GALGOTIAS UNIVERSITY

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

COURSE BOOK
2021-2025

Curriculum and syllabus 2021-2025

Department of Civil Engineering
Program : B. Tech in Environment and Pollution

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	BCE03T3301	Strength of Materials	2	0	0	2	20	30	50
6	BCE03T3302	Basic Fluid Mechanics	2	0	0	2	20	30	50
7	BCE03T3303	Surveying	2	0	0	2	20	30	50
8	BCE03T3304	Basic Transportation Engineering	2	0	0	2	20	30	50
9	BCE03P3302	Basic Fluid Mechanics Lab	0	0	2	1	50	-	50
10	BCE03P3303	Surveying Lab	0	0	2	2	50	-	50
11	BCE03P3305	Engineering Drawing	0	0	4	2	50	-	50
	BCE03P3301	Strength of Materials Lab	0	0	2	1	50	-	50
	BCE03P3304	Basic Transportation Engineering 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	BCE03T3403	Basic Structural Analysis	2	0	0	2	20	30	50
8	BCE03T3407	Environmental Chemistry & Microbiology	3	0	0	2	20	30	50
9	BCE03T3405	Soil Mechanics	2	0	0	2	20	30	50
10	BCE03T3406	Reinforced Concrete Structures	2	0	0	2	20	30	50
11	BCE03P3405	Soil Mechanics 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		Water Engineering: Design & Application	3	0	0	3	20	30	50
2		Water Engineering: Design & Application Lab	0	0	2	1	50	-	50
3		Engineering Economics and Management	3	0	0	3	20	30	50
4		Engineering Clinic - II (Machine Learning)	0	0	2	1	50	-	50

5		Campus to Corporate	3	0	0	3			
6		Aptitude building and Logical Reasoning - III	0	0	2	1	50	-	50
7		Program Elective - I	3	0	0	3	20	30	50
8	BCE03T3502	Engineering Geology, GIS & Remote Sensing	3	0	0	3	20	30	50
9	BCE03P3502	Engineering Geology, GIS & Remote Sensing Lab	0	0	2	1	50	-	50
10	BCE01P3504	CAD Lab - I (AUTOCAD)	0	0	4	2	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				**23.5**			
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	BCE03T3601	Waste Water Engineering: Design and Applications	3	0	0	3	20	30	50
3	BCE03P3601	Waste Water Engineering: Design and Applications Lab	0	0	2	1	50	-	50
4		Foreign Language (German / Japanese / French)	0	0	4	2	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	BCE03T3602	Instrumentation Techniques for Environmental Monitoring	3	0	0	3	20	30	50
11	BCE03P3602	Instrumentation Techniques for Environmental Monitoring Lab	0	0	2	1	20	30	50
12	BCE03T3603	Solid Waste Management	3	0	0	3	20	30	50
13	BCE03P3603	Solid Waste Management Lab	2	0	0	1	20	30	50
		Total				**25.5**			
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	BCE03T3701	Air Pollution & Control	2	0	0	2	20	30	50
4	BCE03P3701	Air Pollution & Control Lab	0	0	2	1	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	BCE01P3703	Industrial Internship - II	0	0	0	1	50	-	50
		Total				**16**			
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

Sl No	**Course Code**	**Name of the Electives**				**Assessment Pattern**			
			L	**T**	**P**	**C**	**IA**	**MTE**	**ETE**
1	BCE03T5701	Industrial Waste Management	3	0	0	3	20	30	50
2	BCE03T5702	Climate Change & CDM	3	0	0	3	20	30	50
3	BCE03T5703	Environmental Toxicology & Risk Assessment	3	0	0	3	20	30	50
4	BCE03T5704	Environmental Impact Assessment & Audit	3	0	0	3	20	30	50
5	BCE03T5705	Ecology and Bio-monitoring Techniques	3	0	0	3	20	30	50
6	BCE03T5706	Hazardous & Biomedical Waste Management	3	0	0	3	20	30	50
7	BCE03T5707	Surface & Ground Water Pollution	3	0	0	3	20	30	50
8	BCE03T5708	Green Technology	3	0	0	3	20	30	50
9	BCE03T5709	Environmental Law and Policy	3	0	0	3	20	30	50
10	BCE03T5710	Occupational Hazards, Health & Safety	3	0	0	3	20	30	50
11	BCE03T5711	Water and Soil Conversation	3	0	0	3	20	30	50
12	BCE03T5712	System Simulation & Modeling	3	0	0	3	20	30	50
13	BCE03T5713	Risk and Reliability Analysis of Environmental System	3	0	0	3	20	30	50
14	BCE03T5714	Irrigation and Drainage Engineering	3	0	0	3	20	30	50
15	BCE03T5715	Environment and Sustainable Development	3	0	0	3	20	30	50

List of Open Electives

Basket 1

Sl No	Course Code	Name of the Elective					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BOE601	Human Computer Interface	3	0	0	3	20	30	50
2	BOE602	Introduction to cyber Physical Systems	3	0	0	3	20	30	50
3	BOE603	Selected Topics in Signal Processing	3	0	0	3	20	30	50
4	BOE604	Selected Topics in Communication Engineering	3	0	0	3	20	30	50
5	BOE605	Autonomus Vehicles	3	0	0	3	20	30	50
6	BOE606	Data Science	3	0	0	3	20	30	50
7	BOE607	Computer Vision	3	0	0	3	20	30	50
8	BOE608	Artificial Intelligence	3	0	0	3	20	30	50
9	BOE609	Cyber Secutity	3	0	0	3	20	30	50
10	BOE6010	Energy Management	3	0	0	3	20	30	50
11	BOE6012	Data Envelopment Analysis	3	0	0	3	20	30	50
12	BOE6013	Operation Management	3	0	0	3	20	30	50
13	BOE6014	Construction Engineering	3	0	0	3	20	30	50
14	BOE6015	Disaster Management	3	0	0	3	20	30	50
15	BOE6016	Bioinformatics	3	0	0	3	20	30	50

Basket 2

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BOE701	Remote Sensing and GIS	3	0	0	3	20	30	50
2	BOE702	Automotive Electronics	3	0	0	3	20	30	50
3	BOE703	Sensors & Actuators	3	0	0	3	20	30	50
4	BOE704	IoT and Smart Cities	3	0	0	3	20	30	50
5	BOE705	Web Design and Management	3	0	0	3	20	30	50
6	BOE706	Principles of Telemedicine	3	0	0	3	20	30	50
7	BOE707	Mobile Application Development	3	0	0	3	20	30	50
8	BOE708	Business Analytics	3	0	0	3	20	30	50
9	BOE709	Cloud Computing	3	0	0	3	20	30	50
10	BOE7010	Block Chain	3	0	0	3	20	30	50
11	BOE7011	Augunmented / Virtual Reality	3	0	0	3	20	30	50
12	BOE7012	Digital Forensics	3	0	0	3	20	30	50

13	BOE7013	Operations Research	3	0	0	3	20	30	50
14	BOE7014	Renewable Energy	3	0	0	3	20	30	50
15	BOE7015	Interior Design	3	0	0	3	20	30	50
16	BOE7016	Landscaping	3	0	0	3	20	30	50
17	BOE7017	Biology for Engineers	3	0	0	3	20	30	50
18	BOE7018	Surveying	3	0	0	3	20	30	50

Minor Courses

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	BCE03T3407	Environmental Chemistry & Microbiology	3	0	0	3	20	30	50
2	BCE03T3501	Water Engineering: Design & Application	3	0	0	3	20	30	50
3	BCE03T3502	Engineering Geology, GIS & Remote Sensing	3	0	0	3	20	30	50
4	BCE03T3602	Instrumentation Techniques for Environmental Monitoring	3	0	0	3	20	30	50
5	BCE03T3603	Solid Waste Management	3	0	0	3	20	30	50
6	BCE03T3701	Air Pollution & Control	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	BCE03T3711	Soil Pollution & Remediation	3	0	0	3	20	30	50
2	BCE03T3712	Planning and Design of Environmental Engineering Works	3	0	0	3	20	30	50
3	BCE03T3713	Water Resources System	3	0	0	3	20	30	50
4	BCE03T3714	Advanced Open Channel Hydraulics	3	0	0	3	20	30	50
5	BCE03T3715	Non-Conventional Energy Systems	3	0	0	3	20	30	50
6	BCE03T3716	Advanced Surveying	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 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	Strength of Material			
Course Code	BCE03T3301			
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 students 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**
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: 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 RaiPublications Company, ISBN: 9788187433545.

2. Gere J. M. and Thimoshenko S. P. (2008), Mechanics of Materials, 8th Edition, CBS Publishers & Distributors, ISBN: 9780534417932.
3. Bansal R. K. (2010), Strength of Materials, 4th Edition, Laxmi Publications, ISBN: 9788131808146.

Name of The Course	**Basic Fluid Mechanics**			
Course Code	**BCE03T3302**			
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.

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.

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**
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.

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	**Introduction to Surveying**			
Course Code	**BCE03T3303**			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

Course Objectives

1. 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**
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.

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	**BCE03P3302**				
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

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	BCE03P3303			
Prerequisite	BCE03T3303			
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	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.

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, Title block.
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	**Basic Transportation Engineering**			
Course Code	**BCE03T3304**			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

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

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 **9 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 **9 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 **10 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 **10 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 Chandra.
2. Kadiyali.L.R., and Lal.N.B., (2005), Principles and Practice of Highway Engineering, Fourth Edition, Khanna Publishers, ISBN- 9788174091659.

Name of The Course	**Basic Transportation Engineering Lab**			
Course Code	**BCE03P3304**			
Prerequisite	**BCE03T3304**			
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 students 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:
Aggregate Crushing Value Test
Aggregate Impact Test
Los Angeles Abrasion Test
Shape Test
Penetration Test of Bitumen
Ductility Test of Bitumen
Softening Point Test of Bitumen
Flash and Fire Point Test of Bitumen
Viscosity Test of Bitumen
Spot Test
California Bearing Ratio Test

Suggested Reading

1. Khanna.S.K., and Justo. C.E.G., (2011), Highway Engineering, Ninth Edition, Nem Chandra.
2. Kadiyali.L.R., and Lal.N.B., (2005), Principles and Practice of Highway Engineering, Fourth Edition, Khanna Publishers, ISBN- 9788174091659.

Name of The Course	**Structural Analysis**			
Course Code	**BCE01T3401**			
Prerequisite	BCE01T3301			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	2	0	0	2

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.

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: 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 IV: Slope deflection method **8 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
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	**Environmental Chemistry & Microbiology**			
Course Code	BCE03T3407			
Prerequisite	-			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To learn basics of aquatic chemistry.
2. To learn about different pollutants of water and their effect over water quality.
3. To learn basics of atmospheric chemistry.
4. To learn basics of microbial structure and functions
5. To learn the utilization of microbes in environmental remediation processes
6. Discussion on latest research papers

Course Outcomes

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

CO1	Theoretical knowledge and numerical calculations related to pH, equilibrium, solubility, dissociation etc..
CO2	Knowledge of sources and mechanisms resulting degradation of water quality.
CO3	Understanding the direct and indirect processes related to air pollution.
CO4	Identification of microbes, and regulation of microbial growth in lab.
CO5	Application of microbes in waste treatment.
CO6	Discuss on Latest Research Paper.

Course Content:

Unit I: Aquatic chemistry **8 lecture hours**
Hydrological cycle, Chemical structure of water molecule, unusual properties of water, solubility of solids and gases in water, Carbonate cycle, pH of water, Chemical Equilibrium, Redox reactions. Application of principles of chemistry for solving environmental engineering problems.
Unit II: Chemistry Water Pollution **8 lecture hours**
Chemistry of pollution due to nutrients (CNP), Oxygen demanding wastes, salts, detergents, heavy metals, pesticides, hydrocarbons, PCBs, radioactive compounds.
Unit III: Atmospheric Chemistry **8 lecture hours**
Composition of atmospheric layers, sources of air pollution, major-pollutants of air, chemistry of photochemical smog formation, acid rain, ozone depletion; greenhouse effect and global warming.
Unit IV: Environmental Microbiology **9 lecture hours**
Microbial taxonomy, Classification of morphological aspects of bacteria, algae, fungi, protozoa, and other aquatic micro flora; microbial growth and dynamics; pure and mixed cultures; Aerobic and Anaerobic metabolism; microbial transformation of organic matter (CNPS), acclimatization of waste; microbial inhibition mechanisms.
Unit V: Role of Microbes in Environment **9 lecture hours**
Role of micro-organisms in wastewater treatment, and air pollution control (bio-scrubbers); microbial degradation of lignocellulosic material, pesticides, hydrocarbons; microbial precipitation of heavy metals.
Unit VI: Latest Research and Innovations: **4 lecture hours**
This unit is based on research papers/ Innovations/ start-up ideas/ white papers/ applications. Minimum one research paper will be discussed in the class

Suggested Reading

1. Sawyer, C.N., McCarty, P.L. &Parkin, G.F. "Chemistry for Environmental Engineering", Mc-Graw Hill.
2. O.P. Gupta, Environmental Chemistry, Khanna Publishing House

Name of The Course	**Soil Mechanics**
Course Code	**BCE03T3405**
Prerequisite	-

Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		2	0	0	2

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
20	30	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. 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	**Reinforced Concrete Structures**				
Course Code	**BCE03T3406**				
Prerequisite	BCE03T3301, BCE03T3403				
Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		3	0	0	3

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 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 type of RC beam.**
CO4	Understand the difference between one-way slab and two-way slab.
CO5	**Know the concept of short column and long column..**

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 IV: 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 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.

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	**Soil Mechanics Lab**			
Course Code	**BCE03P3405**			
Prerequisite	BCE03T3405			
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	**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	Perform different test conducted on cement, aggregate and concrete as per relevant Coda 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

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	**Water Engineering: Design & Application**			
Course Code	**BCE03T3501**			
Prerequisite	BCE01T3302			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To introduce basic concepts of water engineering and design.
2. To understand the meaning and standards of Characteristics of Water
3. To introduce the definition, principle, types and design of sedimentation tank.
4. To introduce the definition, principle, types and design of Filtration.
5. To introduce the O & M of Water treatment plants

Course Outcomes

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

CO1	Students can learn the basic fundamentals of water engineering and design
CO2	Students will know that how the population forecasting calculates.
CO3	Students will understand the factors which effect the water properties.
CO4	Students will learn the procedure to design sedimentation tank..
CO5	Students will know the miscellaneous methods of water treatment.
CO6	Learn about latest technologies and expose students to research articles.

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 Supply Engineering **8 lecture hours**
water demand, design period, population forecasting, source of water, hydrological concepts, ground water and its development, conveyance of water, pipe materials, corrosion, laying of pipes, pipe appurtenances, pumps for water supply, distribution system, planning of water supply projects.
Unit II: Characteristics of Water **8 lecture hours**
Physical, Chemical and Microbiologicalquality parameters. Drinking water quality criteria and standards.
Unit III: Water treatment Processes I **8 lecture hours**
Coagulation, common coagulants and coagulant aids and their reactions. Mixing and flocculation basin design. Sedimentation, design principles, discrete and flocculant suspensions, sedimentation tank details.
Unit IV: Water treatment Processes II **8 lecture hours**
Filtration, gravity and pressure filters, single and multimedia filters.Water softening by chemical precipitation and ion exchange. Aeration of water to remove iron and manganese and taste and odour. Disinfection, disinfectants, chlorination of water supplies. Miscellaneous methods of water treatment
Unit V: Water treatment plants **9 lecture hours**
O & M of Water treatment plants, Domestic & Industrial water treatment.
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. Garg: Water Supply Engineering (Environmental Engineering Vol.-I)
2. Punmia: Water Supply and Wastewater Engineering
3. Steel and McGhee: Water Supply and Sewerage.
4. Birdie: Water Supply and Sanitary Engineering
5. Peavy, Rowe and Tchobanoglous: Environmental Engineering.

Name of The Course	**Engineering Geology, GIS & Remote Sensing**			
Course Code	**BCE03T3502**			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1.B**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

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

CO1	understand of the factors that determine the stability of earth's surface
CO2	the basic remote sensing concepts and its characteristics
CO3	Fundamentals of Aerial Photography
CO4	Image Interpretation and Digital Image Processing
CO5	analysis and interpretation of GIS Basic concepts and Application of GIS
CO6	Learn about latest technologies and expose students to research articles.

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 geology **9 lecture hours**
Relevance of geology in Civil Engineering, Subdivisions of Geology. Weathering, types and its, engineering significance. Laboratory tests used in, civil engineering for assessing intensity of, weathering. Engineering classification of weathered, rock masses. Soil profile. Geological classification of soils.Minerals,Properties that affect the strength of minerals. Physical properties and chemical,composition of following minerals -quartz,
UNIT II: Remote Sensing, Energy Sources and Interaction **5 lecture hours**
Introduction to remote sensing: Definition of Remote Sensing, types of remote sensing, remote sensing system and components. EMR source and characteristics, active and passive remote sensing, EMR propagation through medium, Role of atmosphere, Atmospheric windows, EMR interaction with objects, Spectral signature, EMR interaction with vegetation, soil and water. Satellite orbits and platforms: Geostationary and sun synchronous satellites, Resolution, Applications of remote sensing in civil engineering, Advantages of Remote Sensing, Limitations of Remote Sensing
UNIT III: Fundamentals of Aerial Photography **7 lecture hours**
Basic Principles of Photogrammetry, Types of Aerial Photos, Basic Geometric Characteristics of Aerial Photographs, Photographic Scale, Ground Coverage of Aerial Photograph
Unit IV: Image Interpretation and Digital Image Processing **7 lecture hours**
Visual Image Interpretation of Photographs and Images, Elements of Visual, Interpretation, Interpretation keys, Generation of Thematic Maps, Introduction to Digital Image, Image Rectification and Restoration, Image Rectification and Resolution, Radiometric Correction and Noise Removal
Unit V: Basic concepts and Application of GIS **9 lecture hours**
Basic concepts of GIS – Introduction to GIS-History of development of GIS- Elements of GIS-Computer hardware and software, Components, Architecture**,** Contributing Disciplines, Work Flow Standard Software, Applications of GIS
Unit VI: Latest Research and Innovations: **4 lecture hours**
This unit is based on research papers/ Innovations/ start-up ideas/ white papers/ applications. Minimum one research paper will be discussed in the class

Suggested Reading

1. A.N. Patel and Surendra Singh (1999), Remote Sensing Principles and Applications, Scientific Publisher, Jodpur.
2. Duggal, SK,Rawal,N and Pandey, HK (2014) Engineering Geology, McGraw Hill Education, New Delhi
3. A. Burrough(2000), Principle of Geographical Information Systems for Land Resources Assessment, Clarendon Press, Oxford.
4. T.M.Lilles and R.W.Kiefer (1999), Remote Sensing and Image Interpretation, JohnWiley& Sons, New York.
5. KeithC. Clarke,BradO.Parks, Michael P.Crane (2005),Geographic Information Systems and Environmental Modeling, Prentice-Hall of India.
6. Chang.T.K. 2002: Geographic Information Systems, Tata McGrawHill

Name of The Course	**Water Engineering: Design & Applications Lab**			
Course Code	**BCE03P3501**			
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 students will be able to

CO1	The type of unit operations and processes involved in water treatment plants.
CO2	Understand 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

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	**Remote Sensing & GIS Applications Lab**
Course Code	**BCE03P3502**
Prerequisite	-
Co-requisite	-
Anti-requisite	-

	L	T	P	C
	0	0	2	1

Course Objectives

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

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

CO1	The 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

Continuous Assessment Pattern

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

List of Experiments:

1. Geo referencing of topo sheet and satellite image
2. Introduction to basics of digital images and Data (Vector and Raster)
3. Image enhancement and classification – supervised and unsupervised
4. Digitization of Lake Boundary, river network and other features
5. Using GIS Software for plotting points, lines, polygons on maps.
6. Data collection from GPS
7. Development of environment database on GIS package
8. Use of GIS in selection of Landfill site.
9. Queries and analysis from GIS database
10. Use of GIS in selection of Landfill site.

Suggested Reading

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.
3. T.M.Lilles and R.W.Kiefer (1999), Remote Sensing and Image Interpretation, JohnWiley& Sons, New York.
4. KeithC. Clarke,BradO.Parks, Michael P.Crane (2005), Geographic Information Systems and Environmental Modeling, Prentice-Hall of India.

Name of The Course	**CAD Lab - I (AUTOCAD)**
Course Code	**BCE01T3504**
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	**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	Instrumentation Techniques for Environmental Monitoring			
Course Code	BCE03T3602			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. Estimation of errors in measurement and minimization, measurement of pressure,temperature and flow etc.
2. Fundamentals of functional elements of measuring system, Classification andcalibration.
3. Introduction of Spectro-analytical Methods
4. Understanding of Chromatographic Methods
5. Learn the Electro Analytical Methods and continuous measurement methods.

Course Outcomes

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

CO1	Learn fundamentals of Measuring system, classification and calibration.
CO2	Learned about Management of Data and measurement of non-electrical quantities.
CO3	Can Use Spectro-analytical Methods.
CO4	Able to use Chromatography Methods.
CO5	Have the idea about Electro Analytical Methods and Continuous Monitoring Methods.
CO6	Learn about latest technologies and expose students to research articles.

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 **9 lecture hours**
Fundamentals: The Significance and Application of Measurement. Functional Elements of Generalized Measuring System. Classification of Measuring Instruments, Introduction of Microprocessors and advantages of Microprocessor based instrumentation. Management of Data in quantitative analysis: Accuracy, precision, types of errors, Minimization of error, statistical analysis and curve fittings.
Unit II: Standards of Measurement **8 lecture hours**
Microprocessor based instrumentation. Management of Data in quantitative analysis: Accuracy, precision, types of errors, Minimization of error, statistical analysis and curve fittings.
Unit III: Spectro-analytical Method **9 lecture hours**
Spectro-analytical Method: Colorimetry, Spectrophotometer, Fluorometry, Nephelometry, Turbidimetry, Flame Photometry, Atomic, absorption and emission Spectrophotometer.
Unit IV: Chromatography Method: **9 lecture hours**
Chromatography Method: Classification, Principal and application of Chromatography –Gas chromatography, GC-MS, HPLC, Ion Chromatography, Paper chromatography and thin layer, Chromatography
Unit V: Electro Analytical Method: **8 lecture hours**
Role of micro-organisms in wastewater treatment, and air pollution control (bio-scrubbers); microbial degradation of ligno-cellulosic material,pesticides, hydrocarbons; microbial precipitation of heavy metals.
Unit VI: Discuss 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. Instrumentation and Mechanical Measurement by Prof. A. K. Tayal
2. Hand Book of Analytical Instrumentation by R. S. Khandpur
3. Instrumentation Measurement and Analyst by B. C. Nakra and K K Chaudhry

Name of The Course	Solid Waste Management			
Course Code	BCE03T3603			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

To educate the students on the principles involved in the management of municipal solid waste from source identification up to disposal.

Course Outcomes

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

CO1	To make the students understand the fundamentals of solid wastes and also the types, need and sources of solid wastes.
CO2	To understand about the methods of waste characterization and source reduction and to study the various methods of generation of wastes.
CO3	To understand in detail about the storage, collection and transport of wastes and also to study about the methods used for handling and segregation of wastes.
CO4	To know about the basics of the waste disposal options and also a detailed study on the disposal in landfills and also to learn about landfill remediation.
CO5	To understand about the waste transformation and material/energy recover technologies with regard to municipal solid wastes.
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: Sources, Composition & Properties **9 lecture hours**
Sources, composition & properties of municipal solid waste. Handling & separation of solid waste, Municipal Waste (Management & Handling Rules, 2000), Integrated solid waste management (SWM) System, Hierarchical approach for SWM. Solid Waste Collection &Transportation: Types of collection systems (Hauled- container system& Stationary container system), Collection routes & their Layout, Solid waste transfer stations.
Unit II: waste generation and collection **8 lecture hours**
Solid waste generation and collection rates; Waste handling and separation, storage and processing at source, solid wastes collection methods, separation, processing, and transformation of solid wastes, transfer and transport of solid wastes.
Unit III: Methods of Disposal **8 lecture hours**
Methods of Disposal of Municipal Solid Waste Landfills: Classification, Types & methods, Site selection, Site preparation, Composition, Characteristics, Generation, & Control of Landfill gases; Composition, Formation, Movement & control of leachate in landfills; landfill design. Re-vegetation of closed landfill sites, Long-term post closure plan, Groundwater monitoring during & after closure.
Unit IV: Transformation and recycling **8 lecture hours**
Transformation and recycling of waste materials; Composting: Theory of composting, Manual and mechanized composting, Design of composting plan, Recovery of bioenergy from organic waste. Thermal Conversion Technologies: Incineration, Pyrolysis & Gasification Systems. Types & design of incinerators.
Unit V: E-waste management **8 lecture hours**
E-waste: E waste management, Global statistics, E-waste waste source, E-waste pollution health and environmental impact, E-waste management rule 2016, E-waste management technique, E-waste material recovery.
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. George Tchobanoglous, Hilary Theisen, Samuel A. Viquel, "Integrated Solid Waste Management: Engineering, Principles & Management issues", McGraw-Hill-International Edition.
2. CPHEEO Manual on Municipal Solid Waste Management.

3. Bala Krishnamoorthy, "Environmental Management, Text Book and Cases", PHI Publication.

Name of The Course	Waste water Engineering: Design and Application Lab			
Course Code	BCE03P3601			
Prerequisite	BCE03T3601			
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	0	0	2	1

Course Objectives

To educate the students on the practical manifestation of principles involved in the municipal and industrial waste water from source identification, quality standards, analysis, treatment etc. for safe disposal.

Course Outcomes

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

CO1	Understand the sampling methods involved in waste water analysis.
CO2	Understand the collection and preservation of waste water samples.
CO3	Able to do municipal and industrial waste water sample analysis.
CO4	Apply different types of analytical methods
CO5	Identify waste water sources and collect samples of waste waters from municipal waste water drains and industries out let during a site visit.

Continuous Assessment Pattern

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

List of Experiments:

1. Procedures for sampling of domestic and industrial wastewaters.
2. Preservation of wastewater samples for different tests i.e., DO, BOD, Metals etc.
3. Determination of colour and odour of wastewater sample.
4. Determination of DO, BOD of the wastewater sample.
5. Determination of TDS and TSS in wastewater sample.
6. Determination of COD of wastewater sample.
7. Determination of Chloride content of wastewater sample.
8. To determine the nitrogen content.

Suggested Reading

1. A.P.H.A. "Standard Methods for the Examination of Water and Wastewater", American Public Health Association.
2. Sawyer, C.N., McCarty, P.L. &Parkin, G.F. "Chemistry for Environmental Engineering", Mc-Graw Hill.
3. Mathur, R.P. "Water & Wastewater Testing", Lab Manual, Roorkee.

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	**Instrumentation Techniques for Environmental Monitoring Lab**			
Course Code	**BCE03P3602**			
Prerequisite	B CE03T3602			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. Estimation of errors in measurement and minimization, measurement of pressure, temperature and flow etc.
2. Fundamentals of functional elements of measuring system, Classification and calibration.
3. Introduction of Spectro-analytical Methods
4. Understanding of Chromatographic Methods
5. Learn the Electro Analytical Methods and continuous measurement methods.

Course Outcomes

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

CO1	Learn fundamentals of Measuring system, classification and calibration.
CO2	Learned about Management of Data and measurement of non-electrical quantities.
CO3	Can Use Spectro-analytical Methods.
CO4	Able to use Chromatography Methods.
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. To study the different types of errors involved in sampling of air and water pollutants.
2. To study the instruments principles involved in sampling of air and water pollutants.
3. To study the principle and instruments involved in Sepctro-analytical Methods used in Environmental monitoring.
4. To study the principle and instruments involved in Chromatographic Methods used in Environmental monitoring.
5. To study the principle and instruments involved in Electro analytical methods used in Environmental monitoring.
6. To perform a comparison analysis between Gas, HPLC ion paper chromatography methods.
7. To study the Chemiluminescence analysis for NOX and fluorescence analysis for SO2
8. To study and perform the calibration of instruments used in environmental monitoring.

Suggested Reading

1. Instrumentation and Mechanical Measurement by Prof. A. K. Tayal
2. Hand Book of Analytical Instrumentation by R. S. Khandpur
3. Instrumentation Measurement and Analyst by B. C. Nakra and K K Chaudhry

Name of The Course	**Solid Waste Management Lab**			
Course Code	**BCE03P3603**			
Prerequisite	BCE03T3603			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

To educate the students on the practical manifestation of principles involved in the management of municipal solid waste from source identification up to disposal.

Course Outcomes

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

CO1	Understand the sampling methods involved in MSW.
CO2	Understand the collection and sorting mechanism.

CO3	Do moisture content analysis of municipal solids.
CO4	Apply different types of disposal methods
CO5	Identify methods of hazardous waste disposal during a site visit.

Continuous Assessment Pattern

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

List of Experiments:

1. Survey the MSW of your locality and Identify its sources and write composition of MSW.
2. Carryout sample survey of different localities in groups listing properties of municipal solid waste.
3. Survey your locality and based on it suggest methods of solid waste collection.
4. Survey your locality and based on it suggest suitable methods of handling, separation and storage of solid waste.
5. Identify& discuss the methods of processing different types of solid waste (search internet for latest methods).
6. Compare different methods of disposal of MSW. (search internet for latest methods).
7. Identify methods of hazardous waste disposal during a site visit. and follow safety precautions

Suggested Reading

1. George Tchobanoglous, Hilary Theisen, Samuel A. Viquel, "Integrated Solid Waste Management: Engineering, Principles & Management issues", McGraw-Hill-International Edition.
2. CPHEEO Manual on Municipal Solid Waste Management.

Name of The Course	**Air Pollution & Control**				
Course Code	**BCE03T3701**				
Prerequisite					
Co-requisite	-				
Anti-requisite	-				
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives

1. Introduction to Air Pollution and its effects, Sampling and measurement.
2. Study the Property of Atmosphere, Metrological Variables and plume behavior.
3. To Develop an understanding of the pollution control methods of particulate matter.
4. Gaseous pollution control methods and Automobile pollutions.
5. To give the concept Air population legislation in India and current topics.

Course Outcomes

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

CO1	Learned about Air Pollution, its effects and measurement.
CO2	Understanding of the Metrological concept and Plume behavior
CO3	Understanding of control of particulate Matter by Different Methods.
CO4	Learned about Control of Gaseous Pollutants and automobile Pollution.
CO5	Awareness of Air Pollution Legislation in India and current topic.
CO6	Learn about latest technologies and expose students to research articles

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 Air Pollution **8 lecture hours**
Sources and classification of Air Pollution Effects of Air Pollution on Human health, plants, Animals and Property. Sampling and measurement in ambient, Work Place and stack.
Unit II: Air Pollution and metrology **8 lecture hours**
Meteorology- Concept of Atmosphere, wind movements, Windrose Diagram and Measurement of Meteorological Variables. Atmospheric lapse rates, Adiabatic lapse rate and their consequences, Plume behavior. Plume rise-equation, estimation of stack height.

Unit III: Pollution control Method of a Particulate matter **8 lecture hours**
Types of Particulate control methods-Settling chambers, cyclone separators, scrubbers, filters and Electrostatic Precipitators-Mechanism, Their design and application.
Unit IV: Gaseous Pollution Control method and Automobile Pollution **8 lecture hours**
Types of gaseous Pollution Control method- absorption, adsorption and combustion process. Automobile pollution-Sources of pollution, composition of auto exhaust &control method.
Unit V: Air Pollution Legislation and Global Problem **8 lecture hours**
Air Quality Standard, Ambient Air Quality Standard and Emission standard. Air Pollution, legislation and regulation in India. Air Pollution Indices. Global problem of air pollution and its remedial measure. Air Pollution from major Industrial Operations- Case study
Unit VI: Latest Research and Innovations **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. Introduction to Environmental Engineering and Science: - G. M. Masters
2. Air Pollution:- M.N. RAO and H.V. RAO , M C Graw Hill Education.

Name of The Course	**Air Pollution & Control Lab**			
Course Code	**BCE03P3603**			
Prerequisite	BCE03T3603			
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. Understand the basic principles and concepts of processes involved in ambient air quality, its pollution and monitoring aspects.
2. Design of unit operations and processes involved in air pollution control units.
3. Evaluation of the performance of air pollution control units deployed.

Course Outcomes

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

CO1	The type of unit operations and processes involved in air pollution.
CO2	The design of unit operation or process appropriate to the situation by applying physical, chemical, biological, and engineering principles for air pollution control.
CO3	The ambient air quality, its pollution and monitoring aspects.
CO4	To study sustainable way of air pollution control units and evaluate their performance to meet the desired health and environment related goals.
CO5	To understand air quality testing procedures and standards

Continuous Assessment Pattern

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

List of Experiments:

1. Stack monitoring.
2. Ambient air monitoring for PM10, SO2 and NO2.
3. Measurement of meteorological parameters -wind velocity, wind direction, humidity, temperature, solar in radiations, rain falland drawing wind rose diagram.
4. Determination of O3.
5. Laboratory scale study on few air pollution control devices.

Suggested Reading

1. W.H.O.: Selected Methods of Measuring Air Pollutants.
2. Principles and Practices of Air Pollution Control and Analysis, by J. R. Mudakavi, December 2013
3. Pandey and Carney: Environmental Engineering
4. Keshav Kant and Rajni Kant, "Air Pollution and control Engineering, Kannna Publishing House.

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	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	**Industrial Waste Management**			
Course Code	**BCE03T5701**			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To acquire theoretical knowledge of industrial processes, operations, manufacturing.

2. To study of liquid, solid and air discharges from industries, waste characteristics.
3. To acquire theoretical knowledge of industrial management,
4. To acquire theoretical knowledge of industrial Treatment
5. To acquire theoretical knowledge of industrial disposal.

Course Outcomes

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

CO1	Introduction types of industrial waste, characterization and management.
CO2	Study of manufacturing processes and wastes generated in various industries.
CO3	Discover the scope of prevention of solid, liquid and gaseous waste
CO4	Discover the scope of treatment of solid, liquid and gaseous waste
CO5	Discover the scope of disposal of solid, liquid and gaseous waste.
CO6	Learn about latest technologies and expose students to research articles

Continuous Assessment Pattern

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

Course Content:

Unit I: Management of Industrial Wastes **8 lecture hours**
Solid, Liquid and Gaseous waste, Management of industrial wastewater, Management of solid wastes from industries and management of discharges to the air.
Unit II: Waste Characterization **8 lecture hours**
Waste characterization study, wastes audit, characteristics of industrial wastewater, characteristics of discharges to the air, characteristics of solid waste streams from industries.
Unit III: Wastes from Industries **8 lecture hours**
Textile wastes; Dairy wastes; Slaughterhouse, Poultry and Fish processing waste; Tannery Wastes; Sugar Mill Wastes; Pulp and Paper Mill Waste; Fermentation Industry Waste; Engineering Industry Waste; Petroleum and Petrochemical wastes; Fertilizer and Pesticides Industry waste; Wastes from vegetable, food and allied industries, Rubber Waste.
Unit IV: Pollution Prevention & Treatment **8 lecture hours**
General Approach, Source Reduction, Waste minimization, strength and volume reduction, segregation, reuse, recycle, material conservation, recovery, Benefits of Pollution Prevention. Methods for Treating Wastewaters from Industry: Mechanisms, Waste Equalization, pH Control, Chemical Methods of Wastewater Treatment, Biological Methods of Wastewater Treatment, Physical Methods of Wastewater Treatment
Unit V: Treatment and Disposal **8 lecture hours**
Treatment and Disposal of Solid Wastes from Industry: Land filling, Incineration, Composting Industrial Wastes, Solidification and Stabilization of Industrial Solid Wastes. Methods for Treating Air Discharges from Industry: Reduction at Source, Containment, Treatment.
Unit VI: Latest Research and Innovations **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. Nemerow NL, Industrial Waste Treatment: Contemporary Practice and Vision for the Future, Butterworth-Heinemann,
2. Nemerow NL (1978) Industrial Water Pollution: Origins, Characteristics, and Treatment, Addison-Wesley, ISBN 10: 0201052466 / ISBN 13: 9780201052466
3. Zahid Amjad (2010) The Science and Technology of Industrial Water Treatment, IWA Publishing, CRC Press, ISBN 1843393115 ISBN13 9781843393115
4. WEF Manual of Practice No. FD-3, Industrial Wastewater Management, Treatment, And Disposal, Water Environment Federation, Third Edition, McGraw Hill

Name of The Course	**Climate Change & CDM**				
Course Code	**BCE03T5702**				
Prerequisite					
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	

	3	0	0	3

Course Objectives

1. Basic introduction about green house gases and their role in atmosphere.
2. To aware students about global warming and its implications.
3. To familiarize students with climate change and its effects on human life as well as on different atmospheric phenomenon.
4. To introduce the fundamentals of carbon sequestration and different policies related to climate change.
5. To give idea about clean development mechanism, ozone depletion and mechanism of CFCs degradation.

Course Outcomes

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

CO1	The student will learn about basics of green house gases and its effects.
CO2	The student will be able to understand the concept of global warming along with its effect on human life.
CO3	The student will learn the role of climate change in different atmospheric phenomenon.
CO4	The student will understand the significance of carbon credits, carbon sequestration along with the national and international policies related to climate change.
CO5	Student will be able to attain thorough knowledge about ozone and chlorofluorocarbons.
CO6	Learn about latest technologies and expose students to research articles

Continuous Assessment Pattern

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

Course Content:

Unit I: Green House **8 lecture hours**
Solid, Liquid and Gaseous waste, Management of industrial Introduction, Green House Effect, Green House Gases, Emission sources of greenhouse gases, Greenhouse effect as a natural phenomenon, Green House Effect due to anthropogenic activities, Recent role of greenhouse effect
Unit II: Global Warming **8 lecture hours**
Concept of global warming, Factors responsible for global warming, Global warming potential, Past present and future scenario of global warming, Role of countries and citizens in containing global warming, Implications of global warming
Unit III: Climate Change **8 lecture hours**
Introduction, worldwide observed impacts ofclimate change, Proposed impacts of climate change worldwide, Temperature rise, Sea level rise, Coastal erosion and landslides, Actions to stop global warming, Ways to prevent global warming
Unit IV: Carbon Footprint **8 lecture hours**
Concept of carbon sequestration, Carbon sequestration projects, Carbon sequestration modalities and procedures, Global carbon cycle, Carbon capture and storage, Carbon trading, Montreal protocol, Kyoto protocol, Carbon credits, Role and functions of IPCC, National and International action plan on climate change
Unit V: Ozone Layer **8 lecture hours**
Presence of ozone in the atmosphere, Depletion of stratospheric ozone layer, Chlorofluorocarbons, Mechanism of CFCs degradation, Effect of Ozone depletion, Protection of ozone layer, Introduction about CDM, Its operation, Modalities and procedures for CDM, CDM project types
Unit VI: Latest Research and Innovations **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. Air Pollution, KL Dorean, CBS Publishers & Distributers Pvt. Ltd. New Delhi.
2. Principles and Practices of Air Pollution Control and Analysis, J.R. Mudakavi, I.K. international Publishing House Pvt. Ltd., New Delhi.
3. Carbon Capture: Sequestration and Storage (Issues in Environmental Science and Technology), RE Hester and RM Harrison.
4. Climate Change: causes, Effects and Solutions, John T. Hardy. Willy Publication, USA.

Name of The Course	Environment Toxicology & Risk Assessment			
Course Code	BCE03T5703			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. To introduce the students to environmental toxicology
2. To learn toxic effects of different chemicals
3. To understand the basics of neurotoxicity, developmental, and genetic toxicology
4. To understand the process and mechanism of carcinogenesis
5. To learn the process of risk evaluation

Course Outcomes

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

CO1	Knowledge of direct and indirect toxicity associated with contaminated environment
CO2	Identification of toxicity-based type of contaminant, and vice-versa
CO3	Identification of defects associated with pre-natal exposure, and genetic deformities
CO4	Thorough understanding of carcinogenesis.
CO5	Evaluation and characterization of risk/toxicity associated with a chemical compound
CO6	Learn about latest technologies and expose students to research articles

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**
Definition and importance of Environmental toxicology, Types of toxicity, Toxic substances inair, water, soil and vegetation, mobilization, fate and behavior of toxic substances, Ecosystems and Ecotoxicology: Bioaccumulation and Biomagnification, Case studies.
Unit II: Health effects of environmental chemicals **8 lecture hours**
Pesticides, PAHs, PCBs,Heavy Metals, MTBE, Diethylstilbestrol, Formaldehyde, smog, asbestos.Descriptive toxicology: median lethal dose, nonlethal measures of toxicity, Kinetics of exposure,Toxicosis, Irreversible toxicity.
Unit III: Neurotoxicity **8 lecture hours**
Neurotoxins, mechanism of neurotoxicity, Developmental toxicology: teratogens, basic principles of teratology, thresholds in developmental toxicology, teratology testing. Genetic toxicology:mutation, selection, and evolution, chromosomal abnormalities
Unit IV: Carcinogenesis **8 lecture hours**
Cancer and its origin, mechanism of carcinogenesis, Oncogenes, DNA repair. Carcinogenesis testing: Epidemiology, Bioassays (Ames assay, sister chromatid exchange assay, mouse micronucleus assay), Animal bioassays
Unit V: Risk Assessment **8 lecture hours**
Fundamentals of hazard, exposure, and risk. Elements of risk assessment: hazard identification, data collection and evaluation, exposure analysis, dose-response analysis, unit risk, evaluation of non-carcinogenic toxicity, risk characterization and uncertainty analysis
Unit VI: Latest Research and Innovations **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. Magnus Francis (1994). Toxic substances in the environment. John Wiley & Sons, Inc., USA
2. Pradyot Patnaik (2007) 3rd edition. A comprehensive guide of hazardous properties of chemical compounds. John Wiley & Sons, Inc., USA
3. D. Kofi Asante-Duah (1998). Risk Assessment in Environmental Management: A Guide for Managing Chemical Contamination Problems. Wiley Publishers.
4. Lorris G. Cockerham, Barbara S. Shane (1993) Basic Environmental Toxicology. CRCPress

Name of The Course	Environmental Impact Assessment & Audit			
Course Code	BCE03T5704			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

The overall aims of the course are for students toacquire understanding of the principles, process,and the necessary techniques for environmental impact assessment, mitigation and monitoring.

It also includes analysis and prediction of impact on resources and environment caused due to development projects.

Course Outcomes

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

CO1	To understand the definition, history principle of EIA,
CO2	To understand importance and procedures of EIA
CO3	To know about the tools for evaluation of environmental impact.
CO4	Assessment and prediction of environmental impacts on physical, biological, humansand quality of life.
CO5	Learn Environmental auditing procedures and Indian laws for EIA.
CO6	Learn about latest technologies and expose students to research articles

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**
Definition and history of environmental impact assessment, related law necessary for EIA, Objectives of Environmental Impact Assessment, Process for EIA, TOR, IEE, Components of EIA Reports.
Unit II: Environmental Impacts **8 lecture hours**
Tools for assessment of environmental impacts: checklist, networks, matrices, overlays, baseline study, scoping & scales, network overlays, index methods. Planning of environmental Factors.
Unit III: Assessment Predictions **8 lecture hours**
Prediction and assessment of impacts on air and noise; soil and land-use; water quantity and quality; biological: terrestrial ecology-forest and wildlife, aquatic ecology-plankton, nekton, benthos and importance of coastal habitat; human use, quality of life, socio-economic. Consideration of human values in design & execution of projects.
Unit IV: Environmental Impact Assessment **8 lecture hours**
Environmental Impact Assessment, Mitigation and Monitoring process for environmental impact,Environmental Impact Statement (EIS), Environmental Management System (EMS)
Unit V: Risk Assessment **8 lecture hours**
Environmental Impact Analysis-laws & statuses in India, Elements of Environmental Auditing, Impact Analysis of hydropower, thermal power projects, Industrial & housing complexes etc.
Unit VI: Latest Research and Innovations **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. Canter L.W. Environmental Impact Assessment. McGraw-Hill, Inc.
2. Eccleston, H.C. 2000. Environmental Impact Statements. John Wiley & Sons, Inc.
3. Lee, N. and C. George (editors). 2000. Environmental Assessment in Developing andTransitional Countries. John Wiley & Sons Ltd.
4. Wathern P. 1995. Environmental Impact Assessment: Theory and Practice. BiddlesLtd, Guildford and King's Lynn.
5. Westmman W. E. 1985. Ecology, Impact Assessment, and EnvironmentalPlanning. John Wiley & Sons, Inc.

Name of The Course	Ecology and Bio-monitoring Techniques

Course Code	BCE03T5705			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

1. To learn fundamentals of dynamics of an ecosystem
2. To understand the basics of biogeography
3. To introduce the students to basics of biodiversity
4. To understand the process and mechanism of conservation
5. To learn the basics of bio-monitoring

Course Outcomes

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

CO1	Understanding of ecosystem functions and their interrelationships
CO2	Knowledge of effect of human activities on ecology
CO3	Knowledge of biodiversity status
CO4	Thorough understanding of conservation practices
CO5	Evaluation and characterization of ecosystems based on bio-monitoring
CO6	Learn about latest technologies and expose students to research articles

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**
Ecology: Definition and scope of ecology, types of ecosystem, abiotic and biotic environments, biotic – abiotic interactions, Population ecology: Population attributes, population changes, survivorship curves, growth models, demographic models, dispersion. Community ecology: Community structure, two-species interactions, food webs, succession, disturbance and succession, negative and positive feedbacks in succession. Energy flows, nutrient cycling.
Unit II: **8 lecture hours**
Biogeography: Bio-geographical zones of India; forest distribution and types; terrestrial, aquatic and wetland ecosystems; biomes. Global issues and human ecology: Greenhouse effect and climate change, Ozone depletion, ecosystems responses to long-term climate patterns. Urban ecosystems and hierarchies.
Unit III: **8 lecture hours**
Biodiversity: origin of new species; species, community and ecosystem diversity, genetic diversity; biological classification – phylogenetic relationships; classifying and naming species; biodiversity and livelihood, threats to biodiversity, and hot spots, IUCN protected area categories.
Unit IV: **8 lecture hours**
Introduction to conservation biology, values of biodiversity and conservation ethics, Patterns and process of biodiversity. Biological consequences of habitat fragmentation, covering barriers and isolation, crowding effect, local and regional extinctions, edge effects. Population genetics and conservation; community and ecosystem level conservation, Conservation reserves; Conservation outside protected areas. Control of invasive species. Significance of ecological restoration in conservation.
Unit V: Risk Assessment **8 lecture hours**
Introduction to Biomonitoring: theory, technique and application; Quantification of biodiversity and monitoring of condition and ecological function of terrestrial, aquatic and soil ecosystems; Invertebrates as bio-monitors in post-disturbance habitat; Cutting-edge technologies in biological monitoring: non-invasive sampling and genetic monitoring; Assessment of water quality of wetlands and river systems; Restoration, Rehabilitation and management of degraded aquatic ecosystems.
Unit VI: Latest Research and Innovations **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 Readin

2. F. V. Dyke (2008) Conservation Biology: Foundations, Concepts, Applications, Springer
3. T.M. Smith & R. L. Smith (2012). 8th Edition. Elements of Ecology. Pearson.
4. Eugene Odum (2005). 5th Edition. Fundamentals of Ecology. Cengage Publishers

5. Navjot S. Sodhi & Paul R. Ehlrich (2010). Conservation Biology. Oxford University Press

Name of The Course	Hazardous & Biomedical Waste Management			
Course Code	BCE03T5706			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	T	P	C
	3	0	0	3

Course Objectives

To educate the students on the principals involved in the management of several hazardous and biomedical wastes from source identification up to treatment, transformation, and disposal.

Course Outcomes

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

CO1	To make the students understand the fundamentals of hazardous wastes and also thetypes, and sources of hazardous as well as biomedical wastes.
CO2	To understand about the characteristics of various types of hazardous and biomedical wastes
CO3	To understand in detail about the storage, collection and transport of hazardous and biomedical wastes, and also to study about the methods used for handling and segregation of wastes.
CO4	To improve the knowledge on the waste processing techniques which includes in11111cineration, solidification and stabilization of hazardous wastes
CO5	To know about the basics of the waste disposal options and also a detailed study onthe disposal in landfills and also to learn about landfill remediation.
CO6	Learn about latest technologies and expose students to research articles

Continuous Assessment Pattern

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

Course Content:

Unit: Hazardous waste management **8 lecture hours**
Definition and characteristics, Sources and type-based categorization, Treatment technologies: Physico-chemical, thermal, biological, sea and land disposal, Hazardous Waste (Management & Handling) Rules, Basel convention.
Unit II: Sources, Treatment and Management **8 lecture hours**
Waste destruction technologies, Waste concentration technologies, TSDF cradle to grave concepts, Solidification and Stabilization Technologies, Biological Treatment, Biotreatment. E-Waste: Definition and sources, Environmental and health impacts, Treatment and management, E waste (Management &Handling) Rules.
Unit III: Nuclear or Radioactive Waste **8 lecture hours**
Principles of radioactivity, Sources of radioactivity in environment, Characteristics of nuclear waste, Radioactive materials and its decay, Half-life, Health effects of ionizing Radiation, Factors affecting radiation doses, Safety standards
Unit IV: Radioactive waste and disposal **8 lecture hours**
Detection and Analysis of radioactive materials, Mining and Recovery, Low-level Radioactive waste, High-level radioactive waste, transport of Radioactive Materials, Storage and Disposal of radioactive waste, New waste reduction technologies.
Unit V: Biomedical wastes **8 lecture hours**
Definition, Sources, Characterization of biomedical waste, sources of biomedical waste, classification of biomedical waste, pathological wastes, sharp pharmaceutical wastes, Genetonic wastes, Chemical wastes, waste contaminated with heavy metals. Generation, Segregation and storage of biomedical waste, Packaging, Handling and Transport of wastes, Measures to reduce biomedical wastes, Treatment and disposal of biomedical wastes, Biomedical waste management in developed countries and in India – legal aspects. Biomedical Waste (Management & Handling) Rules
Unit VI: Latest Research and Innovations **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 Readin

1. Freeman H.M. (1988) Standard Handbook of Hazardous Waste Treatment andDisposal, McGraw Hill. New York.
2. Freeman H.M. (1988) Standard Handbook of Hazardous Waste Treatment andDisposal, McGraw Hill. New York.
3. Chaudhury, G.R., Biological degradation and Bioremediation of toxic chemicals,Dioscorides Press, Oregon, 1994.
4. Martin.A.M, Biological degradation of wastes, Elsevier Applied Science, London, 1991.
5. Lie DHF and Liptak B.G, Hazardous wastes and solid wastes, Lewis Publishers, NewYork, 2000

Name of The Course	**Surface & Ground Water Pollution**			
Course Code	**BCE03T5707**			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To educate the students on the hydraulics related to contamination of ground water
2. To educate the students on the hydraulics related to contamination of surface water
3. modelling of ground and surface water quality

Course Outcomes

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

CO1	To make the students understand the fundamentals of Ground water and the various hydrologic cycles.
CO2	To make the students understand about the various steady state hydrologic budgets.
CO3	To make the students understand in detail about the development of Ground Water resources and Aquifers.
CO4	To know about the basics of the Transport process in solute transfer and hydro chemical behavior of contaminants in the ground water.
CO5	To know about the basics of the Transport process in solute transfer and hydro chemical Behavior of contaminants in the surface water
CO6	Learn about latest technologies and expose students to research articles

Continuous Assessment Pattern

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

Course Content:

Unit: Groundwater Hydrology **8 lecture hours**
Introduction to groundwater hydrology; Porous media, distribution of subsurface water, porosity and related properties of soils, subsurface hydrological cycle, hydrogeologic formations. Darcy's law and continuity relations; Darcy's law, hydraulic head and gradient, factors affecting hydraulic conductivity, heterogeneity and anisotropy, limitations to the validity of Darcy's law, Storage in confined aquifers, general continuity equation, continuity equation with a change in total stress. Groundwater management models. Hydrologic Cycle and Flow net: Hydrologic Cycle, Flow nets Graphical construction, Flow nets by numerical simulation, steady state Regional Ground water Flow, Steady state hydrologic, budgets Fluctuations in ground water levels
Unit II: Soil water relationship **8 lecture hours**
Vadose zone and groundwater recharge: Soil water in vadose zone, soil water characteristics curve, Darcy's law and Richard's equation, Infiltration models, evaporation and desorption models, water balance and groundwater recharge
Unit III: Groundwater contamination **8 lecture hours**
Groundwater contamination: sources of subsurface contamination, mass transport processes, general continuity equation, solute partitioning, degradation losses. Solute transport by advection: Potential theory, potential functions, stream functions, travel time along stream lines, residence time distribution theory, standard flow patterns
Unit IV: Radioactive waste and disposal **8 lecture hours**
Advection Dispersion Transport and Models : One dimensional flow and column experiments, transverse dispersion, mechanical dispersion tensor, moments of transport equation, analytical models of chemical spills, and contaminant plumes

Chemical Properties and Principles: Constituents-chemical equilibrium- Association and Dissociation of dissolved species effects of concentration gradients-Mineral dissolution and solubility Oxidation and Reduction Process-Ion exchange and Adsorption
Unit V: Modeling of Groundwater pollution **8 lecture hours**
Governing Equations for flow and transport in surface waters, chemical and biological process models, simplified models for lakes, streams, and estuaries. Model complexity: Selection and development, model resolution, coupled and uncoupled models, linear and nonlinear models, solution techniques, data requirements for calibration, application and evaluation of environmental control
Unit VI: Latest Research and Innovations **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 Readin

1. Karanth ,"Ground Water Assessment, Development and Management" , McGraw Hill Companies.
2. David Keith Todd and Larry W. Mays, "Groundwater Hydrology John Wiley and Sons.
3. K.R. Rushton," Groundwater Hydrology", John Wiley & Sons, Ltd.

Name of The Course	Green Technology				
Course Code	**BCE03T5708**				
Prerequisite					
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. To provide introductory knowledge about green technology and green innovations.
2. To give a basic idea about greener nano particle synthesis and its characterization.
3. To introduce about role of green energy and sustainable development in life.
4. To aware and provide knowledge about green management
5. To update students about the application of green process in different industries.

Course Outcomes

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

CO1	The student will be able to understand the basics of green technology and its applications.
CO2	Understanding about green nanotechnology and green materials.
CO3	Able to comprehend about the role of green energy and sustainable development in life.
CO4	The students will learn about the importance of green management in corporate as well as in industrial sector.
CO5	Learn about the application of green processes in various industrie**s.**
CO6	Learn about latest technologies and expose students to research articles

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 Green Technologies **8 lecture hours**
Introduction of Green protocol: Need, Goal and Limitation of Green Technology, Principles of Green Technology with their explanations and examples. Green Innovation & Sustainability: Criteria for choosing appropriate green energy technologies, life cycle cost; the emerging trends – process/product innovation, technological/environmental leap-frogging; Eco/green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity- WEHAB (Eco-restoration phyto-remediation, ecological sanitation, renewable energy technologies, industrial ecology, agroecology and other appropriate green technologies); design for sustainability.
Unit II: Green Nanotechnology **8 lecture hours**
Nano particles preparation techniques, Greener Nano synthesis, Nanoparticle characterization methods, Green materials: biomaterials, biopolymers, bioplastics, and composites. Nanomaterials for Fuel Cells and Hydrogen; Generation and storage, Nanostructures for efficient solar hydrogen production, Metal Nano clusters in Hydrogen Storage Applications, Metal Nano particles as Electrocatalysts in Fuel Cells

Unit III: Green Energy and Sustainable Development **8 lecture hours**
The inseparable linkages of life supporting systems, biodiversity and ecosystem services and their implications for sustainable development: global warming; greenhouse gas emissions, impacts, mitigation and adaptation; future energy Systems- clean/green energy technologies; International agreements/conventions on energy and sustainability- United Nations Framework Convention on Climate Change (UNFCC); sustainable development.
Unit IV: Green Management **8 lecture hours**
The concept of green management; evolution; nature, scope, importance and types; developing a theory; Definition green management in India; relevance in twenty first century, Green techniques and methods; green tax incentives and rebates (to green projects and Companies); green project management in action; Environmental reporting and ISO 14001; climate change business and ISO 14064; green financing; financial initiative by UNEP; green energy management; green product management
Unit V: Green Industrial Processes **8 lecture hours**
Pollution statistics from various industries, polymer industry, textile industry, greener approach of dyeing, ecofriendly pesticides, pharmaceutical industry, waste water treatment
Unit VI: Latest Research and Innovations **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. Kelliher, F., Reinl, L. Green Innovation and Future Technology. ISBN 978-1-137-47982-
2. Leo A. Meyer. The Green Energy Management. ISBN 0880690534.
3. Jadhav, Nilesh Y. Green and Smart Buildings. ISBN 978-981-10-1002-6.
4. Sengupta, Amretashis, Sarkar, Chandan Kumar. Introduction to Nano. ISBN 978-3- 662-47314-6.
5. Kalia, Susheel, Kaith, B. S., Kaur, Inderjeet. Cellulose Fibers: Bio- and Nano-Polymer Composites. ISBN 978-3-642-17370-7.

Name of The Course	**Environmental Law and Policy**			
Course Code	**BCE03T5709**			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To explain the role of law, policy and institutions in the conservation of natural resources as well as pollution control
2. To explain the role of law, policy and institutions in the management of natural resources as well as pollution control
3. To introduce the laws and policies both at the national level relating to environment
4. To introduce the laws and policies both at the international level relating to environment
5. To equip the students with the skills needed for interpreting laws, policies and judicial Decisions

Course Outcomes

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

CO1	Be familiar with the laws, policies and institutions in the field of environment
CO2	Acquire the skills needed for interpreting laws and policies in a holistic perspective
CO3	Acquire the skills needed for interpreting judicial decisions in a holistic perspective
CO4	Acquire the ability to evaluate the role of law and policy in conservation natural resources and prevention of pollution
CO5	Acquire the ability to evaluate the role of law and policy in management of natural resources and prevention of pollution
CO6	Learn about latest technologies and expose students to research articles

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 the legal system **8 lecture hours**
Constitution, Acts, Rules, Regulations; Indian Judiciary, Doctrine of precedents, judicial review, Write petitions, PIL– liberalization of the rule of locus standi, Judicial activism. Introduction to environmental laws in India; Constitutional provisions, Stockholm conference; Bhopal gas tragedy; Rio conference. General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine, Overview of legislations and basic concepts
Unit II: Wildlife and Biodiversity related laws **8 lecture hours**
Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence Statutory framework on Forests, Wildlife and Biodiversity, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation– Project Tiger, Elephant, Rhino, Snow leopard.
Unit III: Air, Water and Marine Laws **8 lecture hours**
National Water Policy and some state policies Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. Pollution Control Boards Ground water and law Judicial remedies and procedures Marine laws of India; Coastal zone regulations. Legal framework on Air pollution: Air Act,1981; EPA,1986
Unit IV: Environment protection laws **8 lecture hours**
Environment protection laws and large Projects Legal framework on environment protection-Environment Protection Act as the framework legislation–strength and weaknesses; EIA; National Green tribunal The courts infrastructure projects.
Unit V: Hazardous Substances and Activities Legal framework **8 lecture hours**
EPA and rules; PLI Act, 199 Principles of strict and absolute liability. An introduction to International law; sources of international law; law of treaties; signature, ratification Evolution of international environmental law: Customary principles; Common but differentiated responsibility, Polluter pays.

Unit VI: Latest Research and Innovations **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. Birnie P. (2009) et al., International Law and the Environment, 3rd ed., Oxford.
2. Leela Krishnan P. (2006) Environmental Law Case Book, 2nd ed, Lexis Nexis, India.
3. Sands P. (2002) Principles of International Environmental Law, 2nd ed, Cambridge
4. Air Pollution: - M.N. RAO and H.V. RAO , M C Graw Hill Education.

Name of The Course	**Occupational Hazard, Health & Safety**			
Course Code	**BCE03T5710**			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. Introduction to Occupational Hazards and Its Prevention.
2. To give the concept of legislation in India regarding Occupational safety and health
3. To develop an understanding of occupational Diseases.
4. To give the concept of Health protection and prevention of Occupational diseases.
5. To develop an understanding of occupational Hazards and safety management for different industries

Course Outcomes

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

CO1	Learned about Air Pollution, its effects and measurement.
CO2	Understanding of the Metrological concept and Plume behavior
CO3	Understanding of control of particulate Matter by Different Methods.
CO4	Learned about Control of Gaseous Pollutants and automobile Pollution.
CO5	Awareness of Air Pollution Legislation in India and current topic.
CO6	Learn about latest technologies and expose students to research articles

Continuous Assessment Pattern

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

Course Content:

Unit I: Occupational Hazards **8 lecture hours**
Definition of Occupational Hazard, Different type of occupational Hazards such as Physical Hazard, Chemical Hazards, Biological Hazards, Radiational Hazard, Ergonomic Hazards psychosocial Hazard and their prevention.
Unit II: Occupational safety and Health Acts **8 lecture hours**
Occupational safety and Health Act, Occupational Safety and Health Administration, right to know laws, Indian Acts, Labour Act, Factories Act The Employees state Insurance Act, ILO Act, OSHA accident causation, Investigation method and Different model.
Unit III: Occupational Diseases **8 lecture hours**
Definition of Occupational Diseases, Different types of occupational Diseases silicosis, Anthracosis, Byssinosis, Asbestosis, Farmer's Lungs, Lead Poisoning, occupational cancer, occupational dermatitis.
Unit IV: Protection and Prevention **8 lecture hours**
Measure for health protection of workers by nutrition, Environmental Sanitation. Health education, etc. Prevention of occupational disease by Medical measuring, Engineering Measure and legislation.
Unit V: Assessment of hazards and health problem **8 lecture hours**
Assessment of hazards and health problem of different types of Industries- construction, textile, food processing, Agriculture industries, Pharmaceutical Industries and waste water treatment plant. Survey of two industries for occupational hazards and safety management.
Unit VI: Latest Research and Innovations **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 Occupational Health and Hygine: An Introduction:- By Cherilyn Tillman Allen & Unwin
2. Environmental Pollution Health and Toxicology: S. V. S. Rana ,Narosa Publication.
3. Preventive and Social Medicine: K. Park.

Name of The Course	Water and Soil Conservation			
Course Code	**BCE03T5711**			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To introduce various aspects of land resources
2. To introduce various aspects of water resources
3. To introduce the causes of land and water degradation
4. To learn the monitoring and management practices
5. To learn the concepts of management practices for soil and water conservation

Course Outcomes

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

CO1	Understanding of land resources of India
CO2	Identification of problems related to water resources
CO3	Identification of causes of land/soil degradation
CO4	Designing of suitable management practices for soil and water conservation
CO5	To understand management for soil and water conservation
CO6	Learn about latest technologies and expose students to research articles

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**
Mineral resources of India, erosion and weathering, soil formation, soil profiles, types of erosion, estimation of soil loss,

land use and land use planning, earth resource mapping and the use of remote sensing and GIS
Unit II: Water Resources **8 lecture hours**
Hydrology, the hydrological cycle and its components, drainage systems, classification of water resources, characteristics of water resources. Surface run-off, stream flow estimation, problems of water and ground water resource depletion, watershed types and functions.
Unit III: Causes & Improvement of degraded Soil **8 lecture hours**
Release of salts from rocks & minerals, composition of rain water, river water, canal or reservoir water and sea water. Properties of different salts - Chlorides, carbonates, sulphates, bicarbonates & nitrates of calcium, magnesium, sodium & potassium. Role of soil slope, minerals, quality of irrigation water, climate and vegetation cover on salinity & alkalinity of soil. Reclamation of saline & sodic soils.
Unit IV: Soil Loss Measurement **8 lecture hours**
Soil losses due to erosion & extent of erosion - water and wind erosion. Estimation of soil losses - universal soil loss equation, causes of soil loss-soil erodibility, rain fall erosivity, estimation of soil losses by wind erosion
Unit V: Applications for management **8 lecture hours**
Soil and water conservation measures, erosion control, case studies in water resource conservation and management, flood management and control, landslide control and mitigation measures, coastal zone management, watershed management and case studies, earthquake mitigation for buildings and dams, forest fire mitigation and management, RS and GIS techniques in forest fire mapping, management hazards such as controlled burns escaping.
Unit VI: Latest Research and Innovations **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. Schwab, Fravert Edminster & Barnes (1981). Soil & water conservation engineering. John Wiley & Sons Publication.
2. Roy, A.B. (2010). Fundamentals of Geology. Narosa Publications.
3. Singh, Rajvir (2000). Watershed Planning and Management. Yash Publishing House.
4. Soil taxonomy, basic system of soil classification for making & interpreting soil survey. Agriculture Handbook No. 36, Nbss & Lup Publication New Delhi.

Name of The Course	**System Simulation & Modeling**			
Course Code	**BCE03T5712**			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

The overall aims of the course are for students to acquire appropriate level of advanced theoretical knowledge required to interpret and analyze contemporary and past environmental data for modeling. Also develop an insight into modeling skills required to investigate the interrelationships between environmental variables, and to predict their responses to changing internal and external conditions.

Course Outcomes

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

CO1	Learning the fundamentals of environmental systems, Systems approach, Models and modelling.
CO2	Understanding the modes of contaminant transport and their modelling.
CO3	Study of groundwater flow models and contaminant transport.
CO4	Modelling of surface water flow models. Modelling in computer-based software.
CO5	Modelling evaporation from water bodies.
CO6	Learn about latest technologies and expose students to research articles

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**
An overview of mathematical models applied to various environmental issues, Concept, Need, Scope and objectives of environmental modeling, Role of mathematical models in environmental quality management.
Unit II: Model types **8 lecture hours**
Brief review of different types of models, Mathematical (Deterministic), Numerical, Stochastic and Physical Models. Different stages involved in model building, Calibration and verification of model, Limitations in modelling.
Unit III: Common Phynomenon **8 lecture hours**
Transport phenomenon, Diffusion, Dispersion, Advection, Adsorption, Conservative and non-conservative pollutants. Surface water quality modeling – River and streams, Estuaries and lakes.
Unit IV: Pollutants flow modelling **8 lecture hours**
Governing Equations for sub-surface flow and transport of pollutants, Simplified models for sub-surface plume movements. Case studies using appropriate software for sub-surface flow and transport of pollutants.
Unit V: Dissolved oxygen models **8 lecture hours**
DO sag model, BOD model, Streeter Phelps equation for point and distributed sources. Eutrophication models for lakes and flowing water; Use of QUAL2K and Water Quality Analysis Simulation Program (WASP). Application of Air pollution dispersion model.
Unit VI: Latest Research and Innovations **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. Ramaswami A. “Integrated Environmental Modelling”, John Wiley, New York.
2. Chapra S.C., “Surface water quality modelling”, McGraw Hill., New York.
3. Rumynin B.G., “Subsurface Solute Transport Model”, Springer, Netherlands.
4. Schnoor J., “Environmental Modelling”, John Wiley, New York.
5. Jacobson M.Z., “Fundamentals of Atmospheric Modelling”, Cambridge University Press, New York.

Name of The Course	**Risk and Reliability Analysis of Environmental System**				
Course Code	**BCE03T5713**				
Prerequisite					
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

2.

1. To introduce students with concepts of risk and its measurement with regard to environmental systems
2. To familiarize students with characterization of various types of environmental risk and their consequences, vulnerability of environmental hazards.
3. To familiarize students with various aspects of analysis of environmental risk assessment.To familiarize students with various case studies environmental risks in various processes/industries.

Course Outcomes

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

CO1	Student will learn about basics of Geology and its importance in engineering.
CO2	Student will be able to understand the properties of rocks, minerals and its application and importance in environmental engineering.
CO3	Student will learn the various effects of rocks and minerals on the quality of groundwater.
CO4	The unit of GIS will create a clear-cut understanding among students about geographical information system, its components, DMS and its various applications in real life.
CO5	Student will be able to attain thorough knowledge about remote sensing, electromagnetic spectrum, and its diverse applications.
CO6	Learn about latest technologies and expose students to research articles

Continuous Assessment Pattern

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

Course Content:

Unit I: Risk and Reliability-an Introduction **8 lecture hours**
Sources of Environmental hazards, Environmental and ecological risks, Environmental risk assessment framework, Regulatory perspectives and requirements, Risk Analysis and Management and historical perspective; Social benefit v/s technological risks; Path to risk analysis; Perception of risk, risk assessment in different disciplines.
Unit II: Hazard Identification and Analysis **8 lecture hours**
Hazard identification and accounting, Fate and behaviour of toxics and persistent substances in the environment, Properties, processes and parameters that control and transport of contaminants, Receptor exposure to Environmental Contaminants, Dose Response Evaluation, Exposure Assessment, Exposure Factors, Slope Factors, Dose Response calculations and Dose Conversion Factors, Risk Characterization and consequence determination, Vulnerability assessment, Uncertainty analysis.
Unit III: Fault and contaminants analysis **8 lecture hours**
Cause failure analysis, Event tree and fault tree modeling and analysis, Multimedia an multipath way exposure modeling of contaminant migration for estimation of contaminant concentrations in air, water, soils, vegetation and animal products, Estimation of carcinogenic and non-carcinogenic risks to human health.
Unit IV: Risk Assessment Methods **8 lecture hours**
HAZOP and FEMA methods, Methods in Ecological risk assessment, Probabilistic risk assessments, radiation risk assessment, Data sources and evaluation
Unit V: Risk Communication and Awareness **8 lecture hours**
Risk communication and Risk Perception, comparative risks, Risk based decision making, Risk based environmental standard setting, Risk Cost Benefit optimization and tradeoffs, Emergency Preparedness Plans, Emergency planning for chemical agent release, Design of risk management programs, risk-based remediation; Risk communication, adaptive management, precaution and stake holder involvement.
Unit VI: Latest Research and Innovations **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. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff, Risk Assessment and Management Handbook, McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah, Risk Assessment in Environmental management, John Wiley and sons, Singapore, 1998.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.

Name of The Course	**Irrigation and Drainage Engineering**			
Course Code	**BCE03T5714**			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To introduce basic concepts of Irrigation.
2. To introduce the definition, principle and types of Irrigation. modelling of ground and surface water quality
3. To introduce the Weir and Barrage
4. To introduce the basic concepts of Kennedy and Lacey theories
5. To introduce the definition, principle and types of cross-drainage works
6. Learn the Electro Analytical Methods and continuous measurement methods

Course Outcomes

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

CO1	To understand the basic fundamental, principle and types of irrigation.

CO2	To understand concepts of Weir and Barrage.
CO3	To understand the Kennedy and Lacey theories.
CO4	To understand the basics of cross-drainage works behavior of contaminants in the surface water
CO5	To learn about Water Logging, Canal Lining & Regulation Work
CO6	Learn about latest technologies and expose students to research articles

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**
Irrigation Principles: Basic Soil-water plant relation, consumptive use, depth and frequency of irrigation, various methods of application of irrigation water, irrigation efficiency, principal Indian crops and their water requirements, Standards of irrigation water, use of seepage and waste water for irrigation. duty and delta, methods of improving duty, irrigation efficiencies.
Unit II: Diversion Head Works **8 lecture hours**
Weir and Barrage, component parts, Types of failures of floor, Bligh's theory, Lane's weighted theory, Khosla theory, Pressure calculations, corrections Design of sloping glacis Weir, impervious floor, Launching apron, Inverted filter, proportioning of bays in barrage, anal head regulator, Spillways, Under sluices portion and silt
Unit III: Silt Theories and Design of Irrigation Channel **8 lecture hours**
Kennedy's theory, draw backs, Lacey regime theory, comparison between Kennedy and Lacey theories, Design of channel based on Kennedy and Lacey theories, Effect of silt factor, L-Section of canal, Balancing depths, Use of Garrets diagram in channel design, cross section of an irrigation channel. Channel breaches and their repair.
Unit IV: Water Logging, Canal Lining & Regulation Work **8 lecture hours**
Losses in canal, water logging, its causes and effects remedies of water logging. Lining of canal, advantages and disadvantages of lining, Types of lining. Design of lined canal. Necessity of canal falls, types of fall, Design of sarda type fall
Unit V: Cross Drainage Works **8 lecture hours**
Types of cross-drainage works, selection of suitability of type of C.D. work. Design of transition when water depth is constant and when varied, design of surface and sub-surface drains, roadway and airport drainage
Unit VI: Latest Research and Innovations **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. Design of Irrigation Works by R. S. Varshney.
2. Irrigation Engg. & Hydraulic Structure by S. K. Garg.
3. Irrigation and Water Power Engg. by Dr. B. C. Punmia and Dr. Pande.
4. Irrigation Theory and Practice by A M Michael
5. Irrigation Engg. by Birdei and Dass.

Name of The Course	**Environment and Sustainable Development**			
Course Code	**BCE03T5715**			
Prerequisite				
Co-requisite	-			
Anti-requisite	-			
	L	**T**	**P**	**C**
	3	0	0	3

Course Objectives

1. To provide basic introduction to sustainable development concepts, challenges of sustainable development and boundaries of sustainable development.
2. To give a basic understanding of sustainable development framework, its pillars and application.
3. To aware the students about various issues related to environmentally sustainable urban environment and different engineering tools assess and design them.
4. To aware them about the role of technology towards environmental sustainability.
5. To update students about the individual and social responsibilities and role of government towards sustainable development.

Course Outcomes

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

CO1	**The student will be able to understand the basics about sustainable development & its concepts.**
CO2	**Understanding about different dimensions of sustainability as well as its different applications.**
CO3	**Able to identify the environmental sustainability of transport system and capable to suggest required steps for further enhancement.**
CO4	**The students will learn about role of technology in sustainable development.**
CO5	**Development of responsibilities towards the protection of environment and society.**
CO6	Learn about latest technologies and expose students to research articles

Continuous Assessment Pattern

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

Course Content:

Unit I: Sustainability concepts **8 lecture hours**
Evolution of Ideas about sustainability, History of sustainability, Definitions of sustainability, Brundtland commission report, Principles of sustainable development, Objectives of sustainable development, Conceptualization of sustainability, Boundaries of sustainable development
Unit II: Sustainability framework and strategies **8 lecture hours**
Sustainable development framework, Pillars of sustainable development, Impediments to achieving sustainability, , Concept of environmentally sustainable development, Environmental dimensions of sustainability, Frameworks to measure sustainable development, Application of sustainability strategies
Unit III: Sustainability Assessment **8 lecture hours**
Issues of environmentally sustainable urban environment, Sustainable urban transport, Sustainable transport indicators, Engineering tools for assessment and design for environment and sustainability
Unit IV: Sustainability Technology and Infrastructure **8 lecture hours**
Strategies for promoting environmentally sustainable development technology role towards environmentally sustainable transport infrastructure, Importance of incorporating sustainability in design, Case studies of Sustainable design
Unit V: Sustainability Social and Institutional Framework **8 lecture hours**
Social and environmental, responsibilities towards environmentally friendly &sustainable development, Role of local Government, Sustainability in the Third World, Steps for adopting a sustainability approach
Unit VI: Latest Research and Innovations **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. Abdul Malik, Elisabeth Grohmann. Environment protection strategies for sustainabledevelopment by. ISBN 978-94-007-1591-2.
2. Sylvie Faucheux, Martin O' Corner Jan van der straiten. Sustainable development:concepts, rationalities, and strategies, ISBN 978-94-017-3188-1.
3. Jennifer A. Elliott. An introduction to sustainable development. ISBN-13: 978-0415590730.
4. LEAD India (Editor) Rio to Johannesburg: India's Experience in Sustainable Development, Orient Longman, Hyderabad, 2002.
5. Chopra, K., and Kadekodi, G.K. (1999), Operationalizing Sustainable Development, Sage Publication, New Delhi.

Name of The Course	**Advanced Surveying**				
Course Code	**BCE03T5716**				
Prerequisite					
Co-requisite	-				
Anti-requisite	-				
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. To understand the basics and elements of different types of curves on roads and their preliminary survey
2. To learn about surveying applications in setting out of curves, buildings, culverts and tunnels

3. To get introduced to different geodetic methods of survey such as triangulation, trigonometric levelling
4. To learn about errors in measurements and their adjustments in a traverse
5. To get introduced to modern advanced surveying techniques involved such as Remote sensing, Total station, GPS, Photogrammetry etc.

Course Outcomes

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

CO1	**Set out curves, buildings, culverts and tunnels**
CO2	**Carry out a geodetic survey, taking accurate measurements using instruments and adjusting the traverse**
CO3	**Apply mathematical adjustment of accidental errors involved in surveying measurements**
CO4	**Plan a survey for applications such as road alignment and height of the building**
CO5	**Invoke advanced surveying techniques over conventional methods in the field of civil engineering**
CO6	Learn about latest technologies and expose students to research articles

Continuous Assessment Pattern

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

Course Content:

Unit I: Curves **8 lecture hours**
Curve setting – Horizontal curves - Elements of simple and compound curves – Methods of setting out – Reverse curve – Transition curve – Length of curve – Elements of cubic parabola, true spiral and cubic spiral – Vertical curve – parabola – Setting out of buildings – culverts – tunnels.
Unit II: Triangulation **8 lecture hours**
Triangulation – different networks – orders and accuracies – inter visibility and height of stations – signals and towers – Baseline measurement – instruments and accessories – tape corrections – extension of baseline – satellite stations – Reduction to centre.
Unit III: Trigonometric levelling **8 lecture hours**
Trignometrical levelling – Observations for heights and distances – Geodetic observations – Corrections for refraction, curvature, axis signal – Reciprocal observations.
Unit IV: Errors **8 lecture hours**
Errors – Types of errors – Theory of least squares – weighted observations – most probable value – computations of indirectly observed quantities – method of normal equations – conditioned quantities, method of correlates, method of differences – adjustment of simple triangle and quadrilateral network without central station.
Unit V: Electromagnetic distance measurement **8 lecture hours**
Electromagnetic distance measurement (EDM) – Principle – Types – Total station - Photogrammetry – Terrestrial and Aerial photographs – Photo interpretation – Stereoscopy - Remote Sensing – Principle – Idealized remote sensing system – Types – applications - Introduction to GPS – Segments – Principle of working – application.
Unit VI: Latest Research and Innovations **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. Duggal, S.K. Surveying Vol. I and II, Tata McGraw Hill, 2004.
2. Punmia, B.C. Surveying Vol.I and II, Standard Publishers, 1994.
3. Arora, K. R. Surveying Vol. I and II, Standard Book House, 1996.
4. Satheesh Gopi. Advanced Surveying, Pearson Education, 2007.
5. Satheesh Gopi. The Global Positioning System and Surveying using GPS, Tata McGraw, 2005.