-3
Analysis of four quadrant and variable trans-conductance multipliers, Voltage controlled Oscillator, Closed loop analysis of PLL, Frequency synthesizers, Compander ICs.
Unit-4
Analog switches, High speed sample and hold circuits and sample and hold IC's, Types of D/A converter- Current driven DAC, Switches for DAC, A/D converter, Flash, Single slope, Dual slope,

Successive approximation, Voltage to Time and Voltage to frequency converters.
Unit-5
Wave shaping circuits, Multivibrator- Monostable&Bistable, Schmitt Trigger circuits, IC 555 Timer, Application of IC 555, Switched capacitor filter, Frequency to Voltage converters.

Continuous Assessment Pattern

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

Name of The Course	Electromagnetic Field Theory				
Course Code	BEC408				
Prerequisite	Physics				
Corequisite	Physics				
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media
- To be able to solve problems based on the above concepts

Course Outcomes

CO1	Apply coordinate systems and transformation techniques to solve problems on Electromagnetic Field Theory
CO2	Apply the concept of static electric field and solve problems on boundary value problems.
CO3	Analyze the concept of static magnetic field and solve problems using Biot - Savart's Law, Ampere's circuit law, Maxwell's equation.
CO4	Understands magnetic forces, magnetic dipole and magnetic boundary conditions.
CO5	Understands the time-varying Electromagnetic Field and derivation of Maxwell's equations.

Text Book (s)

1. Principles of Electromagnetics N. O. Sadiku, Oxford University Press Inc
2. Engineering Electromagnetics W H Hayt, J A Buck, McGraw Hill Education

Reference Book (s)

1. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill India, 2005
2. Electromagnetics with Applications, Kraus and Fleish, Edition McGraw Hill International Editions, Fifth Edition, 1999Syllabus

Course Content:

Unit-1 Coordinate Systems and Transformation **8 hours**
Coordinate Systems and Transformation : Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar.
Unit-2 Electrostatic fields 8 hours
Electrostatic fields: Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses' Law- Maxwell's equation, Electric dipole and flux line, Energy density in electrostatic fields, Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, Dielectric-constants, Continuity equation and relaxation time, boundary conditions, Electrostatic boundary value problems: Poisson's and Laplace's equations., Methods of Images.
Unit-3 Magneto statics 8 hours

Magneto statics : Magneto-static fields, Biot - Savart's Law, Ampere's circuit law, Maxwell's equation, Application of ampere's law, Magnetic flux density- Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential.
Unit-4 Magnetic forces 8 hours
Magnetic forces: Materials and devices, Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole. Magnetization in materials, Magnetic boundary conditions, Inductors and inductances, Magnetic energy.
Unit-5 Time-varying Fields8 hours
Time-varying Fields: Maxwell's equation, Faraday's Law, transformer and motional electromotive forces, Displacement current, Maxwell's equation in final form, Power and the pointing vector. Basics of Transmission lines.

Continuous Assessment Pattern

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

Name of The Course	Analog and Digital Communication				
Course Code	BEC409				
Prerequisite	Signals and Systems, Digital System Design				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

Course Outcomes

CO1	Analyze and compare different analog modulation schemes for their efficiency and bandwidth
CO2	Analyze the behavior of a communication system in presence of noise
CO3	Investigate pulsed modulation system and analyze their system performance
CO4	Analyze different digital modulation schemes and can compute the bit error performance

Text/Reference Books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000

Unit-1 Introduction Review of signals and systems**8 hours**
Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.
Unit-2 Probability and random process **8 hours**
Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.
Unit-3 Pulse modulation **8 hours**
Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.
Unit-4 Elements of Detection Theory **8 hours**
Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion.

Unit-5 Pass band Digital Modulation schemes **8 hours**
Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels.

Continuous Assessment Pattern

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

Name of The Course	Computer Architecture and Organization				
Course Code	BEC410				
Prerequisite	Computer Fundamentals				
Corequisite	Computer fundamentals				
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

To make students understand the basic structure and operation of digital computer

- To familiarize with implementation of fixed point and floating-point arithmetic operations
- To study the design of data path unit and control unit for processor
- To understand the concept of various memories and interfacing
- To introduce the parallel processing technique

Course Outcomes

CO1	Describe data representation, instruction formats and the operation of a digital computer
CO2	Illustrate the fixed point and floating-point arithmetic for ALU operation
CO3	Discuss about implementation schemes of control unit and pipeline performance
CO4	Explain the concept of various memories, interfacing and organization of multiple processors
CO5	Discuss parallel processing technique and unconventional architectures

Text Book (s)

1. David A. Patterson and John L. Hennessey, ―Computer Organization and Design‖, Fifth edition, Morgan Kauffman / Elsevier, 2014. (UNIT I-V)
2. Miles J. Murdocca and Vincent P. Heuring, ―Computer Architecture and Organization: An Integrated approach‖, Second edition, Wiley India Pvt Ltd, 2015 (UNIT IV,V)

Reference Book (s)

1. V. Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, ―Computer Organization―, Fifth edition, Mc Graw-Hill Education India Pvt Ltd, 2014.
2. William Stallings ―Computer Organization and Architecture‖, Seventh Edition, Pearson Education, 2006.
3. Govindarajalu, ―Computer Architecture and Organization, Design Principles and Applications", Second edition, McGraw-Hill Education India Pvt Ltd, 2014.

Course Content:

Unit-1 Basics of a computer system **8 hours**
Basics of a computer system: Evolution, Ideas, Technology, Performance, Power wall, Uniprocessors to Multiprocessors. Addressing and addressing modes. Instructions: Operations and Operands, Representing instructions, Logical operations, control operations.
Unit-2Fixed and floating point Arithmetic 8 hours
Fixed point Addition, Subtraction, Multiplication and Division. Floating Point arithmetic, High performance arithmetic, Subword parallelism
Unit-3 Logic design 8 hours

Introduction, Logic Design Conventions, Building a Datapath - A Simple Implementation scheme - An Overview of Pipelining - Pipelined Datapath and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions.
Unit-4 Memory Organization 8 hours
Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices.
Unit-5 Parallel Processing 8 hours
Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse scale computers - Introduction to Multiprocessor network topologies.

Continuous Assessment Pattern

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

Name of The Course	Microprocessors and Micro-Controllers				
Course Code	BEC411				
Prerequisite	Digital electronics				
Corequisite	Digital electronics				
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

To understand the Architecture of 8086 microprocessor.

1. To learn the design aspects of I/O and Memory Interfacing circuits.
2. To interface microprocessors with supporting chips.
3. To study the Architecture of 8051 microcontroller.
4. To design a microcontroller based system

Course Outcomes

CO1	Understand the architecture of 8086 microprocessor
CO2	Understand and execute programs based on 8086 microprocessor
CO3	Design Memory Interfacing circuits.
CO4	Design and interface I/O circuits
CO5	Design and implement 8051 microcontroller based systems.

Text Book (s)

1. Yu-Cheng Liu, Glenn A.Gibson, ―Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design‖, Second Edition, Prentice Hall of India, 2007. (UNIT I- III)

2. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, ―The 8051 Microcontroller and Embedded Systems: Using Assembly and C‖, Second Edition, Pearson education, 2011. (UNIT IV-V)

Reference Book (s)

1. DoughlasV.Hall, ―Microprocessors and Interfacing, Programming and Hardware‖,TMH,2012

2. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3 rd edition, Tata McGrawHill, 2012 Syllabus

Course Content:

Unit-1 Introduction **8 hours**
Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.
Unit-28086 signals **8 hours**
8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.
Unit-3 Memory Interfacing and I/O interfacing **8 hours**
Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller –

DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.
Unit-4 Architecture of 8051 **8 hours**
Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.
Unit-5 Programming 8051 **8 hours**
Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors

Continuous Assessment Pattern

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

Name of The Course	Integrated Circuits Lab				
Course Code	BEC455				
Prerequisite	Linear Integrated Circuits, Op-amp				
Corequisite	Analog electronics				
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	2	

Course Objectives:

To understand the basics of linear integrated circuits and available ICs

1. To understand the characteristics of the operational amplifier.
2. To apply operational amplifiers in linear and nonlinear applications.
3. To acquire the basic knowledge of special function IC.
4. To use SPICE software for circuit design

Course Outcomes

CO1	Design amplifiers, oscillators, D-A converters using operational amplifiers
CO2	Design filters using op-amp and performs an experiment on frequency response.
CO3	Analyze the working of PLL and describe its application as a frequency multiplier
CO4	Design DC power supply using ICs.
CO5	Analyze the performance of filters, multivibrators, A/D converter and analog multiplier using SPICE.

List of Experiments

1. Inverting, Non inverting and differential amplifiers.
2. Integrator and Differentiator.
3. Instrumentation amplifier
4. Active low-pass, High-pass and band-pass filters.
5. Astable&Monostablemultivibrators using Op-amp
6. Schmitt Trigger using op-amp.
7. Phase shift and Wien bridge oscillators using Op-amp.
8. Astable and Monostablemultivibrators using NE555 Timer.
9. PLL characteristics and its use as Frequency Multiplier, Clock synchronization
10. DC power supply using LM317 and LM723.

USING SPICE:

1. Active low-pass, High-pass and band-pass filters using Op-amp
2. Astable and Monostablemultivibrators using NE555 Timer.
3. A/ D converter
4. Analog multiplier

Continuous Assessment Pattern

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

Name of The Course	Microprocessor and Micro Controller Lab				
Course Code	BEC456				
Prerequisite	Digital electronics, Microprocessor, Microcontroller				
Corequisite	Digital electronics				
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

To Introduce ALP concepts, features and Coding methods

1. Write ALP for arithmetic and logical operations in 8086 and 8051
2. Differentiate Serial and Parallel Interface
3. Interface different I/Os with Microprocessors
4. Be familiar with MASM

Course Outcomes

CO1	Demonstrate ability to handle arithmetic operations using assembly language programming in TASM and training boards
CO2	Demonstrate ability to handle logical operations using assembly language programming in TASM
CO3	Demonstrate ability to handle string instructions using assembly language programming in TASM
CO4	Demonstrate ability to handle sorting operations and using assembly language programming in TASM
CO5	To study parallel and serial communication using 8051 micro controller

LIST OF EXPERIMENTS:

8086 Programs using kits and MASM

1. Basic arithmetic and Logical operations

2. Move a data block without overlap

3. Code conversion, decimal arithmetic and Matrix operations.

4. Floating point operations, string manipulations, sorting and searching

5. Password checking, Print RAM size and system date

6. Counters and Time Delay Peripherals and Interfacing Experiments

7. Traffic light controller

8. Stepper motor control

9. Digital clock

10. Key board and Display

11. Printer status

12. Serial interface and Parallel interface

13. A/D and D/A interface and Waveform Generation 8051 Experiments using kits and MASM

14. Basic arithmetic and Logical operations

15. Square and Cube program, Find 2‘s complement of a number

16. Unpacked BCD to ASCII

Continuous Assessment Pattern

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

Name of The Course	Control Systems				
Course Code	BEC501				
Prerequisite	Signals and Systems				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response, frequency response and stability of the systems.
- To learn the various approach for the state variable analysis.

Course Outcomes

CO1	Identify the various control system components and their representations.
CO2	Analyze the various time domain parameters
CO3	Analysis the various frequency response plots and its system.
CO4	Apply the concepts of various system stability criterions.
CO5	Design various transfer functions of digital control system using state variable models.

Text Book (s)

1. M.Gopal, ―Control System – Principles and Design‖, Tata McGraw Hill, 4th Edition, 2012.

Reference Book (s)

1. K. Ogata, _Modern Control Engineering‘, 5th edition, PHI, 2012. 3. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.

2. Benjamin.C.Kuo, ―Automatic control systems‖, Prentice Hall of India, 7th Edition,1995.

Course Content:

Unit-1 Introduction **8 hours**
Control System: Terminology and Basic Structure-Feed forward and Feedback control theoryElectrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system
Unit-2 Transient response**8 hours**
Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems
Unit-3 Closed loop frequency response **8 hours**
Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation
Unit-4 Concept of stability **8 hours**
Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.
Unit-5 State variable representation **8 hours**
State variable representation-Conversion of state variable models to transfer functions-Conversion

of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.

Continuous Assessment Pattern

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

Name of The Course	EM Waves				
Course Code	BEC502				
Prerequisite	Electromagnetic Fields				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives

To introduce the basic mathematical concepts related to electromagnetic vector fields. To impart knowledge on the concepts of electrostatics, electric potential, energy density and• their applications. To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and• vector potential and its applications. To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s• equations. To impart knowledge on the concepts of Concepts of electromagnetic waves and• Transmission lines.

Course Outcomes

CO1	Analyze transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
CO2	Provide solution to real life plane wave problems for various boundary conditions.
CO3	Analyze the field equations for the wave propagation in special cases such as lossy and low loss dielectric media.
CO4	Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
CO5	Understand and analyze radiation by antennas.

Text Book / Reference :

1. R. K. Shevgaonkar, “Electromagnetic Waves”, Tata McGraw Hill, 2005.
2. D. K. Cheng, “Field and Wave Electromagnetics”, Addison-Wesley, 1989.
3. M. N.O. Sadiku, “Elements of Electromagnetics”, Oxford University Press, 2007.
4. C. A. Balanis, “Advanced Engineering Electromagnetics”, John Wiley & Sons, 2012.
5. C. A. Balanis, “Antenna Theory: Analysis and Design”, John Wiley & Sons, 2005.

Course Content:

Unit-1 Transmission Lines **8 hours**
Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.
Unit-2 Maxwell’s Equations **8 hours**
Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss’s law, Ampere’s Circuital law, Faraday’s law of Electromagnetic induction. Maxwell’s equations, Surface charge and surface current, Boundary conditions at media interface.
Unit-3 Uniform Plane **8 hours**
WaveHomogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.
Unit-4 Plane Waves at Media Interface **8 hours**

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.
Unit-5 Waveguides **8 hours**
Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

Name of The Course	Digital Signal Processing				
Course Code	BEC504				
Prerequisite	Signals and systems				
Corequisite	Signals and systems				
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

- To learn discrete fourier transform, properties of DFT and its application to linear filtering
- To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the effects of finite precision representation on digital filters
- To understand the fundamental concepts of multi rate signal processing and its applications
- To introduce the concepts of adaptive filters and its application to communication engineering
- Prerequisites

Course Outcomes

CO1	Apply digital signal processing fundamentals and Acquire the knowledge of representation of discrete-time signals in the frequency domain, using z-transform and discrete Fourier transform.
CO2	Design and Analyze FIR filters with desired frequency responses.
CO3	Design and Analyze IIR filters with desired frequency responses.
CO4	Realize FIR/IIR Filter structure and analyze the effects quantization errors in analog to digital conversion of signals
CO5	Understand architecture of DSP Processors, Compressive sensing, Multirate Signal Processing and their applications in real-world problems

Text Book (s)

1. John G. Proakis& Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications‖, Fourth Edition, Pearson Education / Prentice Hall, 2007. (UNIT I – V)

Reference Book (s)

1. Emmanuel C. Ifeachor& Barrie. W. Jervis, ―Digital Signal Processing‖, Second Edition, Pearson Education / Prentice Hall, 2002.

2. A. V. Oppenheim, R.W. Schafer and J.R. Buck, ―Discrete-Time Signal Processing‖, 8th Indian Reprint, Pearson, 2004.

3. Sanjit K. Mitra, ―Digital Signal Processing – A Computer Based Approach‖, Tata Mc Graw Hill, 2007.

4. Andreas Antoniou, ―Digital Signal Processing‖, Tata Mc Graw Hill, 2006.

Course Content:

Unit-1 Introduction	**8 hours**
Discrete and Fast Fourier Transforms: Introduction to DSP, DTFT, Relationship between DFT and other transforms DFT, Properties of DFT, Circular Convolution, DFT as a Linear Transformation, Fast Fourier Transform, Computing an Inverse DFT by doing a Direct DFT. Review of z transform and inverse Z transform.	
Unit-2 Finite Impulse Response Filters	**8 hours**
Finite Impulse Response Filters:- Magnitude and phase response of a digital filters, Frequency response of linear phase FIR filters, Design Techniques for FIR filters.	
Unit-3 Infinite Impulse Response Filters	**8 hours**
Infinite Impulse Response Filters:-IIR filter Design by Approximation of Derivatives, Impulse Invariant Method, Bilinear Transformation, Butterworth filters, Chebyshev Filters and Frequency Transformation.	
Unit-4 Realization of Digital Filters	**8 hours**
Realization of Digital Filters: Basic Structures for IIR Systems, Basic Structures for FIR system. Effects of Finite Word Length in Digital Filters: Introduction, Rounding and Truncation Errors, Quantization effects in analog to digital conversion of signals	
Unit-5 Overview of TMS320	**8 hours**
Overview of TMS320 Family DSP Processors, Applications of DSP: Introduction, Applications of DSP in Biomedical Engineering, Voice processing, applications to RADAR, applications ti Image processing ,Introduction to wavelets, wireless communication, Multirate Signal Processing, Sampling, Sampling rate conversion, introduction to compressive sensing.	

Continuous Assessment Pattern

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

Name of The Course	Object Oriented Programming and Data Structures				
Course Code	BEC503				
Prerequisite	Basic Programming				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

- To learn the features of C
- To learn the linear and non-linear data structures
- To explore the applications of linear and non-linear data structures
- To learn to represent data using graph data structure
- To learn the basic sorting and searching algorithms

Course Outcomes

CO1	Implement linear and non-linear data structure operations using C
CO2	Suggest appropriate linear / non-linear data structure for any given data set.
CO3	Apply hashing concepts for a given problem
CO4	Modify or suggest new data structure for an application
CO5	Appropriately choose the sorting algorithm for an application

TEXTBOOKS:

1. Pradip Dey and Manas Ghosh, ―Programming in C, Second Edition, Oxford University Press, 2011.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, ―Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

REFERENCES:

1. Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education,1996
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structures and Algorithms, Pearson
Education, 1983.
3. Robert Kruse, C.L.Tondo, Bruce Leung, Shashi Mogalla , ― Data Structures and Program Design in C,Second Edition, Pearson Education, 2007
4. Jean-Paul Tremblay and Paul G. Sorenson, ―An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, 1991.

Course Content:

Unit-1 C PROGRAMMING BASICS **8 hours**
Structure of a C program – compilation and linking processes – Constants, Variables – Data Types –Expressions using operators in C – Managing Input and Output operations – Decision Making and Branching – Looping statements. Arrays – Initialization – Declaration – One dimensional and Twodimensional arrays. Strings- String operations – String Arrays. Simple programs- sorting searching –matrix operations.
Unit-2FUNCTIONS, POINTERS, STRUCTURES AND UNIONS
Functions – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic. Structures and unions - definition – Structure within a structure - Union – Programs using structures and Unions – Storage classes, Pre-processor directives.

Unit-3LINEAR DATA STRUCTURES
Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Set representations - Union-Find operations. Graph and its representations – Graph Traversals.
Unit-4NON-LINEAR DATA STRUCTURES
Realization of Digital Filters: Basic Structures for IIR Systems, Basic Structures for FIR system. Effects of Finite Word Length in Digital Filters: Introduction, Rounding and Truncation Errors, Quantization effects in analog to digital conversion of signals
Unit-5SEARCHING AND SORTING ALGORITHMS
Linear Search – Binary Search. Bubble Sort, Insertion sort – Merge sort – Quick sort - Hash tables –Overflow handling. CO-PO Mapping

Continuous Assessment Pattern

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

Name of The Course	Computer Networks				
Course Code	BEC602				
Prerequisite	Communication Systems				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Course Outcomes

CO1	Explain the functions of the different layer of the OSI Protocol.
CO2	Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
CO3	For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component
CO4	For a given problem related TCP/IP protocol developed the network programming.
CO5	Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Text Book :

- Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.
- Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
- Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
- Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
- TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

Course Content:

Unit-1 Data communication Components 8 Hours
Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing – Frequency division, Time division and Wave division, Concepts on spread spectrum.
Unit-2 Data Link Layer and Medium Access Sub Layer 8hours
Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction – Fundamentals Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA
Unit-3 Network Layer 8hours
Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.
Unit-4 Transport Layer 8hours
Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques:

Leaky Bucket and Token Bucket algorithm.
Unit-5 Application Layer 8hours
Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptograph.

Continuous Assessment Pattern

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

Name of The Course	Digital Signal Processing Lab				
Course Code	BEC551				
Prerequisite	Digital signal processing, Signals and systems				
Corequisite	DSP, Signals and systems				
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

- To perform basic signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB
- To implement FIR and IIR filters in MATLAB and DSP Processor
- To study the architecture of DSP processor

Course Outcomes

CO1	Carryout basic signal processing operations
CO2	Demonstrate their abilities towards MATLAB based implementation of various DSP systems
CO3	Analyze the architecture of a DSP Processor
CO4	Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals
CO5	Design a DSP system for various applications of DSP

LIST OF EXPERIMENTS:

MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolutions
3. Auto correlation and Cross Correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations

DSP PROCESSOR BASED IMPLEMENTATION

1. Study of architecture of Digital Signal Processor
2. Perform MAC operation using various addressing modes
3. Generation of various signals and random noise
4. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering
5. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering
6. Implement an Up-sampling and Down-sampling operation in DSP Processor

Continuous Assessment Pattern

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

Name of The Course	Communication Engineering Lab				
Course Code	BEC552				
Prerequisite	Analog and digital communication				
Corequisite	Communication systems				
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

- To visualize the effects of sampling and TDM
- To Implement AM & FM modulation and demodulation
- To implement PCM & DM
- To simulate Digital Modulation schemes
- To simulate Error control coding schemes

Course Outcomes

CO1	Simulate & validate the various functional modules of a communication system
CO2	Demonstrate their knowledge in base band signaling schemes through implementation of digital modulation schemes
CO3	• Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system
CO4	Simulate end-to-end communication Link

LIST OF EXPERIMENTS:

1. Signal Sampling and reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator and Demodulator
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Line coding schemes
8. Simulation of ASK, FSK, and BPSK generation schemes
9. Simulation of DPSK, QPSK and QAM generation schemes
10. Simulation of signal constellations of BPSK, QPSK and QAM
11. Simulation of ASK, FSK and BPSK detection schemes
12. Simulation of Linear Block and Cyclic error control coding schemes
13. Simulation of Convolution coding scheme

Continuous Assessment Pattern

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

Name of The Course	Industrial Internship				
Course Code	BEC553				
Prerequisite					
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives:

- To develop institute-industry interaction
- To know the industry practices
- To understand cutting edge technology in the chosen area

Course Outcomes

CO1	Exposure to industry practices
CO2	Strengthened institute-industry relationship
CO3	Bridging academic knowledge with industry input
CO4	understand cutting edge technology in the chosen area
CO5	Report Writing and Effective communication

Continuous Assessment Pattern

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

Name of The Course	VLSI Design				
Course Code	BEC603				
Prerequisite	Digital electronics, Electronic devices and circuits				
Corequisite	EDC				
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits

Course Outcomes

CO1	Illustrate the basics of IC fabrication Processes
CO2	Understand the basic concepts of MOS Transistor and its operation, Scaling and CAD Design
CO3	Understand and Design various CMOS circuits and investigate the parameters which affects the performance of the CMOS circuits
CO4	Design Complex CMOS Circuits and examine the performance of the Complex circuits
CO5	Clarify the design hierarchy of VLSI Circuits and recognize about the memory devices using CMOS transistors

Text Book (s)

1. S.M.Sze, “VLSI technology”, 2nd Edition, Tata McGraw Hill Education, 2003, ISBN 9780070582910
2. Sung-Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits – Analysis and Design”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2003.
3. N. Weste and K. Eshranghian, "Principles of CMOS VLSI Design", Addison Wesley, 1998.

Reference Book (s)

1. Jacob Backer, Harry W. Li and David E. Boyce, " CMOS Circuit Design, Layout and Simulation ", Prentice Hall of India, 1998.
2. L.Glaser and D. Dobberpuhl, "The Design and Analysis of VLSI, Circuits”, Addison Wesley 1993.
3. Randel & Geiger, “ VLSI Analog and Digital Circuit Design Techniques” McGraw-Hill,1990.
4. John P. Uyemura, "Introduction to VLSI Circuits and Systems," John Wiley & Sons, ,Inc, 2002.

Unit-1 Introduction	**8 hours**
Integrated circuit technology, basic monolithic integrated circuits, epitaxial growth, Masking and etching, diffusion of impurities, transistors for monolithic circuits, monolithic diodes, Integrated resistors, Integrated capacitors and inductors, monolithic circuit layout, additional isolation methods, LSI and MSI, the metal semiconductor contacts	

Unit-2
The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS, Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitances, Numerical and spice simulations
Unit-3
Introduction, Resistive-Load Inverter, Inverters with n-Type MOSFET Load, CMOS Inverter, Delay-Time Definitions, Calculation of Delay Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters, Numerical and spice simulations.
Unit-4
Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, High-Performance Dynamic CMOS Circuits, Introduction, MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates), Introduction, Behavior of Bistable Elements, The SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop
Unit-5
Introduction, Read-Only Memory (ROM) Circuits, Static Read-Write Memory (SRAM) Circuits, Dynamic Read-Write Memory (DRAM) Circuits Introduction, VLSI Design Flow, Design Hierarchy, Concepts of Regularity, Modularity and Locality, VLSI Design Styles, Design Quality, Packaging Technology, Computer-Aided Design 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	Automation and Robotics				
Course Code	EEC501				
Pre-requisite	IoT, Electronic System Design				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To provide the student with basic knowledge and skills associated with robot control.
2. Demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.
3. Demonstrate an ability to perform kinematics and inverse kinematics analysis of robot systems.
4. Demonstrate knowledge of robot controllers.
5. To develop the student's knowledge in various robot structures and their workspace.

Course Outcomes

CO1	Explain Basic Robotic model & its applications.
CO2	Differentiate types of control and the standardization for some robotic system. K4
CO3	Critically evaluate robots for particular applications.
CO4	Analyze particular industrial applications and evaluate possible solutions in terms of automated dedicated/flexible) or mixed manual/automated systems.
CO5	Realize the design problem and preliminary consideration of Industrial automation.

Text Book (s)

1. Mikell P Grover et. al. "Industrial Robots: Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill, 1980, ISBN 9781259006210.
2. Robert J. Schilling, "Fundamentals of Robotics-Analysis and Control", PHI Learning, 2009, ISBN 9788120310476 (Unit-II and Unit-III)

Reference Book (s)

1. K.S. Fu, Ralph Gonzalez, C.S.G. Lee, "Robotics: control, sensing, vision and Intelligence", 1st Edition,TataMcgraw-Hill, 2008, ISBN 9780070265103

Unit-1INTRODUCTION ROBOTICS**9 hours**
Robotics – Basic components – Classification – Performance characteristics – Actuators- Electric actuator- DC motor horse power calculation, magneto-astrictive hydraulic and pneumatic actuators. Sensors and vision systems: Different types of robot transducers and sensors – Tactile sensors – Proximity and range sensors –ultrasonic sensor-touch sensors-slip sensors-sensor calibration- vision systems.
Unit-2ROBOT CONTROL **8 Hours**
Control of robot manipulators- state equations-constant solutions-linear feedback systems-single axis PID control- PD gravity control- computed torque control- variable structure control-Impedance control.
Unit-3END EFFECTORS **8 Hours**
End effectors and tools– types – Mechanical grippers – Vacuum cups – Magnetic grippers – Robot end effectors interface, work space analysis work envelope-workspace fixtures-pick and place operation- continuous path motion-interpolated motion-straight line motion.
Unit-4ROBOT MOTION ANALYSIS **7 Hours**
Robot motion analysis and control: Manipulator kinematics –forward and inverse kinematics- arm equation-link coordinates-Homogeneous transformations and rotations and Robot dynamics
Unit-5ROBOT APPLICATIONS **6 Hours**

Industrial and Non industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries

Continuous Assessment Pattern

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

Name of The Course	Satellite Communication				
Course Code	EEC502				
Prerequisite	Communication systems				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

- Understand the basics of satellite orbits
- Understand the satellite segment and earth segment
- Analyze the various methods of satellite access
- Understand the applications of satellites
- Understand the basics of satellite Networks

Course Outcomes

CO1	To comprehend the orbital aspects, the satellite subsystems and launching methods
CO2	Analyse various multiplexing and multiple access techniques
CO3	Design satellite uplink and downlink under various conditions.
CO4	Demonstrate the GPS concepts for ethical usage in society
CO5	Realize specific applications of satellite Communication

Text Book (s)

1. Wilbur L. Pritchard, H.G. Suyderhoud ,RobertA.Nelson, Satellite Communication Systems Engineering, Prentice Hall, New Jersey, 2006. ISBN-013-791468-7

2. Timothy Pratt and Charles W.Bostain, Satellite Communications, John Wiley and Sons, 2003. ISBN- 047137007X

3. D.Roddy, Satellite Communication, McGrawHill, 2006 ISBN- 0071486895

Reference Book (s)

1. Tri T Ha, Digital Satellite Communication, McGrawHill,1990. ISBN-978-0-07-007752-2
2. B.N.Agarwal, Design of Geosynchronous Spacecraft, Prentice Hall, 1993. ISBN-0132001144

Course Content:

Unit-1 Introduction **8 hours**
Satellite Systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Satellite – description of different Communication subsystems, Bandwidth allocation.
Unit-2 Modulation and Multiplexing Schemes **8 hours**
Different modulation and Multiplexing Schemes, Multiple Access Techniques – FDMA, TDMA, CDMA, and DAMA, Coding Schemes
Unit-3 Link Design **8 hours**
Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.
Unit-4 Radio and Satellite Navigation **8 hours**
Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Receiver Operation and Differential GPS
Unit-5 Applications **8 hours**
Satellite Packet Communications, Intelsat series – INSAT series –VSAT, mobile satellite services,

IMMERSAT, Satellite and Cable Television, DBS (DTH), VSAT, Satellite Phones.

Continuous Assessment Pattern

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

Name of The Course	Digital System design using VHDL				
Course Code	EEC504				
Pre-requisite	Digital Design				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To gain an in-depth understanding of VHDL and to realize different circuits using it both sequential and combinational.
2. To learn the concept of memories and how they are designed using VHDL.
3. To gain an understanding of applications of VHDL in PLDs and Field Programmable Logic Arrays (FPGAs).

Course Outcomes

CO1	Explain VHDL as a programming language.
CO2	Design the combinational and sequential logic circuits using VHDL.
CO3	Design Programmable logic devices(PLDs) and Networks of Arithmetic operations.
CO4	Gain proficiency with VHDL software package and utilize software package to solve problems on a wide range of digital logic circuits.
CO5	Explain VHDL as a programming language.

Text Book (s)

1. Stephen Brown and ZvonkoVranesic," Fundamentals of Digital Logic with VHDL Design", Mc-Graw-Hill (2nd edition). ISBN-10: 0077211642

Reference Book (s)

1. Peter J. Ashenden, "Designers guide to VHDL ",Morgan Kaufman Publishers. 3rd edition, ISBN-10: 0120887851

Unit-1 Introduction **7 hours**
Introduction to Hardware Description Languages (HDL) And HDL Based Design, VHDL-Variables, Signals And Constants, Arrays, VHDL Operators, VHDL Functions, VHDL Procedures, Packages And Libraries, VHDL Description Of Combinational Networks, Modeling Flip-Flops Using VHDL, VHDL Models For A Multiplexer, Compilation And Simulation Of VHDL Code, Modeling A Sequential Machine, VHDL Model For A Counter.
Unit-2VHDL Synthesis and Models8 Hours
"Attributes, Transport and Inertial delays, Operator overloading, Multivalued logic and signal resolution, IEEE-1164 standard logic, Generics, Generate statements, Synthesis of VHDL code, Synthesis examples, Files and TEXTIO.Introduction to data path and control path synthesis."
Unit-3Digital Design with State Machine Charts 7 Hours
State machine charts, Derivation of SM charts, Realization of SM charts. Implementation of the dice game, Alternative realization for SM charts using microprogramming, Linked state machines, Asynchronous state machine based design.
Unit-4Programmable Logic devices (PLDs)9 Hours
"DESIGNING WITH PROGRAMMABLE LOGIC DEVICES: Read-only memories (ROM, EPROM, EEPROM/FLASH), Programmable logic arrays (PLAs), Programmable array logic (PLAs), Other sequential programmable logic devices (PLDs), Design of a keypad scanner. DESIGN OF NETWORKS FOR ARITHMETIC OPERATIONS: Design of a serial adder with accumulator, State graphs for control networks, Design of a binary multiplier, Multiplication of signed binary numbers, Design of a binary divider."
Unit-5Field Programmable Gate Arrays (FPGA) 8 Hours
"Xlinx 3000 series FPGAs, Designing with FPGAs, Xlinx 4000 series FPGAs, using a one-hot state assignment, Altera complex programmable logic devices (CPLDs), Altera FELX 10K series COLDs.

Representation of floating-point numbers, Floating-point multiplication, Other floating-point operations."

Continuous Assessment Pattern

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

Name of The Course	Principles of Secure Communication				
Course Code	EEC505				
Prerequisite	Digital communication system				
Corequisite	Digital communication system				
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

To understand the communication systems and various methods of communication system. To understand the ways to provide security to communication systems.

Course Outcomes

CO1	Understanding of the various types of spread spectrum techniques for secure communication.
CO2	slow and fast frequency hopping, performance of FHSS in AWGN Channel.
CO3	Analyze the various cryptographic techniques and Apply the Encryption standards like DES, AES.
CO4	Understanding the principle of Block Cipher and Encryption Standards.
CO5	Knowing current network authentication applications, PKI, Web security and their vulnerabilities that are exploited by intentional and unintentional attacks.

Text Book (s)

1.Digital Communication by Simon Haykin, Wiley.1 st edition ISBN 978-1-1185-4405-1,
2.Cryptography and Network Security by W. Stallings 5th Ed., PHI ISBN-10: 0136097049 ISBN-13: 978-0136097044.

Reference Book (s)

1.Cryptography and secure Communications by M.Y. Rhee, Mc Graw Hill, ISBN-10: 0071125027; ISBN-13: 978-0071125024.
2.Communication System Security by LidongChen,Guang Gong, ISBN 9781439840368-CAT# K11870.

Course Content:

Unit-1 Introduction **8 hours**
Model of Spread Spectrum digital communication system, direct sequence spread spectrum signal, error rate, performance of the decoder, processing gain and jamming margin, uncoded DSSS signals, applications of DSSS signals in anti-jamming, Code division multiple access and multipath channels, effect of pulsed interference on DSSS systems, Generation of PN sequences using m sequence and Gold sequences, narrowband interference in DSSS systems, acquisition and tracking of DSSS system.
Unit-2
Basic concepts of Frequency Hopping, slow and fast frequency hopping, performance of FHSS in AWGN Channel, FHSS in CDMA system, Time hopping and hybrid Spread spectrum system, acquisition and tracking of FH SS systems.
Unit-3
Classical encryption techniques, Symmetric cipher model, cryptography and cryptanalysts,

Substitution techniques, transposition techniques.
Unit-4
Block cipher principle, data encryption standard (DES), strength of DES, differential and linear cryptanalysts, block cipher design principles, Finite fields, simplified advanced encryption standard (S-AES), multiple encryption and triple DES, Block cipher modes of operation, stream ciphers and RC4 algorithm.
Unit-5
Prime numbers, Fermat and Euler's theorem, Chinese remainder theorem, discrete algorithms, principles of public key cryptosystems, RSA algorithm, key management Diffie-Hellman key exchange, message authentication requirements and functions.

Continuous Assessment Pattern

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

Name of The Course	Neural Networks and Fuzzy Control				
Course Code	EEC506				
Pre-requisite	Control Systems				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	3	0	5	

Course Objectives:

1. Get the exposure to Artificial Neural Networks & Fuzzy Logic.
2. Understand the importance of tolerance of imprecision and uncertainty for design of robust &low cost intelligent machines
3. Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers
4. Develop and implement a basic trainable neural network or a fuzzy logic system for a typical control, computing application or biomedical application

Course Outcomes

CO1	Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines.
CO2	Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.
CO3	Understanding of fuzzy relation rule and aggregations
CO4	Understand concept of classical and fuzzy sets, fuzzification and defuzzification
CO5	Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem

Text Book (s)

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004
3. Stamatios V. Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications 1st Edition “
4. S. Rajasekaran, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications "

Reference Book (s)

1. "Aaron M. Tenenbaum, YedidyahLangsam and Moshe J. Augenstein “Data Structures Using C and C++” , PHI, 1996."
2. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with applications”, McGraw Hill, 2007.
3. "Kosko, B, “Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence”, PrenticeHall, NewDelhi, 2004"
4. "Timothy J Ross, “Fuzzy Logic with Engineering Applications”,John Willey and Sons, West Sussex, England, 2005."

Unit-1Introduction to Artificial Neural Network9 hours
Artificial neural networks and their biological motivation – Terminology – Models of neuron – Topology – characteristics of artificial neural networks – types of activation functions – learning methods – error correction learning – Hebbian learning – Perceptron – XOR Problem –Perceptron learning rule convergence theorem – Adaline.
Unit-2Feed-forward and Recurrent Neural Networks12 Hours

"Architecture: perceptron model, solution, single layer artificial neural network, multilayer perceptron model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications; Recurrent neural networks: Linear auto associator – Bi-directional associative memory – Hopfield neural network."
Unit-3 Fuzzy Logic & Fuzzy Sets **9 Hours**
Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function ,Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers.
Unit-4 Fuzzy Relations & Aggregations **9 Hours**
Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule based Model: Mamdani Model, TSK model, Fuzzy Propositions, De-fuzzification: MOM, COA
Unit-5 Fuzzy Optimization and Neuro Fuzzy Systems **6 Hours**
Fuzzy optimization –one-dimensional optimization. Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks.

Continuous Assessment Pattern

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

Name of The Course	Wireless Sensor Networks				
Course Code	EEC507				
Prerequisite	Communication systems				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

- Learn Ad hoc network and Sensor Network fundamentals
- Understand the different routing protocols
- Have an in-depth knowledge on sensor network architecture and design issues
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks
- Have an exposure to mote programming platforms and toolsCourse Outcomes

Course Outcomes

CO1	Analyze the knowledge of wireless sensor networks in various application areas.
CO2	Comprehend and analyze localization and tracking issues associated with WSN network.
CO3	Evaluate the performance of energy saving approaches used in MAC Protocols.
CO4	Understand and analyze various routing metrics and routing algorithms in WSN network
CO5	Apply the techniques used for sensor data gathering, data storage and data retrievals in WSN.

Text Book (s)

1.Networking Wireless Sensors: BhaskarKrismachari, Cambridge University Press

2. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati,

Reference Book (s)

1. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas , Morgan Kaufmann Series in Networking 2004.

2. Wireless Sensor Networks: Technology, Protocols, and Applications: KazemSohraby, Daniel Minoli, TaiebZnati, Wiley Inter Science.

Course Content:

Unit-1 Introduction **8 hours**
Sensor Network Concept: Introduction, Networked wireless sensor devices, Advantages of Sensor networks, Applications, Key design challenges. Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, Mobile deployment.
Unit-2 Localization and Tracking **8 hours**
Localization and Tracking: Issues and approaches, Problem formulations: Sensing model, collaborative localization. Coarse-grained and Fine-grained node localization. Tracking multiple objects.
Unit-3 Wireless Communications **8 hours**
Wireless Communications: Link quality, shadowing and fading effects Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.
Unit-4 Routing **8 hours**

Routing: Metric-based approaches, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing. Sensor network
Unit-5 Database perspective on sensor networks **8 hours**
Databases: Data-centric routing, Data-gathering with compression, Querying, Data-centric storage and retrieval, The database perspective on sensor networks

Continuous Assessment Pattern

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

Name of The Course	Nanoscience and Technology			
Course Code	EEC508			
Prerequisite	Applied Physics			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

The objective of this course is to know the revolutions behind nanotechnology and nanomachines. The student will be clear about the aspects of intermolecular forces, various properties and other phenomena seen in the nanomaterials.

Course Outcomes

The students will be able to

CO1	Explain the fundamentals of nanotechnology
CO2	Classify the nanomaterials based on dimensions
CO3	Explain the properties of materials in their nanostructured state.
CO4	Explain the bonding forces in nanostructures.
CO5	Demonstrate the impact of grain size in the properties of nanomaterials

Text Book

1. Ratner, M. A., & Ratner, D. (2003). *Nanotechnology: A gentle introduction to the next big idea*. Upper Saddle River, NJ: Prentice Hall.

Reference Books

1. Wilson, M. (2002). *Nanotechnology: Basic science and emerging technologies*. Boca Raton: Chapman & Hall/CRC.
2. Poole, C. P., & Owens, F. J. (2003). *Introduction to nanotechnology*. Hoboken, NJ: J. Wiley.

Course Content:

Unit-1 Introduction 8 hours
Background to nanotechnology – Definition for Nanotechnology - Scientific Revolutions – Types of nanotechnology – Top-Down and Bottom-Up – Moore's Law – Basic problems and limitations – Opportunities at the Nanoscale
Unit-2 Intermolecular Forces 8 hours
Intermolecular forces – hydrophobic – van der Waals – hydrogen bonding – electrical double layer, self-assembly, micelles
Unit-3 0D,1D and 2D Nanomaterials 8 hours
Introduction to 0D, 1D & 2D nanomaterials, introduction to quantum confinement, introduction to quantum mechanical tunneling.
Unit-4 Quantum effects 8 hours
Influence of nanosize on electronic transport, ballistic conductivity, quantum hall effect, single domain magnetic nanoparticles, uniaxial anisotropy, superparamagnetism, magnetic thin films – shape anisotropy. Exchange anisotropy
Unit-5 Grain size effects 8 hours
Grain size effects on strength of metals- Optical properties of quantum dots and metal nanoparticles – Hall – petch relationship – super plasticity.

Continuous Assessment Pattern

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

Name of The Course	Mobile Ad Hoc Networks				
Course Code	EEC509				
Prerequisite	Computer networks				
Corequisite	Communication systems				
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

The students should be able to

- Understand about adhoc networks, Wireless channels

Course Outcomes

CO1	Explain the characteristics features, wireless channels and mobility models of mobile Adhoc networks.
CO2	Summarize the protocols used at the MAC layer and scheduling mechanisms.
CO3	Compare and analyze types of routing protocols used for unicast and multicast routing.
CO4	Examine the network security solution and routing mechanism.
CO5	evaluate the energy management schemes and Quality of service solution in ad hoc networks

Text Book (s)

1.C.Siva ram murthy,B.S. Manoj, "Ad hoc wireless networks-Architectures and protocols" Pearson Education, 2005
2. Stefano Basagni, Marco Conti, "Mobile ad hoc networking", Wielyinterscience 2004

Reference Book (s)

1. Charles E.Perkins ,"Ad hoc networking", Addison Wesley,2001

Course Content:

Unit-1 Introduction **8 hours**
Introduction to adhoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models:- Indoor and out door models.
Unit-2 Contention based protocols **8 hours**
Design goals of a MAC protocol, Contention based protocols; Contention based protocols with reservation mechanisms and scheduling mechanisms, MAC protocols using directional antennas.
Unit-3 Routing protocols **8 hours**
Table driven routing protocols, On demand routing protocols, hybrid routing protocols, Hierarchical routing protocols, Power aware routing protocols, Tree based and mesh based multicast routing protocols
Unit-4 Security considerations in ad hoc sensor networks **8 hours**
Maximum life time routing, Secure routing protocols, Intrusion detection, Security considerations in ad hoc sensor networks
Unit-5 Energy management schemes **8 hours**
Energy management schemes-Battery management, transmission power management, system power management schemes. Quality of service solutions in ad hoc wireless networks.

Continuous Assessment Pattern

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

Name of The Course	Digital Image Processing				
Course Code	EEC510				
Prerequisite	Signals and systems				
Corequisite	DSP				
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

To introduce the fundamentals of visual information, representation of 2-D and 3-D information, enhancement of information, retrieval of information, and various colour models.

Course Outcomes

CO1	Students will be able to describe and Interpret basic elements of Digital Image Processing, Analyze the need and suitability of transforms in image processing applications
CO2	Design and implement filters for image enhancement in spatial domain and frequency domain for real time applications and apply image restoration algorithms
CO3	Segment and Extract features from images for analysis and recognition
CO4	Perform Wavelet analysis on images
CO5	Interpret Still and Video compression algorithms

Text Book (s)

1.Digital Image Processing/ Gonzalez and Woods/ Pearson Education 2008/Third Edition

2. Fundamentals of Digital Image Processing/ A.K. Jain/ PHI Indian Edition

3. Digital Image Processing using MATLAB/ Gonzalez, Woods, and Eddins/ Mc Graw Hill Second/ 2013

Reference Book (s)

1.Digital Image Processing/ K.R. Castleman/ Pearson 2014

2. Digital Image Processing Algorithms and Applications/I. Pitas/John Wiley 2002

3. Image Processing, Analysis, and Machine Vision/Milan Sonka, Vaclav Hlavac, Roger Boyale/ Cengage Learning 4th Edition

Course Content:

Unit-1 Introduction **8 hours**
Need for DIP- Fundamental steps in DIP – Elements of visual perception -Image sensing and Acquisition – Image Sampling and Quantization – Imaging geometry, discrete image mathematical characterization, Two dimensional Fourier Transform- Properties – Fast Fourier Transform – Inverse FFT Discrete cosine transform and KL transform.-Discrete Short time Fourier Transform
Unit-2 Image Enhancement and Restoration **8 hours**
Image enhancement in spatial domain: Gray-level transformations, histogram equalization, spatial filters- averaging, order statistics; Edge detection: first and second derivative filters, Sobel, Canny, Laplacian and Laplacian-of Gaussion masks; Image filtering in frequency domain: Smoothing and sharpening filtering in frequency domain, ideal and Butterworth filters, homomorphic filtering; Image restoration: Degradation/ restoration process, noise models, restoration in presence of noise-only spatial filtering, linear position-invariant degradations, estimating the degradation function, inverse filtering, Wiener filtering, constrained least squares filtering

Unit-3 Image Segmentation	**8 hours**
Detection of discontinuities – Edge linking and Boundary detection- Thresholding- -Edge based segmentation-Region based Segmentation- matching-Advanced optimal border and surface detection- Use of motion in segmentation. Image Morphology – Boundary descriptors- Regional descriptors.	
Unit-4 Wavelets and Multi-resolution image processing	**8 hours**
Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.	
Unit-5 Image and Video Compression	**8 hours**
Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000. Fundamentals of Video Coding-Inter-frame redundancy, motion estimationtechniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.	

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	EEC511				
Pre-requisite	Signals and Systems, Modulation Theory, Digital Communication				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To understand the fundamental concept of entropy and information as they are used in communications.
2. To enhance knowledge of probabilities, entropy, measures of information.
3. To identify the implications and consequences of fundamental theories and laws of information theory and coding with reference to the application in modern communication and computer systems.
4. To design different encoders using the different coding schemes like Huffman Coding, ShannaonFano Coding, Cyclic codes, etc.,

Course Outcomes

CO1	Calculate the information content of a random variable from its probability distribution.
CO2	Relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities.
CO3	Define channel capacities and properties using Shannon Theorems.
CO4	Construct efficient codes for data on imperfect communication channels.
CO5	Generalize the discrete concepts to continuous signals on continuous channels.

Text Book (s)

1. R Bose, "Information Theory, Coding and Cryptography", TMH 2007.
2. Fred Halsall, "Multidedia Communications: Applications, Networks, Protocols and Standards", Perason Education Asia, 2002

Reference Book (s)

1. K Sayood, "Introduction to Data Compression" 3/e, Elsevier 2006.
2. S Gravano, "Introduction to Error Control Codes", Oxford University Press 2007.
3. Amitabha Bhattacharya, "Digital Communication", TMH 2006

Course Content:

Unit-1 INFORMATION THEORY **8 hours**
Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – BSC, BEC – Channel capacity, Shannon limit.
Unit-2ERROR CONTROL CODING: BLOCK CODES **7 Hours**
Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder – CRC
Unit-3ERROR CONTROL CODING: CONVOLUTIONAL CODES **5 Hours**
Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding.

Unit-4SOURCE CODING: TEXT, AUDIO AND SPEECH **8 Hours**
Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding
Unit-5SOURCE CODING: IMAGE AND VIDEO **7 Hours**
Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

Continuous Assessment Pattern

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

Name of The Course	Modern Digital signal Processing				
Course Code	EEC512				
Pre-requisite	Signals and Systems, Digital Communication				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	3	0	3	

Course Objectives:

1. This course examines the fundamentals of detection and estimation for signal processing.
2. It will help the students to implement new algorithms for signal processing applications in frequency, time and mixed domains

Course Outcomes

CO1	Learn Multirate signal processing.
CO2	Design and Analyze adaptive, Kalman filter and Wiener filter.
CO3	Understand the spectral estimation.
CO4	Know digital signal processing application in frequency and time domain.
CO5	Understand the fundamentals of DSP processor architecture

Text Book (s)

1. Oppenheim A.V., Schafer, Ronald W. & Buck, John R., "Discrete Time Signal processing",Pearson Education ,2nd Edition.
2. Monson H. Hayes "Statistical Digital Signal Processing and Modeling" John Wiley & Sons, 2009
3. Steven W. Smith, " Digital Signal Processing: A Practical Guide for Engineers and Scientists", Elsevier, 2003.
4. Papoulis, Circuits and Systems, Modern Approach, HRW, 1980

Reference Book (s)

1. John G. Proakis, "Digital Signal Processing Principles, Algorithms and Applications", 4th edition , PHI 2007.
2. Lawrence R. Rabiner, Bernard Gold, "Theory and Application of Digital SignalProcessing", PHI 2001.
3. Roberto Cristi "Modern Digital Signal Processing", Thomson Brooks/Cole, 2004.
4. R.F. Ziemer, W.H. Tranter and D.R.Fannin, Signals and Systems - Continuous and Discrete, 4th Edn. Prentice Hall, 1998.

Course Content:

Unit-1 Introduction to Modern Digital Signal Processing **6 hours**
"Introduction to Modern Digital Signal Processing: Signals, systems and signal processing (continuous & discrete an overview), time domain and frequency domain analysis of signals. Sampling and reconstruction of signals, Concepts of Two dimensional, Multi-rate and adaptive signal processing."
Unit-2 Design of Filters **9 Hours**
Design of digital filters, Introduction to adaptive signal processing, LMMSE filters – Wiener and Kalman, Adaptive filters – LMS and RLS, Lattice filters, Tracking performance of time varying filters, Adaptive filters, Applications, moving average filters, adaptive filters: FIR adaptive filters adaptive channel equalization ,adaptive noise cancellation ,IIR adaptive filters - RLS filters and Filter banks.
Unit-3 Fast Fourier Transform and Spectral estimation **9 Hours**

Discrete and fast Fourier transform algorithms, Goertzel and Chirp-z transform for computation of DFT, effect of finite register length in DFT computation, Fourier analysis of non-stationary signals, Power spectral estimation
Unit-4 Introduction to Digital signal Processors **9 Hours**
Introduction to Digital signal Processors:Architecture and applications , Fixed and Floating Point Processors, Complex numbers – fixed and floating point representation. Applications: Applications of Digital ,Signal Processing to Speech & Audio coding and processing
Unit-5 Design and implementation example **9 Hours**
"An IIR and FIR audio filters - Modelling in MATLAB - Analog measurement on DSP Systems, Fixed and floating Point Realization impacts. Speech production, Articulatory and Acoustic phonetics, Time domain analysis, Frequency domain analysis, Cepstral analysis, LPC analysis."

Continuous Assessment Pattern

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

Name of The Course	ASIC Design and FPGAs				
Course Code	EEC513				
Pre-requisite	Digital system design				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives: To introduce students to the process of designing application specific hardware implementations of algorithms for ASICs and FPGAs. Students will work with commercial computer aided design tools to synthesize designs described in hardware description languages. Topics covered will include differences between hardware description languages for synthesis and simulation, behavioral synthesis, gate-level design, register transfer level design, design methodologies, finite state machines, design reuse and intellectual property cores, and optimization**.**

Course Outcomes

CO1	Understand the fundamentals of logic designing and Analog / Mixed signal (AMS) IC designing
CO2	Develop advanced RTL design using Verilog
CO3	Perform ASIC verification
CO4	Conduct analysis of backend design parameter
CO5	Demonstrate high performance designs using HDL techniques

Text Book (s)

1. M.J.S .Smith, - " Application - Specific Integrated Circuits " - Addison -Wesley Longman Inc., 1997
2. Skahill, Kevin," VHDL for Programmable Logic", Addison-Wesley, 1996

Reference Book (s)

1. John F. Wakherly, " Digital Design: Principles and Practices", 2nd Edn 1994, Prentice Hall International Edn
2. Charles W. Mckay, "Digital Circuits a proportion for microprocessors", Prentice

Course Content:

Unit-1 Introduction to ASIC and VHDL**9 hours**
"Introduction To ASICS, CMOS Logic And ASIC Library Design,Types of ASICs - Design flow - CMOS transistors CMOS Design rules - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort -Library cell design - Library architecture. Review of VHDL/Verilog: Entities and architectures "
Unit-2 Programmable ASICS **7 Hours**
Programmable Asics, Programmable ASIC Logic Cells And Programmable ASIC I/O Cells Anti fuse - static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA - Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks
Unit-3 Programmable ASIC Interconnect & Software **9 Hours**
Programmable ASIC Interconnect, Programmable ASIC Design Software And Low Level Design Entry Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX - Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools - EDIF- CFI design representation.
Unit-4ASIC Construction & FPGA partitioning **8 Hours**
ASIC Construction, Floor Planning, Placement And Routing,System partition - FPGA partitioning - partitioning methods - floor planning - placement - physical design flow - global routing - detailed routing - special routing -circuit extraction - DRC.

Unit-5 Design using Xilinx **9 Hours**
Design using Xilinx family FPGA

Continuous Assessment Pattern

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

Name of The Course	Soft Computing				
Course Code	EEC514				
Prerequisite	Mobile computing				
Corequisite	Mobile computing				
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

To learn the basic concepts of Soft Computing • To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems. • To apply soft computing techniques to solve problems.

Course Outcomes

CO1	Understand basics of Soft Computing
CO2	Apply suitable ANN techniques for various applications.
CO3	Apply suitable Fuzzy techniques for various applications.
CO4	Apply suitable Genetic Algorithm techniques for various applications.
CO5	Integrate various soft computing techniques for complex problems.

Text Book (s)

1.N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.

2. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.

3. S.Rajasekaran, G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

Reference Book (s)

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, ―Neuro-Fuzzy and Soft Computing‖, Prentice-Hall of India, 2002.
2. 2. KwangH.Lee, ―First course on Fuzzy Theory and Applications‖, Springer, 2005.
3. 3. George J. Klir and Bo Yuan, ―Fuzzy Sets and Fuzzy Logic-Theory and Applications‖, Prentice Hall, 1996.
4. 4. James A. Freeman and David M. Skapura, ―Neural Networks Algorithms, Applications, and Programming Techniques‖, Addison Wesley, 2003.

Course Content:

Unit-1 Introduction **8 hours**
Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.
Unit-2 Back propagation Neural Networks **8 hours**
Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization - Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory - Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.
Unit-3 Introduction to Fuzzy Logic **8 hours**
Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy

Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.
Unit-4 Genetic Algorithm **8 hours**
Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators - Convergence of Genetic Algorithm.
Unit-5 Hybrid Systems **8 hours**
Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

Continuous Assessment Pattern

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

Name of The Course	Mobile Computing				
Course Code	EEC515				
Prerequisite	Computer networks				
Corequisite					
Antirequisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives:

- To understand the concept about Mobile networks, protocol stack and standards
- To understand and analyze the network layer solutions for Mobile Computing
- To study about fundamentals of 3G Services, its protocols and applications
- To have in depth knowledge on internetworking of WLAN and WWAN
- To learn about evolution of 4G Networks, its architecture and applications

Course Outcomes

CO1	Understand the principles of mobile computing framework and mobile communication technologies.
CO2	Explain the wireless network architecture and associated protocols.
CO3	Differentiate the services that GSM network offers to people, employees, and businesses
CO4	Demonstrate the working of various routing protocols for Ad Hoc networks.
CO5	Explain the data management issues in mobile computing environment.

Text Book (s)

1.Jochen Schiller, *Mobile Communications*, Second Edition, Pearson Education, 2003.

2.Asoke K Talukder and Roopa R. Yavagal, *Mobile Computing – Technology, Applicationsand Service Creation*; TMH Pub., New Delhi, 2006

Reference Book (s)

1.C D M Cordeiro, D. P. Agarwal, *Adhoc and Sensor Networks: Theory and applications*, World Scientific, 2006.Syllabus

Course Content:

Unit-1 Introduction **8 hours**
Introduction of mobile computing, overview of wireless telephony: cellular concept, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, Multiple access techniques like Frequency division multiple access (FDMA), Time division multiple access (TDMA), Code division multiple access (CDMA), Space division multiple access (SDMA).
Unit-2 Wireless Networking **8 hours**
Wireless Networking, Wireless LAN Overview: MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, WAP: Architecture, protocol stack, application environment, applications.
Unit-3 GSM Architecture **8 hours**
GSM Architecture, GSM Entities ,Call Routing in GSM, GSM Addresses and Identifiers, Network Aspects in GSM , GSM Frequency Allocation, Authentication and Security, Mobile Computing over SMS, Short Message (SMS) , Value Added Services through, MS, Accessing the SMS Bearer,

GPRS, WAP , MMS.
Unit-4 Routing protocols8 hours
Ad Hoc networks, localization, MAC issues, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Ad Hoc Networks, applications.
Unit-5 Data management issues 8 hours
Data management issues, data replication for mobile computers, adaptive clustering for mobile wireless networks, file system, disconnected operations. Mobile Agents computing, security and fault tolerance, transaction processing in mobile computing environment.

Continuous Assessment Pattern

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

Name of The Course	Microwave Engineering			
Course Code	EEC516			
Prerequisite	Instrumentation			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives:

- To enable the student to understand the basic principles in antenna and microwave system design
- To enhance the student knowledge in the area of various antenna designs.
- To enhance the student knowledge in the area of microwave components and antenna for practical applications.

Course Outcomes

CO1	Describe and design transmission line with the help of various strip lines
CO2	Design and implement various waveguides like directional coupler, phase shifter, attenuator etc., for real time applications.
CO3	Understand, design and interpret the microwave semiconductor devices for real time microwave communication.
CO4	Understand different microwave tubes and apply them for different real time applications.
CO5	Design set up for different microwave measurements.

Text Book (s)

1.Samuel Y. Liao, "Microwave Devices and Circuits" ,3rd Edition, Pearson education.
2.R.E.Collin, "Foundations for Microwave Engineering", 2nd Edition, Tata McGraw Hill, 1992.

Reference Book (s)

1.D.Pozar, "Microwave Engineering", John Wiley & Sons, New York, 1998. Syllabus

Course Content:

Unit-1 Introduction **8 hours**
Microwave frequency, Applications of Microwave, microwave transmission line, Introduction to Micro strip Transmission line (TL), Coupled TL, Strip TL, Coupled Strip Line, Coplanar TL, Shielded strip lines, smith chart.
Unit-2
Rectangular Wave Guide: Field Components, TE, TM Modes, Dominant (TE10) mode, Power Transmission, Power losses, Excitation of modes, Circular Waveguides: TE, TM modes, Microwave cavities (Resonators), Scattering matrix- The transmission matrix, Passive microwave devices: Microwave Hybrid Circuits, E Plane Tee, H plane Tee and Magic Tee , Terminations, Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Isolators, Circulators.
Unit-3
Operation, characteristics and application of BJTs and FETs, Principles and characterstics: -tunnel diodes, Varactor diodes, PIN diode, Schottky diodes, Transferred Electron Devices : Gunn diode(Gunn Effect, RWH theory, two valley model theory, modes of operation), Avalanche Transit

time devices: IMPATT and TRAPATT devices, Microwave Oscillators and Mixers.
Unit-4
Klystrons, Reentrant Cavities, Velocity-Modulation Process, Bunching Process, Output Power and Beam Loading, Multicavity Klystron Amplifiers, Beam-Current Density, Output Current Output Power of Two-Cavity Klystron, Reflex Klystrons, Velocity Modulation, Power Output and Efficiency, Helix Traveling-Wave Tubes (TWTs), Slow-Wave structures, Amplification Process, Convection Current, Axial Electric Field, Wave Modes, Gain Consideration, Microwave Crossed-Field Tubes , Magnetron Oscillators, Cylindrical Magnetron, Coaxial Magnetron, TunableMagnetron , Backward wave Oscillators.
Unit-5
Introduction, Microwave Measurements devices: Slotted line carriage, Tunable detectors, VSWR Meter, microwave power measurements techniques, frequency measurement, wavelength measurements, Impedance and Refection coefficient measurements, VSWR, Insertion and attenuation measurements: Power ratio method, RF substitution method, VSWR measurements(Low and High). AWR software tool introduction.

Continuous Assessment Pattern

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

Name of The Course	Radar Guidance and Navigation				
Course Code	EEC518				
Pre-requisite	Antenna and Wave Propagation				
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

1. To introduce the fundamental concepts of RADAR (Radio Detection And Ranging) and Navigational aids
2. To provide exposure the students to different types of RADAR systems and Navigation
3. To Understand the needs of technological solution for designing and developing Radar functions and signal scanning
4. To Apply the knowledge of Radar Transmitters and Receivers

Course Outcomes

CO1	Apply the knowledge Radar Equation in various applications
CO2	Analyze Doppler effect, CW and multiple frequency CW Radar
CO3	Describe MTI and Pulse Radar functions and operations
CO4	Understand Radar signal scanning and tracking technique
CO5	Understand function and operation of Radar Transmitters, Antennas and Receivers

Text Book (s)

1. Introduction to Radar System M.I. Skolnik ,Publisher: McGraw Hill
2. Radar Systems and Radio Aids to Navigation, Sen& Bhattacharya, Publisher: Khanna publishers

Reference Book (s)

1. Electronic and Radio Engg. F.E. Terman, Publisher: McGraw Hill
2. Andreas F. Molisch, "Wideband Wireless Digital Communication", Pearson Education 2001.
3. Radar Engg. Hand Book M.I. Skolnik, Publisher: McGraw Hill
4. Roger J Suullivan, "Radar Foundations for Imaging and Advanced Topics

Course Content:

Unit-1 Introduction and Radar equation**10 hours**
Introduction: The simple form of Radar Equation, Radar Block diagram and Operation, Radar Frequencies, millimeter and submilimeter waves, Applications of Radar. Radar Equation: Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Signal to Noise Ratio, Matched filter impulse response, Integration of radar Pulses, Radar Cross Section of Targets, Cross section Fluctuations, Radar Clutter-surface clutter, sea clutter and Land clutter ,weather clutter, Transmitter Power, Pulse Repetition Frequency and Range ambiguities, Antenna Parameters, system losses, propagation effects, other considerations.
Unit-2CW and FM CW Radar **8 Hours**
Doppler effect. CW radar. FM CW radar. Multiple frequency CW Radar.
Unit-3MTI And Pulse Doppler Radar **8 Hours**
Introduction, Delay line Cancellers, Multiple or staggered Pulse Repetition Frequencies, Range gated Doppler Filters, Block Diagram of Digital Signal Processor, Example of MTI radar Processor, , Pulse Doppler Radar, Non coherent MTI ,MTI from moving platform, Other types of MTI, Airborne radar.
Unit-4 Tracking Radar **8 Hours**
Sequential loping, conical scan, Monopulse, Tracking in range and Doppler, Acquisition

Unit-5 Radar Transmitters, Antennas and Receivers and Electronic Scanning Radar **7 Hours**
Principle of phased array for electronic scanning, Advantages and capabilities of electronic scanning, block diagram of an electronic scanning system and its operation

Continuous Assessment Pattern

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

Name of The Course	Introduction to IoT and its Applications				
Course Code	EEC519				
Prerequisite	IoT				
Corequisite	IoT				
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

To understand the basic concept of IoT and study the applications of IoT.

Course Outcomes

CO1	Understand the concepts of Internet of Things
CO2	Analyze basic protocols in wireless sensor network
CO3	Design IoT applications in different domain and be able to analyze their performance
CO4	Implement basic IoT applications on embedded platform
CO5	Analyze and design of academic project

Text Book (s)

1.Rajkumar Buyya, Amir VahidDastjerdi, "Internet of Things Principles and Paradigms " Copyright © 2016 Elsevier Inc.

2.Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015. 2. Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen

Reference Book (s)

1.API Features and Arduino Projects for Linux Programmers", Apress, 2014.

2.Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.

Course Content:

Unit-1 Introduction **8 hours**
The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related, Standardization, Recommendations on Research Topics.
Unit-2 OpenIoT Architecture for IoT **8 hours**
Background/Related Work - OpenIoT Architecture for IoT/Cloud Convergence - Scheduling Process and IoT Services Lifecycle - Scheduling and Resource Management - Validating Applications and Use Cases - Future Research Directions
Unit-3 Device/Cloud Collaboration Framework **8 hours**
Introduction - Background and Related Work - Device/Cloud Collaboration Framework - Powerful Smart Mobile Devices - Runtime Adaptation Engine - Privacy-Protection Solution - Applications of Device/Cloud Collaboration - Context - Aware Proactive Suggestion - Semantic QA Cache - Image and Speech Recognition.- Future Work
Unit-4 Principles, Architectures, and Applications **8 hours**
Principles, Architectures, and Applications: Introduction - Motivating Scenario - Definitions and Characteristics. - Reference Architecture - Applications - Research Directions and Enablers.- Commercial Products - Case Study

Unit-5 Data Transmission	**8 hours**
Introduction - Scenario -- Architecture Overview- Sensors - The Gateway - Summary - Data Transmission	

Continuous Assessment Pattern

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

Name of The Course	Optical Communication				
Course Code	EEC520				
Prerequisite	Communication systems				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives:

- To study about the various optical fiber modes, configuration and transmission characteristics of optical fibers
- To learn about the various optical sources, detectors and transmission techniques
- To explore various idea about optical fiber measurements and various coupling techniques
- To enrich the knowledge about optical communication systems and networks

Course Outcomes

CO1	Understand the evolution of optical system with respect to angles, modes and structure.
CO2	Analyze the different types of Optical Sources and Optical link design
CO3	Evaluate the technical requirements of Systems and identify the suitable Fibre, Transmitters, Receivers and associated system modules.
CO4	Evolve proper Network design for Short / Long distance Optical Communication links taking into consideration potential
CO5	Evaluate SONET / SDH / WDM Systems

Text Book (s)

1. Gerd Keiser, “Optical Fiber Communications” McGraw-Hill, 3rd Edition, 2000.

2. R. Ramaswami& K.N. Sivarajan, Morgan Kaufmann,” Optical Networks A practical perspective”, 2nd Edition, Pearson Education, 2000.

Reference Book (s)

1.John M. Senior , “Optical Fiber Communication”, Second Edition, Pearson Education, 2007.

2.J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 3rd Edition, 2008.

3.J.Gower, "Optical Communication System", Prentice Hall of India, 2001.

Course Content:

Unit-1 Introduction **8 hours**
Introduction to vector nature of light, propagation of light, propagation of light ina cylindrical dielectric rod, Ray model, wave model. Different types of optical fibers, Modal analysis of a step index fiber. Signalde gradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR
Unit-2
Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detectorresponsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

Optical switches - coupled mode analysis of directional couplers, electro-opticswitches.
Unit-3
WDM -WDM Components -Tunable Optical Filters-Multiplexers and Demultiplexers - Add–Drop Multiplexers - Star Couplers- Wavelength Routers- Optical Cross-Connects - Wavelength Converters- - WDM Transmitters and receivers - Nonlinear Raman Crosstalk Stimulated Brillouin Scattering - Cross-Phase Modulation - Four-Wave Mixing – Dispersion -Management-Precompensation Schemes- Post compensation Techniques -Fiber Bragg Gratings- Optical Phase Conjugation- PMD Compensation.
Unit-4
Attenuation measurements- Dispersion measurements – Fiber Refractive index profile measurements – Fiber cut- off Wave length Measurements – Fiber numerical Aperture Measurements – Fiber diameter
Unit-5
Basic Networks – SONET / SDH – Broadcast – and –select WDM Networks –Wavelength Routed Networks – Non linear effects on Network performance –-Link Power budget -Rise time budget-Noise Effects on System Performance-Operational Principles of WDM Performance of WDM + EDFA system – Solutions – Optical CDMA – Ultra High Capacity

Continuous Assessment Pattern

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