GALGOTIAS UNIVERSITY

Email: admissions@galgotiasuniversity.edu.in
Website: www.galgotiasuniversity.edu.in

COURSE BOOK

SCHOOL OF CIVIL ENGINEERING -2020

Volume-I

Curriculum and syllabus for
SCHOOL OF CIVIL ENGINEERING

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

CONTENTS

GALGOTIAS UNIVERSITY

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

Program: B.Tech Civil Engineering

Scheme: 2020-2021

Vision

To be a Centre of Excellence for imparting high end research and technical education in Civil Engineering producing socially aware professionals to provide sustainable solutions to global community.

Mission

M1: To impart quality education and mould technically sound, ethically responsible professionals in the field of Civil Engineering.

M2: Collaborate with industry and society to design a curriculum based on the changing needs of stakeholders and provide excellence in delivery and assessment.

M3: Establish state-of-the-art facilities for world class education and research.

M4: To mentor students in pursuit of higher education, entrepreneurship and global professionalism.

PEOs

PEO1: Graduates shall attain state of the art knowledge in the different streams of Civil Engineering and be trained for playing the role of competent Civil Engineer in multidisciplinary projects.

PEO2: Graduates shall be capable of pursuing productive careers in private and government organizations at the national and international level and to become successful entrepreneurs.

PEO3: Graduates shall display a high sense of social responsibility and ethical thinking and develop sustainable engineering solutions.

PSOs

PSO1: Develop the ability to implement emerging techniques to plan, analyze, design, execute, manage, maintain and rehabilitate systems and processes in diverse area like structural, environmental, geotechnical, transportation and water resources engineering.

PSO2: Excel in research, innovation, design, problem solving using different softwares and artificial intelligence and develop an ability to interact and work seamlessly in multidisciplinary environment.

POs

PO1: Apply the knowledge of Mathematics, Science, and Engineering fundamentals, and an engineering specialization to solution of complex engineering problems (Engineering Knowledge)

PO2: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (Problem analysis)

PO3: Design of solutions for complex engineering problems and design of system components or processes that meet the specified needs with appropriate considerations of public health and safety, and cultural, societal, and environmental considerations (Design/development of solutions)

PO4: Use research based methods including design of experiments, analysis and interpretation of data and synthesis of information leading to logical conclusions (Conduct investigations of complex problems)

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling complex engineering activities with an understanding of limitations (Modern tool usage)

PO6: Apply reasoning within the contextual knowledge to access societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice (The engineer and society)

PO7: Understand the impact of the professional engineering solutions in the societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments (Environment and sustainability)

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice (Ethics)

PO9: Function effectively as an individual independently and as a member or leader in diverse teams, and in multidisciplinary settings (Individual and team work)

PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large such as being able to comprehend and write effective reports and design documentation, make effective oral presentations, and give and receive clear instructions (Communication)

PO11: Demonstrate knowledge and understanding of engineering management principles and apply those to one's own work as a member and leader of a team to manage projects in multidisciplinary environments (Project management and finance)

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (Life-long Learning).

Curriculum

Semester 1									
Sl. No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1		Energy Sources and Audit	1	0	0	1	20	30	50
2		Data Analytics (Excel and Tableu)	1	0	0	1	20	30	50
3		AI Fundamentals	2	0	0	2	20	30	50
4		Differential / Vector calculus and Matrices	3	0	0	3	20	30	50
5		Programming for Problem Solving (C)	1	0	4	3	20	30	50
6		Communication Skill (BEC-1)	3	0	0	3	20	30	50
7		Engineering Physics	2	0	0	2	20	30	50
8		Engineering Physics Lab	0	0	2	1	50	-	50
9		Bio Systems in Engineering	2	0	0	2	20	30	50
10		AC DC Circuits	2	0	2	3	20	30	50
		Total				**21**			
Semester II									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1		Integral and Multiple Calculus	2	0	0	2	20	30	50
2		Partial Differential Equations	1	0	0	1	20	30	50
3		Embedded Technology and IOT	1	0	2	2	20	30	50
4		Waste Management	0	0	2	1	50	-	50
5		Environmental Science	0	0	1	0.5	50	-	50
6		Liberal and Creative Arts	0	0	1	0.5	50	-	50
7		Creativity, Innovation and Entrepreneurship	1	0	2	2	20	30	50
8		Application of Python Programming	0	0	2	1	50	-	50
9		Introduction to Digital System	2	0	2	3	20	30	50
10		Data Structure Using C	2	0	2	3	20	30	50
11		Digital Fabrication	0	0	2	1	50	-	50
12	BCE01T3201	Engineering Mechanics	3	0	0	3	20	30	50
		Total				**20**			
Semester III									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1		Mathematics-III (Functions of Complex Variables and Transforms)	3	0	0	3	20	30	50
2		Aptitude building and Logical Reasoning - I	0	0	2	1	50	-	50
3		Disruptive Technologies	0	0	4	2	50	-	50
4		AI and its Applications	0	0	4	2	50	-	50
5	BCE01T3301	Mechanics of Materials	3	0	0	3	20	30	50
6	BCE01T3302	Fluid Mechanics	3	0	0	3	20	30	50
7	BCE01T3303	Surveying	3	0	0	3	20	30	50

8	BCE01P3302	Fluid Mechanics Lab	0	0	2	1	50	-	50
9	BCE01P3303	Surveying Practices	0	0	2	1	50	-	50
10	BCE01P3304	Engineering Drawing	0	0	4	2	50	-	50
11	BCE01P3301	Mechanics of Materials Lab	0	0	2	1	50	-	50
		Total				**22**			
Semester IV									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1		Mathematics-IV (Numerical and Computational Methods)	2	0	0	2	20	30	50
2		Numerical and Computational Methods Lab	0	0	2	1	50	-	50
3		Aptitude building and Logical Reasoning - II	0	0	2	1	50	-	50
4		Engineering Clinic - I (IOT)	0	0	2	1	50	-	50
5		Communication Skill (BEC-2) - 3 credit	3	0	0	3	20	30	50
6	BCE01T3402	Construction Engineering	3	0	0	3	20	30	50
7	BCE01T3401	Structural Analysis	3	0	0	3	20	30	50
8	BCE01T3404	Hydrology & Hydraulic Systems	3	0	0	3	20	30	50
9	BCE01T3403	Geotechnical Engineering	3	0	0	3	20	30	50
10	BCE01P3401	Structural Analysis Lab	0	0	2	1	50	-	50
11	BCE01P3403	Geotechnical Engineering Lab	0	0	2	1	50	-	50
12	BCE01P3402	Construction Engineering Lab	0	0	2	1	50	-	50
		Total				**23**			
Semester V									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1		Engineering Economics and Management	3	0	0	3	20	30	50
2		Engineering Clinic - II (Machine Learning)	0	0	2	1	50	-	50
3		Aptitude building and Logical Reasoning - III	0	0	2	1	50	-	50
4	BCE01T3501	Design of Reinforced Concrete Structures	3	0	0	3	20	30	50
5	BCE01T3502	Transportation Engineering - I	3	0	0	3	20	30	50
6	BCE01T3503	Water Supply & Treatment Systems	3	0	0	3	20	30	50
7		Program Elective - I	2	0	0	2	20	30	50
8	BCE01P3504	CAD Lab - I (AUTOCAD)	0	0	4	2	50	-	50
9	BCE01P3502	Transportation Engineering Lab	0	0	2	1	50	-	50
10	BCE01P3503	Water Quality Analysis Lab	0	0	2	1	50	-	50
11		Social Internship	0	0	2	1	50	-	50
12		Hobby Class	0	0	1	0.5	50	-	50
13	BCE01P3505	Industrial Internship - I	0	0	0	1	50	-	50
		Total				**22.5**			

Semester VI									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1		Excel Training & PPT Training	0	0	1	0.5	50	-	50
2	BCE01T3601	Design of Steel Structures	3	0	0	3	20	30	50
3		Foreign Language (German / Japanese / French)	0	0	4	2	50	-	50
4	BCE01P3605	Analysis and Design Lab (STAAD PRO)	0	0	2	1	50	-	50
5		Aptitude building and Logical Reasoning - IV	0	0	2	1	50	-	50
6	BCE01P3606	Design and Innovation	0	0	2	1	50	-	50
7		Open Elective - I	3	0	0	3	20	30	50
8		Program Elective - II	2	0	0	2	20	30	50
9		Program Elective - III	2	0	0	2	20	30	50
10	BCE01T3602	Transportation Engineering - II	3	0	0	3	20	30	50
11	BCE01T3603	Waste Water Treatment & Disposal Systems	3	0	0	3	20	30	50
12	BCE01T3604	Quantity Surveying and Estimating	2	0	0	2	20	30	50
13	BCE01P3604	Quantity Surveying and Estimating Lab (PRIMAVERA)	0	0	2	1	50	-	50
		Total				**24.5**			

Semester VII									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1		Program Elective - IV	2	0	0	2	20	30	50
2		Program Elective - V	2	0	0	2	20	30	50
3	BCE01T3701	Remote Sensing & Geographical Information System	1	0	2	2	20	30	50
4		Campus to Corporate	3	0	0	3	20	30	50
5		Ethics and Professional Competency	0	0	2	1	50	-	50
6	BCE01P3998	Capstone Phase-1	0	0	4	2	50	-	50
7		Open Elective - II	3	0	0	3	20	30	50
8	BCE01P3702	Project Planning and Management Lab (PRIMAVERA)	0	0	2	1	50	-	50
9	BCE01P3703	Industrial Internship - II	0	0	0	1	50	-	50
		Total				**17**			

Semester VIII									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE01P3999	Capstone Phase-2	0	0	20	10	50	-	50
		Total				**10**			

List of Program Electives

Basket 1 (Geotechnical)

Sl No	Course Code	Name of the Electives				Assessment Pattern			
			L	T	P	C	IA	MTE	ETE
1	BCE01T5501	Advanced Geotechnical Engineering	2	0	0	2	20	30	50
2	BCE01T5502	Ground Improvement Techniques	2	0	0	2	20	30	50
3	BCE01T5503	Soil Dynamics and Machine Foundation	2	0	0	2	20	30	50
4	BCE01T5504	Structures on Expansive Soils	2	0	0	2	20	30	50
5	BCE01T5505	Foundation Engineering	2	0	0	2	20	30	50
6	BCE01P5506	Mini Project	0	0	4	2	50	-	50

Basket 2 (Transportation)

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE01T5601	Mass Transport Management	2	0	0	2	20	30	50
2	BCE01T5602	Traffic Engineering	2	0	0	2	20	30	50
3	BCE01T5603	Highway Pavement Design	2	0	0	2	20	30	50
4	BCE01T5604	Pavement Constructions	2	0	0	2	20	30	50
5	BCE01T5605	Transportation Safety and Environment	2	0	0	2	20	30	50
6	BCE01P5606	Mini Project	0	0	4	2	50	-	50

Basket 3 (Environment)

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE01T5621	Pollution Control and Monitoring	2	0	0	2	20	30	50
2	BCE01T5622	Air and Noise Pollution	2	0	0	2	20	30	50
3	BCE01T5623	Solid Waste Management	2	0	0	2	20	30	50
4	BCE01T5624	Bioenergy Technologies	2	0	0	2	20	30	50
5	BCE01T5625	Environmental Ecology	2	0	0	2	20	30	50
6	BCE01P5626	Mini Project	0	0	4	2	50	-	50

Basket 4 (Structures)

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE01T5701	Advanced Structural Analysis	2	0	0	2	20	30	50
2	BCE01T5702	Rehabilitation of structures & Vaastu Principles	2	0	0	2	20	30	50
3	BCE01T5703	Bridge Engineering	2	0	0	2	20	30	50
4	BCE01T5704	Earthquake Engineering	2	0	0	2	20	30	50

5	BCE01T5705	Advanced Concrete Design	2	0	0	2	20	30	50
6	BCE01P5706	Mini Project	0	0	4	2	50	-	50

Basket 5 (Construction Management)

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE01T5721	Construction Planning and Management	2	0	0	2	20	30	50
2	BCE01T5722	Economics and Project Finance for Civil Engineers	2	0	0	2	20	30	50
3	BCE01T5723	Construction Contracts Administration and Management	2	0	0	2	20	30	50
4	BCE01T5724	Value Engineering and Valuation	2	0	0	2	20	30	50
5	BCE01T5725	Infrastructure Development	2	0	0	2	20	30	50
6	BCE01P5726	Mini Project	0	0	4	2	50	-	50

Minor Courses

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE01T3303	Surveying	3	0	0	3	20	30	50
2	BCE01T3402	Construction Engineering	3	0	0	3	20	30	50
3	BCE01T3403	Geotechnical Engineering	3	0	0	3	20	30	50
4	BCE01T3301	Mechanics of Materials	3	0	0	3	20	30	50
5	BCE01T3503	Water Supply & Treatment Systems	3	0	0	3	20	30	50
6	BCE01T3502	Transportation Engineering - I	3	0	0	3	20	30	50
		Total Credit				**18**			

Major Courses

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE01T3711	Pre Stressed Concrete Structures	3	0	0	3	20	30	50
2	BCE01T3712	Applications of Matrix Methods in Structural Analysis	3	0	0	3	20	30	50
3	BCE01T3713	Open Channel Hydraulics	3	0	0	3	20	30	50
4	BCE01T3714	Water Resources Systems Engineering	3	0	0	3	20	30	50
5	BCE01T3715	Transport Planning and Management	3	0	0	3	20	30	50
6	BCE01T3716	Industrial Waste Treatment and Disposal	3	0	0	3	20	30	50
		Total Credit				**18**			

Name of The Course	Engineering Mechanics			
Course Code	BCE01T3201			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. To enable students to calculate the reactive forces.
2. To make students to learn the geometric properties of different shapes.
3. To enable students to determine stresses and strains for axially loaded member.
4. Students will be taught to draw shear force diagrams and bending moment diagrams.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand fundamental principles of forces and the concept of free body diagram.
CO2	Calculate the centroid, centre of gravity and moment of inertia of various surfaces.
CO3	Determine stresses and strains for one dimensional axially loaded member.
CO4	Analyze plane trusses by different methods.
CO5	Draw the shear force diagrams and bending moment diagrams for statically determinate beams.
CO6	Discussion on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to Mechanics & Equilibrium of Forces 8 lecture hours
Fundamental Principles - Vectorial Representation of Forces - Coplanar forces - Resolution and Composition of forces and equilibrium of particles – introduction of Forces on a particle in space - Equivalent system of forces - Principle of transmissibility - Single equivalent force - Free body diagram - Equilibrium of rigid bodies in two dimensions and three dimensions.
Unit II: Properties of Surfaces 8 lecture hours
Centroid – Centre of gravity – Parallel axis theorem - First moment of area – Second moment of area – Product of inertia of plane areas – Polar moment of inertia.
Unit III: Stresses & Strains 8 lecture hours
Axial Stress and Strain - Solution of simple problems – Tapered Section - One Dimensional axial loading of members of varying cross-section – Stress - Strain Diagram of mild steel.
Unit IV: Analysis of plane truss 8 lecture hours
Trusses: Introduction - Simple Truss - Analysis of Simple truss - Method of Joints - Method of Sections – Tension Coefficient Method.
Unit V: Introduction to shear force and bending moment 8 lecture hours
Beam: Introduction, Shear force and Bending moment, Shear Force Diagram and Bending Moment Diagram for statically determinate beams.
Unit VI: Discussion on Latest Research Paper 2 lecture hours
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Tayal. A. K. (2009), Engineering Mechanics – Statics and Dynamics, 12th Edition, Umesh Publications, ISBN: 9788188114016
2. Punamia B. C. (2010), Mechanics of Materials, 15th Edition, Laxmi publications (P) Ltd, ISBN:

9788131806463.

3. Shames I. H. (2006), Engineering Mechanics – Statics and Dynamics, 4th Edition, Prentice-Hall of India Private limited, ISBN- 9780133569247.

Name of The Course	**Fluid Mechanics**			
Course Code	**BCE01T3302**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To enable the students to understand fluid properties.
2. To enable the students to explain different types of flows.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand fluid properties.
CO2	Determine momentum and energy correction factors.
CO3	Explain open channel flow.
CO4	Apply Buckingham π theorem.
CO5	Distinguish between laminar flow and turbulent flow.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Fluid Properties and Hydrostatics **8 lecture hours**
Density – Viscosity – Surface tension – compressibility – capillarity – Hydrostatic forces on plane – inclined and curved surfaces – buoyancy – centre of buoyancy – metacentre.
Unit II: Fluid Dynamics **9 lecture hours**
Control volume – Fluid Kinematics - Types of flows; Steady flow, Unsteady flow, Uniform and Non Uniform flow, Rotational flow, Irrotational flow, 1-D, 2-D, 3-D flows– Streamline and Velocity potential lines- Euler and Bernoulli's equations and their applications – moment of momentum – Momentum and Energy correction factors – Impulse – Momentum equation - Navier-Stokes Equations-Applications
Unit III: Open Channel Flow **9 lecture hours**
Flow through pipes – Open Channels and Measurement pipe flow: Darcy's law – Minor losses – Multi reservoir problems – pipe network design – Moody's diagram – Hagen Poiseuille equation – Turbulent flow. Specific Energy – Critical flow concept – specific force – Hydraulic jump – uniform flow and gradually varying flow concepts. – Measurement of pressure – flow – velocity through pipes and open channels.
Unit IV: Dimensional Analysis **6 lecture hours**
Dimensional homogeneity – Raleigh and Buckingham π theorems – Non-dimensional numbers – Model laws and distorted models - Module quantities - Specific quantities.
Unit V: Boundary layers **8 lecture hours**
Boundary layers – Laminar flow and Turbulent flow – Boundary layer thickness – momentum – Integral equation – Drag and lift-Separation of boundary layer-Methods of separation of boundary layer.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. R. K. Bansal (2010), A Textbook of Fluid Mechanics and Hydraulic Machines 9th Ed. Laxmi Publication, ISBN- 9788131808153.

2. P. N. Modi and S. M. Seth (2011), Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Publications. ISBN- 9788189401269.

3. V.L. Streeter, (2001), Fluid Mechanics, McGraw Hill Book Co. ISBN – 9780071156004.

Name of The Course	**Surveying**			
Course Code	**BCE01T3303**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To enable the students to understand the basics of surveying and different techniques of surveying.
2. To help the students to learn the field applicability of the different survey methods.
3. To make the students learn different types of errors encountered in different types of surveying.

Course Outcomes

On completion of this course, the students will be able to

CO1	Learn about basics involved in different types of surveying like tape, compass, leveling, and theodolite (total station).
CO2	Demonstrate skills in performing measurement of distance, angles, leveling, and curve setting.
CO3	Develop skills for estimating distance between given points, area of a given plot and earthwork involved in cuttings and fillings.
CO4	Develop skill to carry out tachometry, geodetic surveying wherever situation demands.
CO5	Develop skills to apply error adjustment to the recorded reading to get an accurate surveying output.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Plane Surveying and Theodolite **9 lecture hours**
Introduction to plane surveying, conventional tape measurement, electronic distance measurement – Meridians, Azimuths and bearings – Theodolites – Temporary and permanent adjustment – Horizontal and Vertical angle measurements – Electronic total station.
Unit II: Leveling and Contouring **8 lecture hours**
Differential leveling, Longitudinal & cross section leveling, Refraction & curvature correction, Reciprocal leveling -Tachometry – Stadia tachometry, tangential tachometry & substance tachometry- Contouring.
Unit III: Calculation of Earthwork and GPS **8 lecture hours**
Area, volume calculation of earth work – Introduction to Global positioning system – GPS surveying methods.
Unit IV: Curve Surveying **6 lecture hours**
Definitions, designation of curve, elements of simple curve - Settings of simple circular curve, Compound and reverse curve- Transition curve – Introduction to vertical curves.
Unit V: Geodetic surveying **9 lecture hours**
Introduction to geodetic surveying, Triangulation surveying – Base line measurement & correction, Satellite station. Surveying adjustments – Principle of least square and adjustment of triangulation network.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**

This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Punmia B.C. (2005), Surveying, Volume 1, 16th Edition Laxmi Publications. ISBN: 9788170080794
2. Punmia B.C. (2005), Surveying, Volume 2, 15th Edition Laxmi Publications. ISBN: 9788170080800
3. Kanetkar T.P. (2006), Surveying and Levelling, Vol I, Pune. ISBN: 9788185825113.
4. Kanetkar T.P. (2008), Surveying and Levelling, Vol II, Pune. ISBN: 9788185825007

Name of The Course	**Mechanics of Materials**				
Course Code	**BCE01T3301**				
Prerequisite	BCE01T3201				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. To know the concept of stresses and strains.
2. To know the concept of shear force and bending moment.
3. To calculate deflection in beams and trusses.
4. To determine the buckling and crushing load of compression members.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the concepts of volumetric strain, principle stresses and torsion.
CO2	Analyse shear force and bending moment for different types of beams.
CO3	Calculate deflections in beams.
CO4	Determine deflections in plane trusses.
CO5	Distinguish between short column and long column.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Volumetric Strain, Principle Stresses and Torsion **10 lecture hours**
Bulk Modulus – Modulus of rigidity – Change in volume – Volumetric Strain - Principle stresses - Mohr's circle – Introduction to torsion - Torsion of shafts of circular section - torque and twist - shear stress due to torque.
Unit II: Shear Force and Bending Moment **8 lecture hours**
Types of beams, supports and loadings - shear force and bending moment diagram - bending stresses and shear stresses in beams.
Unit III: Deflection of Beams **8 lecture hours**
Introduction - Theory of bending - deflection of beams by Macaulay's method - moment area method and conjugate beam method.
Unit IV: Strain Energy **7 lecture hours**
Strain Energy - Castigliano's theorem - calculation of deflection in statically determinate beams and plane trusses - Unit load methods - Williot Mohr's diagram.
Unit V: Theory of Columns **7 lecture hours**
Theory of Columns - long column and short column - Euler's formula - Rankine's formula - Secant formula - beam column.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Gere J. M. and Thimoshenko S. P. (2008), Mechanics of Materials, 8th Edition, CBS Publishers & Distributors, ISBN: 9780534417932.

2. Popov E. P. (2009), Engineering Mechanics of Solids, 2nd Edition, Prentice Hall Publisher, ISBN: 9788120321076.
3. Bansal R. K. (2010), Strength of Materials, 4th Edition, Laxmi Publications, ISBN: 9788131808146.

Name of The Course	Mechanics of Materials Lab			
Course Code	BCE01P3301			
Prerequisite	BCE01T3301			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	2	1

Course Objectives

1. To supplement the theoretical knowledge gained in Mechanics of Materials with practical testing for determining the strength of materials under externally applied loads.
2. This would enable the student to have a clear understanding of the design for strength and stiffness.

Course Outcomes

On completion of this course, the students will be able to

CO1	Conduct tension and compression tests on the components.
CO2	To determine hardness, impact strength, fatigue strength of the specimens.
CO3	Measure strain and load using specific gauges.
CO4	Measure torsion in mild steel.
CO5	Compression and tension test on helical springs.

Continuous Assessment Pattern

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

List of Experiments:

1. Tension test on a mild steel rod, thin and twisted bars.
2. Compression test on Bricks, Concrete blocks.
3. Double shear test on Mild steel and aluminium rods.
4. Impact test on metal specimen (Charpy test and Izod test).
5. Hardness test on metals (Steel, Copper and Aluminium) - Brinell Hardness Number.
6. Hardness test on metals (Steel, Copper and Aluminium) - Rockwell Hardness Number.
7. Deflection test – Verification of Maxwell theorem.
8. Compression and tension test on helical springs.
9. Fatigue test on Steel.
10. Torsion test on mild steel

Aluminium

Suggested Reading

1. Gere J. M. and Thimoshenko S. P. (2008), Mechanics of Materials, 8th Edition, CBS Publishers & Distributors, ISBN: 9780534417932.
2. Popov E. P. (2009), Engineering Mechanics of Solids, 2nd Edition, Prentice Hall Publisher, ISBN: 9788120321076.
3. Bansal R. K. (2010), Strength of Materials, 4th Edition, Laxmi Publications, ISBN: 9788131808146.

Name of The Course	Fluid Mechanics Lab			
Course Code	BCE01P3302			
Prerequisite	BCE01T3302			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	2	1

Course Objectives

1. Introduce concepts, laws, observations, models of fluids at rest and in motion and understanding fluid behavior for engineering design and control of fluid system.
2. Develop competence with mass, energy and momentum balances for determining resultant interactions of flows and engineered and natural systems.
3. The development of boundary layers and advancement of practical hydraulics and

understanding the concept of advanced fluid mechanics.

Course Outcomes

On completion of this course, the students will be able to

CO1	To find frictional losses in a pipe when there is a flow between two places.
CO2	Calculation of conjugate depth in a flow and to analyse the model and prototype.
CO3	Find the dependent and independent parameters for a model of fluid flow.
CO4	Explain the various methods available for the boundary layer separation
CO5	Calculate losses in pipe.

Continuous Assessment Pattern

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

Course Content:

1. Verification of Bernoullis Theorem
2. Metacentric Height
3. Calibration of V- Notch
4. Calibration of Rectangular Notch
5. Calibration of Trapezoidal Notch
6. Calibration of Venturimeter
7. Calibration of Orificemeter
8. Losses in Pipes

Suggested Reading

1. R. K. Bansal (2010), A Textbook of Fluid Mechanics and Hydraulic Machines 9th Ed. Laxmi Publication, ISBN- 9788131808153.

2. P. N. Modi and S. M. Seth (2011), Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Publications. ISBN- 9788189401269.

3. D.S. Kumar (2004), Fluid Mechanics and Fluid Power Engineering, Katson Publishing House, ISBN - 9788185749181.

4. V.L. Streeter, (2001), Fluid Mechanics, McGraw Hill Book Co. ISBN – 9780071156004.

Name of The Course	**Surveying Practices**			
Course Code	**BCE01P3303**			
Prerequisite	BCE01T3303			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. To teach the students basics of surveying and expose different techniques of surveying.
2. To help the students to learn the field applicability of the different survey methods.
3. To teach students about types of errors encountered in different types of surveying.

Course Outcomes

On completion of this course, the students will be able to

CO1	Learn about basics involved in different types of surveying like tape, compass, leveling, and theodolite (total station).
CO2	Demonstrate skills in performing measurement of distance, angles, leveling, and curve setting.
CO3	Develop skills for estimating distance between given points, area of a given plot and earthwork involved in cuttings and fillings.
CO4	Develop skill to carry out tachometry, geodetic surveying wherever situation demands.
CO5	Develop skills to apply error adjustment to the recorded reading to get an accurate surveying output.

Continuous Assessment Pattern

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

List of Experiments:

1. Chain Survey- Determination of area by perpendicular offsets
2. Chain Survey- Measurement of distance by chaining & ranging

3. Compass Survey- Plotting & adjustment of closed traverse
4. Theodolite Survey- Measurement of horizontal angles by method of repetition
5. Measurement of Vertical Angles and Determination of Height of an Object
6. Plane Table Survey- Radiation method
7. Levelling- Rise & Fall method
8. Levelling- Height of collimation method
9. Trignometrical Levelling- Single plane method
10. Curve Surveying- Setting out a simple circular curve by Rankine's method
11. Contouring- To determine the contours for a given location
12. GPS Survey- Coordinates & Distance measurement using GPS
13. Total Station- Measurement of Altitude of Given Elevated Points
14. Total Station- Measurement of distance & coordinates of given points
15. Stereoscope- Use of stereoscope for 3D viewing
16. Stereoscope- Determination of height of objects from a stereo pair using the parallax bar

Suggested Reading

1. Punmia B.C. (2005), Surveying, Volume 1, 16th Edition Laxmi Publications. ISBN: 9788170080794
2. Punmia B.C. (2005), Surveying, Volume 2, 15th Edition Laxmi Publications. ISBN: 9788170080800
3. Kanetkar T.P. (2006), Surveying and Levelling, Vol I, Pune. ISBN: 9788185825113.
4. Kanetkar T.P. (2008), Surveying and Levelling, Vol II, Pune. ISBN: 9788185825007

Name of The Course	**Engineering Drawing**			
Course Code	**BCE01P3304**			
Prerequisite	BCE01T3201			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	4	2

Course Objectives

1. To create awareness and emphasize the need for Engineering Drawing in all the branches of engineering.
2. To follow basic drawing standards and conventions.
3. To develop skills in three-dimensional visualization of engineering component.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the needs and objectives for engineering drawings.
CO2	Solve specific geometrical problems in plane geometry involving lines.
CO3	Produce orthographic projection for points and lines.
CO4	Draw orthographic projections for planes.
CO5	Draw orthographic projections for solids.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction **9 lecture hours**
Engineering Drawing: An Overview, its need and objectives. Introduction to Computer Aided Drafting- Introduction to AutoCAD/CATIA; Initial setup commands, Utility commands, drawing aids, entity draw commands, display commands and edit commands.
Unit II: Lettering, Numerals and Dimensioning **9 lecture hours**
Drawing scale, various types of lines and their uses. Lettering. Dimensioning; Basic types of dimensioning
Unit III: Orthographic Projection – Points and Lines **10 lecture hours**
Object in four quadrant, 2-D description of quadrants. Projection of points. Projection of

lines- Inclined lines, projection of a skew line, line parallel to perpendicular plane.
Unit IV: Orthographic Projection –Planes **10 lecture hours**
Planes under study, classification of planer surface, projection of planer surface- principal, inclined, oblique planes.
Unit V: Orthographic Projection – Solids **10 lecture hours**
Introduction- Division of engineering solids, Polyhedra- Regular and Irregular polyhedral, solids of revolution, projection of solids. Axis inclined to one reference plane and parallel to the other.

Suggested Reading

1. Kulkarni D.M., Rastogi A.P. and Sarkar A.K., "Engineering Graphics with AutoCAD", PHI Learning Private Limited, New Delhi, 2010.
2. Bhatt N. D., "Engineering Drawing", Charotar publishing House, 1998.
3. French and Vierk, "Fundamentals of Engineering Drawing", McGraw Hill, 2002.
4. John K.C., "Engineering Graphics for Degree", PHI Learning Private Limited, New Delhi, 2010.

Name of The Course	**Structural Analysis**			
Course Code	**BCE01T3401**			
Prerequisite	BCE01T3301			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To understand the concept of static indeterminacy.
2. To know the different techniques available for the analysis of statically indeterminate structures.
3. To identify the best suitable method of analysis.

Course Outcomes

On completion of this course, the students will be able to

CO1	Identify the method of analysis for statically indeterminate structures.
CO2	Understand the difference between statically determinate structures and statically indeterminate structures.
CO3	Use the influence line diagram for analysing beam.
CO4	Understand strain energy method to analyse arches.
CO5	Analyse beams and portals by slope deflection method.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Theorem of Three Moments **8 lecture hours**
Static indeterminacy - Theorem of three moments - analysis of propped cantilevers - fixed & continuous beam - bending moment and shear force diagram.
Unit II: Strain Energy Method **8 lecture hours**
Static indeterminacy - Strain energy method - analysis of indeterminate structures, beams, pin jointed and rigid jointed structures - temperature effect - bending moment and shear force diagram.
Unit III: Influence Line **8 lecture hours**
Influence line - influence lines for bending moment and shear force for beams, Muller Breaslau's principle - Maxwell's reciprocal theorem - Maxwell Betti's theorem.
Unit IV: Analysis of Arches **8 lecture hours**

Two hinged and three hinged parabolic arches - circular arches - cables - tension forces in towers - influence line for horizontal thrust and bending moment.
Unit V: Slope deflection method **8 lecture hours**
Kinematic indeterminacy - Slope deflection method - analysis of continuous beams and portals - bending moment and shear force diagram.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Vazirani & Ratwani (2003), Analysis of Structures, Vol. 1 & II, Khanna Publishers, ISBN: 0125249853.
2. S. Ramamrutham (2004), Theory of Structures, 5thEdition, Dhanpat Rai Publications, ISBN: 978041528091
3. C. S. Reddy (2010), Structural Analysis, 3rd Edition, Tata McGraw Hill, ISBN:9780070702769.
4. Kenneth M. Leet, Gilbert A, Uang C. M. (2010), Fundamentals of Structural Analysis, 4th Edition, Tata McGraw Hill,ISBN:9780071289382.

Name of The Course	**Construction Engineering**			
Course Code	**BCE01T3402**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To know different types of modern construction materials and their uses.
2. To know different types of cement, mineral and chemical admixtures, aggregates and their Engineering properties and uses.
3. To understand the properties and application of various special concretes.
4. To know the methodology of mix design and their application in accordance with various field conditions.

Course Outcomes

On completion of this course, the students will be able to

CO1	Develop ability to choose the modern construction materials appropriate to the climate and functional aspects of the buildings.
CO2	Supervise the construction technique to be followed in brick and stone masonry, concreting, flooring, roofing and plastering etc.
CO3	Understand the properties of cement and its laboratory testing methods.
CO4	Determine quality of fine aggregate and course aggregate.
CO5	Learn about the different properties of concrete.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Properties of Construction Materials **8 lecture hours**
Physical and Mechanical properties of construction materials – Bricks - Stones - Structural Steel and Aluminum – Roofing Material – Physical descriptions of asbestos sheets, GI sheets, tubes and light weight roofing materials - Timber and its Products – Modern materials – Neoprene - Thermo Cole - Vinyl flooring - decorative panels and laminates - anodized aluminum - architectural glass and ceramics - Ferro cement – PVC - Polymer base materials and FRP.

Unit II: Construction Technology **8 lecture hours**
Introduction to Masonry design, Principles of construction– Bonding – Reinforced brick work – – Stone masonry – Hollow block masonry - Pointing - Plastering – DPC Floor and Roof Construction: Floors, General Principles – Types of floors – Floor coverings – Types of roofs.
Unit III: Calculation of Earthwork and GPS **8 lecture hours**
ASTM classification of Cement – Properties of Cement - Testing of Cement – Field Testing – Laboratory Testing methods – Setting time of cement – soundness of cement – fineness and compressive strength of cement - Heat of Hydration.
Unit IV: Fine Aggregate and Coarse Aggregate **8 lecture hours**
Fine aggregate – Properties and testing methods – Bulking of Sand – sieve analysis – fineness modulus of sand - Cement mortar – properties and uses, Chemical Admixtures- Plasticizer – super plasticizer – air entraining agents etc.
Unit V: Properties of Concrete **8 lecture hours**
Concrete – selection of materials for concrete - water cement ratio - Properties of fresh concrete - workability – measurement of workability – Strength of concrete – gain of strength with age – testing of hardened concrete - Compressive strength - Tensile strength – Flexural strength – modulus of elasticity of concrete – Introduction to Mix Design of concrete.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Shetty, M.S. (2010), Concrete Technology, S. Chand & Company Ltd. ISBN- 9788121900034.
2. Neville. A.M. (2010) Specification of Properties of Concrete, Standard Publishers Distributors. ISBN- 9780273755807
3. Gambhir, M. L. (2012), Concrete Technology, McGraw- Hill. ISBN- 9780070151369.
4. 4. IS: 10262-2009, Guidelines for concrete mix design proportioning, BIS, New Delhi.

Name of The Course	**Geotechnical Engineering**			
Course Code	**BCE01T3403**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To impart the fundamental concepts of soil mechanics.
2. To understand the bearing capacity.
3. To know the importance of index properties like grain size, consistency limits, soil classification.
4. To understand the concept of compaction and consolidation of soils.

Course Outcomes

On completion of this course, the students will be able to

CO1	Give an engineering classification of a given soil.
CO2	Understand the principle of effective stress, and then calculate stresses that influence soil behavior.
CO3	Determine soil deformation parameters, and calculate settlement magnitude and rate of settlement.
CO4	Specify soil compaction requirements.
CO5	Conduct laboratory tests, and obtain soil properties and parameters from the test observations and results.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**

20	30	50	100

Course Content:

Unit I: Weight volume relations and Index properties **12 lecture hours**
Distribution of soil in India, Soil - Types, 3-phase diagram, Weight-volume relations, Classification, Index properties (Atterberg's limits), Theory of compaction, Importance of geotechnical engineering.
Unit II: Soil water and Permeability **8 lecture hours**
Soil water - Effective and neutral stresses – Flow of water through soils – Permeability – Darcy's law –Seepage and flow-nets - Quick sand conditions.
Unit III: Stress distribution in soils **8 lecture hours**
Vertical pressure distribution- Boussinesq's equation for point load and uniformly distributed loads of different shapes– Newmark's influence chart – Westergaard's equation – Isobar diagram – Pressure bulb - Contact pressure, Earth Pressures Theories.
Unit IV: Compressibility and Consolidation **8 lecture hours**
Compressibility – e-log p curve – Pre-consolidation pressure - Primary consolidation – Terzaghi'sconsolidation theory - Laboratory consolidation test – Determination of C_v by Taylor's and Casagrande's methods.
Unit V: Shear strength of soils **9 lecture hours**
Stress analysis by Mohr's circle - Mohr's strength theory – Shear strength of soils – Mohr-Coloumb strength envelope – Laboratory shear tests – Direct shear test – Triaxial compression – Unconfined compression test – Vane shear test – Shear strength of saturated cohesive soils – Shear strength of cohesion less soils - conditions for liquefaction.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. K.R.Arora (2011), Soil Mechanics and Foundation Engineering, Standard Publishers Distributors, Delhi, ISBN: 978-81-801-4112-6.
2. Arun Kr. Jain, B.C. Punmia, Ashok Kr. Jain (2005), Soil Mechanics and Foundations, Sixteenth Edition, Laxmi Publications. ISBN: 978-81-700-8791-5.
3.Gopal Ranjan, A.S.R Rao (2000), Basic and Applied Soil Mechanics 2nd Edition, New Age International. ISBN: 978-81-224-1223-9.
4. William Powrie, Soil Mechanics: Concepts and Applications, Second Edition, Spon Press. ISBN: 978-04-153-1156-4.
5. Karl Terzaghi, Soil Mechanics in Engineering Practice, Warren Press. ISBN: 978-14-465-1039-1.

Name of The Course	**Hydrology & Hydraulic Systems**			
Course Code	**BCE01T3404**			
Prerequisite	BCE01T3302			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To understand the concept of weather and hydrology.
2. To have an idea about precipitation and abstraction.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the importance of hydrology.
CO2	Explain diurnal and monsonic wind systems.
CO3	Process and analyze precipitation data.

CO4	Distinguish between centrifugal pump and Reciprocating pump.
CO5	Determine the specific speed for different types of turbines.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction **9 lecture hours**
Definition – Development of hydrology – hydrologic design – Hydrologic failures – Importance in Engineering – Hydrological budget.
Unit II: Hydro Meteorology **9 lecture hours**
Weather and hydrology – General circulation Temperature humidity – Wind – Diurnal and monsonic wind systems.
Unit III: Precipitation and Abstraction **9 lecture hours**
Formation of precipitation – forms of precipitation – types of precipitation – Rainfall measurement – gauges – recorders – processing precipitation data – check for consistency – supply of missing data – Aerial mean mass curve technique – Intensity duration frequency curves. Process of evaporation, transpiration – Infiltration factors affecting evaporation – Measurement of evaporation and infiltration indices – Horton's equation.
Unit IV: Pumps **9 lecture hours**
Centrifugal pump – velocity triangle – characteristic curves – specific speed – applications – Reciprocating pump – types – Indicator diagram – acceleration and friction – air vessels.
Unit V: Turbines **9 lecture hours**
Classification – Pelton Turbine – Francis Turbine – Kaplan Turbine - velocity triangle – characteristic curves – specific speed.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1.Subramanya K. (2008), Engineering Hydrology, Tata McGraw Hill Co., Graw Hill Co. ISBN: 9780074624494.
2. Varshney R.S. (2012), Engineering Hydrology, Nem Chand & Brothers Publishers. ISBN: 8185240688.
3. Das (2009), Hydrology & Soil Conservation Engineering, Prentice-Hall of India. ISBN: 9788120335868.
4. Modi P. N. and Seth S. M. (2011), Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Publications, ISBN-9788189401269.
5. Bansal R. K. (2010), A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publication, ISBN-9788131808153.

Name of The Course	**Structural Analysis Lab**			
Course Code	**BCE01P3401**			
Prerequisite	BCE01T3401			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. To know the concept and procedure of different type of method to find slope and deflection for different type of structures.
2. To understand the advantage and disadvantage of different types of methods used for find slope.

Course Outcomes

On completion of this course, the students will be able to

CO1	Measure deflection of a simply supported beam and verify Clark-Maxwell's theorem.
CO2	Determine the Flexural Rigidity of a given beam.
CO3	Verify the Moment - area theorem for slope and deflection of a given beam.
CO4	Determine deflection studies for a continuous beam.
CO5	Visualize the behaviour of two hinged arch and three hinged arch.

Continuous Assessment Pattern

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

List of Experiments:

1. Deflection of a simply supported beam and verification of Clark-Maxwell's theorem.
2. To determine the Flexural Rigidity of a given beam.
3. To verify the Moment - area theorem for slope and deflection of a given beam.
4. Deflection of a fixed beam and influence line for reactions.
5. Deflection studies for a continuous beam and influence line for reactions.
6. Study of behaviour of columns and struts with different end conditions.
7. Experiment on three hinged arch.
8. Experiment on two hinged arch.
9. Deflection of a statically determinate pin jointed truss.
10. Unsymmetrical Bending of curved beam.

Suggested Reading

1. Vazirani & Ratwani (2003), Analysis of Structures, Vol. 1 & II, Khanna Publishers, ISBN: 0125249853.
2. S. Ramamrutham (2004), Theory of Structures, 5thEdition, Dhanpat Rai Publications, ISBN: 978041528091
3. C. S. Reddy (2010), Structural Analysis, 3rd Edition, Tata McGraw Hill, ISBN:9780070702769.
4. Kenneth M. Leet, Gilbert A, Uang C. M. (2010), Fundamentals of Structural Analysis, 4th Edition, Tata McGraw Hill,ISBN:9780071289382

Name of The Course	**Construction Engineering Lab**			
Course Code	BCE01P3402			
Prerequisite	BCE01T3402			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. To know the concept and procedure of different type of test conducted on cement, aggregate and concrete.
2. To understand the properties of different building materials and their Civil Engineering Significance.
3. To understand the IS Code provision of testing different types of building materials.

Course Outcomes

On completion of this course, the students will be able to

CO1	Identify the suitability of materials for construction work.
CO2	Determine the fineness of cement by Blain air permeability apparatus.
CO3	Determine the specific gravity of given sample of OPC.
CO4	Determine the consistency of the concrete mixes for different W/C ratio by slump test with and without admixture.
CO5	Cast concrete cubes and determine compressive strength of concrete.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks

50	-	50	100

List of Experiments:

1. To determine the water content required producing a cement paste of normal consistency and also determining initial and final setting time of a given cement sample.
2. To determine the fineness of cement by Blain air permeability apparatus.
3. To determine the specific gravity of given sample of OPC.
4. To determine the particle size distribution of fine and coarse aggregate by sieve analysis method.
5. Determination of specific gravity of coarse and fine aggregate.
6. To determine the silt content in the given sample of fine aggregate and also determine necessary adjustment for the bulking of fine aggregate and draw curve between water content and bulking.
7. To determine the consistency of the concrete mixes for different W/C ratio by slump test with and without admixture.
8. To determine the workability of concrete mix of given proportion by compaction factor test.
9. To cast concrete cubes and to determine compressive strength of concrete by non-destructive and destructive method of testing.

Suggested Reading

1. Rangwala, (2011), Engineering Materials, 38th edition, Charotar Publishing House Pvt. Ltd. ISBN: 978-93-80358-26-0.
2. Ashok Kumar Jain, Dr. B.C. Punmia, Arun Kumar Jain (2009), Building Construction, Laxmi Publications Pvt. Ltd, ISBN: 978-81-318-0428-5.
3. M. L. Gambhir, (2009), Concrete Technology, Tata McGraw Hill Education, ISBN: 978-00-701-5136-9.
4. P. C. Varghese, (2009), Engineering Materials, 1st edition, PHI Learning, ISBN: 978-81-203-2848-8.

Name of The Course	**Geotechnical Engineering Lab**			
Course Code	**BCE01P3403**			
Prerequisite	BCE01T3403			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. To impart the fundamental concepts of soil mechanics.
2. To understand the bearing capacity.
3. To know the importance of index properties like grain size, consistency limits, soil classification.
4. To understand the concept of compaction and consolidation of soils.

Course Outcomes

On completion of this course, the students will be able to

CO1	Give an engineering classification of a given soil.
CO2	Understand the principle of effective stress, and then calculate stresses that influence soil behavior.
CO3	Determine soil deformation parameters, and calculate settlement magnitude and rate of settlement.
CO4	Specify soil compaction requirements.
CO5	Conduct laboratory tests, and obtain soil properties and parameters from the test observations and results.

Continuous Assessment Pattern

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

List of Experiments:

1. To determine moisture content of soil
2. To determine the specific gravity of soil fraction passing 4.75mm I.S sieve by density bottle/Pycnometer bottle
3. To determine the grain size distribution curve for given soil sample by sieve analysis and hydrometer analysis.
4. To determine the consistency limits (i.e Liquid limit, Plastic limit & Shrinkage limit)of given samples
5. To determine in-situ density of compacted soils by using core cutter & pouring cylinder methods.
6. To determine the relative density of given coarse grained materials
7. To determine the maximum dry density and optimum moisture content for the given soil sample.
8. To determine coefficient of permeability of given soil sample by constant head and variable head method.
9. To determine unconfined compressive strength of a given soil sample
10. To determine shear strength of a given soil specimen using vane shear apparatus
11. To determine shear strength of a given soil specimen using direct shear apparatus
12. To determine the shear parameters of soil by Undrained Triaxial Test.

Suggested Reading

1. K.R.Arora (2011), Soil Mechanics and Foundation Engineering, Standard Publishers Distributors, Delhi, ISBN: 978-81-801-4112-6.
2. Arun Kr. Jain, B.C. Punmia, Ashok Kr. Jain (2005), Soil Mechanics and Foundations, Sixteenth Edition, Laxmi Publications. ISBN: 978-81-700-8791-5.
3.Gopal Ranjan, A.S.R Rao (2000), Basic and Applied Soil Mechanics 2nd Edition, New Age International. ISBN: 978-81-224-1223-9.
4. William Powrie, Soil Mechanics: Concepts and Applications, Second Edition, Spon Press. ISBN: 978-04-153-1156-4.
5. Karl Terzaghi, Soil Mechanics in Engineering Practice, Warren Press. ISBN: 978-14-465-1039-1.

Name of The Course	**Design of Reinforced Concrete Structures**			
Course Code	**BCE01T3501**			
Prerequisite	BCE01T3301, BCE01T3401			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To make the students to learn design of beams by working stress method.
2. To enable the students to understand the limit state method of design of beams, columns and slabs.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the behavior of structural members and the concept of design.
CO2	Calculate moment of resistance for different types of RC beam section.
CO3	Design any RC beam by limit state method.
CO4	Understand the difference between one way slab and two way slab.
CO5	Know the concept of short column and long column.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Material Properties and Design Concepts **9 lecture hours**
Material properties: Compressive strength, tensile strength, design stress-strain curve of concrete - modulus of elasticity - grades of concrete - different types and grades of reinforcing steel - design stress-strain curve of steel. Introduction to design concepts, elastic behaviour of rectangular section, under, balanced and over reinforced section. Deflection and cracking in beams and

slabs using IS code provisions. Design of singly reinforced beams by working stress method.
Unit II: Introduction to Limit State Design **9 lecture hours**
Philosophy and principle of limit state design along with the assumptions, partial safety factors, characteristic load and strength. Introduction to stress block parameters, concept of balanced, under reinforced and over reinforced sections, limit state of collapse in flexure of rectangle and flanged sections with examples. Limit state of collapse in shear and torsional strength of sections with examples.
Unit III: Limit state design of beams **9 lecture hours**
Design principles and procedures for critical sections for bending moment and shear forces. Flexural and shear design example of singly and doubly reinforced simply supported and cantilever beams using the codal provision. Detailing of longitudinal and shear reinforcement, anchorage of bars, check for development length. Reinforcement requirements, slenderness limits for beams for lateral stability. Flexural and shear design of simply supported T and L beams. Design of rectangular section for torsion.
Unit IV: Limit State Design of Slabs **9 lecture hours**
Introduction to one way and two way slabs, design of one way cantilever, simply supported and continuous slab, design of two way slabs.
Unit V: Limit State Design of Compression Members **9 lecture hours**
General design aspects of compression members, Design of short axially loaded columns with reinforcement detailing, Design of columns with uniaxial bending and biaxial bending using SP- 16 charts, Design of long column.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Gambhir, M.L., (2011), "Fundamentals of Reinforced Concrete Design", Prentice-Hall of India. ISBN: 9788120330481.
2. S Unnikrishna Pillai &Devdas Menon, (2005), Reinforced Concrete Design, Tata Mcgraw Hill, ISBN: 9780070141100.
3. Varghese, P.C., (2009), Limit State Design of Reinforced Concrete, 2nd ed. ISBN: 9788120320390.

Name of The Course	**Transportation Engineering-I**			
Course Code	**BCE01T3502**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To impart the knowledge in Highway Geometrics, Traffic Engineering, materials, construction and design of pavements.

Course Outcomes

On completion of this course, the students will be able to

CO1	Design various geometric elements of highways.
CO2	Understand the procedure to collect the traffic data for design and traffic management.
CO3	Test the highway materials as per IS/IRC guidelines.
CO4	Do structural design of flexible and rigid pavements.
CO5	Know various highway constructions techniques and its maintenance.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

Internal Assessment (IA)	**Mid Term Exam (MTE)**	**End Term Exam (ETE)**	**Total Marks**

20	30	50	100

Course Content:

Unit I: Highway and Traffic Planning **8 lecture hours**
Introduction to Transportation modes – Highway alignment and field surveys – Master Plan – Transport economics – Traffic Studies – Volume, speed, origin and destination studies. Introduction to Multi-modal Transportation, Automated Transport systems, High urban transport, Impact of transport on environment.
Unit II: Highway Geometrics **14 lecture hours**
Highway classification (Rural and Urban roads), Road Geometrics – Highway cross section elements – camber – Sight Distance, Horizontal Alignment Design, Super Elevation, Extra widening, Transition curves, Set back distance, Design of Vertical curves.
Unit III: Traffic Engineering **6 lecture hours**
Traffic characteristics, road user & vehicular characteristics, traffic studies, traffic operations, traffic control devices, intelligent transport systems, Intersections, Interchanges, Parking Layout & Road signs.
Unit IV: Highway Materials and Construction **8 lecture hours**
Material requirement for pavements – Soil classification for Highway – Soil tests – CBR and Plate Load Test, Aggregate – materials testing and specification, Bitumen – material testing and specification construction of bituminous and rigid pavements, Highway Maintenance – Material recycling
Unit V: Highway Design **9 lecture hours**
Pavement Analysis – Factors affecting pavement thickness – Soil – Wheel load – Temperature – environmental factors; Flexible Pavement Design – Axle Load surveys – CBR method of Design, Rigid Pavement Design – IRC method
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Khanna.S.K and Justo. C.E.G., (2011), Highway Engineering, Ninth Edition.
2. Kadiyali.L.R, and Lal.N.B, (2005), Principles and Practice of HighwayEngineering, Fourth Edition, Khanna Publishers, ISBN- 9788174091659.
3. ChakroborthyPartha, and Das Animesh, (2003), Principles of Transportation Engineering, Eighth Printing, Prentice-Hall of India, ISBN-9788120320840.
4. Rao.G.V., (1996), Principles of Transportation and Highway Engineering, Tata McGraw-Hill Co, ISBN- 9780074623633.

Name of The Course	**Water Supply and Treatment Systems**			
Course Code	**BCE01T3503**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To make the students to understand the basic principles and concepts of unit operations and processes involved in water treatment.
2. To enable the students to learn design of unit operations and processes involved in water treatment.

Course Outcomes

On completion of this course, the students will be able to

CO1	Define water demand.
CO2	Understand about treatment of raw water.
CO3	Differentiate between slow sand filters and rapid sand filters.
CO4	Understand disinfection processes in water treatment.

CO5	Explain water supply networks.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Water sources- classification and Distribution **8 lecture hours** **8 lecture hours**
Water demand, Factors governing water demands and seasonal variations, Effect of population dynamics on water demand, Principles for forecasting of water-demand and its calculations, Self-purification of surface water bodies – Oxygen sag curve, permissible values for drinking water
Unit II: Water Treatments Units **8 lecture hours**
Physicochemical Principles applied in water treatment, Unit operations, principles and processes for pretreatment and treatment of raw water, pre-chlorination and chlorination, principles and objectives for designing chlorination systems, General design considerations for designing water treatment plants.
Unit III: Unit Operations & Processes **8 lecture hours**
Principles, functions and design of screen, grit chambers, flash mixers, flocculators, sedimentation tanks and sand filters- Slow sand and rapid sand filters, layouts – Flash mixer – Clariflocculator – Slow sand and rapid sand filters
Unit IV: Disinfection Processes in Water treatment **8 lecture hours**
Principles, Objectives, Unit Operations & Advanced Processes in Water treatment, Disinfection – Aeration – iron and manganese removal, Defluoridation and demineralization – Water softening
Unit V: Water supply systems **9 lecture hours**
Various water supply systems - Water supply networks - Various water storage systems
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Garg S.K. (2010), Environmental Engineering Vol. I Water Supply Engineering, Khanna Publishers. ISBN: 9788174091208
2. H.S.Peavy, D.R.Rowe & George Tchobanoglous (2005), Environmental Engineering, McGraw-Hill Company, New Delhi. ISBN: 9789380358246
3. Nathanson, Jerry A. (2007), Basic Environmental Technology: Water Supply, Waste Management, and Pollution Control, 5th ed., PHI Learning Private Limited ISBN: 978-81-203-3836-4
4. Rangwala (1999), Water supply & Sanitary Engineering, Charotar Publishing House, Anand-16th Edition. ISBN: 9788185594590
5. Metcalf and Eddy (2003), Wastewater Engineering, Treatment and reuse, Tata McGraw-Hill Edition, Fourth edition. ISBN:9780070495395

Name of The Course	**CAD Lab - I (AUTOCAD)**			
Course Code	**BCE01T3501**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	4	2

Course Objectives

1. To enable the students to understand the regulations as per National Building Code.
2. To make the students to learn the functional requirements and building rules.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand AUTOCAD commands and draw lines, circles and different types of polygon.
CO2	Draw plan, elevation and cross-sectional views of one storey residential building.
CO3	Draw staircases.
CO4	Draw plan, elevation and cross-sectional views of two storey residential building.
CO5	Draw plan, elevation and cross-sectional views of workshop with trussed roof.

Continuous Assessment Pattern

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

List of Experiments:

1. AUTOCAD commands, drawing of lines, circles and different types of polygon.
2. Drawing plan, elevation and cross-sectional views of one storey residential building.
3. Drawing of staircases.
4. Drawing plan, elevation and cross-sectional views of two storey residential building.
5. Drawing plan, elevation and cross-sectional views of five story commercial building.
6. Drawing plan, elevation and cross-sectional views of three story hospital building.
7. Drawing plan, elevation and cross-sectional views of ten story college building.
8. Drawing plan, elevation and cross-sectional views of workshop with trussed roof

Suggested Reading

1. V. B. Sikka (2012), "Civil Engineering Drawing", S.K.Kataria& Sons, New Delhi. ISBN: 978-93-5014-272-1

2. N. Kumaraswamy (2012), A.Kameswara Rao "Building Planning & Drawing", Charotar Publishing House Pvt. Ltd. ISBN: 9789380358581

3. AUTOCAD Manuals

Name of The Course	**Transportation Engineering Lab**			
Course Code	**BCE01P3502**			
Prerequisite	BCE01T3502			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. To enable the students to know testing of different highway materials as per IS/IRC guidelines.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand aggregate crushing value test.
CO2	Explain aggregate impact test.
CO3	Perform Los Angeles abrasion test.
CO4	Understand ductility test of bitumen.
CO5	Explain California Bearing ratio test.

Continuous Assessment Pattern

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

List of Experiments:

1. Aggregate Crushing Value Test
2. Aggregate Impact Test
3. Los Angeles Abrasion Test
4. Shape Test
5. Penetration Test of Bitumen
6. Ductility Test of Bitumen
7. Softening Point Test of Bitumen
8. Flash and Fire Point Test of Bitumen
9. Viscosity Test of Bitumen
10. Spot Test
11. California Bearing Ratio Test

Suggested Reading

1. Khanna.S.K., and Justo. C.E.G., (2011), Highway Engineering, Ninth Edition, Nem.

2. Kadiyali.L.R., and Lal.N.B., (2005), Principles and Practice of Highway Engineering, Fourth Edition, Khanna Publishers, ISBN- 9788174091659.
3. ChakroborthyPartha, and Das Animesh, (2003), Principles of Transportation Engineering, Eighth Printing, Prentice-Hall of India, ISBN-9788120320840
4. Rao.G.V., (1996), Principles of Transportation and Highway Engineering, Tata McGraw-Hill Co, ISBN- 9780074623633.

Name of The Course	Water Quality Analysis Lab			
Course Code	BCE01P3503			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	2	1

Course Objectives

1. To enable the students to understand the basic principles and concepts of unit operations and processes involved in water treatment.
2. To make the students to know turbidity test of a given water sample.

Course Outcomes

On completion of this course, the students will be able to

CO1	Determine pH of a given water sample.
CO2	**Determine total solids, suspended solids, dissolved solids and volatile solids in wastewater.**
CO3	Determine turbidity and specific conductivity of the given water samples.
CO4	**Determine alkalinity of a given water sample**
CO5	**Determine chloride concentration of a given water sample.**

Continuous Assessment Pattern

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

List of Experiments:

1. To determine the pH of a given water sample.
2. To determine the total solids, suspended solids, dissolved solids and volatile solids in wastewater.
3. To determine the turbidity and specific conductivity of the given water samples.
4. To determine the Alkalinity of given water sample.
5. To determine total hardness, permanent hardness and temporary hardness for given water sample.
6. To determine the chloride concentration of a given water sample.
7. To determine amount of sulphates in a given sample
8. To determine the dissolved oxygen content in a given water sample.
9. To determine BOD of the given wastewater sample.
10. To determine the COD of given sample.
11. To determine the optimum dosage of coagulant for turbidity removal of a given water sample.

Suggested Reading

1. Garg S.K. (2010), Environmental Engineering Vol. I Water Supply Engineering, Khanna Publishers. ISBN: 9788174091208
2. H.S.Peavy, D.R.Rowe & George Tchobanoglous (2005), Environmental Engineering, McGraw-Hill Company, New Delhi. ISBN: 9789380358246
3. Nathanson, Jerry A. (2007), Basic Environmental Technology: Water Supply, Waste Management, and Pollution Control, 5th ed., PHI Learning Private Limited ISBN: 978-81-203-3836-4
4. Rangwala (1999), Water supply & Sanitary Engineering, Charotar Publishing House, Anand-16th Edition. ISBN: 9788185594590
5. Metcalf and Eddy (2003), Wastewater Engineering, Treatment and reuse, Tata McGraw-Hill Edition, Fourth edition. ISBN:9780070495395

Name of The Course	Industrial Internship - I
Course Code	BCE01P3505

Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		0	0	0	1

Course Objectives

1. To gain first-hand experience of working as an engineering professional, including the technical application of engineering knowledge.
2. To experience the discipline of working in a professional organisation and multidisciplinary team.
3. To develop technical, interpersonal and communication skills.

Course Outcomes

On completion of this course, the students will be able to

CO1	Apply engineering knowledge in solving real-life problems.
CO2	Attain new skills and be aware of the state-of-art in engineering disciplines of their own interest.
CO3	Get exposure to real-life-working environment & practices, and to attain the professionalisms.
CO4	Work with multi-tasking professionals and multidisciplinary team.
CO5	Prepare a technical report, to improve presentation and other soft skills.

Continuous Assessment Pattern

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

Course Content:

Exposure to real life problems at various reputed industries engaged in areas of Civil Engineering.

Mode of Evaluation:

The evaluation of this training shall be included in the next semester evaluation. The student will be assigned a faculty guide who would be the supervisor of the student. The faculty will be identified before the end of the examination.

Students have to prepare an exhaustive technical report of the internship undertaken which will be duly signed by the officer under whom internship was taken in the industry/ organization. The covering format shall be signed by the concerned faculty in-charge of the student. The officer-in-charge would also give his rating of the student in a sealed envelope to the Dean of the SOCE. The student at the end of internship will present his report about the internship before a committee constituted by the Dean of the School which would be comprised of at least three members comprising of the Division Chair/Program Chair. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Dean.

The marks by the external examiner would be based on the report submitted by the student which shall be evaluated by the external examiner and cross examination done of the student concerned. Not more than three students would form a group for such industrial internship.The final evaluation of the Industrial Internship will be based on the following criteria:

1. Presentation and contents of the report demonstrating well developed communication skill.
2. The professionalism displayed by the student during industrial training including the scope of quality industrial training attained.
3. Contribution of the employer in providing quality training and relevance of the student's industrial training to their degree.
4. Marks/grades for this course will be withheld until students complete the training. Without this mark/grade students cannot graduate.

Components	**Internship Progress Report**		**Final Evaluation**	
	Internal Supervisor	**Industry Supervisor**	**Project Report**	**Presentation and Viva voice**
Marks	**25**	**25**	**25**	**25**
Total Marks	**50**		**50**	

Overall Marks	100

Name of The Course	Design of Steel Structures			
Course Code	BCE01T3601			
Prerequisite	BCE01T3401			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. To enable the students to understand the concepts of steel design.
2. To make the students to learn different types of pitched roofs.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand different types of structural rolled steel sections and their properties and design of connections.
CO2	Design laterally supported and laterally unsupported steel beams.
CO3	Design built up column sections, lacings, battens, column bases and tension members.
CO4	Design plate girders and understand curtailment of flange plates and stiffeners.
CO5	Analyze and design roof trusses and purlins.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction and Design of Connection **8 lecture hours**
Introduction, Types and properties of structural rolled steel sections, Design of connections – Riveted - Welded - Bolted – Solution of simple problems.
Unit II: Design of beams **9 lecture hours**
Simple and built-up beams – design of laterally supported and unsupported beams - concept of shear.
Unit III: Design of Compression Members and Tension Members **9 lecture hours**
Design of column – built up section – single and double lacing – batten – Column bases – design of tension members.
Unit IV: Plate Girders **10 lecture hours**
Plate girders - design of plate girders - curtailment of flange plates – Concept of stiffeners and splices
Unit V: Roof Trusses **8 lecture hours**
Types of roof trusses - Calculation of dead load, live load, wind load – Analysis and design of roof truss – Design of purlins.
Unit VI: Discuss on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Vajrani V. N., Ratwani M. M. and Mehra H. (2012), Design and Analysis of Steel Structures, 18th Edition, Oscar Publications, ISBN: 9788174092953.
2. Syal I. C. (2009), Design of Steel Structures, Standard Publishers Distributors, New Delhi, ISBN: 9788180141270.
3. Ramchandra (2006), Non Linear Analysis of Steel Structures, Standard Publishers Distributors, ISBN:9788180140785.
4. IS: 800-2007 & Steel Table.

Name of The Course	Transportation Engineering - II
Course Code	BCE01T3602
Prerequisite	BCE01T3502

Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives

1. To teach the students about the different transportation systems.
2. To familiarise with various components involved in their respective modes and their basic design concepts.

Course Outcomes

On completion of this course, the students will be able to

CO1	Demonstrate the ability to identify the components of railway track, their functions, alignment and the station yards.
CO2	Understand the requirements of railway alignment
CO3	Recognize and identify the requirement of an airport and the principle involved in it.
CO4	Design runway and taxiway.
CO5	Learn to classify the harbours and demonstrate the ability to identify the components of a dock.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to Railway Engineering **8 lecture hours**
History and administrative setup of Indian Railways; rail gauges, permanent way – functions, requirements, sections in embankment and cutting, stresses in different components of track, Types of joints and fastenings.
Unit II: Track Geometrics and Safety **8 lecture hours**
Requirements of Railway alignment, vertical alignment and horizontal alignment, points and crossings – terminologies, Turnouts – Types and design aspects, Signals classification and their functions, train operation control systems, interlocking of tracks.
Unit III: Introduction to airports and Aircraft Characteristics **8 lecture hours**
Air transport development in India, national and international organizations in air transport, aircraft characteristics and their impact on planning of an airport, selection of site for an airport, airport obstruction, imaginary surfaces, runway orientation clam period and wind coverage.
Unit IV: Geometric Designs and Airport Traffic control Aids **8 lecture hours**
Runway and taxiway geometric designs, exit taxiway, its design and fillet curves, runway configuration, separation clearance, design of apron and their layout. Visual aids, marking and lighting of runway and apron area, wind and landing direction indicator.
Unit V: Docks and Harbour Engineering **8 lecture hours**
Historical development in India , tides, winds & waves, docks, harbours, break waters, jetties, landing stages & wharves, dry docks, transit sheds, cargo handling, inland water transport, Maintenance.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Chandra.S., and Agarwal. M.M., (2007), Railway Engineering, Oxford University Press India, ISBN- 9780195687798.
2. Rangwala.S.C., Rangwala.P.S., (2008), Airport Engineering, Charotar Publishing House Pvt. Limited, ISBN-9788185594972.
3. Oza.H.P., and Oza. G.H., (2011), Dock and Harbour Engineering, Sixth Edition, Charotar Publishing House Pvt., ISBN-9789380358383.

Name of The Course	**Waste Water Treatment & Disposal Systems**			
Course Code	**BCE01T3603**			
Prerequisite	BCE01T3503			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To teach students the basic principles and concepts of unit operations and processes involved in wastewater treatment.
2. To develop student's skill in the basic design of unit operations and processes involved in wastewater treatment.
3. To develop a student's skill in evaluating the performance of wastewater treatment plants.

Course Outcomes

On completion of this course, the students will be able to

CO1	Demonstrate an ability to recognize the type of unit operations and processes involved in wastewater treatment plants.
CO2	Demonstrate an ability to choose the appropriate unit operations and processes required for satisfactory treatment of wastewater.
CO3	Demonstrate an ability to design individual unit operation or process appropriate to the situation by applying physical, chemical, biological and engineering principles.
CO4	Demonstrate ability in design of wastewater treatments units in a cost effective and sustainable way and evaluate its performance to meet the desired health and environment related goals.
CO5	Recognize the importance of wastewater treatment to protect the water resources.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Wastewater Treatment **8 lecture hours**
Physical, chemical and biological principles involved in wastewater treatment and designing of unit-operations and processes. Permissible standards for wastewater disposal
Unit II: Pre and Primary Treatment **9 lecture hours**
Objectives-Unit operations and processes-Principles, functions and design of flash mixers, screens, sedimentation tanks and sand filters-Disinfection-Aeration, grit chambers and primary sedimentation tanks.
Unit III: Secondary Treatment **7 lecture hours**
Secondary Treatment-Activated Sludge Process and Trickling filters; other treatment methods-Stabilization Ponds and Septic Tanks-Advances in Sewage Treatment.
Unit IV: Sewage Disposal and Sludge Management **8 lecture hours**
Methods-Dilution-Self-purification of surface water bodies-Oxygen Sag Curve-Land disposal-Sewage Farming-Deep well injection-Soil dispersion system-Thickening-Sludge digestion-Bio-gas recovery, Drying beds-Conditioning and

Dewatering-Sludge disposal. Introduction to solid waste management, landfills and EIA.
Unit V: Waste Disposal System **8 lecture hours**
Wastewater Treatment-Typical layouts-Screens-Grit Chamber-Sedimentation tanks-Trickling filter-Activated Sludge, sludge Digester-Septic tanks-Soil Dispersion System-Waste Stabilization pond.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Garg.S.K, (2010), Environmental Engineering-Sewage Disposal and Air Pollution Engineering, 1st Edition, Khanna Publishers, ISBN- 978-81-740-9230-4.
2. Metcalf & Eddy, (2002), Wastewater Engineering Treatment & Reuse, Tata McGraw-Hill Education, ISBN: 978-00-704-9539-5
3. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, (2001), Environmental Engineering, Tata McGraw-Hill Education, ISBN No: 978-00-710-0231-8.
4. Hammer & Hammer Jr., Water and Wastewater Technology, 7th Edition, ISBN-978-81-203-4601-7.

Name of The Course	**Quantity Surveying and Estimating**			
Course Code	**BCE01T3604**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To enable the students to understand the types of estimates.
2. To make the students to understand rate analysis and process of preparation of bill of quantity.

Course Outcomes

On completion of this course, the students will be able to

CO1	Prepare a detailed estimate for different types of structures.
CO2	Estimate RCC and steel work.
CO3	Understand rate analysis & preparation of bills.
CO4	Determine the valuation of a building.
CO5	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I:Estimation of building **9 lecture hours**
Estimation of building works – Procedure of estimating, Types of estimates, detailed estimate of buildings including sanitary & electrical fittings.
Unit II: Estimate of R.C.C and Steel works **9 lecture hours**
Estimate of R.C.C and Steel works - Scheduling - Slab - beam - column & trusses, Road – earthwork fully in banking, cutting, partly cutting & partly filling - Detailed estimate for WBM, Bituminous road.
Unit III: Rate analysis & preparation of bills **9 lecture hours**
Rate analysis - preparation of bills – Data analysis of rates for various items of works – abstract estimates for Building projects – Introduction to software for Bill of Quantities & estimates.
Unit IV: Valuation **9 lecture hours**
Valuation- rent fixation, tenders, - contracts – accounting procedure, measurement book, stores, cost & quality control – PWD & CPWD practice

- Specifications of various items of works - Schedule of Rates.
Unit V: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. B.N. Datta (2010), Estimating and costing, USBPD. ISBN 9788174767295.

2. Rangwala (2011), Specifications of Estimating, Costing and Valuation, Charotar Publishing House Pvt. Ltd. ISBN 9789380358543.

3. Vazirani, V. N. (2013), Civil Engineering Estimating Costing & Valuation, Khanna publishers. ISBN 9788174091277.

Name of The Course	**Quantity Surveying and Estimating Lab (PRIMAVERA)**				
Course Code	**BCE01P3604**				
Prerequisite	BCE01T3604				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems pertaining to civil engineering domain.
2. To foster collaborative learning skills.
3. To develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Identify, formulate, and solve engineering problems.
CO2	Understand specifications of various items of works and schedule of rates and prepare valuation reports.
CO3	Submit a project report comprising of the application and feasibility of the project.
CO4	Work and communicate efficiently in multidisciplinary teams.

Continuous Assessment Pattern

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

List of Experiments:

Students will carry out the following estimation and costing works for a given multi-storied building.

1. Determination of volume of excavation of earth.
2. Estimation for concrete and steel in footings.
3. Form work required for footings.
4. Estimation for brick walls and plastering.
5. Form work required for columns including scaffolding and shuttering.
6. Estimation for concrete and steel in columns.
7. Form work required for slabs including scaffolding and shuttering.
8. Estimation for concrete and steel in slabs.
9. Form work required for beams including scaffolding and shuttering.
10. Estimation for concrete and steel in beams.
11. Rate analysis for various items of works.
12. Preparation of bills.
13. Studies of PWD and CPWD practices.
14. Bar bending schedule.
15. Valuation of the building.

Suggested Reading

1. B.N. Datta (2010), Estimating and costing, USBPD. ISBN 9788174767295.

2. Rangwala (2011), Specifications of Estimating, Costing and Valuation, Charotar Publishing House Pvt. Ltd. ISBN 9789380358543.

3. Vazirani, V. N. (2013), Civil Engineering Estimating Costing & Valuation, Khanna publishers. ISBN 9788174091277.

Name of The Course	Analysis and Design Lab (STAAD PRO)			
Course Code	BCE01P3605			
Prerequisite	BCE01T3401, BCE01T3501			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	2	1

Course Objectives

1. To teach the students to understand the details of STAAD – PRO software package.
2. To enable the students to know the behaviour of RCC structures.
3. To enable the students to design different components of structures

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the details of STAAD – PRO software package.
CO2	Know the behavior of RCC structures.
CO3	Know the bending moment diagram drawn in tension face and shear force diagram.
CO4	Design RCC beams and columns.
CO5	Analyze and design RCC portal frames.

Continuous Assessment Pattern

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

List of Experiments:

1. Analysis and design of simply supported RCC beam.
2. Analysis and design of cantilever RCC beam.
3. Analysis and design of continuous RCC beam.
4. Analysis and design of doubly reinforced RCC beam.
5. Analysis and design of RCC columns with different end conditions.
6. Analysis and design of RCC portal frames.

Suggested Reading

1. V. N. Vazirani & M. M. Ratwani, (1998), Analysis of Structures, Khanna Publishers

2. R. L. Jindal, (1996), Indeterminate Structures, Tata McGraw Hill Publishing House.
3. G. S. Pandit & Gupta S. P., (1998), Structural Analysis (A matrix approach), Tata McGraw Hill Publishing Ltd.
4. Wang C. K., (1996), Matrix Method of Structural Analysis, Jon Wiley publications.

Name of The Course	Design and Innovation			
Course Code	BCE01P3606			
Prerequisite	BCE01T3401, BCE01T3501			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	2	1

Course Objectives

1. To teach the students to understand the details of STAAD – PRO software package.
2. To enable the students to know the behaviour of RCC structures.
3. To enable the students to design different components of structures

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the details of STAAD – PRO software package.
CO2	Know the behavior of RCC structures.
CO3	Know the bending moment diagram drawn in tension face and shear force diagram.
CO4	Design RCC beams and columns.
CO5	Analyze and design RCC portal frames.

Continuous Assessment Pattern

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

List of Experiments:

1. **Design of (G+2) masonry building.**
2. **Design of staircase.**
3. **Design of (G+3) RCC building.**
4. **Design of (G+4) RCC building.**

Suggested Reading

1. V. N. Vazirani & M. M. Ratwani, (1998), Analysis of Structures, Khanna Publishers.
2. R. L. Jindal, (1996), Indeterminate Structures, Tata McGraw Hill Publishing House.
3. G. S. Pandit & Gupta S. P., (1998), Structural Analysis (A matrix approach), Tata McGraw Hill Publishing Ltd.
4. Wang C. K., (1996), Matrix Method of Structural Analysis, Jon Wiley publications.

Name of The Course	**Remote Sensing & Geographical Information System**				
Course Code	**BCE01T3701**				
Prerequisite	BCE01T3303				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	1	0	2	2	

Course Objectives

1. To introduce the students to the basic concepts and principles of various components of remote sensing.

2. To provide an exposure to GIS and its practical applications in civil engineering.

Course Outcomes

On completion of this course, the students will be able to

CO1	Know Principles of Remote Sensing.
CO2	Define GIS.
CO3	Understand the process of data entry.

Continuous Assessment Pattern

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

Course Content:

UNIT I: EMR and ITS Interaction with Atmosphere & Earth Material **5 lecture hours**
Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein's Displacement Law – Atmospheric scattering, absorption – Atmospheric windows – spectral signature concepts – typical spectral reflective characteristics of water, vegetation and soil.
UNIT II: Geographic Information System **5 lecture hours**
Introduction – Maps – Definitions – Map projections – types of map projections – map analysis – GIS definition – basic components of GIS – standard GIS softwares – Data type – Spatial and nonspatial (attribute) data – measurement scales – Data Base Management Systems (DBMS).
UNIT III: Data Entry, Storage And Analysis **5 lecture hours**
Data models – vector and raster data – data compression – data input by digitization and scanning – attribute data analysis – integrated data analysis – Modeling in GIS Highway alignment studies – Land Information System.

Suggested Reading

1. Lillesand,T.M., Kiefer, R.W. and J.W.Chipman. "Remote Sensing and Image Interpretation" 5th Edition. John Willey and Sons Asia Pvt. Ltd., New Delhi, 2004.

2. Anji Reddy, M. "Textbook of Remote Sensing and Geographical Information System" 2nd edition. BS Publications, Hyderabad, 2001.
3. Lo. C.P.andA.K.W.Yeung, "Concepts and Techniques of Geographic Information Systems", Prentice Hall of India Pvt. Ltd., New Delhi, 2002
4. Peter A.Burrough, Rachael A. McDonnell, " Principles of GIS", Oxford University Press, 2000

Remote Sensing & Geographical Information System Lab

Course Content

1. Introduction of ARCGIS software
2. Storage of data
3. Geographical data modeling
4. Storage of geographical coordinates
5. Arc map – View & edit data, analyze data
6. Enhancement of images

Name of The Course	**Capstone Phase-1**			
Course Code	**BCE01P3998**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	4	2

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
3. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Submit a project synopsis comprising of the application and feasibility of the project.
CO2	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety and sustainability.
CO3	Work and communicate efficiently in multidisciplinary teams.
CO4	Identify, formulate, and solve engineering problems.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

Components	Project Progress Report	Final Evaluation	
	Internal Supervisor	Project Report	Presentation and Viva voice
Marks	**20**	**30**	**50**
Total Marks	**100**		

Name of The Course	**Project Planning and Management Lab (PRIMAVERA)**			
Course Code	**BCE01P3702**			
Prerequisite	BCE01P3604			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems pertaining to civil engineering domain.
2. To foster collaborative learning skills.
3. To develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Identify, formulate, and solve engineering problems.
CO2	Understand specifications of various items of works and schedule of rates and prepare valuation reports.
CO3	Submit a project report comprising of the application and feasibility of the project.
CO4	Work and communicate efficiently in multidisciplinary teams.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

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

List of Experiments:

1. Scheduling for a (G+2) masonry building.
2. Scheduling for a (G+2) RCC building.
3. Scheduling for a (G+4) RCC building.
4. Scheduling for a (G+6) RCC building..

Suggested Reading

1. B. N. Datta (2010), Estimating and costing, USBPD. ISBN 9788174767295.
2. Rangwala (2011), Specifications of Estimating, Costing and Valuation, Charotar Publishing House Pvt. Ltd. ISBN 9789380358543.
3. Vazirani, V. N. (2013), Civil Engineering Estimating Costing & Valuation, Khanna publishers. ISBN 9788174091277.

Name of The Course	**Industrial Internship - II**				
Course Code	**BCE01P3703**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		0	0	2	1

Course Objectives

1. To gain first-hand experience of working as an engineering professional, including the technical application of engineering knowledge.
2. To experience the discipline of working in a professional organization and multidisciplinary team.
3. To develop technical, interpersonal and communication skills.

Course Outcomes

On completion of this course, the students will be able to

CO1	Apply engineering knowledge in solving real-life problems.
CO2	Attain new skills and be aware of the state-of-art in engineering disciplines of their own interest.
CO3	Get exposure to real-life-working environment & practices, and to attain the professionalisms.
CO4	Work with multi-tasking professionals and multidisciplinary team.
CO5	Prepare a technical report, to improve presentation and other soft skills.

Continuous Assessment Pattern

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

Course Content:

Exposure to real life problems at various reputed industries engaged in areas of Civil Engineering.

Mode of Evaluation:

The evaluation of this training shall be included in the next semester evaluation. The student will be assigned a faculty guide who would be the supervisor of the student. The faculty will be identified before the end of the examination.

Students have to prepare an exhaustive technical report of the internship undertaken which will be duly signed by the officer under whom internship was taken in the industry/ organization. The covering format shall be signed by the concerned faculty in-

charge of the student. The officer-in-charge would also give his rating of the student in a sealed envelope to the Dean of the SOCE. The student at the end of internship will present his report about the internship before a committee constituted by the Dean of the School which would be comprised of at least three members comprising of the Division Chair/Program Chair. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Dean.

The marks by the external examiner would be based on the report submitted by the student which shall be evaluated by the external examiner and cross examination done of the student concerned. Not more than three students would form a group for such industrial internship.The final evaluation of the Industrial Internship will be based on the following criteria:

1. Presentation and contents of the report demonstrating well developed communication skill.
2. The professionalism displayed by the student during industrial training including the scope of quality industrial training attained.
3. Contribution of the employer in providing quality training and relevance of the student's industrial training to their degree.
4. Marks/grades for this course will be withheld until students complete the training. Without this mark/grade students cannot graduate.

Components	Internship Progress Report		Final Evaluation	
	Internal Supervisor	Industry Supervisor	Project Report	Presentation and Viva voice
Marks	25	25	25	25
Total Marks	50		50	
Overall Marks	100			

Name of The Course	Capstone Phase-2
Course Code	BCE01P3999
Prerequisite	-
Co-requisite	-
Anti-requisite	-

L	T	P	C
0	0	4	2

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
3. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Submit a project synopsis comprising of the application and feasibility of the project.
CO2	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety and sustainability.
CO3	Work and communicate efficiently in multidisciplinary teams.
CO4	Identify, formulate, and solve engineering problems.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

Components	Project Progress Report	Final Evaluation	
	Internal Supervisor	Project Report	Presentation and Viva voice
Marks	20	30	50
Total Marks	100		

Name of The Course	Advanced Geotechnical Engineering			
Course Code	BCE01T5501			
Prerequisite	BCE01T3403			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	2	0	0	2

Course Objectives

1. To understand the design aspects of foundation.
2. To evaluate the stress developed in the soil medium.
3. To understand the framework of soil investigation.

Course Outcomes

On completion of this course, the students will be able to

CO1	Comprehend and utilize the geotechnical literature to establish the framework for foundation design.
CO2	Plan and implement a site investigation program including subsurface exploration to evaluate soil/structure behavior and to obtain the necessary design parameters.
CO3	Carry out slope stability analysis for various fills and slopes.
CO4	Understand theories of earth pressures and designing of retaining walls.

Continuous Assessment Pattern

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

Course Content:

Unit I: Soil Exploration and Types of Foundations **7 lecture hours**
Objective of site investigation - reconnaissance – detailed site investigation - methods of exploration – geophysical methods - seismic refraction survey. Depth of exploration – factors governing location and depth of foundation – types of foundations – selection of foundation – plate load test – standard penetration test.
Unit II: Capacity and Settlements of Shallow Foundations **7 lecture hours**
Terzaghi's theory of bearing capacity – general and local shear failure - effect of water table – design of footings – settlement of footings - immediate and time dependent settlement – permissible limits – differential settlement, introduction to Codal provisions.
Unit III: Deep Foundations **7 lecture hours**
Classification and selection of piles – static and dynamic formulae for single pile capacity – efficiency and capacity of pile groups – design of pile group – settlement of pile groups– load test on piles.
Unit IV: Theories of Earth Pressure **7 lecture hours**
Definitions – Earth pressure at rest – Rankine's active and passive earth pressures - Coulomb's earth pressure theories – types of retaining walls and its design. Introduction of tunneling, ground improvement methods – compaction, deep compaction and fiber reinforced plastic and geo-textiles.

Suggested Reading

1. Shashi K. Gulhati&Manoj Datta (2005), Geotechnical Engineering 1st edition, Tata McGraw Hill Ltd. ISBN: 978-00-705-8829-5.
2. Donald P Coduto, William A. Kitch, Man-chu Ronald Yeung (2010), Geotechnical Engineering: Principles and Practices 2nd revised Edition, Pearson Education. ISBN: 978-01-313-5425-8.
3. Joseph E. Bowles (2006), Foundation Analysis and Design 5th edition, McGraw-Hill, New York. ISBN: 978-00-711-8844-9.
4. Braja M. Das (2007), Principles of Foundation Engineering 6th Edition, Nelson Engineering. ISBN: 978-81-315-0202-0.

Name of The Course	Ground Improvement Techniques			
Course Code	**BCE01T5502**			
Prerequisite	BCE01T3403			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To find out proper methods of ground improvement.
2. To understand various soil engineering problems.
3. To use geo-textiles and stabilizers for soil improvement.

Course Outcomes

On completion of this course, the students will be able to

CO1	Choose correct method for ground improvement.
CO2	Choose correct stabilizing material for expansive soils.
CO3	Design grouting process for various soil engineering problems.
CO4	Understand disinfection processes in water treatment.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction & Dewatering **7 lecture hours**
Need and objectives of ground improvement, classification of ground modification techniques, suitability and feasibility, emerging trends in ground improvement, methods of de-watering, sumps and interceptor ditches, single, multi stage well points, vacuum well points. Horizontal wells, foundation drains, blanket drains, criteria for selection of fill material around drains, Electro-osmosis.
Unit II: Stabilization **7 lecture hours**
Soil improvement by adding materials, lime, flyash, cement and other chemicals and bitumen, sand column, stone column, sand drains, prefabricated drains, lime column, soil-lime column, stabilization of soft clay or silt with lime, bearing capacity and settlement of treated soils, improvement in slope stability, control methods.
Unit III: Dynamic compaction **7 lecture hours**
Principles of compaction, field compaction techniques static vibratory, impact, compaction control, compaction using vibratory probes, vibro-techniques, vibro equipment, vibro-compaction and replacement process, vibro systems and liquefaction, soil improvement by thermal treatment, preloading techniques, surface compaction, introduction to bio technical stabilization.
Unit IV: Grouting **7 lecture hours**
Introduction, suspension grout, solution grout, grouting equipments and methods, grouting, design and layout granular piles – ultimate bearing capacity and settlement, method of construction, load test.

Suggested Reading

1. Colin Jfp Jones (1996), Earth Reinforcement & Soil Structures, Thomas Telford. ISBN: 978-07-277-3489-1.

2. Nelson, John D. Nelson, Ron Miller (1997), Expansive Soils: Problems and Practice in Foundation and Pavement Engineering New edition, Wiley-Interscience. ISBN: 978-04-711-8114-9.

3. P. Purushothama Raj (1999), Ground Improvement Techniques 1st Edition, Laxmi Publications. ISBN: 978-81-318-0594-7.

4. Rao (1990), Engineering with Geo-synthetics, Mcgraw-hill Education. ISBN: 978-00-746-0323-9.

Name of The Course	Soil Dynamics and Machine Foundation			
Course Code	BCE01T5503			
Prerequisite	BCE01T3403			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	2	0	0	2

Course Objectives

1. To understand the fundamentals of soil dynamics.
2. To know the behavior of the machine foundations and its design.
3. To design foundations so as to mitigate the effect of seismic activities.

Course Outcomes

On completion of this course, the students will be able to

CO1	Solve geotechnical earthquake engineering problems.
CO2	Identify the pattern of wave propagation, attenuation of seismic waves
CO3	Study the parameters of the soil under dynamic conditions.
CO4	Design vibration isolation.

Continuous Assessment Pattern

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

Course Content:

Unit I: Types of Vibratory Motion **7 lecture hours**
Vibratory motion-terminology- Single degree freedom system -Free and Forced vibrations with and without damping; Transient response of single degree freedom system.
Unit II: Wave Propagation in Soil media **7 lecture hours**
Wave propagation in an elastic homogeneous isotropic medium - Rayleigh, Shear and compression waves - waves in elastic half space and its equation.
Unit III: Dynamic Properties of Soils **7 lecture hours**
Coefficient of elastic, uniform and non-uniform compression and shear - effect of vibration on the dissipative properties of soils - determination of dynamic properties of soil – Codal provisions.
Unit IV: Design Procedures of Machine Foundations **7 lecture hours**
Dynamic loads - simple design procedures for foundations under reciprocating machines – machines producing impact loads - rotary type machines- Codal provision – Vibration isolation.

Suggested Reading

1. Swami Saran (2010), Soil Dynamics and Machine Foundations 2nd edition, Galgotia Publications Pvt Ltd. ISBN: 978-81-751-5441-4.
2. Prasad (2011) Advanced Soil Dynamics and Earthquake Engineering, Prentice Hall, New Delhi. ISBN: 978-81-203-2670-5.
3. Srinivasulu.P. &Vaidyanathan.C. (1998), Hand book on Machine Foundations, McGraw Hill Publications. ISBN: 978-00-709-6611-6.
4. Braja M. Das (2010), Principles of Soil Dynamics 2nd Edition, Cengage Learning Canada. ISBN: 978-04-954-1135-2.

Name of The Course	Structures on Expansive Soils			
Course Code	BCE01T5504			
Prerequisite	BCE01T3403			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	2	0	0	2

Course Objectives

1. To understand problems related to expansive soils.
2. To identify preventive measures for mitigating effect of soil expansion on structures founded on expansive soil.

Course Outcomes

On completion of this course, the students will be able to

CO1	Know the physical & mineralogical properties of expansive soil.
CO2	Predict heave and shrinkage.
CO3	Conduct tests for identification of swelling soil.
CO4	Design suitable method for improving properties of expansive soil.

Continuous Assessment Pattern

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

Course Content:

Unit I: Origin and Occurrence of Expansive Soils **7 lecture hours**
Occurrence and distribution in India - Moisture equilibrium - Soil, structure, environmental interaction - Distress symptoms case histories.
Unit II: Identification of Expansive Soils **7 lecture hours**
Soil Structure - Clay mineralogy Swell potential - Field exploration - laboratory tests for identification.
Unit III: Remedial foundation Techniques **7 lecture hours**
Design considerations-Individual and continuous footings - stiffened mats, under reamed piles, Codal provisions
Unit IV: Chemical stabilization and Special Foundation **7 lecture hours**
Mechanical alteration – Sand cushion technique - CNS concept – Chemical stabilization with lime, flyash and cement – Special foundations – Under-reamed piles – Straight-shafted drilled piers - Belled piers – Granular pile-anchors.

Suggested Reading

1. Swami Saran (2008), Analysis and Design of sub structures 2nd edition, Limit State Design, Oxford & IBH Publishing Co. Pvt Ltd., 66, Janpath, New Delhi. ISBN: 978-81-204-1700-7.
2. F.H.Chen (1995), Foundations in Expansive Soils, Elseivier Publications. ISBN:978-04-444-3036-6.
3. R.E.Peck, W.E.Hansen&T.H.Thornburn (2004), Foundation Engineering, John Wiley. ISBN: 978-04-716-7585-3.
4. Varghese P.C (2009), Foundation Engineering 1st Edition, Prentice-Hall of India Private Limited. ISBN: 978-81-203-2652-1.

Name of The Course	**Foundation Engineering**			
Course Code	**BCE01T5505**			
Prerequisite	BCE01T3403			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. This subject is taught to impart the knowledge in the area of analysis and design of foundations and earth retaining structures

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the concepts of shallow foundations.
CO2	Design raft foundations.
CO3	Know the concept of pile group.
CO4	Design pile foundation.

Continuous Assessment Pattern

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

Course Content:

Unit I:Shallow foundation **7 lecture hours**

Shallow Foundations – Spread footings – Contact pressure – Structural design of individual footings – Pedestals – Combined footings (Rectangular and trapezoidal .
Unit II: Raft foundation **7 lecture hours**
Eccentrically loaded footings – Raft foundations
Unit III: Piles and Pile Groups **7 lecture hours**
Pile Foundations – Types of piles – Static and dynamic pile formula – Pile groups – Efficiency of pile group
Unit IV: Pile foundations **7 lecture hours**
Settlement of piles – Batter piles – Analysis of pile groups – Structural design of piles and pile caps

Suggested Reading

1. Gopal Ranjan and A S R Rao (2000), Basic and Applied Soil Mechanics, Second Edition, New Age International, ISBN-13: 9788122412239.
2. J. E. Bowles, (2000), Foundation Analysis and Design, Fifth Edition, McGraw Hill Education India Pvt. Ltd., ISBN-13: 9781259061035.
3. P. C. Verghese, (2009), Design of Reinforced Concrete Foundations, First Edition, PHI Learning Pvt. Ltd., ISBN-13: 9788120336155

Name of The Course	**Mini Project**			
Course Code	**BCE01P5506**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems pertaining to civil engineering domain.
2. To foster collaborative learning skills.
3. To develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Identify, formulate, and solve engineering problems.
CO2	Understand planning and scheduling of a project.
CO3	Submit a project report comprising of the application and feasibility of the project.
CO4	Work and communicate efficiently in multidisciplinary teams.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

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

List of Projects:

Students will select topic in geotechnical engineering field.

Suggested Reading

1.Gopal Ranjan, A.S.R Rao (2000), Basic and Applied Soil Mechanics 2nd Edition, New Age International. ISBN: 978-81-224-1223-9.
2. William Powrie, Soil Mechanics: Concepts and Applications, Second Edition, Spon Press. ISBN: 978-04-153-1156-4.
3. Karl Terzaghi, Soil Mechanics in Engineering Practice, Warren Press. ISBN: 978-14-465-1039-1.
4. Aysen (2004), Problem Solving in Soil Mechanics, Taylor & Francis Group. ISBN: 978-04-153-8392-9.

Name of The Course	**Mass Transport Management**
Course Code	**BCE01T5601**
Prerequisite	BCE01T3502
Co-requisite	-
Anti-requisite	-

	L	T	P	C
	2	0	0	2

Course Objectives

1. To teach the concepts of MRTS and their importance, the accessories involved in MRTS.
2. To develop the students skills to have better understanding about the finance management, route surveys and evaluation.

Course Outcomes

On completion of this course, the students will be able to

CO1	Learn the basic principles of MRTS and their importance so as to apply perfectly in the Management issues.
CO2	Demonstrate the ability to understand the accessories required for MRTS, bus terminals and the organization and operation.
CO3	Understand the principles and implement new methods in financing, revenues and have good public relations.
CO4	Prepare route surveys and planning, schedules and evaluate a system with the acquired knowledge.

Continuous Assessment Pattern

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

Course Content:

Unit I: Importance of MRTS **7 lecture hours**
Structures of urban areas – provision of transport facilities – different mass transportation systems – basic management issues.
Unit II: Organizational Structures **7 lecture hours**
Organizational structures – management by objectives – delegation of powers – man power planning.
Unit III: Financing-Budgeting **7 lecture hours**
Methods of financing – budgeting and recounting – fare structures – replacement programmes, fare collected system – revenue leakage and prevention. Incentives – public relations.
Unit IV: Route Surveys **7 lecture hours**
Route surveys and planning – preparation of schedules and duty roasters – travel time accident studies.

Suggested Reading

1. Glaister.S., (1995), Fundamentals of Transport economics, BasiclBalckwell, Oxford, ISBN-9780312311520.
2. Khisty.C.J., and Lall.B.K., (2003) "Transportation Engineering", Indian Edition, Prentice-Hall of India , ISBN-9788120322127.
3. Stubbs.P.C. et al., (1984), Transport Economics, Allen and Ulbwin, Boston, ISBN-9780043381212.
4. Chon. Louss F. andMcVoy.G.R., (1982), "Environmental Analysis of Transportation System", A Willy Interscience Publication, John Wiley & Sons, New York, ISBN-9780471080985.

Name of The Course	**Traffic Engineering**			
Course Code	**BCE01T5602**			
Prerequisite	BCE01T3502			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To teach the concepts of traffic studies, traffic facilities and their regulations and management.
2. To understand the methods for efficient management of traffic in urban roads.

Course Outcomes

On completion of this course, the students will be able to

CO1	Perform traffic studies.
CO2	Know importance of traffic management.
CO3	Identify the specification of traffic facilities.
CO4	Understand disinfection processes in water treatment.
CO5	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Traffic Studies **7 lecture hours**
Road user and Vehicle Characteristics - Traffic Studies -Traffic volume and composition - speed, Headway - Concentration and Delay & Flow principles - Capacity and level of service.
Unit II: Traffic Facilities **7 lecture hours**
Signals - Islands - Types and General layout of at-grade and grade separated intersections.
Unit III: Traffic Regulations and Management **7 lecture hours**
Traffic signs and markings - Parking practices - Traffic management measures.
Unit IV: General Principles and Flexible Pavement Design **7 lecture hours**
Factors affecting pavements stability – equivalent single wheel load – vehicle, soil, traffic & Climatic factors - stress distribution in different conditions - CBR method of design - AASSO method & Burmister design method.

Suggested Reading

1. Kadiyali.L.R. (2008), Traffic Engineering and Transportation Planning, Khanna Publishers, ISBN-9788174092205.

2. ChakroborthyPartha, and Das Animesh, (2003), Principles of Transportation Engineering, Eighth Printing, Prentice-Hall of India, ISBN-9788120320840.

3. Khisty.C.J., and Lall.B.K., (2003) "Transportation Engineering", Indian Edition, Prentice-Hall of India , ISBN- 9788120322127.

4. Garber. Nicholas J., and Hoel. Lester A., (2009), Traffic & Highway Engineering, Fourth Edition, Cengage Learning, ISBN-9780495082507.

Name of The Course	**Highway Pavement Design**			
Course Code	**BCE01T5603**			
Prerequisite	BCE01T3502			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To introduce various analysis and design procedures of different types of pavements.
2. To familiarise with maintenance, evaluation, strengthening and rehabilitation of the pavements.

Course Outcomes

On completion of this course, the students will be able to

CO1	Learn the basic principles of flexible and rigid pavements.
CO2	Demonstrate the ability to analyse and design the flexible and rigid pavements by applying various methods and thorough in construction procedures and the functions of pavements
CO3	Ability to critically evaluate flexible and rigid pavements by deflection measurement.
CO4	Demonstrate the ability to apply strengthening techniques and rehabilitation of pavements.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks

20	30	50	100

Course Content:

Unit I: General Principles of Pavement Design **7 lecture hours**
Components of a road and functions – factors affecting pavements stability – equivalent single wheel load – vehicle and traffic factors – moisture factors – climate factors – soil factors – stress distribution in different conditions – modulus of elasticity of various layers.
Unit II: Flexible Pavement Design **7 lecture hours**
Empirical method using soil classification tests – estimation of CBR value method of designing pavement – plate bearing test method Ashpalt Institute method – AASSO method – Burmister design method.
Unit III: Rigid Pavement Design **7 lecture hours**
Stresses in concrete pavement – IRC method – design of steel reinforcements – design of different joints in concrete pavements and their functions – construction of concrete pavements and their functions.
Unit IV: Pavement Evaluation **7 lecture hours**
Distresses in flexible pavements – distress in rigid pavements – service ability index – structural evaluation of flexible and rigid pavements – evaluation by deflection measurement – strengthening of pavements – flexible overlays – rigid overlays.

Suggested Reading

1. ChakroborthyPartha, and Das Animesh, (2003) "Principles of Transportation Engineering", Eighth Printing, Prentice-Hall of India, ISBN-9788120320840.
2. Yoder.E.J., and Witczak. M. W., Principles of Pavement Design, Second Edition, John Wiley & Sons, ISBN-9780471977803.
3. Garber. Nicholas J., and Hoel. Lester A., (2009), Traffic & Highway Engineering, Fourth Edition, Cengage Learning, ISBN-9780495082507.
4. S.K. Sharma (1998), Principles, Practice and Design of Highway Engineering, S. Chand & Co Ltd, New Delhi.
5. Bruce.A.G. and Clarkeson.J., (1952), Highway Design and Construction, Third Edition, International Textbook Co.

Name of The Course	**Pavement Constructions**			
Course Code	**BCE01T5604**			
Prerequisite	BCE01T3502			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To make the students to understand stabilization of Soil.
2. To enable the students to understand different types of pavement constructions.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand stabilization of Soil.
CO2	Explain construction of non-bituminous pavements.
CO3	Understand construction of bituminous pavements.
CO4	Explain Construction of Cement Concrete Roads

Continuous Assessment Pattern

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

Course Content:

Unit I: Stabilization of Soil **7 lecture hours**
History of road construction, stages of construction, seasonal limitations of pavement construction. Mechanical stabilization, cementing additives and chemicals, thermal stabilization.
Unit II: Construction of Non-bituminous Pavements **7 lecture hours**
Brief introduction to earthwork machinery: shovel, hoe, clamshell, dragline, bulldozers, cleaning and grubbing, excavation for road and drain, principles of field compaction of embankment / subgrade. Compacting equipments. Granular roads. Construction steps of GSB, WBM and WMM.
Unit III: Construction of Bituminous Pavements **7 lecture hours**
Various types of bituminous constructions. Prime coat, tack coat, seal coat and surface dressing. Construction of busg, premix carpet, BM, DBM and AC. Brief coverage of machinery for construction of bituminous roads: bitumen boiler, sprayer, pressure distributer, hot-mix plant, cold-mix plant, tipper trucks, mechanical paver or finisher, rollers. Mastic asphalt. Introduction to various IRC and MORTH specifications.
Unit IV: Construction of Cement Concrete Roads **7 lecture hours**
Construction of cement concrete pavements, machinery involved in construction, slip-form pavers, joints in cement concrete pavements, IRC and MORTH specifications. Construction of other types of pavements: basic concepts of the following: soil stabilized roads, use of geo-synthetics, reinforced cement concrete pavements, prestress concrete pavements, roller compacted concrete pavements and fibre reinforced concrete pavements. Use of fly ash in cement concrete road construction.

Suggested Reading

1. Kadiyali.L.R., and Lal.N.B., (2005), Principles and Practice of Highway Engineering, Fourth Edition, Khanna Publishers, ISBN- 9788174091659.

2. ChakroborthyPartha, and Das Animesh, (2003), Principles of Transportation Engineering, Eighth Printing, Prentice-Hall of India, ISBN-9788120320840.

3. Rao.G.V., (1996), Principles of Transportation and Highway Engineering, Tata McGraw-Hill Co, ISBN- 9780074623633.

4. Khisty.C.J., and Lall.B.K., (2003), Transportation Engineering, Indian Edition, Prentice-Hall of India, ISBN- 9788120322127.

Name of The Course	**Transportation Safety and Environment**			
Course Code	**BCE01T5605**			
Prerequisite	BCE01T3502			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To make the students to understand transportation safety.
2. To enable the students to understand proper use of land.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the problem of road accidents in India
CO2	Explain traffic segregation.
CO3	Understand the concepts of road safety audit.
CO4	Monitor and evaluate non-engineering measures for road safety.

Continuous Assessment Pattern

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

Course Content:

Unit I: Trends in roads development **7 lecture hours**
Trends in roads and highways development. Problem of road accidents in India. Characteristics of road accidents. Causes of accidents. Global and Indian road safety scenario. Factors responsible for success stories in road safety. Role of highway professionals in highway safety.
Unit II: Planning of roads for safety **7 lecture hours**
Planning of roads for safety. Land use planning and zoning. Development control and encroachment. Network hierarchy. Route planning through communities. Access control. Traffic segregation. Traffic calming designing for safety: road link design, alignment design. Cross-sectional elements. Traffic control devices. Road side safety. Road side facilities. Some critical elements. Junction design Basic principles. Selection of junction type. Factors affecting safety at various junction types. Elements to improve road safety. Provisions for vulnerable road users.
Unit III: Road safety audit **7 lecture hours**
Road safety audit. Concepts of road safety audit, Road safety auditors & key personnel in RSA. Organizing and conducting a road safety audit. Example and commonly identified. Issues during RSA, Road safety audit report. Development of cost-effective of road safety audit accident investigation and prevention. Basic strategies for accident reduction. Significance of accident data. Accident investigation and identification of potential sites for treatment. Problem diagnosis. Selection of countermeasures. Example of selection of counter measures. Detailed design and implementation of countermeasures.
Unit IV: Monitoring of road safety **7 lecture hours**
Monitoring and evaluation non-engineering measures for road safety, behavioral counter measures, education. Training and publicity. The goal of police traffic control activities. Strategy for road safety management by police. Role of NGOs in road safety. Legal framework for road safety transport related pollution, noise pollution, air pollution, effects of weather conditions, vehicular emission parameters, pollution standards. EIA requirements of highway projects, world bank guidelines, EIA practices in India. Fuel crisis and transportation, factors affecting fuel consumption, fuel economy in various modes of transportation, various types of alternative fuels.

Suggested Reading

1. Kadiyali.L.R., and Lal.N.B., (2005), Principles and Practice of Highway Engineering, Fourth Edition, Khanna Publishers, ISBN- 9788174091659.
2. ChakroborthyPartha, and Das Animesh, (2003), Principles of Transportation Engineering, Eighth Printing, Prentice-Hall of India, ISBN-9788120320840.
3. Rao.G.V., (1996), Principles of Transportation and Highway Engineering, Tata McGraw-Hill Co, ISBN- 9780074623633.
4. Khisty.C.J., and Lall.B.K., (2003), Transportation Engineering, Indian Edition, Prentice-Hall of India, ISBN- 9788120322127.

Name of The Course	**Mini Project**			
Course Code	**BCE01P5606**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems pertaining to civil engineering domain.
2. To foster collaborative learning skills.
3. To develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Identify, formulate, and solve engineering problems.
CO2	Understand planning and scheduling of a project.
CO3	Submit a project report comprising of the application and feasibility of the project.
CO4	Work and communicate efficiently in multidisciplinary teams.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

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

List of Projects:

Students will select topic in transportation engineering field.

Suggested Reading

1. Kadiyali.L.R., and Lal.N.B., (2005), Principles and Practice of Highway Engineering, Fourth Edition, Khanna Publishers, ISBN- 9788174091659.
2. ChakroborthyPartha, and Das Animesh, (2003), Principles of Transportation Engineering, Eighth Printing, Prentice-Hall of India, ISBN-9788120320840.
3. Rao.G.V., (1996), Principles of Transportation and Highway Engineering, Tata McGraw-Hill Co, ISBN- 9780074623633.
4. Khisty.C.J., and Lall.B.K., (2003), Transportation Engineering, Indian Edition, Prentice-Hall of India, ISBN- 9788120322127.

Name of The Course	Pollution Control and Monitoring
Course Code	BCE01T5621
Prerequisite	-
Co-requisite	-
Anti-requisite	-

	L	T	P	C
	2	0	0	2

Course Objectives

1. To understand the factors that must be satisfied for potable water, land and air for the removal and treatment of pollutants.
2. To provide a strong link between the Pollution Damage, Public Authority Control Systems and Technical Control Systems
3. To know the relationship between social, legislative and biological constraints in a modern developed society.

Course Outcomes

On completion of this course, the students will be able to

CO1	Describe the principles of the biological and chemical treatment processes that are required to ensure adequate quality and quantities of potable water.
CO2	Implement the principal techniques currently in use for wastewater treatment and to review operational procedures for the plant involved.
CO3	Use advanced methods for monitoring and modeling spatial and temporal patterns of pollution.
CO4	Understand disinfection processes in water treatment.

Continuous Assessment Pattern

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

Course Content:

Unit I: Water Pollution & Control **7 lecture hours**
Natural process-pollution due to industrial, agricultural and municipal wastes-limitations of disposal by dilution-BOD consideration in streams – Oxygen Sag Curve-Water pollution control legislation.

Unit II: Air Pollution and Control **7 lecture hours**
Pollution and their sources-effects of pollution on human health, vegetation and climate-prevention and control of particulate-industry and air-pollution surveys and sampling-Air quality monitoring- air pollution control legislation.
Unit III: Noise Pollution and Control **7 lecture hours**
Sound and Noise: Sources of noise pollution – environmental and industrial noise; effects of noise pollution; fundamentals of sound generation, propagation etc; sound measurement; sound level meters – types, components, Measures for prevention and control of noise; environmental and industrial noise; noise control legislation.
Unit IV: Environmental Sanitation **7 lecture hours**
Relation of food to disease-principles of food sanitation-sanitation of kitchens, restaurants and other catering establishments-quality changes in milk-milk as carrier of infection-pasteurisation of milk-HTST and LTLT processes – cattle shed sanitation. Orientation of buildings with respect to the direction of prevailing winds and solar movement. Air movement inside the buildings for a healthy residential environment.

Suggested Reading

1. Rao C.S. (2006), Environmental Pollution Control Engineering, New Age International, ISBN: 9788122418354.
2. Arcadio P Sincero, Gregoria A Sincero (2009), Environmental Engineering : A Design Approach, PHI Learning, ISBN: 9788120314740.
3. George Tchobanoglous, Donald R. Rowe, Howard S. Peavy, Environmental Engineering, McGraw-Hill Publishing Co., ISBN: 9780071002318.
4. P. AarneVesilind, Susan M. Morga (2004), Introducing to Environmental Engineering, Nelson Engineering, ISBN: 9780534378127.

Name of The Course	**Air and Noise Pollution**			
Course Code	**BCE01T5622**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To understand the aspects of atmospheric pollution and its flow.
2. To know about the issues such as atmospheric composition, monitoring, acidic deposition, urban air quality
3. To understand the use and application of air quality models for the identification of plume flow.

Course Outcomes

On completion of this course, the students will be able to

CO1	The main chemical components and reactions occur in the atmosphere and examine the factors responsible for perturbing this.
CO2	The Implementation of the methods for monitoring and modeling spatial and temporal patterns of pollution.
CO3	The air pollution issues at a range spatial scales and how these are relaxed.
CO4	The environmental impacts of atmospheric pollutants and assess their concentration.

Continuous Assessment Pattern

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

Course Content:

Unit I: Sources and Effects of Air Pollution **7 lecture hours**
Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles.
Unit II: Control of Air Pollution **7 lecture hours**
Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment, gaseous pollutant control by adsorption & absorption, condensation, combustion – Pollution control for specific major industries.
Unit III: Air Quality Management **7 lecture hours**
Air quality standards – Air quality monitoring – Air pollution control efforts – Zoning – Town planning regulation of new industries – Legislation and enforcement – Environmental Impact Assessment – Methods.
Unit IV: Noise Pollution & Control **7 lecture hours**
Sound and Noise: Sources of noise pollution – environmental and industrial noise; effects of noise pollution- fundamentals of sound generation - propagation, sound measurement - sound level meters – types, components, Noise prevention & control measures, environmental and industrial noise - noise control legislation.

Suggested Reading

1. M N Rao& H V N Rao (2007), Air Pollution, Tata McGraw-Hill Publishing Company, 26th reprint, New Delhi. ISBN: 0074518718

2. Noel De Nevers (2010), Air Pollution Control Engineering, 2nd Edition, Waveland Press, Inc., Long Grove, Illinois. ISBN: 978-1577666745

3. Singal, S.P. (2000), Noise Pollution and Control, First Edition, Narosa Publishing House, New Delhi.ISBN: 8173193630

4. Rao C.S. (2006) Environmental Pollution Control Engineering, 2nd edition, New Age International,New Delhi. ISBN: 9788122418354

Name of The Course	**Solid Waste Management**			
Course Code	**BCE01T5623**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To gain insight into collection, transfer and transport of municipal solid waste
2. Understand the design and operation of municipal solid waste landfill
3. Understand the design and operation of resource recovery facility
4. Understand the design and operation of waste to energy facility

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand solid waste and its composition.
CO2	Understand method of solid waste collection and transportation.
CO3	Understand various processes involved in solid waste collection, segregation and transportation.
CO4	Design solid waste disposal facility.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to Solid Waste Management **7 lecture hours**
Legal and Organizational foundation: Definition of solid waste–waste generation–major legislation, monitoring responsibilities, sources and types of solid waste – sampling and characterization – Determination of composition of MSW–storage and handling of solid waste – Future changes in waste composition.
Unit II: Waste collection systems **7 lecture hours**
Waste collection systems, analysis of collection system–alternative techniques for collection system. Need for transfer operation, transport means and methods, transfer station types and design requirements.
Unit III: Process of Solid Waste and Energy recovery **7 lecture hours**
Unit operations for separation and processing, Materials Recovery facilities, Waste transformation through combustion and aerobic composting, anaerobic methods for materials recovery and treatment – Energy recovery – Incinerators
Unit IV: Disposal of Solid Wastes **7 lecture hours**
Land farming, deep well injections. Landfills: Design and operation including: site selection, Geo-environmentalinvestigations,engineeredsites,liner sandcovers,leachatecontrolandtreatment,gas recovery and control, including utilization of recovered gas (energy), and landfill monitoring and reclamation,,Requirementsandtechnicalsolution,designatedwastelandfillremediation–Integrated waste management facilities. TCLP tests and leachate studies. Economics of the on-site v/s offsite waste management options. Natural attenuation process and its mechanisms.

Suggested Reading

1.GeorgeTechobanoglousetal," Integrated Solid Waste Management", McGraw-Hill Publication, 1993

1. Hand book of Solid Waste Management by Frank Kreith, George Tchobanoglous, McGrawHill Publication

2. Bagchi, A., Design, Construction, and Monitoring of Landfills,(2ndEd). Wiley Inter Science, 1994.ISBN: 0-471-30681-9.

3. Sharma,H.D.,and Lewis,S.P., Waste Containment Systems, Waste Stabilization, and Landfills: Design and Evaluation. Wiley Interscience,1994, ISBN: 0471575364.

Name of The Course	**Bio-Energy Technologies**			
Course Code	**BCE01T5624**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. Bio-energy and its mechanism
2. Different processes for production of bio energy
3. To under different techniques and tools
4. Bio energy production from different solid wastes
5. Energy Consumption and Cost - Environmental Aspects

Course Outcomes

On completion of this course, the students will be able to

CO1	Solid waste management by bio energy
CO2	Different processes used for biodegradation of solid waste and production of bio energy
CO3	The industrial applications of Bio-Energy.
CO4	Environmental aspect of Bio-Energy

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to Bio Energy **7 lecture hours**
Bio Energy - Bio Conversion Mechanism - Utilization of Photosynthate
Unit II: Biological Conversion **7 lecture hours**
Combustion, Pyrolysis, Gasification and Liquefaction - Biological Conversion - Methanol, Ethanol Production - Fermentation - Anaerobic Digestion Biodegradation and Biodegradability of Substrate - Hydrogen Generation from Algae – Biological Pathways
Unit III: Biomass Production **7 lecture hours**
Through Fermentation and Gasification - Biomass Production from different Organic Wastes - Effect of Additives on Biogas Yield - Biogas production from Dry Dung Cakes
Unit IV: Energy Production **7 lecture hours**
Viability of Energy Production - Wood Gasifier System, Operation of Spark Ignition and Compression Ignition with Wood Gas. Operation and Maintenance

Suggested Reading

1. R.C.Maheswari, Bio Energy for Rural Energisation , Concepts Publication, 1997

2. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood, Chichester, 1984

3. Khandelwal KC, Mahdi SS, Biogas Technology - A Practical Handbook, Tata McGraw Hill, 1986

4. Anthony San Pietro, Biochemical and Photosynthetic aspects of Energy Production, Academic Press, New York, 1980

Name of The Course	**Environmental Ecology**			
Course Code	**BCE01T5625**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To establish Ecology's credibility in high environmental, ethical and quality standards of goods and services.
2. Access the market opportunity presented by the 'greenmarket'.
3. Raise consumer awareness and concern for environmental issues, and encourage their support for ecological values in consumer practices.
4. Also to develop affair and equitable means to link economic and environmental values

Course Outcomes

On completion of this course, the students will be able to

CO1	Develop legal and economic structures
CO2	Able to provide reasonable return on investment, financial or personal effort, dividends, wages and so forth
CO3	Develop ecologically sustainable production and industry through developing the potential of all fibres.
CO4	Develop environmentally and socially friendly alternatives

Continuous Assessment Pattern

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

Course Content:

Unit I: Concepts of Ecology **7 lecture hours**
Fundamentals of ecology, Natural ecosystems and their food chains, food webs, bioenergetics, biochemical cycles and ecological succession, deoxygenating nutrient enrichment
Unit II: Bio Diversity **7 lecture hours**
Biological diversity and its importance, reduction in biological diversity by human activities, classes and general effects of physical and Biological interaction with pollutants, lethal and sub-lethal effects.
Unit III: Ecosystem Ecology **7 lecture hours**

Ecosystems responses to deoxygenating nutrient enrichment, pesticides, hydrocarbons, metal and salts, thermal pollution, suspended solids and silt.
Unit IV: Community Ecology **7 lecture hours**
Principles of population and community ecology– concepts of systems and models–building and analysis of models–environmental systems, structures and interaction between coastalaeolian, glacial, fluvial, weathering, soil and detrital systems.

Suggested Reading

1. Odum. E. P, "Fundamentals of ecology",W.B. Sanders, Philadelphia, 2002
2. White. I.D., Mottershead. D.N., Harrison .S.J, "Environmental Systems – an introductory text", Chapmanandahll ,London,1998.
3. Colinvaux.P, "Introduction to Ecology", John Wile & sons, Newyork, 1973.

Name of The Course	**Mini Project**			
Course Code	**BCE01P5626**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems pertaining to civil engineering domain.
2. To foster collaborative learning skills.
3. To develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Identify, formulate, and solve engineering problems.
CO2	Understand planning and scheduling of a project.
CO3	Submit a project report comprising of the application and feasibility of the project.
CO4	Work and communicate efficiently in multidisciplinary teams.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

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

List of Projects:

Students will select topic in Environmental engineering field.

Suggested Reading

1. Rao C.S. (2006), Environmental Pollution Control Engineering, New Age International, ISBN: 9788122418354.
2. Arcadio P Sincero, Gregoria A Sincero (2009), Environmental Engineering : A Design Approach, PHI Learning, ISBN: 9788120314740.
3. George Tchobanoglous, Donald R. Rowe, Howard S. Peavy, Environmental Engineering, McGraw-Hill Publishing Co., ISBN: 9780071002318.
4. P. AarneVesilind, Susan M. Morga (2004), Introducing to Environmental Engineering, Nelson Engineering, ISBN: 9780534378127.

Name of The Course	**Advanced Structural Analysis**			
Course Code	**BCE01T5701**			
Prerequisite	BCE01T3401			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To enable the students to understand the behaviour of indeterminate structures.
2. To help the students to know the concepts of elastic analysis and plastic analysis.

3. To teach students about the concepts of matrix analysis of structures.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the concept of moment distribution method.
CO2	Understand the concept of plastic analysis.
CO3	Use flexibility matrix method for analyzing beams and plane trusses.
CO4	Apply stiffness matrix method in the analysis of beams and plane trusses.

Continuous Assessment Pattern

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

Course Content:

Unit I: Moment distribution method **7 Lecture Hours**
Moment distribution method - analysis of continuous beams and portals - bending moment and shear force diagram
Unit II: Plastic Analysis **7 Lecture Hours**
Plastic moment of resistance - shape factor - collapse load - analysis of continuous beams and portals.
Unit III: Flexibility matrix **7 Lecture Hours**
Concept of flexibility matrix - analysis of continuous beams - pin jointed plane trusses.
Unit IV: Stiffness matrix **7 Lecture Hours**
Stiffness matrix for beam element - analysis of continuous beams - pin jointed plane trusses.

Suggested Reading

1.Ashok K. Jain, (2009), Advanced Structural Analysis with Finite Element & Computer Applications, Nem Chand & Brothers, ISBN 978-81-852-4081-7.

2.Hibbeler, R. C. (2005), Structural Analysis (5th Ed.), Pearson Education India, ISBN-10: 0131470892.

3. S. S. Bhavikatti, (2005), Structural Analysis, 2nd edition, Vikas Publishing House, ISBN: 812-59-171-60.Rao C.S. (2006)

Name of The Course	**Rehabilitation of structures & Vaastu Principles**			
Course Code	**BCE01T5702**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. This subject imparts a broad knowledge in the area of repair and rehabilitation of structures

Course Outcomes

On completion of this course, the students will be able to

CO1	Know the strategies of maintenance and repairing
CO2	Get an idea of repairing techniques.
CO3	Understand the properties of repairing materials.
CO4	Know about Vaastu Principles

Continuous Assessment Pattern

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

Course Content:

Unit I: Repairing materials **7 lecture hours**

Diagnosis and Assessment of Distress - Visual inspection – Non destructive tests –Ultrasonic pulse velocity method – Rebound hammer technique – ASTM classifications – Pullout tests – Core test.
Unit II: Repairing techniques **7 lecture hours**
Materials for Repairing - Special concretes and mortar - Concrete chemicals - Special elements for accelerated strength gain - Expansive cement - Polymer concrete – Ferro cement, Fibre reinforced concrete - Fibre reinforced plastics.
Unit III: Repairs to structures **7 lecture hours**
Techniques for Repair - Rust eliminators and polymers coatings for rebars during repair - Foamed concrete - Mortar and dry pack - Vacuum concrete - GModulee and shotcrete - Epoxy injection - Mortar repair for cracks - Shoring and underpinning.
Unit IV: Vaastu Principles **7 lecture hours**
Vaastu Principles – Applications - Advantages

Suggested Reading

1. Shetty M. S., (2008), Concrete Technology, Seventh Edition, S. Chand & Company Ltd.*ISBN-13: 9788121900034*.
2. Ravindra K. Dhir, M. Roderick Jones & Li Zheng, (2005), Repair and Renovation of Concrete Structures, American Society of Civil Engineers, *ISBN-13: 9780727734051*.
3. A. R. Santha Kumar, (2006), Concrete Technology, First Edition, Oxford University Press, ISBN-13: 9780195671537.

Name of The Course	**Bridge Engineering**				
Course Code	**BCE01T5703**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	2	0	0	2	

Course Objectives

1. To understand the design and codal concepts of different types of bridges.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand IRC Code
CO2	Use Pigeauds curves for designing deck slab for T-beam Bridge.
CO3	Understand Courbon's method of load distribution to analyze and design girders for T-beam Bridge.
CO4	Design piers and abutments

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction and design of slab culvert **7 lecture hours**
Site selection, various types of bridges, loads on bridges according to IRC codes, Design of RC bridges under concentrated loads using effective width method.
Unit II: Deck slab of T-Beam Bridges **7 lecture hours**
Pigeauds curves, Calculation of bending moments, Design of deck slab for T-beam Bridge for different types of vehicles.
Unit III: Girders of T-Beam Bridge **7 lecture hours**
Courbon's method of load distribution, Analysis and design of girders for T-beam Bridge for different types of vehicles, Concept of box culverts
Unit IV: Design of Substructures **7 lecture hours**
Types of piers, Forces acting on piers, Design of piers, General features of abutments, Forces acting on abutments, Design of abutments

Suggested Reading

1. Victor D. J. (2008), Essentials of Bridge Engineering, 6th Edition, Oxford University Press, ISBN: 9788120417175.
2. Ramachandra (2004), Design of Steel structures, 4th Edition, Standard Publishers Distributors, ISBN: 9780071544115.
3. Duggal S. K. (2008), Design of Steel Structures, 3rd Edition, Tata McGraw-Hill, ISBN: 9780070260689.
4. IRC Bridge Codes.

Name of The Course	**Earthquake Engineering**			
Course Code	**BCE01T5704**			
Prerequisite	**BCE01T3501**			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To enable the students to understand the elements of earthquake engineering.
2. To teach the students about SDOF and MDOF systems.
3. To teach the students about the earthquake resistant design of multi-storeyed structures.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the elements of earthquake engineering
CO2	Compute design moments and shears for framed structure as per IS: 1893.
CO3	Calculate free vibrations and forced vibrations of different degree of freedom and dynamic response to time dependent forces
CO4	Know about earthquake damages

Continuous Assessment Pattern

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

Course Content:

Unit I: Elements of Earthquakes **7 lecture hours**
Elements of Seismology - Earthquakes -Structure of the Earth -History of the Earth -Earthquake Mechanism -Propagation of Seismic Waves - Earthquake Phenomena -Earthquake Measurements -Definitions of magnitude, intensity, epicentre etc; General features of tectonics of seismic regions, seismographs, liquefaction, effect of Tsunami.
Unit II: Free and Forced Vibrations **7 lecture hours**
Dynamic Loads - D'Alembert's Principle and inertia forces-Stiffness and flexibility of elastic structures - Theory of Vibrations - Free vibrations of single degree, two degree and multi degree freedom systems - computations of dynamic response to time dependent forces- mass and stiffness matrices – natural frequencies - Plate Tectonics Theory.
Unit III: Earthquake Resistant Design **7 lecture hours**
Principles of Earthquake Resistant Design - Response spectrum theory. Application of response spectrum theory to seismic design of structures.
Unit IV: Earthquake Damages **7 lecture hours**
Earthquake Damages to Various Civil Engineering Structures - Case Histories Earthquake-Earthquake response of structures

Suggested Reading

1. Anil K. Chopra, (2011), Dynamics of Structures – Theory and Applications to Earthquake Engineering, 4th Edition, Prentice-Hall India Pvt Ltd. ISBN: 0132858037

2. Agarwal P. &Shrikhande M., (2006), Earthquake Resistant Design of Structures, Prentice-Hall India Pvt Ltd, ISBN: 9788120328921
3. Pauley & Priestly (1995), Seismic design of reinforced concrete and masonry buildings, John Wiley & Sons.
4. StrattaJ.L. (2000), Manual of Seismic Design, Prentice-Hall India Pvt Ltd.

Name of The Course	**Advanced Concrete Design**			
Course Code	**BCE01T5705**			
Prerequisite	BCE01T3501			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To enable the students to learn the limit state method of design of concrete members.
2. To enable the students to understand the concepts of advanced concrete design for different structures.

Course Outcomes

On completion of this course, the students will be able to

CO1	Design different types of RC footings.
CO2	Design dog legged and open well stair case.
CO3	Design cantilever and counterfort retaining walls.
CO4	Understand the concept of yield line theory.

Continuous Assessment Pattern

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

Course Content:

Unit I: Design of Footings **7 lecture hours**
Types of foundation - Design of isolated footing - combined footing – Concept of raft footing and well foundation
Unit II: Design of Stair Cases **7 lecture hours**
General specifications, Types of stair cases, Loads on stair cases, Effective span of stairs, Design of dog legged stair case, Design of open well stair case
Unit III: Retaining Walls **7 lecture hours**
General specifications, Forces acting on retaining walls, Stability consideration, Wall proportioning, Design of cantilever retaining walls and counterfort retaining walls.
Unit IV: Yield Line Theory **7 lecture hours**
Yield line pattern, Moment capacity along yield line, Ultimate load on slabs, Analysis by virtual work method and equilibrium method.

Suggested Reading

1. Gambhir, M.L., (2011), Design of Reinforced Concrete Structures, ISBN: 9788120331938.
2. Varghese, P.C., (2009), Advanced Reinforced Concrete Design, 2nd ed. ISBN: 9788120327870.
3. Jain, A.K., (1999) "Reinforced Concrete: Limit State Design 7th Edition, ISBN: 8185240663.
4. IS:456 (2000) & SP:16.

Name of The Course	**Mini Project**			
Course Code	**BCE01P5706**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems pertaining to civil engineering domain.
2. To foster collaborative learning skills.

3. To develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Identify, formulate, and solve engineering problems.
CO2	Understand planning and scheduling of a project.
CO3	Submit a project report comprising of the application and feasibility of the project.
CO4	Work and communicate efficiently in multi disciplinary teams.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

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

List of Projects:

Students will select topic in Environmental engineering field.

Suggested Reading

1. Gambhir, M.L., (2011), Design of Reinforced Concrete Structures, ISBN: 9788120331938.
1. Varghese, P.C., (2009), Advanced Reinforced Concrete Design, 2nd ed. ISBN: 9788120327870.
2. Jain, A.K., (1999) "Reinforced Concrete: Limit State Design 7th Edition, ISBN: 8185240663.
3. IS:456 (2000) & SP:16.

Name of The Course	**Construction Planning and Management**			
Course Code	**BCE01T5721**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. To provide a fundamental understanding of social and economic conditions within which the construction project takes place.
2. To know the management techniques and project management skills and their application.

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the special management skills required in multidisciplinary and global Construction Industry.
CO2	Integrate and apply theoretical concepts, ideas, tools and techniques to Construction practice.
CO3	Plan, schedule and control project activities using Project management software.
CO4	Know about the details of project management.

Continuous Assessment Pattern

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

Course Content:

Unit I: Principles of Management **7 lecture hours**
Definition – Importance – Functions of Management – Relevance to government and Quasi Government departments – Private Contractors – Contracting firms – Organizational structure.
Unit II: Construction Planning and Labour Welfare **7 lecture hours**
Collection of field data – Preliminary estimates – Approval and sanction of estimates – Budget provisions – Scheduling using MS project software - Relationships between management

and labour – Problems – Labour legislations – Minimum Wages act – Industrial Psychology – Safety procedures in construction – MS Project Application.
Unit III: Management Techniques **7 lecture hours**
Concepts of Network – Network methods CPM/PERT – Cost control – Principles – Control by graphical representation, by bill of quantities and by network analysis.
Unit IV: Project Management **7 lecture hours**
Tendering - Arbitration - International projects – Detailed Project Reports (DPR) / Build Own Operate Transfer (BOOT) Projects / Build Operate and Transfer (BOT) – case studies.

Suggested Reading

1. Jha Kumar Neeraj (2013), "Construction Project Management", Pearson Education India. ISBN9788131732496.
2. Chitkara, K. K. (2010), "Construction Project Management : Planning, Scheduling and Controlling", Tata McGraw-Hill Publishing Company Limited. ISBN 9780070680753.
3. R. L. Peurifoy and C. J. Schexnayder (2008), "Construction Planning, Equipment and Methods", Tata McGraw-Hill Publishing Company Limited. ISBN 9780073401126

Name of The Course	**Economics and Project Finance for Civil Engineers**				
Course Code	**BCE01T5722**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	2	0	0	2	

Course Objectives

1. To understand the importance of Economics in Engineering.
2. To know the basic concepts of engineering economics and finance.
3. To provide understanding of methods used for evaluating Engineering alternatives.

Course Outcomes

On completion of this course, the students will be able to

CO1	Evaluate the engineering alternates economically.
CO2	Evaluate the options incorporating the uncertainty involved in the construction business.
CO3	Understand the process of maintaining balance sheets, profit and loss statements.
CO4	Know the various sources of finance for projects.

Continuous Assessment Pattern

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

Course Content:

Unit I: Engineering economics - Basic principles **7 lecture hours**
Time value of money, Cash flow diagrams, Quantifying alternatives for decision making, Equivalence - single payment in the future (P/F, F/P). Future payment compared to uniform series payments (F/A, A/F). One present payment compared to uniform series payments (P/A, A/P), Arithmetic gradient, and Geometric gradient.
Unit II: Comparison of Alternatives **7 lecture hours**
Present worth method- equal lives, unequal lives, infinite lives, future worth method and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Sensitivity Analysis, Breakeven analysis
Unit III: Taxes, depreciation and inflation **7 lecture hours**
Depreciation, Taxes, Inflation, Escalation, Equipment economics- Equipment costs, Owning and operating costs, Buy/Rent/Lease options, Replacement analysis.

Unit IV: Construction Accounts Management **7 lecture hours**
Construction accounting, Chart of Accounts, Financial statements - Profit and loss account, Balance sheets.

Suggested Reading

1. Jha Kumar Neeraj (2013), "Construction Project Management", Pearson Education India. ISBN9788131732496

2. D. C. Bose (2010), "Fundamentals of Financial management", Prentice Hall of India Pvt. Limited. ISBN 9788120340749

3. R. L. Peurifoy and C. J. Schexnayder (2008), "Construction Planning, Equipment, and Methods", Tata McGraw-Hill Publishing Company Limited. ISBN 9780073401126.

Name of The Course	**Construction Contracts Administration and Management**				
Course Code	**BCE01T5723**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	2	0	0	2	

Course Objectives

1. To understand the broad principles and concepts of construction management.
2. To create awareness of MIS techniques in construction industry.
3. To represent various works measurement standards

Course Outcomes

On completion of this course, the students will be able to

CO1	Take responsibilities as construction manager
CO2	Apply MIS technique in the real time construction operation
CO3	Acquire knowledge of work measurement application in construction industry
CO4	Know about the details of work study.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to management **7 lecture hours**
History of construction management, modern management, system approach and emergence of management thought, need, nature and purpose of construction management, major problems in construction industry, firm organization, chain of command, division of work, organization charts, functions and responsibilities of construction manager, case studies, future of construction management
Unit II: Principles of construction management **7 lecture hours**
Planning, organizing, staffing, leading, controlling. Decision making in construction industry, nature of managerial decision making, the rational model of decision making, challenges to the rational model, improving the effectiveness of decision making tools and techniques, benefit-cost analysis, replacement analysis, break even analysis, risk management in construction industry.
Unit III: Site mobilization and demobilization aspects **7 lecture hours**
Various resource management based on funds availability, organization and monitoring of the construction work with respect to cost-time schedules, coordinating, communicating and reporting techniques, Application of MIS to construction, Training of Construction Managers.
Unit IV: Work Study **7** **lecture hours**
Definition, Objectives, basic procedure, method study and work measurement, work study applications in Civil Engineering. Method study – Definition, Objective, Procedure for selecting the work, recording facts, symbols, flow process charts, multiple activity charts, string diagrams.

Suggested Reading

1. Jha Kumar Neeraj (2013), “Construction Project Management”, Pearson Education India. ISBN9788131732496
2. D. C. Bose (2010), "Fundamentals of Financial management", Prentice Hall of India Pvt. Limited. ISBN 9788120340749
3. R. L. Peurifoy and C. J. Schexnayder (2008), "Construction Planning, Equipment, and Methods", Tata McGraw-Hill Publishing Company Limited. ISBN 9780073401126.

Name of The Course	**Value Engineering and Valuation**			
Course Code	**BCE01T5724**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. Define Value engineering and its objectives
2. Estimation of project budget using capitalized income approach
3. Analyse a building using LCC methodology

Course Outcomes

On completion of this course, the students will be able to

CO1	Establish value engineering techniques and methodology.
CO2	Draw value engineering job plan and work plan phases.
CO3	Acquire concept of Delphi techniques and rules for brainstorming.
CO4	Know about the details of value engineering.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to value engineering 7 lecture hours
Introduction to value engineering (VE), definition, objectives of value engineering, reasons for unnecessary costs, VE techniques and methodology, interface with the other programs.
Unit II: Elements of the project budget 7 lecture hours
Elements of the project budget need for cost control, meaning of capitalization, capitalization process, and capitalized income approach to construction project budgeting.
Unit III: Life cycle cost 7 lecture hours
Life cycle cost (LCC) and building costs, LCC technology and examples, LCC methodology, LCC formats and analysis and weighted evaluation – application of LCC to buildings.
Unit IV: Value engineering 7 lecture hours
Value engineering and total project management, level of effort, team selection, value engineering job plan, and work plan phases.

Suggested Reading

1. Tenah, K.A. (1985). "The Construction Management Process", Reston Publishing Company, Inc. Virginia
2. Dell’Isola, Alphonse (1997). “Value Engineering: Practical Applications.” R.S. Means Company, Inc: Kingston, MA.
3. Oberiender, G. D. (1993). “Project Management for Engineering and Construction”. McGraw-Hill, Inc.: New York.

Name of The Course	**Infrastructure Development**			
Course Code	**BCE01T5725**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. Importance of prefabrication in construction
2. Advantages of modular coordination in prefabrication

3. Application of different equipments in construction industry

Course Outcomes

On completion of this course, the students will be able to

CO1	Evaluate advantages and disadvantages of prefabrication in construction industry
CO2	Comprehend different I.S. recommendations for modular planning
CO3	Analyse the role of different equipments in construction industry
CO4	Know about concrete mixers

Continuous Assessment Pattern

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

Course Content:

Unit I: Precast and Prefabricated construction **7 lecture hours**
Precast and Prefabricated construction - need for prefabrication, classification and scope. Advantages and disadvantages of prefabrication and design principles of prefabrication system.
Unit II: Modular coordination **7 lecture hours**
Modular coordination and its importance, I.S. Recommendations for modular planning, standardization, mass production and methods of Transportation
Unit III: Construction equipment **7 lecture hours**
Construction equipment- hoisting equipment such as hoist winch, hoisting chains and hooks, slings. Various types of cranes - tower crane, mobile crane, and derrick crane, safety in crane operations, their characteristics performance and applications to building process.
Unit IV: Concrete mixers **7 lecture hours**
Concrete mixers, truck mixers, pneumatic concrete placer and vibrators for concrete, and Scaffolding. Their characteristics performance and applications to building process.

Suggested Reading

1. Peurify, R.L.(1996). “Construction, Planning, Equipment and Methods." McGraw-Hill Book Company, Inc, NY
2. Mahesh Varma (1997) “Construction Equipment and its planning & applications." Metropolitan Book Co (P) Ltd, New Delhi, India.
3. U.K. Srivastava (1999). "Construction Planning and Management." Galgotia Publications Pvt., ltd, New Delhi, India

Name of The Course	**Mini Project**				
Course Code	**BCE01P5726**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	2	0	0	2	

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems pertaining to civil engineering domain.
2. To foster collaborative learning skills.
3. To develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Identify, formulate, and solve engineering problems.
CO2	Understand planning and scheduling of a project.
CO3	Submit a project report comprising of the application and feasibility of the project.
CO4	Work and communicate efficiently in multidisciplinary teams.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

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

List of Projects:

Students will select topic in Construction Planning and Management field.

Suggested Reading

1. Jha Kumar Neeraj (2013), "Construction Project Management", Pearson Education India. ISBN9788131732496.
2. Chitkara, K. K. (2010), "Construction Project Management : Planning, Scheduling and Controlling", Tata McGraw-Hill Publishing Company Limited. ISBN 9780070680753.
3. R. L. Peurifoy and C. J. Schexnayder (2008), "Construction Planning, Equipment and Methods", Tata McGraw-Hill Publishing Company Limited. ISBN 9780073401126.

Name of The Course	**Pre-Stressed Concrete Structures**				
Course Code	**BCE01T3711**				
Prerequisite	BCE01T3501				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. To analyze sections for flexure and deflection.
2. To analyse the Losses of pre stressed members.
3. To analyse the Transfer of Prestress in Pre tensioned Members and Anchorage Zone Stresses in Post Tensioned Members

Course Outcomes

On completion of this course, the students will be able to

CO1	Analyze sections for flexure and deflection
CO2	Analyze the Losses of pre stressed members
CO3	Analyze the Transfer of Prestress in Pre tensioned Members and Anchorage Zone Stresses in Post Tensioned Members.
CO4	Visualize and work on multi-disciplinary tasks
CO5	Use modern engineering tools, software and equipment to analyze and design.
CO5	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Basic Principles of Pre-Stressing, Prestressing Systems **8 lecture hours**
Basic concepts of prestressing, High strength concrete and steel, Stress-strain characteristics and properties, Various prestressing systems, Pre-tensioning and Post- tensioning systems with anchorages, Advantages and limitations of prestressed concrete.
Unit II: Analysis of Sections for Flexure **8 lecture hours**
Basic assumptions, Analysis of stresses in concrete due to pre- stress and loads for different types of cross section, Pressure line or thrust line, Cable profile, Concept of load balancing, Cracking moment.
Unit III: Losses of Pre-Stress & Deflections **8 lecture hours**
Nature of losses in pre-stress, Various losses encountered in pre-tensioning and post tensioning methods, Deflection, Factors influencing deflection, Elastic deflection under transfer loads and due to different cable profile. Deflections limits as per IS-1343, Effects of creep on deflection, crack widths
Unit IV: Flexural and Shear Strength of Prestressed Concrete Sections **8 lecture hours**

Types of flexural failure, IS code recommendations for flexure, Ultimate flexural strength of section. Shear and principal stresses, Ultimate shear resistance of prestressed concrete members, Shear reinforcement
Unit V: Transfer of Prestress in Pre tensioned Members and Anchorage Zone Stresses in Post Tensioned Members **8 lecture hours**
Transmission of pre-stress in pre-tensioned members, Transmission length, Bond stresses, Codal provisions for bond and transmission length, Anchorage stress in post- tensioned member. Bearing stress and bursting tensile force, IS code provisions.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Raju, N. K., "Pre-stressed concrete", Tata McGraw Hill, New Delhi, 1st Edition, 2012.
2. Ramamruthum, S., "Pre-stressed Concrete", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2003.
3. Lin, T. Y., Burns, N. H., "Design of pre- stressed Concrete Structures", John Wiley and Sons. New York, 3rd Edition, 1981

Name of The Course	**Applications of Matrix Methods in Structural Analysis**				
Course Code	**BCE01T3303**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. To understand the basic concepts of flexibility method and stiffness method.
2. To distinguish between force method and displacement method.
3. To understand the behaviour of plane trusses & plane frames.

Course Outcomes

On completion of this course, the students will be able to

CO1	Know the concept of static and kinematic indeterminacy
CO2	Understand the concept of flexibility matrix method and stiffness matrix method
CO3	Analyze plane trusses & plane frames
CO4	Understand the concept of plate girders, gantry girders and roof trusses.
CO5	Calculate different types of loadings on roof trusses
CO6	Discussion on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to Flexibility Matrices and Stiffness Matrices **8 lecture hours**
Flexibility and stiffness matrices- relationship between flexibility and stiffness matrices- properties of stiffness and flexibility matrices - concept of co-ordinates-solution of simple problems.
Unit II: Analysis of Beams by Flexibility Matrix Method **8 lecture hours**
Flexibility matrices for beams - solution of statically indeterminate beams–shear force diagram and bending moment diagram.
Unit III: Analysis of Beams by Stiffness Matrix Method **8 lecture hours**

Stiffness matrices for beams - solution of kinematically indeterminate beams–shear force diagram and bending moment diagram
Unit IV: Analysis of Plane Truss by Stiffness Matrix Method **8 lecture hours**
Stiffness matrices for plane truss - solution of simple problems.
Unit V: Analysis of Plane Frame by Stiffness Matrix Method **8 lecture hours**
Stiffness matrices for plane truss - solution of simple problems.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Pundit G.S., & Gupta S.P., (2008), Structural Analysis (A matrix approach), Tata McGraw Hill Publishing Ltd.
2. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach". Sixth Edition, 2007, Chapman & Hall.
3. Devdas Menon,"Advanced Structural Analysis" (2009), Narosa Publishing House
4. Devdas Menon, "Structural Analysis" (2008), Narosa Publishing House, 2008

Name of The Course	**Open Channel Hydraulics**				
Course Code	**BCE01T3303**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. To provide knowledge about various types of flows and properties in open channels.
2. To provide knowledge in detail about gradually varied flow, rapidly varied flow and spatially varied flow.

Course Outcomes

On completion of this course, the students will be able to

CO1	Know the various types of flows in open channels
CO2	Determine velocity distribution across and along the channel, and hydraulic jumps.
CO3	Design the channel sections, drains, and jumps for various hydraulic and hydrologic projects.
CO4	Understand the concept of plate girders, gantry girders and roof trusses.
CO5	Calculate different types of loadings on roof trusses
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction **8 lecture hours**
Introduction, Pipe Flow and Free Surface Flow, Continuity Equation, Energy in Free Surface Flow, Basic Momentum Equation, Velocity Distribution, Velocity Measurement and Distribution, Velocity-area Method, Radio-active tracer technique for Measurement of River Discharges, Errors in Depth Measurement in High Velocity Flows, Secondary Current and Spiral Flow, Energy and Momentum Coefficients-Derivation and Coefficients for Different Velocity Distributions, Comparison between Momentum and Energy Equation, Pressure Distribution, Specific Energy Equations for Rectangular Channels, Application of Specific Energy, Specific Force.

Unit II: Critical Flow **8 lecture hours**
Characteristics of Critical Flow, Occurrence, Critical Depth in Trapezoidal & Circular Channels, Hydraulic Exponent for Critical Flow, Critical Flow Depth Computations, Flow Measurement, Measuring Flumes, Critical Depth Flumes, Weirs-Introduction, Types of Control Structures, Proportional weirs, Flow Over weirs, Polygonal weirs, Special types of weirs, Broad Crested weirs, Different types of Broad Crested weirs, Bear Trap weir, Flow below a Sluice Gate, Brink Depth, Modern Measurements of Flow Measurements, Outlets & Modules, Errors in Measurements, International Standards for Flow Measurement in Open Channel.
Unit III: Uniform Flow **8 lecture hours**
Concept of Uniform Flow, Derivation of Uniform Flow Equations, Resistance in Open Channel Hydraulics, History of Uniform Flow Velocity and Resistance Factor, Friction, Ganguillet and Kutter Formula, Conveyance, Section Factor for Uniform Flow Computation, Hydraulic Exponent for Uniform Flow Computation, Maximum Discharge, Classification of bed Slope, Solution of Manning Equation by Newton Raphson Method, Slope-area Method, Normal & Critical Slopes, Design of Canals, Typical Canal Cross Sections, Lining the Canal, Seepage Prevention with Impermeable membranes, Failure of Canal Lining, Most Efficient Hydraulic Section, Design of Unlined Channels
Unit IV: Gradually Varied Flow **8 lecture hours**
Introduction, Dynamic Equation for Steady Gradually Varied Flow, Classification of Gradually Varied Flow Profiles, Real Life Cases of Water Surface Profiles, Sketching of Composite Water Surface Profiles, Computation of Gradually Varied Flow, Integration of Differential Equation, Improved Euler Method, Fourth-order Runga-Kutta Method

Unit V: Hydraulic jump **8 lecture hours**
Normal Hydraulic Jumps, Classification of Jumps, Momentum Equation, General Hydraulic Jump Equation, Energy loss in the Jump, Turbulent Characteristics of the Jump, Pressure Distribution in the Jump, Velocity Distribution in Hydraulic Jump, Length of the Jump, Air Entrainment Characteristics of the Jump, Pre Entrained Hydraulic Jump, Air Concentration Distribution along the Jump, Decay of Turbulence Downstream from a Stilling Basin, Hydraulic Jumps in Sloping Channels, Stilling Basin, Baffle Stilling Basin, Bhavani Type Stilling Basin, Stilling Basin in Sudden Expansion, Slotted Bucket Stilling Basin.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Subramanya, K., (2008) Flow in Open Channels, 3rd ed., Tata McGraw-Hill. ISBN - 9780070699663
2. V. T .Chow (2009), Open Channel Hydraulics, Blackburn Press. 9781932846188.
3. Asawa, G. L., (2010), Fluid Flow in Pipes and Channels, CBS Publishers. ISBN - 9788123917238
4. Chanson, H., (2004), The Hydraulics of Open Channel Flow: An Introduction, Elsevier Scientific. ISBN- 9780750659789

Name of The Course	**Water Resources System Engineering**			
Course Code	**BCE01T3303**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To provide information about need of water resources engineering in India and teach basic concepts of surface and ground water hydrology and irrigation aspects.
2. To teach various optimization techniques.
3. To provide information about water resources engineering structures**.**

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the components of planning and management in water resources
CO2	Use various optimization methods
CO3	Use linear and dynamic programming of water resource problems.
CO4	Understand the concept of plate girders, gantry girders and roof trusses.
CO5	Calculate different types of loadings on roof trusses
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction and Basic Concepts **8 lecture hours**
Introduction, System Components, Planning and management, Concept of a system, Advantages and limitations of systems approach, Modelling of Water Resources Systems, Simulation and optimization, Economics in water resources, Challenges in water sector.
Unit II: Introduction to Optimization **8 lecture hours**
Objective function, Maxima, minima and saddle points, convex and concave functions, Constrained and unconstrained optimization using calculus, Lagrange multipliers, Kuhn-Tucker conditions.
Unit III: Linear & Dynamic Programming and Applications **8 lecture hours**
General form of LP, Standard and Canonical forms of LP, Elementary transformations, Graphical method, Feasible and infeasible solutions, Simplex method, Dual and sensitivity analysis, LP problem formulation, Reservoir sizing and Reservoir operation using LP, Introduction, multistage decision problem, Recursive Equations, Principle of optimality, Discrete DP, Curse of Dimensionality, Water allocation problem.
Unit IV: Multi-objective & Stochastic Optimization **8 lecture hours**
Position, Velocity and Acceleration – Rectilinear motion – Curvilinear motion of a particle – Tangential and Normal components – Radial and Transverse components – Rotation of rigid bodies about a fixed axis – General plane motion – Absolute and relative motion method – Instantaneous centre of rotation in plane motion - Linear momentum – Equation of motion – Angular momentum of a particle and rigid body in plane motion – D'Alembert's principle
Unit V: Simulation **8 lecture hours**
Principle of work and energy for a particle and a rigid body in plane motion – Conservation of energy - Principle of impulse and momentum for a particle and a rigid bodies in plane motion – Conservation of momentum – System of rigid bodies – Impact - direct and central impact – coefficient of restitution
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Jain S.K. and Singh V.P., (2003) 'Water Resources Systems Planning and Management', Elsevier, The Netherlands. ISBN – 9780444514295.
2. Hamdy A. Taha(2006). Operations Research: An Introduction, Prentice Hall, ISBN- 9780131889231.
3. Loucks D.P, Stedinger J.R and Haith D.A, (1981) 'Water Resources Systems Planning and Analysis', Prentice Hall, USA, 1981. ISBN – 9780139459238.
4. Mays L.W and Tung Y-K, (2002) 'Hydrosystems Engineering and Management', Water Resources Pubns, 1992. ISBN – 9781887201322.

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Name of The Course	**Transport Planning and Management**			
Course Code	**BCE01T3303**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To teach the transportation planning process, trip generation and distribution methods.
2. To teach various techniques involved in traffic assignments, and introduce evaluation techniques based on economy and performance.

.Course Outcomes

On completion of this course, the students will be able to

CO1	Identify the different planning process involved in transportation and the importance of Zoning.
CO2	Demonstrate the ability to understand the various distribution methods, trip generation and critically apply the analysis techniques practically.
CO3	Understand the principles in traffic assignment and apply them suitably as a successful transportation Engineer.
CO4	Demonstrate the ability to evaluate a transport projects critically in all aspects and apply transport planning process effectively for medium and small sized towns.
CO5	Calculate different types of loadings on roof trusses.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Transport Planning Process **8 lecture hours**
Scope – interdependence of land use and traffic – systems approach to transport planning – survey of existing conditions and forecasting future conditions. Transport survey – definition of study area – zoning survey – types and methods – inventory on transport facilities – inventory of land use and economic activities.
Unit II: Trip Generation **6 lecture hours**
Factors governing trip generation and attraction rates – multiple linear regression analysis – category analysis – critical appraisal of techniques
Unit III: Trip Distribution Methods **9 lecture hours**
Uniform factor method, average factor methods – gravity model and its calibration – opportunity model.
Unit IV: Modal Split and Trip Assignment **8 lecture hours**
Modal split – factors, advantages and limitations, logit model and its calibration, Traffic assignment – general principles – assignment techniques – all nothing assignment – multiple root assignment – capacity – restraint assignment – diversion curves
Unit V: Evaluation Techniques **8 lecture hours**
Economic evaluation techniques – performance evaluation – rating and ranking methods – case studies in evaluation – rating and ranking methods – case studies in evaluation of transport projects –

land use transport models – transport planning for medium and small sized towns.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Kadiyali.L.R. (2008), Traffic Engineering and Transportation Planning, Khanna Publishers, ISBN-9788174092205.

2. Ortuzar.J.D., and Willumsen. Luis G. (2011), Modelling Transport, Fourth Edition, John Wiley & Sons, ISBN-9781119993520.

3. Wright.P.H.,Ashford.N., and Stammer.R., (1998), Transportation Engineering – Planning & Design, Fourth Edition, John Wiley & Sons, New York, ISBN-9780471173960.

4. Dickey.J.W., (1995), Metropolitan Transportation Planning, Tata McGraw-Hill publishing company Ltd, New Delhi

Name of The Course	**Industrial Waste Treatment and Disposal**				
Course Code	**BCE01T3716**				
Prerequisite	**-**				
Co-requisite	**-**				
Anti-requisite	**-**				
		3	**0**	**0**	**3**

Course Objectives

1. Get the adequate knowledge about phenomena of atmospheric environment and treatment, sources, characteristics and treatment processes of various types of industries.
2. Know the various processes of wastewater treatment of different industries and the engineering requirements for treatment facilities.
3. Design the waste treatment system for the different industry

Course Outcomes

On completion of this course, the students will be able to

CO1	Provide solutions of physical, chemical and biological treatment and biosensors applied to biological process control
CO2	Use new techniques for collection, recycling and disposal and treatment of wastewater and solid wastes.
CO3	Design the wastewater supply and treatment technology
CO4	Evaluate and monitor the treatment systems according to the need of different industries
CO5	Calculate different types of loadings on roof trusses
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Industrial Pollution **8 lecture hours**
Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health – Hazardous Wastes – Environmental legislations related to prevention and control of industrial effluents and hazardous wastes – Pollution Control Boards
Unit II: Waste Management Approach **8 lecture hours**
Waste management approach – Waste Audit – Volume and strength reduction – material and process modifications – Recycle, reuse and byproduct recovery – Applications.
Unit III: Liquid Waste Treatment Techniques **8 lecture hours**
Equalization – Neutralization – removal of suspended and dissolved organic solids - Chemical oxidation – Removal of dissolved

inorganics – Combined treatment of industrial and municipal wastes – Residue management.
Unit IV: Industrial Solid Waste Treatment **8 lecture hours**
Physico-chemical treatment – solidification – incineration – Secured landfills – Legal Provisions.
Unit V: Case Studies of Industrial Pollution Control **8 lecture hours**
Sources & their Characteristics, waste treatment flow sheets for selected industries such as textiles, tanneries, dairy, sugar, paper, distilleries, steel plants, refineries, fertilizer, and thermal power plants
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Patwardhan A.D. (2008), Industrial Waste Water Treatment, PHI Learning Pvt Ltd. ISBN: 978-81-203-3350-5
2. Nelson, L. Nemerow (2007), Industrial Waste Treatment: contemporary practice and vision for future, Elsevier Butterworth-Heinemann Publication. ISBN: 9780123724939
3. Woodard & Curran Inc. (2006), Industrial Waste Treatment Handbook, Second Edition, Elsevier Butterworth-Heinemann Publication. ISBN: 9780750679633
4. Thomas T. Shen (1999), Industrial Pollution Prevention, Springer publications. ISBN: 3540652086
5. W .W. Eckenfelder Jr. (2000), "Industrial Water Pollution Control", McGraw-Hill Book Company, New Delhi. ISBN: 9780070393646

Name of The Course	**Disaster Management**
Course Code	**BCE01T5641**
Prerequisite	-
Co-requisite	-
Anti-requisite	-

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

Course Objectives

1. To know about the types of natural and environmental disasters.
2. To develop skills in various stages of disaster preparedness, mitigation and management.
3. To know the methodology for disaster risk assessment.

.Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the types of natural and environmental disasters and its causes.
CO2	Know about organizational and Administrative strategies for managing disasters.
CO3	Explain the engineering and non-engineering controls of mitigating various natural disasters.
CO4	About the early warning systems, monitoring of disasters effect and necessity of rehabilitation
CO5	Learn methodologies for disaster risk assessment with the help of latest tools like GPS, GIS, Remote sensing, information technologies, etc.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Natural and Man Made Disasters – Overview **8 lecture hours**
Introduction- Natural Disasters around the world- Natural Disaster Risk Assessment- Earth and its characteristics – Environmental Change and Degradation - Climate Change - Global warming – Human Dimensions of Global environment

Change – Disaster mitigation, preparedness, response and recovery- comprehensive emergency management Early warning systems and Disaster Preparedness– Rehabilitation, Vulnerable Populations - Logistics and Services, Food, Nutrition and Shelter -Role of UN Red cross and NGOs, Understanding Man-Made Disasters, Nuclear Disasters, Chemical Disasters, Biological Disasters, Building Fire, Coal Fire, Forest Fire, Oil Fire, Air &Water Pollution, Industrial Pollution, accidents, toxic gas leakages and occupational hazards, exposure to manual and codes issued by NDMA, BIS etc for adopting disaster proof designs related to civil infrastructure development like Housing, dams, highways, airports, industrial complexes etc.

Unit II: Plate Tectonics& Earthquakes

8 lecture hours

Introduction and Review - Natural Disasters - Principles, Elements, and Systems - Geological- Geo-morphological aspects, - Earthquake- Geology, Seismology, Characteristics and dimensions– Landslides- Human impact on the mountainous terrain and its relationship with Rainfall, liquefaction etc- Tsunami - Nature and characteristics.

Unit III: Critical climate system aspects and Processes
8 lecture hours

Oceanic, Atmospheric and Hydrologic cycles - Severe Weather & Tornadoes , Cyclones, Floods and Droughts - Global Patterns - - Mitigation & Preparation – Drought – Famine- nature & dimensions – Drought Assessment & Monitoring

Unit IV: Natural hazards Assessment and Communication
8 lecture hours

Mapping - Modeling, risk analysis and loss estimation – Natural disaster risk analysis - prevention and mitigation - Applications of Space Technology (Satellite Communications, GPS, GIS and Remote Sensing and Information / Communication Technologies (ICT) in Early warning Systems - Disaster Monitoring and Support Centre– Information Dissemination – Mobile Communications etc.

Unit V: Administrative mechanisms

8

lecture hours

Roles and responsibilities NDMA/SDMA,Social organizations – Education and Training – Establishment of capacity building among various stake holders – Government - Educational institutions – Use of Multi-media knowledge products for self-education.

Unit VI: Discussion on Latest Research Paper

2 lecture hours

This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Edward A Keller, Robert H Blodgett (2007), Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes, Pearson Prentice Hall, 2nd Edition. ISBN: 9780132361316
2. Didax (2007), Natural Disasters, Didax Educational Resources: ISBN: 9781583242728
3. Edward Bryant (2005), Natural Hazards, Cambridge University Press, New York. ISBN: 978-0521537438
4. Robert L Kovach Earth's Fury (1995), An Introduction to Natural Hazards and Disasters, Prentice Hall. ISBN: 9780130424334
5. Davi Alexander (1993), Natural Disasters, Routledge. ISBN: 9781857280937

GALGOTIAS UNIVERSITY

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

School of Civil Engineering

Program: M. Tech in Structural Engineering

Scheme: 2018/2019/2020 (onwards)

Date of BoS: 12.11.2017, 22.07.2018, 04.06.2019

Curriculum

Semester 1									
Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	CENG5001	Professional and Communication Skills	0	0	4	2	50	-	50
2	MATH5001	Advanced Numerical and Statistical Methods	3	1	0	4	20	50	100
3	MSTR5001	Structural Dynamics	3	0	0	3	20	50	100
4	MSTR5002	Matrix Methods of Structural Analysis	3	0	0	3	20	50	100
5	MSTR5003	Advanced Concrete Technology	3	0	0	3	20	50	100
6	MSTR5004	Design of Concrete Structural Systems	3	0	0	3	20	50	100
7	MSTR5005	Matrix methods of Structural Analysis Lab (STAAD PRO)	0	0	2	1	50	-	50
8	MSTR5006	Design of Concrete and Structural Systems Lab (STAAD PRO)	0	0	2	1	50	-	50
Semester II									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MSTR6001	Finite Element Analysis	3	0	0	3	20	50	100
2	MSTR6002	Theory of Elasticity and Plasticity	3	0	0	3	20	50	100
3	MSTR6003	Limit State Design of Steel Structures	3	0	0	3	20	50	100
4		Elective - 1	3	0	0	3	20	50	100
5		Elective – 2	3	0	0	3	20	50	100
6		Elective - 3	3	0	0	3	20	50	100
7	MSTR6004	Structural Engineering lab (CASTING)	0	0	2	1	50	-	50
8	MSTR6005	Finite Element Analysis Lab (STAAD PRO)	0	0	2	1	50	-	50
Semester III									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MSTR7001	Application of Numerical Methods in Structural Engineering	3	0	0	3	20	50	100
2		Elective – 4	3	0	0	3	20	50	100
3		Elective – 5	3	0	0	3	20	50	100
4	MSTR7002	Seminar (or) Mini Project	- -	- -	2	1	50	-	50
5	MSTR7003	Comprehensive Examination	-	-	-	2	50	-	50
6	MSTR7004	Project (Phase I)	0	0	0	5	50	-	50

Semester IV									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MSTR8001	Project (Phase II)	0	0	0	15	50	-	50

List of Electives

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MSTR6010	Advanced Foundation Engineering	3	0	0	3	20	50	100
2	MSTR6011	Design of Concrete Bridges	3	0	0	3	20	50	100
3	MSTR6012	Design of Industrial Structures	3	0	0	3	20	50	100
4	MSTR6013	Earthquake Resistant Design	3	0	0	3	20	50	100
5	MSTR6014	Design of Tall Buildings	3	0	0	3	20	50	100
6	MSTR6015	Energy Efficient Buildings	3	0	0	3	20	50	100
7	MSTR6016	Environmental Engineering Structures	3	0	0	3	20	50	100
8	MSTR6017	Experimental Stress Analysis	3	0	0	3	20	50	100
9	MSTR6018	Machine Foundations	3	0	0	3	20	50	100
10	MSTR6019	Maintenance & Rehabilitation of Structures	3	0	0	3	20	50	100
11	MSTR6020	Theory and Design of Plates & Shells	3	0	0	3	20	50	100
12	MSTR6021	Off Shore Structures	3	0	0	3	20	50	100
13	MSTR6022	Prefabricated Structures	3	0	0	3	20	50	100
14	MSTR6023	Pre-stressed Concrete Structures	3	0	0	3	20	50	100
15	MSTR6024	Soil Structure Interaction	3	0	0	3	20	50	100
16	MSTR6025	Stability of Structures	3	0	0	3	20	50	100
17	MSTR6026	Structural Optimization	3	0	0	3	20	50	100
18	MSTR6027	Composite Structures	3	0	0	3	20	50	100

Name of The Course	Structural Dynamics			
Course Code	MSTR5001			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:

1. To find the behaviour of structures subjected to dynamic loads such as wind, earthquake and blast loads.

2. To study different dynamic analysis procedures for calculating response of structures.

COURSE OUTCOMES:

At the end of the course, students will be able to:

CO1	Solve the problems on single degree of freedom system.
CO2	Understand the concept of harmonic loading and impulse loading and the related analysis procedures.
CO3	Understand the concept of multi degree of freedom system.
CO4	Evaluate the mode shapes for different structures.
CO5	Know the orthogonality condition.

TEXT BOOKS

1. Mario Paz, (2004), Structural Dynamics - Theory and Computation, Second Edition, CBS Publishers, ISBN-13: 9788123909783.

REFERENCE BOOKS

1. J. Humar, (2012), Dynamics of Structures, Third Edition, CRC Press, ISBN-13: 9780415620864.
2. Anil K. Chopra, (2003), Dynamics of Structures - Theory and Applications to Earthquake Engineering, Third Edition, Pearson India, ISBN-13: 9788131713297.

COURSE CONTENT

Unit I:SDOF Systems **8 lecture hours**
Single Degree of Freedom System - Introduction - Alembert's principle - Mathematical models for SDOF systems - Free vibration - Damped and undamped - Critical damping - Logarithmic decrement.
Unit II: Harmonic and Impulse Loading **8 lecture hours** **Response to Harmonic Loading and Impulse Loading - Analysis of undamped system - damped system - general dynamic loading.**
Unit III: Vibration Analysis **8 lecture hours** **Vibration Analysis - Rayleigh's method - Approximate Analysis - Improved Rayleigh method.**
Unit IV:MDOF Systems **8 lecture hours** **Multi degree of Freedom System - Evaluation of structural property matrices - Mode shape - Orthogonality conditions - Undamped and damped system - Mode superposition method.**
Unit V: Continuous Systems **8 lecture hours** **Continuous Systems - Differential equation of motion - Transverse vibration of linearly elastic beams - Analysis of undamped free vibration of simply supported and cantilever beams - Orthogonality condition.**

Continuous Assessment Pattern

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

Name of The Course	Matrix Methods of Structural Analysis
Course Code	MSTR5002
Prerequisite	Structural Analysis

Corequisite	-				
Antirequisite	-				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

1. The course is intended to teach the basic concepts of indeterminate structures, static indeterminacy and kinematic indeterminacy.

2. Different matrix methods will be taught and their uses will be explained in the class.

COURSE OUTCOMES:

On completion of this course, the students will be able to

CO1	**Solve different structures by flexibility matrix method and stiffness matrix method.**
CO2	**Visualize and analyze plane trusses and plane frames.**
CO3	**Understand the effect of settlement of supports.**
CO4	**Analyze space trusses and plane frames.**
CO5	**Solve any problem on grid.**

TEXT BOOKS

1. Pundit G.S. & Gupta S.P., (2008), Structural Analysis (A matrix approach), Second Edition, Tata McGraw Hill Education, ISBN-13: 9780070667358.

REFERENCE BOOKS

1. J. S. Przemieniecki, (1985), Theory of Matrix Structural Analysis, New Edition, Dover Publication, ISBN-13: 97804866494.
2. Richard B. Nelson, Lewis P. Felton, (1997), Matrix Structural Analysis, John Wiley & Sons, Imported Edition, ISBN-13: 9780471123248.

COURSE CONTENT

Unit I: Introduction to flexibility matrix and stiffness matrix 8 lecture hours
Concept of static indeterminacy and kinematic indeterminacy - concept of flexibility matrix and stiffness matrix - properties of matrices - coordinate system - solution of simple problems - derivation of stiffness matrix of beam element from strain energy.

Unit II: Analysis of plane structures by flexibility matrix method 8 lecture hours
Analysis of continuous beam, plane truss and plane frame by flexibility matrix method - Internal forces due to thermal expansion and lack of fit – effect of settlement of supports.

Unit III: Analysis of plane structures by stiffness matrix method 8 lecture hours
Analysis of continuous beam, plane truss and plane frame by stiffness matrix method - Internal forces due to thermal expansion and lack of fit – effect of settlement of supports

Unit IV: Space truss
8 lecture hours
Analysis of space truss by flexibility matrix method and stiffness matrix method.

Unit V: Analysis of space structures by stiffness matrix method8 lecture hours
Analysis of space frame and grid structures by stiffness matrix method

Continuous Assessment Pattern

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

Name of The Course	**Advanced Concrete Technology**				
Course Code	**MSTR5003**				
Prerequisite	**Concrete Technology**				
Corequisite	-				
Antirequisite	-				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

1. This course mainly aims to develop the knowledge about properties of cement concrete and importance of admixtures in concrete.

2. To make the students to understand Mix Design Method.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Know the various materials used in concrete and admixtures.**
CO2	**Do the Mix design by different methods.**
CO3	**Get a thorough knowledge of various types of cement, aggregates and properties of special concrete.**
CO4	**Know the different procedures for testing concrete.**
CO5	**Understand different types of special concrete.**

TEXT BOOKS

1. Shetty. M. S., (2008), Concrete Technology, Seventh Edition, S. Chand & Company Ltd.ISBN-13: 9788121900034.

REFERENCE BOOKS

1. M. L. Gambhir, (2013), Concrete Technology, Fifth Edition, McGraw Hill Education India Pvt. Ltd., ISBN-13: 9781259062551.
2. A. R. Santha Kumar, (2006), Concrete Technology, First Edition, Oxford University Press, ISBN-13: 9780195671537.

COURSE CONTENT

Unit I:Material, reinforcement and admixtures 8 lecture hours **Materials - Concrete materials - Reinforcements and admixtures.**
Unit II:Mix design **8 lecture hours** **Mix Design – Specifications - Design of concrete mixes by IS code method - ACI method - Road Note No: 4 methods – High strength concrete.**
Unit III:Modern trends in concrete **8 lecture hours** **Behaviour of Concrete - Modern trends in concrete manufacture and placement techniques - Behaviour of fresh concrete and hardened concrete - Resistance to static and dynamic loads.**
Unit IV: Concrete testing 8 lecture hours
Testing of Concrete - Non-destructive testing and quality control – Durability - Corrosion protection and fire resistant.
Unit V:Special concrete8 lecture hours **Special Concrete - Pre-cast concrete - Light weight concrete - Under water concrete – Pump concrete - Polymer concrete - Composites and fibre reinforced concrete.**

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 of Concrete Structural Systems**			
Course Code	**MSTR5004**			
Prerequisite	**Design of Concrete Structures**			
Corequisite	**-**			
Antirequisite	**-**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

1. **This subject is intended to teach the concept of advanced concrete design.**
2. **The practical aspects of various designs of structure will be explained in the classes**

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Understand rotation capacity of a RC section and moment curvature relationship.**
CO2	**Analyse and design deep beams.**
CO3	**Design flat slabs.**

CO4	Understand the concept of designing slender columns and shear walls.
CO5	Design different types of water tanks.

TEXT BOOKS

1. Krishnaraju N., (2013), Advanced Reinforced Concrete Design, Second Edition, CBS Publisher, *ISBN-13: 9788123912257.*

REFERENCE BOOKS

1. P. C. Varghese, (2009), Advanced Reinforced Concrete Design, Second Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120327870.
2. M. L. Gambhir, (2009), Design of Reinforced Concrete Structures, First Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120331938.
3. P. Dayaratnam, (2011), Design of Reinforced Concrete Structures, Fourth Edition, Oxford & IBH – Pubs Company, ISBN-13: 9788120414198.
4. B. C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, (2006), R. C. C. Designs, Laxmi Publication (P) Ltd., ISBN-13: 9788131809426.

COURSE CONTENT

Unit I:Limit state design of beams 8 lecture hours Limit state analysis and design of beams in flexure - Behaviour of reinforced concrete Members in bending - Plastic hinge – Rotation capacity – Factors affecting rotation capacity of a section –Plastic moment – Moment curvature relationship – Redistribution of moments.
Unit II:Deep beams 8 lecture hours Limit state design of deep beams.
Unit III: Flat Slabs 8 lecture hours Design of Flat Slabs using BIS 456.
Unit IV: Columns and shear walls 8 lecture hours Design of slender columns subjected to combined bending moment and axial force using SP: 16, Design of shear walls, Ductile detailing.
Unit V: Design of Water Tanks 8 lecture hours Types of water tanks, Design of underground rectangular water tanks, Design of overhead water tank (Intze type tank), Design of staging.

Continuous Assessment Pattern

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

Name of The Course	Finite Element Analysis
Course Code	MSTR6001
Prerequisite	Matrix Methods of Structural Analysis
Corequisite	-
Antirequisite	-

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. The course is intended to teach the basic concepts of finite element analysis.
2. The practical application of finite element method and their advantages and disadvantages will be explained in the class.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	Carry out finite element analysis of beam.
CO2	Understand the concept of displacement polynomials.
CO3	Analyse plane trusses, plane frames and grids.
CO4	Calculate strain-displacement matrix and stress-strain matrix for plane stress elements.

CO5	Know the concepts of isoparametric elements.

TEXT BOOKS

1. C. S. Krishnamoorthy, (2008), Finite Element Analysis, Second Edition, Tata McGraw Hill Education Pvt. Ltd., ISBN-13: 978007462100.

REFERENCE BOOKS

1. Cook R. D., Malkas D. S. &Plesha M. E, (2008), Concepts and applications of Finite element analysis, Fourth Edition, Wiley India Pvt. Ltd., ISBN-13: 9788126513369.

2. Reddy, (2005), An Intro. To The Finite Element Methods, Third Edition, Tata McGraw Hill Education Pvt. Ltd., ISBN-13: 9780070607415.

3. Singiresu S. Rao, (2010), The Finite Element Method in Engineering, Fifth Edition, Elsevier Science, ISBN-13: 9780080952048.

COURSE CONTENT

Unit I:Introduction to FEM8 lecture hours **Introduction - Background - General description of the method – Analysis procedure - Stress and strain vectors – Stain displacement equations – Linear constitutive equations – Overall stiffness matrix – Overall load matrix - Analysis of beams.**
Unit II: Displacement models **8 lecture hours** **Theory of Finite Element - Concept of an element - Various elements shapes - Displacement polynomials - Convergence requirements - Shape functions - Element strains and stresses - Direct formulation of element stiffness matrix for beam element and plane truss element.**
Unit III:Analysis of structures by FEM **8 lecture hours** **Overall Problems - Discretization of a body or structure - Minimization of band width - Construction of stiffness matrix and loads for the assemblage - Boundary conditions - Analysis of plane truss, space truss, plane frame and grid.**
Unit IV: Plane stress and plane strain 8 lecture hours **Plane stress - Plane strain - CST, LST & QST elements – Rectangular element - solutions of problems.**
Unit V:Isoparametric elements 8 lecture hours
Natural Coordinate - Isoparametric Formulation - Natural coordinates (area and volume) - Isoparametric Bar element - Plane bilinear isoparametric element - Plane stress element - Quadratic plane stress elements - Application of Gauss Quadrature formulation.

Continuous Assessment Pattern

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

Name of The Course	Theory of Elasticity and Plasticity
Course Code	MSTR6002
Prerequisite	-
Corequisite	-
Antirequisite	-

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. This subject is taught to impart knowledge on theory of elasticity and plasticity.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	Analyse the stresses and strains for two dimensional and three dimensional elements.
CO2	Understand the equilibrium and compatibility conditions.
CO3	Know the concept of Prandle's membrane analogy.
CO4	Solve the problems on Torsion for different shaped bars.
CO5	Understand the concept of plasticity.

TEXT BOOKS

1. Timoshenko and Goodier, (1970), Theory of Elasticity, Third Edition, McGraw Hill Professional, ISBN-13: 9780070858053.

REFERENCE BOOKS

1. Srinath, (2002), Advanced Mechanics of Solids, Third Edition, Tata McGraw Hill Pvt. Ltd., ISBN-13: 9780070139886.
2. D. Peric, E. A. de Souza Neto& D. R. J. Owen, (2011), Computational Methods for Plasticity, Wiley, ISBN-13: 9781119964544.

COURSE CONTENT

Unit I: Stresses and strains **8 lecture hours** **Analysis of Stress and Strain - Elasticity approach – Definition and notation of stress – Components of stress and strain – Generalized Hooke's law -Two dimensional Problems in Cartesian Coordinates - Plane stress and plain strain problems with practical examples - Equations of equilibrium and compatibility conditions in Cartesian coordinates – Airy's stress function - Bending of simply supported beams..**
Unit II: Axi-symmertic problems **8 lecture hours** **Two dimensional Problems in Polar Coordinates - Equations of equilibrium and compatibility conditions in polar coordinates – Axi-symmetrical problems - Thick cylinder under uniform pressure - Circular arc beams subjected to pure bending**
Unit III: Prandle's membrane analogy **8 lecture hours** **Principal stresses and strains for three dimensional element – Equations of equilibrium and compatibility conditions for 3D problems in Cartesian co-ordinates - Transformation of stresses and strains.**
Unit IV: Torsion 8 lecture hours **Torsion - Torsion of various shaped bars - Pure torsion of prismatic bars - Prandtle's membrane analogy - Torsion of thin walled tubes and hollow shafts.**
Unit V: Introduction to plasticity **8 lecture hours** **Introduction to plasticity – Stress – Strain diagram – Plastic analysis – Yield criteria – St. Venant's theory – Von Mises criterion – Plastic work – Strain hardening.**

Continuous Assessment Pattern

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

Name of The Course	Limit State Design of Steel Structures			
Course Code	MSTR6003			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. To know how to design and use the different types of steel structural elements.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	Design different types of connections.
CO2	Design members for pitched roof truss, bracings and purlins.
CO3	Understand the design of plate girders and gantry girders.
CO4	Design chimney.
CO5	Understand the concept of plastic analysis.

TEXT BOOKS

1. Dayarathnam. P., (1996), Design of Steel Structures, Second Edition, S. Chand and Publishers, ISBN-13: 0788121923200.

REFERENCE BOOKS

1. Duggal S. K., (2014), Limit State Design of Steel Structures, Second Edition, McGraw Hill, ISBN-13: 9789351343509.
2. Ramchandra, VirendraGehlot, (2010), Limit State Design of Steel Structures: Based on

IS: 800-2007 IN S. I. Units, Scientific Publishers, ISBN-13: 9788172336141.

COURSE CONTENT

Unit I: Eccentric and Moment Cconnections 8 lecture hours **Different types of beam-column connections – Design of rigid and semi rigid connection.**
Unit II: Industrial Buildings **8 lecture hours** **Roof Trusses - Calculation of dead load, live load and wind load - Design of joints – Design of members for pitched roof truss – Bracings – Design of Purlins.**
Unit III: Plate Girder and Gantry Girder **8 lecture hours** **Elements of plate girders – Shear strength of web - Design of plate girders - Curtailment of flange plates – Design of stiffeners – Design of gantry girder**
Unit IV: Chimney8 lecture hours **Calculation of wind load and seismic load, Design of chimney, Design of foundation of chimney**
Unit V: Plastic Analysis **8 lecture hours** **Plastic Analysis of Structures – Introduction - Shape factors – Mechanisms - Plastic hinge - Analysis of beams and portal frames - Design of continuous beams.**

Continuous Assessment Pattern

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

Name of The Course	**Application of Numerical Methods in Structural Engineering**			
Course Code	**MSTR7001**			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

1. This subject is taught to impart knowledge on numerical methods in structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Solve the linear simultaneous equations.**
CO2	**Use the Finite difference method.**
CO3	**Calculate bending moment, slope and deflection for beams using Simpson's rule and Gauss Quadrature method.**
CO4	**Understand the concept of finite strip method of analysis of plates.**
CO5	**Evaluate the eigen values and eigen vectors for stability problems.**

TEXT BOOKS

1. N. Krishnaraju& K. U. Muthu, (2008), Numerical Methods for Engineering problems, Second Edition, Macmillan India Ltd., ISBN-13: 9780333924242.

REFERENCE BOOKS

1. Jain M. K., Iyengar, R. K. & Jain R. K. (2004), Numerical Methods: Problems and Solutions, Second Edition, New Age International (P) Ltd., ISBN-13: 9788122415346.
2. Klaus-Jsrgan Bathe, (2008), Finite Element Procedures, First Edition, Prentice Hall of India, ISBN-13: 9788120310759.

COURSE CONTENT

Unit I: Simultaneous equations **8 lecture hours** **Solution of linear simultaneous equations – Gauss elimination method, Gauss-Jordan method, Gauss-Siedal method - Banded - Semi-banded matrix– Skyline technique.**
Unit II: Finite difference method **8 lecture hours** **Finite difference method – Solution of simultaneous equations – Bending moment - Slope and deflection in beams - Membrane analogy using finite difference method for slabs-slope and deflection of slabs.**
Unit III: Numerical methods **8 lecture hours** **Numerical Methods – Numerical integration (Trapezoidal and Simpson's rule) for determining shear, moment and deflection in beams– Gauss Quadrature formula.**
Unit IV: Finite Strip method for analysis of plates8 lecture hours **Finite Strip Method – Shape Functions – Strain - Displacement Relationship – Strip Stiffness Matrix – Load Matrix – Solution of Problems.**
Unit V: Eigen values and Eigen Vectors **8 lecture hours** **Mass Matrix - Stiffness matrix - Dynamic Analysis - Eigen values & Eigen Vectors.**

Continuous Assessment Pattern

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

Name of The Course	**Matrix Methods of Structural Analysis Lab (STAAD PRO)**			
Course Code	**MSTR5005**			
Prerequisite	**Matrix Methods of Structural Analysis**			
Corequisite	**-**			
Antirequisite	**-**			
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

List of experiments:

1. Analysis of propped cantilever beam

2. Analysis of two span continuous beams

3. Analysis of statically determinate plane truss

4. Analysis of statically indeterminate plane truss

5. Analysis of kinematically indeterminate plane truss

6. Analysis of one bay – one storey plane frame

7. Analysis of multi bay – multi storied plane frame

8. Analysis of space truss

9. Analysis of grid

10. Analysis of space frame

Continuous Assessment Pattern

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

Name of The Course	**Design of Concrete and Structural Systems lab (STAAD PRO)**
Course Code	**MSTR5006**
Prerequisite	**Design of Concrete and Structural system**
Corequisite	**-**
Antirequisite	**-**

	L	T	P	C
	0	0	2	1

List of experiments:

1. Design of Continuous beams

2. Design of Deep beams

3. Design of Columns

4. Design of Shear walls

Continuous Assessment Pattern

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

Name of The Course	**Structural Engineering Laboratory (CASTING)**
Course Code	**MSTR6004**
Prerequisite	**Design of Concrete Structures**
Corequisite	-
Antirequisite	-

	L	T	P	C
	0	0	2	1

List of experiments:

1. To determine the compressive strength of fibre reinforced concrete by testing cubes

specimen.

2. Casting and testing of simply supported RCC beams for flexural failure.

3. Casting and testing of simply supported RCC beams for shear failure.

4. To determine tensile strength on a steel reinforcement bar.

5. To determine shear strength of steel bar under double shear.

6. To conduct bending test of I-section steel beam.

7. To conduct bending test of steel channel section.

8. To study rebound hammer test on concrete blocks.

9. To study ultra sonic pulse velocity test

Continuous Assessment Pattern

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

Name of The Course	**Finite Element Analysis Lab (STAAD PRO)**
Course Code	**MSTR6005**
Prerequisite	**Matrix Methods of Structural Analysis Lab**
Corequisite	-
Antirequisite	-

	L	T	P	C
	0	0	2	1

List of experiments:

1. Analysis of three span continuous beams.

2. Analysis of propped cantilever beam.

3. Analysis of statically determinate plane truss.

4. Analysis of statically indeterminate plane truss.

5. Analysis of one bay – one storey plane frame.

6. Analysis of two bays – one storey plane frame.

7. Analysis of a 2-D building frame subjected to dead load, live load and seismic load.

8. Analysis of grid.

Continuous Assessment Pattern

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

50	50	100

Name of The Course	Seminar				
Course Code	MSTR7002				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
	L	T	P	C	
	0	0	2	1	

COURSE OBJECTIVES

1. To make literature survey for various recently emerging technologies.
2. To select any topic of interest and to review the related literature in detail.
3. To compare and analyze the various topologies for the selected topic of interest.
4. To conclude the advantages, drawbacks and future scopes of the technique.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	Get familiarity with the recently advanced techniques.
CO2	Get detailed information about the topic of interest.
CO3	Know how to do literature survey.
CO4	Develop the interest in different research areas of Structures.

TEXT BOOKS

Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal.

REFERENCE BOOKS

Depending upon their area of interest, students may choose any reference book of relevant field.

COURSE CONTENT

Depending upon their area of interest, students will choose any topic.

Continuous Assessment Pattern

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

Name of The Course	Mini Project				
Course Code	MSTR7002				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
	L	T	P	C	
	0	0	2	1	

COURSE OBJECTIVES

1. To make literature survey for various recently emerging technologies.
2. To select any topic of interest and to review the related literature in detail.
3. To compare and analyze the various topologies for the selected topic of interest.
4. To conclude the advantages, drawbacks and future scopes of the technique.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	Get familiarity with the recently advanced techniques.
CO2	Get detailed information about the topic of interest.
CO3	Know how to do literature survey.
CO4	Develop the interest in different research areas of Structures.

TEXT BOOKS

Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal.

REFERENCE BOOKS

Depending upon their area of interest, students may choose any reference book of relevant field.

COURSE CONTENT

Depending upon their area of interest, students will choose any topic.

Continuous Assessment Pattern

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

Name of The Course	Project (Phase I)				
Course Code	MSTR7004				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		0	0	0	5

Course Objectives

1. **To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.**
2. **Foster collaborative learning skills.**
3. **Develop self-directed inquiry and life-long skills.**
4. **To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.**

Course Outcomes

On completion of this course, the students will be able to

CO1	Submit a project synopsis comprising of the application and feasibility of the project.
CO2	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety and sustainability.
CO3	Work and communicate efficiently in multidisciplinary teams.
CO4	Identify, formulate, and solve engineering problems.
CO5	Develop an understanding of professional and ethical responsibility.

TEXT BOOKS

Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal.

REFERENCE BOOKS

Depending upon their area of interest, students may choose any reference book of relevant field.

Depending upon their area of interest, students will choose any topic.

Continuous Assessment Pattern

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

Name of The Course	Project (Phase II)
Course Code	MSTR8001
Prerequisite	Project (Phase I)
Corequisite	-
Antirequisite	-

	L	T	P	C
	0	0	0	15

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	**Submit a project synopsis comprising of the application and feasibility of the project.**
CO2	**Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety and sustainability.**
CO3	**Work and communicate efficiently in multidisciplinary teams.**
CO4	**Identify, formulate, and solve engineering problems.**
CO5	**Develop an understanding of professional and ethical responsibility.**

TEXT BOOKS

Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal.

REFERENCE BOOKS

Depending upon their area of interest, students may choose any reference book of relevant field.

COURSE CONTENT

Depending upon their area of interest, students will choose any topic.

Continuous Assessment Pattern

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

PROGRAM ELECTIVES

Name of The Course	**Advanced Foundation Engineering**
Course Code	**MSTR6010**
Prerequisite	**Geotechnical Engineering –II (Foundation Engg.)**
Corequisite	**-**
Antirequisite	**-**

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge in the area of analysis and design of foundations and earth retaining structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Understand the concepts of shallow foundations.**
CO2	**Design the retaining walls and sheet piles.**
CO3	**Know the concept of pile group.**
CO4	**Design pile foundation.**
CO5	**Know the types well foundations.**

TEXT BOOKS

1. Gopal Ranjan and A S R Rao (2000), Basic and Applied Soil Mechanics, Second Edition, New Age International, ISBN-13: 9788122412239.

REFERENCE BOOKS

1. J. E. Bowles, (2000), Foundation Analysis and Design, Fifth Edition, McGraw Hill Education India Pvt. Ltd., ISBN-13: 9781259061035.
2. P. C. Verghese, (2009), Design of Reinforced Concrete Foundations, First Edition, PHI Learning Pvt. Ltd., ISBN-13: 9788120336155.

COURSE CONTENT

Unit I: Shallow foundation 8 lecture hours **Shallow Foundations – Spread footings – Contact pressure – Structural design of individual footings – Pedestals – Combined footings (Rectangular and trapezoidal) – Eccentrically loaded footings – Mat foundations**
Unit II: Deep foundation 8 lecture hours **Pile Foundations – Types of piles – Static and dynamic pile formula – Pile groups – Efficiency of pile group**
Unit III: Pile foundations 8 lecture hours **Settlement of piles – Batter piles – Analysis of pile groups – Structural design of piles and pile caps**
Unit IV: Retaining structures 8 lecture hours **Retaining Structures – Stability of walls – Design of cantilever and counter fort walls – Design of gravity walls – Coffer dams – Braced coffer dams – Stability of bottom excavation – Anchorage – Walls and tie rods**
Unit V:Well foundations8 lecture hours **Well Foundations – Types of wells or caissons – Components – Shapes of wells – Forces acting – Construction– Design of drilled caissons**

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 of Concrete Bridges**			
Course Code	**MSTR6011**			
Prerequisite	**Reinforced Concrete Structures**			
Corequisite	**-**			
Antirequisite	**-**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To understand the design and codal concepts of different types of bridges.

Course Outcomes

On completion of this course, the students will be able to

CO1	**Understand IRC Code.**
CO2	**Use Pigeauds curves for designing deck slab for T-beam Bridge.**
CO3	**Understand Courbon's method of load distribution to analyze and design girders for T-beam Bridge.**
CO4	**Design plate girders and steel truss bridges.**
CO5	**Design piers and abutments.**

Text Books

1. Victor D. J. (2008), Essentials of Bridge Engineering, 6th Edition, Oxford University Press, ISBN: 9788120417175.
2. Ramachandra (2004), Design of Steel structures, 4th Edition, Standard Publishers Distributors, ISBN: 9780071544115.

Reference Books

1. Duggal S. K. (2008), Design of Steel Structures, 3rd Edition, Tata McGraw-Hill, ISBN: 9780070260689.
2. IRC Bridge Code.

COURSE CONTENT

Unit I: Introduction and design of slab culvert 8 lecture hours **Site selection, various types of bridges, loads on bridges according to IRC codes, Design of RC bridges under concentrated loads using effective width method**
Unit II: Deck slab of T-Beam Bridges 8 lecture hours **Pigeauds curves, Calculation of bending moments, Design of deck slab for T-beam Bridge for different types of vehicles**
Unit III: Girders of T-Beam Bridge 8 lecture hours **Courbon's method of load distribution, Analysis and design of girders for T-beam Bridge for different types of vehicles, Concept of box culverts.**
Unit IV: Design of Plate Girders and Steel Trussed Bridges 8 lecture hours **Design principles, Design and detailing of plate girder bridges, Types of trusses, Design of steel trussed bridges.**
Unit V: Design of Substructures 8 lecture hours **Types of piers, Forces acting on piers, Design of piers, General features of abutments, Forces acting on abutments, Design of abutments.**

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 of Industrial Structures

Course Code	MSTR6012				
Prerequisite	Construction Technology				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. This subject is taught to impart a broad knowledge in the area of industrial structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Know the requirements of various industries.**
CO2	**Get an idea about the materials used and planning.**
CO3	**Know the construction techniques.**
CO4	**Learn about circulation, communication and transport.**
CO5	**Understand the functional requirements.**

TEXT BOOKS

1. El Reedy, (2010), Construction Management and Design of Industrial Concrete and Steel Structures, Taylor & Francis Group, ISBN-13: 9781439815991.

REFERENCE BOOKS

1. Nelson G. L., (1988), Light Agricultural and Industrial Structures: Analysis and Design Kluwer Academic Publisher, ISBN-13: 9780442267773.
2. Dr. Raja Rizwan Hussain, (2011), Pre-Cast Concrete for Multi-Storey Structures, Createspace Publisher, ISBN: 9781467918220.

COURSE CONTENT

Unit I: Industrial requirements 8 lecture hours **General - Specific requirements for industries like textile, sugar, cement, chemical, etc - Site layout and external facilities.**
Unit II: Planning of building works 8 lecture hours

Planning of Building Work – Standards - Structural materials including plastics – Polymers - Fibre glass - Pressed card boards, etc - Multi-storey buildings - Steel skeletal structures - Reinforced concrete frames – Workshops - Ware houses - Single storey buildings - Sheds in steel and reinforced concrete - North-lights - Single span spherical and other special constructions - Cooling towers and chimneys - Bunkers and silos' prefabrication - Construction.
Unit III: Construction techniques **8 lecture hours** **Construction Techniques - Expansion joints - Machine foundations - Other foundations - Water proofing - Roofs and roofing - Roof drainage - Floors and flooring joists - Curtain walling - Outer wall facing - Sound and shock proof mountings - Use of modern hoisting and other construction equipments.**
Unit IV: Circulation **8 lecture hours** **Circulation - Communication and Transport - Fixed points (central cores) – Staircases - Grid floor sections - Lifts refuse disposals - Utilization of waste materials – Cranes - Continuous conveyors - Mobile cranes – Transporters – Doors - Sliding gates.**
Unit V:Functional Requirements8 lecture hours **Functional Requirements – Lighting: Natural lighting - Protection from the sun - sly lights - window cleaning installations -Services: Layout – wiring – fixtures - cable and pipe bridges - electrical installations - lighting substation - Effluent. Ventilation and fire protection: Ventilation - Air-conditioning - Fire escapes and chutes - Fire alarms - Extinguishers and hydrants.**

Continuous Assessment Pattern

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

Name of The Course	Earthquake Resistant Design

Course Code	MSTR6013				
Prerequisite	Structural Dynamics				
Corequisite	-				
Antirequisite	-				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

COURSE OBJECTIVES

1. To impart the knowledge about the earthquake and its occurrence.

2. To know about the mathematical modeling of structures subjected to earthquakes and their behaviour

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Understand about the basic of seismology.**
CO2	**Evaluate the behaviour of structures under dynamic loadings.**
CO3	**Know methodology for earthquake resistant design for shear walls.**
CO4	**Design the buildings using capacity design method.**
CO5	**Design seismic resistant multi storied building.**

TEXT BOOKS

1. **Anil K. Chopra, (2011), Dynamics of Structures – Theory and Applications to Earthquake Engineering, Second Edition, Ingram International Inc., ISBN-13: 9780132858038.**

REFERENCE BOOKS

1. Pankaj Agarwal and Manish Shrikhande, (2007), Earthquake Resistant Design of Structures, First Edition, Prentice-Hall India Pvt Ltd, ISBN-13: 9788120328921.
2. Gupta B. L., (2010), Principles of Earthquake Resistant Design of Structures & Tsunami, Standard Publishers & Distributors, ISBN-13: 9788180141485.

COURSE CONTENT

:Basic of seismology &Theory of vibrations 6 lecture hours **Brief Introduction: Elements of Seismology – Definitions of magnitude – Intensity –**

Epicentre – General features of tectonics of seismic regions – Seismographs Free vibrations of single degree freedom systems – Computations of dynamic response to time dependent forces –Solution of problems.
Unit II: Dynamic analysis of building 9 lecture hours Dynamic analysis of building – MDOF system – Eigen values and eigen vectors – Mode shape – Calculation of storey shear.
Unit III: Earthquake resistant design of shear wall 9 lecture hours Determination of design lateral forces – Design of shear wall – Detailing of reinforcements as per IS: 13920.
Unit IV: Capacity design method 8 lecture hours Capacity – Design Principles – Design criteria for strength – Stiffness and ductility – Earthquake Analysis – Concept of earthquake resistance design – Code provisions for design of RCC building – IS: 1893 and IS: 4326 – Energy absorption capacity - Behaviour and design of masonry buildings subjects to earthquake ground motion.
Unit V: Multi storey building analysis 8 lecture hours Seismic analysis and design of a multi storied building – Seismic retrofitting strategies for RC and masonry buildings.

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 of Tall Buildings**
Course Code	**MSTR6014**
Prerequisite	**Design of Steel Structures, Structural analysis**
Corequisite	**-**
Antirequisite	**-**

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. This course is intended to teach the concept of tall structures.

2. Various methods to analyse the tall structure will be explained in the classes.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Know the types of tall buildings.**
CO2	**Analyze the plane frame systems by different methods.**
CO3	**Design the shear wall systems.**
CO4	**Know the details of in filled frame systems.**
CO5	**Perform the three dimensional analysis.**

TEXT BOOKS

1. Bryan Stafford Smith and Alex Coull, (2011), Tall Building Structures: Analysis and Design, Wiley India, ISBN-13: 9788126529896.

REFERENCE BOOKS

1. SarwarAlamRaz, (2002), Structural Design in Steel, Second Edition, New Age International, ISBN-13: 9788122432282.
2. Ghali. A., Neville. A. M and Brown T. G, (2009), Structural Analysis - A unified classical and Matrix Approach, Sixth Edition, Span press, ISBN-13: 9780415774338.

COURSE CONTENT

Unit I: Classification of buildings 8 lecture hours **Introduction - Classification of buildings according to NBC – Types of loads – wind load – Seismic load – Quasi static approach**
Unit II: Plane frame systems 8 lecture hours **Plane Frame System - Calculation of wind load – Approximate method – Portal - Cantilever and factor methods – Kani's method – Substitute frame method for dead load and live loads.**

Unit III: Shear wall system **8 lecture hours** **Shear Wall System - Rosman's analysis – Design aspect – RC frame and shear wall interaction – Equivalent frame method**
Unit IV: In-filled frame system **8 lecture hours** **In-filled Frame Systems - Importance – Methods of analysis – Equivalent truss and frame method – Force-displacement method – Effect of perforation in the in-filled frame.**
Unit V:Three dimensional analysis8 lecture hours **Three Dimensional Analysis - Basic principles – Centre of rotation of a rigid floor – Force displacement method.**

Continuous Assessment Pattern

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

Name of The Course	**Energy Efficient Buildings**				
Course Code	**MSTR6015**				
Prerequisite	-				
Corequisite	-				
Antirequisite	-				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

COURSE OBJECTIVES

1. This course aims to highlight importance of Energy- Efficient Buildings within the context of Energy issues in the 21st century.
2. To familiarize students with the concept of Energy efficiency, Renewable sources of energy and their effective adaptation in green buildings
3. To give a full understanding of Building Form and Fabric, Infiltration, ventilation, Lighting, cooling and water conservation.
4. To highlight the importance of Environmental Management as well as Environmental impact Assessment methods in Energy efficient buildings.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Understand to make buildings energy efficient.**
CO2	**Have a fuller grasp on Renewable Energy mechanisms such as Passive Solar heating and collection, Photovoltaics, and Ground source heat pumps, and their adaption to green building concepts.**
CO3	**Understand the concepts of Site and Climate, Building Form, Building Fabric, Infiltration and ventilation, Lighting, Heating, Cooling, Energy Management and water conservation.**
CO4	**Have the necessary skills to undertake an Environmental Impact Assessment study for Energy Efficient Buildings. They shall be equipped with the associated cutting-edge management strategies too.**
CO5	**Monitor energy consumption.**

TEXT BOOKS

1. William T. Meyer, (2007), Energy Economics and Building Design, McGraw - Hill, ISBN: 9780070417519.

REFERENCE BOOKS

1. Sim Van Der Ryn and Stuart Cowan, "Ecological Design", Annotated Edition, Island Press ISBN-13: 9781597261418.
2. Richard D. Rush, (1991), The Building System Integration Handbook., Butterworth – Heinemann Ltd, ISBN-13: 9780750691987.

COURSE CONTENT

I Unit I: Green Buildings, Energy and Environment 8 lecture hours

Green Buildings within the Indian Context - Types of Energy - Energy Efficiency and Pollution - Better Buildings - Reducing energy consumption - Low energy design.
Unit II: Renewable Energy, Site and Climate 8 lecture hours **Renewable Energy sources that can be used in Green Buildings - Solar energy - Passive Solar Heating - Passive Solar collection - Wind and other renewable - A passive solar strategy - Photovoltaics - Climate and Energy - Macro and Microclimate - Indian Examples.**
Unit III: Building Form and Fabric **8 lecture hours** **Building Form - Surface area and Fabric Heat Loss - utilizing natural energy - Internal Planning - Grouping of buildings - Building Fabrics - Windows and doors - Floors - Walls - Masonry - Ecological walling systems - Thermal Properties of Construction Material.**
Unit IV: Infiltration, Ventilation, Lighting, Cooling and Water Conservation **8 lecture hours** **Infiltration and ventilation - Natural ventilation in commercial buildings - passive cooling - modelling air flow and ventilation - Concepts of daylight factors and day lighting - daylight assessment - artificial lighting - New light sources - Cooling buildings - passive cooling - mechanical cooling - Water conservation- taps, toilets and urinals, novel systems - collection and utilization of rain water.**
Unit V: Energy Awareness **8 lecture hours** **Energy awareness - monitoring energy consumption - Building Environmental Assessment - environmental criteria - assessment methods - assessment tools (e.g. LEED) – Ecohomes - Sustainable architecture and urban design - principles of environmental architecture - Benefits of green buildings - Energy Conservation Building code – NBC.**

Continuous Assessment Pattern

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

Name of The Course	Environmental Engineering Structures			
Course Code	MSTR6016			
Prerequisite	Design of Concrete Structures			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge in the area of analysis and design of pipes and sewage structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	Understand the concepts of pipe network and design.
CO2	Design the water tanks and concrete roofing systems.
CO3	Understand the economic analysis of tanks.
CO4	Design the special purpose structures.
CO5	Understand the concepts of filter walls and clarifiers.

TEXT BOOKS

1. **P. Dayaratnam, (2011), Design of Reinforced Concrete Structures, Fourth Edition, Oxford & IBH – Pubs Company, ISBN-13: 9788120414198.**

REFERENCE BOOKS

1. **M. L. Gambhir, (2009), Design of Reinforced Concrete Structures, First Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120331938.**

2. **Krishna Raju, (2004), Pre-stressed Concrete (Problems and Solutions), Second Edition, CBS Publishers & Distributors, ISBN-13: 9788123902174.**

COURSE CONTENT

Unit I:Pipe design 8 lecture hours **Design of Pipes - Structural design of concrete - Pre-stressed concrete steel and cast iron piping mains - Sewerage tanks design - Anchorage for pipe – Massive outfalls – Structural design and laying – Hydrodynamic considerations.**
Unit II: Water tank design 8 lecture hours **Analysis and design of water tanks - Design of concrete roofing systems using cylindrical, spherical and conical shapes using membrane theory and design of various types of folded plates for roofing using concrete - IS Codes for the design of water retaining structures.**
Unit III: Economic analysis 8 lecture hours **Design of circular, rectangular, spherical and Intze type of tanks using concrete - Design of pre-stressed concrete cylindrical tanks – Economic analysis.**
Unit IV: Swimming pools 8 lecture hours **Design of Special Purpose Structures - Underground reservoirs and swimming pools - Intake towers - Structural design including foundation of water retaining structures such as settling tanks, clarifloculators, aeration tanks etc. – Effect of earth pressure and uplift considerations – Selection of materials of construction.**
Unit V:Mixing tank8 lecture hours **Design of filter walls and clarifiers - Mixing tanks.**

Continuous Assessment Pattern

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

Name of The Course	Experimental Stress Analysis			
Course Code	MSTR6017			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. This subject is taught to impart knowledge about the instruments and its applications.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Know the working principle of strain gauges.**
CO2	**Perform the model analysis using different theorems.**
CO3	**Know the concepts of photo elasticity and its applications.**
CO4	**Understand the processes of scattered light photo elasticity.**
CO5	**Use the various Non-destructive testing methods.**

TEXT BOOKS

1. Jindal, (2012), Experimental Stress Analysis, Pearson India, ISBN-13: 9788131759103.

REFERENCE BOOKS

1. J. Srinivas, (2012), Stress Analysis and Experimental Techniques: An Introduction, Alpha Science International Ltd, ISBN-13: 9781842657232.
2. Sadhu Singh, (2009), Experimental Stress Analysis, Khanna Publishers, ISBN-13: 9788174091826.

COURSE CONTENT

Unit I: Strain gauges 8 lecture hours **Strain Gauges - Mechanical and optical strain gauges – Description and operation – Electrical**

resistance- Inductance and capacitance gauges – Detailed treatment on resistant gauges – Measurement of static and dynamic strains – Strain rosettes – Effect of transverse strains – Use of strain recorders and load cells.
Unit II: Model Analysis **8 lecture hours** **Model Analysis - Structural similitude – Use of models – Structural and dimensional analysis – Buckingham Pi Theorem – Muller Breslau's principle for indirect model analysis – Use of Begg's and Eney'sdeformeters – Moment indicators – Design of models for direct and indirect analysis.**
Unit III: Two dimensional photo elasticity **8 lecture hours** **Two dimensional photo elasticity - Stress optic law – Introduction to polariscope – Plane and circular polariscope – Compensators and model materials – Material and model fringe value – Calibration of photo elastic materials – Isochromatic and isoclinic fringes – Time edge effects.**
Unit IV: Three dimensional photo elasticity **8 lecture hours** **Three dimensional photo elasticity - Introduction – Stress freezing techniques – Stress separation techniques – Scattered light photo elasticity – Reflection polariscope**
Unit V: Non-destructive testing8 lecture hours **Miscellaneous Methods - Brittle coating method – Birefringence techniques – Moire fringe method – Non-destructive testing – Ultrasonic pulse velocity technique – Rebound hammer method – X-ray method – Gamma-ray method.**

Continuous Assessment Pattern

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

Name of The Course	**Machine Foundations**			
Course Code	**MSTR6018**			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge of dynamic behaviour of soils, effects of dynamic loads and the various design methods.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Know the basic principles of soil dynamics.**
CO2	**Understand the elastic properties of soil.**
CO3	**Learn the multi degree freedom system.**
CO4	**Know the mathematical models for dynamic analysis.**
CO5	**Understand the concepts of stiffness, damping, inertia, guide lines for design.**

TEXT BOOKS

1. K. G. Bhatia, (2007), Foundations for Industrial Machines: Handbook for Practicing Engineers, D-Cad Publishers, ISBN-13: 9788190603201.

REFERENCE BOOKS

1. Srinivasulu P. and Vaidyanathan C. V., (2004), Hand Book of Machine Foundations, First Edition, Tata Education Pvt. Ltd., ISBN-13: 9780070966116.
2. Shambhu P. Dasgupta&Indrajit Chowdhury, (2009), Dynamics of Structures and Foundations: A Unified Approach: Fundamentals (Volume 1), First Edition, Taylor & Francis Publishers, ISBN-13: 9780415471459.

COURSE CONTENT

Unit I: Introduction **8 lecture hours** **Introduction: Elements of soil dynamics – Basic definitions – Importance of dynamics analysis – general requirements of machine foundations – types of machine foundation**
Unit II: Properties of soil **8 lecture hours** **Elastic properties of soils – Elastic deformation of soils and elastic constants - co-efficient of elastic uniform compression of soils - co-efficient of elastic non-uniform compression of soil, co-efficient of elastic uniform shear of soil, effect of vibration on the dissipatice properties of soil, effect of vibration on the porosity and hydraulic properties of soils, elements of the theory of residual settlements of decrease the residual dynamic settlement of foundations**
Unit III: Design parameters **8 lecture hours** **Theory of massive machine foundation – theory of single and multi degree freedom, system – Evaluation of Design parameters – vertical vibrations of foundations, rocking, vibration of foundations, vibration of pure shear, vibration of foundations accompanied by simultaneous rotations**
Unit IV: Block foundation 8 lecture hours **Analysis and Design of foundation - models of vibration of block foundation – method of analysis for block foundation, design procedure from block foundations – relevant code for design of foundation, foundations for impact load and cyclic load – design data – Barker's Empirical procedures, analog models for dynamic analysis of single pile. Dynamic bearing capacity, earth pressure, dynamic soil structure interaction**
Unit V: Vibration isolation **8 lecture hours** **Vibration isolation – active and passive types of isolation – methods of isolation in machine foundation – properties of isolating materials – guide lanes for design and construction details of machine foundation**

Continuous Assessment Pattern

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

Name of The Course	Maintenance & Rehabilitation of Structures			
Course Code	MSTR6019			
Prerequisite	Concrete Technology			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. This subject imparts a broad knowledge in the area of repair and rehabilitation of structures

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Understand the properties of fresh and hardened concrete.**
CO2	**Know the strategies of maintenance and repairing.**
CO3	**Get an idea of repairing techniques.**
CO4	**Understand the properties of repairing materials.**
CO5	**Know about weathering wear, fire leakage and marine exposure.**

TEXT BOOKS

1. Shetty M. S., (2008), Concrete Technology, Seventh Edition, S. Chand & Company Ltd.ISBN-13: 9788121900034.

REFERENCE BOOKS

1. Ravindra K. Dhir, M. Roderick Jones & Li Zheng, (2005), Repair and Renovation of Concrete Structures, American Society of Civil Engineers, ISBN-13: 9780727734051.
2. A. R. Santha Kumar, (2006), Concrete Technology, First Edition, Oxford University Press, ISBN-13: 9780195671537.

COURSE CONTENT

Unit I:Properties of concrete **8 lecture hours** **Serviceability and Durability of Structures - Quality Assurance for concrete construction - Fresh concrete properties – Strength – Permeability - Cracking - Effects due to climate – Temperature – chemicals - Wear and erosion - Design and construction errors - Corrosion mechanism - Effects of cover thickness and cracking - Methods of corrosion protection – Inhibitors - Resistant steels – Coatings - Cathodic protection**
Unit II: Repairing materials **8 lecture hours** **Diagnosis and Assessment of Distress - Visual inspection – Non destructive tests –Ultrasonic pulse velocity method – Rebound hammer technique – ASTM classifications – Pullout tests – Core test**
Unit III: Repairing techniques **8 lecture hours** **Materials for Repairing - Special concretes and mortar - Concrete chemicals - Special elements for accelerated strength gain - Expansive cement - Polymer concrete – Ferro cement, Fibre reinforced concrete - Fibre reinforced plastics.**
Unit IV: Repairs to structures **8 lecture hours** **Techniques for Repair - Rust eliminators and polymers coatings for rebars during repair - Foamed concrete - Mortar and dry pack - Vacuum concrete - GModulee and shotcrete - Epoxy injection - Mortar repair for cracks - Shoring and underpinning.**
Unit V: Example of Repairs to Structures8 lecture hours **Example of Repairs to Structures - Repairs to overcome low member strength – Deflection – Cracking - Chemical disruption - Weathering wear - Fire leakage - Marine exposure**

Continuous Assessment Pattern

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

Name of The Course	Theory and Design of Plates & Shells			
Course Code	MSTR6020			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. This subject is taught to impart knowledge about the behavior of plates and shells.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Understand the concept of thin plates.**
CO2	**Analyse laterally loaded circular plates.**
CO3	**Analyse laterally loaded thin plates.**
CO4	**Understand the concept of shells.**
CO5	**Analyse and design of doubly curved shells**

TEXT BOOKS

1. G. S. Ramaswamy, (1996), Design and Construction of Concrete Shell Roofs, First Edition, CBS Publishers and distributors. ISBN-13: 9780812390995.

REFERENCE BOOKS

1. Timoshenko and Krieger, (2010), Theory of Plates and Shells, Second Edition, Tata McGraw Hill Education Pvt. Ltd., ISBN-13: 9780070701250.
2. K. Bhaskar, (2013), Plates: Theories and Applications, First Edition, Ane Books Pvt. Ltd., ISBN-13: 9789382127024.

COURSE CONTENT

Unit- I:Thin plates **8 lecture hours** **Introduction:- Assumptions in the theory of thin plates – Pure bending of Plates –Relations between bending moments and curvature - Particular cases of pure bending of rectangular plates, Cylindrical bending - immovable simply supported edges – Synclastic bending and Anticlastic bending – Limitations - Boundary conditions.**
Unit- II: Circular plates **8 lecture hours** **Laterally Loaded Circular Plates:- Differential equation of equilibrium – Uniformly loaded circular plates with simply supported and fixed boundary conditions – Annular plate with uniform moment and shear force along the boundaries.**
Unit III: Plate bending **8 lecture hours** **Laterally loaded thin plates – Differential equation of plates - Navier's solution and Levy's method – Rectangular plates with various edge conditions**
Unit IV: Theory of shells **8 lecture hours** **Types of shells – Structural action – Membrane theory – Limitations – Beam method of analysis.**
Unit V: Curved shell 8 lecture hours **Analysis and design of doubly curved shells – Elliptic paraboloid - Conoid and hyperbolic paraboloid roofs.**

Continuous Assessment Pattern

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

Name of The Course	**Offshore Structures**
Course Code	**MSTR6021**
Prerequisite	**-**
Corequisite	**-**
Antirequisite	**-**

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. This subject is taught to impart knowledge about analysis and design of offshore structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Understand the effect of wind on structures.**
CO2	**Know about wave generation and propagation.**
CO3	**Calculate wave forces.**
CO4	**Design plat forms, derrick, jacket towers.**
CO5	**Learn the principles of jacketing towers.**

TEXT BOOKS

1. Gerwick, (1999), Construction of Marine and Offshore Structure, Second Edition, CRC

Press, ISBN-13: 9780849374852.

REFERENCE BOOKS

1. **Lymon C. Reese, Bruce J. Muga& James F. Wilson, Offshore Structures, Second Edition, John Wiley & Sons, ISBN-13: 978047121264675.**
2. **Templetion J. S., (2007), Offshore Technology in Civil Engineering, Hall of Fame, Papers from the Early Years, Volume-2, American Society of Civil Engineers, ISBN-13: 9780784409251.**

COURSE CONTENT

Unit I: Rigid and flexible structures **8 lecture hours** **Wind on structures - Rigid structures - Flexible structures - Static and Dynamic effects.**
Unit II: Wave generation **8 lecture hours**

Wave generation and Propagation - Small and finite amplitude wave theories - Wave energy and pressure distribution.
Unit III: Wave forces 8 lecture hours **Wave forces on structures - Environmental loading - Use of Morrison equation.**
Unit IV: Types of structures 8 lecture hours **Loads - Design of platforms – Derricks – Helipads – Design.**
Unit V:Design of platform, helipad etc8 lecture hours **Principles and examples of Jacket towers - Mooring cables.**

Continuous Assessment Pattern

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

Name of The Course	**Prefabricated Structures**			
Course Code	**MSTR6022**			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge in the area of prefabricated structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Know the types of prefabrication systems.**
CO2	**Understand about handling and erection stresses.**
CO3	**Learn about construction and expansion joints.**
CO4	**Understand the process of erection of R.C. structures.**
CO5	**Design pre fabricated modules.**

TEXT BOOKS

1. Hass, A. M., (1995) Precast concrete Design and Applications, Applied Science Publishers, England.

REFERENCE BOOKS

1. Promyslov, V. (1998), Design and Erection of Reinforced concrete structures, MIR Publishers, Moscow.ISBN: 0719024323.
2. Levit, M., (2000), Precast concrete materials, Manufacture properties and usage, Applied Science Publishers, London. ISBN 0-203-79881-3.

COURSE CONTENT

Unit I:Introduction **8 lecture hours** **Types of foundation - Modular co-ordination – Components - Prefabrication systems and structural schemes - Design considerations - Economy of prefabrication - Prefabrication of load-carrying members - DisModuleing of structures - Structural behaviour of pre cast structures.**
Unit II: Handling and erection stresses **8 lecture hours** **Handling and erection stresses - Application of pre stressing of roof members - Floor systems - Two way load bearing slabs - Wall panels**
Unit III: Dimensioning and detailing of joints **8 lecture hours** **Dimensioning and detailing of joints for different structural connections - Construction and expansion joints.**
Unit IV: Erection of structures **8 lecture hours** **Production - Transportation and Erection - Organising of production - Storing and**

erection equipment - Shuttering and mould design - Dimensional tolerances, Erection of R.C. structures, Total prefabricated buildings
Unit V:Design of pre fabricated Modules8 lecture hours **Prefabricated Modules for Industrial structures - Multi-storied buildings and Water tanks - Application of pre stressed concrete in prefabrication**

Continuous Assessment Pattern

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

Name of The Course	**Pre-stressed Concrete Structures**			
Course Code	**MSTR6023**			
Prerequisite	**Reinforced Concrete Structures**			
Corequisite	**-**			
Antirequisite	**-**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES

1. This subject is taught to give the concepts of pre-stress.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Know the concepts, methods and materials of pre-stressing systems.**
CO2	**Design the pre-stressed concrete members.**
CO3	**Calculate the deflections in pre-stressed concrete members.**
CO4	**Design anchorage zones and composite pre-stressed concrete members.**
CO5	**Know the concepts of pre-stressed concrete beams.**

TEXT BOOKS

1. Krishna Raju.N, (2004), Pre stressed Concrete, Third Edition, Tata McGraw Hill Co

REFERENCE BOOKS

1. Rajagopal.N, (2005), Prestressed Concrete, Second Edition, Narosa Publishing House. ISBN 13, : 9788173195433

2. Dayarathnam P, (2004), Prestressed Concrete Structures, S.Chand Publishers.

3. Sinha.N.C and Roy.S.K, (2000), Fundamentals of Pre-stressed Concrete, S.Chand& Company.

COURSE CONTENT

Unit I:Materials and losses in pre stress 8 lecture hours **Difference between reinforced and pre-stressed concrete – Principles of pre-stressing – Methods and systems of pre-stressing – Principles of pre-stressing – Classification of pre-stressed concrete structures – Materials – High strength concrete and High strength steel – Stress-strain diagram - Losses in pre-stress.**
Unit II: Design of pre-stressed concrete beams 8 lecture hours **Design of prismatic pre-stressed concrete members for bending at service load.**
Unit III: Deflections **8 lecture hours** **Simple cable profiles – Calculation of deflections – Design of beams for shear and torsion at working and ultimate loads.**
Unit IV: Anchorage design 8 lecture hours **Design of Anchorage zone by Guyon's method – Concept of Magnel's method – IS:1343 recommendations.**
Unit V: Composite prestressed concrete beams 8lecture hours **Pre-stressed concrete beams – Design procedure – Calculation of stresses at**

important stages both for propped and unpropped constructions – Shrinkage stresses - Statically indeterminate structures – Concept of concordant cable and profile – Sketching of pressure lines for continuous beams.

Continuous Assessment Pattern

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

Name of The Course	Soil Structure Interaction				
Course Code	MSTR6024				
Prerequisite	Geotechnical Engineering				
Corequisite	-				
Antirequisite	-				
		L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. This subject is taught to impart knowledge on soil structure interaction analysis, its influences in the design parameters.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Understand the concept of different soil models.**
CO2	**Calculate modulus of subgrade for different types of soil.**
CO3	**Carry out soil structure interaction for shallow foundation.**
CO4	**Do the elastic analysis of piles and pile groups.**
CO5	**Know non-linear soil properties.**

TEXT BOOKS

1. Desai, C. and Christian, I.T., (2003), Numerical methods in Geo-technical Engineering, Khanna Publishers ISBN-978-3-642-01461-1.

REFERENCE BOOKS

1. Selvadurai A.P.S., Elastic Analysis-Soil foundation interaction.ISBN 13: 9780444416636

2. Hetenyi, M; Beams on elastic foundation. ISBN: 0472084453

3. Baker, A.L.L. Raft foundation, The Soil line method of design ISBN 10: 8122410782

4. Nainan P. Kurian, Design of foundation systems (Narosa) ISBN: 978-81-7319-939-4

5. Structure –Soil interaction – State of art report, Institute of Structural Engineers, 1978

6. ACl-336 suggested Analysis and design practice, for combined footings and mats. American Concrete Institute, Delhi - 1988.

7. Poulous, H.G. and Davis, E.H, Pile foundation analysis and design, John Wiley, 1980. ISBN 10: 0471020842

COURSE CONTENT

Unit I:Mathematical model, Winkler model, Two parameter model 8 lecture hours **Soil models: single parameter model (Winkler), two parameter models – Filonenko - Borodich model, Pasternak model, Heteni model, visco elastic model, elastic continuum model, contact pressure distribution below the flexible and rigid footing and. raft parameter affecting conduct pressure.**
Unit II: Modulus of subgrade, reaction 8 lecture hours **Contact pressure and subgrade modulus and beams on elastic foundation method - analysis of contact pressure distribution – modulus of subgrade reaction – classical solution for beam of infinite length subjected to concentrated load and moment, beams of finite length (formulation of basic equation for slabs resting on elastic foundation), Application of design of combined footing.**
Unit III: Beams and slabs **8 lecture hours** **Plates in elastic medium – soil structure interaction for shallow foundation – interface behaviour - Thin and thick plates – analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, simple solutions, Baker's method for rafts.**
Unit IV: Analysis of piles **8 lecture hours** **Soil pile interaction : Introduction – elastic analysis of single pile, theoretical solutions for**

settlement and load distribution analysis of pile group interaction analysis – Load distribution with groups with rigid cap – elastic continuum and elasto-plastic analysis of piles and pile groups (Ultimate lateral resistance of piles by various approaches).
Unit V:Pile displacement8 lecture hours Laterally loaded pile and piled raft: Non-linear load – deflection response P-Y reactions, non-linear soil properties lift capacity of piles and anchors, Piles raft system – soil structure interaction in framed structures. FEM modules use of approximately software packages

Continuous Assessment Pattern

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

Name of The Course	**Stability of Structures**				
Course Code	**MSTR6025**				
Prerequisite	**Structural analysis**				
Corequisite	**-**				
Antirequisite	**-**				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

COURSE OBJECTIVES

1. This subject is taught to impart the knowledge in the area of stability of structures.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	**Understand the behaviour of columns.**
CO2	**2. Learn the theory of the beam columns.**
CO3	**3. Analyse the frame stability.**
CO4	**4. Understand the concept of plate buckling.**
CO5	**5. Understand the concept of buckling of shells.**

TEXT BOOKS

1. Aswini Kumar, (2002), Stability theory of structures, Tata McGraw Hill Publishing Co. Limited, New Delhi.

REFERENCE BOOKS

1. Timoshenko & Gere (2000), Theory of Elastic Stability, McGraw Hill. **ISBN**-13: 978-0-486-47207-2
2. N.G.R. Iyengar (1996), Structural Stability of Columns and Plates, Affiliated East West Press, **ISBN** 81-85814-24-4. 3.

COURSE CONTENT

Unit I :Column analysis 8 lecture hours Introduction - Static equilibrium – Governing equation for columns – Analysis for various boundary conditions - Analysis of Eccentrically loaded column.
Unit II: Beam column analysis 8 lecture hours Beam Columns – Theory of Beam column – Stability analysis of beam column with different types of loads – Failure of beam columns.
Unit III: Frames stability 8 lecture hours Analysis and stability of frames
Unit IV: Plates 8 lecture hours Plates subjected to inplane forces - Differential equation – Analysis – Approximate techniques - Analysis for various boundary conditions – Wood and Armer equation for analysis and design.
Unit V: Shells 8 lecture hours Buckling of shells – Differential equation – Analysis – Application

Continuous Assessment Pattern

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

Name of The Course	Structural Optimization			
Course Code	MSTR6026			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. This course is intended to teach the importance of Optimization problems in the Structural Engineering.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	Understand the concepts of Optimization problems in the Structural Engineering.
CO2	Know the different methods for the Optimization problems.
CO3	Understand the concepts of Linear and Non-Linear Programming techniques.
CO4	Understand the concepts of Stochastic Optimization Methods.
CO5	Understand the concepts of Genetic Algorithm based Optimization Methods.

TEXT BOOKS

1. S.S.Rao, (1996), Engineering Optimization: Theory and Practice, Third Edition, John Wiley &Sons,Inc.ISBN 0-471-55034-5

REFERENCE BOOKS

1. Smith, D. R., "Variational Methods in Optimization," Dover Publications, 1998. ISBN, 0486404552,
2. Haftka, R. T. and Gurdal, Z., "Elements of Structural Optimization," Kluwer Academic Publishers, 1992. ISBN, 0792315049
3. Bendsoe, M. P. and Sigmund, O., "Topology Optimization: Theory, Methods, and Applications," Springer, 2003. ISBN-10: 3540429921

COURSE CONTENT

Unit I:Formulation of Structural Optimization problems. 8 lecture hours
Formulation of Structural Optimization problems: Design variables - Objective function - constraints. Fully stressed design.
Unit II: Linear Programming techniques 8 lecture hours
Review of Linear Algebra: Vector spaces, basis and dimension, canonical forms.
Unit III: Non-Linear Programming techniques 8 lecture hours
Linear Programming: Revised Simplex method, Application to structural Optimization.
Unit IV: Stochastic Optimization Methods 8 lecture hours
Nonlinear Programming: Deterministic Methods_ Unconstrained and constrained Optimization - Kuhn-Tucker conditions, Direct search and gradient methods - One dimensional search methods - DFP and BFGS algorithms, constrained Optimization - Direct and Indirect methods - SLP, SQP and SUMT, Application of NLP methods to optimal structural design problems. Optimality criteria based methods, Reanalysis techniques - Approximation concepts - Design sensitivity Optimization of sections, steel and concrete structures - framed structures, bridge structures.
Unit V: Genetic Algorithm based Optimization Methods 8 lecture hours
Genetic Algorithm based Optimization Methods

Continuous Assessment Pattern

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

Name of The Course	Composite Structures			
Course Code	MSTR6027			
Prerequisite	-			
Corequisite	-			
Antirequisite	-			
	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

1. To know the types of composites
2. To understand the need for stress strain relation
3. To understand the fabrication methods
4. To understand the laminated plates
5. To study and understand the different methods & analysis of composite materials.

COURSE OUTCOMES

On completion of this course, the students will be able to

CO1	Analyze composite structures
CO2	Do microscopic and macroscopic analysis
CO3	Analyze sandwich and laminated plates
CO4	Understand the failure criteria for composites.
CO5	Know the fabrication techniques

TEXT BOOKS

1. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1991.ISBN0-324-06680-5
2. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1915.ISBN 81-297-0277-0

REFERENCE BOOKS

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York. ISBN 0-324-06680-5
2. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York.ISBN 0-324-06680-5
3. J. N. Reddy, "Mechanics of Laminated Composite Plates and Shells - Theory and Analysis", CRC Press (USA) ISBN 9780849315923

COURSE CONTENT

Unit I: Stress Strain Relationship
8 lecture hours
Introduction - advantages and application of composite materials, reinforcements and matrices - Generalised Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials.

Unit II: Finite Element Analysis of Plates
8 lecture hours
Introduction - concept of mesh - Displacement function - Stress-Strain Matrix – Stiffness matrix of plate element – Solution of problem

Unit III: Methods of Analysis
8 lecture hours
Micro mechanics - Mechanics of materials approach, elasticity approach to determine material properties - Macro Mechanics - Stress-strain relations with respect to natural axis, arbitrary axis - Determination of material properties - Experimental characterization of lamina.

Unit IV: Laminated Plates
8 lecture hours
Governing differential equation for a general laminate, angle ply and cross ply laminates - Failure criteria for composites.

Unit V: Sandwich Constructions, Fabrication Process 8lecture hours
Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels - Various Open and closed mould processes - Manufacture of fibers - Types of resins and properties and applications – Netting analysis.

Continuous Assessment Pattern

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

GALGOTIAS UNIVERSITY

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

School of Civil Engineering

Program: M.Tech. Energy & Environmental Engineering

Scheme: 2018/2019/2020-2021

Curriculum

Semester 1									
Sl. No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	CENG5001	Professional and Communication Skills	0	0	4	2	**50**	**-**	**50**
2	MATH5001	Advanced Numerical and Statistical Methods	3	1	0	4	**20**	**50**	**100**
3	MENE5001	Renewable Energy Technology	3	0	0	3	**20**	**50**	**100**
4	MENE5002	Physico-chemical, Biological Principles and Processes	4	0	0	4	**20**	**50**	**100**
5	MENE5003	Environmental Quality Monitoring	2	0	0	2	**20**	**50**	**100**
6	MENE5004	Energy Auditing, Conservation & Management	3	0	0	3	**20**	**50**	**100**
7	MENE5005	Renewable Energy Technology Lab	0	0	2	1	**50**	**-**	**50**
8	MENE5006	Environmental Quality Monitoring Lab	0	0	4	2	**50**	**-**	**50**
Semester II									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	MENE6001	Energy, Instrumentation, Measurement & Control	3	0	0	3	20	50	100
2	MENE6002	Environmental Audit & Impact Assessment	3	0	0	3	20	50	100
3	MENE6003	Design of Water & Wastewater Treatment Systems	3	0	0	3	20	50	100
4	MENE6004	Air Pollution & Its Control	3	0	0	3	20	50	100
5	MENE6019	Elective-I (Energy Environment Climate Change)	3	0	0	3	20	50	100
6	MENE6039	Elective-II (Risk Assessment and Disaster Management)	3	0	0	3	20	50	100
7	MENE6005	Seminar	0	0	0	1	50	-	50
8	MENE6006	Energy, Instrumentation, Measurement & Control Lab	0	0	2	1	50	-	50
Semester III									
Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	MENE7001	Comprehensive Examination	0	0	0	2	50		50
2	MENE7002	Project (Phase I)	0	0	0	5	50		50
3	MENE6029	Energy Efficient Buildings (Elective-III)	3	0	0	3	20	50	100
4	MENE6032	Solid Waste Management (Elective-IV)	3	0	0	3	20	50	100
5	MENE6037	Remote Sensing & GIS Applications (Elective-V)	3	0	0	3	50	50	50
Semester IV									
	Course Code	**Name of the Course**					**Assessment Pattern**		

Sl No			L	T	P	C	IA	MTE	ETE
1	MENE8001	Project (Phase II	0	0	0	15	**50**		**50**

List of Electives

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MENE6013	Solar Energy Technology	3	0	0	3	20	50	100
2	MENE6015	Hydrogen & Fuel Cells	3	0	0	3	20	50	100
3	MENE6019	Energy Environment Climate Change	3	0	0	3	20	50	100
4	MENE6027	Bioenergy Technologies	3	0	0	3	20	50	100
5	MENE6029	Energy Efficient Building	3	0	0	3	20	50	100
6	MENE6032	Solid Waste Management	3	0	0	3	20	50	100
7	MENE6034	Design of Wastewater Treatment & Disposal System	3	0	0	3	20	50	100
8	MENE6035	Urban Environmental Quality Management	3	0	0	3	20	50	100
9	MENE6037	Remote Sensing & GIS Applications	3	0	0	3	20	50	100
10	MENE6038	Application of Bio-technology in Environmental Engineering	3	0	0	3	20	50	100
11	MENE6039	Risk Assessment and Disaster Management	3	0	0	3	20	50	100
12	MENE6040	Mathematical Modelling in Environmental Engineering	3	0	0	3	20	50	100
13	MENE6041	Clean Development Mechanism & Green Technologies	3	0	0	3	20	50	100
14	MENE6042	Environmental Ecology	3	0	0	3	20	50	100
15	MENE6046	Environmental Economics, Legislation and Management	3	0	0	3	20	50	100

Detailed Syllabus

Name of The Course	**Renewable Energy Technology**			
Course Code	**MENE5001**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. Fundamental knowledge to the student about renewable and non-renewable energy.
2. Brief idea to students about types of energy and conversion technologies, processes, systems and devices.
3. Plasticize students to work with instruments
4. Encourage students to take up projects in those areas.
5. Implementation of renewable energy in project and development.

Course Outcomes

At the end of the course, students will be able to:

CO1	Explain the basic principles of various renewable energy conversion processes and devices used therein.
CO2	Understand the relationships between natural resources, consumption, population, economics of consumerism, etc in an environmental context.
CO3	Identify various parameters that influence the performance of devices/processes.
CO4	An understanding the problems of energy distribution, design, plan and execute.
CO5	To make a thought in terms of scientific and technological advancement in the spirit of a sustainable energy.

1.

Course Content

Unit I: Introduction to energy and resources **9 lecture hours** Introduction to energy and resources – Renewable energy sources - Availability of solar energy – Sun-earth relationships - Estimation of solar radiation using Page-Angstrom method - Solar radiation measurement – Flat plate collectors – Solar water heating systems – Evacuated Tubular Concentrators - Solar air heating systems and applications – Concepts on solar drying, cooking, desalination, solar ponds and solar cooling - Passive heating and cooling of buildings – Basics of solar concentrators and types - Solar thermal power generation.
Unit II: Solar Cells **10 lecture hours** Physics of solar cells – Cell types and manufacture – PV applications - Characteristics of cells and module – Performance parameters - Estimation of module power output – PV system configurations – System components: Battery, charge controller and inverter.
Unit III: Biomass **10 lecture hours** Biomass to energy conversion processes – Anaerobic digestion, process parameters, biogas composition, digester types, high rate anaerobic conversion systems – Alcohol from biomass – Biodiesel: preparation, characteristics and application - Biomass combustion and power generation – Briquetting – Gasification: Process, types of gasifiers, applications – Waste to energy technologies.
Unit IV: Wind Power **7 lecture hours** Power in the wind - Types of wind mills – WEG components - Airfoils: lift and drag – Power curves and energy estimation - Micro siting – Indian wind potential. Small Hydro Power: Types, site identification, head and flow measurement, discharge curve, estimation of power potential and system components.
Unit V: Renewable Energy Technologies **9 lecture hours** Technologies for harnessing other renewable energy sources like geothermal, wave, tidal and ocean thermal energy.

2.

3. **Continuous Assessment Pattern**

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

Name of The Course	Physico-chemical, Biological Principles and Processes			
Course Code	MENE5002			
Prerequisite	Basic physics, chemistry and mathematics			
Corequisite				
Antirequisite				
	L	T	P	C
	4	0	0	4

Course Objectives

The objective of this course is to:

1. To study about the solid- liquid- gas interactions
2. To understand about process kinetics
3. To deal with the microbial applications in environmental engineering
4. To study microbial activity and its application to treat wastewater
5. To apply microbial kinetics to addressed wastewater treatment problems

Course Outcomes

At the end of the course, students will be able to:

CO1	Understand the mass transfer and transport of impurities in system
CO2	Apply the concepts of oxidation-reduction equilibrium
CO3	Study and applying practically about microbial kinetics
CO4	Application of micro-organism for wastewater treatment
CO5	Apply microbial principles to environmental engineering

Text Books

1. Benefield, L.D. Judkins J.F. and Weand B.L. (1982). Process Chemistry for Water and Wastewater Treatment, End ed., Prentice-Hall, Inc, New Jersey, USA
2. Metcalf and Eddy, M.C., "Wastewater Engineering: Treatment, Disposal and Reuse", Tata McGraw-Hill Publications, New Delhi, 2003

Reference Books

1. Benefield L.D. and Randall, C.W. (1980). Biological process design for wastewater treatment. Prentice-Hall. N.J.
2. Pelczar, M.J., Chan ECS and Krieg NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
3. Talaro K., Talaro A CassidaPelzar and Reid, (1993) Foundations in Microbiology, W.C. Brown Publishers.
4. Sawyer, McCarty, and Parkin, 2003.Chemistry for Environmental Engineers, 5th" McGraw Hill,

Course Content

Unit I: Structure and Properties of Water **8 hours**

Structure and Properties of Water- their significance in environmental engineering, Sources of Water impurities, Abiotic reactions, Biological metabolism. Solid-Liquid-Gas interactions, Mass transfer and transport of impurities in water, diffusion, dispersion. Physical and Chemical interactions due to various forces, suspensions and dispersions.

Unit II: Chemical Reactions **8 hours**

Chemical reactions, Chemical equilibrium and thermodynamics, Acid-baseequilibria, solubility equilibria, oxidation-reduction equilibria. Process kinetics, reaction rates and catalysis, surface and colloidal chemistry, Adsorption. Settling of particles in water stabilization.

Unit III: Eco Systems **8 hours** Ecosystems; biotic and abiotic components, biogeochemical cycles, ecology of population; Ecological niche, Mortality and survivorship, CommModuley Interactions. typical natural and artificial ecosystems
Unit IV : Biochemistry **8 hours** Biochemistry; Biological compounds– enzymes, coenzymes and amino acids, Microbiological concepts; Cells, classification and characteristics of living organisms, Characterization techniques, Reproduction, Metabolism, Microbial growth kinetics.
Unit V: Applications of Microbiological principles to environmental engineering **8 hours** Applications of Microbiological principles to environmental engineering; assimilation of wastes, engineered systems, Concepts and Principles of carbon oxidation, Nitrification, Denitrification, Methanogenasis, etc., Concepts of quantization of degradable pollutants.

Continuous Assessment Pattern

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

Name of The Course	Environmental Quality Monitoring			
Course Code	MENE5003			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To teach students about various water quality parameters and their effect
2. Explain brief procedure for collection and preservation of samples of water and wastewater
3. Give idea to students about different standard methodologies for sampling and analysis of environment at whole and its constituents like water, wastewater, air and soil
4. To teach advance analytical methods for environmental quality monitoring
5. Conduct small projects on water quality monitoring of polluted and waste water in field condition

Course Outcomes

At the end of the course, students will be able to:

CO1	Schedule field studies and other data acquisition activities to be considered for compliance
CO2	Use a tiered monitoring approach consisting of rapid assessment or screening studies at site
CO3	Supervise monitoring techniques of various environmental parameters
CO4	Generate monitoring data relevant to decision making process
CO5	Manage and report environmental quality data in a way that it is meaningful and understandable to intended audience

Text Books

1. Metcalf and Eddy, (2003), Wastewater Engineering Treatment and Reuse, 4th edition, Tata McGraw Hill Education Private Limited, ISBN:978-00-704-9539-5.Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education, 2nd Edition, 2006

2. S.K.Garg (2010), Sewage Disposal and Air Pollution Engineering, Khanna Publishers, ISBN:978-81-740-9230-4

3. MN.Rao, H.V.N.Rao, (2007), Air Pollution, Tata McGraw Hill Publishing Company Limited, ISBN: 978-00-745-1871-7

Reference Books

1. Stanley E. Manahan (2005), Environmental Chemistry, 8th Edition, CRC Press, ISBN: 978-15-667-0633-9.

2. Clair N Sawyer, Perry L. McCarty and Gene F. Parkin (2002), Chemistry for Environmental Engineering and Science, McGraw-Hill Science.Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.

3. Gilbert M Master, Wendell P Ela, (2008), Environmental Engineering and Sceince, PHI Learning Pvt. Limited, ISBN:978-81-203-3691-9

4. Howard S.Peavy, Donald R Rowe, George Tchobanoglous, (1985), Environmental Engineering, 5.McGraw Hill Publishing Co.,ISBN:978-0-710-0231-8

Course Content

Unit I: General Sampling and Analytical Techniques 9 hours General principles for collection of representative sample, frequency of sampling, validation, interpretation and analysis of data, various statistical techniques, quality control, assessment and management.
Unit II: Methods for Physicochemical Analysis of Water/ Wastewater 10 hours Gravimetric methods for solids analysis in water and wastewater, determination of acidity, alkalinity and turbidity, analysis of common cations and anions in water/wastewater through various chemical techniques, determination of nitrogen, phosphorus and chemical oxygen demand (COD), acid-base titrations, precipitation titrations, complexometric titrations, oxidation-reduction titrations, working principles of electrodes, different types of electrodes.
Unit III: Biological Methods and Microbiology 10 hours

Biochemical oxygen demand (BOD), MPN test for microbial pollution, plate counts; confirmatory tests for various microbiological agents.
Unit IV: Air Pollution Measurements **7 hours** Sampling techniques for air pollution measurements; analysis of particulates and common chemical air pollutants, analysis of oxides of nitrogen, oxides of sulphur, carbon monoxide, hydrocarbon and poly aromatic hydro carbons.
Unit V: Advanced Analytical Methods **9 hours** Working principles of Spectrophotometric methods; Nephelometric methods; Atomic absorption spectroscopy and its various analytical versions; Ion chromatography, High performance liquid chromatography, CHNO/S Analyzer, TOC analyzer and other advanced analytical instruments.

Continuous Assessment Pattern

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

Name of The Course	Energy Auditing Conservation and Management				
Course Code	MENE5004				
Prerequisite					
Corequisite					
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives

1. To teach the basic concepts of energy audit and management.
2. Give brief knowdge about mathematical calculation and modelling of energy performance
3. Teach students about data collection and analysis
4. The energy auditing procedures, techniques, policy planning, implementation and energy audit instrument
5. To give a broadly knowledge about planning and management for economical growth

Course Outcomes

At the end of the course, students will be able to:

CO1	Understand the general aspect of energy auditing and management
CO2	Development of knowledge about the energy auditing procedures, techniques, policy planning and implementation.
CO3	Understand about energy audit instrument.
CO4	Mathematical approach of data collection and analysis.
CO5	Design of energy modelling and optimization

Text Books

1. Energy Management: W.R.Murphy, G.Mckay (Butterworths).
2. Energy Management Principles: C.B.Smith (Pergamon Press).
3. Efficient Use of Energy : I.G.C.Dryden (Butterworth Scientific)
4. Energy Economics -A.V.Desai (Wieley Eastern)
5. Industrial Energy Conservation : D.A. Reay (Pergammon Press)

Reference Books

1. Stanley E. Manahan (2005), Environmental Chemistry, 8th Edition, CRC Press, ISBN: 978-15-667-0633-9.
2. Clair N Sawyer, Perry L. McCarty and Gene F. Parkin (2002), Chemistry for Environmental Engineering and Science, McGraw-Hill Science.Daniel P Bovet and

Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.

3. Gilbert M Master, Wendell P Ela, (2008), Environmental Engineering and Sceince, PHI Learning Pvt. Limited, ISBN:978-81-203-3691-9

4. Howard S.Peavy, Donald R Rowe, George Tchobanoglous, (1985), Environmental Engineering, 5.McGraw Hill Publishing Co.,ISBN:978-0-710-0231-8

Course Content

Unit I: General Aspects **9 hours** General Philosophy and need of Energy Audit and Management. Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy. Energy Audit: Need, Types, Methodology and Approach. Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, Maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution.
Unit II: Procedures and Techniques **10 hours** **Data gathering :** Level of responsibilities, ener Facts, figures and impression about energy /fuel a Special tests, Questionnaire for data gathering. **Analytical Techniques:** Incremental cost conce of Energy inputs and rejections, Heat transfer ca process and energy system simulation.
Unit III: Energy Policy Planning and Implementation 10 hours Location of Energy Manager, Top Management Support, Managerial functions, Role and responsibilities of Energy Manager, Accountability. Motivating – Motivation of employees, Requirements for Energy Action Planning. Information Systems: Designing, Barriers, Strategies, Marketing and Communicating Training and Planning.
Unit IV: Energy Balance &MIS **7 hours** First law of efficiency and Second law of efficiency, Facility as an Energy system, Methods for preparing process flow, Materials and Energy Balance diagram, Identification of losses, Improvements. Energy Balance sheet and Management Information System (MIS) Energy Modeling and Optimization.
Unit V: Energy Audit Instruments **9 hours** Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy

4. **Continuous Assessment Pattern**

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

Name of The Course	**Renewable Energy Technology Lab**				
Course Code	**MENE5005**				
Prerequisite	**Renewable Energy Technology**				
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	0	**0**	**2**	**1**	

Course Objectives

This subject is taught

1. To impart knowledge in the area of biomass to energy
2. Working principle knowledge of instruments
3. Brief knowledge about various renewable energy parameters
4. Knowledge about handling the instruments and how to operate in filed
5. The role of instruments in different engineering applications.

Course Outcomes

At the end of the course, students will be able to:

CO1	Study the devices used to measure various forms of energy.
CO2	Understand the basic working principle of energy measuring devices
CO3	Knowledge of various flow parameters
CO4	Handling efficiency of instruments and problem solving
CO5	Technical approach of the instruments in field condition

Text Books

1. Fundamentals of Aerodynamics (McGraw-Hill International Editions: Mechanical Engineering Series) by John David Anderson , Tata Mcgraw-Hill Education.
2. Electrical Measurements and Measuring Instruments by A.K Sawhney**.**
3. Flow measurement: practical guides for measurement and control by David W. Spitzer, Instrument Society of America.

Reference Books

1. Energy Management Handbook by Steve Doty, Wayne C. Turne
2. Handbook of Energy Engineering by Albert Thumann, D. Paul Mehta.
3. Guide to Energy Management by B. L. Capehart, Wayne C. Turner, William J. Kennedy

COURSE CONTENT

1. Determination of proximate analysis (Moisture content, ash, Volatile matter & fixed carbon) for a Given Biomass Sample.
2. Determination of Total solids, volatile Solids and calorific value for a given organic Biomass Sample.
3. Determination of elemental analysis (chemical method) for a Given Biomass Sample.
4. Determination of C/N Ratio for a given organic Biomass Sample.
5. Determination of Chemical Oxygen Demand, BOD, Total dissolved solids (TDS) and pH for a Given Slurry or Liquid Sample.
6. Determination of Dissolved Oxygen & Biochemical in a Liquid Slurry Waste Sample.
7. Determination of Calorific Value of a solid and liquid Biomass Sample using Bomb calorimeter.
8. To study the Effect of Different Loading Rates, Total Volatile Solids and Hydraulic Retention time on Generation of Biogas in Batch Type Digesters.
9. Determination of Lignin, Cellulose, Hemicelluloses in a Given Biomass Sample.
10. Determination of Potassium, Sodium and Phosphorous in a Given Waste Slurry Sample.
11. Determination of Crude Protein in a Given Biomass Sample.
12. Study of Gasifier and its performance evaluation with solid and loose biomass.
13. Characterization of liquid biomass (Viscosity, density, flash/fire point, cloud point) and its comparison with diesel

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (EA)	Total Marks
50	**50**	**100**

Name of The Course	**Environmental Quality Monitoring Lab**			
Course Code	**MENE5006**			
Prerequisite	**Environmental Quality Monitoring**			
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

Course Objectives

This subject is taught

1. To impart knowledge in the area of sampling and statistical analysis

2. Working principle knowledge of instruments
3. Brief knowledge about various parameters
4. Knowledge about handling the instruments and how to operate in field
5. The role of instruments in different engineering applications.

Course Outcomes

At the end of the laboratory experiments, the student will be able to

CO1	Learn various instruments process and about their features.
CO2	How to handle the instruments
CO3	Supervise monitoring techniques of various environmental parameters
CO4	Generate monitoring data and their application in various treatment process
CO5	Manage and report environmental quality data in a way that is meaningful and understandable to intended project

List of Experiments

1. Estimation of pH
2. Determination of Total, suspended, dissolved volatile & fixed residue in a waste/water sample
3. Determination of Turbidity
4. Determination of the Carbonate, Bicarbonate, and Hydroxide Alkalinity
5. Determination of the type and Extend of Acidity
6. Estimation of the Optimum Dose of Coagulants for Coagulation
7. Estimation of the Hardness of water (EDTA Method)
8. Estimation of the Chloride Concentration.
9. Determination of the Dissolved Oxygen (DO) and percentage saturation
10. Determination of Biochemical Oxygen Demand (BOD) of wastewater
11. Determination of Chemical Oxygen Demand (COD) of wastewater

Text Books

1. Metcalf and Eddy, (2003), Wastewater Engineering Treatment and Reuse, 4th edition, Tata McGraw Hill Education Private Limited, ISBN: 978-00-704-9539-5.
2. S.K.Garg (2010), Sewage Disposal &Air Pollution Engineering, Khanna Publishers, ISBN: 978-81-740-9230-4
3. MN.Rao, H.V.N.Rao, (2007), Air Pollution, Tata McGraw Hill Publishing Company Limited, ISBN: 978-00-745-1871-7

Reference Books

1. Stanley E. Manahan (2005), Environmental Chemistry, 8th Edition, CRC Press, ISBN: 978-15-667-0633-9.
2. Clair N Sawyer, Perry L. McCarty and Gene F. Parkin (2002), Chemistry for Environmental Engineering and Science, McGraw-Hill Science.
3. Gilbert M Master, Wendell P Ela, (2008), Environmental Engineering and Sceince, PHI Learning Pvt. Limited, ISBN:978-81-203-3691-9
4. Howard S.Peavy, Donald R Rowe, George Tchobanoglous, (1985), Environmental Engineering, 5.McGraw Hill Publishing Co.,ISBN:978-0-710-0231-8
C.S.Rao (2006), Environmental Pollution Control Engineering, New Age International, ISBN:978-81-224-1835-4

Continuous Assessment Pattern

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

Name of The Course	**Energy, Instrumentation, Measurement & Control**			
Course Code	**MENE6001**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

This subject is taught
1. To impart knowledge in the area of numerical integration and Calculus
2. Working principle knowledge of energy meter
3. Brief knowledge about various flow parameters

4. Knowledge about handling the instruments and how to operate in filed
5. The role of instruments in different engineering applications.

Course Outcomes

At the end of the course, students will be able to:

CO1	Study the devices used to measure various forms of energy.
CO2	Understand the basic working principle of energy measur
CO3	Knowledge of various flow parameters
CO4	Handling efficiency of instruments and problem
CO5	Technical approach of the instruments in field c

Text Books

1. Fundamentals of Aerodynamics (McGraw-Hill International Editions: Mechanical Engineering Series) by John David Anderson, Tata Mcgraw-Hill Education.
2. Electrical Measurements and Measuring Instruments by A.K Sawhney**.**
3. Flow measurement: practical guides for measurement and control by David W. Spitzer, Instrument Society of America.

Reference Books

1. Energy Management Handbook by Steve Doty, Wayne C. Turne
2. Handbook of Energy Engineering by Albert Thumann, D. Paul Mehta.
3. Guide to Energy Management by B. L. Capehart, Wayne C. Turner, William J. Kennedy

Course Content

Unit I: Electrical Energy Metering
9 lecture hours

Electrical energy meter, One –Phase energy meters, Three Phase Energy meters, working principle, various compensation, and Automatic meter reading systems.

Unit II: Thermal Energy Metering
10 lecture hours

Combustion analyser, Fuel efficiency monitor RTDs, Potentiometric & Paperless Recorders Pyrometer, Digital indicators, PID Controllers Thermistors, Heat Flux sensor.

Unit III: Air Flow Metering
10 lecture hours

Air flow meters: vane (flap) type air flow meters and “hot wire" and "hot film" air mass meters. Anemometer, types and its classification, working principle.

Unit IV: Gas Flow Metering
7 lecture hours

Types and its basic working principle, Odometer.

Unit V: Fluid Flow Metering
9 lecture hours

Classification of fluid flow meters based on the operating principle- Differential Pressure Flowmeters, Velocity Flow meters, Positive Displacement Flowmeters, Mass Flowmeters, Open Channel Flowmeters, Types:-Orifices, Venturies, Nozzles, Rotameters, Pitot Tubes, Calorimetrics, Turbine, Vortex, Electromagnetic, Doppler, Ultrasonic, Thermal, Coriolis.

Continuous Assessment Pattern

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

Name of The Course	Environmental Audit & Impact Assessment			
Course Code	**MENE6002**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

The course is intended

1. To teach the basic concepts of environmental audit impact assessment and policy.

2. To provide a critical overview of the theory and practice of EIA as operated internationally to those students who need to understand EIA
3. Field visit and EIA study of different field cases
4. How to conduct project on sustainability of environment
5. To teach various conventions and laws involving EIA.

Course Outcomes

At the end of the course, students will be able to:

CO1	Define EIA, different types of EIAs and benefits of EIA
CO2	Describe the role of EIA in sustainable development
CO3	Skill development for project planning process
CO4	Take a decision-making process in environmental clearance and public relation
CO5	Make a plan for International environmental issues and sustainable development

Text Books

1. Fundamentals of Aerodynamics (McGraw-Hill International Editions: Mechanical Engineering Series) by John David Anderson, Tata Mcgraw-Hill Education.
2. Electrical Measurements and Measuring Instruments by A.K Sawhney**.**
3. Flow measurement: practical guides for measurement and control by David W. Spitzer, Instrument Society of America.

Reference Books

1. Energy Management Handbook by Steve Doty, Wayne C. Turne
2. Handbook of Energy Engineering by Albert Thumann, D. Paul Mehta.
3. Guide to Energy Management by B. L. Capehart, Wayne C. Turner, William J. Kennedy

Course Content

Unit I: General Aspects
9 lecture hours

Definition of Environmental Audit (EA). Types of environmental audits. Policies and legislation relating to environmental audits. Conducting an audit. Audit reports. Relationship between an environmental audit and an EIA. The benefits of EA. Guidelines for EAs (General Principles, Criteria, evidence and findings, Reporting). EA objectives, roles and responsibility. EA as environmental management tool for small scale and large scale enterprises. EA and sustainable development. Responsibilities in conducting EAs. The benefits of database in EAs. Future Direction of EA

Unit II: Environmental Impact Assessment-1
10 lecture hours

Economic development, population growth Environmental Impact assessment. The history and aims of EIA. EIA administration and prac environmental protection are complimentar development.

EIA in project planning and management. The costs and benefits of EIA. Introduction to the key principles and elements of EIA, core values (sustainability, integrity, utility). EIA guiding principles (e.g. participation, transparency, flexibility, etc). Introduction to the main features of the EIA system. Role of public participation stages that follow EIA Understanding of the strengths and limitations of EIA.

Unit IV: Environmental Policy-1
7 lecture hours

Overview of the legislative and institutional characteristics essential for the support of a national EIA system. Factors that help to establish an effective national EIA system. Steps involved in establishing and modifying a national EIA system.

Unit V: Environmental policy-2
9 lecture hours

The level of public involvement in EIA and the relative advantages and disadvantages they offer. Techniques for communicating with the public. Consensus building and dispute resolution mechanisms. International environmental issues and sustainable development plans. International

environmental laws and policies of relevance to EIA -Treaties, conventions etc.

5. **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 of Water and Wastewater Treatment Systems			
Course Code	MENE6003			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

Brief knowledge to the student about

1. various water treatment processes and their designing criteria
2. implementation of technologies in wastewater treatment in order to make water safe to drink
3. to teach various options available in treatment of waste water for recycle and safe disposal
4. design of bioreactors for degradation of nutrients
5. application of wastewater treatment in field by research projects

Course Outcomes

At the end of the course, the student will be able to

CO1	Understand various unit operations involved in water treatment and design various water treatment units required
CO2	Planning and siting of water treatment plant
CO3	Effect of wastes disposal to water
CO4	Design of physical units for waste treatment.
C05	Design of bioreactors for biodegradation of wastewater treatment

Text Books

1. Metcalf and Eddy, M.C., "Wastewater Engineering: Treatment, Disposal and Reuse", Tata McGraw-Hill Publications, New Delhi, 2003
2. Benefield, L.D. Judkins J.F. and Weand B.L. (1982). Process Chemistry for Water and Wastewater Treatment, End ed., Prentice-Hall, Inc, New Jersey, USA
3. Benefield L.D. and Randall, C.W. (1980). Biological process design for wastewater treatment. Prentice-Hall. N.J.
4. Pelczar, M.J., Chan ECS and Krieg NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.
5. Talaro K., Talaro A CassidaPelzar and Reid, (1993) Foundations in Microbiology, W.C. Brown Publishers.
6. Sawyer, McCarty, and Parkin, 2003.Chemistry for Environmental Engineers, 5th" McGraw Hill

Reference Books

McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto

Course Content

Unit I: Definitions and Concepts **9 lecture hours** Water sources, Philosophy of water treatment, Review of water quality characteristics and potable water standards, Estimation of water quantity, Theory and design of Conventional Unit Operations used in Water Treatment: Screening, Sedimentation, Floatation, coagulation, flocculation, filtration, softening and disinfection processes.
Unit II: Theory and Design of Advanced Unit Operations used in Water Treatment **10 lecture hours** Membrane processes, Ion Exchange, Aeration/stripping, Precipitation, Adsorption, Oxidation-reduction and advanced oxidation processes; Water Treatment Plant Design; Selection of raw water source, Planning and siting

of water treatment plant, Chemical requirement and residuals management.
Unit III: Philosophy of Wastewater Treatment **10 lecture hours** Philosophy of wastewater Treatment, Review of Wastewater quality parameters and discharge standards for aquatic and land disposal, Estimation of wastewater quantity; Wastewater Collection; Design of sewers and sewerage systems
Unit IV: Wastewater Disposal **7 lecture hours** Disposal to inland waters such as lakes reservoirs, rivers and streams, disposal to sea, disposal on Land. Wastewater treatment; Preliminary treatment, Bar-rack, Screens, Grit chamber, Equalization tank, Primary sedimentation
Unit V: Secondary treatments **9 lecture hours** Aerobic processes, Anaerobic processes. Tertiary treatment, Nutrient removal, Residual management, Design; Planning and setting of Wastewater treatment plant, Chemical requirements and material balance.

6. **Continuous Assessment Pattern**

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

Name of The Course	Environmental Quality Monitoring			
Course Code	MENE6004			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

The course is intended to teach
1. The basics concept of air pollution
2. Instruments of monitoring of air quality
3. Technology required controlling air pollution
4. Effect of air pollution on environment
5. How to apply study for clean air development

Course Outcomes

At the end of the course, the student will be able to

CO1	Brief knowledge and experience to identify the type the source of pollutant.
CO2	Monitoring of air quality by different instruments
CO3	Control of air pollution by using different ECS.
CO4	Field project on remediation of air quality
C05	Use of different methods for air quality improvement

Text Books

1. M.N.Rao& H V N Rao (2000), Air pollution, Tata McGraw Hill Publishing Ltd

Reference Books

1. Air Pollution Control Technology Handbook, Second Edition" by Karl B Schnelle Jr and Russell F Dunn

Course Content

Unit I: Air Pollution & its Classification **9 lecture hours**

Definition, Air Quality, Classification of Air Pollutants.
Unit II: Effects of Air pollution **10 lecture hours** Effects of Air pollution on human, plant and animal, Air Pollution Episodes.
Unit III: Air Pollution Monitoring **10 lecture hours** Collection of Gaseous Air Pollutants, Collection of Particulate Pollutants, Measurement of SO_2, Nox, CO, Oxidants and Ozone.
Unit IV: Meteorology & Dispersion of pollutants 7 lecture hours Wind Circulation, Lapse Rate, Stability Conditions, Maximum Mixing Depths, Plume Rise and dispersion.
Unit V: Emission Control Systems **9 lecture hours** Air pollution control technologies for particulates and gaseous contaminants, Gravity settlers, Electrostatic precipitators, Bag Filters, Scrubbers, Cyclone, control for moving sources.

Continuous Assessment Pattern

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

Name of The Course	Energy, Environment and Climate Change			
Course Code	MENE6019			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To impart the knowledge of modern energy and climate change
2. Lays the foundation for energy conservation by analyzing various schemes, which is of prime importance in the modern energy crisis
3. To conduct energy audit and hence suggest means to improve energy management
4. To understand the importance of economic dispatch and unit commitment problem
5. This subject is taught to impart knowledge in environmental degradation due to the technical advancement.

Course Outcomes

Student will get the knowledge of:

CO1	Current emerging technologies and conduct energy audit and hence suggest means to improve energy management
CO2	India's stand in terms of various technologies
CO3	Environmental impacts due to energy production
CO4	Measures taken to control the global environmental changes
C05	Understand the importance of economic dispatch and unit commitment problem

Text Books

1. Adrian Bejan, Peter Vadasz, Detlev G. Kroger (1999), Kluwer Academic Publishers.
2.A K De (2001), Environmental Concerns, New Age Publications Pvt Ltd.

Reference Books

1. O.L. Elgard (1987), Electrical Energy System Theory – An Introduction, Tata McGraw-Hill Publication.
2. Robert H.MillerandJamesH.MalinOwaki(1987), PowerSystemOperation,3rdEdition,Tata McGraw-Hill.

3.P.S.R. Murthy(1994), Power System Operation and Control, Tata McGraw-Hill Publication

COURSE CONTENT

Unit I: Energy Sources **9 lecture hours** Definition, Modules, Forms of Energy, Power, Coal, Oil, Natural gas, Nuclear, Geothermal, R

Energy, Bio-Energy, Hydro, Tidal, Ocean , Nuclear Energy, Nuclear Fission and Fusion, Geothermal Energy.
Unit II: Energy Scenario **10 lecture hours** Global Energy Scenario: Energy consumption pattern in various sectors, Impact on economy, India`s Energy Scenario, Urban and Rural energy consumption patterns, Impact of Energy on Development, Energy Infra structure in India
Unit III: Impact of Energy Projects on Environment 10 lecture hours Overview of global environmental problems, Environmental degradation due to Energy production and use, Pollution due to thermal power stations , Environmental aspects of Wind Energy Farms ,Environmental aspects of Nuclear power generation, Nuclear waste disposal, Impact of Hydro power generation on Ecology and Environment, Guidelines for Environmental impact assessment (EIA) of Energy Projects
Unit IV: Climate Change Concerns **7 lecture hours** Green House Gas Emissions, Depletion of Ozone layer, Global Warming, Climate Change Concerns, Climate Change in India, Kyoto protocol, Clean Development Mechanism [CDM], Carbon Fund Concept of Carbon credit
Unit V: Climate Change Policy Issues **9 lecture hours** Impact of Climate Change on Glaciers, Rivers and Water Resources, Climate Change Policy Issues in Himalayas, International Status of Climate Change Policies, Indian Action Plan on Climate Change

Continuous Assessment Pattern

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

Name of The Course	**Risk Assessment and Disaster Management**			
Course Code	**MENE6039**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

To enable a comprehensive understanding of:

1. To provide knowledge related to the broad field of environmental risk assessment
2. Steps involved in the risk assessment process, including statistical characterization of observed data
3. Knowledge about tools that can be used in defining environmental risks, particularly as related to human health.
4. To develop practical skills in disaster mitigation, planning, response and post disaster rehabilitation, particularly related to health and public health.
5. To provide knowledge related to cyber and important legal provision for sustainable development

Course Outcomes

At the end of the course, students will be able to:

CO1	To gain knowledge related to the broad field of environm
CO2	Statistical characterization of field data
CO3	Use of tools for environmental risks, particularly as relat
CO4	To apply biotechnological concept and tools for green pr
CO5	Gain knowledge on eco-sustainable waste management e

Text Books

1. Rao V. Kolluru,"Environmental Strategicshand book", Mc-graw Hill Inc., New York, 1994.

Reference Books

1. BrockNeely.W&BlanG.E,"EnvironmentalExposurefromchemicals,VolumeII,ChcPressIunc., Florida,1989.
2. WoodsenW.E.,"Humanfactorsdesignhandbook– informationandguidelinesfordesigntosystem

s, facilities, equipment and product for human use", McGraw Hill, New York, 1981.

Course Content

Unit I: Risk Assessment 9 lecture hours Introduction- Methodologies and Guidelines: Principles, Code of practice – Appointment of personnel and their responsibilities–Emergency plans: onsite and offsite. Steps in risk assessment: Identification of risk, Extent of risk and disaster, Risk-Based Decisions for Corrective Action –Timely updation. Developing a Site Conceptual Model -Focusing on Risk-Based Decisions in Corrective Action – Risk Assessment: Dose Response and Target Level Calculations-Experiences in Environmental Risk Assessment.
Unit II: Occupational Health and Safety 10 lecture hours Occupational risk analysis survey and health evaluation, behavioral studies, occupational injury, disease reporting, investigation: monitoring and control of environmental hazards. Occupationally induced illness, non-occupational illness, and discomfort at work, the epidemiological approach, occupational health practice: investigation, monitoring, control, examples of occupational health hazards: nasal cancer, asbestosis, bronchitis, heart disease. Occupational health services.
Unit III:Methodologies and Management Techniques 10 lecture hours Risk assessment techniques for accidental release of toxic and inflammable materials, hazard analysis, potential risk, conceivable release mechanisms and release rates, fire and explosion hazards and simplified models for their assessment. Operations Management(OM),Risk Assessment and Disaster Response, Quantification Techniques, NGO Management, SWOT Analysis based on Design &Formulation Strategies, Insurance & Risk Management.
Unit IV: Disaster Management7 lecture hours Introduction & Dimensions of Natural & Anthropogenic Disasters, Principles/Components of Disaster Management, Organizational Structure for Disaster Management, Disaster Management Schemes/SOPs, Natural Disasters and Mitigation Efforts, Flood Control, Drought Management, Cyclones, Avalanches, Mangroves, Land Use Planning, Inter-Linking of Rivers, Role of Union/States, Role of Armed Forces/Other Agencies in Disasters, Role of Financial Institutions in Mitigation Effort, Group Dynamics, Concept of Team Building, Motivation Theories and Applications, School Awareness and Safety Programs, Psychological and Social Dimensions in Disasters, Trauma and Stress, Emotional Intelligence, Electronic Warning Systems.
Unit V: Use of Information systems, Experiences and case studies 9 lecture hours Recent Trends in Disaster Information Provider, GeoInformatics in Disaster Studies, Cyber Terrorism, Remote Sensing &GIS Technology, Laser Scanning Applications in Disaster Management, Statistical Seismology, Quick Reconstruction Technologies, Role of Media in Disasters, Management of Epidemics, Bio-Terrorism, Forecasting / Management of Casualties. Important Statutes/ Legal Provisions, IEDs/Bomb Threat Planning, NBC Threat and Safety Measures, Forest Fires.

Continuous Assessment Pattern

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

Name of The Course	Seminar			
Course Code	MENE6005			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	0	1

Course Objectives

To enable a comprehensive understanding of:

1. To prepare students to compete for a successful career in Energy & Environmental Engineering profession through global education standards.
2.To enable the students to aptly apply their acquired knowledge in basic sciences and mathematics in solving Energy & Environmental Engineering problems.
3.To produce skillful graduates to analyze, design and develop a system/component/ process for the required needs under the realistic constraints.
4.To train the students to approach ethically any multidisciplinary engineering challenges with economic, environmental and social contexts
5. To create an awareness among the students about the need for lifelong learning to succeed in their professional career

Course Outcomes

At the end of the course, students will be able to:

CO1	To demonstrate the ability to identify, formulate and solve engineering problems.
CO2	To demonstrate the ability to design and conduct experiments, analyze and interpret data.
CO3	The ability to visualize and work on laboratory and multi-disciplinary tasks.
CO4	To demonstrate the skills to use modern engineering tools, software's and equipment to analyze problems.
CO5	To demonstrate the knowledge of professional, ethical responsibilities and in both verbal and written form.

COURSE CONTENT

Unit I: Student presentations 9 lecture hours

- Each student will present one paper during the term

Unit II: Class evaluations 10 lecture hours

- Each week each student is asked to write a short evaluation of one of the papers being presented

Unit III: Class Discussion 10 lecture hours

- Discuss the papers – expose the flaws, analyse the writing, what was the impact?

Unit IV: Assessment 7 lecture hours

- Short review submitted each week (you may work in pairs)
- Longer review of the paper you presented

Unit V: Key skills 9 lecture hours

- Summarise
- Evaluate
- Identify the important questions
- Understand the context

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (IA)	Total Marks
50	50	100

Name of The Course	**Energy, Instrumentation, measurement & Control Lab**			
Course Code	**MENE6006**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives

This subject is taught

1. To impart knowledge in the area of numerical integration and Calculus
2. Working principle knowledge of energy meter
3. Brief knowledge about various flow parameters
4. Knowledge about handling the instruments and how to operate in filed

5. The role of instruments in different engineering applications.

Internal Assessment (IA)	External Assessment (IA)	Total Marks
50	50	100

Course Outcomes

At the end of the course, students will be able to:

CO1	Study the devices used to measure various forms of energy.
CO2	Understand the basic working principle of energy measuring devices
CO3	Knowledge of various flow parameters
CO4	Handling efficiency of instruments and problem solving
CO5	Technical approach of the instruments in field condition

Text Books

1. Fundamentals of Aerodynamics (McGraw-Hill International Editions: Mechanical Engineering Series) by John David Anderson, Tata Mcgraw-Hill Education.
2. Electrical Measurements and Measuring Instruments by A.K Sawhney**.**
3. Flow measurement: practical guides for measurement and control by David W. Spitzer, Instrument Society of America.

Reference Books

1. Energy Management Handbook by Steve Doty, Wayne C. Turne
2. Handbook of Energy Engineering by Albert Thumann, D. Paul Mehta.
3. Guide to Energy Management by B. L. Capehart, Wayne C. Turner, William J. Kennedy

COURSE CONTENT

1. Determination of electrical Energy in One – Phase & Three Phase energy meters,
2. Fuel efficiency by Flue gas analyzer,
3. Fuel efficiency Thermometers,
4. Determine the difference in potential by Potentiometric
5. Measurement of temperature and converts into current signals by Temperature Transmitters
6. Determination of intensity of light by Optical Pyrometer
7. Measurement of air flow in Air flow meters
8. Determination of speed of airflow in Anemometer
9. Measurement of volumetric flow rate of fluid by Rotameter
10. Determination fluid flow velocity by Pitot Tube
11. Measurement of mass flow rate by Mass Flowmeters
12. Determination of velocity of water by Open Channel Flowmeters

Continuous Assessment Pattern

Name of The Course	Project (Phase I)				
Course Code	MENE7002				
Prerequisite					
Corequisite					
Antirequisite					
	L	T	P	C	
	0	0	0	5	

Course Objectives

1. To provide a comprehensive understanding of the concepts and methodologies for project identification, project preparation, project evaluation and project financing
2. To make the students understand the project cycle and their wide socio-economic and environmental impacts
3. To make the students learn how to evaluate a project in view of global concern about sustainable development of energy and environment projects
4. To make students to develop lab scaled experimental setup to addressed environmental problems
5. To help students to carryout case studies on various environmental problems

Course Outcomes

At the end of the course, students will be able to:

CO1	Identify various energy and environmental features of a project
CO2	Small projects for environmental development and sustainability
CO3	Develop a project with suitable technology, and environmental impacts
CO4	Solve complex environmental problems by different tools and techniques
CO5	Carry out techno-economic evaluation of energy projects with environmental considerations

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (IA)	Total Marks
50	50	100

Name of The Course	Energy Efficient Buildings				
Course Code	MENE6029				
Prerequisite					
Corequisite					
Antirequisite					
	L	T	P	C	
	3	0	0	3	

Course Objectives

The student will be exposed

1. Importance of Energy- Efficient Buildings within the context of Energy issues in the 21st century.
2. The concept of Energy efficiency, Renewable sources of energy and their effective adaptation in green buildings
3. Understanding of Building Form and Fabric, Infiltration, ventilation, Lighting, cooling and water conservation.
4. The importance of Environmental Management as well as Environmental Impact Assessment methods in Energy efficient buildings.
5. To help students understanding energy flow and its conservation.

Course Outcomes

At the end of the course, students will be able to:

CO1	Understand why buildings should be made energy efficient.
CO2	Have a fuller grasp on Renewable Energy mechanisms such as Passive Solar heating and collection, photovoltaics.
CO3	Ground source heat pumps, and their adaption to green building concepts.
CO4	Understand the concepts of Site and Climate, Building Form, Building Fabric, Infiltration and ventilation, Lighting, Heating, Cooling, Energy Management and water conservation.
CO5	Environmental Impact Assessment study for Energy Efficient Buildings. They shall be equipped with the associated cutting-edge management strategies.

Text Books

1. William T. Meyer., Energy Economics and Building Design., New York: McGraw- Hill, Inc

Reference Books

1. Public Technology, Inc. (1996). Sustainable Building Technical Manual: Green Building Design, Construction, and Operations. Public Technology, Inc., Washington, DC.
2. Sim Van Der Ryn, Stuart Cowan, "Ecological Design", Island Press (1996).
3. Dianna Lopez Barnett, William D. Browning ,"A Primer on Sustainable Building", Rocky Mountain Green Development Services,.
4. The HOK Guidebook to Sustainable Design, Sara Mendler and William Odell, John Wiley.
5. David A. Gottfried, Sustainable Building Technical Manual., Public Technology Inc
6. Richard D. Rush, . Building System Integration Handbook., New York: John Wiley & Sons
7. Ben Farmer &HentieLouw., Companion to Contemporary Architectural Thought, London & New York: Routledge
8. PeterNoever (ed)., Architecture in Transition: Between Deconstruction and New Modernism., Munich: Prestel.

Course Content

Unit I: Green Buildings, Energy and Environment 9 hours Green Buildings within the Indian Context, Ty Buildings, Reducing energy consumption, Low
Unit II: Renewable Energy, Site and Climate 10 hours Renewable Energy sources that can be used in Green Buildings – Solar energy, Passive Solar Heating, Passive Solar collection, Wind and other renewables. A passive solar strategy, Photovoltaics, Climate and Energy, Macro and Microclimate. Indian Examples.
Unit III: Building Form and Fabric 10 hours Building Form – Surface area and Fabric Heat Loss, utilizing natural energy, Internal Planning, Grouping of buildings. Building Fabrics- Windows and doors, Floors, Walls, Masonry, Ecological walling systems, Thermal Properties of construction material.
Unit IV: Infiltration, Ventilation, Lighting, Cooling and Water Conservation 7 hours Infiltration and ventilation, Natural ventilation in commercial buildings, passive cooling, modeling air flow and ventilation, Concepts of daylight factors and day lighting, daylight assessment, artificial lighting, New light sources. Cooling buildings, passive cooling, and mechanical cooling. Water conservation- taps, toilets and urinals, novel systems, collection and utilization of rain water.
Unit V:Energy Awareness 9 hours Energy awareness, monitoring energy consumption, Building Environmental Assessment - environmental criteria - assessment methods - assessment tools (e.g. LEED). Ecohomes, Sustainable architecture and urban design – principles of environmental architecture. Benefits of green buildings – Energy Conservation Building code - NBC

Continuous Assessment Pattern

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

Name of The Course	Solid Waste Management			
Course Code	MENE6032			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

The student will be exposed

4. To gain insight into collection, transfer and transport of municipal solid waste

5. Understand the design and operation of municipal solid waste landfill
6. Understand the design and operation of resource recovery facility
7. Understand the design and operation of waste to energy facility
8. Understand the effect of waste management on environmental sustainability

Course Outcomes

At the end of the course, students will be able to:

CO1	Understand solid waste and its composition
CO2	Understand method solid waste collection and transportation
CO3	Understand various processes involved in solid waste collection, segregation and transportation.
CO4	Design solid waste disposal facility.
CO5	Understand the identification of hazardous wastes.

Text Books

1. GeorgeTechobanoglous et al," Integrated SolidWaste Management ", McGraw-HillPublication, 1993

Reference Books

1. HandbookofSolidWasteManagementbyFrankKreith,GeorgeTchobanoglous,McGrawHill Publication
2. Bagchi, A., Design,Construction, andMonitoringofLandfills,(2ndEd). WileyInterscience, 1994.ISBN: 0-471-30681-9.
3. Sharma,H.D.,andLewis,S.P.,WasteContainmentSystems,WasteStabilization,andLandfills: DesignandEvaluation.Wiley Interscience,1994.ISBN: 0471575364.
4. GeorgeTechobanoglous et al," IntegratedSolidWasteManagement ", McGraw HillPublication, 1993.
5. CharlesA.Wentz; "HazardousWaste Management ", McGraw-Hill Publication, 1995.

Course Content

Unit I:
9 hours

Legal and Organizational foundation: Definition of solid waste–waste generation–major legislation, monitoring responsibilities, sources and types of solid waste – sampling and characterization – Determination of composition of MSW–storage and handling of solid waste – Future changes in waste composition.

Unit II:
10 hours

Waste collection systems, analysis of collection system–alternative techniques for collection system. Need for transfer operation, transport means and methods, transfer station types and design requirements.

Unit III:Process of Solid Waste and Energy recovery 10 hours

Unit operations for separation and processing, Materials Recovery facilities, Waste transformation through combustion and aerobic composting, anaerobic methods for materials recovery and treatment – Energy recovery – Incinerators

Unit IV: Disposal of Solid Wastes
7 hours

Land farming, deep well injections. Landfills**:** Design and operation including: site selection, Geo-environmentalinvestigations,engineeredsites,liners andcovers,leachatecontrolandtreatment,gas recovery and control, including utilization of recovered gas (energy), and landfill monitoring and reclamation,,Requirementsandtechnicalsolution, designatedwastelandfillremediation–Integrated waste management facilities. TCLP tests and leachate studies. Economics of the on-site v/s offsite waste management options. Natural attenuation process and its mechanisms.

Unit V: Household Hazardous Waste Management 9 hours

Design practices of solid wastes. Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waste regulations – minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport. Regulatory

requirements for identification, characterization and disposal of hazardous, nonhazardous waste.

Continuous Assessment Pattern

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

Name of The Course	Remote Sensing & GIS Applications			
Course Code	MENE6037			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

This subject explains the basic concepts of

1. Basic concept of Remote Sensing
2. Knowledge of Geographic Information Systems with its applications.
3. History of development of GIS
4. Concepts of digital image processing
5. Applications of GIS and remote sensing

Course Outcomes

At the end of the course, students will be able to:

CO1	Basic remote sensing concepts and its characteristics
CO2	GIS and its requirements
CO3	Data management with GIS
CO4	Carry out analysis and interpretation of GIS results
CO5	Modelling through GIS

Text Books

1. A.N. Patel and Surendra Singh (1999), Remote Sensing Principles and Applications, Scientific Publisher, Jodpur.
2. A. Burrough(2000), Principle of Geographical Information Systems for Land Resources Assessment,ClarendonPress,Oxford.

Reference Books

1. T.M.Lilles and R.W.Kiefer (1999),Remote Sensing and Image Interpretation, JohnWiley& Sons, New York.
2. KeithC. Clarke,BradO.Parks, Michael P.Crane (2005),Geographic Information Systems and Environmental Modeling, Prentice-Hall of India.

Course Content

Unit I: Basic concepts of remote Sensing 9 hours Basic concepts of Remote Sensing - Introduction to remote sensing – Electromagnetic radiation - Characteristic of real remote sensing systems–Plat forms– Satellite-Indian remote sensing satellite-Sensors
Unit II: Image Processing 10 hours Image processing - Elements of image interpretation –Concepts of digital image processing
Unit III: Basic concepts of GIS 10 hours Basic concepts of GIS – Introduction to GIS- History of development of GIS- Elements of GIS-Computer hardware and software
Unit IV: Map Overlay 7 hours Map overlay-Vector and raster data model-Mapping concept-Data storage and data base management- Development of map overlay – Overlay operation
Unit V: Applications of GIS and Remote Sensing 9 hours Applications of GIS and remote sensing in resource management

Continuous Assessment Pattern

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

Name of The Course	Project (Phase II)			
Course Code	MENE8001			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	0	0	0	15

Course Objectives

1. To provide a comprehensive understanding of the concepts and methodologies for project identification, project preparation, project evaluation and project financing
2. To make the student understand the project cycle and their wide socio-economic and environmental impacts
3. To make the student learn how to evaluate a project in view of global concern about sustainable development of energy and environment projects

Course Outcomes

After taking this course the student will be able to

1. Identification various energy and environmental features of a project
2. Laboratory and field based study
3. Small projects for environmental development and sustainability
4. Develop a project with suitable technology, and environmental impacts
5. Solve complex environmental problems by different tools and techniques
6. Carryout techno-economic evaluation of energy projects with environmental considerations

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (IA)	Total Marks
50	50	100

PROGRAMME ELECTIVES

Name of The Course	Solar Energy technology			
Course Code	MENE6013			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

1. To impart the knowledge in the area of solar energy
2. Solar energy and the effective utilization to improve energy management
3. To understand the importance of economic dispatch and unit commitment problem
4. Solar energy using different technologies.
5. Design of liquid and air heaters

Course Outcomes

At the end of the course, students will be able to:

CO1	Atmospheric attenuation
CO2	Fixing of Solar energy
CO3	Application of energy into daily life activities
CO4	Find out heat removal rate
CO5	Design of active systems for liquid and air heaters

Text Books

1. DuffieJ.A and Beckman, W.A., “Solar Engineering of Thermal Processes”, 2nd Edition, John Wiley& Sons Inc., Newyork, -1991

2. G.N. Tiwari. "Solar Energy: Fundamentals, Design, Modelling and Applications", Third Reprint, Narosa Publishing House, New Delhi-2006

Reference Books

1. Edward Anderson, "Fundamentals for Solar Energy Conversion", Addison Wesley pubCO.,1983.
2. FankKreith,Jan F.Kreider,:Principles of solar Engg", 1978.
3. Koushika M.D," Solar Energy Principles and Applications", IBT publications and distributors, 1988.
4. Kaushik S.C, Tiwari G.N and Nayak J.K, "Thermal control in passive solar buildings" .IBT Publishers & Distributors, 1988.

Course Content

Unit I: Solar Radiation 9 hours Source of radiation – Sun earth relationship-extra-terrestrial radiation.– Atmospheric attenuation – Terrestrial radiation-radiation on a horizontal surfaces and inclined planes relations between horizontal radiation and inclined surfaces – relations between monthly, daily and hourly radiation and components of the radiations– solar charts – Critical radiation-Measurement of global, direct and diffuse solar radiation- pyrohelio meter, pyrano meter, pyro geo meter, net pyradiometer-sunshine recorder .
Unit II: Solar Collectors – Flat Plate Collectors 10 hours Design considerations – classification- Flat plate collectors- air heating collectors liquid heating –Temperature distributions- Heat removal rate- Useful energy gain – Losses in the collectors-for efficiency of flat plate collectors – selective surfaces – tubular solar energy collectors analysis of concentric tube collector – testing of flat plate collectors.
Unit III: Concentric Solar Collectors and Thermal Application 10 hours Concentric collectors-Limits to concentration – concentrator mounting – tracking mechanism - performance analysis focusing solar concentrators: Heliostats. Solar powered absorption A/C system (Ammonia/water) solar water pump, solar chimney, solar drier, solar dehumidifier, solar still, solar cooker.
Unit IV: Simulation and Energy Storage 7 hours Simulation in Solar Process Design-TRANSYS- Design of active systems- f chart methods for liquid and air heaters- phi bar, of chart method - sensible, latent heat and thermo-chemical storage-pebble bed etc. materials for phase change- Glauber'ssaltorganic compounds -solar ponds.
Unit V: Solar PV System 9 hours Photo- voltaic cell – characteristics-maximum power- tracking-cell arrays-power electric circuits for output of solar panels--inverters-batteries-charge regulators, Construction concepts.

Continuous Assessment Pattern

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

Name of The Course	Hydrogen Fuel Cells			
Course Code	MENE6015			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

The student will be exposed

1. Importance of hydrogen as a future energy carrier
2. How to storage compressed gas
3. Fuel cell classification
4. Different parameters of fuel cell
5. Design of fuel cell

Course Outcomes

Student will get the knowledge of:

CO1	Knowledge about hydrogen energy
CO2	Able to get techniques to store compressed gas
CO3	Knowledge about various types of fuel cell
CO4	Find out the energy transferred and effect of various parameters
CO5	Design of fuel cell

Text Books

1. Aldo V. da Rosa(2005),Fundamentals of Renewable Energy Processes, Elsevier Academic Press.

Reference Books

1. Wolf Vielstich, Arnold Lammand H.A. Gastieger(2003), Handbook of Fuel Cells Vol 1-4, John Wiley.
2. GregorHogenEd. (2003), Fuel Cell Technology Handbook, CRC Press.

COURSE CONTENT

Unit I:
9 hours
Importance of hydrogen as a future energy carrier –Thermodynamic and thermo physical properties-Chemical production of hydrogen– Steam reforming, thermal decomposition etc. - Purification - Desulfurization, removal of CO_2, CO, etc.- Electrolytic hydrogen production– Electrolyzer configurations -Thermolytic hydrogen production – Direct dissociation of water, chemical dissociation of water, photolytic hydrogen production, photobiological hydrogen production

Unit II:
10 hours
Compressed gas storage-Cryogenic liquid storage-Solid state storage–Adsorption and chemical compounds, Metal hydrides, hydride heat pumps and compressors

Unit III:
10 hours
Fuel cells classification – operating temperatures, state of electrolyte, type of fuel, chemical nature of electrolyte.
water pump, solar chimney, solar drier, solar dehumidifier, solar still, solar cooker.

Unit IV:
7 hours
Polymer Electrolyte Membrane Fuel Cells (PEMFC) – Alkaline Fuel Cells (AFC)- Phosphoric Acid Fuel Cells (PAFC)- Direct Methanol Fuel Cells (DMFC)-Molten Carbonate Fuel Cells (MCFC)-Solid Oxide Fuel Cells (SOFC)

Unit V:
9 hours
Stationary systems, automotive systems, portable fuel cells, small (less than 1 kW) fuel cells

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End T (ETE
20	30	

Name of The Course	**Energy Environment and Climate Change**			
Course Code	**MENE6019**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives
The student will be exposed

1. Various forms of energy

2. Global energy scenarios and its consumption pattern
3. Environmental problems due to energy consumption
4. CMD to address various environmental problems
5. Various national and international policies related to environmental and sustainably

Course Outcomes

Student will get the knowledge of:

CO1	Current emerging technologies
CO2	India's stand in terms of various technologies
CO3	Environmental impacts due to energy production
CO4	Measures taken to control the global environmental changes
CO5	Able to play role in policy making process

Text Books

1. Adrian Bejan, Peter Vadasz, Detlev G. Kroger (1999), Kluwer Academic Publishers.
2. A K De (2001), Environmental Concerns, New Age Publications Pvt Ltd.

Reference Books

1. Wolf Vielstich, Arnold Lammand H.A. Gastieger(2003), Handbook of Fuel Cells Vol 1-4, John Wiley.
2. GregorHogenEd. (2003), Fuel Cell Technology Handbook, CRC Press.

COURSE CONTENT

Unit I: **9 hours** Definition, Modules, Forms of Energy, Power, Origin of Fossil fuels, World and Indian Resources of Coal, Oil, Natural gas, Nuclear, Geothermal, Renewable Energy potential : Solar Energy, Wind Energy, Bio-Energy, Hydro, Tidal, Ocean , Nuclear Energy, Nuclear Fission and Fusion , Geothermal Energy
Unit II: **10 hours** Global Energy Scenario: Energy consumption pattern in various sectors, Impact on economy, India`s Energy Scenario, Urban and Rural energy consumption patterns, Impact of Energy on Development, Energy Infra structure in India
Unit III: **10 hours** Overview of global environmental problems, Environmental degradation due to Energy production and use, Pollution due to thermal power stations , Environmental aspects of Wind Energy Farms ,Environmental aspects of Nuclear power generation, Nuclear waste disposal, Impact of Hydro power generation on Ecology and Environment, Guidelines for Environmental impact assessment (EIA) of Energy Projects
Unit IV: **7 hours** Green House Gas Emissions, Depletion of Ozone layer, Global Warming, Climate Change Concerns, Climate Change in India, Kyoto protocol, Clean Development Mechanism [CDM], Carbon Fund Concept of Carbon credit
Unit V: **9 hours** Impact of Climate Change on Glaciers, Rivers and Water Resources, Climate Change Policy Issues in Himalayas, International Status of Climate Change Policies, Indian Action Plan on Climate Change

Continuous Assessment Pattern

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

Name of The Course	Bio-Energy Technologies			
Course Code	MENE6027			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

Student will learn about

1. Bio-energy and its mechanism
2. Different processes for production of bioenergy
3. To under different techniques and tools
4. Bioenergy production from different solid wastes
5. Energy Consumption and Cost - Environmental Aspects

Course Outcomes

Student will get the knowledge of:

CO1	Solid waste management by bioenergy
CO2	Different processes used for biodegradation of solid waste and production of bioenergy
CO3	The industrial applications of Bio-Energy.
CO4	Environmental aspect of Bio-Energy
CO5	Energy Consumption and Cost - Environmental Aspects

Text Books

1.R.C.Maheswari, Bio Energy for Rural Energisation , Concepts Publication, 1997

Reference Books

1.David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood, Chichester, 1984

2.Khandelwal KC, Mahdi SS, Biogas Technology - A Practical Handbook, Tata McGraw Hill, 1986

3. Anthony San Pietro, Biochemical and Photosynthetic aspects of Energy Production, Academic Press, New York, 1980

4.EL - Halwagi MM, Biogas Technology : Transfer &Diffusio, Elsevier Applied SC, London 1986

COURSE CONTENT

Unit I: **9 hours** Bio Energy - Bio Conversion Mechanism - Utilization of Photosynthate
Unit II: **10 hours** Combustion, Pyrolysis, Gasification and Liguefaction - Biological Conversion - Methanol, Ethanol Production - Fermentation - Anaerobic Digestion Biodegradation and Biodegradability of Substrate - Hydrogen Generation from Algae – Biological Pathways
Unit III: **10 hours** Through Fermentation and Gasification - Biomass Production from different Organic Wastes - Effect of Additives on Biogas Yield - Biogas production from Dry Dung Cakes
Unit IV: **7 hours** Viability of Energy Production - Wood Gasifier System, Operation of Spark Ignition and Compression Ignition with Wood Gas. Operation and Maintenance
Unit V: **9 hours** Energy Effectives and Cost Effectiveness - Aspects of Energy Consumption and Cost - Environmental Aspects of Bio-energy Conversion.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End T (ETE
20	30	

Name of The Course	Energy Efficient Buildings			
Course Code	MENE6029			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

The student will be exposed

1. Importance of Energy- Efficient Buildings within the context of Energy issues in the 21st century.
2. The concept of Energy efficiency, Renewable sources of energy and their effective adaptation in green buildings
3. Understanding of Building Form and Fabric, Infiltration, ventilation, Lighting, cooling and water conservation.
4. The importance of Environmental Management as well as Environmental Impact Assessment methods in Energy efficient buildings.
5. To help students understanding energy flow and its conservation.

Course Outcomes

At the end of the course, students will be able to:

CO1	Understand why buildings should be made energy efficient.
CO2	Have a fuller grasp on Renewable Energy mechanisms such as Passive Solar heating and collection, photovoltaics.
CO3	Ground source heat pumps, and their adaption to green building concepts.
CO4	Understand the concepts of Site and Climate, Building Form, Building Fabric, Infiltration and ventilation, Lighting, Heating, Cooling, Energy Management and water conservation.
CO5	Environmental Impact Assessment study for Energy Efficient Buildings. They shall be equipped with the associated cutting-edge management strategies.

Text Books

2. William T. Meyer., Energy Economics and Building Design., New York: McGraw- Hill, Inc

Reference Books

1. Public Technology, Inc. (1996). Sustainable Building Technical Manual: Green Building Design, Construction, and Operations. Public Technology, Inc., Washington, DC.
2. Sim Van Der Ryn, Stuart Cowan, “Ecological Design”, Island Press (1996).
3. Dianna Lopez Barnett, William D. Browning ,”A Primer on Sustainable Building”, Rocky Mountain Green Development Services,.
4. The HOK Guidebook to Sustainable Design, Sara Mendler and William Odell, John Wiley.
5. David A. Gottfried, Sustainable Building Technical Manual., Public Technology Inc
6. Richard D. Rush, . Building System Integration Handbook., New York: John Wiley & Sons
7. Ben Farmer &HentieLouw., Companion to Contemporary Architectural Thought, London & New York: Routledge
8. PeterNoever (ed)., Architecture in Transition: Between Deconstruction and New Modernism., Munich: Prestel.

Course Content

Unit I: Green Buildings, Energy and Environment 9 hours

Green Buildings within the Indian Context, Typ
Buildings, Reducing energy consumption, Low

Unit II: Renewable Energy, Site and Climate 10 hours

Renewable Energy sources that can be used in Green Buildings – Solar energy, Passive Solar Heating, Passive Solar collection, Wind and other renewables. A passive solar strategy, Photovoltaics, Climate and Energy, Macro and Microclimate. Indian Examples.

Unit III: Building Form and Fabric 10 hours

Building Form – Surface area and Fabric Heat Loss, utilizing natural energy, Internal Planning, Grouping of buildings. Building Fabrics- Windows and doors, Floors, Walls, Masonry, Ecological walling systems, Thermal Properties of construction materials.

Unit IV: Infiltration, Ventilation, Lighting, Cooling and Water Conservation 7 hours

Infiltration and ventilation, Natural ventilation in commercial buildings, passive cooling, modeling air flow and ventilation, Concepts of daylight

factors and day lighting, daylight assessment, artificial lighting, New light sources. Cooling buildings, passive cooling, and mechanical cooling. Water conservation- taps, toilets and urinals, novel systems, collection and utilization of rain water.
Unit V:Energy Awareness **9 hours** Energy awareness, monitoring energy consumption, Building Environmental Assessment - environmental criteria - assessment methods - assessment tools (e.g. LEED). Ecohomes, Sustainable architecture and urban design – principles of environmental architecture. Benefits of green buildings – Energy Conservation Building code - NBC

Continuous Assessment Pattern

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

Name of The Course	Solid Waste Management			
Course Code	MENE6032			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

The student will be exposed

9. To gain insight into collection, transfer and transport of municipal solid waste
10. Understand the design and operation of municipal solid waste landfill
11. Understand the design and operation of resource recovery facility
12. Understand the design and operation of waste to energy facility
13. Understand the effect of waste management on environmental sustainability

Course Outcomes

At the end of the course, students will be able to:

CO1	Understand solid waste and its composition
CO2	Understand method solid waste collection and tran
CO3	Understand various processes involved in solid wa
CO4	Design solid waste disposal facility.
CO5	Understand the identification of hazardous waste

Text Books

1. GeorgeTechobanoglous et al," Integrated SolidWaste Management ", McGraw-HillPublication, 1993

Reference Books

1 HandbookofSolidWasteManagementbyFrankKreith,GeorgeTchobanoglous,McGrawHill Publication
2 Bagchi, A., Design,Construction, andMonitoringofLandfills,(2ndEd). WileyInterscience, 1994.ISBN: 0-471-30681-9.
3 Sharma,H.D.,andLewis,S.P.,WasteContainmentSystems,WasteStabilization,andLandfills: DesignandEvaluation.Wiley Interscience,1994.ISBN: 0471575364.
4 GeorgeTechobanoglous et al," IntegratedSolidWasteManagement ", McGraw HillPublication, 1993.
5 CharlesA.Wentz; "HazardousWaste Management ", McGraw-Hill Publication, 1995.

Course Content

Unit I: **9 hours** Legal and Organizational foundation: Definition of solid waste–waste generation– major legislation, monitoring responsibilities, sources and types of solid waste – sampling and characterization – Determination of composition of MSW–storage and handling of solid waste – Future changes in waste composition.

Unit II:
10 hours
Waste collection systems, analysis of collection system–alternative techniques for collection system. Need for transfer operation, transport means and methods, transfer station types and design requirements.

Unit III:Process of Solid Waste and Energy recovery 10 hours
Unit operations for separation and processing, Materials Recovery facilities, Waste transformation through combustion and aerobic composting, anaerobic methods for materials recovery and treatment – Energy recovery – Incinerators

Unit IV: Disposal of Solid Wastes
7 hours
Land farming, deep well injections. Landfills**:** Design and operation including: site selection, Geo-environmentalinvestigations,engineeredsites,liners andcovers,leachatecontrolandtreatment,gas recovery and control, including utilization of recovered gas (energy), and landfill monitoring and reclamation,,Requirementsandtechnicalsolution, designatedwastelandfillremediation–Integrated waste management facilities. TCLP tests and leachate studies. Economics of the on-site v/s offsite waste management options. Natural attenuation process and its mechanisms.

nit V: Household Hazardous Waste Management 9 hours
Design practices of solid wastes. Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waste regulations – minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport. Regulatory requirements for identification, characterization and disposal of hazardous, nonhazardous waste.

Continuous Assessment Pattern

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

Name of The Course	**Design of Wastewater Treatment & Disposal System**			
Course Code	**MENE6034**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives
The student will be exposed
1. Need of advanced wastewater treatment
2. Process for removal nutrients
3. Physical and chemical methods
4. Economic value of environmental resources
5. Economics of biodiversity conservation

Course Outcomes
At the end of the course, students will be able to:

CO1	Know about the conventional treatment units and processes.
CO2	Role of microorganisms in wastewater treatment.
CO3	Nutrients removal by chemical and biological process
CO4	Sludge treatment, handling and disposal.
CO5	Wastewater reuse, recycling and disposal of treated effluents

Text Books
1. R.K.Turner,D.W.PearceandI.Bateman(1994),EnvironmentalEconomics:AnElementary Introduction,HarvesterWheatsheaft,London.
2. D.W.PearceandR.K.Turner(1990),EconomicsofNaturalResourcesandtheEnvironment, HarvesterWheatsheaf, London.

Reference Books

1.D.W.Pearce,A.MarkandyaandE.B.Barbier(1989), BlueprintforaGreenEconomy,Earthscan, London.
2.MichaelS.CommonandMichaelStuart(1996),EnvironmentalandResourceEconomics:An Introduction, 2nd Edition,Harlow:Longman.
3.RogerPerman,MichaelCommon,YueMaandJames McGilvray(2003),NaturalResourceand Environmental Economics,3rd Edition, Pearson Education.
4.N.Hanley,J.ShogrenandB.White (2001),AnIntroductiontoEnvironmentalEconomics, Oxford University Press.

COURSE CONTENT

Unit I: Chemical Nutrient Removal **9 hours** Effects of chemical constituents in wastewater / process selection and development of treatm applications / Removal of residual suspended s
Unit II: Chemical Nutrient Removal **10 hours** Sources and forms of Nitrogen (N) and Phosphorus (P) / Processes for N and P removals. Conventional biological nitrification/ denitrification processes and its process fundamentals. Sequencing Batch Reactor (SBR) and Simultaneous Nitrification – Denitrification (SND) processes for nitrogen removal. New processes for nitrogen removal: ANAMMOX, SHARON, CANON etc. Biological removal of Phosphorus- Process fundamentals and types of processes. Combined removal of N and P by biological methods.
Unit III: Economic Value of Environmental Resources 10 hours Nitrogen removal by physical and chemical methods-Air stripping of ammonia/Break point Chlorination/Ion –exchange. Removal of phosphorus by chemical addition
Unit IV: Concept of Total Economic Value **7 hours** Economic value of environmental resources and environmental damage-Concept of Total Economic Value-Alternative approaches to valuation-Cost benefit analysis and discounting
Unit V: Economics of bio-diversity Conservation **9 hours** Economics of biodiversity conservation - Valuing individual environmental damage- Concept of Total Economic Value - Policy responses at national and international levels

Continuous Assessment Pattern

Internal Assessment (IA)	External Assessment (EA)	Total Marks
50	50	100

Name of The Course	**Urban Environmental Quality Management**				
Course Code	**MENE6035**				
Prerequisite					
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives

The student will be exposed
1. Investigating the causes, consequences and degradation of environmental resources
2. Possible solutions to problems associated with degradation of environmental resources
3. Analyse the potential non-sustainability of certain types
4. Economic activities using economic analysis as a tool
5. To plan and to execute monitoring programmes

Course Outcomes

Student will get the knowledge of:

CO1	Have knowledge of the nature and effects of enviro
CO2	Have a detailed knowledge of the techniques involv
CO3	Be able to measure and assess the effects of noise, on human activity and health

CO4	Have an awareness of the need for integrated pollution control	
CO5	Have the skills to plan and to execute monitoring programmes for the detection and control of environmental pollutants, including water, air and noise terrestrial pollution	

Text Books

1. Varshney, C.K. "Water Pollution andManagement",Wiley Eastern Ltd., New Delhi, 1998

Reference Books

1. Plowden,S., "TheCostofNoise",London, Metra, 1996.
2. Fallion, A.B. &E. Simon,"TheUrbanPattern", Van Nistrand, New York.
3. M.J. Suess&S.R. Craxford, "Manualon Urban AirQuality",WHO, Copenhagen.

COURSE CONTENT

Unit I: Urbanization & Pollution
9 hours
Consequences of urbanization, demand of resources by the public - Sources of Pollution to the urban environment: Status of pollution levels in major cities- Slum formation: Impact of slum on general quality of life on Urban elite – status of slum settlements in major cities

Unit II: Air & Noise Pollution in Urban Environment 10 hours
Air Pollution Sources: Nature of air pollution in theUrban environment due to human activities ofindustrialization,effectofairpollutiononUrbanEnvironment.
AirpollutionIndicesforAssessment of status of Urbanairquality.- SourcesofnoisepollutioninUrbanareas, effectofnoisepollutiononUrban environment, status ofnoise pollution in major cities.

Unit III:Water and Land pollution in Urban Environment 10 hours
Water Demands and Pollution in Urban areas: Nature of water pollutants and as similative capacity of natural Urban aquatic systems Urban water quality indices-Sources of land pollution in urban areas: Impact of urban soil pollution on quality of living system– prediction of soil pollution indices.

Unit IV: Management of Urban Environment Quality
7 hours
Land use planning–traffic management. Safe municipal water supply and planning of safe municipal water supply and drainage system– solid waste management including disposal– abatement of noise pollution – Provision of zones – regulation

Unit V: Conservation and Disaster Management
9 hours
Natural Conservation: Planning of urbanization on ecological basis, preservation and development of green recovery areas.- Urban Disaster Management: Management of Industrial explosions, landslides, earthquakes, Floods and Management of epidemics.

Continuous Assessment Pattern

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

Name of The Course	**Remote Sensing & GIS Applications**			
Course Code	**MENE6037**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives
This subject explains the basic concepts of

1. Basic concept of Remote Sensing
2. Knowledge of Geographic Information Systems with its applications.
3. History of development of GIS
4. Concepts of digital image processing
5. Applications of GIS and remote sensing

Course Outcomes

At the end of the course, students will be able to:

CO1	Basic remote sensing concepts and its characteristics
CO2	GIS and its requirements
CO3	Data management with GIS
CO4	Carry out analysis and interpretation of GIS results
CO5	Modelling through GIS

Text Books

1. A.N. Patel and Surendra Singh (1999), Remote Sensing Principles and Applications, Scientific Publisher, Jodpur.
2. A. Burrough(2000), Principle of Geographical Information Systems for Land Resources Assessment,ClarendonPress,Oxford.

Reference Books

1. T.M.Lilles and R.W.Kiefer (1999),Remote Sensing and Image Interpretation, JohnWiley& Sons, New York.
2. KeithC. Clarke,BradO.Parks, Michael P.Crane (2005),Geographic Information Systems and Environmental Modeling, Prentice-Hall of India.

Course Content

Unit I: Basic concepts of remote Sensing 9 hours Basic concepts of Remote Sensing - Introduction to remote sensing – Electromagnetic radiation - Characteristic of real remote sensing systems–Plat forms– Satellite-Indian remote sensing satellite-Sensors
Unit II: Image Processing 10 hours Image processing - Elements of image interpretation –Concepts of digital image processing
Unit III: Basic concepts of GIS 10 hours Basic concepts of GIS – Introduction to GIS- History of development of GIS- Elements of GIS-Computer hardware and software
Unit IV: Map Overlay 7 hours Map overlay-Vector and raster data model-Mapping concept-Data storage and data base management- Development of map overlay – Overlay operation
Unit V: Applications of GIS and Remote Sensing 9 hours Applications of GIS and remote sensing in resource management

Continuous Assessment Pattern

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

Name of The Course	**Application of Bio-Technology in Environmental Engineering**			
Course Code	**MENE6038**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

This subject explains the basic concepts of

7. 1. To introduce microbial and biotechnological concepts and theories.
8. 2. To understand the

biotechnological tools and their applications for environmental management.

3. To become familiar with the effective use of biotechnology in eco-sustainable waste management.

4. To understand various toxic chemicals

5. To understand various biotechnological technologies for environmental damages

Course Outcomes

At the end of the course, students will be able to:

CO1	To gain knowledge related to biology of microorganism
CO2	Environmental Management Strategies for Sustainable Development
CO3	Application of Microorganism in green technology
CO4	To address problems of toxic chemicals in environment
CO5	Gain knowledge on Biotechnological remedies for environmental damages

Text Books

1. Pelczar, M. Microbiology, 5th Edn,Tata McGraw Hill, ISBN 0074623206
2. Wainwright,M. An Introductionto Environmental Biotechnology,Kluwer AcademicPublisher,ISBN 0792385691

Reference Books

1. Alexander, M.Biodegradationand Bioremediation.2nd Ed.,AcademicPress, California,USA.ISBN 012049860X
2. Sayler, Gray S.,RobertFox, JamesW.Blackburn,Environmental Biotechnology forWasteTreatment, PlenumPress, New York. ISBN 0306439433
3. BruceE. Rittmann, Eric Seagren,Brian A.Wrenn,Albert J.Valocchi, ChittaranjanRay, LutgardeRaskin, In-SituBioremediation, 2ndEd., Noyes Publications,U.S.A. ISBN0815513488.

Course Content

Unit I:
9 hours

Principlesof biology-Cell,structure,types, functionsandcommunicationduringdevelopment s; Genes and development-geneexpressionandtheir regulation,regulation ofcellandanimalbodydevelopment; EnvironmentandEcosystemanditscomponents;Energy andbiogeochemicalcycles;Microorganismsand Environment- microbes as functionary part of ecosystem, terrestrial and non-terrestrial environments, marineandfreshwaterenvironments; Ecological Niche;

Unit II:
10 hours

Historical Overview of Development and Pollution, Environmental Sustainability and Biodiversity; Biotechnology,Humanandenvironment-conceptsofbiotechnology,itsusefulnesstohumankind and global environment theories and philosophy; Contradiction between economic and environment; Environmental Management Strategies for Sustainable Development;

Unit III:
10 hours

Microbial cell and enzyme technology-adaptedmicroorganisms,bioremovalofnutrients, micro-algal biotechnology; Interactionofmixedmicrobial population andits applications in bioprocessing of wastes, role of extracellular polymers, bioremediation of environmental problems; Concept of DNA technology, plasmid,mutation,geneticallyengineeredmicrobial strainsandapplicationsofgeneticengineeringin environmental management;

Unit IV:
8 hours

Problems of toxic chemicals-sources and categories, halogenated and non-halogenated, petroleum hydrocarbons, metals,humanhealtheffectscausedbytoxicchemicalpollutions; Biodegradationoftoxic pollutants, mechanisms of detoxification- oxidation reactions, dehalogenation, biotransformation of metals; XenobioticCompounds- types, sources and its hazards;Recalcitranceof xenobioticcompoundsand leading factors; Biodegradation of xenobiotic compounds

Unit V:
9 hours

Biotechnological remedies for environmental damages- decontamination of ground water

systems, subsurfaceenvironment,reclamationconcepts-bioremediation;Productionofproteins,Biotransformation of waste into biofertilizers, biogasandelectricalenergy, affectingphysical,chemicalandmicrobiological factors, health risk, odor management, technological advances; Environmental effects and ethics of microbial technology; Biosafety; Clean Technology- concepts and applications inindustrial process,clean synthesis; Farmingasanengineeringprocess.

Continuous Assessment Pattern

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

Name of The Course	Risk Assessment and Disaster Management			
Course Code	**MENE6039**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1) To enable a comprehensive understanding of:
2) To provide knowledge related to the broad field of environmental risk assessment
3) Steps involved in the risk assessment process, including statistical characterization of observed data
4) Knowledge about tools that can be used in defining environmental risks, particularly as related to human health.
5) To develop practical skills in disaster mitigation, planning, response and post disaster rehabilitation, particularly related to health and public health.

Course Outcomes

At the end of the course, students will be able to:

CO1	To gain knowledge related to the broad field of environmental risk assessment
CO2	Statistical characterization of field data
CO3	Use of tools for environmental risks, particularly as related to human health
CO4	To apply biotechnological concept and tools for green production technologies
CO5	Gain knowledge on eco-sustainable waste management ensuring sustainable development

Text Books

1 Rao V. Kolluru,"Environmental Strategicshand book", Mc-graw Hill Inc., New York, 1994.

Reference Books

1 BrockNeely.W&BlanG.E,"EnvironmentalExposurefromchemicals,VolumeII,ChcPressIunc., Florida,1989.
2 WoodsenW.E.,"Humanfactorsdesignhandbook–informationandguidelinesfordesigntosystems, facilities, equipment and product for human use", McGraw Hill, New York, 1981.

Course Content

Unit I: Risk Assessment 9 lecture hours Introduction- Methodologies and Guidelines: Principles, Code of practice – Appointment of personnel and their responsibilities–Emergency plans: onsite and offsite. Steps in risk assessment: Identification of risk, Extent of risk and disaster, Risk-Based Decisions for Corrective Action –Timely updation. Developing a Site Conceptual Model -Focusing on Risk-Based Decisions in Corrective Action – Risk Assessment: Dose Response and Target Level Calculations-Experiences in Environmental Risk Assessment.
Unit II: Occupational Health and Safety 10 lecture hours Occupational risk analysis survey and health evaluation, behavioral studies, occupational

injury, disease reporting, investigation: monitoring and control of environmental hazards. Occupationally induced illness, non-occupational illness, and discomfort at work, the epidemiological approach, occupational health practice: investigation, monitoring, control, examples of occupational health hazards: nasal cancer, asbestosis, bronchitis, heart disease. Occupational health services.

Unit III:Methodologies and Management Techniques 10 lecture hours

Risk assessment techniques for accidental release of toxic and inflammable materials, hazard analysis, potential risk, conceivable release mechanisms and release rates, fire and explosion hazards and simplified models for their assessment. Operations Management(OM),Risk Assessment and Disaster Response, Quantification Techniques, NGO Management, SWOT Analysis based on Design &Formulation Strategies, Insurance & Risk Management.

Unit IV: Disaster Management7 lecture hours

Introduction & Dimensions of Natural & Anthropogenic Disasters, Principles/Components of Disaster Management, Organizational Structure for Disaster Management, Disaster Management Schemes/SOPs, Natural Disasters and Mitigation Efforts, Flood Control, Drought Management, Cyclones, Avalanches, Mangroves, Land Use Planning, Inter-Linking of Rivers, Role of Union/States, Role of Armed Forces/Other Agencies in Disasters, Role of Financial Institutions in Mitigation Effort, Group Dynamics, Concept of Team Building, Motivation Theories and Applications, School Awareness and Safety Programs, Psychological and Social Dimensions in Disasters, Trauma and Stress, Emotional Intelligence, Electronic Warning Systems.

Unit V: Use of Information systems, Experiences and case studies 9 lecture hours

Recent Trends in Disaster Information Provider, GeoInformatics in Disaster Studies, Cyber Terrorism, Remote Sensing &GIS Technology, Laser Scanning Applications in Disaster Management, Statistical Seismology, Quick Reconstruction Technologies, Role of Media in Disasters, Management of Epidemics, Bio-Terrorism, Forecasting / Management of Casualties. Important Statutes/ Legal Provisions, IEDs/Bomb Threat Planning, NBC Threat and Safety Measures, Forest Fires.

Continuous Assessment Pattern

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

Name of The Course	Mathematical Modelling in Environmental Engineering			
Course Code	MENE6040			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives

To enable a comprehensive understanding of:

1. The scope and extent of mathematical modelling
2. The basic tenets of mathematical modelling and its application to environmental Processes
3. Mathematical modelling techniques
4. Plume Rise estimation Emissions inventories
5. Mathematical modelling methods applied to Global Environmental Problems

Course Outcomes

At the end of the course, students will be able to:

CO1	Basic understanding of how mathematical models can be used to solve environmental problems
CO2	Set up material balance models for conservative and non-conservative systems
CO3	Formulate and solve Boundary value problems.
CO4	Plume Rise estimation Emissions inventories
CO5	Formulate, Set-up, and solve complex environmental Problems.

9.

Text Books

1.Gilbert M., Master,'Introductionto Environmental Engineering and Science' Prentice-Hall ofIndia,NewDelhi,1998

Reference Books

1. Howard S.Peavy, Donald R. Rowe, and George Tchobanoglous.'Environmental Engineering'. McGraw-Hill BookCompany, New York.1985
2. Roland b. Stull : Introduction to Boundary Layer Meteorology. John Wiley 1988.
3. Plus, Journal Articles from J.Geophys. Res.,Geophysical Research Letters, Quarterly Journal of the Royal Meteorological Society.
10.

Course Content

Unit I:
9 lecture hours

The origins: Formation of the Physical Environment. The evolution of the Earth's atmosphere. Quantification of the Lapse Rate. The states of stability of the atmosphere Quantification of Wind circulation : Geo-strophic winds. Necessity of mathematical models. Concentration calculationsand conversions in liquids and gases. Converting ppm into micro grammes/m3 and vice-versa. Material Balance–Steady-stateconservativesystems-non-conservativepollutants.Mass-nergyflowsandbalances–specific examples in real-life environmental problems: Thermal pollution of a River

Unit II:
10 lecture hours

The importance of Air Pollution modelling. Modelling the Atmospheric Boundary Layer–mixing length, and eddy diffusion. The formulation and solution of the Gaussian Plume Model. Gaussian Dispersion Coefficients. Plume Rise estimation Emissions inventories. Point, Line and Area Sources. Simple noise quality models : Models for Road way Noise

Unit III:
10 lecture hours

Modelling the mass transport of Sulphur Dioxide into falling raindrops. Reaction Pathways. Mass and Charge Balance.Theconvective diffusion equation. Normalisation of the CDE with reaction kinetics. Modelling the Homogeneous and Heterogeneous Pathways for Ozone depletion.

Unit IV:
7 lecture hours

Solar and Terrestrial Radiation. Quantifying the Green House Effect. A model for estimating the

Equilibrium temperature of the Earth. Aerosol and cloud processes. The Basic tenets of Global Circulation Models for Weather Forecasting
Unit V: **9 lecture hours** The unusual qualities of water. Modelling Biochemical Oxygen demand (BOD). Estimating the BOD Reaction Rate Constant. The effect of Oxygen-demanding wastes on rivers. A model for De-oxygenation. The Oxygen- sag curve. Solid waste modelling: Waste to Energy. Modelling the methane potential of discards.

11.

12.

13. **Continuous Assessment Pattern**

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

Name of The Course	**Clean Development Mechanism & Green Technologies**			
Course Code	**MENE6041**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

To enable a comprehensive understanding of:

1. The course is intended to teach the basics of CDM.
2. To become familiar with CDM processes.
3. To study CDM to address environmental problems
4. To study use of CDM in sustainable development
5. Case studies of various CDM of major projects

Course Outcomes

At the end of the course, students will be able to:

CO1	Well aware of developments in Clean Development Mechanism.
CO2	14. Understanding of Global Warming and Climatic changes.
CO3	Develop ecologically sustainable production and industry through developing the potential of all fibres.
CO4	Develop environmentally and socially friendly alternatives
CO5	Many of the deleterious practices, processes and products currently in use

15.

Text Books

1. Introductionto Environmental Engineeringand Science. Gilbert M.Masters.Prentice-Hall of India. 2005.

Reference Books

1.White. I.D., Mottershead. D.N., Harrison .S.J, "Environmental Systems – an introductory text", Chapmanandahll ,London,1998.
2.Colinvaux.P.,"Introduction toEcology", JohnWiley& sons,Newyork,1973.

16.

Course Content

Unit I: Principle of Clean Development Mechanism 9 lecture hours Introduction to Climate Change and Global Warming, International Response to Climate Change & Global Warming
Unit II: Kyoto Protocol 10 lecture hours Kyoto Protocol and its mechanism, objectives of Kyoto protocol and details of the agreement, Amendments of Kyoto Protocol.
Unit III: Clean Development Mechanism Process 10 lecture hours Overview of Clean Development Mechanism, Administration and Participation, CDM, Project Cycle and Financing, Post Kyoto Negotiations and India.
Unit IV: Sustainable Development in CDM 7 lecture hours CDM, Sustainable Development and its Assessment, The CDM Market, Types of Major

CDM Projects, Small Sectors and CDM, preparing CDM project design document (PDD) Course Project
Unit V: Case Studies of CDM Projects 9 lecture hours Types of Major CDM Projects, Small Sectors and CDM, Detailed studies of CDM approved projects.

17.

18.

19. **Continuous Assessment Pattern**

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

Name of The Course	**Environmental Ecology**			
Course Code	**MENE6042**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

To enable a comprehensive understanding of:

1. To establish Ecology's credibility in high environmental, ethical and quality standards of goods and services.
2. Access the market opportunity presented by the 'greenmarket'.
3. Raise consumer awareness and concern for environmental issues, and encourage their support for ecological values in consumer practices.
4. To develop affair and equitable means to link economic and environmental values
5. The development of mutually beneficial relationships with all segments of the community.

Course Outcomes

At the end of the course, students will be able to:

CO1	Develop legal and economic structures
CO2	Able to provide reasonable return on investment, financial or personal effort, dividends, wages and so forth.
CO3	Develop ecologically sustainable production and industry through developing the potential of all fibres.
CO4	Develop environmentally and socially friendly alternatives
CO5	Many of the deleterious practices, processes and products currently in use

20.

Text Books

Odum. E. P, "Fundamentals of ecology",W.B. Sanders, Philadelphia, 2002

Reference Books

1.White. I.D., Mottershead. D.N., Harrison .S.J, "Environmental Systems – an introductory text", Chapmanandahll ,London,1998.
2.Colinvaux.P.,"Introduction toEcology", JohnWiley& sons,Newyork,1973.

21.

Course Content

Unit I: Concepts of Ecology **9 lecture hours** Fundamentals of ecology, Natural ecosystems and their food chains, food webs, bioenergetics, biochemical cycles and ecological succession**,** deoxygeneation nutrient enrichment
Unit II: Bio Diversity **10 lecture hours** Biological diversity and its importance, reduction in biological diversity by human activities, classes and general effects of physical and Biological interaction with pollutants, lethal and sub-lethal effects.
Unit III: Ecosystem Ecology **10 lecture hours** Ecosystems responses to deoxygeneation nutrient enrichment, pesticides, hydrocarbons, metal and salts, thermal pollution, suspended solids and silt.
Unit IV: CommunityEcology **7 lecture hours** Principles of population and community ecology– concepts of systems and models–building and

analysis Of models–environmental systems, structures and interaction between coastalaeolian, glacial, fluvial, weathering, soil and detrital systems.
Unit V:Integration Ecological Principles 9 lecture hours Integration of classical, agro and restoration ecological principle sand methods, Biomonitoring and its role in the evaluation of aquatic ecosystem, rehabilitation of ecosystem through ecological engineering principles.

22.

23.

24. **Continuous Assessment Pattern**

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

Name of The Course	**Environmental Economics, Legislation and Management**			
Course Code	**MENE6046**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

The student will be exposed

1. To make the student investigating the causes, consequences
2. possible solutions to problems associated with degradation of environmental resources
3. Analyse the potential non-sustainability of certain types of economic activities using economic analysis as a tool.
4. The economic implications of alternative to pollution
5. Alternative methods for valuing environmental resources and environmental damage

Course Outcomes

At the end of the course, students will be able to:

CO1	The economic significance and the economic cause diversity
CO2	The extent to which market based mechanisms mig degradation problem in the absence of overt interv
CO3	The economic implications of alternative 'interven including the use of charges, subsidies and market
CO4	Alternative methods for valuing environmental res
CO5	The economic consequences of policy instrument f

Text Books

1. R.K.Turner, D.W.Pearce and I.Bateman (1994), Environmental Economics:AnElementaryIntroduction, Harvester Wheatsheaft, London.
2. D.W. Pearce and R.K. Turner (1990), Economics of Natural Resources and the Environment, Harvester Wheatsheaf, London.

Reference Books

1. D.W.Pearce, A.Markand ya and E.B.Barbier(1989),Blue print for a Green Economy, Earthscan, London.
2. Michael S.Common and Michael Stuart(1996),Environmental and Resource Economics: An Introduction, 2nd Edition, Harlow: Longman.
3. RogerPerman, Michael Common,YueMaand James Mc Gilvray(2003),Natural Resource and Environmental Economics,3rd Edition, Pearson Education.
4. N.Hanley,J. Shogren and B.White (2001), An Introduction to Environmental Economics, Oxford University Press..

Course Content

Unit I: Introduction to Sustainable Development

9 lecture hours

Introduction to sustainable development - Economy-Environment inter-linkages - Meaning of sustainable development- Limits to growth and the environmental Kuznets curve –The sustainability debate- Issues of energy and the economics of energy – Non-renewable energy, scarcity, optimal resources, back stop technology, property research, externalities, and the conversion of uncertainty

Unit II: Economic Significance
10 lecture hours

Economic significance and causes of environmental degradation - The concepts of policy failure, externality and market failure - Economic analysis of environmental degradation - Equi-marginal principle.

Unit III: Economics of Pollution
10 lecture hours

Economics of Pollution - Economics of optimal pollution, regulation, monitoring and enforcement - Managing pollution using existing markets: Bargaining solutions - Managing pollution through market intervention: Taxes, subsidies and permits.

Unit IV: Economic Value of Environmental Resources 7 lecture hours

Economic value of environmental resources and environmental damage-Concept of Total Economic Value-Alternative approaches to valuation-Cost benefit analysis and discounting

Unit V: Economics of bio-diversity Conservation
9 lecture hours

Economics of biodiversity conservation - Valuing individual species and diversity of species - Policy responses at national and international levels

Continuous Assessment Pattern

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

GALGOTIAS UNIVERSITY

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

School of Civil Engineering

Program: BTech in Construction Technology

Scheme: 2020-2021

Vision

To be a Centre of Excellence for imparting high end research and technical education in Civil Engineering with specialization in Construction Technology producing socially aware professionals to provide sustainable solutions to global community.

Mission

M1: To impart quality education and mould technically sound, ethically responsible professionals in the field of Civil Engineering with specialization in Construction Technology.

M2: Collaborate with industry and society to design a curriculum based on the changing needs of stakeholders and provide excellence in delivery and assessment.

M3: Establish state-of-the-art facilities for world class education and research.

M4: To mentor students in pursuit of higher education, entrepreneurship and global professionalism.

PEOs

PEO1: Graduates shall attain state of the art knowledge in the different streams of Civil Engineering with specialization in Construction Technology and be trained for playing the role of competent Civil Engineer in multidisciplinary projects.

PEO2: Graduates shall be capable of pursuing productive careers in private and government organizations at the national and international level and to become successful entrepreneurs.

PEO3: Graduates shall display a high sense of social responsibility and ethical thinking and develop sustainable engineering solutions.

PSOs

PSO1: Develop the ability to implement emerging techniques to plan, analyze, design, execute, manage, maintain and rehabilitate systems and processes in construction technology and other diverse areas like structural, environmental, geotechnical, transportation and water resources engineering.

PSO2: Excel in research, innovation, design, problem solving using different softwares and artificial intelligence and develop an ability to interact and work seamlessly in multidisciplinary environment.

POs

PO1: Apply the knowledge of Mathematics, Science, and Engineering fundamentals, and an engineering specialization to solution of complex engineering problems (Engineering Knowledge)

PO2: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (Problem analysis)

PO3: Design of solutions for complex engineering problems and design of system components or processes that meet the specified needs with appropriate considerations of public health and safety, and cultural, societal, and environmental considerations (Design/development of solutions)

PO4: Use research based methods including design of experiments, analysis and interpretation of data and synthesis of information leading to logical conclusions (Conduct investigations of complex problems)

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling complex engineering activities with an understanding of limitations (Modern tool usage)

PO6: Apply reasoning within the contextual knowledge to access societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice (The engineer and society)

PO7: Understand the impact of the professional engineering solutions in the societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments (Environment and sustainability)

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice (Ethics)

PO9: Function effectively as an individual independently and as a member or leader in diverse teams, and in multidisciplinary settings (Individual and team work)

PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large such as being able to comprehend and write effective reports and design documentation, make effective oral presentations, and give and receive clear instructions (Communication)

PO11: Demonstrate knowledge and understanding of engineering management principles and apply those to one's own work as a member and leader of a team to manage projects in multidisciplinary environments (Project management and finance)

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (Life-long Learning).

Curriculum

Semester 1

Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1		Energy Sources and Audit	1	0	0	1	20	30	50
2		Data Analytics (Excel and Tableu)	1	0	0	1	20	30	50
3		AI Fundamentals	2	0	0	2	20	30	50
4		Differential / Vector calculus and Matrices	3	0	0	3	20	30	50
5		Programming for Problem Solving (C)	1	0	4	3	20	30	50
6		Communication Skill (BEC-1)	3	0	0	3	20	30	50
7		Engineering Physics	2	0	0	2	20	30	50
8		Engineering Physics Lab	0	0	2	1	50	-	50
9		Bio Systems in Engineering	2	0	0	2	20	30	50
10		AC DC Circuits	2	0	2	3	20	30	50
		Total credits				**21**			

Semester II

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1		Integral and Multiple Calculus	2	0	0	2	20	30	50
2		Partial Differential Equations	1	0	0	1	20	30	50
3		Embedded Technology and IOT	1	0	2	2	20	30	50
4		Waste Management	0	0	2	1	50	-	50
5		Environmental Science	0	0	1	0.5	50	-	50
6		Liberal and Creative Arts	0	0	1	0.5	50	-	50
7		Creativity, Innovation and Entrepreneurship	1	0	2	2	20	30	50
8		Application of Python Programming	0	0	2	1	50	-	50
9		Introduction to Digital System	2	0	2	3	20	30	50
10		Data Structure Using C	2	0	2	3	20	30	50
11		Digital Fabrication	0	0	2	1	50	-	50
12	BCE01T3201	Engineering Mechanics	3	0	0	3	20	30	50
		Total credits				**20**			

Semester III

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1		Mathematics-III (Functions of Complex Variables and Transforms)	3	0	0	3	20	30	50
2		Aptitude building and Logical Reasoning - I	0	0	2	1	50	-	50
3		Disruptive Technologies	0	0	4	2	50	-	50

4		AI and its Applications	0	0	4	2	50	-	50
5	BCE02T3301	Strength of Materials	2	0	0	2	20	30	50
6	BCE02T3302	Basic Fluid Mechanics	2	0	0	2	20	30	50
7	BCE02T3303	Introduction to Surveying	2	0	0	2	20	30	50
8	BCE02T3304	Basic Transportation Engineering	2	0	0	2	20	30	50
9	BCE02P3302	Basic Fluid Mechanics Lab	0	0	2	1	50	-	50
10	BCE02P3303	Surveying Lab	0	0	2	1	50	-	50
11	BCE01P3304	Engineering Drawing	0	0	4	2	50	-	50
12	BCE02P3301	Strength of Materials Lab	0	0	2	1	50	-	50
13	BCE02P3304	Basic Transportation Engineering Lab	0	0	2	1	50	-	50
		Total credits				**22**			

Semester IV

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1		Mathematics-IV (Numerical and Computational Methods)	2	0	0	2	20	30	50
2		Numerical and Computational Methods Lab	0	0	2	1	50	-	50
3		Aptitude building and Logical Reasoning - II	0	0	2	1	50	-	50
4		Engineering Clinic - I (IOT)	0	0	2	1	50	-	50
5		Communication Skill (BEC-2) - 3 credit	3	0	0	3	20	30	50
6	BCE01T3402	Construction Engineering	3	0	0	3	20	30	50
7	BCE02T3403	Basic Structural Analysis	2	0	0	2	20	30	50
8	BCE02T3404	Water & Waste Water Treatment Systems	2	0	0	2	20	30	50
9	BCE02T3405	Soil Mechanics	2	0	0	2	20	30	50
10	BCE02T3406	Reinforced Concrete Structures	2	0	0	2	20	30	50
11	BCE02P3404	Water Analysis Lab	0	0	2	1	50	-	50
12	BCE02P3405	Soil Mechanics Lab	0	0	2	1	50	-	50
13	BCE01P3402	Construction Engineering Lab	0	0	2	1	50	-	50
		Total credits				**22**			

Semester V

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1		Mathematics-V (Application of Statistical Methods in Construction)	3	0	0	3	20	30	50
2		Engineering Economics and Management	3	0	0	3	20	30	50
3		Engineering Clinic - II (Machine Learning)	0	0	2	1	50	-	50
4		Campus to Corporate	3	0	0	3	20	30	50

5		Aptitude building and Logical Reasoning - III	0	0	2	1	50	-	50
6	BCE02T3501	TQM in Construction	3	0	0	3	20	30	50
7		Program Elective - I	3	0	0	3	20	30	50
8	BCE01P3504	CAD Lab - I (AUTOCAD)	0	0	4	2	50	-	50
9	BCE02T3502	Construction Contracts Administration and Management	3	0	0	3	20	30	50
10		Social Internship	0	0	2	1	50	-	50
11		Hobby Class	0	0	1	0.5	50	-	50
12	BCE02P3501	Industrial Internship - I	0	0	0	1	50	-	50
		Total credits				**24.5**			

Semester VI

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1		Excel Training & PPT Training	0	0	1	0.5	50	-	50
2	BCE02T3601	Introduction to Design of Steel Structures	2	0	0	2	20	30	50
3		Foreign Language (German / Japanese / French)	0	0	4	2	20	30	50
4	BCE01P3605	Analysis and Design Lab (STAAD PRO)	0	0	2	1	50	-	50
5		Aptitude building and Logical Reasoning - IV	0	0	2	1	50	-	50
6	BCE01P3606	Design and Innovation	0	0	2	1	50	-	50
7		Open Elective - I	3	0	0	3	20	30	50
8		Program Elective - II	3	0	0	3	20	30	50
9		Program Elective - III	3	0	0	3	20	30	50
10	BCE02T3602	Project Economics & Financial Management	3	0	0	3	20	30	50
11	BCE02T3603	Quantity Surveying and Estimating	3	0	0	3	20	30	50
12	BCE02P3607	Estimation Lab (PRIMAVERA)	0	0	4	2	50	-	50
		Total credits				**24.5**			

Semester VII

Sl No	**Course Code**	**Name of the Course**					**Assessment Pattern**		
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1		Program Elective - IV	3	0	0	3	20	30	50
2		Program Elective - V	3	0	0	3	20	30	50
3		Ethics and Professional Competency	0	0	2	1	50	-	50
4	BCE02P3998	Capstone Phase-1	0	0	4	2	50	-	50
5		Open Elective - II	3	0	0	3	20	30	50
6	BCE02T3701	Project Planning and Scheduling	2	0	0	2	20	30	50
7	BCE02P3701	Project Planning and Scheduling Lab (PRIMAVERA)	0	0	2	1	50	-	50
8	BCE02P3702	Industrial Internship - II	0	0	0	1	50	-	50
		Total credits				**16**			

Semester VIII									
Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE02P3999	Capstone Phase-2	0	0	20	10	50	-	50
		Total credits				**10**			

Total Grand Credits = 160

List of Program Electives

Sl No	Course Code	List of Programme Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE02T5701	Sustainable Construction Materials	3	0	0	3	20	30	50
2	BCE02T5702	Environment & Energy for Sustainable Construction	3	0	0	3	20	30	50
3	BCE02T5703	Human Rights	3	0	0	3	20	30	50
4	BCE02T5704	Human Resource Development	3	0	0	3	20	30	50
5	BCE02T5705	Materials Management	3	0	0	3	20	30	50
6	BCE02T5706	Value Engineering and Valuation	3	0	0	3	20	30	50
7	BCE02T5707	Infrastructure Development	3	0	0	3	20	30	50
8	BCE02T5708	International Contracting	3	0	0	3	20	30	50
9	BCE02T5709	Thrust Areas in Project Management	3	0	0	3	20	30	50
10	BCE02T5710	Leadership & Team Building	3	0	0	3	20	30	50
11	BCE02T5711	Material Management & Inventory Control	3	0	0	3	20	30	50
12	BCE02T5712	Marketing Research	3	0	0	3	20	30	50

Minor Courses

Sl No	Course Code	Minor Courses					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE01T3402	Construction Technology	3	0	0	3	20	30	50
2	BCE02T3501	TQM in Construction	3	0	0	3	20	30	50
3	BCE02T3703	Management and Project Planning in Construction	3	0	0	3	20	30	50
4	BCE02T3502	Construction Contracts Administration and Management	3	0	0	3	20	30	50
5	BCE02T3602	Project Economics & Financial Management	3	0	0	3	20	30	50
6	BCE02T3603	Quantity Surveying and Estimating	3	0	0	3	20	30	50
		Total Credit				**18**			

Major Courses

Sl No	Course Code	Major Courses					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE02T3711	Advanced Construction Technology	3	0	0	3	20	30	50
2	BCE02T3712	Operations Research	3	0	0	3	20	30	50
3	BCE02T3713	Retrofitting of Structures	3	0	0	3	20	30	50
4	BCE02T3714	Construction Safety	3	0	0	3	20	30	50
5	BCE02T3715	Economics and Project Finance for Civil Engineers	3	0	0	3	20	30	50
6	BCE02T3716	Repair and Maintenance of Buildings	3	0	0	3	20	30	50
		Total Credit				**18**			

Detailed Syllabus

Name of The Course	**Engineering Mechanics**				
Course Code	**BCE01T3201**				
Prerequisite	**-**				
Co-requisite	**-**				
Anti-requisite	**-**				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives

1. To calculate the reactive forces.
2. To analyze structures.
3. To learn the geometric properties of different shapes.

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand fundamental principles of forces and the concept of free body diagram.
CO2	Calculate the centroid, centre of gravity and moment of inertia of various surfaces.
CO3	Determine stresses and strains for one dimensional axially loaded member.
CO4	Analyze plane trusses by different methods
CO5	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to Mechanics & Equilibrium of Forces **8 Lecture Hours**
Fundamental Principles - Vectorial Representation of Forces - Coplanar forces - Resolution and Composition of forces and equilibrium of particles – introduction of Forces on a particle in space - Equivalent system of forces - Principle of transmissibility - Single equivalent force - Free body diagram - Equilibrium of rigid bodies in two dimensions and three dimensions.
Unit II: Properties of Surfaces **8** **Lecture Hours**
Centroid – Centre of gravity – Parallel axis theorem - First moment of area – Second moment of area – Product of inertia of plane areas – Polar moment of inertia
Unit III: Stresses & Strains **8** **Lecture Hours**
Axial Stress and Strain - Solution of simple problems – Tapered Section - One Dimensional axial loading of members of varying cross-section – Stress - Strain Diagram of mild steel.
Unit IV: Analysis of plane truss **8** **Lecture Hours**
Trusses: Introduction - Simple Truss - Analysis of Simple truss - Method of Joints - Method of Sections – Tension Coefficient Method
Unit V: Introduction to shear force and bending moment 8 **Lecture Hours**
Beam: Introduction, Shear force and Bending moment, Shear Force Diagram and Bending Moment Diagram for statically determinate beams.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Punamia B. C. (2010), Mechanics of Materials, 15th Edition, Laxmi publications (P) Ltd, ISBN: 9788131806463.

2. Shames I. H. (2006), Engineering Mechanics – Statics and Dynamics, 4th Edition, Prentice-Hall of India Private limited, ISBN-9780133569247.

Name of The Course	**Basic Fluid Mechanics**			
Course Code	**BCE02T3302**			
Prerequisite	**-**			
Co-requisite	**-**			
Anti-requisite	**-**			
	L	**T**	**P**	**C**
	2	**0**	**0**	**2**

Course Objectives

1. Introduce concepts, laws, observations, models of fluids at rest and in motion and understanding fluid behavior for engineering design and control of fluid system.
2. Develop competence with mass, energy and momentum balances for determining resultant interactions of flows and engineered and natural systems.
3. The development of boundary layers and advancement of practical hydraulics and understanding the concept of advanced fluid mechanics.
4. Students understand Citizens' Role and Civil Society- Social Movements and Non-Governmental Organizations.

Course Outcomes

On completion of this course the student will be able to:

CO1	To find frictional losses in a pipe when there is a flow between two places.
CO2	Calculation of conjugate depth in a flow and to analyse the model and prototype.
CO3	Find the dependent and independent parameters for a model of fluid flow.
CO4	Explain the various methods available for the boundary layer separation.

Continuous Assessment Pattern

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

Course Content:

Unit I: Fluid Properties and Hydrostatics **7** **Lecture Hours**
Density – Viscosity – Surface tension – compressibility – capillarity – Hydrostatic forces on plane – inclined and curved surfaces – buoyancy – centre of buoyancy – metacentre.
Unit II: Fluid Dynamics **7** **Lecture Hours**
Control volume – Fluid Kinematics - Types of flows; Steady flow, Unsteady flow, Uniform and Non Uniform flow, Rotational flow, Irrotational flow, 1-D, 2-D, 3-D flows– Streamline and Velocity potential lines- Euler and Bernoulli's equations and their applications – moment of momentum – Momentum and Energy correction factors – Impulse – Momentum equation-Navier-Stokes Equations-Applications
Unit III: Open Channel Flow **7** **Lecture Hours**
Dimensional homogeneity – Raleigh and Buckingham π theorems – Non-dimensional numbers – Model laws and distorted models-Module quantities-Specific quantities.
Unit IV: Dimensional Analysis **7** **Lecture Hours**
Dimensional homogeneity – Raleigh and Buckingham π theorems – Non-dimensional numbers – Model laws and distorted models-Module quantities-Specific quantities.

Suggested Reading

1. P. N. Modi and S. M. Seth (2011), Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Publications. ISBN-9788189401269.
2. D.S. Kumar (2004), Fluid Mechanics and Fluid Power Engineering, Katson Publishing House, ISBN - 9788185749181.

3. V.L. Streeter, (2001), Fluid Mechanics, McGraw Hill
Book Co. ISBN – 9780071156004

Name of The Course	Basic Fluid Mechanics Lab			
Course Code	BCE02P3302			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	2	1

Course Objectives

1. Introduce concepts, laws, observations, models of fluids at rest and in motion and understanding fluid behavior for engineering design and control of fluid system.
2. Develop competence with mass, energy and momentum balances for determining resultant interactions of flows and engineered and natural systems.
3. The development of boundary layers and advancement of practical hydraulics and understanding the concept of advanced fluid mechanics..

Course Outcomes

On completion of this course the student will be able to:

CO1	To find frictional losses in a pipe when there is a flow between two places.
CO2	Calculation of conjugate depth in a flow and to analyse the model and prototype..
CO3	Find the dependent and independent parameters for a model of fluid flow.
CO4	Explain the various methods available for the boundary layer separation.

Continuous Assessment Pattern

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

Course Content:

List of Experiments:

1. Verification of Bernoullis Theorem
2. Metacentric Height
3. Calibration of V- Notch
4. Calibration of Rectangular Notch
5. Calibration of Trapezoidal Notch
6. Calibration of Venturimeter
7. Calibration of Orificemeter
8. Losses in Pipes

Suggested Reading

1. P. N. Modi and S. M. Seth (2011), Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Publications. ISBN- 9788189401269.
2. D.S. Kumar (2004), Fluid Mechanics and Fluid Power Engineering, Katson Publishing House, ISBN - 9788185749181.
3. V.L. Streeter, (2001), Fluid Mechanics, McGraw Hill Book Co. ISBN – 9780071156004.

Name of The Course	Surveying Lab			
Course Code	BCE02P3303			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	2	1

Course Objectives

1. To teach the students basics of surveying and expose different techniques of surveying.
2. To help the students to learn the field applicability of the different survey methods.
3. To teach students about types of errors encountered in different types of surveying.

Course Outcomes

On completion of this course the student will be able to:

CO1	Learn about basics involved in different types of surveying like tape, compass, leveling, and theodolite (total station).
CO2	Demonstrate skills in performing measurement of distance, angles, leveling, and curve setting.
CO3	Develop skills for estimating distance between given points, area of a given plot and earthwork involved in cuttings and fillings.
CO4	Develop skill to carry out tachometry, geodetic surveying wherever situation demands.
CO5	Develop skills to apply error adjustment to the recorded reading to get an accurate surveying output.

Continuous Assessment Pattern

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

Course Content:

List of Experiments:

17. Chain Survey- Determination of area by perpendicular offsets
18. Chain Survey- Measurement of distance by chaining & ranging
19. Compass Survey- Plotting & adjustment of closed traverse
20. Theodolite Survey- Measurement of horizontal angles by method of repetition
21. Measurement of Vertical Angles and Determination of Height of an Object
22. Plane Table Survey- Radiation method
23. Levelling- Rise & Fall method
24. Levelling- Height of collimation method
25. Trignometrical Levelling- Single plane method
26. Curve Surveying- Setting out a simple circular curve by Rankine's method
27. Contouring- To determine the contours for a given location
28. GPS Survey- Coordinates & Distance measurement using GPS
29. Total Station- Measurement of Altitude of Given Elevated Points
30. Total Station- Measurement of distance & coordinates of given points
31. Stereoscope- Use of stereoscope for 3D viewing
32. Stereoscope- Determination of height of objects from a stereo pair using the parallax bar

Suggested Reading

1. Punmia B.C. (2005), Surveying, Volume 1, 16th Edition Laxmi Publications. ISBN: 9788170080794
2. Punmia B.C. (2005), Surveying, Volume 2, 15th Edition Laxmi Publications. ISBN: 9788170080800
3. Satheesh Gopi (2010), GPS Principles and Applications, Tata Mc Graw Hill publishing company Ltd. ISBN: 9780070141704

Name of The Course	**Introduction to Surveying**
Course Code	**BCE02T3303**

Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course Objectives

1. To teach the students basics of surveying and expose different techniques of surveying.
2. To help the students to learn the field applicability of the different survey methods.
3. To teach students about types of errors encountered in different types of surveying.

Course Outcomes

On completion of this course the student will be able to:

CO1	Learn about basics involved in different types of surveying like tape, compass, leveling, and theodolite (total station).
CO2	Demonstrate skills in performing measurement of distance, angles, leveling, and curve setting.
CO3	Develop skills for estimating distance between given points, area of a given plot and earthwork involved in cuttings and fillings.
CO4	Develop skill to carry out tachometry, geodetic surveying wherever situation demands.

Continuous Assessment Pattern

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

Course Content:

Unit I: Plane Surveying and Theodolite **7** **Lecture Hours**
Introduction to plane surveying, conventional tape measurement, electronic distance measurement – Meridians, Azimuths and bearings – Theodolites – Temporary and permanent adjustment – Horizontal and Vertical angle measurements – Electronic total station.
Unit II: Leveling and Contouring **7** **Lecture Hours**
Differential levelling, Longitudinal & cross section leveling, Refraction & curvature correction, Reciprocal leveling -Tachometry – Stadia tachometry, tangential tachometry & substance tachometry- Contouring.
Unit III Calculation of Earthwork and GPS **7** **Lecture Hours**
Area, volume calculation of earth work – Introduction to Global positioning system – GPS surveying methods.
Unit IV: Curve Surveying **7** **Lecture Hours**
Definitions, designation of curve, elements of simple curve - Settings of simple circular curve, Compound and reverse curve- Transition curve – Introduction to vertical curves.

Suggested Reading

1. Punmia B.C. (2005), Surveying, Volume 1, 16th Edition Laxmi Publications. ISBN: 9788170080794
2. Punmia B.C. (2005), Surveying, Volume 2, 15th Edition Laxmi Publications. ISBN: 9788170080800
3. Satheesh Gopi (2010), GPS Principles and Applications, Tata Mc Graw Hill publishing company Ltd. ISBN: 9780070141704

Name of The Course	**Engineering Drawing**				
Course Code	**BCE01P3304**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		0	**0**	**4**	**2**

Course Objectives

4. To create awareness and emphasize the need for Engineering Drawing in all the branches of engineering.
5. To follow basic drawing standards and conventions.

6. To develop skills in three-dimensional visualization of engineering component.

Course Outcomes

On completion of this course the student will be able to:

CO1	Prepare drawings as per standards (BIS).
CO2	Solve specific geometrical problems in plane geometry involving lines, plane figures and special Curves.
CO3	Produce orthographic projection of engineering components working from pictorial drawings.
CO4	Develop skill Planes under study.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction **7** **Lecture Hours**
Engineering Drawing: An Overview, its need and objectives. Introduction to Computer Aided Drafting- Introduction to AutoCAD/CATIA; Initial setup commands, Utility commands, drawing aids, entity draw commands, display commands and edit commands.
Unit II: Lettering, Numerals and Dimensioning **7** **Lecture Hours**
Drawing scale, various types of lines and their uses. Lettering. Dimensioning; Basic types of dimensioning- linear, angular and radial dimensioning. Title block.
Unit III Orthographic Projection – Points and Lines **7** **Lecture Hours**
Object in four quadrant, 2-D description of quadrants. Projection of points. Projection of lines- Inclined lines, projection of a skew line, line parallel to perpendicular plane.
Unit IV: Orthographic Projection –Planes **7** **Lecture Hours**
Planes under study, classification of planer surface, projection of planer surface- principal, inclined, oblique planes.

Suggested Reading

1. Bhatt N. D., "Engineering Drawing", Charotar publishing House, 1998.
2. French and Vierk, "Fundamentals of Engineering Drawing", McGraw Hill, 2002.
3. John K.C., "Engineering Graphics for Degree", PHI Learning Private Limited, New Delhi, 2010.

Name of The Course	**Strength of Materials**			
Course Code	**BCE02T3301**			
Prerequisite	**-**			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	**0**	**0**	**2**

Course Objectives

1. To know the concept of stresses and strains.
2. To know the concept of shear force and bending moment.
3. To calculate deflection in beams and trusses.
4. To determine the buckling and crushing load of compression members.

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand the concepts of volumetric strain and torsion.
CO2	Analyse shear force and bending moment for different types of beams.
CO3	Calculate deflections in beams and trusses.
CO4	Study compression member, columns and finding buckling and crushing load.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks

20	30	50	100

Course Content:

Unit I: Volumetric Strains and Torsion. **7 Lecture Hours**
Bulk Modulus – Modulus of rigidity – Change in volume – Volumetric Strain - Introduction to torsion - Torsion of shafts of circular section - torque and twist - shear stress due to torque
Unit II: Shear Force and Bending Moment **7 Lecture Hours**
Types of beams, supports and loadings - shear force and bending moment diagram - bending stresses and shear stresses in beams
Unit III: Deflection of Beams **7 Lecture Hours**
Introduction - Theory of bending - deflection of beams by Macaulay's method - moment area method and conjugate beam method.
Unit IV: Theory of Columns **7 Lecture Hours**
Theory of Columns - long column and short column - Euler's formula - Rankine's formula - Secant formula - beam column.

Suggested Reading

1. Ramamrutham S. and Narayanan R. (2008), Strength of Materials, 3rd Edition, Dhanpat Rai Publications Company, ISBN: 9788187433545.
2. Bansal R. K. (2010), Strength of Materials, 4th Edition, Laxmi Publications, ISBN: 9788131808146.

Name of The Course	**Construction Engineering**				
Course Code	**BCE01T3402**				
Prerequisite	**-**				
Co-requisite	**-**				
Anti-requisite	**-**				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives

5. To know different types of modern construction materials and their uses.
6. To know different types of cement, mineral and chemical admixtures, aggregates and their Engineering properties and uses.
7. To understand the properties and application of various special concretes.
8. To know the methodology of mix design and their application in accordance with various field conditions.

Course Outcomes

On completion of this course the student will be able to:

CO1	Develop ability to choose the modern construction materials appropriate to the climate and functional aspects of the buildings.
CO2	Supervise the construction technique to be followed in brick and stone masonry, concreting, flooring, roofing and plastering etc.
CO3	Understand the properties of cement and its laboratory testing methods.
CO4	Determine quality of fine aggregate and course aggregate
CO5	Learn about the different properties of concrete**.**
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Properties of Construction Materials **8 Lecture Hours**
Physical and Mechanical properties of construction materials – Bricks - Stones - Structural Steel and Aluminum – Roofing Material – Physical descriptions of asbestos sheets, GI sheets, tubes and light weight roofing materials - Timber and its Products – Modern materials – Neoprene - Thermo Cole - Vinyl flooring - decorative panels and laminates - anodized aluminum - architectural glass and

ceramics - Ferro cement – PVC - Polymer base materials and FRP.
Unit II: Construction Technology **8** **Lecture Hours**
Introduction to Masonry design, Principles of construction– Bonding – Reinforced brick work – – Stone masonry – Hollow block masonry - Pointing - Plastering – DPC Floor and Roof Construction: Floors, General Principles – Types of floors – Floor coverings – Types of roofs.
Unit III: Properties of cement **8** **Lecture Hours**
ASTM classification of Cement – Properties of Cement - Testing of Cement – Field Testing – Laboratory Testing methods – Setting time of cement – soundness of cement – fineness and compressive strength of cement - Heat of Hydration.
Unit IV: Fine Aggregate and Coarse Aggregate **8** **Lecture Hours**
Fine aggregate – Properties and testing methods – Bulking of Sand – sieve analysis – fineness modulus of sand - Cement mortar – properties and uses, Chemical Admixtures- Plasticizer – super plasticizer – air entraining agents etc.
Unit V: Properties of Concrete **8** **Lecture Hours**
Concrete – selection of materials for concrete - water cement ratio - Properties of fresh concrete - workability – measurement of workability – Strength of concrete – gain of strength with age – testing of hardened concrete - Compressive strength - Tensile strength – Flexural strength – modulus of elasticity of concrete – Introduction to Mix Design of concrete.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Shetty, M.S. (2010), Concrete Technology, S. Chand & Company Ltd. ISBN-9788121900034.
2. IS: 10262-2009, Guidelines for concrete mix design proportioning, BIS, New Delhi.

Name of The Course	**Soil Mechanics**			
Course Code	**BCE02T3405**			
Prerequisite	**-**			
Co-requisite	**-**			
Anti-requisite	**-**			
	L	**T**	**P**	**C**
	2	**0**	**0**	**2**

Course Objectives

5. To impart the fundamental concepts of soil mechanics.
6. To understand the bearing capacity.
7. To know the importance of index properties like grain size, consistency limits, soil classification.
8. To understand the concept of compaction and consolidation of soils.

Course Outcomes

CO1	Give an engineering classification of a given soil
CO2	Understand the principle of effective stress, and then calculate stresses that influence soil behavior.
CO3	Determine soil deformation parameters, and calculate settlement magnitude and rate of settlement
CO4	Specify soil compaction requirements.

Continuous Assessment Pattern

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

Course Content:

Unit I: Weight volume relations and Index properties **7 Lecture Hours**
Distribution of soil in India, Soil - Types, 3-phase diagram, Weight-volume relations, Classification, Index properties (Atterberg's limits), Theory of compaction, Importance of geotechnical engineering.
Unit II: Soil water and Permeability **7** **Lecture Hours**
Soil water - Effective and neutral stresses – Flow of water through soils – Permeability – Darcy's law –Seepage and flow-nets - Quick sand conditions.
Unit III: Stress distribution in soils **7** **Lecture Hours**
Vertical pressure distribution- Boussinesq's equation for point load and uniformly distributed loads of different shapes– Newmark's influence chart – Westergaard's equation – Isobar diagram – Pressure bulb - Contact pressure, Earth Pressures Theories.
Unit IV: Compressibility and Consolidation **7 lecture hours**
Compressibility – e-log p curve – Pre-consolidation pressure - Primary consolidation – Terzaghi'sconsolidation theory - Laboratory consolidation test – Determination of C_v by Taylor's and Casagrande's methods.

Suggested Reading

1.K.R.Arora (2011), Soil Mechanics and Foundation Engineering, Standard Publishers Distributors, Delhi, ISBN: 978-81-801-4112-6.

2.Gopal Ranjan, A.S.R Rao (2000), Basic and Applied Soil Mechanics 2nd Edition, New Age International. ISBN: 978-81-224-1223-9.

3. Arun Kr. Jain, B.C. Punmia, Ashok Kr. Jain (2005), Soil Mechanics and Foundations, Sixteenth Edition, Laxmi Publications. ISBN: 978-81-700-8791-5.

Name of The Course	**Strength of Materials Lab**

Course Code	**BCE02P3301**			
Prerequisite	**-**			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives

To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness.

Course Outcomes

On completion of this course the student will be able to:

CO1	Conduct tension and compression tests on the components
CO2	To determine hardness, impact strength, fatigue strength of the specimens.
CO3	Measure strain and load using specific gauges.
CO4	Measure torsion in mild steel.
CO5	Compression and tension test on helical springs.

Continuous Assessment Pattern

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

Course Content:

List of Experiments

1. Tension test on a mild steel rod, thin and twisted bars.
2. Compression test on Bricks, Concrete blocks.
3. Double shear test on Mild steel and Aluminium rods.
4. Impact test on metal specimen (Charpy test and Izod test).

5. Hardness test on metals (Steel, Copper and Aluminium) - Brinnell Hardness Number.
6. Hardness test on metals (Steel, Copper and Aluminium) - Rockwell Hardness Number.
7. Deflection test – Verification of Maxwell theorem.
8. Compression and tension test on helical springs.
9. Fatigue test on Steel.
10. Torsion test on mild steel

Suggested Reading

1. Gere J. M. and Thimoshenko S. P. (2008), Mechanics of Materials, 8th Edition, CBS Publishers & Distributors, ISBN: 9780534417932.
2. Popov E. P. (2009), Engineering Mechanics of Solids, 2nd Edition, Prentice Hall Publisher, ISBN: 9788120321076.
3. Bansal R. K. (2010), Strength of Materials, 4th Edition, Laxmi Publications, ISBN: 9788131808146.

Name of The Course	**Construction Engineering Lab**				
Course Code	**BCE01P3402**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

Course Objectives

1. To know the concept and procedure of different type of test conducted on cement, aggregate and concrete.
2. To understand the properties of different building materials and their Civil Engineering Significance.
3. To understand the IS Code provision of testing different types of building materials

Course Outcomes

On completion of this course the student will be able to:

CO1	Identify the suitability of materials for construction work.
CO2	Perform different test conducted on cement, aggregate and concrete as per relevant Codal provision.
CO3	Demonstrate the relevant BIS testing procedure to be carried out to ascertain the quality of building materials.

Continuous Assessment Pattern

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

Course Content:

List of Experiments

10. To determine the water content required producing a cement paste of normal consistency and also determining initial and final setting time of a given cement sample.
11. To determine the fineness of cement by Blain air permeability apparatus.
12. To determine the specific gravity of given sample of OPC.
13. To determine the particle size distribution of fine and coarse aggregate by sieve analysis method.
14. Determination of specific gravity of coarse and fine aggregate.
15. To determine the silt content in the given sample of fine aggregate and also determine necessary adjustment for the bulking of fine aggregate and draw curve between water content and bulking.
16. To determine the consistency of the concrete mixes for different W/C ratio by slump test with and without admixture.
17. To determine the workability of concrete mix of given proportion by compaction factor test.
18. To cast concrete cubes and to determine compressive strength of concrete by non-destructive and destructive method of testing.

Suggested Reading

1. S. K. Duggal, (2008), *Building Materials*, 3rd Edition, New Age International Publishers, ISBN: 978-81-224-2392-1
2. Sushil Kumar (2010), *Building Construction*, Standard Publishers Distributors, ISBN: 978-81-801-4168-3.
3. M. S. Shetty, (2009), *ConcreteTechnology: Theory and Practice*, S.Chand Publishers, ISBN: 978-81-219-0003-4
4. A. R. Santhakumar (2006), *Concrete Technology*, Oxford University Press, ISBN: 978-01-956-7153-7

Name of The Course	**Soil Mechanics Lab**			
Course Code	**BCE02P3405**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives

1. To impart the fundamental concepts of soil mechanics.
2. To understand the bearing capacity.
3. To know the importance of index properties like grain size, consistency limits, soil classification.
4. To understand the concept of compaction and consolidation of soils.

Course Outcomes

On completion of this course the student will be able to:

CO1	Give an engineering classification of a given soil.
CO2	Understand the principle of effective stress, and then calculate stresses that influence soil behavior.
CO3	Determine soil deformation parameters, and calculate settlement magnitude and rate of settlement.
CO4	Specify soil compaction requirements.
CO5	Conduct laboratory tests, and obtain soil properties and parameters from the test observations and results

Continuous Assessment Pattern

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

Course Content:

List of Experiments

13. To determine moisture content of soil
14. To determine the specific gravity of soil fraction passing 4.75 mm I.S sieve by density bottle/Pycnometer bottle
15. To determine the grain size distribution curve for given soil sample by sieve analysis and hydrometer analysis.
16. To determine the consistency limits (i.e Liquid limit, Plastic limit & Shrinkage limit)of given samples
17. To determine in-situ density of compacted soils by using core cutter & pouring cylinder methods.
18. To determine the relative density of given coarse grained materials
19. To determine the maximum dry density and optimum moisture content for the given soil sample.
20. To determine coefficient of permeability of given soil sample by constant head and variable head method.
21. To determine unconfined compressive strength of a given soil sample
22. To determine shear strength of a given soil specimen using vane shear apparatus
23. To determine shear strength of a given soil specimen using direct shear apparatus
24. To determine the shear parameters of soil by Undrained Triaxial Test

Suggested Reading

1. Gopal Ranjan, A.S.R Rao (2000), Basic and Applied Soil Mechanics 2nd Edition, New Age International. ISBN: 978-81-224-1223-9.
2. William Powrie, Soil Mechanics: Concepts and Applications, Second Edition, Spon Press. ISBN: 978-04-153-1156-4.

3. Karl Terzaghi, Soil Mechanics in Engineering Practice, Warren Press. ISBN: 978-14-465-1039-1

Name of The Course	Basic Structural Analysis			
Course Code	BCE02T3403			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	2	0	0	2

Course Objectives

4. To understand the concept of static indeterminacy.
5. To know the different techniques available for the analysis of statically indeterminate structures.
6. To identify the best suitable method of analysis.

Course Outcomes

On completion of this course the student will be able to:

CO1	Identify the method of analysis for statically indeterminate structures
CO2	Understand the difference between statically determinate structures and statically indeterminate structures
CO3	Use the influence line diagram for analysing beam.
CO4	Understand strain energy method to analyse arches.

Continuous Assessment Pattern

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

Course Content:

Unit I: Theorem of Three Moments **7** **Lecture Hours**
Static indeterminacy - Theorem of three moments - analysis of propped cantilevers - fixed & continuous beam - bending moment and shear force diagram.
Unit II: Strain Energy Method **7** **Lecture Hours**
Static indeterminacy - Strain energy method - analysis of indeterminate structures, beams, pin jointed and rigid jointed structures - temperature effect - bending moment and shear force diagram.
Unit III: Analysis of Arches **7** **Lecture Hours**
Two hinged and three hinged parabolic arches - circular arches - cables - tension forces in towers - influence line for horizontal thrust and bending moment.
Unit IV: Slope deflection method **7** **Lecture Hours**
Kinematic indeterminacy - Slope deflection method - analysis of continuous beams and portals - bending moment and shear force diagram.

Suggested Reading

1.Vazirani & Ratwani (2003), Analysis of Structures, Vol. 1 & II, Khanna Publishers, ISBN: 0125249853.

2. S. Ramamrutham (2004), Theory of Structures, 5th Edition, Dhanpat Rai Publications, ISBN: 978041528091

Name of The Course	Basic Transportation Engineering			
Course Code	BCE02T3304			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	2	0	0	2

Course Objectives

2. To impart the knowledge in Highway Geometrics, Traffic Engineering, materials, construction and design of pavements

Course Outcomes

On completion of this course the student will be able to:

CO1	Design various geometric elements of highways.
CO2	Understand the procedure to collect the traffic data for design and traffic management.
CO3	Test the highway materials as per IS/IRC guidelines.
CO4	Do structural design of flexible and rigid pavements.

Continuous Assessment Pattern

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

Course Content:

Unit I: Highway and Traffic Planning **7 Lecture Hours**
Introduction to Transportation modes – Highway alignment and field surveys – Master Plan – Transport economics – Traffic Studies – Volume, speed, origin and destination studies. Introduction to Multi-modal Transportation, Automated Transport systems, High urban transport, Impact of transport on environment.
Unit II: Highway Geometrics **7 Lecture Hours**
Highway classification (Rural and Urban roads), Road Geometrics – Highway cross section elements – camber – Sight Distance, Horizontal Alignment Design, Super Elevation, Extra widening, Transition curves, Set back distance, Design of Vertical curves.
Unit III: Traffic Engineering **7 Lecture Hours**
Traffic characteristics, road user & vehicular characteristics, traffic studies, traffic operations, traffic control devices, intelligent transport systems, Intersections, Interchanges, Parking Layout & Road signs.
Unit IV: Highway Materials and Construction **7 Lecture Hours**
Material requirement for pavements – Soil classification for Highway – Soil tests – CBR and Plate Load Test, Aggregate – materials testing and specification, Bitumen – material testing and specification construction of bituminous and rigid pavements, Highway Maintenance – Material recycling.

Suggested Reading

1.Khanna.S.K., and Justo. C.E.G., (2011), Highway Engineering, Ninth Edition, Nem.
2. Kadiyali.L.R., and Lal.N.B., (2005), Principles and Practice of Highway Engineering, Fourth Edition, Khanna Publishers, ISBN- 9788174091659.
3. Chakroborthy Partha, and Das Animesh, (2003), Principles of Transportation Engineering, Eighth Printing, Prentice-Hall of India, ISBN- 9788120320840.
4. Rao.G.V., (1996), Principles of Transportation and Highway Engineering, Tata McGraw-Hill Co, ISBN- 9780074623633.

Name of The Course	**Water & Waste Water Treatment Systems**			
Course Code	**BCE02T3404**			
Prerequisite	**-**			
Co-requisite	**-**			
Anti-requisite	**-**			
	L	**T**	**P**	**C**
	2	**0**	**0**	**2**

Course Objectives

1. Understand the basic principles and concepts of unit operations and processes involved in water treatment.
2. Design of unit operations and processes involved in water treatment.
3. Evaluation of the performance of water treatment plants.

Course Outcomes

On completion of this course the student will be able to:

CO1	The type of unit operations and processes involved in water treatment plants.
CO2	Unit operations and processes required for satisfactory treatment of water.

CO3	Demonstrate an ability to recognize the type of unit operations and processes involved in wastewater treatment plants.
CO4	Demonstrate an ability to choose the appropriate unit operations and processes required for satisfactory treatment of wastewater.

Continuous Assessment Pattern

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

Course Content:

Unit I: Water Treatments Units **7 Lecture Hours**
Physicochemical Principles applied in water treatment, Unit operations, principles and processes for pretreatment and treatment of raw water, pre-chlorination and chlorination, principles and objectives for designing chlorination systems, General design considerations for designing water treatment plants.
Unit II: Unit Operations & Processes **7 Lecture Hours**
Principles, functions and design of screen, grit chambers, flash mixers, flocculators, sedimentation tanks and sand filters- Slow sand and rapid sand filters, layouts – Flash mixer – Clariflocculator – Slow sand and rapid sand filters.
Unit III: Wastewater Treatment **7 Lecture Hours**
Physical, chemical and biological principles involved in wastewater treatment and designing of unit-operations and processes. Permissible standards for wastewater disposal.
Unit IV: Pre and Primary Treatment **7 Lecture Hours**
Objectives-Unit operations and processes-Principles, functions and design of flash mixers, screens, sedimentation tanks and sand filters-Disinfection-Aeration, grit chambers and primary sedimentation tanks.

Suggested Reading

1. Garg S.K. (2010), Environmental Engineering Vol. I Water Supply Engineering, Khanna Publishers. ISBN: 9788174091208
2. H.S.Peavy, D.R.Rowe & George Tchobanoglous (2005), Environmental Engineering, McGraw-Hill Company, New Delhi. ISBN: 9789380358246

Name of The Course	**Basic Transportation Engineering Lab**			
Course Code	**BCE02P3304**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives

1. To impart the knowledge in testing of different highway materials as per IS/IRC guidelines.

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand about aggregate crushing value test and aggregate impact test.
CO2	Perform Los Angeles Abrasion Test and Shape Test.
CO3	Understand different procedures for testing bitumen.
CO4	Test the highway materials as per IS/IRC guidelines.
CO5	Carry out Spot Test and California Bearing Ratio Test

Continuous Assessment Pattern

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

Course Content:

List of Experiments

12. Aggregate Crushing Value Test
13. Aggregate Impact Test
14. Los Angeles Abrasion Test
15. Shape Test
16. Penetration Test of Bitumen
17. Ductility Test of Bitumen
18. Softening Point Test of Bitumen
19. Flash and Fire Point Test of Bitumen
20. Viscosity Test of Bitumen
21. Spot Test
22. California Bearing Ratio Test

Suggested Reading

1. Kadiyali.L.R., and Lal.N.B., (2005), Principles and Practice of Highway Engineering, Fourth Edition, Khanna Publishers, ISBN-9788174091659.
2. Chakroborthy Partha, and Das Animesh, (2003), Principles of Transportation Engineering, Eighth Printing, Prentice-Hall of India, ISBN-9788120320840.
3. Rao.G.V., (1996), Principles of Transportation and Highway Engineering, Tata McGraw-Hill Co, ISBN- 9780074623633.
4. Khisty.C.J., and Lall.B.K., (2003), Transportation Engineering, Indian Edition, Prentice-Hall of India, ISBN- 9788120322127.

Name of The Course	**Water Analysis Lab**			
Course Code	BCE02P3404			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives

1. Understand the basic principles and concepts of unit operations and processes involved in water treatment.
2. Design of unit operations and processes involved in water treatment.
3. Evaluation of the performance of water treatment plants.

Course Outcomes

On completion of this course the student will be able to:

CO1	The type of unit operations and processes involved in water treatment plants.
CO2	Unit operations and processes required for satisfactory treatment of water.
CO3	The design of unit operation or process appropriate to the situation by applying physical, chemical, biological and engineering principles.
CO4	To study unit operations & advanced processes in water treatment its disinfection and aeration and softening.
CO5	The design of water treatments units in a cost effective and sustainable way and evaluate its performance to meet the desired health and environment related goals.

Continuous Assessment Pattern

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

Course Content:

List of Experiments

12. To determine the pH of a given water sample.
13. To determine the total solids, suspended solids, dissolved solids and volatile solids in wastewater.
14. To determine the turbidity and specific conductivity of the given water samples.
15. To determine the Alkalinity of given water sample.
16. To determine total hardness, permanent hardness and temporary hardness for given water sample.
17. To determine the chloride concentration of a given water sample.
18. To determine amount of sulphates in a given sample

19. To determine the dissolved oxygen content in a given water sample.
20. To determine BOD of the given wastewater sample.
21. To determine the COD of given sample.
22. To determine the optimum dosage of coagulant for turbidity removal of a given water sample.

Suggested Reading

1. Nathanson, Jerry A. (2007), Basic Environmental Technology: Water Supply, Waste Management, and Pollution Control, 5th ed., PHI Learning Private Limited ISBN: 978-81-203-3836-4
2. Rangwala (1999), Water supply & Sanitary Engineering, Charotar Publishing House, Anand-16th Edition. ISBN: 9788185594590
3. Metcalf and Eddy (2003), Wastewater Engineering, Treatment and reuse, Tata McGraw-Hill Edition, Fourth edition. ISBN:9780070495395

Name of The Course	**CAD Lab-I (AUTOCAD)**			
Course Code	**BCE01P3504**			
Prerequisite	**-**			
Co-requisite	**-**			
Anti-requisite	**-**			
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives

1. To understand the regulations as per National Building Code To analyse the structures.
2. To identify the functional requirements and building rules.
3. To understand the sketches and working drawings.

Course Outcomes

On completion of this course the student will be able to:

CO1	Implement the regulations for layout planning and preparation of drawings
CO2	Prepare building drawings for residential building and hospital buildings by AUTOCAD.
CO3	Design the different projections of the buildings.

Continuous Assessment Pattern

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

Course Content:

List of Experiments

9. AUTOCAD commands, drawing of lines, circles and different types of polygon.
10. Drawing plan, elevation and cross-sectional views of one storey residential building.
11. Drawing of staircases.
12. Drawing plan, elevation and cross-sectional views of two storey residential building.
13. Drawing plan, elevation and cross-sectional views of five story commercial building.
14. Drawing plan, elevation and cross-sectional views of three story hospital building.
15. Drawing plan, elevation and cross-sectional views of ten story college building.
16. Drawing of workshop with trussed roof.

Suggested Reading

1. S.C Rangwala (2013), "Civil Engineering Drawing", Charotar Publishing House Pvt. Ltd. ISBN: 978-93-80358-68-0
2. Richard B. Eaton (2005), "Building Construction Drawing", Donhead Publisher. ISBN: 9780821805633.
3. Padmini Murugesan (1997), Civil Engineering Drawing, Prithiba Publishers and Distributors. ISBN: 81-7525-282-0.

Name of The Course	**Analysis and Design Lab (STAAD PRO)**
Course Code	**BCE01P3605**

Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

Course Objectives

1. To teach the students to understand the details of STAAD – PRO software package.
2. To enable the students to know the behaviour of RCC structures.
3. To enable the students to design different components of structuresCourse Outcomes

On completion of this course the student will be able to:

CO1	Understand the details of STAAD – PRO software package.
CO2	Know the behavior of RCC structures.
CO3	Know the bending moment diagram drawn in tension face and shear force diagram.
CO4	Design RCC beams and columns.
CO5	Analyze and design RCC portal frames.

Continuous Assessment Pattern

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

Course Content:

List of Experiments

7. Analysis and design of simply supported RCC beam.
8. Analysis and design of cantilever RCC beam.
9. Analysis and design of continuous RCC beam.
10. Analysis and design of doubly reinforced RCC beam.
11. Analysis and design of RCC columns with different end conditions.
12. Analysis and design of RCC portal frames.

Suggested Reading

1. R. L. Jindal, (1996), Indeterminate Structures, Tata McGraw Hill Publishing House.
2. G. S. Pandit & Gupta S. P., (1998), Structural Analysis (A matrix approach), Tata McGraw Hill Publishing Ltd.
3. Wang C. K., (1996), Matrix Method of Structural Analysis, Jon Wiley publications.
4. IS:456 (2000), IS:800

Name of The Course	**Design and Innovation**				
Course Code	**BCE01P3606**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		0	**0**	**2**	**1**

Course Objectives

1. To teach the students to understand the details of STAAD – PRO software package.
2. To enable the students to know the behaviour of RCC structures.
3. To enable the students to design different components of structures

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand the details of STAAD – PRO software package.
CO2	Know the behavior of RCC structures.
CO3	Know the bending moment diagram drawn in tension face and shear force diagram.
CO4	Design masonry building.
CO5	Design RCC building.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term Exam (ETE)	Total Marks

50	-	50	100

Course Content:

List of Experiments

5. Design of (G+2) masonry building.
6. Design of staircase.
7. Design of (G+3) RCC building.
8. Design of (G+4) RCC building.

Suggested Reading

1. R. L. Jindal, (1996), Indeterminate Structures, Tata McGraw Hill Publishing House.
2. G. S. Pandit & Gupta S. P., (1998), Structural Analysis (A matrix approach), Tata McGraw Hill Publishing Ltd.
3. Wang C. K., (1996), Matrix Method of Structural Analysis, Jon Wiley publications.
4. IS:456 (2000), IS:800

Name of The Course	**Industrial Internship - I**				
Course Code	**BCE02P3501**				
Prerequisite	**-**				
Co-requisite	**-**				
Anti-requisite	**-**				
		L	**T**	**P**	**C**
		-	**-**	**-**	**1**

Course Objectives

4. To gain first-hand experience of working as an engineering professional, including the technical application of engineering knowledge.
5. To experience the discipline of working in a professional organization and multidisciplinary team.
6. To develop technical, interpersonal and communication skills.

Course Outcomes

On completion of this course, the students will be able to

CO1	Apply engineering knowledge in solving real-life problems.
CO2	Attain new skills and be aware of the state-of-art in engineering disciplines of their own interest.
CO3	Get exposure to real-life-working environment & practices, and to attain the professionalisms.
CO4	Work with multi-tasking professionals and multidisciplinary team.
CO5	Prepare a technical report, to improve presentation and other soft skills.

Continuous Assessment Pattern

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

Course Content:

Exposure to real life problems at various reputed industries engaged in areas of Civil Engineering.

Mode of Evaluation:

The evaluation of this training shall be included in the next semester evaluation. The student will be assigned a faculty guide who would be the supervisor of the student. The faculty will be identified before the end of the examination.

Students have to prepare an exhaustive technical report of the internship undertaken which will be duly signed by the officer under whom internship was taken in the industry/ organization. The covering format shall be signed by the concerned faculty in-charge of the student. The officer-in-charge would also give his rating of the student in a sealed envelope to the Dean of the SOCE. The student at the end of internship will present his report about the internship before a committee constituted by the Dean of the School which would be comprised of at least three members comprising of the Division Chair/Program Chair. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Dean.

The marks by the external examiner would be based on the report submitted by the student which shall be evaluated by the external examiner and cross

examination done of the student concerned. Not more than three students would form a group for such industrial internship.The final evaluation of the Industrial Internship will be based on the following criteria:

1. Presentation and contents of the report demonstrating well developed communication skill.
2. The professionalism displayed by the student during industrial training including the scope of quality industrial training attained.
3. Contribution of the employer in providing quality training and relevance of the student's industrial training to their degree.
4. Marks/grades for this course will be withheld until students complete the training. Without this mark/grade students cannot graduate.

Components	Internship Progress Report		Final Evaluation	
	Internal Supervisor	Industry Supervisor	Project Report	Presentation and Viva voice
Marks	25	25	25	25
Total Marks	50		50	
Overall Marks	100			

Name of The Course	Reinforced Concrete Structures			
Course Code	BCE02T3406			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	2	0	0	2

Course Objectives

1. To teach the students about the design of beams, columns, slabs by working stress method.
2. To enable the students to understand the limit state method of design of beams, columns and slabs.

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand the behavior of structural members and the concept of design.
CO2	Calculate moment of resistance for different types of RC beam sections.
CO3	Design any type of RC beam.
CO4	Understand the difference between one way slab and two way slab.

Continuous Assessment Pattern

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

Course Content:

Unit I: Material Properties and Design Concepts **7** **Lecture Hours**
Material properties: Compressive strength, tensile strength, design stress-strain curve of concrete - modulus of elasticity - grades of concrete - different types and grades of reinforcing steel - design stress-strain curve of steel. Introduction to design concepts, elastic behaviour of rectangular section, under, balanced and over reinforced section. Deflection and cracking in beams and slabs using IS code provisions. Design of singly reinforced beams by working stress method.
Unit II: Limit state design of beams **7** **Lecture Hours**
Design principles and procedures for critical sections for bending moment and shear forces. Flexural and shear design example of singly and doubly reinforced simply supported and cantilever beams using the codal provision. Detailing of longitudinal and shear reinforcement, anchorage of bars, check for development length. Reinforcement requirements, slenderness limits for beams for lateral stability. Flexural and shear design of simply supported T and L beams. Design of rectangular section for torsion.
Unit III: Limit State Design of Slabs **7** **Lecture Hours**
Introduction to one way and two way slabs, design of one way cantilever, simply supported and continuous slab, design of two way slabs.

Unit IV: Limit State Design of Compression Members **7** **Lecture Hour**
General design aspects of compression members. Design of short axially loaded columns with reinforcement detailing. Design of columns with uniaxial bending and biaxial bending using SP- 16 charts, design of long column.

Suggested Reading

1. Gambhir, M.L., (2011), "Fundamentals of Reinforced Concrete Design", Prentice-Hall of India. ISBN: 9788120330481.
2. S Unnikrishna Pillai & Devdas Menon, (2005), Reinforced Concrete Design, Tata Mcgraw Hill, ISBN: 9780070141100.
3. Varghese, P.C., (2009), Limit State Design of Reinforced Concrete, 2nd ed. ISBN: 9788120320390.
4. B. C. Punmia (2003), Design of reinforced concrete structures, Lakshmi Publishers.

Name of The Course	**Introduction to Design of Steel Structures**			
Course Code	**BCE02T3601**			
Prerequisite	**-**			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	**0**	**0**	**2**

Course Objectives

1. To understand the concepts of steel design.
2. To know the analysis and design of plate girder and gantry girder and its applications.
3. To know different types of roofs, calculation of forces and design of roof trusses.

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand different types of structural rolled steel sections and their properties and design of connections.
CO2	Design laterally supported and unsupported beams.
CO3	Design built up column sections, lacings, battens, column bases and tension members.
CO4	Design plate girders and understand curtailment of flange plates and stiffeners.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction and Design of Connection. **7** **Lecture Hours**
Introduction, Types and properties of structural rolled steel sections, Design of connections – Riveted - Welded - Bolted – Solution of simple problems.
Unit II: Design of beams **7** **Lecture Hours**
Simple and built-up beams – design of laterally supported and unsupported beams - concept of shear.
Unit III: Design of Compression Members and Tension Members **7** **Lecture Hours**
Design of column – built up section – single and double lacing – batten – Column bases – design of tension members.
Unit IV: Roof Trusses. **7** **Lecture Hours**
Types of roof trusses - Calculation of dead load, live load, wind load – Analysis and design of roof truss – Design of purlins.

Suggested Reading

1. Vajrani V. N., Ratwani M. M. and Mehra H. (2012), Design and Analysis of Steel Structures, 18th Edition, Oscar Publications, ISBN: 9788174092953.

2. Syal I. C. (2009), Design of Steel Structures, Standard Publishers Distributors, New Delhi, ISBN: 9788180141270.
3. Ramchandra (2006), Non Linear Analysis of Steel Structures, Standard Publishers Distributors, ISBN:9788180140785.
4. IS: 800-2007 & Steel Table.

Name of The Course	Quantity Surveying and Estimating			
Course Code	BCE02T3603			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. To understand the types of estimates.
2. To identify the methods of quantity estimation used for different structural components.
3. To understand rate analysis and process of preparation of bill of quantity.

Course Outcomes

On completion of this course the student will be able to:

CO1	Prepare a detailed estimate for different types of structures.
CO2	Prepare valuation reports and cost quality control.
CO3	Estimates the quantity of items and analyse its rates considering material, labour and machinery cost with the help of software.
CO4	Prepare valuation reports and cost quality control.
CO5	Know specifications of various items of works
CO6	Understand latest research paper..

Continuous Assessment Pattern

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

Course Content:

Unit I: Estimation of building **8 Lecture Hours**
Estimation of building works – Procedure of estimating, Types of estimates, detailed estimate of buildings including sanitary & electrical fittings.
Unit II: Estimate of R.C.C and Steel works **8 Lecture Hours**
Estimate of R.C.C and Steel works - Scheduling - Slab - beam - column & trusses, Road – earthwork fully in banking, cutting, partly cutting & partly filling - Detailed estimate for WBM, Bituminous road.
Unit III: Rate analysis & preparation of bills **8 Lecture Hours**
Rate analysis - preparation of bills – Data analysis of rates for various items of works – abstract estimates for Building projects – Introduction to software for Bill of Quantities & estimates.
Unit IV: Valuation **8 Lecture Hours**
Valuation- rent fixation, tenders, - contracts – accounting procedure, measurement book, stores, cost & quality control – PWD & CPWD practice - Specifications of various items of works - Schedule of Rates.
Unit V: Detailed specifications and Schedule of Rates **8 Lecture Hours**
Specifications of various items of works - Schedule of Rates.
Unit VI: Discussion on Latest Research Paper **4 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class..

Suggested Reading

1. Rangwala (2011), Specifications of Estimating, Costing and Valuation, Charotar Publishing House Pvt. Ltd. ISBN 9789380358543.

2. Vazirani, V. N. (2013), Civil Engineering Estimating Costing & Valuation, Khanna publishers. ISBN 9788174091277.

Name of The Course	Industrial Internship - II			
Course Code	BCE02P3702			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	-	-	-	1

Course Objectives

1. To gain first-hand experience of working as an engineering professional, including the technical application of engineering knowledge.
2. To experience the discipline of working in a professional organization and multidisciplinary team.
3. To develop technical, interpersonal and communication skills.

Course Outcomes

On completion of this course, the students will be able to

CO1	Apply engineering knowledge in solving real-life problems.
CO2	Attain new skills and be aware of the state-of-art in engineering disciplines of their own interest.
CO3	Get exposure to real-life-working environment & practices, and to attain the professionalisms.
CO4	Work with multi-tasking professionals and multidisciplinary team.
CO5	Prepare a technical report, to improve presentation and other soft skills.

Continuous Assessment Pattern

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

Course Content:

Exposure to real life problems at various reputed industries engaged in areas of Civil Engineering.

Mode of Evaluation:

The evaluation of this training shall be included in the next semester evaluation. The student will be assigned a faculty guide who would be the supervisor of the student. The faculty will be identified before the end of the examination.

Students have to prepare an exhaustive technical report of the internship undertaken which will be duly signed by the officer under whom internship was taken in the industry/ organization. The covering format shall be signed by the concerned faculty in-charge of the student. The officer-in-charge would also give his rating of the student in a sealed envelope to the Dean of the SOCE. The student at the end of internship will present his report about the internship before a committee constituted by the Dean of the School which would be comprised of at least three members comprising of the Division Chair/Program Chair. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Dean.

The marks by the external examiner would be based on the report submitted by the student which shall be evaluated by the external examiner and cross examination done of the student concerned. Not more than three students would form a group for such industrial internship.The final evaluation of the Industrial Internship will be based on the following criteria:

1. Presentation and contents of the report demonstrating well developed communication skill.
2. The professionalism displayed by the student during industrial training including the scope of quality industrial training attained.
3. Contribution of the employer in providing quality training and relevance of the student's industrial training to their degree.
4. Marks/grades for this course will be withheld until students complete the training. Without this mark/grade students cannot graduate.

Components	Internship Progress Report	Final Evaluation

	Internal Supervisor	Industry Supervisor	Project Report	Presentation and Viva voice
Marks	25	25	25	25
Total Marks	50		50	
Overall Marks	100			

Name of The Course	Capstone Phase - I			
Course Code	BCE02P3998			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	4	2

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

Course Outcomes

On completion of this course the student will be able to

CO1	Submit a project synopsis comprising of the application and feasibility of the project.
CO2	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety and sustainability.
CO3	Work and communicate efficiently in multidisciplinary teams..
CO4	Identify, formulate, and solve engineering problems.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

Components	Project Progress Report	Final Evaluation	
	Internal Supervisor	Project Report	Presentation and Viva voice
Marks	20	30	50
Total Marks	100		

Name of The Course	TQM in Construction			
Course Code	BCE02T3501			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. To familiarize with quality management in construction Industry.
2. To familiarize with clauses for quality management in construction Industry.
3. To understand the leadership in construction Industry.

Course Outcomes

On completion of this course the student will be able to:

CO1	To realize the importance of significance of quality.
CO2	Manage quality improvement teams.
CO3	Identify requirements of quality improvement programs
CO4	To realize the importance of significance of quality.
CO5	Identify requirements of quality management in the construction industry.
CO6	Understand latest research paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Quality management **8 Lecture Hours**
Quality management in construction industry, new approach to quality management, and road to quality management.
Unit II: Quality assurance **8 Lecture Hours**
Formal QA, quality assurance, ISO 9000, clauses of ISO 9000, third party assessment for construction works.
Unit III: Leadership and total quality management **8 Lecture Hours**
Leadership and total quality management, tools for total quality management, teamwork for total quality management, stages in team development, and role within a team.
Unit IV: Learning organization **8 Lecture Hours**
Learning organization, lean production and management applied to construction industry.
Unit V: Total quality management **8 Lecture Hours**
Quality management in the construction industry, research objectives, senior management and total quality management, cultural change in construction.
Unit VI: Discussion on Latest Research Paper **4 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Steven McCabe. (1998). "Quality Improvement Techniques in Construction." LONGMAN.
2. Kwakye, A.A. (1997), "Construction Project Administration", Adisson Wesley Longman, London.

Name of The Course	Estimation Lab (PRIMAVERA)			
Course Code	**BCE02P3607**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

Course Objectives

1.To develop the capacity of students in correlating theoretical knowledge into practical systems pertaining to civil engineering domain.
2. To foster collaborative learning skills.
3. To develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report both in oral and written format.

Course Outcomes

On completion of this course the student will be able to:

CO1	Identify, formulate, and solve engineering problems.
CO2	Understand specifications of various items of works and schedule of rates and prepare valuation reports.
CO3	Submit a project report comprising of the application and feasibility of the project.
CO4	Work and communicate efficiently in multidisciplinary teams.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Exam (MTE)	End Term	Total Marks

		Exam (ETE)	
50	-	50	100

Course Content:

List of Experiments

1. Determination of volume of excavation of earth.

2. Estimation for concrete and steel in footings.

3. Form work required for footings.

4. Estimation for brick walls and plastering.

5. Form work required for columns including scaffolding and shuttering.

6. Estimation for concrete and steel in columns.

7. Form work required for slabs including scaffolding and shuttering.

8. Estimation for concrete and steel in slabs.

9. Form work required for beams including scaffolding and shuttering.

10. Estimation for concrete and steel in beams.

11. Rate analysis for various items of works.

12. Preparation of bills.

13. Studies of PWD and CPWD practices.

14. Bar bending schedule.

15. Valuation of the building.

Suggested Reading

1. Rangwala (2011), Specifications of Estimating, Costing and Valuation, Charotar Publishing House Pvt. Ltd. ISBN 9789380358543.

2. Vazirani, V. N. (2013), Civil Engineering Estimating Costing & Valuation, Khanna publishers. ISBN 9788174091277.

Name of The Course	**Capstone Phase – 2**			
Course Code	**BCE02P3999**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	**0**	**20**	**10**

Course Objectives

5. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
6. Foster collaborative learning skills.
7. Develop self-directed inquiry and life-long skills.
8. To enhance the communication skills of the students by
   providing opportunities to discuss in groups and to present
   their observations, findings and report in formal reviews
   both in oral and written format.

Course Outcomes

On completion of this course the student will be able to:

CO1	Submit a project synopsis comprising of the application and feasibility of the project.
CO2	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety and sustainability.
CO3	Work and communicate efficiently in multidisciplinary teams..
CO4	Identify, formulate, and solve engineering problems.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

Components	Project Progress Report	Final Evaluation	
	Internal Supervisor	Project Report	Presentation and Viva voice
Marks	**20**	**30**	**50**
Total Marks	**100**		

Name of The Course	**Construction Contracts Administration and Management**				
Course Code	**BCE02T3502**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives

1. Understand the broad principles and concepts of construction management.
2. To create awareness of MIS techniques in construction industry.
3. Represent various works measurement standards.

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand construction contract various stages of a project..
CO2	Understand the conceptual clarity about contract Formation
CO3	Understand the contract management, Project Procurement, Service level Agreements and productivity.
CO4	Understand the conceptual clarity about FIDIC conditions.
CO5	Understand the Construction Claims and Dispute Resolution.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Construction Contracts **8 Lecture Hours**
Contract Act (1872) :a)Definition of the contract as per the ACT. Valid, Voidable, Void contracts, Objectives of the act.(from model 5) b) Clauses 1 to 75- Contract formation, contract performance, valid excuses for non-performance, Breach of contract, effects of breach- understanding the clauses and applying them to situations/scenarios on construction projects. Importance of the Workmen's Compensation Act on construction projects.
Unit II: Contract Formation **8 Lecture Hours**
Standard forms of contracts, methods of inviting tenders, pre-bid meetings, pre-qualification system, scrutiny of tenders and comparative statement. b) Contract formation, conditions of contracts, contracts with various stakeholders on a major construction projects, contract pricing by the client, project management consultants and the contractor, contract performance, contract correspondence and contract closure.
Unit III: Contract Conditions **8 Lecture Hours**
General condition and Particular conditions, b) Conditions of Ministry of Statistics and Program Implementation- Government Of India. Model forms of contract.
Unit IV: FIDIC **8 Lecture Hours**
ICE introduction, FIDIC conditions- evolution of FIDIC document, types based on whether design is of employer or contractor, Design & Build contract, EPC contract, short forms of contract- Colour Code. Various conditions of Red Book.
Unit V: Construction Claims and Dispute Resolution

8 Lecture Hours
Construction Claims : Extra items and causes of claims. Types of construction claims, documentation. settlement of claims .Dispute Resolution: Causes of disputes and importance of role of various stakeholders in prevention of disputes, Alternate Dispute Resolution methods-mediation, conciliation, arbitration and Dispute Resolution Boards.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Civil Engineering Contracts and Estimates - B. S. Patil – Universities Press- 2006 Edition, reprinted in 2009.
2. The Indian Contract Act (9 of 1872), 1872- Bare Act- 2006 edition, Professional Book Publishers.
3. The Arbitration and Conciliation Act,(1996), 1996 (26 of 1996)- 2006 Edition, Professional Book Publisher.
4. Law of contract Part I and Part II, Dr. R.K. Bangia- 2005 Edition, Allahabad Law Agency.

Name of The Course	**Project Economics & Financial Management**			
Course Code	**BCE02T3602**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To help the students to develop cognizance of the importance of Financial Management in corporate valuation.
2. To enable students to describe how people analyze the corporate leverage under different conditions and understand why people valuate different corporate in different manner.
3. To provide the students to analyze specific characteristics of Supply Chain Industry and their future action for cash flow.

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand importance of the economic background to measurement.
CO2	Understand the cost implication to different forms of construction and maintenance and maintenance and replacement lives of material.
CO3	Understand the long term finance planning.
CO4	Understand the conceptual clarity about corporate sector.
CO5	Understand the conceptual clarity about accounting process.
CO6	Understand latest research paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Principles of Economics **8** **Lecture Hours**
Importance of the economic background to measurement, objectives of business firm. Factors bearing on size of firms. Motives to growth. Obstacles to growth of firms, Study of present economy. Capital: Analysis of need for working capital, Estimation of requirements of working capital, Credit Management, Cash Management,. Corpus Fund
Unit II: Economic Analysis: **8** **Lecture Hours**
Cost implication to different forms of construction and maintenance and maintenance and replacement lives of material, Installation and

running cost of services, Capital investment in project, Cost analysis by traders and by functional element, Cost planning techniques, Cost control during design and Construction, Depreciation, Various Appraisal Criteria Methods. Break-even analysis, Cash flow analysis, Risk Analysis and Management Practice, Role of Lender's Engineer. Cost pricing method
Unit III: Financial Planning: **8** **Lecture Hours**
Need and sources of Finance, Long term finance planning, Stock, Borrowings, Debentures, Loan Capital, Public Deposit, Dividend Policies, Bonus Shares, Market value of shares, Reserves. Budget: Budgetary control system. Types of budgets, Procedure for master budgets. Budget manual. Accounting Information System:, Project Commentary, project Running Commentary .
Unit IV: Corporate Sector: **8** **Lecture Hours**
Corporate tax planning, Public policies on ICRA grading of exchange, World financial market, Role of financing institutes in Construction sector, SEBI regulation., GST, CGST, SGST, Direct Tax Court System
Unit V: Construction Accounts: **8** **Lecture Hours**
Accounting process, preparation of profit and loss account and balance sheet as per the companies Act2013, preparation of contract accounts for each project, methods of recording and reporting site accounts between project office and head office, Ratio Analysis. Escrow Account for PPP Project.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Construction project scheduling and control ---- Mubarak, Wiley India.
2. Construction Management & PWD Accounts --- D Lal, S. K. Kataria & Sons, 2012
3. Construction Management and Accounts -- Singh H. Tata McGraw Hill, New Delhi, 1988 4. Construction Management: Planning and finance-- Cormican D. Construction press, London, Feb 2002.
5. Principles of Corporate Finance, Brealey R.A. Tata McGraw Hill, New Delhi, 2003.

Name of The Course	**Sustainable Construction Materials**			
Course Code	**BCE02T5701**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. This course mainly aims to develop the knowledge about sustainable construction materials and importance of sustainable construction.
2. To make the students to understand sustainable construction materials & process.
3. Students get ideas about different types structure conditions.
4. Students understand repair techniques.

Course Outcomes

On completion of this course the student will be able to:

CO1	Know the sustainable construction materials – meaning, scope, nature, present status of the sustainable construction materials.
CO2	Study and application of various conditions of sustainable construction.
CO3	Get a thorough knowledge of various types of Sustainable Projects.
CO4	Know the different procedures for Disputes Resolving.
CO5	Understand different types of Risk Management in project.
CO6	Understand latest research paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Necessity and importance. **8 Lecture Hours**
Necessity and importance of sustainable construction materials. Material composition and properties, production, storage, distribution, testing, acceptance criteria, limitations of use, economic consideration, and recent development related to the following materials to be studied.
Unit II: Various construction chemicals/admixtures **8 Lecture Hours**
Various construction chemicals/admixtures , Fly ash and its use in concrete ,Silica fume concrete ,Self-compacting concrete, Fiber Reinforced plastics and concrete ,Light weight concrete.
Unit III: Special Materials **8 Lecture Hours**
Crumb modified bitumen Rubber, Glenium Concrete, Materials used in nuclear-containment structures. Gas pressure welding of rebar. Precast concrete.
Unit IV: High performance concrete **8 Lecture Hours**
High performance concrete, Nano technology in cement concrete, Ferro cement Technology. Mix design As per Is code 10262:2019
Unit V: Maintenance of Structure **8 Lecture Hours**
Materials for Repairing - Special concretes and mortar - Concrete chemicals - Special elements for accelerated strength gain - Expansive cement - Polymer concrete – Ferro cement, Fibre reinforced concrete - Fibre reinforced plastics. Risk Management in project.
Unit VI: Discussion on Latest Research Paper **4 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Concrete Technology by Neville.
2. Construction Materials, Methods & Techniques(3e) by William P Spence, Yesdee Publication 2012, Pvt. Ltd,, Chennai, India
3.Concrete Structure properties & Materials by Mehta P.K & Mantreio P.J.M, Prentice hall.
4.Concrete Technology by M.S.Shetty, S.Chand Publ.
5. Civil Engineering and Construction Review magazine.
6. New Building Materials and Construction World magazine.
7. Is code 10262: 2019

Name of The Course	Environment And Energy For Sustainable Construction			
Course Code	**BCE02T5702**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. The objective of this course is to expose the students to the concepts of sustainability in the context of building and conventional engineered building materials, such as Concrete, Bricks, and achieving the same through lower Carbon cements, Superior brick kilns and Recycled aggregate minimizing consumption of natural resources including water.
2. To make the students to understand VOC and indoor air quality.
3. To make the students to understand Energy codes ECBC requirement.

4. Students understand Role and Civil Society-Social Movements and Non-Governmental / Governmental Organizations.

Course Outcomes

On completion of this course the student will be able to:

CO1	Know about Role of Material in sustainable construction.
CO2	Study and know about operational energy in sustainable construction.
CO3	Get a thorough knowledge of Comparative energy performance emission
CO4	Know &Understand Energy codes ECBC requirement.
CO5	Understand latest research paper.
CO6	Students understand use of renewable energy in buildings.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction **8 Lecture Hours**
Embodied energy, Operational energy in Building and Life cycle energy. Ecological foot print, Bio-capacity and calculation of planet equivalent.
Unit II: Role of Material **8 Lecture Hours**
Carbon from Cement, alternative cements and cementitious material, Alternative fuel for cements for reduction in carbon emission. Sustainability issues for concrete, Role of quality, minimization of natural resource utilization, High volume fly ash concrete, geo-polymer concrete etc. concrete with alternative material for sustainability.
Unit III: Aggregates and water consumption **8 Lecture Hours**
Reduction in water consumption in concrete, Recycled aggregate, Energy for grinding crushing of cement aggregate etc. and reduction. Operational energy in building role of materials and thermal conductivity. Clay Bricks, Types kilns, Comparative energy performance emission performance and financial performance, Indoor air quality.
Unit IV: Sustainability and Health **8 Lecture Hours**
Paints, Adhesive and sealants for use in building, Volatile organic content (VOC) emission issues and indoor air quality for Sustainability and Health hazard Operational energy reduction and net zero building, Optimization for design of building for energy efficiency and example of optimization through use of Evolutionary genetic algorithm.
Unit V: Building Integrated Photo Voltaic **8 Lecture Hours**
Use of Building Integrated Photo Voltaic (BIPV) and other renewable energy in buildings, basic concepts and efficiency. Radiation budget, Surface water balance, Effects of trees and microclimatic modification through greening.
Unit VI: Discussion on Latest Research Paper **4 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1.Fereidoon P. Sioshansi (2011) Energy, Sustainability and the Environment, Butterworth-Heinemann. Page; 640pp. ISBN 9780123851376.
2.Ali Sayigh (2013) Sustainability, Energy and Architecture, Academic Press. Pages; 552pp. ISBN 9780123977571.
3.Vivian Tam Khoa Le (2019) Sustainable Construction Technologies, Butterworth-Heinemann. Pages; 490pp. ISBN 9780128117507.

Name of The Course	Human Rights			
Course Code	BCE02T5703			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. This course mainly aims to develop the knowledge about human rights and importance of human rights in construction as well as in day to day life.
2. To make the students to understand Human rights / laws.
3. To make the students to understand Human rights and the international scene.
4. Students understand Citizens' Role and Civil Society- Social Movements and Non-Governmental Organizations**.**

Course Outcomes

On completion of this course the student will be able to:

CO1	Know the Basic Human right –meaning, scope, nature, present status of the Human rights.
CO2	Study and application of various conditions of Rights.
CO3	Get a thorough knowledge of various types of Human rights – Types of Human rights.
CO4	Know the different procedures for Human rights.
CO5	Understand different types of Human rights in day to day life.
CO6	Understand latest research paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Human Rights – Concept, Development, Evolution **8** **Lecture Hours**
Human Rights – Concept, Development, Evolution- Philosophical, Sociological and Political debates- Benchmarks of Human Rights Movement.
Unit II: Human Rights and the Indian Constitution **8** **Lecture Hours**
Human Rights and the Indian Constitution - Constitutional framework - Fundamental Rights & Duties - Directive Principles of State Policy - Welfare State & Welfare Schemes.
Unit III: Human Rights & State Mechanisms **8 Lecture Hours**
Human Rights & State Mechanisms- Police & Human Rights- Judiciary & Human Rights- Prisons & Human Rights- National and State Human Rights Commissions.
Unit IV: Human Rights of the Different Sections **8** **Lecture Hours**
Human Rights of the Different Sections and contemporary issues- Unorganized Sector, - Right to Environment, particularly Industrial sectors of Civil Engineering and Mechanical Engineering - Globalization and Human Rights- Right to Development.
Unit V: Citizens' Role and Civil Society **8** **Lecture Hours**
Citizens' Role and Civil Society- Social Movements and Non-Governmental Organizations- Public Interest Litigation-Role of Non-Government organizations in implementation of Human rights. - Right to Information.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications.

Minimum one latest research paper will be discussed in the class.

Suggested Reading

1.BASIC HUMAN RIGHTS Authors Name V M Thorat ISBN 9789388293082
2.Study material on UNESCO, UNICEF web site.
3.Human Rights in India- A Mapping, Usha Ramanathan: free download from http://www.ielrc.org/content/w0103.pdf
4.Introduction to International Humanitarian Law by Curtis F. J. Doebbler - CD Publishing.
5.Information, by Toby Mendel - UNESCO, 2008

Name of The Course	**Human Resource Development**			
Course Code	**BCE02T5704**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. The course aims to equip students to develop themselves into a critically reflective and capable HRD practitioner, or a manager who can facilitate the learning of others.
2.The major objective of the course is to explain and demonstrate the contribution of HRD in an organization and enable student to develop an ability to decide learning and training needs; and have competence in the design and delivery of learning programmes.
3.To make the students to understand about counselling programmes of HRD.
4.Students understand about Career development and Intellectual capital.

Course Outcomes

On completion of this course the student will be able to:

CO1	Perceive strategic perspective of HRD.
CO2	Understand HRD Process Model.
CO3	Understand Employee coaching and performance management.
CO4	Know about counselling programmes of HRD.
CO5	Know about Career development and Intellectual capital.
CO6	Understand latest research paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to Human Resource Development **8** **Lecture Hours**
Emergent of HRD, Critical HRD roles, challenges for HRD. HRD in global perspective, HRD-Performance link, Strategic perspective of HRD.
Unit II: HRD Process Mode **8** **Lecture Hours**
Identification of HRD needs and Design and development of HRD programs. Methods of Implantation, Evaluation of HRD programs.
Unit III: Performance management **8** **Lecture Hours**
Coaching to improve poor performance, coaching analysis. Coaching to improve poor performance, coaching analysis.
Unit IV: Unit IV: Competency framework of HRD **8** **Lecture Hours**
Why competency mapping? Understanding the competency mapping framework, Overview of counselling programmes, employee assistance programme, stress management, employee wellness and health promotion.
Unit V: Intellectual capital (IC) **8** **Lecture Hours**
Components of IC, measurement models of IC, IC index and challenges for HR. Career Planning, management, and development: Career

development stages and activities, role of individual and organization in career planning, Issues in career management.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Pat Hargreaves and Peter Jarvis (1998) The Human Resource Development Handbook, London: Kogan Page; 212pp. ISBN 0 7494 2429 (hardback)
2.Francesco sofo (1999) Human Resource Development: Perspective, Roles and Practice choices, Warri wood, New South Wales: Business and Professional Publishing; 365pp. ISBN 1 875680 74 8; (paper)
3.John Walton (1999) strategic Human Resource Development, Harlow: Pearson Education; 614pp. ISBN 0 273 62636 1 (paper)

Name of The Course	**Value Engineering and Valuation**				
Course Code	**BCE02T5706**				
Prerequisite	**-**				
Co-requisite	**-**				
Anti-requisite	**-**				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives

1. Define Value engineering and its objectives
2. Estimation of project budget using capitalized income approach
3. Analyze a building using LCC methodology

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand the basics of Value Engineering (VE) to ensure that a standardized method is used for VE applications to projects.
CO2	Learn to perform "function analysis" for buildings and civil projects
CO3	Understand the appropriate time to apply VE for building design projects.
CO4	Understand the value engineering and total project management.
CO5	Understand the function system in project management.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Value engineering **8** **Lecture Hours**
Introduction to value engineering (VE), definition, objectives of value engineering, reasons for unnecessary costs, VE techniques and methodology, interface with the other programs.
Unit II: Project budget **8** **Lecture Hours**
Elements of the project budget, need for cost control, meaning of capitalization, capitalization process, and capitalized income approach to construction project budgeting.
Unit III: Life cycle cost (LCC) and building costs **8** **Lecture Hours**
Life cycle cost (LCC) and building costs, LCC technology and examples, LCC methodology, LCC formats and analysis and weighted evaluation – application of LCC to buildings.
Unit IV: Value engineering and total project management **8** **Lecture Hours**
Value engineering and total project management, level of effort, team selection, value engineering job plan, and work plan phases
Unit V: Function system

	8 **Lecture Hours**
Classifying function, defining function, project level function system technique (fast) diagram, creativity and fixation, interpersonal skills, generation of ideas, brainstorming, rules for brainstorming, Delphi technique, application of Delphi technique to civil engineering projects.	
Unit VI: Discussion on Latest Research Paper	**4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.	

Suggested Reading

1. Jay Mandelbaum Danny L. Reed, Project Leader
2.Tenah, K.A. (1985). "The Construction Management Process", Reston Publishing Company, Inc. Virginia
3. Dell'Isola, Alphonse (1997). "Value Engineering: Practical Applications." R.S. Means Company, Inc: Kingston, MA.
4. Oberiender, G. D. (1993). "Project Management for Engineering and Construction". McGraw-Hill, Inc.: New York

Name of The Course	**Infrastructure Development**				
Course Code	**BCE02T5707**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives

1. Importance of prefabrication in construction
2. Advantages of modular coordination in prefabrication
3. Application of different equipments in construction industry

Course Outcomes

On completion of this course the student will be able to:

CO1	Interpret the basic principles of geo-mechanics and their application in infrastructure development.
CO2	Interpret the design of structural elements.
CO3	Explain the complexities of delivery of infrastructure works and processes used for project development and management.
CO4	Learn to issues related to infrastructure development.
CO5	To study different infrastructure project.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Construction Industry	**8** **Lecture Hours**
Nature, characteristics, size and structure. Role of infrastructure development in employment generation and improving of the National economy. Various Agencies associated with infrastructure development in India as regards various sectors.	
Unit II: Status of Infrastructure in India	**8** **Lecture Hours**
Resource Planning- Planning for material, Labour, time and cost-Resources Utilization, material, Labour, time and cost - Procurement-inventory control	
Unit III: MATERIAL, EQUIPMENT AND LABOUR	**8** **Lecture Hours**
Road sector Port , Railway, communication, water supply and drainage, Power sector, oil and gas industry, Health and educational services. Infrastructure Development, Indian budget and its relation with Infrastructure development projects in India. Various programs related with Infrastructure development in rural and urban	

sector. Public Private Partnership (PPP) in Infrastructure, Draft Concession Agreement for PPP projects, Escrow Agreement.
Unit IV:Issues related to infrastructure development **8** **Lecture Hours**
Pre – requisites necessary to ensure success for switching over from public sector management to private sector management, issues in developing, funding and managing infrastructure projects, role, responsibility of project management consultants. FDI in Infrastructure development, Problem areas and solutions.
Unit V: SPV's for Infra projects **8** **Lecture Hours**
JNNURM - Jawaharlal Nehru National Urban Renewal Mission, PMGSY – Pradhan Mantri Gram Sadak Yojana, RGGVY - Rajiv Gandhi Grameen Vidyutikaran Yojana, Ports Connectivity Projects, Indira Gandhi International Air Port project, Indo – US Nuclear Deal, Nuclear Power Projects in India.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Construction Engineering & management of Projects(For Infrastructure & Civil Works) by S. C. Sharma, Khanna Publishers, 2nd Edition, 2011
2. India Infrastructure Report – Rakesh Mohan.
3. Infrastructure Today – Magazine.
4. Document of five year plans, published by Govt. of India.
5. Public Private Partnership in Infrastructure by R. N. Joshi Vision Publications – 2010.
6. Infrastructure Development in India by Rajarshi Majumder Rawat Publications – 2010

Name of The Course	**International Contracting**

Course Code	**BCE02T5708**			
Prerequisite	**-**			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. This course mainly aims to develop the knowledge about international contracting and importance of contact in construction.
2. To make the students to understand international contract/construction laws.
3. To make the students to understand Risk Management in project.
4. Students understand Managing Variations in Contracts.

Course Outcomes

On completion of this course the student will be able to:

CO1	Know the International contracting – meaning, scope, nature, present status of the International Construction.
CO2	Study and application of various conditions of contract.
CO3	Get a thorough knowledge of various types of International Projects – Types of BOT systems. Understand different types of Risk Management in project.
CO4	Know the different procedures for Disputes Resolving.
CO5	Understand different types of Risk Management in project.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: International Contracting: Defining the Playing Field **8 Lecture Hours**

International contracting –meaning, scope, nature, present status of the International Construction market, role of Asia- Pacific region countries in the present construction development. Impact of WTO/GATS on the Indian Construction Sector as regards domestic market and export sector. Selection of personnel to suit socio-economic-environmental culture in other countries, suitable organizational structure.
Unit II: Study Of various Contract Condition 8 Lecture Hours
Study and application of various conditions of contract under the FIDIC document. Development of regulatory framework. Project exports from India. International financing: Various institution such as WB, IMF, ADB. African bank etc. and their role, rules – regulations in funding various projects, forming alliance, bilateral and multilateral funding, trade practices etc.
Unit III: International Projects 8 Lecture Hours
International Projects – Types of BOT systems such as BOT, BOOT, BOO, DBO, BOR, BLT, BRT, BTO & DBFOT, MOOT, ROO, ROT, and BOLT – Contractual procedures, special features, and methods of handling.
Unit IV: Disputes Resolving 8 Lecture Hours
Disputes Resolving – International Courts, formation of DRB's (Dispute resolving boards) - functioning and experiences in India and abroad, Advantages of DRB's UNICTRAL Proceedings for International Arbitration. Institutionalized Arbitration, CIDC – SIAC Arbitration. CASE studies of any 2 major project executed/functioning under International Contracting.
Unit V: Project & Risk Management 8 Lecture Hours
Risk Management in project, Case-Contractor Withdraws from negotiation due to risk exposure. The many face of risk. Definition of risk. Risk Policy of Contractors.

Unit VI: Discussion on Latest Research Paper 4 Lecture Hours
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1.International Contracting: Contract Management in Complex Construction Projects. Book by A. J. van Weele and John Puil ISBN 978-1-908979-50-6

2.A Short Course in International Contracts: Drafting the International Sales by Karla C.Shippe: world trade press.

3.Simon M.S. McGraw Hill (2007);" Construction Contracts & Claims", New York. ISBN: 9780070574335. 278 p.

4.FIDIC documents.

Name of The Course	**Thrust Areas in Project Management**			
Course Code	**BCE02T5709**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To understand the knowledge of Project Pre-planning and Partnering
2. To analyze the SWOT and SCM of the construction project
3. To study about the critical chain management
4. To understand the concepts of cost variance, cost performance index and schedule performance index methods of determining earned value
5. To study on the reporting requirements of particular specifications.
6. Understand latest research paper.

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand project characteristics and various stages of a project.

CO2	Understand the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic.
CO3	Understand the critical chain in construction projects based on the theory of constraints.
CO4	Understand the importance of earned value analysis.
CO5	Understand the various stakeholders of projects associated with reporting.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Project Pre-planning and Partnering **8** **Lecture Hours**
a) Project preplanning:- Project Influence cost diagram. Need for project preplanning in the context of time and cost overruns, reduction in economic benefits. Definition selecting pre-planning team and evaluation of alternatives. Decision whether to invest in project design Concept of PDRI—Project definition rating index. PDRI for residential and industrial buildings. Utility of PDRI with respect to benchmarking. Any case study on Project pre—planning. b) Project partnering:- Delimitation, partnering as an effective risk sharing mechanism, partnering charter, partnering workshop. Advantages of partnering role in preventing construction disputes, risk management and QM. C Critical success factors for implementation Any case study on project partnering.
Unit II: S. W. O. T. analysis and S. C. M **8** **Lecture Hours**
a) S. W. O. T Strengths, Weaknesses, opport Moduleies, threats analysis. Conduct S. W. O. T. for individual construction organization, Indian Construction industry. Advantages, S. W. O. T. matrix utility of S. W. O. T. matrix on strategic planning and management. b) S. C. M. Supply Chain Management. Concept of Supplier and customer in context of ISO. Identifying the chain associated connecting various processes between the supplier and the customer in context of construction project. Management strategy for implementing S. S. C. M. in construction organizations and on construction projects. Benefits of S. C. M.
Unit III: Critical Chain Management (CCM) and Fast Track Construction **8** **Lecture Hours**
Critical Chain Management (CCM):-- Concept of critical chain in construction projects based on the theory of constraints. Developing critical chain plans for a single project and multiple projects. Measuring, monitoring and controlling the critical chain. Advantages of CCM. Fast Track Construction:-- Diagrammatic representation of the concept of the fast track construction. Advantage, suitability of fast track construction. Form of contract suitable for fast track projects. Concept of guaranteed maximum pricing (GMP). Any one case study on fast track constriction.
Unit IV: Earned Value Analysis **8** **Lecture Hours**
Definition of earned value. Importance of Earned value analysis. Concepts of cost variance, schedule variance, cost performance index and schedule performance index methods of determining earned value viz. Ratio method, repetitive type work package method, Complex construction work package method, start or finish method. Accounting practices for determining the earned value.

Unit V: Project Reporting **8 Lecture Hours**
Guidelines for report preparation, various stakeholders of projects associated with reporting. Scheduling program default report content, report Sorting, selection criteria, interpretation. Reporting requirements of particular specifications. Use of project Management software's in reporting. Study of sample project reports.
Unit VI: Discussion on Latest Research Paper **4 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Prasanna Chandra; Projects- Planning, Analysis, Selection, Financing, Implementation and Review',VI Edition, Tata Mc Graw Hill, 8th Edition 2015.
2. Pre-project planning handbook—published by Construction Industry Institute (CIT) USA.
3.ASCE journal papers on project pre-planning to be used. ASCE journal papers on project partnering to be used.
4. Project Management—Financial evaluation with strategic planning, networking and control—Bhavesh Patel—2nd edition 2010, reprinted in 2011—Vikas publishing House Pvt. Ltd.

Name of The Course	**Leadership & Team Building**			
Course Code	**BCE02T5710**			
Prerequisite	**-**			
Co-requisite	**-**			
Anti-requisite	**-**			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To study Develop and strengthen interpersonal skills
2. To study how to become familiar with and discuss different leadership models and studies
3. To study the various stages of leadership, its styles and connection to factors for success in today's society.
4. To study the way in which various mechanisms can allow for significant improvements in individual, team, and organizational performance.

Course Outcomes

On completion of this course the student will be able to:

CO1	Students will apply competencies and skills acquired in the leadership program.
CO2	Apply leadership theory and practice to decision-making and actions as a manager
CO3	Recognize the implications of leadership style and its impact on team and organization performance
CO4	Identify and critically assess assumptions that influence decisions and actions on management, leadership, teamwork and relationship building
CO5	To study the leadership models.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: EFFECTIVE COMMUNICATION: 8 Lecture Hours
Characteristics of the ideal communicator. Basic communication skills: empathy, active listening, assertiveness, rapport. Models of verbal and non-verbal communication. Steps to building a successful presentation. Structuring a story. Keys to high-impact slides. Ways to combat anxiety: cognitive and relaxation techniques. Oral expression techniques.

Unit II: MULTIPLE INTELLIGENCES & EMOTIONAL INTELLIGENCE **8 Lecture Hours**
Emotional intelligence: origin and pillars, Components of emotional intelligence according to Daniel Goleman, The world of emotions: multiple functions. Self-esteem: self-awareness. Our feelings regarding our interests, values, and ways of thought. The ability to overcome obstacles: "Resilience as an affective strength. Managing relationships: how to confront a crisis. Improving our social relationships: empathy and assertiveness. Leading minds: the intelligences in relation to leaders and creators.
Unit III: EFFECTIVE LEADERSHIP **8** **Lecture Hours**
Will and motivation. Personal leadership, self-knowledge, and self-control. Using power responsibly and respectfully: the leader as a team-builder. Serving the organization. Ability to plan future actions and transmit that vision to others. Take the initiative and stimulate others.
Unit IV: LEADERSHIP & VALUES **8** **Lecture Hours**
Value-based management. The foundation of values. Freedom and decision making. Conflicting ideas.
Unit V: LEADERSHIP MODELS **8Lecture Hours**
Types of leadership. Traditional, legal, and legitimate leader .Formal and informal. Individual, executive, and institutional. Categories: autocratic, democratic, charismatic, paternalistic, authentic, spiritual. Dictatorial, etc. Classifying leadership, Characteristics of a leader. Leadership techniques
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1 Leadership and Team Building by vijay kumar haldar.

2. Team Building and Leadership (With Text & Cases) 1st Edition (English, Paperback, D. K. Tripathi)

3. Seven habits of highly effective people—Stephen Covey—Franklin Covey Publications

Name of The Course	**Material Management & Inventory Control**			
Course Code	**BCE02T5711**			
Prerequisite	**-**			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To Study about the material organizing and purchasing
2. To Study about the material supply and demand
3. To Study about the material storage and causes of wastage of materials

Course Outcomes

On completion of this course the student will be able to:

CO1	Identifying the scope for integrating materials management function over the logistics and supply chain operations..
CO2	Apply various purchasing method and inventory controlling techniques into practice.
CO3	Analyzing the materials in storage, handling, packaging, shipping distributing and standardizing.
CO4	To study the storage management..
CO5	To study the wastage management.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Material Classification **8 Lecture Hours**
Organizing for materials management – basis for forming organizations – conventional and modern approaches to organizing materials management. Materials identification – classifying of materials – codification of materials – standardization – simplification and variety reduction of materials
Unit II: Material Purchasing **8 Lecture Hours**
Material Purchasing– Planning Purchasing Materials – Norms Of Vendor Rating – Cei Methodology – Material Selection And Development – Purchasing Procedures And Methods – Legal Aspects – Insurance Of Materials.
Unit III: Procurement Management **8 Lecture Hours**
Supply Management – Sources Of Supply – Out Sourcing Material Management Procurement Organization - Procurement Planning - Functions Of Material Management - Inventory Control.
Unit IV: Store Management **8 Lecture Hours**
Storing of Materials-Management of stores – location – different types of stores – methods of storing – safety and security of materials – stores equipment – materials handling equipment – factors affecting materials handling
Unit V: Waste Management **8 Lecture Hours**
Scrap & Obsolete Materials-Management of surplus obsolete and scrap materials – reasons for accumulation of surplus obsolete and scrap materials – methods of disposal – regulations and procedures
Unit VI: Discussion on Latest Research Paper **8 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Datta .A.K, "Materials Management: Procedures, Text and Cases", PHI Learning Pvt. Ltd., 2004.
2. Arnold, "Introduction To Materials Management", Pearson Education India,2009
3. Richard J. Tersine, "Principles Of Inventory And Materials ,Management", Prentice Hall,2004
4. Richard J. Tersine, "Modern Materials Management", John Hardin Campbell - 2007

Name of The Course	**Marketing Research**			
Course Code	**BCE02T5712**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To study Meaning of research
2. To study the literature survey, and strategies of literature survey.
3. To study the report writing need of effective documentation.

Course Outcomes

On completion of this course the student will be able to:

CO1	Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.
CO2	Have basic knowledge on qualitative research techniques.
CO3	Have adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis..
CO4	Have basic awareness of data analysis-and hypothesis testing procedures.
CO5	To study the advanced data analysis techniques.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to Research Meaning of research **8** **Lecture Hours**
Introduction to Research Meaning of research, types of research, process of research, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, formulation of research hypotheses. Search for causation. Developing a Research Proposal Format of research proposal, Individual research proposal, Institutional research proposal, Significance, objectives, methodology, Funding for the proposal, Different funding agencies. Framework for the planning
Unit II: Literature survey **8** **Lecture Hours**
Literature survey Definition of literature and literature survey, need of literature survey, sources of literature, elements and objectives of literature survey, styles of literature survey, and strategies of literature survey.
Unit III: Data collection **8** **Lecture Hours**
Data collection, Measuring, Sampling and Scaling Classification of data, benefits and drawbacks of data, evaluation of data, qualitative methods of data collection, methods of qualitative research, Sampling, sample size, sampling strategy, attitude measurement and scaling, types of measurements, criteria of good measurements, classification of scales.
Unit IV: Preliminary data analysis Testing of hypothesis **8** **Lecture Hours**
Preliminary data analysis Testing of hypothesis-concepts and testing, analysis of variance techniques, introduction to nonparametric tests. Validity and reliability, Approaches to qualitative and quantitative data analysis.
Unit V: Advanced data analysis techniques **8** **Lecture Hours**
Advanced data analysis techniques Correlation and regression analysis, Introduction to factor analysis, discriminate analysis, cluster analysis, multidimensional scaling, Descriptive statistics, Inferential statistics, Multi-dimensional measurement and factor analysis.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1.Malhotra N.K. (2011) Marketing Research, Pearson Education, Inc.

2. Zikmund W.G. (2007) Business research Methods, Thomspns, Akash Press New Delhi.

3. Research Methodology: Methods and Trends, by Dr. C. R. Kothari, New Age International Publishers.

4. Research Methods in Education, Louis Cohen, Manion, Morrison, Routledge (Taylor &Francis Group)/ Cambridge University Press India Pvt. Ltd.

Name of The Course	**Advanced Construction Technology**			
Course Code	**BCE02T3711**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To Study Bridges, Steel Bridges, Arch Bridges, Cantilever Bridges Segmental construction & Box Girders
2. To Study about Construction of Metro Railway & Monorail.

Course Outcomes

On completion of this course the student will be able to:

CO1	To give an experience in the implementation of new technology concepts which are applied in field of Advanced construction
CO2	Understand various types of Bridges, Steel Bridges, Arch Bridges, Cantilever bridge.
CO3	To Study about Construction of Metro Railway & Monorail..
CO4	To study the construction methods and techniques of high rise building.
CO5	Understand various types of offshore structure such as- Beacons, Oil drilling Platforms, light houses.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Construction of power generating structures **8** **Lecture Hours**
Construction of power generating structures – Atomic Power stations, Thermal power stations. Co-generation Power Plant, Windmills, Transmission towers, Chimneys (single and multi-flue), cooling towers - Natural draft cooling towers (NDCT) & Induced draft cooling tower (IDCT), Ash handling system, Containment Structure, Electro Static Precipitator (ESP), Case study of Kaiga atomic power station, Madras atomic power station. Or Any other Case Study and Safety Hazards
Unit II: Bridges **8** **Lecture Hours**
Bridges, Steel Bridges, Arch Bridges, Cantilever Bridges Segmental construction & Box Girders. Construction of special type of bridges such as cable stayed bridge, suspension and Pre-stressed bridge, construction of foundation and Super structure.
Unit III: Construction of Metro Railway & Monorail **8** **Lecture Hours**
Construction of Metro Railway & Monorail - Underground and over ground structures, different methods and techniques of construction. Problems and solutions – during maintenance and upkeep of structures. Fire, Ventilation, Dewatering and power supply, Subsidence, Vibration etc., Concept of Magrail.
Unit IV: High rise buildings **8** **Lecture Hours**
High rise buildings – Construction methods and techniques using different materials, Minerals, Admixtures in-situ concrete, Precast Concrete & Structural Steel, finished concrete, tunnel form, fire Fighting ,Safety & Hazards, Job Safety Analysis. Innovative methods of construction – Slip form technology, Jump form technology, Aluform & Tunnel Form Technology, Dry wall technology, Plastering Machines.
Unit V: Offshore structure **8** **Lecture Hours**
Offshore structure such as- Beacons, Oil drilling Platforms, light houses. Barges - Jack up Platform, Deck Barge, Hydro clam barges, Hoppers Barges, Submersible barges, Function, utilization & economics of barges.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**

This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. S.P. Arora & S.P. Bindra, A Text Book of Building Construction, Dhanpat Rai & Sons, New Delhi
2. S.K. Sarkar and S. Saraswati, Construction Technology, Oxford University Press,
3. New Delhi. B.C. Punamia, Building Construction, Laxmi Publications, New Delhi
4. S.C. Rangwala, Building Construction, Charotar Publication Pvt Ltd. Anand

Name of The Course	**Operations Research**				
Course Code	**BCE02T3712**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	**0**	**0**	**3**	

Course Objectives

1. To Study use of operations Research in Civil Engineering and Managerial Decision making process
2. To Study about transportation Model and its variants.
3. To Study multi stage decision processes.

Course Outcomes

On completion of this course the student will be able to:

CO1	To understand the use of Operations Research in Civil Engineering and Managerial decision making process
CO2	Solve Linear Programming Problems
CO3	Solve Transportation and Assignment Problems
CO4	Understand the usage of game theory and Simulation for Solving Business Problems.
CO5	Understand multivariable optimization without constraints.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I Operations Research in Civil Engineering **8** **Lecture Hours**
Use of Operations Research in Civil Engineering and Managerial Decision making process. Introduction to Optimization Techniques and their application in Engineering Planning, Design and Construction. Various models; Objective function and constraints, convex and concave functions, regions and sets.
Unit II: Linear programming **8** **Lecture Hours**
Linear programming: Formulation of Linear optimization models, Civil engineering applications. Simplex method, special cases in simplex method, Method of Big M, Two phase method, duality, sensitivity analysis.
Unit III: Transportation and assignment model **8** **Lecture Hours**
Transportation Model and its variants, Assignment Model and its variants, Decision theory.
Unit IV: Dynamic programming **8** **Lecture Hours**

Dynamic programming: Multi stage decision processes, Principle of optimality, Recursive equation, Application of D.P.Non-Linear programming: Single variable unconstrained optimization –Local & Global optima, Uni-modal Function- Sequential Search Techniques: Dichotomous, Fibonacci, Golden Section methods.
Unit V: Multivariable optimization without constraints **8** **Lecture Hours**
Use of Building Integrated Photo Voltaic (BIPV) and other renewable energy in buildings, basic concepts and efficiency. Radiation budget, Surface water balance, Effects of trees and microclimatic modification through greening.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1.Hillier, Frederick S. & Lieberman, "Introduction to Operations Research Concepts and Cases", 2010, 8 th Ed. TMH

2. N.D. Vohra, "Quantitative Techniques in Management", 2010, 4thEd.TMH.

3. J.K. Sharma, "Operations Research Theory and Applications 2009,4th Ed. McMillan.

4. Kasana, HS & Kumar, KD, "Introductory Operations Research theory and Applications", 2008, Springer.

5. Chakravarty, P, "Quantitative Methods for Management and Economics", 2009, 1st Ed. HPH.

Name of The Course	**Retrofitting of Structures**			
Course Code	**BCE02T3713**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. Learn the fundamentals of maintenance and repair strategies.
2. Study the quality assurance, serviceability and durability of concrete.
3. Know the various materials and techniques used for repair of structures.
4. Educate the different repair, strengthening, rehabilitation and retrofitting techniques.
5. Instruct the various health monitoring and demolition techniques.

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand the fundamentals of maintenance and repair strategies.
CO2	Diagnose for serviceability and durability aspects of concrete.
CO3	Know the materials and techniques used for repair of structures.
CO4	Decide the appropriate repair, strengthening, rehabilitation and retrofitting technique required for a case study building.
CO5	Use an appropriate health monitoring and demolition techniques.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Rehabilitation repairs and retrofitting **8** **Lecture Hours**
Importance of rehabilitation repairs and retrofitting as a part of construction engineering. Difference between the term. Rehabilitation studies of buildings, underground construction, bridges, streets and highways, sewage treatment plants – masonry work, R.C.C. works, steel structures- types of distress.

Unit II: Numerical condition surveys **8** **Lecture Hours**
Numerical condition surveys for foundation, structural and functional deterioration, design criteria, materials and technology. Predictive performance models, evaluating alternatives based on technical, commercial, management, financial feasibilities, data collection and database management, maintenance of rehabilitated structures. Procedure adopted by BIFR (Board of Industrial and Financial Reconstruction).
Unit III: Serviceability and Durability of concrete **8** **Lecture Hours**
Serviceability and Durability of concrete: Quality assurance for concrete construction, concrete properties – strength, permeability, thermal properties and cracking. – Effects due to climate, temperature, chemicals, corrosion – design and construction errors – Effects of cover thickness and cracking.
Unit IV: Earthquake **8** **Lecture Hours**
Earthquake damages of buildings, their retrofitting, restoration, effects of earthquakes, response of buildings to earthquake motion, factors related to building damages due to earthquake, methods of seismic retrofitting, restoration of buildings.
Unit V: New Construction materials **8** **Lecture Hours**
New Construction materials, processes and techniques used for repairs, rehabilitation and retrofitting- Construction chemicals based on nanotechnology, construction points based on nanotechnology, various types of fibre wrappings etc.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1.Diagnosis and treatment of structures in distress by R.N.Raikar, Published by R&D Centre of Structural Designers & Consultants Pvt.Ltd., Mumbai, 1994.

2. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice-Hall of India, 2006.

Name of The Course	**Construction Safety**			
Course Code	**BCE02T3714**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To study and understand the various safety concepts and requirements applied to construction industry.
2. To study the various construction safety problems and safety programs.
3. To study the various laws related to safety in construction industry
4. To study the importance of workers compensation insurance.

Course Outcomes

On completion of this course the student will be able to:

CO1	Ability to identify safety risks on jobsites.
CO2	Able to create and manage an effective safety program in a construction company.
CO3	Will be aware of various laws related to construction safety
CO4	Understand Laws related to construction industry.
CO5	Understand case based reasoning.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Safety management function **8** **Lecture Hours**
Safety management function, Importance of safety in construction industry, Line versus staff authority, Safety responsibility and accountability in construction industry, Safety organizations, Role of various parties, duties, responsibilities of top management, site managers, supervisors etc., Role of safety officers, Responsibilities of general employees, Safety administration.
Unit II: Construction safety problems **8** **Lecture Hours**
Construction safety problems, Hazards in construction projects, Accident: definition, causes, cost, measurement, investigation and prevention of accidents, Legal and financial aspects of accident, Safety Program: Need, Elements of an Effective and safety program, general safety program in construction industry. Hazard Identifications and Control Techniques – HAZOP, FMEA, FMECA.
Unit III: Safety in use of construction equipment **8** **Lecture Hours**
Safety in use of construction equipment - vehicles, cranes, hoists and lifts etc., Safety of scaffolding, ladders, working platforms etc, safety while using electrical appliances, explosives, blasting etc, fire safety, Fire safety Causes and safety of accidents on various construction sites such as buildings, dams, tunnels, bridges, roads, high rise constructions etc., safety measures for storage and handling of building materials. Safety equipment and gear used on construction site, First aid on site.
Unit IV: Laws related to construction industry **8** **Lecture Hours**
Laws related to construction industry, Laws related to the Industrial Safety, Safety Provisions in the Factory Act, Labour laws. Measurement of Safety Performance, Safety Audit. Experience modification rating, workers insurance.
Unit V: Case based reasoning **8** **Lecture Hours**
Case based reasoning, case indexing, retrieval, accident prevention and forecasting using CBR method. Systems safety analysis, faulty tree analysis, failure modes and effects analysis in construction industry.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. John V. Grimaldi. (1996). “Safety Management.” AITBS Publishers & Distributors, New Delhi, India.
2. Kwakye, A.A. (1997), “Construction Project Administration”, Adisson Wesley Longman, London.
3. Jimmy W.Hinze, “Construction Safety ", Prentice Hall Inc., 1997.
4. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, “Construction Safety and Health Management ", Prentice Hall Inc., 2001. Internal continuous assessment: 100 marks Internal continuous assessment is in the form of periodical tests, assignm
5. James, J.O Brien, “Construction Inspection Handbook - Quality Assurance and Quality

Name of The Course	**Economics And Project Finance For Civil Engineers**			
Course Code	**BCE02T3715**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**

	3	0	0	3

Course Objectives

1.This course mainly aims to develop the knowledge about Engineering Economy
2.Importance of finance for civil engineers
3.To make the students to understand Engineering Economy and importance of finance
4. Develop knowledge about project finance

Course Outcomes

On completion of this course the student will be able to:

CO1	Know the Engineering Economy and importance of finance for civil engineers.
CO2	Study and application of various conditions of finance.
CO3	Get a thorough knowledge of various types of Projects finance.
CO4	Understand different types of Engineering Economy.
CO5	Students learn about the behaviour of different types of Projects
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Engineering economics **8** **Lecture Hours**
Engineering economics: Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalence- Single payment in the future (P/F, F/P), Present payment compared to uniform series payments (P/A,A/P), Future payment compared to uniform series payments (F/A,A/F),Arithmetic gradient, Geometric gradient.
Unit II: Comparison of alternatives **8** **Lecture Hours**
Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis.
Unit III: Depreciation **8** **Lecture Hours**
Depreciation, Inflation and Taxes: Depreciation, Inflation, Taxes.
Unit IV: Equipment economics **8** **Lecture Hours**
Equipment economics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis.
Unit V: Cost estimating **8** **Lecture Hours**
Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, parametric estimate, and Life cycle cost.
Unit VI: Discussion on Latest Research Paper **4** **Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Blank, L. T. and Tarquin, A. J.,"Engineering Economy", Fourth Edition, WCB/McGraw-Hill, 1998.
2. Bose, D. C., "Fundamentals of Financial management", 2nd ed. PHI, New Delhi, 2010.
3. Boyer, C.B. and Merzbach, U. C., "A History of Mathematics", 2nd ed., John Wiley & Sons, New York, 1989.
4. Gould, F.E., "Managing the Construction Process", 2nd ed., Prentice Hall, Upper Saddle River, New Jersey, 2002.
5. Peurifoy , R. L. and Oberlender, G. D., "Estimating Construction Costs", 5th ed., McGrawHill, New Delhi, 2004.

6. Schexnayder, C. J. and Mayo, R.E., "Construction Management Fundamentals", International Edition, McGraw-Hill, 2003.

Name of The Course	Repair And Maintenance Of Buildings			
Course Code	BCE02T3716			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. This course will help students learn how to identify various deterioration mechanisms or damage mechanisms in concrete structures.
2. The course will discuss the scientific aspects and its use while practicing repair works at site. Use of various non-destructive, partially-destructive tools to assess the condition of the structure will be discussed.
3. To make the students to beam shear capacity strengthening.
4. Students understand Concrete assessment.

Course Outcomes

On completion of this course the student will be able to:

CO1	Understand the Corrosion mechanisms.
CO2	Know the Deterioration of cementitious systems.
CO3	Get an idea of Surface repairing techniques.
CO4	Understand the properties of repairing materials.
CO5	Know Strengthening and stabilization of Building materials.
CO6	Understand latest research paper

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction
8 Lecture Hours
Significance of corrosion, and corrosion mechanisms, Embedded metal corrosion.
Unit II: Deterioration of cementitious systems
8 Lecture Hours
Sulphate and Acid attack, Alkali Silica Reaction (ASR), Shrinkage, and others.
Unit III: Concrete assessment
8 Lecture Hours
Concrete assessment using non-destructive tests (NDT), Concrete assessment and load effects.
Unit IV: Surface repair
8 Lecture Hours
Condition assessment, Analysis, strategy, and design.
Unit V: Repairs to structures
8 Lecture Hours
Material requirement, surface preparation, placement of repair material.
Unit VI: Discussion on Latest Research Paper
4 Lecture Hours
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Brian J.B. Wood, (2009), Building Maintenance, Wiley-Blackwell, ISBN-10: 1405179678.
2. Ravindra K. Dhir, M. Roderick Jones & Li Zheng, (2005), Repair and Renovation of Concrete Structures, American Society of Civil Engineers, ISBN-13: 9780727734051.
3. IS Code 10262: 2019

GALGOTIAS UNIVERSITY

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

Program: MTech in Transportation Engineering

Scheme: 2020-2021

Vision

To be a Centre of Excellence for imparting high end research and technical education in Civil Engineering producing socially aware professionals to provide sustainable solutions to global community.

Mission

M1: To impart quality education and mould technically sound, ethically responsible professionals in the field of Civil Engineering.

M2: Collaborate with industry and society to design a curriculum based on the changing needs of stakeholders and provide excellence in delivery and assessment.

M3: Establish state-of-the-art facilities for world class education and research.

M4: To mentor students in pursuit of higher education, entrepreneurship and global professionalism.

PEOs

PEO1: Graduates shall attain state of the art knowledge in the different streamsof Civil Engineering and be trained for playing the role of competent Civil Engineer in multidisciplinary projects.

PEO2: Graduates shall be capable of pursuing productive careers in private andgovernment organizations at the national and international level and to become successful entrepreneurs.

PEO3: Graduates shall display a high sense of social responsibility and ethicalthinking and develop sustainable engineering solutions.

PSOs

PSO1: Develop the ability to implement emerging techniques to plan, analyze, design, execute, manage, maintain and rehabilitate systems and processes in transportation engineering.

PSO2: Excel in research, innovation, design, problem solving using different softwares and artificial intelligence and develop an ability to interact and work seamlessly in multidisciplinary environment.

POs

PO1: Apply the knowledge of Mathematics, Science, and Engineering fundamentals, and an engineering specialization to solution of complex engineering problems (Engineering Knowledge)

PO2: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences (Problem analysis)

PO3: Design of solutions for complex engineering problems and design of system components or processes that meet the specified needs with appropriate considerations of public health and safety, and cultural, societal, and environmental considerations (Design/development of solutions)

PO4: Use research based methods including design of experiments, analysis and interpretation of data and synthesis of information leading to logical conclusions (Conduct investigations of complex problems)

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling complex engineering activities with an understanding of limitations (Modern tool usage)

PO6: Apply reasoning within the contextual knowledge to access societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice (The engineer and society)

PO7: Understand the impact of the professional engineering solutions in the societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable developments (Environment and sustainability)

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice (Ethics)

PO9: Function effectively as an individual independently and as a member or leader in diverse teams, and in multidisciplinary settings (Individual and team work)

PO10: Communicate effectively on complex engineering activities with the engineering community and with society at large such as being able to comprehend and write effective reports and design documentation, make effective oral presentations, and give and receive clear instructions (Communication)

PO11: Demonstrate knowledge and understanding of engineering management principles and apply those to one's own work as a member and leader of a team to manage projects in multidisciplinary environments (Project management and finance)

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change (Life-long Learning).

Curriculum

Semester 1

Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	CENG 5001	Professional and Communication Skills	3	0	0	3	20	30	50
2	MATH5001	Advanced Numerical and Statistical Methods	3	1	0	3	20	30	50
3	MTPE5001	Material Characterization and Pavement Engineering	3	0	0	3	20	30	50
4	MTPE5002	Highway Geometric Design	3	0	0	3	20	30	50
5	MTPE5003	Traffic Engineering and Safety	3	0	0	3	20	30	50
6	MTPE5004	Intelligent Transportation Systems	3	0	0	3	20	30	50
7	MTPE5005	Pavement Material Lab	0	0	2	1	50	-	50
8	MTPE5006	Traffic Engineering Lab	0	0	2	1	50	-	50
		Total Credits				**20**			

Semester II

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MTPE6001	Advanced Traffic Engineering and Safety	3	0	0	3	20	30	50
2	MTPE6002	Urban Mass Transportation Planning Operations and Management	3	0	0	3	20	30	50
3	MTPE6003	Computational Techniques In Transportation Engineering	3	0	0	3	20	30	50
4		Elective – 1	3	0	0	3	20	30	50
5		Elective – 2	3	0	0	3	20	30	50
6		Elective – 3	3	0	0	3	20	30	50
7	MTPE6004	Transportation Systems Planning and Management Lab	0	0	2	1	50	-	50
8	MTPE6005	Seminar	0	0	2	1	50	-	50
		Total Credits				**20**			

Semester III

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MTPE7001	Smart and Sustainable Transportation	3	0	0	3	20	30	50
2		Elective - 4	3	0	0	3	20	30	50
3		Elective - 5	3	0	0	3	20	30	50
4	MTPE7002	Mini Project	-	-	2	1	50	-	50
5	MTPE7003	Comprehensive Examination	-	-	-	2	50	-	50
6	MTPE7004	Project (Phase I)	0	0	0	5	50	-	50
		Total Credits				**17**			

Semester IV

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE

1	MTPE8001	Project(Phase II)	0	0	0	15	50	-	50
		Total Credits				**15**			

Total Grand Credits = 72

Program Electives (Credits to be earned 15)

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MTPE6010	Airport planning and design	3	0	0	3	20	30	50
2	MTPE6011	Remote Sensing and GIS	3	0	0	3	20	30	50
3	MTPE6012	Selection of Construction Equipment and Modelling	3	0	0	3	20	30	50
4	MTPE6013	Transport Economics and Finance	3	0	0	3	20	30	50
5	MTPE6014	Traffic Flow Theory	3	0	0	3	20	30	50
6	MTPE6015	Highway construction practices	3	0	0	3	20	30	50
7	MTPE6016	ML and Deep learning techniques to transportation problems	3	0	0	3	20	30	50
8	MTPE6017	Behavioural Travel Modelling	3	0	0	3	20	30	50
9	MTPE6018	Rural Road Technology	3	0	0	3	20	30	50
10	MTPE6019	Traffic Management & Design	3	0	0	3	20	30	50
11	MTPE6020	Public Transportation System	3	0	0	3	20	30	50
12	MTPE6021	Ground Improvement Techniques	3	0	0	3	20	30	50
13	MTPE6022	Bridge Engineering	3	0	0	3	20	30	50
14	MTPE6023	Transportation Network Analysis	3	0	0	3	20	30	50
15	MTPE6024	Project Management	3	0	0	3	20	30	50

Detailed Syllabus

Name of The Course	Material Characterization and Pavement Engineering			
Course Code	**MTPE5001**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

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

Course Objectives

1. To provide students with a thorough understanding of the important factors in pavement design and analysis.
2. The focus will be on practices of pavement design of highway agencies.
3. To evaluate the physical and mechanical properties of sub grade, and pavement materials and design of flexible and rigid pavements subjected to wheel loads.

Course Outcomes

On completion of this course, the students will be able to

CO1	Determine the proportions of ingredients required for the mix design of both asphalt mixtures and cement concrete.
CO2	Characterize the pavement materials including soil, aggregate, cement, asphalt mixtures, and cement concrete.
CO3	Select appropriate asphalt binder for construction of a flexible pavement depending upon the traffic and climatic conditions.
CO4	Choose appropriate stabilization technique for pavement.
CO5	Understand various pavement material characterization techniques, and able to design a suitable pavement for known wheel loading characteristics and subgrade soil conditions.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

Course Content:

Unit I: Subgrade Soil Characterization **8 Lecture Hours**
Properties of subgrade layers; different types of soils, Mechanical response of soil; Soil Classification; Index and other basic properties of soil; A critical look at the different laboratory and in-situ procedures for evaluating the mechanical properties of soils viz. SPT, DCPT, CPT, CBR, Plate Load test & resilient modulus; Suitability of different type of soil for the construction of highway embankments and pavement layers; Field compaction and control, properties of compacted soils.
Unit II:Introduction to Soil Stabilization and Aggregates **8 Lecture Hours**
Introduction, types of stabilization – mechanical, cementing and chemical, proportioning of materials, grouting – principle, grouting materials, grouting plant and equipment, injection methods and applications of grouting. Aggregate Characterization, Origin, Classification, Types of aggregates; Sampling of aggregates; Mechanical and shape properties of aggregates, Aggregate texture and skid resistance, polishing of aggregates; Proportioning and Blending of aggregates: Super pave gradation, Fuller and Thompson's Equation, 0.45 power maximum density graph, Use of locally available materials in lieu of aggregates.
Unit III: Bituminous Binders and Mixes **8 Lecture Hours**
Types of binders, properties and sues of bitumen, physical tests on bitumen, rheological and performance related properties of bitumen, grading of bitumen – penetration, viscosity and performance grading. Bituminous cutbacks and

emulsions – preparation, types and uses, modified bitumen- CRMB, NRMB, PMB, Criteria for selection of bituminous binders, tests on ageing of bitumen – RTFOT and PAV. Bituminous mixes – types, requirements, methods of mix design – Marshall, Hveem, Hubbard field and super pave, tests on bituminous mixes
Unit IV: Cement and Cement Concrete Mix Characterization **8 Lecture Hours**
Types of cements and basic cement properties, Special cements; Quality tests on cement; Tests on cement concrete including compressive strength, flexural strength, modulus of elasticity and fatigue properties; Introduction to advanced concretes like self-compacted concrete, Light weight concrete, Roller Compacted Concrete for pavement application; IS method of cement concrete mix design with case studies; Role of different admixtures in cement concrete performance; Joint fillers for Jointed Plain Cement Concrete Pavements and their characterization.
Unit V: Stresses in Pavements **8 Lecture Hours**
Types of stresses and causes Stresses and strains in flexible pavements, Stresses and strains in an infinite elastic half space use of Boussinesq's equations – Burmister's two layer and three-layer theories; Wheel load stresses, various factors in traffic wheel loads; Equivalent single wheel load of multiple wheels. Repeated loads and EWL factors. Introduction to Westergaard's equations for calculation of stresses in rigid pavement due to the influence of traffic and temperature; Considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. "Material, Design, Construction, Maintenance, and Testing of Pavement (Geotechnical Special Publications)" by Dar-Hao Chen and Cindy Estakhri
2. "Street Pavements and Paving Materials: A Manual of City Pavements, the Methods and Materials of Their Construction (Classic Reprint)" by Geo W Tillson
3. "Pavement Design and Materials" by A T Papagiannakis and E A Masad
4. "Recent Developments in Soil and Pavement Mechanics" by Almeida Marcio
5. "Asphalt Concrete: Simulation, Modeling and Experimental Characterization (Geotechnical Special Publication)" by EyadMasad and VassilisPanaskaltsis

Name of The Course	**Highway Geometric Design**			
Course Code	**MTPE5002**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To cover the principles of transportation infrastructure design in the wider context of the civil engineering profession.
2. The design and execution of large transport infrastructure projects is a multi-layered exercise
3. This module aiming to provide an overview of the key stages involved.
4. This module will develop a good command of the concepts involved in geometric design of intersections, horizontal & vertical alignment of roads & pedestrian facilities.

Course Outcomes

On completion of this course, the students will be able to

CO1	Basic principles of planning and design of roads
CO2	Alignment, road aesthetics and adaptation to the environment.

CO3	Apply basic principles for the design of roads within the context of a design problem
CO4	Assess the environmental impacts of location and design
CO5	Prepare detailed plans for such infrastructure elements.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Highway Cross Section Elements and Geometric Design of Highways **8** **Lecture Hours**
Functional Classification of Highway System; Design Controls – Topography, Driver characteristics, Vehicle Characteristics, Traffic, Capacity and Level of Service, Design Speed.Objectives of Geometric Design. Carriageway, Shoulders, Formation, right of way; Kerbs, foot paths, Medians- design specifications; Pavement Surface characteristics – Skid Resistance, factors affecting Skid resistance, Measurement of Skid Resistance; Road Roughness, measurement of Road roughness; Camber, Objectives of Camber, design standards.
Unit II:Horizontal and Vertical Alignment **8** **Lecture Hours**
Objective of horizontal curves; Super elevation – Need for Super elevation; Method of computing super elevation; Minimum Radius of Curve; Methods of attainment of super elevation; Extra widening on Curves; Transition Curves – Objective and Design. Gradients – Types of Gradients, Design Standards; Vertical Curves – Summit Curves, Valley Curves and Design criteria for Vertical Curves; Combination of Vertical and Horizontal Curves – Grade Compensation; Sight Distances – Stopping Sight Distance, Overtaking Sight Distance and Intermediate Sight Distance; Importance of Sight Distances for Horizontal and Vertical Curves.
Unit III: Intersection Design and Drainage **8** **Lecture Hours**
Types of Intersections; Design Principles for Intersections; Design of At-grade Intersections – Channelization, Objective; Traffic Islands and Design standards; Rotary Intersection – Concept and Design, Advantages and Disadvantages; Grade separated Interchanges – Types, warrants and Design standards. Importance – sub surface drainage –surface drainage– Design of road side drives – Hydrological – Hydraulical considerations and design of filter media, problems on above.
Unit IV: Traffic Signs and Road Markings **8** **Lecture Hours**
Types of Road Signs; Guidelines for the provision of Road Signs; Cautionary Signs, Regulatory Signs, Information Signs – Design standards; Road markings – Objective of Road Markings; Types of Road Markings; Role of Road markings in Road Safety and Traffic Regulation; Specification for Road Markings. Highway Appurtenances – Delineators, Traffic Impact Attenuators, Safety Barriers.
Unit V:Pedestrian Facilities **8 Lecture Hours**
Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays – Types and Guide lines; Design of On-street and Off street Parking facilities – Guidelines for lay out Design.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, Prentice-Hall.

2. Kerbs Robert D. and Richard D. Walker, Highway Materials, McGraw-Hill, 1971.
3. Concrete Pavements, AF Stock, Elsevier, Applied Science Publishers
4. Relevant IRC and IS Codes of Practices (Separate List will be given).
5. Pavement and Surfacing for Highway & Airports, Micheal Sargious, Applied Science Publishers Limited.

Name of The Course	Traffic Engineering and Safety			
Course Code	MTPE5003			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. To study the fundamentals of traffic engineering & some of the statistical methods to analyze traffic safety.
2. To acquire knowledge and understanding of the road environment
3. To impart knowledge and understanding of the causes and consequences of accidents.
4. To understand roles and responsibilities in ensuring road safety.

Course Outcomes

On completion of this course, the students will be able to

CO1	To understand fundamental of Traffic Engg.
CO2	To investigate & determine the collective factors & remedies of accident involved.
CO3	To design & planning various road geometrics.
CO4	Generate awareness about number of people dying every year in road accidents, traffic rules and characteristics of accident.
CO5	Gain information and knowledge about people responsible for accidents and their duties
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to Road Safety **8 Lecture Hours**
Road traffic accidents scenario in India and in world. Road Safety and its importance. Traffic Rules and Driving Behavior. Characteristics of accidents, accidents vs. crash. Awareness about rules and regulations of traffic. Assisting Traffic control authorities. Multidisciplinary approach to planning for traffic safety and injury control. Vulnerable road users: crashes related to pedestrian and bicyclists, their safety, provision for disabled.
Unit II:Fundamentals of Traffic Engineering and Studies **8 Lecture Hours**
Basic Characteristics of Motor-Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Traffic Design of Parking Facilities, Traffic Engineering Studies; Statistical Methods in Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons. Components of road traffic - the vehicle, driver and road. Objectives and scope of traffic engineering. Traffic Engineering: Road user characteristics; human and vehicle characteristics, factors affecting road traffic; methods of measurement. Concepts of passenger car units for mixed traffic flow. Sampling in traffic studies; adequacy of sample size; application of sampling methods for traffic studies, objectives, methods of traffic study, equipment, data collection, analysis and interpretation (including case studies) of (i) Spot speed (ii) Speed and delay (iii) Volume (iv) Origin - destination (v) Parking. Traffic maneuvers and Stream Characteristics; application in intersection design.
Unit III: Responsibility of Road accidents and Safety measures

8 Lecture Hours
People responsible for accident prevention: Police, Politicians, Community members, Policy makers, Teachers, Parents, Infrastructure authorities, Drivers and Official road safety body. Reasons of students/ children have accidents. 4 E's of Accidents Prevention: 1. Engineering - by altering the environment 2. Enforcement - by imposing laws 3. Encouragement - by the use of publicity campaigns 4. Education - by gaining and using knowledge.
Unit IV: Accident Investigations and Risk Management **8 Lecture Hours**
Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction.
Unit V: Road Safety in Planning and Geometric Design **8 Lecture Hours**
Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety. Vehicle and Human Characteristics, Road Design and Road Equipment, Redesigning Junctions, Cross Section Improvements, Reconstruction and Rehabilitation of Roads, Road Maintenance, Traffic Control, Vehicle Design and Protective Devices, Post Accident Care.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers
2. Transportation Engineering – An Introduction, C.Jotinkhisty, B. Kent Lall
3. Fundamentals of Traffic Engineering, Richardo G Sigua
4. Handbook of Road Safety measures, second Edition, Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson
5. Road Safety by NCHRP.

Name of The Course	**Intelligent Transportation Systems**			
Course Code	**MTPE5004**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To develop an understanding of system engineering processes
2. To describe the concepts of system architecture and their evolution
3. Understand the capability of key technologies
4. Understand impact of technology on different modes and movement

Course Outcomes

On completion of this course, the students will be able to

CO1	Differentiate different ITS user services
CO2	Select appropriate ITS technology depending upon site specific conditions.
CO3	Able to appreciate the advantages of ITS and suggest the appropriate technologies for field conditions.
CO4	Able to suggest the appropriate system/s in various functional areas of transportation.
CO5	Able to amalgamate the various systems, plan and implement the applications of ITS.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Fundamentals of ITS **8 Lecture Hours**
Definition of ITS, the historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS. ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.
Unit II:Telecommunications in ITS **8 Lecture Hours**
Information Management, Traffic Management Centers (TMC). Application of sensors to Traffic management; Traffic flow sensor technologies; Transponders and Communication systems; Data fusion at traffic management centers; Sensor plan and specification requirements; Elements of Vehicle Location and Route Navigation and Guidance concepts.
Unit III: ITS User Needs and Services and Functional areas **8 Lecture Hours**
Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveller Information systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS).
Unit IV: ITS Architecture **8 Lecture Hours**
Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods; Planning and human factor issues for ITS, Case studies on deployment planning and system design and operation; ITS and safety, ITS and security, ITS as a technology deployment program, research, development and business models, ITS planning.
Unit V:ITS applications 8 Lecture Hours
Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations; commercial vehicle operations; public transportation applications; Automated Highway Systems- Vehicles in Platoons –ITS in World – Overview of ITS implementations in developed countries, ITS in developing countries - Case study
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Choudury M A and Sadek A, “Fundamentals of Intelligent Transportation Systems Planning” Artech House.
2. Kan Paul Chen, John Miles, “Recommendations for World Road Association (PIARC)” ITS Hand Book 2000.
3. Sussman, J. M., “Perspective on ITS”, Artech House Publishers, 2005.
4. US Department of Transportation, “National ITS Architecture Documentation”, 2007 (CDROM).
5. Turban. E and Aronson. J. E, “Decision Support Systems and Intelligent Systems”, Prentice Hall

Name of The Course	**Pavement Material Lab**			
Course Code	**MTPE5005**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. Have a better understanding of the characteristics of the flexible and rigid pavements; and

2. Be familiar with the criteria for the design of pavements and supporting materials.

Course Outcomes

On completion of this course, the students will be able to

CO1	Carry out sieve analysis
CO2	Determine density by Pycnometer.
CO3	Perform water absorption test.
CO4	Carry out flakiness index test
CO5	Determine specific gravity of bitumen

Continuous Assessment Pattern

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

Course Content:

List of Experiments:

1. Sieve Analysis
2. Density Determination By Pycnometer
3. Specific Gravity And Water Absorption Test
4. Flakiness Index Test
5. Elongation Index Test
6. Los Angeles Abrasion Test
7. Specific Gravity Of Bitumen
8. Penetration Test
9. Ductility Test
10. Softening Point Test

Suggested Reading

1. Khanna.S.K., and Justo. C.E.G., (2011), Highway Engineering, Ninth Edition, Nem.
2. Kadiyali.L.R., and Lal.N.B., (2005), Principles and Practice of Highway Engineering, Fourth Edition, Khanna Publishers, ISBN- 9788174091659.
3. ChakroborthyPartha, and Das Animesh, (2003), Principles of Transportation Engineering, Eighth Printing, Prentice-Hall of India, ISBN-9788120320840
4. Rao.G.V., (1996), Principles of Transportation and Highway Engineering, Tata McGraw-Hill Co, ISBN- 9780074623633.

Name of The Course	**Traffic Engineering Lab**			
Course Code	**MTPE5006**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

To impart knowledge on statistical analyses of traffic data; use of speed-flow-density relationships; conduct shock wave analysis and compute road and intersection capacity; as well as the design of traffic signals application of traffic, parking and demand management methods.

Course Outcomes

On completion of this course, the students will be able to

CO1	Determine impact value
CO2	Determine aggregate crushing value
CO3	Determine Flakiness Index
CO4	Determine Angularity Number
CO5	Determine loss on heating of oil & asphaltic compound

Continuous Assessment Pattern

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

Course Content

List of Experiments:

1. Aggregate Impact value
2. Aggregate Crushing Value
3. Ten Percent Fines Value
4. Determination of Flakiness Index
5. Determination of Angularity Number
6. Traffic (Roadway Capacity)
7. Traffic (Saturation Flow)
8. Specific Gravity of Bituminous Material
9. Loss on Heating of Oil & Asphaltic Compound

Suggested Reading

1. Khanna. S. K., and Justo. C. E. G., (2011), Highway Engineering, Ninth Edition, Nem.
2. Kadiyali.L.R., and Lal.N.B., (2005), Principles and Practice of Highway Engineering, Fourth Edition, Khanna Publishers, ISBN- 9788174091659.
3. ChakroborthyPartha, and Das Animesh, (2003), Principles of Transportation Engineering, Eighth Printing, Prentice-Hall of India, ISBN-9788120320840
4. Rao.G.V., (1996), Principles of Transportation and Highway Engineering, Tata McGraw-Hill Co, ISBN- 9780074623633.

Name of The Course	**Advanced Traffic Engineering and Safety**			
Course Code	**MTPE6001**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To be aware of various methods of collecting traffic data
2. To understand the basics of highway planning and design, and workout problems in design of road geometrics
3. To learn the importance of road safety

Course Outcomes

On completion of this course, the students will be able to

CO1	Explain traffic flow, forecast, accidents, traffic and environment management.
CO2	Analyse trends of traffic flow, forecast, accidents, traffic and environment management
CO3	Evaluate traffic flow, forecast, accidents and environment for traffic management.
CO4	Design and recommend solutions for better traffic management.
CO5	Traffic Safety Practices
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Traffic flow theory and Forecast **8 Lecture Hours**
Scope, relationship between flow variables, bottle necks, Problems. Queuing theory and applications; vehicle arrivals, delays at intersections, Elements of simulation technique in traffic Engineering, Problems. Traffic Forecast – objects, factors governing traffic growth, estimation of traffic growth from past trends, econometric models. Common methods of traffic forecast, Problems.
Unit II:Surface Transportation Accidents **8 Lecture Hours**
Causes, scientific investigations and data collection. Analysis of individual accidents to arrive at causes; statistical methods of analysis of accident data, computer analysis. Road safety issues, various measures for road safety - engineering, educational and enforcement measures, Short term and long-term measures. Road safety education and training. Economic evaluation of improvement measures by "before and after studies". Problems.
Unit III: Traffic management techniques **8 Lecture Hours**
Local area management. Transportation system management. Low cost measures. Various types of medium- and long-term traffic management measures and their uses. Evaluation of the effectiveness and benefits of different traffic management measures, Elements of area traffic control and Intelligent transportation systems.
Unit IV: Traffic Safety **8 Lecture Hours**
Principles and Practices – Safety along links - Safety at intersections. Road Safety Audit – Countermeasures, evaluation of effectiveness of counter-measures– Road safety programs.

Unit V: Discussion on Latest Research Paper 2 lecture hours
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. ITE Hand Book, Highway Engineering Hand Book, Mc Graw - Hill.
2. AASHTO A Policy on Geometric Design of Highway and Streets
3. Pignataro, L.J., Traffic Engineering – Theory & Practice, John Wiley,
4. R. J. Salter and N. B. Hounsell, Highway Traffic Analysis and Design, Macmillan Press Ltd, 1996
5. Relevant IRC codes

Name of The Course	**Urban Mass Transportation Planning Operations and Management**			
Course Code	**MTPE6002**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To be aware of various methods of Transportation Planning
2. To understand the basics of planning and management
3. To learn the importance of travel demand models
4. To introduce the issues of transportation planning and transportation policy
5. To introduce travel survey method for understanding travel behavior.
6. To introduce the key concepts of the urban transportation planning system

Course Outcomes

On completion of this course, the students will be able to

CO1	Design and administer surveys to provide the data required for transportation planning.
CO2	Estimate travel demand generation at aggregate and disaggregate levels
CO3	Identify the factors of travel mode choice and develop modal split models.
CO4	Estimate the traffic impact of new developments using the four-stage sequential models.
CO5	Develop land use integrated travel demand models.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Urban Transportation Planning Process & Concepts **8 Lecture Hours**
Role of Transportation and Changing Concerns of Society in Transportation Planning; Transportation Problems and Problem Domain; Objectives and Constraints; Flow Chart for Transportation Planning Process- Inventory, Model Building, Forecasting and Evaluation Stages, Planning in System Engineering Framework; Concept of Travel Demand and its Modeling based on Consumer Behavior of Travel Choices- Independent Variables, Travel Attributes.
Unit II:Methods of Travel Demand Estimation **8 Lecture Hours**
Assumptions in Demand Estimation- Sequential, Recursive and Simultaneous Process - Introduction to Transportation Planning Practices; Definition of Study Area, Zoning. Trip Generation Analysis: Trip Generation Models- Zonal Models, Category analysis, Household Models, Trip Attractions of Work Centers & Commercial Trips

Trip Distribution Analysis: Trip End and Trip Interchange Models; Trip Distribution Models - Growth Factor Models, Gravity Models, Opportunity Models and their calibration; Estimation of Travel Demand based on link volume philosophy; Entropy based Trip Distribution models.
Unit III: Mode Split and Route Split analysis 8 Lecture Hours
Mode Split Analysis- Mode Choice Behaviour, Competing Modes, Mode Split Curves, Probabilistic Models and Two Stage Mode Split Analysis; Route Split Analysis- Elements of Transportation Networks, Coding, Minimum Path Tress, Diversion Curves, Allor-Nothing Assignment, Capacity Restrained Assignment, Multipath Assignment
Unit IV: Land Use Transportation Models 8 Lecture Hours
Location models - Opportunity Models, Lowry based Land use Transportation Models – Allocation Function, Constraints, Travel Demand Estimation – Iterative Solutions, Matrix Formulation, Dynamic and Disaggregated extensions; Urban Forms & Urban Structures.
Unit V: Traffic Regulation and Management 8 Lecture Hours
Traffic Signs, Markings and Signals; Principles of Signal Design, Webster's method of Signal Design, Redesign of Existing Signals including Case Studies; Signal System and Coordination. Traffic Management measures: Speed, vehicle, parking, enforcement regulations, mixed traffic regulation, various management techniques.
Unit VI: Discussion on Latest Research Paper 2 lecture hours
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Hutchinson, B.G., Principles of Urban Transportation System Planning, Mc-Graw Hill 1974
2. Khisty, C J., Transportation Engineering – An Introduction, Prentice-Hall, NJ, 2007
3. Dickey, J.W., Metropolitan Transportation Planning, Tata Mc-Graw Hill, 1980
4. Meyer, Michael D, ITE Transportation Planning Handbook, John Wiley & Sons 2016
5. Bruton M.J., Introduction to Transportation Planning, Hutchinson of London, 1970.

Name of The Course	**Computational Techniques In Transportation Engineering**			
Course Code	**MTPE6003**			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To be introduced to systems approach.
2. To learn the fundamentals of simulation and the GPSS language.
3. To be introduced to advanced computational techniques such as GA and ANN

Course Outcomes

On completion of this course, the students will be able to

CO1	Working knowledge of simulation and GPSS programming.
CO2	Good understanding of GA applications
CO3	Applications of GPSS
CO4	Knowledge of Genetic Algorithms
CO5	Complete understanding of Artificial Neural Networks
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to systems approach **8 Lecture Hours**
Typical transportation systems - Mathematical models. Fundamentals of simulation - Monte Carlo method - Continuous and discrete models - Simulation languages. Probability concepts - Random numbers - Pseudo random generators - Arrival patterns - Service time distributions – Manual simulation of simple queuing system.
Unit II: GPSS Fundamentals **8 Lecture Hours**
Creating and moving transactions - Queues and facilities - Event scheduling – Standard numerical attributes – Parameters and save values - Functions - Priority - Pre-emption - Collection of statistics - Report preparation. Internal logic of GPSS processor - Program control statements.
Unit III: Applications of GPSS **8 Lecture Hours**
Simple queuing problems - Inventory problems - Simulation of ports - Railway platforms and level crossings - Traffic signals. Analysis of simulation results - Model validation - Replication of random conditions - Time series analysis.
Unit IV: Genetic Algorithm **8 Lecture Hours**
Genetic Algorithm - Terminology in GA – Strings, Structure, Parameter string - Data Structures – Operators - Algorithm – Application in Transportation. Fuzzy Logic.
Unit V: Artificial Neural Networks **8 Lecture Hours**
Basics of ANN – Topology - Learning Processes - Supervised and unsupervised learning. Least mean square algorithm, Back propagation algorithm - Applications.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Gordon, G., System Simulation, Prentice-Hall of India, 2005
2. GPSS/PC, User Manual, Minuteman Software, USA, 2005
3. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison-Wesley, 1989
4. J.M. Zurada. Introduction to artificial neural systems. Jaico Publishers, 2006

Name of The Course	**Transportation Systems Planning and Management Lab**			
Course Code	**MTPE6004**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. To enable the students to understand the various techniques of transportation management.
2. To make the students to understand he performance of various transportation systems.

Course Outcomes

On completion of this course, the students will be able to

CO1	Study the various techniques of transportation management.
CO2	Study the performance of various transportation systems.
CO3	Understand transportation infrastructure management.
CO4	Interpret road pricing, congestion management, and information technologies in transportation.
CO5	Explain System assurance, safety, security, and disruption management

Continuous Assessment Pattern

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

Course Content:

List of Projects:

1. Network analysis and traffic flow theory
2. Transportation decision-making, policy, economics, and finance
3. Transportation infrastructure management
4. Road pricing, congestion management, and information technologies in transportation
5. System assurance, safety, security, and disruption management

Suggested Reading

1. Kadiyali, L. R., Traffic Engineering and Transport Planning, Khanna Publishers, 2011
2. Highway Engg.-Khanna S.K. and Justo C. E. G. New Chand Publication
3. C A O'Flaherty, "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA

Name of The Course	Smart and Sustainable Transportation			
Course Code	MTPE7001			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. The historical evolution of transportation planning, policy and practice
2. The social, economic and environmental implications of various modes of transportation, including the relationship between transportation, urban form and public health;
3. Evaluation of the relative strengths and weaknesses of local transportation plans from a multimodal and multijurisdictional perspective.
4. Unsustainable impacts of different transport modes, e.g. passenger cars, trucks, rail, sea and air transport
5. Alternative propulsion technologies, e.g. biofuels, hybrid and electric vehicles, hydrogen

Course Outcomes

On completion of this course, the students will be able to

CO1	Explain the unsustainable impacts of today's transport sector
CO2	Analyse and compare the potentials and challenges of technological, organisational and policy solutions
CO3	Critically judge solutions and propose a plan towards sustainable transportation
CO4	Role of transit systems
CO5	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to sustainable Transportation infrastructure **8 Lecture Hours**
Introduction to various types of mass transportation systems Need of mass transportation, recent trends in transit, mass transportation characteristics.
Unit II:Transportation Land Use and Urban Form **8 Lecture Hours**
Transportation and Urban Sprawl, Its environmental impacts.
Unit III: Public Transportation Systems **8 Lecture Hours**
Introduction to public transit, History - Personal public transit experiences, Opportunities for transit professionals Transportation economics, Sustainability Transit modes and technologies, Transit system performance, Transit capacity, Frequency and headway , Quality of service,

Coefficient of rolling friction, modes comparison, system configurations, system performance calculations.
Unit IV: Transit Systems **8 Lecture Hours**
Transit classification and Right of way, Smart growth Transit Oriented Development Ridership and surge factors, station planning, ADA Designing for pedestrians, Safety and security, hazard analysis Bus transit, Transit procurement, commercial processes, technical specifications London Transport video.
Unit V: Sustainable Transportation Modes Planning **8 Lecture Hours**
Pedestrian – Planning Principles, Tools, Designs, Methods to measure success, Cycles- Planning Principles, Cycle Track Network, Crossings and intersections and junctions, Transit Planning, Road Side Infrastructure Planning.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1.Paquette, R.J., et al, Transportation Engineering Planning and Design, John Wiley & Sons, New York, 1982.

2. Horenjeff Robert; The planning & Design of Airports, McGraw Hill Book Co., 2007

3. Alan Black, Urban Mass Transportation Planning, McGraw-Hill, 1995

Name of The Course	**Airport Planning And Design**
Course Code	**MTPE6010**
Prerequisite	-
Co-requisite	-
Anti-requisite	-

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

Course Objectives

1. To make the students conversant with the types of pavements and their design.
2. Learn the importance of orientation of runways,
3. Air traffic control devices and airport drainage

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the role of airport planning and design in reducing runway incursions and surface incidents, and increasing airfield efficiency
CO2	Compare airport capacity with the existing and forecasted demand and ascertain whether improvements to increase capacity are needed
CO3	Identify and discuss key issues with regard to airport master planning, standards, airport facilities and terminal planning, functions and operations
CO4	Describe the purpose of forecasting for airports and explain key elements and methods used in planning for future airport needs
CO5	Explain the concept of level of service applied to an airport facility
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction **8 Lecture Hours**
Air transport- structure and organization, the challenges and the issues.
Unit II:Airport Planning and Geometric Design

8 Lecture Hours
Airport master plan, Aircraft characteristics, Geometric design of airfields, Development of Air Transportation in India: Airport site election. Modern aircraft. Airport obstructions: Zoning Laws, Imaginary surfaces, Approach and Turning zone, clear zone, vert. Clearance for Highway & Railway. Runway and taxiway design: Wind rose, cross wind component, Runway Orientation and configuration. Basic runway length and corrections, runway geometric design standards.
Unit III: Planning and design of the terminal area **8 Lecture Hours**
The planning terminal system; design considerations and visual aids, Taxiway Layout and geometric design standards. Taxiway and other areas. Air traffic control: Need, Network, control aids, Instrumental landing systems
Unit IV:Structural design of airport pavements **8 Lecture Hours**
Design factors, Design of flexible and rigid pavements, Airside Capacity and delay Mathematical models for capacity and delay, space time concept
Unit V: Air traffic control Elements **8 Lecture Hours**
Major components and functions of the National airspace system, Airport drainage Design runoff, inlet size and location design, surface and subsurface design
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1.Horonjeff , R. Mickelvey, F.X, Planning & design of airports, Mc Graw Hill, New York, 4th edition. 2010

2.Khanna, S.K., Arora, M.G., and S.S. Jain; Airport Planning and Design, Nem Chand & Brothers 2012

3.Air transportation planning and design by Virender Kumar & Satish Chandra, Galgotia Publications, N.Delhi

Name of The Course	**Remote Sensing and GIS**			
Course Code	**MTPE6011**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To understand the basics of advanced tools such as Remote sensing, GIS and GPS
2. To highlight their applications in the field of Civil engineering
3. To be introduced to various Remote Sensing/GIS/GPS equipment & processing packages.

Course Outcomes

On completion of this course, the students will be able to

CO1	Describe the methods and applications of remote sensing in Civil engineering.
CO2	Define and summarize surveying techniques using global positioning systems
CO3	Define the significance of GIS in civil engineering.
CO4	Data Handling in GIS
CO5	Applications of GIS
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Cconcepts and foundations of remote sensing **8 Lecture Hours**

Energy source EMS – Remote Sensing System – EMR interaction with particulate matter – Spectral Signature curves – Data Acquisition and interpretation – Visual Image Interpretation – Photogrammetry – Radar, LIDAR, SAR systems
Unit II:Platform/Sensors **8 Lecture Hours**
Classification – satellite system/sensor parameters – earth resources and meteorological satellites – microwave remote sensing techniques – Data Processing – Digital Image processing – Characteristics of Digital Satellite Image – ground truthing.
Unit III: History of Development **8 Lecture Hours**
Maps – Types of Maps, Projections – Components/Architecture of GIS – Data – Spatial and Non–Spatial – Data Input Sources – Raster and Vector data structures – DBMS – Data Output – Data quality – Sources/ types of errors
Unit IV: Data handling in GIS **8 Lecture Hours**
Processing, analysis and Modelling – Raster and Vector spatial analysis – Density analysis – Spatial autocorrelation – network analysis – nearest neighbour analysis – Surface modelling – DTM – Introduction to Geodesy – Space Geodetic Techniques – GPS
Unit V:Application of Remote Sensing **8 Lecture Hours**
GIS and GPS – Survey, mapping and monitoring – Transportation planning – Infrastructure development – Structural engineering – Geotechnical Engineering – Earthquake Engineering – Environmental studies – Water resources
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1.Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication, 2004.
2.C.P. Lo and Albert K. W. Yeung, Concepts and Techniques of Geographical Information Systems, Prentice– Hall India, 2006.
3.Thomas. M. Lillesand and Ralph. W. Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, 2003.
4.Joseph G., Fundamentals of Remote Sensing, University Press, 2005.
5.Panigrahi, N., Geographical Information systems, University Press, 2005.

Name of The Course	**Selection of Construction Equipment and Modelling**			
Course Code	**MTPE6012**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To develop concepts related with Construction management & Equipment management which involves Planning, scheduling, controlling, and organizing of project and Execution of the project with economic development & prosperity.
2. To study Scheduling of the project & resource allocating in terms of site management.
3. To finalize quantities of items, Equipment and resource requirement of civil engineering Works
4. To know the co-relation of client, consultant and contractor for the construction project with practical aspects

Course Outcomes

CO1	Describe concepts related with Construction management & Equipment management
CO2	Describe the basic assumption made for creating a Network, Terminology
CO3	Define the Program Evaluation and Review Technique (PERT)
CO4	Belt conveyor system
CO5	Hauling equipment
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Construction Management **8 Lecture Hours**
Introduction, Objectives and Scope of Construction Management. Work break down structure for various projects, Construction Resources, PMC and Conventional Methods: Gantt Bar chart, Mile stone chart, Line of balance (L O B) technique, Introduction of PMC.
Unit II:Network Analysis: Critical Path Method (CPM) **8 Lecture Hours**
Introduction , Basic assumption made for creating a Network, Terminology, Types of networks , Network Rules, CPM, Bar chart, Type of floats and their significance, Time grid diagram, Updating of networks and Time cost Optimization, Terms and definitions : Event, Activity, Dummies, Interrelationship of Events, Interrelationship of Activity, Various schedules i.e. Material, labour, equipment etc. Resource allocation models with and without constraints. Difference between PERT and CPM.
Unit III: Program Evaluation and Review Technique (PERT) **8 Lecture Hours**
Activities and project time estimates for probabilistic model, Time Estimates: TL, TE, Evaluation of project completion time probabilities, Comparison between Deterministic and Probabilistic Approaches, Cash Flow analysis and expenditure schedules. Cash flow for Owner and Contractor, Job Lay out, Supervision and Safety in Large Construction Projects. Introduction to Construction Equipment: Their contribution and importance in construction Industry. Classification of Equipment, Financial aspects related to construction equipments: Discounted present worth analysis, Depreciation, Cost of owning and operating construction equipment, Basics of equipment replacement policy.
Unit IV: Belt conveyor system **8 Lecture Hours**
Related to performance of IC engines, rim pull, drawbar pull, Coefficient of traction, Gradability, Soil fundamentals, Power Shovels, Draglines, Hoes, Clam Shells and trenching machines, their basic Parts, Operation, Output estimation, Factors influencing output and methods to enhance it, Tractors and related equipment: Bulldozers, Rippers, Scrapers & overview of other Equipment, Terminology, Classification, Components, Power requirement estimation and design.
Unit V:Hauling equipment: **8 Lecture Hours**
Trucks and wagons, operation and guideline for selection and deployment.
Unit VI: Discussion on Latest Research Paper **2 lecture hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Sharma, M.R., Fundamentals of Construction Planning and Management, S.K. Kataria & Son, New Delhi, 2012.
2. Chitkara, K. K., Construction Project Management Techniques and Practices, Tata McGraw Hill, New Delhi, 2004
3. Sengupta and Guha, Construction Management and Planning, Tata McGraw Hill, New Delhi.
4. Chitkara, K. K., Construction Project Management Planning, Scheduling and Controlling, Tata McGraw Hill, New Delhi.
5. Seetharaman, S., Construction Engineering & Management, Umesh Publications, 2007.

Name of The Course	**Transport Economics and Finance**			
Course Code	**MTPE6013**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To enable students to think critically about transportation economics.
2. To make students to understand economic policies affecting the transportation system.
3. To enable students to apply basic econometric methods to the analysis of transportation data.

Course Outcomes

On completion of this course, the students will be able to

CO1	Think critically about transportation economics.
CO2	Evaluate economic policies that affect the transportation system.
CO3	Apply basic econometric methods to the analysis of transportation data.
CO4	Understand the institutional and political barriers associated with transportation pricing and financing,
CO5	Actively discuss and debate contested transportation economic issues,
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Economic evaluation of transport plans 8 Lecture Hours
Need for economic evaluation, cost and benefits of transport projects, time horizon in economic assessment, basic principles of economic evaluation, interest rate, method of economic evaluation, benefit cost ratio method, first year rate of return, net present value method, internal rate of return method, comparison of various methods of economic evaluation.
Unit II: Vehicle operating costs 8 Lecture Hours
Introduction, road user cost study in India , components of VOC, factors affecting VOC, fuel, consumption relationship, spare parts consumption, maintenance and repairs, labour cost, tyre life, lubricants, utilization, and fixed costs.
Unit III: Value of travel time savings 8 Lecture Hours
Introduction, classes of transport users enjoying travel time savings, methodology for monetary evaluation of passengers' travel time, review of work in India on passengers' travel time.
Unit IV: Accident costs 8 Lecture Hours
Introduction, relevance of accident costing for a developing country, review of alternative methodologies for accident costing, Indian studies.
Unit V: Traffic congestion, traffic restraints and road pricing, Highway finance 8 Lecture Hours
Congestion as a factor in road traffic, traffic restraint, road pricing, Basic principles, distribution of highway cost, sources of revenue, highway financing in India.
Unit VI: Discussion on Latest Research Paper 2 lecture hours
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. "Principles of Transportation engineering" by Chakroborty & Das, Prentice Hall, 2009.
2. "Highway Engineering" by S. K Khanna & CEG Justo, Nem Chand Bros., Roorkee, 2001.
3. "Principles and practices of Highway Engineering" by L. R Kadyali, Khanna Publishers, 2013.

Name of The Course	**Traffic Flow Theory**			
Course Code	**MTPE6014**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To be introduced to traffic flow theory.
2. To study macroscopic and microscopic modelling.
3. To learn the fundamentals of ITS.

Course Outcomes

On completion of this course, the students will be able to

CO1	Analyze the traffic stream parameters.
CO2	Apply the queuing theory
CO3	Define the significance of ITS under Indian conditions.
CO4	Role of Geographical Information Systems
CO5	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Traffic stream parameters **9 Lecture Hours**
Traffic stream parameters - Fundamental diagram of volume-speed-density surface. Discrete and continuous probability distributions. Mergingmanoeuvres - critical gaps and their distribution.
Unit II:Macroscopic models **9 Lecture Hours**
Macroscopic models - Heat flow and fluid flow analogies - Shock waves and bottleneck control approach. Microscopic models - Application of queuing theory - regular, random and Erlang arrival and service time distributions
Unit III: Queue discipline **9 Lecture Hours**
Queue discipline - Waiting time in single channel queues and extension to multiple channels. Linear and non-linear car following models - Determination of car following variables - Acceleration noise.
Unit IV: Geographical Information System **9 Lecture Hours**
Geographical Information System – Global Positioning System – Intelligent Transportation Systems - Area Traffic Control – Automatic Toll Collection – Smart Cards – Collision Detection System.
Unit V: Discussion on Latest Research Paper **4 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Drew, D.R., Traffic Flow Theory and Control, McGraw Hill., 1978.
2. TRB, Traffic Flow Theory - A Monograph, SR165, 1975.
3. Burrough P.A. and Rachel A. McDonell, Principles of Geographical Information Systems, Oxford Publication, 2004.
4. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.

Name of The Course	**Highway Construction Practices**			
Course Code	**MTPE6015**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To provide a coherent development to the students for the courses in sector of Engineering like Transportation & Traffic Engineering etc.
2. To present the foundations of many basic Engineering tools and concepts related Highway Engineering.
3. To give an experience in the implementation of Engineering concepts which are applied in field of Transportation Engineering
4. To involve the application of scientific and technological principles of planning, analysis, design and management to highway engineering

Course Outcomes

On completion of this course, the students will be able to

CO1	Understanding of Highway Constructions
CO2	Quality Control of Concrete Pavements
CO3	Knowledge about pavement Construction procedures
CO4	Understanding on Bituminous constructions
CO5	Advances in Construction Maintenances
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Types of Highway Construction and layers **8 Lecture Hours**
Water Bound Macadam (WBM), Wet Mix Macadam (WMM), Dry Lean Concrete (DLC), Stabilized Roads, Bituminous Construction and Cement Concrete Constructions. Types of bituminous constructions, Interface treatments, Wearing Courses for roads.
Unit II:Quality Control in construction of concrete pavements **8 Lecture Hours**
Bridge deck slabs, Selection of wearing course under different climatic and traffic conditions, IRC specifications, Construction techniques and Quality Control, Concrete road construction, tests on concrete mixes, Construction equipment's, Methods of construction of joints in concrete pavements, Quality Control in construction of concrete pavements.
Unit III: Types of Pavement construction procedure **8 Lecture Hours**
Construction of continuously reinforced, Prestressed, Steel Fibre Reinforced (SFRC), Pavements, IRC, MOST, ACI specifications, Ferro cement, Ferro-fibro-Crete, Pavement and overlay construction
Unit IV:Hill Landsides **8 Lecture Hours**
Causes and control measures. Hill road construction practices, Construction of bituminous and cement concrete roads at high attitudes, Hill road drainage.
Unit V:Construction and Maintenance Problems **8 Lecture Hours**
Construction and maintenance problems and remedial measures.
Unit VI: Discussion on Latest Research Paper **2 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. H.M.SO. (London), "Bituminous Materials in Road Construction", 1966.
2. Hewes, Laurence, Isley "American Highway Practice", New York, John Wiley and Sons, Inc.Vol. II, 4th Edition, 1949.
3. Sherrad H.M., "Australian Road Practices", Melbourne University Press, 1958
4. H.M.S.O. (London), Concrete Roads, 1966.
5. Sparkes, F.N. and Smith A.F., "Concrete Roads", Edward Amola and Co., London, 1952.

Name of The Course	**ML and Deep learning Techniques to Infrastructure Problems**				
Course Code	**MTPE6016**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. Comprehensive exposition of the modern and advanced techniques in Machine Learning and Deep Learning
2. Understanding the role of ML in monitoring structural reliability
3. Sensitivity Analysis of Structures

Course Outcomes

On completion of this course, the students will be able to

CO1	Gain comprehensive knowledge of Applications of Machine Learning and Deep Learning Techniques
CO2	Understand decision tree learning algorithm
CO3	Knowledge about Probability and Reliability
CO4	Knowledge about uncertainties and Structural Deformations
CO5	Evaluate Hypotheses
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction to Machine Learning for civil engineers **8 Lecture Hours**
Linear algebra, Probability theory, Probability distributions for Machine Learning, Bayesian methods for the estimation of epistemic uncertainty, Regression methods, Classification Methods, State-space models for time series: Theory, State-space models for time series: Applications
Unit II:Decision Tree Learning **8 Lecture Hours**
Decision tree learning algorithm-Inductive bias-Issues in Decision tree learning; Artificial Neural Networks – Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of back propagation rule Back propagation Algorithm Convergence, Generalization.
Unit III: Introduction to the reliability of structures & systems **8 Lecture Hours**
Revision of probability theory, Laws of probability. Reliability formulation, Multivariate probability densities, Monte Carlo sampling, MCFOSM & FOSM
Unit IV: Sensitivity Analysis **8 Lecture Hours**
SORM, Reliability of systems, Uncertainties, Estimation of parameters from observations, Stresses & Deformations
Unit V: Evaluating Hypotheses **8 Lecture Hours**
Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms; Bayesian Learning: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm.
Unit VI: Discussion on Latest Research Paper **2 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Hands-On Machine Learning with Scikit-Learn and TensorFlow (2nd Edition) by AurélienGéron
2. The Hundred-Page Machine Learning Book by Andriy Burkov
3. Building Machine Learning Powered Applications: Going from Idea to Product by Emmanuel Ameisen
4. Grokking Deep Learning by Andrew W. Trask
5. Deep Learning with Python by Francois Chollet

Name of The Course	**Behavioural Travel Modelling**			
Course Code	**MTPE6017**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. Comprehensive exposition of the modern and advanced techniques in behavioral travel demand modeling.
2. Understanding of demand theory, statistical models, survey methods in transport, land use transportation models
3. Practical applications of Behavioral model

Course Outcomes

On completion of this course, the students will be able to

CO1	Identify the importance of urban travel demand analysis in a society
CO2	Discuss the need for behavioural modelling approach in the management of urban travel demand
CO3	Formulate real-world disaggregate travel demand problems in scientific terms and plan for a rational solution using discrete choice models
CO4	Design a survey process and use appropriate data analysis and model building methods in an urban travel demand study
CO5	Understand the future of travel modelling
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Urban Travel Demand Analysis - Introduction **8 Lecture Hours**
Objectives of urban travel demand analysis; Comprehensive transportation study; Factors influencing, the role of models in policy making, Data collection techniques: Observations and surveys, questionnaires and diaries, new technologies
Unit II:Individual choice theory **8 Lecture Hours**
Binary choice models, multinomial and multi-dimensional choice models, issues in model specification, methods and statistics of model estimation with emphasis on maximum-likelihood estimation, aggregation and forecasting with discrete choice models, validation and transferability aspects, ordered multinomial models, nested logit models
Unit III: Survey design and analysis **8 Lecture Hours**
Travel surveys and their role in transport planning, survey methods, precision and accuracy in travel surveys, sample design, sampling procedures, survey format, pilot surveys, survey administration, collection of stated and revealed preference data, survey data processing.
Unit IV: Advanced concepts **8 Lecture Hours**
Accommodating unobserved population heterogeneity in choice behaviour, mixed logit models, joint stated preference and revealed preference modeling, and longitudinal choice analysis
Unit V:Future Directions **8 Lecture Hours**
Discrete choice models for integrated land use and transport modeling, review of state-of-the-art and future directions.
Unit VI: Discussion on Latest Research Paper **2 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Ortuzar, J. D. and Willumsen, L.G., Modelling Transport, John Wiley & Sons, New York, 1996.
2. Domencich, T.A. and McFadden, D., Urban Travel Demand: A Behavioral Analysis, North-Holland, 1975
3. Ben-Akiva, M. and Lerman, S, Discrete Choice Analysis: Theory and Application to Travel Demand, MIT Press, 1985.
4. Oppenheim, N., Urban Travel Demand Modeling: From Individual Choices to General Equilibrium, John Wiley, 1995.

Name of The Course	**Rural Road Technology**			
Course Code	**MTPE6018**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. Link issues of poverty with rural access and explain the approaches taken by the Rural Roads Project
2. Identify key lessons from the case study and Contrast lessons from the case study with their own country context
3. Analyse the links between rural access, economic development and poverty alleviation.

Course Outcomes

On completion of this course, the students will be able to

CO1	Plan rural road network
CO2	Design highway geometrics
CO3	Justify the geometric design standards adopted for low volume roads
CO4	Understand the procedure for conducting safety audit
CO5	Design pavements for low volume roads
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Planning and Alignment **8 Lecture Hours**
Planning of Rural Roads, Concept of Network planning, rural roads planning, road alignment and surveys, governing factors on route selection, factors considered for alignment.
Unit II:Materials and Pavement Design **8 Lecture Hours**
Introduction, Soil, material surveys, embankment and subgrade materials, stabilized Soils, Road aggregates, aggregate for base courses, new materials as stabilizers, materials for desert areas, materials for bituminous constructions and surfacing; materials for rigid pavements, special pavement, climatic suitability of concrete materials. Introduction, design procedure, pavement components, design of flexible and rigid pavements, special pavements design, types of drainage, and general criteria for road drainage, system of drainage, surface and subsurface systems.
Unit III: Course Content : 8 Lecture Hours
Introduction, selection of materials and Methodology, Embankment and subgrade, sub – base (granular), base(granular), shoulder, bituminous concrete, semi- rigid pavements, construction, concrete pavements, construction of special pavements, equipment required for different procedures.
Unit IV: Waste material for pavement construction **8 Lecture Hours**
Introduction, fly ash for road construction, design & construction, design &construction of fly ash embankment lime fly ash and stabilized soil, lime fly ash pavements, control of compaction, concrete stabilized fly ash with admixtures.
Unit V:Quality Control in Construction and Maintenance **8 Lecture Hours**
Introduction, Pre-requirements, organizational setup, specification, and code of practice, Laboratory equipment, Earth and granular layers, bituminous courses, semi- rigid and rigid pavements, special requirements, recovered of quality control data. Distresses/Defects in rigid and flexible pavements, Maintenance and evaluation, inventory roads and inspections, types of Maintenance Activities, Maintenance
Unit VI: Discussion on Latest Research Paper **2 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. IRC manual for rural roads. Special publication – 20(2002)
2. HMSO, Soil Mechanics for rural Engineers in, London
3. IRC related code books
4. NRRDA – guidelines and code books

Name of The Course	Traffic Management and Design			
Course Code	MTPE6019			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. To have an overall knowledge of the traffic components and assess the traffic characteristics and related problems.
2. To develop a strong knowledge base of traffic planning and its management in any transportation area.
3. To provide knowledge of traffic control devices and its techniques in transportation interaction.

Course Outcomes

On completion of this course, the students will be able to

CO1	Gain knowledge in the fundamental's components of traffic engineering and its features.
CO2	The students will get a vast understanding on various traffic enforcements rules and regulations.
CO3	The students will get aware of the different software used in the field of transportation and its utility in solving the traffic problems.
CO4	Understand Role of parking and fuel consumption
CO5	Understand Congestion Pricing
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Fundamental of traffic flow **8 Lecture Hours**
Basic components of traffic flow, road user, vehicle, environment and their characteristics, speed –volume –density relationship, homogenous and heterogonous traffic flow, PCU concept, vehicle operating cost. Transportation surveys - O-Surveys, spot-speed survey (using endoscope and radar speedometer) traffic volume counts, travel time, parking survey, interaction volume count and delay surveys, methods analysis and interpretation.
Unit II:Traffic Control Devices **8 Lecture Hours**
Signs, markings, islands, channelization, one-way streets, speed breakers, bus stop locations, and bus ways, segregations, tidal flow arrangements, area traffic control, parking, pedestrian flow control, Traffic regulations ,driver, vehicle ,flow and general controls traffic devices control ,types of parking design principles ,parking restrictions, one way streets, zebra crossing, railings, pedestrian signal foot over bridges ,traffic management authorities, road lighting.
Unit III: Traffic Signal Design **8 Lecture Hours**
Elements of traffic signal: Definitions, analysis of saturation headway, saturation flow, lost time, critical flows, derivation of cycle length; Design principles of a traffic signal: Phase design, cycle time determination, green splitting, pedestrian phases, and performance measures; Evaluation of a traffic signal: Definitions and measurement of stopped and control delay, Webster's delay model, oversaturated conditions
Unit IV: Specialized Traffic Studies **8 Lecture Hours**
Parking Studies: Parking inventory, statistics, parking surveys; in out, license palate, on-street

and off-street parking; Accident Studies: Accident data collection, statistics, safety audit, safety measures; Fuel consumption and emission studies: Consumption models, pollutants, air quality models, mitigation measures
Unit V: Congestion Studies **8 Lecture Hours**
Congestion studies: Performance measures, intensity, duration, extent of congestion, traveler perception, remedial measures, congestion pricing
Unit VI: Discussion on Latest Research Paper **2 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Kadiyali, L.R., Traffic Engineering & Transport Planning, Khanna Publishers, New Delhi

2. JotinKhisty, S.C. and Kent Lall, B., Transportation Engineering – An Introduction, Prentice-Hall, NJ

3. S. C. Saxena Traffic Planning And Design .Dhanpat Rai Pub, NewDelhi

4. Hutchison, B.G., Introduction to Transportation Engineering, & Planning, McGraw Hill Book Co.

5. John W. Dickey, Metropolitan Transportation Planning, Tata McGraw Hill Pub. Co.

Name of The Course	**Public Transportation Systems**			
Course Code	**MTPE6020**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To cover concepts of Transportation planning, various modes, transit systems and their suitability
2. To give idea of modeling in planning, to develop the methodology of travel demand modeling for Urban Transportation Systems
3. To provide knowledge of Land use planning and transportation interaction.

Course Outcomes

On completion of this course, the students will be able to

CO1	Know about Urban Transportation System Planning process.
CO2	Urban Mass Transit Systems
CO3	Travel Demand Modelling
CO4	Mass Transit Systems
CO5	Future Role of Transit Systems.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction **8 Lecture Hours**
Development plans, objectives and goals; level of planning; role of transportation at national, regional and urban level, Urbanization Definition of urban area; trends in urbanization; urban class groups; metropolitan city; transportation problems & identification
Unit II: Urban Mass Transportation Systems **8 Lecture Hours**
Urban transit problems, travel demand, types of transit systems, public, private, para-transit transport, mass and rapid transit systems, BRTS and Metro rails, capacity, merits and comparison of systems, coordination, types of coordination.
Unit III: Travel Demand Modeling **8 Lecture Hours**
Trip generation-zonal regression and category analysis, Trip distribution-growth factor models, gravity model, opportunity models, Desire line diagram. Modal split analysis-trip end models, trip interchange models, logit models, Trip assignment techniques-route choice, diversion curves, shortest path algorithms, Allor-nothing assignment, capacity restraint models and Direct demand models

Unit IV: Mass Transit Systems **8 Lecture Hours**
Introduction to routing and scheduling, transit system's performance parameters. Corridor identification and corridor screen line analysis. Urban forms and structures: point, linear, radial, poly-nuclear developments and suitable transit systems, Urban goods movement. Preparation of comprehensive plan and transportation system management planning.
Unit V: Future Scope of Transit Systems **8 Lecture Hours**
Future Scope of Transit Systems, Role of Transit Systems and case studies
Unit VI: Discussion on Latest Research Paper **2 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. B. G. Hutchinson, Principles of urban transportation system planning- McGraw-Hill, New York, 1974
2. Edward K. Morlok, Transportation Engg. and Planning
3. Dickey, Metropolitan Transportation Planning Tata McGraw-Hill, New Delhi, 1975
4. Blunder and Black, Land use transportation System
5. J. Ortuzer and L.G. Willumsen, Modelling Transport, Johan Wiley and Sons Chincester,1994

Name of The Course	**Ground Improvement Techniques**				
Course Code	**MTPE6021**				
Prerequisite	-				
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. To learn how to improve weak soils by modern ground improvement techniques
2. To study the role of soil reinforcement in soil stabilization
3. To know the importance of geo-synthetics in ground improvement

Course Outcomes

On completion of this course, the students will be able to

CO1	Understand the importance of ground improvement techniques in civil engineering construction activities.
CO2	Do reinforced wall design using steel strip or geo-reinforcement
CO3	Perform any modern ground improvement design including soil stabilization
CO4	Understand the methods of Soil Reinforcement
CO5	Understand the role of Geo-synthetics
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction **8 Lecture Hours**
Engineering properties of soft – weak and compressible deposits – problems associated with weak deposit – Requirements of ground improvements – introduction to engineering ground modification, need and objectives.
Unit II: Soil Stabilization **8 Lecture Hours**
Science of soil stabilization – Mechanical modification – Hydraulic modification – Dewatering systems – Chemical modification – Modification by admixtures like lime, Cement, Bitumen etc. – Grouting – Deep jet mixing methods
Unit III: Recent Ground improvement techniques **8 Lecture Hours**

Stabilization using industrial waste – modification by inclusion and confinement – soil nailing – stone column – compaction piles – dynamic compaction – prefabricated vertical drains – preloading – electro – osmosis – soil freezing vacuum consolidation – deep explosion – dry powdered polymers – enzymes
Unit IV: Soil reinforcement **8 Lecture Hours**
Historical background, RCC – Vidalean concept of reinforced earth – Mechanisms – Types of reinforcements – Soil – Reinforcement – Interaction studies – Internal & External stability criteria – Design Principles of steep reinforced soil slops – pavements – Embankments on soft soils.
Unit V: Geo-Synthetics **8 Lecture Hours**
Geo-synthetic clay liner – Construction details – Geo Synthetic Materials – Functions – Property characterization – Testing Methods for Geo – Synthetics – Recent research and Developments. Control of Improvement – Field Instrumentation – design and analysis for bearing capacity and settlement of improved deposits.
Unit VI: Discussion on Latest Research Paper **2 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw – Hill International Editions, 1990.
2. Purushotham Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi
3. Sharma.S.K., Principles, Practice and Design of Highway Engineering, S.Chand& Co. New Delhi,1985.
4. Jones C. J. F. P, Earth Reinforcement and Soil Structures, Butterworths, London.

Name of The Course	**Bridge Engineering**			
Course Code	**MTPE6022**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To develop an understanding of basic concepts in bridge engineering like components, classification, importance, investigation of bridges and loading conditions.
2. To study the design of Culvert, Foot Bridge, Slab Bridge, T-beam Bridge and Box Culvert using IRC.
3. To study the design of various sub-structures like piers, abutments, foundations and study the importance of the bearing and joints in construction of the bridge.

Course Outcomes

On completion of this course, the students will be able to

CO1	Prepare a detailed project report for the construction of bridge giving hydraulic particulars of the river and soil details
CO2	Be able to select the suitable site and type of the bridge.
CO3	Design various types of bridges like Culvert, Slab Bridge and T-beam Bridge using provisions of IRC.
CO4	Design pier, abutment, foundations, bearing and detailing of joints.
CO5	Importance of Bearings
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Components of Bridges **8 Lecture Hours**

Components of Bridges – Classification – Importance of Bridges – Investigation for Bridges – Selection of Bridge site – Economical span – Location of piers and abutments – Subsoil exploration – Scour depth – Traffic projection – Choice of bridge type
Unit II: Specification of road bridges **8 Lecture Hours**
Specification of road bridges – width of carriageway – loads to be considered – dead load – IRC standard live load – Impact effect
Unit III: General design considerations **8 Lecture Hours**
General design considerations – Design of culvert – Foot Bridge - Slab Bridge – T-beam bridge – Pre-stressed concrete bridge – Box Culvert - Fly over bridges
Unit IV: Evaluation of sub structures **8 Lecture Hours**
Evaluation of sub structures – Pier and abutments caps – Design of pier – Abutments – Type of foundations
Unit V: Importance of Bearings **8 Lecture Hours**
Importance of Bearings – Bearings for slab bridges – Bearings for girder bridges – Electrometric bearing – Joints – Expansion joints. Construction and Maintenance of bridges – Lessons from bridge failures
Unit VI: Discussion on Latest Research Paper **2 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Ponnuswamy, s., Bridge Engineering, Tata McGraw - Hill, New Delhi, 1997
2. Victor, D.J., Essentials of Bridge Engineering, Oxford & IBH Publishers Co., New Delhi, 1980.
3. N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, New Delhi, 2006.

Name of The Course	**Transportation Network Analysis and Optimization**			
Course Code	**MTPE6023**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To learn the fundamental definitions of networks.
2. To study the different Shortest Path Algorithms and network assignment techniques.
3. To be exposed to various network analysis software.

Course Outcomes

On completion of this course, the students will be able to

CO1	Define and analyse different types of networks.
CO2	Apply the Shortest Path
CO3	Apply Minimum cost algorithms
CO4	Understand various applications of network analysis
CO5	Have a working knowledge of various network analysis software.
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Network flows **8 Lecture Hours**
Applications, definitions, graphs, paths, trees, cycles, loops, walk, network representation (adjacency list and matrices) and basic network transformations; Network algorithms; Complexity, Search Algorithms, Strategies for designing polynomial algorithms.

Unit II:Shortest Path Algorithms **8 Lecture Hours**
Label setting, Dijkstra's and Dial's algorithms, Optimality conditions, label correcting algorithms and optimality conditions, detecting negative cycles, all-pair shortest path algorithms; pre-flow push polynomial time algorithms, capacity scaling techniques
Unit III: Minimum cost network assignment **8 Lecture Hours**
Optimality conditions, cycle-cancelling algorithm, Successive shortest path algorithm, other polynomial time variants; Network equilibrium analysis; principles and optimization formulations, Frank-Wolfe algorithm; Special cases and variants
Unit IV:Applications **8 Lecture Hours**
Applications of min-cost, max-flow, and shortest path algorithms to transportation and infrastructure networks: transportation networks, airline, freight, facility location, logistics, network design, project scheduling, reliability of distribution systems, telecommunication/power networks etc
Unit V:Computer Software Applications **8 Lecture Hours**
Principles of TRIPS, SATURN, EMME/2, CUBE; Demo Versions, Case studies
Unit VI: Discussion on Latest Research Paper **2 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Ahuja, R., Magnanti, T.L., and Orlin, J.B., Network Flows: Theory, Algorithms and Application, Prentice Hall, New Jersey, 1993.
2. Bell, M.G., Transportation Networks, Elsevier Science Publishers, 1999.

Name of The Course	**Project Management**
Course Code	**MTPE6024**
Prerequisite	
Co-requisite	
Anti-requisite	

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

Course Objectives

Upon Completion of the Course Students will be able to understand Project Management practices and planning

Course Outcomes

On completion of this course, the students will be able to

CO1	Explain project planning activities that accurately forecast project costs, timelines, and quality.
CO2	Evaluate the budget and cost analysis of project feasibility.
CO3	Analyze the concepts, tools and techniques for managing projects.
CO4	Illustrate project management practices to meet the needs of Domain specific stakeholders from multiple sectors of the economy (i.e. consulting, government, arts, media, and charity organizations).
CO5	Understanding of Agile Technology
CO6	Discuss on Latest Research Paper.

Continuous Assessment Pattern

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

Course Content:

Unit I: Introduction **8 Lecture Hours**
Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS), Introduction to Agile Methodology.
Unit II:Capital Budgeting **8 Lecture Hours**
Capital Investments: Importance and Difficulties, phases of capital budgeting, levels of decision making, facets of project analysis, feasibility study – schematic diagram, objectives of capital budgeting
Unit III: Project Costing

8 Lecture Hours
Cost of Project, Means of Finance, Cost of Production, Working Capital Requirement and its Financing, Profitability Projections, Projected Cash Flow Statement, Projected Balance Sheet, Multi-year Projections, Financial Modeling, Social Cost Benefit Analysis
Unit IV: Tools & Techniques of Project Management **8 Lecture Hours**
Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Critical Path Method (CPM), Computerized project management
Unit V: Project Management and Certification **8 Lecture Hours**
An introduction to SEI, CMMI and project management institute USA – importance of the same for the industry and practitioners. PMBOK 6 - Introduction to Agile Methodology, Themes / Epics / Stories, Implementing Agile. Domain Specific Case Studies on Project Management: Case studies covering project planning, scheduling, use of tools & techniques, performance measurement
Unit VI: Discussion on Latest Research Paper **2 Lecture Hours**
This unit is based on research papers / Innovations / start-up ideas / white papers / applications. Minimum one latest research paper will be discussed in the class.

Suggested Reading

1. Project Planning Analysis Selection Financing Implementation & Review, Prasanna Chandra, 8th Edition, 2010, Tata McGraw Hill Publication, ISBN 0-07-007793-2.

2. A Guide to the Project Management Body of Knowledge (PMBOK Guide), Project Management Institute, 5th Edition, 2013, ISBN: 978-1-935589-67-9

3. Project Management A System approach to Planning Scheduling & Controlling, Harold Kerzner, 11th Edition, 2013, John Wiley & Sons Inc., ISBN 978-1-118-02227-6.

4. Project Management – Planning and Controlling Techniques, Rory Burke, 4th Edition, 2004, John Wiley & Sons, ISBN: 9812-53-121-1

Name of The Course	**Seminar**			
Course Code	**MTPE6005**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives

1. To make literature survey for various recently emerging technologies.
2. To select any topic of interest and to review the related literature in detail.
3. To compare and analyze the various topologies for the selected topic of interest.
4. To conclude the advantages, drawbacks and future scopes of the technique.

Course Outcomes

On completion of this course, the students will be able to

CO1	Get familiarity with the recently advanced techniques.
CO2	Get detailed information about the topic of interest
CO3	Know how to do literature survey.
CO4	Develop the interest in different research areas of Structures.

Continuous Assessment Pattern

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

Suggested Reading

1. Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal
2. Depending upon their area of interest, students may choose any reference book of relevant field.

Name of The Course	Mini Project			
Course Code	MTPE7002			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	2	1

Course Objectives

1. To make literature survey for various recently emerging technologies.
2. To select any topic of interest and to review the related literature in detail.
3. To compare and analyze the various topologies for the selected topic of interest.
4. To conclude the advantages, drawbacks and future scopes of the technique.

Course Outcomes

On completion of this course, the students will be able to

CO1	Get familiarity with the recently advanced techniques
CO2	Get detailed information about the topic of interest.
CO3	Know how to do literature survey
CO4	Develop the interest in different research areas of Structures.

Continuous Assessment Pattern

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

Suggested Reading

1. Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal.
2. Depending upon their area of interest, students may choose any reference book of relevant field.

Name of The Course	Project (Phase I)			
Course Code	MTPE7004			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	0	5

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Submit a project synopsis comprising of the application and feasibility of the project
CO2	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety and sustainability.
CO3	Work and communicate efficiently in multidisciplinary teams.
CO4	Identify, formulate, and solve engineering problems.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

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

Suggested Reading

1. Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal.

2. Depending upon their area of interest, students may choose any reference book of relevant field.

Name of The Course	Project (Phase II)			
Course Code	MTPE8001			
Prerequisite	MTPE7004			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	0	15

Course Objectives

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

Course Outcomes

On completion of this course, the students will be able to

CO1	Submit a project synopsis comprising of the application and feasibility of the project.
CO2	Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety and sustainability.
CO3	Work and communicate efficiently in multidisciplinary teams.
CO4	Identify, formulate, and solve engineering problems.
CO5	Develop an understanding of professional and ethical responsibility.

Continuous Assessment Pattern

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

Suggested Reading

1. Depending upon their area of interest, students may choose any text book of relevant field or any article from Journal
2. Depending upon their area of interest, students may choose any reference book of relevant field depending upon their area of interest; students may choose any reference book of relevant field.