

**B.TECH. CIVIL ENGINEERING**  
**COURSE STRUCTURE**

# **B.TECH. CIVIL ENGINEERING**

## **PROGRAM OBJECTIVES**

**PO 1 Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and engg. specialization to the solution of complex engineering problems.

**PO-2 Problem analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

**PO-3 Design/development of solutions:** Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO-4 Conduct investigations of complex problems:** Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO-5 Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**PO-6 The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO-7 Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO-8 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO-9 Individual and team work:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

**PO-10 Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

**PO-11 Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

**PO-12 Life-long learning:** 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.

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<b>COURSE CURRICULUM OF CIVIL ENGINEERING DEPARTMENT- 2023 Batch (165 CREDITS)</b>								
<b>B. TECH (CIVIL ENGINEERING) 1<sup>st</sup> SEMESTER</b>								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	HSS	21B11HS111	English	2	0	0	2	2
2	HSS	21B17HS171	English Lab	0	0	2	1	2
3	Basic Science	18B11MA111	Engineering Mathematics -I	3	1	0	4	4
4	Basic Science	18B11PH111	Engineering Physics-I	3	1	0	4	4
5	Basic Science	18B17PH171	Engineering Physics Lab - I	0	0	2	1	2
6	Engineering Science	19B11CI111	Programming for Problem Solving-II	2	0	0	2	2
7	Engineering Science	19B17CI171	Programming for problem Solving Lab-II	0	0	4	2	4
8	Engineering Science	18B17GE173	Engineering Graphics <b>OR</b>	0	0	3	1.5	3
		18B17GE171	Workshop Practice					
9		18B17GE172	Mandatory Induction Program	-	-	-	-	-
				Total			17.5	22
<b>B. TECH (CIVIL ENGINEERING) 2<sup>nd</sup> SEMESTER</b>								
S.No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Engineering Science	18B11EC211	Electrical Science	3	1	0	4	4
2	Engineering Science	18B17CI211	Data Structure & Algorithms	3	1	0	4	4
3	Basic Science	18B11MA211	Engineering Mathematics -II	3	1	0	4	4
4	Basic Science	18B11PH211	Engineering Physics-II	3	0	0	3	3
5	Basic Science	18B17PH271	Engineering Physics Lab -II	0	0	2	1	2
6	Engineering Science	18B17EC271	Electrical Science Lab	0	0	2	1	2
7	Engineering Science	18B17CI271	Data Structure & Algorithms Lab	0	0	4	2	4
8	Engineering Science	18B17GE171	Workshop Practice <b>OR</b>	0	0	3	1.5	3
		18B17GE173	Engineering Graphics					
9	HSS	23B11HS211	Universal Human Values II: Understanding Harmony	2	1	0	3	3
10	HSS	23B11HS212	Professional Communication Practice	0	0	2	Audit	2
				Total			23.5	31

<b>B. TECH (CIVIL ENGINEERING) 3<sup>rd</sup> SEMESTER</b>								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Engineering Science	18B11CE315	Engineering Mechanics	3	0	0	3	3
2	Professional Core	23B11CE311	Fluid Mechanics	3	0	0	3	3
3	Professional Core	23B11CE313	Building Materials & Construction	3	0	0	3	3
4	Professional Core	23B11CE312	Surveying	3	0	0	3	3
5	Professional Core	23B17CE371	Fluid Mechanics Lab	0	0	2	1	2
6	Professional Core	18B17CE372	Surveying Lab	0	0	2	1	2
7	Basic Science	18B11CE311	Chemistry	3	0	0	3	3
8	Basic Science	18B17CE371	Chemistry Lab	0	0	2	1	2
9	Basic Science	18B11MA311	Numerical Methods	3	0	0	3	3
10	HSS	23B11HS311	Life Skills and Interpersonal Dynamics	2	1	0	3	3
				Total			24	27
<b>B. TECH (CIVIL ENGINEERING) 4<sup>th</sup> SEMESTER</b>								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Core Courses	18B11CE415	Mechanics of Solids	3	0	0	3	3
2	Engineering Science Courses	18B11CE413	Computer Aided Civil Engineering Drawing	0	0	2	1	2
3	Professional Core Courses	23B11CE411	Concrete Technology	3	0	0	3	3
4	Professional Core Courses	23B11CE412	Water Supply Engineering	3	0	0	3	3
5	Professional Core Courses	18B11CE411	Geotechnical Engineering	3	0	0	3	3
6	Professional Core Courses	18B17CE471	Geotechnical Engineering Lab	0	0	2	1	2
7	Professional Core Courses	23B17CE471	Concrete Technology Lab	0	0	2	1	2
8	Humanities & Social Science	18B11HS411	Finance and Accounts	3	0	0	3	3
9	Mandatory Courses	23B11GE411	Environmental Studies	2	0	0	2	2
				Total			20	23

B. TECH (CIVIL ENGINEERING) 5 <sup>th</sup> SEMESTER								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Core Courses	18B11CE513	Structural Analysis	3	0	0	3	3
2	Professional Core Courses	18B11CE512	Sewage Treatment and Disposal	3	0	0	3	3
3	Professional Elective Courses		Elective -1	3	0	0	3	3
4	Professional Core Courses	18B17CE572	Environmental Engineering Lab	0	0	2	1	2
5	Professional Core Courses	18B11CE515	Design of Concrete Structures	3	1	0	4	4
6	Professional Core Courses	18B11CE511	Highway Engineering	3	0	0	3	3
7	Professional Core Courses	18B17CE571	Highway Engineering Lab	0	0	2	1	2
8	Humanities & Social Science	18B11HS511	Project Management and Entrepreneurship	3	0	0	3	3
9	Professional Core Courses	18B11CE514	Foundation Engineering	3	0	0	3	3
				Total			24	26
B. TECH (CIVIL ENGINEERING) 6 <sup>th</sup> SEMESTER								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Core Courses	23B11CE611	Water Resources Engineering	3	0	0	3	3
2	Professional Elective Courses		Elective -2	3	0	0	3	3
3	Professional Core Courses	23B11CE612	Design of Steel Structures	3	0	0	3	3
4	Professional Elective Courses		Elective -3	3	0	0	3	3
5	Professional Elective Courses		Elective -4	3	0	0	3	3
6	Open Elective		Open Elective 1 (HSS)	3	0	0	3	3
7	Professional Core Courses	18B17CE671	Computer Aided Planning and Costing	0	0	4	2	4
8	Project	18B19CE691	Minor Project	0	0	6	3	6
				Total			23	28

<b>B. TECH (CIVIL ENGINEERING) 7<sup>th</sup> SEMESTER</b>								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	Project Hours		
1	Open Elective		Open Elective 2	3	0	0	3	3
2	Open Elective		Open Elective 3	3	0	0	3	3
3	Project	18B19CE791	Major Project-I	0	0	12	6	12
4	Professional Elective Courses		Elective - 5	3	0	0	3	3
5	Professional Elective Courses		Elective - 6	3	0	0	3	3
6	Mandatory Courses	18B11GE111	Indian Constitution (HSS Audit)	1	0	0	Audit	1
				Total			18	25
<b>B. TECH (CIVIL ENGINEERING) 8<sup>th</sup> SEMESTER</b>								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	Project Hours		
1	Project	18B19CE891	Major Project-II	0	0	12	6	12
2	Professional Elective Courses		Elective - 7	3	0	0	3	3
3	Open Elective		Open Elective 4	3	0	0	3	3
4	Open Elective		Open Elective 5	3	0	0	3	3
				Total			15	21

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B. TECH (CIVIL ENGINEERING)								
ELECTIVE-I								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Elective	18B1WCE531	Construction Technology and Management	3	0	0	3	3
2	Professional Elective	18B1WCE532	Solid Waste Management	3	0	0	3	3
3	Professional Elective	18B1WCE533	Air and Noise Pollution and Control	3	0	0	3	3
4	Professional Elective	23B1WCE531	Geoinformatics	3	0	0	3	3
						Total	3	3
ELECTIVE-II								
S.No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Elective	18B1WCE631	Advanced Structural Analysis	3	0	0	3	3
2	Professional Elective	18B1WCE632	Pavement Analysis and Design	3	0	0	3	3
3	Professional Elective	18B1WCE633	Industrial Waste Treatment	3	0	0	3	3
						Total	3	3
ELECTIVE-III								
S.No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Elective	18B1WCE634	Transportation Engineering	3	0	0	3	3
2	Professional Elective	18B1WCE635	Traffic Engineering	3	0	0	3	3
3	Professional Elective	18B1WCE636	Highway Construction, Maintenance and Management	3	0	0	3	3
						Total	3	3



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ELECTIVE-IV								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Elective	18B1WCE637	Advanced Concrete Technology	3	0	0	3	3
2	Professional Elective	18B1WCE638	Underground Technology	3	0	0	3	3
3	Professional Elective	18B1WCE639	Open Channel Flow and Hydraulic Machine	3	0	0	3	3
						Total	3	3
ELECTIVE-V								
S.No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Elective	18B1WCE731	FEM and its Applications in Civil Engineering	3	0	0	3	3
2	Professional Elective	18B1WCE732	Environmental Management and Impact Assessment	3	0	0	3	3
3	Professional Elective	18B1WCE733	Advanced Foundation Engineering	3	0	0	3	3
						Total	3	3
ELECTIVE-VI								
S.No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Elective	18B1WCE734	Earthquake Engineering	0	0	3	3	3
2	Professional Elective	18B1WCE735	Design of Prestressed Concrete Structures	3	0	0	3	3
3	Professional Elective	18B1WCE736	Dam and Reservoir Design	3	0	0	3	3
						Total	3	3

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ELECTIVE-VII								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Elective	18B1WCE831	Advanced Reinforced Concrete Design	3	0	0	3	3
2	Professional Elective	18B1WCE832	Advanced Highway Material and construction	3	0	0	3	3
3	Professional Elective	18B1WCE833	Hydropower Engineering	3	0	0	3	3
						Total	3	3
OPEN ELECTIVE-II								
S.No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Open Elective	18B1WCE640	Optimization Techniques	3	0	0	3	3
2	Open Elective	22B1WCE731	Remote Sensing and Geomatics	3	0	0	3	3
OPEN ELECTIVE-III								
S.No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Open Elective	18B1WCE737	Finite Element Method	3	0	0	3	3
2	Open Elective	22B1WCE731	Perennial Power Structures	3	0	0	3	3
OPEN ELECTIVE-IV								
S.No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Open Elective	18B1WCE738	Financial Management	3	0	0	3	3
2	Open Elective	22B1WCE831	Disaster Risk Analysis and Management	3	0	0	3	3
OPEN ELECTIVE-V								
S.No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Open Elective	18B1WCE834	Sustainable Development	3	0	0	3	3
2	Open Elective	22B1WCE832	Introduction of Sustainable Engineering and Energy Efficient Buildings	3	0	0	3	3

S.No.	Group(s)	Credit Distribution
1	Humanities and Social Sciences including Management courses	12
2	Basic Science courses	24
3	Engineering Science courses	22
4	Professional core courses	51
5	Professional Elective courses (from CSE branch)	21
6	Open subjects – Electives (from other technical and /or emerging	15
7	Project Work, Seminar and Internship	15
8	Mandatory Courses	0
	<b>Total credits</b>	<b>160</b>

  

S.No.	Semester	Proposed Credits	Credit breakup for BTech (CE)
1	First	17.5	
2	Second	20.5	
3	Third	24	
4	Fourth	18	
5	Fifth	24	
6	Sixth	23	
7	Seventh	18	
8	Eighth	15	
	<b>Total</b>	<b>160</b>	

# **B.TECH. CIVIL ENGINEERING SYLLABUS**

# Engineering Graphics

COURSE CODE: 18B17GE173

COURSE CREDITS: 1.5

CORE/ELECTIVE: CORE

: 0-0-3

**Pre-requisite: None**

**Course Objectives:**

1. To introduce the students to the “universal language of Engineers” for effective communication through drafting exercises of geometrical solids.
2. To enable students to acquire and use engineering drawing skills as a means of accurately and clearly communicating ideas, information and instructions.
3. To impart knowledge to students about creating a sheet and software aided layout of required dimensions in 2-D and 3-D view.

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO1	To impart and inculcate proper understanding of the theory of projection.	Familiarity
CO2	To improve the visualization skills	Assessment
CO3	To enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient	Usage
CO4	To impart the knowledge on understanding and drawing of simple residential/office buildings.	Usage

**List of Experiments**

S.No	Description	Hours
1	Introduction to Lettering	3
2	Scales and their types	2
3	Construction of Polygons	4
4	Projection of points	2
5	Projection of lines	4
6	Projection of planes	3
7	Drawing of building plan	6
8	Introduction to Basic Commands in Auto-CAD	3
9	Orthographic projections in Auto-CAD	3
10	Isometric Projection in Auto-CAD	4
11	Projections of solids in Auto-CAD	1
12	Section of solids in Auto-CAD	1
<b>Total Lab hours</b>		<b>36</b>

**Suggested/Resources:**

1. Engineering Drawing & Graphics with AutoCAD by K.Venugopal, New Age International Pvt. Ltd., New Delhi (India)
2. Engineering Drawing by N.D.Bhatt, V.M.Panchal and Pramod R. Ingle, Charotar Publishing House, Anand, Gujarat (India)
3. Engineering Drawing [With Introduction to Auto-CAD] by Roop Lal and Ramakant Rana, IK International Publishing House Pvt. Ltd.

**Evaluation Scheme:**

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	10 Marks
4	Lab Assessment	50 Marks
	<b>Total</b>	<b>100 marks</b>

# Workshop Practices

COURSE CODE:18B17GE171

COURSE CREDITS: 1.5

CORE/ELECTIVE: CORE

: 0-0-3

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**Pre-requisite: Concrete Technology**

**Course Objectives:**

1. To learn the basics of different workshop practices by understanding and implementing used in different shops of workshop.

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO1	Study of various carpentry processes and its applications in carpentry	Familiarity
CO2	Study and practice the use of various carpentry tools for different carpentry processes	Familiarity
CO3	Study and manufacturing of different wood working joints	Assessment
CO4	Study the principles, classification and application of different welding processes	Usage
CO5	Study and Manufacturing of various welding joints using electric arc welding and gas welding	Usage

**List of Experiments**

S.NO.	Subtitle	Topics
1.	Carpentry	To Study the carpentry processes
		To study and identify carpentry tools
		To prepare a T-Lap Joint
		To prepare Motise-tenon joint
		To prepare corner joint
2.	Welding	To study the different welding processes with mechanism
		To prepare lap welding joint
		To prepare butt welding joint
3.	Sheet Metal work	To cut and prepare V joint from metal using hexablade
4.	Turning	To study the lathe machine and its operation with one turning job

**Suggested/Resources:**

1. Workshop Practices by S.K. Hajra and Chaudhary

**Evaluation Scheme:**

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Average
CO1	3	3	3	3	2	2	1	1	1	1	1	1	1.83
CO2	3	3	3	3	3	1	1	1	1	1	1	3	2.00
CO3	3	3	2	3	2	3	2	1	1	1	2	1	2.00
CO4	3	3	3	2	3	2	1	1	1	1	1	1	1.83
CO5	2	2	3	3	3	3	1	1	1	1	1	1	1.83
Average	2.80	2.80	2.80	2.80	2.60	2.20	1.20	1.00	1.00	1.00	1.20	1.40	



# Engineering Mechanics

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Elementary Knowledge of Physics and Mathematics upto Class XII

## Course Objectives:

1. Learn to beams under different loading conditions and to find out the shear force and bending moment diagram.
2. Learn to analyze different types to trusses and to find out the forces in the members.
3. Learn to find the centroid and moment of inertia of different types of crosssections.
4. Learn to calculate the types of motion applied to a body and its characteristics.

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Analyse the beam under flexure for different loadings and to draw shear force and bending moment diagram.	Familiarity
CO-2	Analyse planar and spatial systems to determine the forces in members of trusses, frames and problems related to friction.	Assessment
CO-3	Determine the resultant force and moment for a given system of forces; Determine the centroid and second moment of area.	Assessment
CO-4	Determine different types of stresses induced in a static body. Types of beams and Shear force and bending moment diagram.	Assessment

## Course Contents:

Unit	Contents	Lectures
1	<b>Introduction to Engineering Mechanics:</b> Principles of Statics, System of Forces, Moment of a Force, Varignon's Theorem, Couple Transfer of a Force to Parallel Position, Composition of Concurrent Coplanar Forces, Equilibrant of a Force System, Composition of Coplanar Non-concurrent Force System, X and Y Intercepts of Resultant, Types of Forces on a Body, Free Body Diagram, Equilibrium of Bodies, Equilibrium of Concurrent Force Systems, Equilibrium of Connected Bodies, Equilibrium of Non-concurrent Force Systems.	8
2	<b>Plane truss and Space truss:</b> Perfect, Deficient and Redundant Trusses, Assumptions, Nature of Forces in Members, Methods of Analysis, Method of Joints, Method of Section.	8

<b>3</b>	<b>Distributed forces, center of gravity and moment of inertia:</b> determination of areas and volumes, center of gravity and centroids, centroid of a line, first moment of area and centroid, second moments of plane area, moment of inertia from first principles, moment of inertia of composite sections, theorems of pappus-guldinus, centre of gravity of solids.	<b>8</b>
<b>4</b>	<b>Simple stresses and strains:</b> Meaning of Stress, Unit of Stress, Axial Stress, Strain , Stress-Strain Relation , Nominal Stress and True Stress, Factor of Safety, Hooke's Law , Extension/Shortening of a Bar, Bars with Cross-sections Varying in Steps ,Bars with Continuously Varying Cross-sections , Shear Stress, Simple Shear, Poisson's Ratio , Volumetric Strain , Elastic Constants , Relationship between Modulus of Elasticity and Modulus of Rigidity Relationship between Modulus of Elasticity and Bulk Modulus, Composite/Compound Bars Thermal Stresses, Thermal Stresses in Compound Bar, Hoop Stresses.	<b>9</b>
<b>5</b>	<b>Beams:</b> Introduction, types of supports, types of beams, types of loading, reactions from supports of beams, shear force and bending moment sign convention, relationship between load intensity, shear force and bending moment, shear force and bending moment diagrams, SFD and BMD for few standard cases, short-cut procedure.	<b>9</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. S. S. Bhavikatti : Mechanics of solids, 3rd Edition, New age international (p) limited, publishers
2. Vector Mechanics; Static & Dynamics by Beer & Johnston, TMH publication
3. Engineering Mechanics; A.K.Tayal, Umesh Publication

**Other useful resource(s):**

1. Link to NPTEL course contents:<https://nptel.ac.in/courses/106104019/>
2. Link to topics related to course:
  - i. <https://nptel.ac.in/courses/105106116/1>
  - ii. <https://nptel.ac.in/courses/105106116/8>
  - iii. <https://nptel.ac.in/courses/105106116/14>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course outcomes (Engineering Mechanics)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	1.75
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	2
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	1.75
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	2.08
Average	2	2.5	2.5	2.5	2.5	1	1	1	2	2.25	1.5	2	

## Concrete Technology Laboratory

COURSE CODE: 23B17CE471

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** Concrete Technology

### Course Objectives:

1. To learn the basics of different tests performed for quality control of cement, fine aggregates, coarse aggregates and water.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO1	Identify Quality Control tests on concrete making materials	Assessment
CO2	Understand the behavior of fresh and hardened concrete	Assessment
CO3	Design concrete mixes as per IS and ACI codes	Assessment
CO4	Understand the durability requirements of concrete	Usage
CO5	Understand the need for special concretes	Usage

### List of Experiments:

S.No.	Description	Hours
1	To determine consistency, fineness, setting time, specific gravity, soundness and strength of cement.	6
2	To determine specific gravity, sieve analysis and zoning, bulking of fine aggregate, bulk density, silt content of fine aggregate.	6
3	To determine specific gravity, sieve analysis, bulk density, flakiness index, elongation index, water absorption and moisture content, soundness of coarse aggregate.	6
4	To prepare a Concrete mix design by ACI 211.1-91 method, IS code method as per 10262- 2007 and 456-2000, DOE method	4
5	Tests on Concrete - workability tests, slump cone test, compaction factor test, Vee-bee consistometer test, flow table test, strength tests- compressive strength, flexural strength, split tensile strength.	4
6	To find the effects of admixture - Accelerator, Retarder, Super Plasticizer	2
7	Nondestructive Testing on concrete by Rebound Hammer test, Ultrasonic Pulse Velocity test	2
<b>Total hours</b>		<b>30</b>

**Suggested/Resources:**

1. Concrete technology lab manual by M.L.Gambhir

**Evaluation Scheme:**

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Concrete Technology Laboratory)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Average
CO1	3	3	3	3	2	2	1	1	1	1	1	1	1.83
CO2	3	3	3	3	3	1	1	1	1	1	1	3	2.00
CO3	3	3	2	3	2	3	2	1	1	1	2	1	2.00
CO4	3	3	3	2	3	2	1	1	1	1	1	1	1.83
CO5	2	2	3	3	3	3	1	1	1	1	1	1	1.83
CO6	2	3	3	3	2	2	2	2	2	2	2	2	2.25
Average	2.67	2.83	2.80	2.80	2.60	2.20	1.20	1.00	1.00	1.00	1.20	1.40	

# Building Materials and Construction

COURSE CODE:23B11CE313

COURSE CREDITS:

3 CORE/ELECTIVE:

CORE L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. To gain understanding of properties and usage of bricks, stones, timber and miscellaneous materials used in construction.
2. To become familiar with classification of buildings, walls, brick masonry and stone masonry
3. To be well versed with the properties and usage of plastering, roofs, floors, doors, damp proofing, stairs etc.
4. To gain state of the art knowledge of properties and usage of scaffolding, sound and fire proofing, paints and distempers.

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Learn about properties and usage of bricks, stones, timber and miscellaneous materials used in construction.	Familiarity
CO-2	Learn about classification of buildings, walls, brick masonry and stone masonry	Familiarity
CO-3	Learn the properties and usage of plastering, roofs, floors, doors, damp proofing, stairs etc.	Familiarity
CO-4	Learn the properties and usage of scaffolding, sound and fire proofing, paints and distempers.	Familiarity

## Course Contents:

Unit	Contents	Lectures required
1	<b>Bricks:</b> Classification, properties and selection criteria of bricks, burning of bricks, tests for bricks.	2
2	<b>Stones:</b> Stone classification, characteristics of good building stone, common building stones in India, Limestone.	1
3	<b>Timber:</b> Characteristics of good timber, defects in timber, seasoning of timber, plywood.	2
4	<b>Miscellaneous Materials:</b> Classification of Engineering Materials, Mechanical properties of Materials, (Added) Cement, Concrete, steel, glass, plastics, P.V.C., paint, varnish, adhesive materials, bitumen, ceramics, Geosynthetic material.	7
5	<b>Buildings and Walls:</b> Classification of buildings, types of walls	1
6	<b>Brick Masonry:</b> Technical terms, types of bonds, strength of brick masonry, defects in brick masonry, reinforced brickwork	2
7	<b>Stone Masonry:</b> Technical terms, stones, cutting and dressing, lifting of stones, joints in stone masonry, classification of stone masonry, selection of stone for masonry	1
8	<b>Plastering and Pointing:</b> Objects and requirements of plastering, terminologies, tools, methods of plastering, selection of good plaster, types of mortars, plaster finishes, defects, Pointing: Methods and types of pointing	4
9	<b>Roofs and Floors:</b> Types and construction of roofs, features, necessity, arches, lintels, types & construction of ground floor, upper floor, floor finishes	3
10	<b>Doors and Windows:</b> Location, Technical terms of door & window, door frame, size, designation of door and window, types of door & window	2
11	<b>Damp Proofing and Termite Proofing:</b> Causes, effects, various methods and material used for damp proofing and termite proofing	3
12	<b>Stairs:</b> Technical terms, requirements, dimension of step, types and classification of stairs	3
13	<b>Paints, Distemper, White wash and Color wash:</b> Paints and Paintings, characteristics of ideal paint, Constituents of paint, defects in paintings, painting on different surfaces, (Removed) classification and type of paints, Distempering & process of distempering, white washing & color washing	4
14	<b>Scaffolding:</b> Components and types of scaffolding	2

15	<b>Sound and Fire proof construction:</b> Sound Insulation, Insulation values for different type of walls, sound proof materials, Fire: Causes, fire hazards, fire load, grading of building according to fire resistance, (Removed) characteristics of fire resisting materials, fire alarms, fire extinguishing equipments. <b>Concept of Sustainable Materials; Material Selection for sustainable design, Green buildings rating</b>	5
	<b>Systems(Added)</b>	
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

1. S.K Duggal: Building Materials, 4th Edition, New Age International Publishers,2012.
2. B.C Punmia, Ashok Kr. Jain, Arun Kr. Jain: Building Construction,11<sup>th</sup> Edition, Lakshmi Publications,2016.
3. M.L Gambhir, Neha Jamwal, Building Materials, Mc Graw Hill, 2014

### Suggested Reference Book(s):

1. Rangwala, Building Construction, 33<sup>rd</sup> Edition, Charotar Publishing House Pvt. Ltd.,
2. M.K Gupta, Practical Handbook on Building Construction, Nabhi , 2014.

### Other useful resource(s):

1. Link to MIT Open Courseware :<https://ocw.mit.edu/courses/architecture/4-461-building-technology-i-materials-and-construction-fall-2004/lecture-notes>
2. Link to NPTEL course:<https://nptel.ac.in/syllabus/syllabus.php?subjectId=105102088>

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) -10 Attendance - 5



**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

<b>Course Outcomes (Building Materials and Construction)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	2	3	2	2	3	3	1	2	2	2	2	<b>2.17</b>
CO-2	3	1	3	3	3	1	3	3	3	3	2	3	<b>2.58</b>
CO-3	2	2	3	1	3	2	2	2	2	2	1	2	<b>2</b>
CO-4	3	3	3	3	2	3	1	2	3	1	3	3	<b>2.5</b>
<b>Average</b>	<b>2.5</b>	<b>2</b>	<b>3</b>	<b>2.25</b>	<b>2.5</b>	<b>2.25</b>	<b>2.25</b>	<b>2</b>	<b>2.25</b>	<b>2</b>	<b>2</b>	<b>2.25</b>	

# Surveying

COURSE CODE:23B11CE312

COURSE CREDITS:

3 CORE/ELECTIVE:

CORE L-T-P: 3-0-0

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**Pre-requisite:** None

## Course Objectives:

Surveying is of special importance and interest to a Civil Engineer. Surveying is a general term that covers any survey work carried out in connection with the construction of an engineering project, such as buildings, dam, highways, railways, bridges, canals, water supply, drainage works and other civil engineering works. The main objectives are:

1. To produce up-to-date *Engineering Plans* of the areas in which the work will be carried out.
2. To determine the corrections in different measurements
3. To ensure that the construction takes place in the correct relative and absolute position on the ground.
4. Knowledge of advanced surveying methods; Remote Sensing and GIS

## Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Understanding of basic principles of various methods of surveying, and related problems.	Assessment
CO-2	Will be able to apply various corrections in different measurements.	Assessment
CO-3	Will be able to get the correct relative and absolute position on the ground where construction is required.	Assessment
CO-4	Knowledge of modern survey equipment, Implement procedures for its use and care of field equipment.	Assessment
CO-5	Understanding of the design of curves.	Assessment
CO-6	Understanding of advanced surveying methods; Remote Sensing and GIS	Familiarity

## Course Contents:

Unit	Contents	Lectures required
1	<b>Introduction:</b> History of surveying and mapping, importance of geomatics engineering, plane and geodetic surveying, concept of datum and map projection system, Classification of Surveying, Principles of Surveying.	2
2	<b>Chain Surveying:</b> Instruments for chaining, Errors due to incorrect chain, Chaining on sloping ground, Errors in chaining, Tape corrections, Chain triangulation, setting out right angles, basic problems in chaining, conventional symbols used in chaining	2
3	<b>Compass surveying:</b> Instruments (prismatic and surveyor compass), bearing and angles, magnetic declination, local attractions.	3
4	<b>Leveling:</b> Instruments, Optical defects in lenses, Temporary adjustment of a level, and different types of leveling, curvature and refraction corrections, leveling problems, errors in leveling, the level tube.	5
5	<b>Contouring:</b> Contours, contour interval, contour gradient, characteristics of contours, methods of locating contours and their interpretation, uses of contour maps.	4
6	<b>Plane Table Surveying:</b> Instruments, principle and methods of plane- tabling, three-point problem, two-point problem, errors in plane tabling, advantages and disadvantages.	3
7	<b>Tacheometric and Theodolite:</b> Surveying: transit and non-transit, definition and terms, measurement of horizontal and vertical angles, instruments and tachometric method	4
8	<b>Modern Field Survey Systems:</b> Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Global Positioning, Systems- Segments, GPS measurements,	4
9	<b>Curves:</b> Elements of simple and compound curves – Method of setting out of simple circular curve – Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve.	5
10	<b>Remote Sensing and GIS:</b> Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital image processing, Introduction to GIS, types of data, components of GIS.GIS architecture, vector data models, raster data models	7
12	<b>Photographic Surveying:</b> Principles, Types of photographs, Concept of Relief Displacement, advantages of aerial photography	3
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. S K Duggal: Surveying, 3<sup>rd</sup> Edition, Tata McGraw-Hill Publishing Company , 2012
2. A.M.Chandra: Plane Surveying, 2<sup>nd</sup> Edition, New Age International Publishers, New Delhi, 2006
3. B.C.Punmia: Surveying-1, Surveying-2, Laxmi Publication Delhi, 2005
4. N.N.Basak: Surveying & Leveling Tata McGraw Hill Publishing Com. New Delhi

**Reference Books:**

1. B.C.Punmia: Surveying-3, Laxmi Publication Delhi, 2005

**Suggested Reference Book(s):**

1. Kavanagh, Barry F.: Surveying : Principles and applications, 7<sup>th</sup> Edition, Pearson Education Asia, 2006
2. A.M.Chandra: Higher Surveying 2<sup>nd</sup> Edition, New Age International Publishers New Delhi, 2006
3. Clark David: Plane and Geodetic surveying for Engineers, vol-1 & vol-2, 6<sup>th</sup> Edition, CBS Publishers, 2006

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105107122/>
2. Link to topics related to course:
  - i. <https://nptel.ac.in/courses/105107122/1-3>
  - ii. <https://nptel.ac.in/courses/105107122/8-18>
  - iii. <https://nptel.ac.in/courses/105107122/23-32>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (5) - 10 Quizzes (2)-10 Attendance - 5

### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Surveying)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	2	1	2	2	2	3	2	3	2	3	2.25
CO-2	3	2	2	2	2	2	2	1	2	2	3	3	2.16
CO-3	3	3	3	3	2	1	2	2	2	2	3	3	2.41
CO-4	2	3	2	3	3	1	1	2	1	1	2	3	2
CO-5	3	2	3	3	3	2	1	2	3	3	2	3	2.5
CO-6	3	3	3	3	2	1	1	2	1	1	3	3	2.16
Average	2.83	2.5	2.5	2.5	2.33	1.5	1.5	2	1.83	2	2.5	3	

# Water Supply Engineering

COURSE CODE:23B11CE412

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** None

## Course Objectives:

1. The objective of this course is to familiarize the students with the basics of water quality and its treatment methods, importance of planning and execution of modern water supply schemes.

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the different sources of raw water and the associated water demands from such sources.	Familiarity
CO-2	Understand the different treatment processes associated for supplying treated water for different uses and meeting the quality criterion of Indian standards.	Assessment
CO-3	Understand the importance of the disinfection process (purification)of treated water supply for domestic purposes.	Assessment
CO-4	Understand the different components of water distribution system including network analysis.	Assessment

## Course Contents:

Unit	Contents	Lectures required
1	<p><b>Introduction:</b> Importance of planned water supplies; financing, planning and execution of modern water supply schemes.</p> <p><b>Water demands:</b> Various types of demands; the per capita demand: variations in demand; design periods; population forecasting by various methods.</p> <p><b>Sources of water:</b> Kinds of water sources and their characteristics; factors governing the selection of a source of water supply, storage capacity of impounded reservoir.</p> <p><b>Quality of water:</b> Physical, chemical and biological characteristics of water, common water born diseases, standards of purified water for various purposes</p>	10

<b>2</b>	<p><b>Treatment of water:</b> screening and types; aeration units; sedimentation; sedimentation tanks and their types; sedimentation aided with coagulation; classifications of filters and their constructional and operational details.</p> <p><b>Water softening:</b> Importance of water softening; lime- soda process; zeolite process.</p> <p><b>Miscellaneous treatment methods:</b> Removal of color, odor and taste, iron and manganese; fluoridation and de-fluoridation.</p>	<b>12</b>
<b>3</b>	<p><b>Disinfection:</b> Methods of disinfection; chlorination and its types.</p>	<b>5</b>
<b>4</b>	<p><b>Collection and Distribution of water:</b> Intakes and their design for lakes, streams and rivers; methods of distribution; concept of service and balancing reservoirs; capacity of distribution reservoirs; Design of water distribution systems; analysis of pipe networks by Hardy Cross method, equivalent pipe method, method of sections and Newton-Raphson method; Layout of distribution system; the house water connection; construction and maintenance of distribution systems.</p> <p><b>Pipes-Joints-Fittings:</b> various types of conduits; testing and inspection; joints in pipes; valves in pipe line.</p> <p><b>Pumps and pumping stations:</b> Types of pumps and their choice; pumping stations; economical diameter of rising main; hand pumps; pump testing; Water hammer and its control measures.</p>	<b>15</b>
<b>Total lectures</b>		<b>42</b>

#### Suggested Text Book(s):

1. J. S Birdie, G S Birdie: Water Supply and Sanitation Engineering, 9<sup>th</sup> Edition, Dhanpat Rai Publications, India, 2014.
2. Garg S.K: Environmental Engineering – Water Supply Engineering (Volume -1), Khanna Publishers, India, 2015.
3. B.C. Punmia, A.K. Jain, A.K. Jain: Water Supply Engineering, 2<sup>nd</sup> Edition, Laxmi Publications. India, 2016

#### Suggested Reference Book(s):

1. H. Peavy, D. Rowe, G. Tchobanoglous "Environmental Engineering", 1<sup>st</sup> Edition, McGraw Higher Education Publications, India, 2017.

#### Other useful resource(s):

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105104102/Domestic%20water%20treat.htm>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Water Supply Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	3	2	2	3	2	2	2	3	2	1	1	<b>2.08</b>
CO-2	3	2	2	2	3	2	2	2	3	1	1	2	<b>2.08</b>
CO-3	3	2	3	2	3	3	2	3	3	1	2	1	<b>2.33</b>
CO-4	2	3	3	2	3	2	3	2	3	1	2	1	<b>2.25</b>
Average	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2</b>	<b>3</b>	<b>2.25</b>	<b>2.25</b>	<b>2.25</b>	<b>3</b>	<b>1.25</b>	<b>1.5</b>	<b>1.25</b>	



# Surveying Lab

COURSE CODE: 18B17CE372

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** None

## Course Objectives:

1. To get students familiar about the usage and working principle of different surveying instruments
2. Application of instruments to calculate various parameters such as horizontal angles, ground elevations, vertical distance, vertical angles, horizontal distance etc.
3. Able to plot the ground features in the maps with the help of plane table survey.

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO1	Calculate horizontal angles, bearing of lines, and measurement of horizontal distance, ranging of line using different instruments in the field.	Assessment
CO2	Able to perform different types of leveling operation to be performed in the field, knowledge of establishing BM.	Assessment
CO3	Able to measure vertical distance vertical angles, horizontal distance.	Assessment
CO4	Able to plot the ground features in the field with the help of plane table survey.	Assessment
CO5	Understanding of using Total Station, Tacheometer, Levels in the field.	Assessment

## List of Experiments

S.No	Description	Hours
1	To plot a traverse of a given area with the help of compass and a chain.	2
2	To establish bench mark at given site by performing fly leveling.	2
3	To work out difference of elevation between two points by reciprocal leveling.	2
4	To determine the position of station occupied by plane table using three point problem.	2
5	To locate the points at desired locations in the field by the method of intersection.	2
6	Measure angle between two horizontal points with the help of theodolite by method of repetition.	2
7	To determine the constants of a given tachometer	2

8	To determine whether the leveling bubble and telescope line-of-sight are parallel, by peg test method	2
9	Measuring height of the object with the help of Theodolite, when the base of the object is accessible.	2
10	Find out the horizontal distance and difference of elevation between two Points by fixed hair of tacheometry.	2
11	Introduction to Total Station	2
<b>Total Lab hours</b>		<b>22</b>

### Suggested/Resources:

1. S K Duggal: Surveying, 3<sup>rd</sup> Edition, Tata McGraw-Hill Publishing Company , 2012
2. A.M.Chandra: Plane Surveying, 2<sup>nd</sup> Edition, New Age International Publishers, New Delhi, 2006
3. B.C.Punmia: Surveying-1, Surveying-2, Laxmi Publication Delhi, 2005
4. N.N.Basak: Surveying & Leveling Tata McGraw Hill Publishing Com. New Delhi

### Reference Books:

1. B.C.Punmia : Surveying-3, Laxmi Publication Delhi, 2005

### Evaluation Scheme:

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Surveying Lab)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Average
CO1	3	3	3	3	2	2	1	3	3	3	3	3	2.67
CO2	3	3	3	3	3	2	1	3	3	3	3	3	2.75
CO3	3	3	2	3	2	3	2	3	3	3	3	3	2.75

<b>CO4</b>	3	3	3	2	3	2	1	3	3	3	3	3	<b>2.67</b>
<b>Average</b>	2	2	3	3	3	3	1	2	3	3	2	3	

# Chemistry

COURSE CODE:18B11CE311

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** XII Chemistry

## Course Objectives:

1. Learn chemical bonding, characteristics of solids and concept of physical chemistry.
2. Learn applied chemistry and its applications
3. Learn chemistry of materials as polymers, refractories, ceramics, glasses and zeolites and their uses.
4. Apply strengthening of steel to the concept of alloy steels.
5. Analyze different types of pollution and its control.

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Basic introduction of Chemical Bonding and Characteristics of solids.	Familiarity
CO-2	Understanding the concept of physical chemistry in terms of electrochemistry, titrations, surface and colloidal chemistry.	Familiarity and usage
CO-3	To familiarize students with applied chemistry and its applications as a civil engineer in terms of use of paints, coatings etc.	Familiarity and usage
CO-4	To understand the strengthening of steel with the help of heat treatment and concept of alloy steels and other metals.	Usage
CO-5	Understanding fundamentals of chemistry of materials as polymers, refractories, ceramics, glasses and zeolites and their uses.	Assessment
CO-6	Deal with chemistry of natural waters, chemical speciation, different types of pollution and its control.	Assessment

**Course Contents:**

Unit	Contents	Lectures required
1	<b>Chemical Bonding and Characteristics of solids:</b> Introduction to various kinds of bonding including hydrogen bonding, crystals types (Molecular crystals, Ionic crystals, covalent crystals, metallic crystals-their bonding and characteristics, some characteristics crystal structures, Crystal analysis by X-ray Diffraction.	3
2	<b>Physical Chemistry:</b> Conductivity of electrolytes, Specific conductivity, measurement of conductance, Acid – base equilibria, pH, Buffer solution, Electrochemistry: electrochemical cells, reference electrodes, Electrochemical series, Reaction kinetics up to second order, Thermodynamics : Laws and applications, Solution chemistry: concentration units, Acid base titrations, Complexometric titrations, redox titrations, Surface chemistry, Absorption, adsorption, Colloidal chemistry, Ion Exchange, Membrane process, Reverse osmosis, Electrodialysis.	14
3	<b>Applied Chemistry:</b> Corrosion and its control. Types of corrosion, Galvanic series, Factors influencing corrosion and protection against corrosion, Protective coatings, Metallic coatings, Electroplating and electroless plating, paints, formulation of paints, Failure of paint film, Varnishes, enamels, emulsion paints, lacquers, metals and alloys. Physical properties of metals, cast iron, wrought iron, steel, effect of impurities in steel, Heat treatment of steel, Alloys, purpose of making alloys, preparation of alloys, alloy steels, application of alloy steels.	14
4	<b>Chemistry of Materials:</b> Polymers, Introduction, Specific uses of important polymers, ceramics, Types of ceramics, Refractories, Glasses, Types of glasses, Zeolites, Clay minerals.	6
5	<b>Environmental Chemistry:</b> Atmospheric pollution, Composition of the atmosphere, Residence times, Sources and reactions of some of its constituents and pollutants, (CO <sub>2</sub> , NO <sub>x</sub> , SO <sub>x</sub> , CFCs), Acid Rain, Smog, Ozone production and depletion, Natural and anthropogenic sources of pollution, Water pollution: Chemistry of natural waters, Water pollution due to organics (detergents, fertilizers, pesticides), Heavy metal pollutants in water, sources, reactions, speciation and toxicity.	5
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Engineering Chemistry: By P. C. Jain and Jain.
2. Environmental Chemistry: By A. K. De

**Suggested Reference Book(s):**

1. Engineering Chemistry: By Shashi Chauhan
2. Engineering Chemistry: By B S Chauhan
3. Inorganic Chemistry: By J. D. Lee
4. Inorganic Chemistry: By B. K. Kapoor
5. Environmental Chemistry: By B S Chauhan
6. Physical Chemistry: By Gurdeepraj

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/104104011>
2. Link to topics related to course:
  - i. <https://nptel.ac.in/courses/104104011/>
  - ii. <https://nptel.ac.in/courses/104104066/>
  - iii. <https://nptel.ac.in/courses/104103019/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Chemistry)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	2	2	2	1	1	-	1	2	-	1	<b>1.4</b>
CO-2	2	3	3	3	3	-	2	1	2	2	-	2	<b>1.91</b>
CO-3	3	3	3	3	3	1	2	-	3	-	2	1	<b>2.0</b>
CO-4	2	3	3	3	3	-	1	1	2	2	-	1	<b>1.75</b>
CO-5	2	3	3	3	3	1	1	1	2	2	1	1	<b>2.0</b>
CO-6	3	3	3	3	3	1	-	1	3	3	-	2	<b>2.08</b>
<b>Average</b>	<b>2.5</b>	<b>2.83</b>	<b>2.83</b>	<b>2.83</b>	<b>2.83</b>	<b>1.0</b>	<b>1.6</b>	<b>1.0</b>	<b>2.4</b>	<b>1.8</b>	<b>1.5</b>	<b>1.3</b>	

## Chemistry Lab

COURSE CODE:18B17CE371

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** None

### Course Objectives:

1. Learn acid base titrations
2. Learn to calculate viscosity and surface tension parameters.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO1	Able to familiar with the various experiments involved with titration for the determination of strength and normality.	Familiarity
CO2	Able to familiar with the various experiments involved with titration for the standardization of different compounds.	Familiarity
CO3	Able to correlate the volumetric analysis with determination of hardness and chloride content of given water samples.	Assessment
CO4	Able to correlate the volumetric analysis with determination of acidity and alkalinity of water samples.	Assessment
CO5	Able to enhance practical skills related to all the measurements of different parameters of liquids as viscosity, surface tension.	Usage
CO6	Able to enhance practical skills related to all the pH measurements of different samples.	Usage

### List of Experiments

S.No.	Description	Hours
1	To Prepare N/10 Standard Solution of NaOH	2
2	To Determine Strength of Given Oxalic Acid Solution	2
3	To Prepare 0.1 M (Approximately) Standardized Sodium Carbonate	2
4	To Determine the Alkalinity of a Given Water Sample.	2
5	To Determine the Acidity of Given Water Sample	2
6	To Determine the Amount of Carbon Dioxide in a Given Water Sample	2
7	To Determine the Viscosities of Given Organic Liquids with the Help of Ostwald Viscometer.	2
8	To Determine the Surface Tension of Given Organic Liquids with the help of Stalagmometer.	2
9	To Determine the Chloride Content of Given Water Sample	2
10	To Determine Total Hardness of Given Water Sample by EDTA Method	2
11	To Determine the pH Values of Different Water Samples.	2
<b>Total Lab hours</b>		<b>22</b>



**Suggested/Resources:**

1. Lab Manual; \\172.16.73.6/civil
2. [https://www.bvrit.ac.in/Freshman\\_Lab\\_Manuals/freshman\\_engineering\\_chemistry/Engineering%20Chemistry.pdf](https://www.bvrit.ac.in/Freshman_Lab_Manuals/freshman_engineering_chemistry/Engineering%20Chemistry.pdf)

**Evaluation Scheme:**

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Chemistry Lab)	PO1	PO2	PO3	PO4	PO5	PO-	PO7	PO8	PO9	PO10	PO11	PO12	Average
CO1	3	3	3	3	2	2	1	1	1	1	1	1	1.83
CO2	3	3	3	3	3	1	1	1	1	1	1	3	2.00
CO3	3	3	2	3	2	3	2	1	1	1	2	1	2.00
CO4	3	3	3	2	3	2	1	1	1	1	1	1	1.83
CO5	2	2	3	3	3	3	1	1	1	1	1	1	1.83
CO6	2	3	3	3	2	2	2	2	2	2	2	2	2.25
<b>Average</b>	<b>2.67</b>	<b>2.83</b>	<b>2.80</b>	<b>2.80</b>	<b>2.60</b>	<b>2.20</b>	<b>1.20</b>	<b>1.00</b>	<b>1.00</b>	<b>1.00</b>	<b>1.20</b>	<b>1.40</b>	

## Mechanics of Solids

COURSE CODE: 18B11CE415

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Engineering Mechanics

### Course Objectives:

1. To impart the knowledge of mechanics of deformable bodies under static loads including temperature variation
2. To teach students the development of strains & stresses in solids and their relationships
3. To develop knowledge of behavior of structural members (beams, columns, shafts, etc.) under loading and draw bending moment and shear forces diagram of members for different loading.
4. To impart knowledge of methods used to compute slope and deflections in beams under transverse loads.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	At the end of the course students will have knowledge of various stress and strain systems, their relationships and behavior of materials under loads.	Assessment
CO-2	The students will develop concept of complex stresses and their treatment to find maximum value of a stress.	Assessment
CO-3	Students will develop understanding of how various forcing functions (shear force, bending moment and torque) vary along a structural element and be able to plot the same.	Assessment
CO-4	The students will be able to analyze a structural member (beams, columns, shafts, etc.) in depth with determination of crucial stresses, strains and deformation characteristics.	Assessment
CO-5	The students will be able to use the subject knowledge to decide failure locations in a solid body subjected to different types of loading.	Assessment

**Course Contents:**

Unit	Contents	Lectures required
1	<b>Mechanics of Deformable Solids:</b> Definition of stress and strain. Hooke's law for axial loads. Constants of elasticity: Young's modulus, shear modulus, Poisson's ratio.	7
2	<b>Axial load:</b> Calculation of stress and strain, design of bars for axial load. Statically indeterminate structures. Thermal effects on axial deformation and geometric —misfits. Shear stress and shear strain. Bars of uniform, varying and tapering cross sections, composite bars.	5
3	<b>Torsion of circular bars:</b> Computation of shear stress, Hooke's law for shear; design of circular bars. stress distributions in beams.	3
4	<b>Complex Stresses:</b> Stresses on inclined planes, principal stresses and strains, Mohr's circle of stresses, theories of elastic failure. Generalized Hooke's law for isotropic materials.	6
5	<b>Shear Force and Bending Moment Diagram:</b> Relationships between loads, shear force and bending moment. Shear force and bending moment diagram for different beams and their application.	5
6	<b>Bending Stress:</b> Flexural stress in linearly elastic beams; design of beams for strength; differential equations of the deflection curve; computation of slope and deflection; unsymmetrical bending	6
7	<b>Slope and deflection of beams:</b> Differential equation of the deflection curve, double integration method, Macaulay's method, moment area method and conjugate beam method.	7
8	<b>Buckling of columns:</b> The ideal pin-ended column; Euler buckling load; the effect of end conditions on column buckling.	3
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Beer , Johnston, Dewolf, Mazurek, Sanghi: Mechanics of Materials, 7th Edition, McGraw Hill Education India Private Limited, 2017
2. Shames Irving H: Introduction to Solid Mechanics, 3rd Edition, Prentice Hall India Learning Private Limited, 2002.
3. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain: Mechanics of Materials, Laxmi Publications; Revised edition (2017)

**Suggested Reference Book(s):**

1. Russell C. Hibbeler: Static and Mechanics of Materials, 5th Edition, Pearson, 2018.
2. William Nash: Schaum's Outline of Strength of Materials, 6th Edition, McGraw Hill Education India Private Limited, 2013

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105102090/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Mechanics of Solids)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	3	2	2	1	2	3	2	2	3	2.4
CO-2	3	3	3	3	2	2	1	2	3	2	2	2	2.3
CO-3	3	3	3	2	2	2	1	2	2	2	2	3	2.2
CO-4	3	3	3	2	2	1	1	2	3	3	2	2	2.2
CO-5	3	2	3	3	3	1	1	3	3	3	3	2	2.5
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.2</b>	<b>1.6</b>	<b>1</b>	<b>2.2</b>	<b>2.8</b>	<b>2.4</b>	<b>2.2</b>	<b>2.2</b>	

# Computer Aided Civil Engineering Drawing

COURSE CODE:18B11CE413

COURSE CREDITS:

1 CORE/ELECTIVE:

CORE L-T-P: 0-0-2

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**Pre-requisite:** None

## Course Objectives:

1. To learn the fundamentals of civil engineering drawings.
2. To develop knowledge of civil engineering software tools such as AutoCAD.

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO1	To be able to understand and interpret Civil Engineering Drawings.	Familiarity
CO2	Learn and master basic skills in AutoCAD.	Assessment
CO3	Understand basics of multidisciplinary engineering drawings such as mechanical, electrical, plumbing drawings.	Assessment
CO4	To gain proficiency in planning and developing drawings for small residential buildings.	Usage
CO5	Comprehend the basics of building information modeling.	Usage

## List of Experiments:

S.No.	Description	Hours
1	Introduction and interpretation to concept of engineering drawings using AutoCAD (Basic drawing entity commands.	2
2	Entity modification commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards and other advance commands.	4
3	Materials, Architectural, Structural, Electrical and Plumbing symbols drawing and interpretation using AutoCAD.	2
4	Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.	2
5	English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall.	2
6	Elements of planning building drawing, Methods of making line drawing and detailed drawing.	2
7	Site plan, floor plan, elevation and section drawing of small residential buildings.	4
8	Foundation plan. Roof drainage plans.	2

<b>9</b>	Standard fittings and fixtures, finishes.	<b>2</b>
<b>10</b>	Principles of isometrics and perspective drawing, Perspective view of building	<b>4</b>
<b>11</b>	Fundamentals of Building Information Modelling (BIM).	<b>2</b>
<b>Total Lab hours</b>		<b>28</b>

### Suggested Text Book(s):

1. Engineering Graphics with AutoCAD by Kulkarni, Dhananjay M., A. P. Rastogi, and Ashoke K. Sarkar. PHI Learning Pvt. Ltd., 2009.
2. Civil Engineering Drawing by Rangwala and Dalal 3rd edition 2017
3. Civil Engineering Drawing & House Planning: A Text Book, by B.P Verma 2006
4. Building Information Modeling for Dummies by Stefan Mordue, 2015

### Evaluation Scheme:

<b>1</b>	Mid Sem. Evaluation	20 Marks
<b>2</b>	End Sem. Evaluation	20 Marks
<b>3</b>	Attendance	15 Marks
<b>4</b>	Lab Assessment	45 Marks
	Total	100 marks

### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Computer Aided Civil Engineering Drawing)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Average
<b>CO1</b>	3	2	3	2	1	2	2	1	3	3	1	3	<b>2.17</b>
<b>CO2</b>	3	2	3	3	3	2	x	x	3	2	x	3	<b>2.67</b>
<b>CO3</b>	2	2	2	2	1	2	3	2	2	2	2	3	<b>2.08</b>
<b>CO4</b>	2	2	3	2	1	2	2	1	2	1	2	2	<b>1.83</b>
<b>CO5</b>	2	1	2	2	3	2	2	1	3	2	3	2	<b>2.08</b>
<b>Average</b>	<b>2.4</b>	<b>1.8</b>	<b>2.6</b>	<b>2.2</b>	<b>1.8</b>	<b>2</b>	<b>2.25</b>	<b>1.25</b>	<b>2.6</b>	<b>2</b>	<b>2</b>	<b>2.6</b>	

# Fluid Mechanics

COURSE CODE: 23B11CE311

COURSE CREDITS:

3 CORE/ELECTIVE:

CORE L-T-P: 3-0-0

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**Pre-requisite:** None

**Course Objectives:**

1. To get familiar with knowledge of fundamental of fluid and fluid flow characteristics.
2. To understand various methods to determine pressure measurement velocity measurement of fluid.
3. To understand various Principles of pipe flow losses occurred on pipe flow and its applications in real life.
4. To impart the knowledge of Dimensional analysis for solving the problems of fluid mechanics
5. To get familiar with the concept of flow phenomenon around the immersed bodies

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Knowledge of basic fundamentals of fluid and fluid flow characteristics.	Familiarity
CO-2	The students will understand basic methods to determine pressure measurement of fluid	Assessment
CO-3	Understanding of kinematics of fluid flow	Assessment
CO-4	Understanding of principles of pipe flow and basic fluid flow measurement instruments and techniques.	Assessment
CO-5	They will develop understanding of methods of dimensional analysis & modeling criteria.	Assessment
CO-6	Understanding the flow phenomenon around the immersed bodies	Assessment

**Course Contents:**

<b>Unit</b>	<b>Contents</b>	<b>Lectures required</b>
<b>1</b>	<b>Properties of fluid:</b> mass density, specific weight, specific volume, specific gravity; Viscosity, Newton's Law of viscosity, Types of Fluids, Surface tension and Capillarity.	<b>3</b>
<b>2</b>	<b>Pressure and its Measurement:</b> Pascal's Law, Pressure variation in a fluid at rest, Measurement of pressure: Manometers	<b>4</b>
<b>3</b>	<b>Hydrostatic forces on surfaces:</b> Total pressure and centre of pressure, Pressure measurement on Vertical plane surface, horizontal plane surface, curved surface and Inclined surface	<b>3</b>
<b>4</b>	<b>Buoyancy and Flotation:</b> Buoyancy, Metacentre, Metacentric height, Experimental method of determination of metacentric height	<b>2</b>
<b>5</b>	<b>Kinematics of fluid flow:</b> Steady & unsteady, uniform & non-uniform, rotational & irrotational, laminar & turbulent flow, Continuity equations for 1-D & 2-D flows, velocity and acceleration, velocity potential function, stream function, types of motion, vorticity.	<b>5</b>
<b>6</b>	<b>Dynamics of fluid flow:</b> Euler's equation, Bernoulli's equation & its applications, Impulse-momentum equation & its applications, Flow measurements: Venturimeter, Pitot-tube, Orifice-meter	<b>6</b>
<b>7</b>	<b>Dimensional analysis:</b> methods of analysis, Rayleigh's method, pie-Buckingham theorem, Dimensionless numbers.	<b>3</b>
<b>8</b>	<b>Boundary Layer Theory:</b> Concept of boundary layer, laminar and turbulent boundary layers, boundary layer thickness, Von Karman integral equation, laminar sublayer	<b>4</b>
<b>9</b>	<b>Forces on submerged bodies:</b> drag and lift force, Expression for drag and lift, Drag on a sphere, Drag on a cylinder, Karman vortex trail	<b>4</b>
<b>10</b>	<b>Flow through pipes:</b> Losses in pipe sections, hydraulic gradient line and total energy line, flow through pipes in series and parallel, compound pipes, Heigen Pousille's equation, Darcy-Weisbach's equation, branching of pipes and pipe networks.	<b>8</b>
<b>Total lectures</b>		<b>42</b>



**Suggested Text Book(s):**

1. Modi and Seth: Fluid mechanics and hydraulic machines, 3rd Edition, Prentice-Hall of India, 2010.
2. R K Bansal: A text Book of Fluid mechanics, - Laxmi Publication, 2010
3. D S Kumar: Fluid mechanics and Fluid power Engineering,6th Edition S. K. Kataria& Sons, 2002

**Suggested Reference Book(s):**

1. Douglas, John F., Gasiorek, Janusz M., Swaffield, John A. 4TH Edition, Pearson Education Asia,2006
2. R J Garde, Fluid Mechanics Through Problems 3rd Edition,New Age International Publishers 2016

**Other useful resource(s):**

1. Link to NPTEL course contents:<https://nptel.ac.in/courses/105101082/>
2. Link to topics related to course:
  - i. <https://nptel.ac.in/courses/105101082/3>
  - ii. <https://nptel.ac.in/courses/105101082/4>
  - iii. <https://nptel.ac.in/courses/105101082/6-16>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (5) - 10 Quizzes (2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Fluid Mechanics)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	3	3	3	2	2	3	x	x	1	1	1	3	2
CO-2	3	3	3	2	2	3	x	x	2	1	2	3	2.4
CO-3	3	3	3	3	2	2	x	x	2	2	1	3	2.4
CO-4	3	3	3	3	3	2	x	x	2	3	2	3	2.7
CO-5	3	3	3	3	3	2	x	x	1	2	2	3	2.5
CO-6	3	3	3	3	2	3	x	x	2	2	2	3	2.6
<b>Average</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2.67</b>	<b>2.33</b>	<b>2.5</b>	<b>0</b>	<b>0</b>	<b>1.67</b>	<b>1.8</b>	<b>1.67</b>	<b>3</b>	

## Water Resource Engineering

COURSE CODE:23B11CE611

COURSE CREDITS:

3 CORE/ELECTIVE:

CORE L-T-P: 3-0-0

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**Pre-requisite:** Fluid Mechanics, Soil Mechanics

Course Objectives:

1. To impart the knowledge of hydrology that deals with the occurrence, distribution, movement and properties of water on the earth and beneath the surface as groundwater.
2. To supplement the knowledge of various irrigation techniques, water requirements of the crops and the estimation of the water supplies.
3. To learn about distribution systems for canal irrigation, design of unlined and lined irrigation canals design with their economic justification and sediment problems associated with canals.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Knowledge of various components of hydrologic cycle that affect the movement of water in the earth and their estimation techniques.	Familiarity and Assessment
CO-2	Ability to estimate stream flow through various stream flow measurements techniques.	Assessment
CO-3	Grasping of the concepts of movement of ground water beneath the earth and ability to estimate the yielding capacity of the source.	Familiarity and Assessment
CO-4	Knowledge of the basic requirements of irrigation and various irrigation techniques and estimation of water to be supplied for crop requirements.	Familiarity and Usage
CO-5	Understanding of distribution systems for canal irrigation and the basics of design of unlined and lined irrigation canals.	Familiarity and Usage

## Lecture plan

S No.	Topic	No. of lectures
1	<b>Hydrology:</b> Hydrological cycle, precipitation and its measurement, DAD curve, mean rainfall over a drainage basin, snowfall and snowmelt, ground and surface water resource, single and multipurpose projects	4
2	Evaporation, transpiration, depression storage, infiltration, overland flow, $\Phi$ index , w-index, infiltration capacity, measurement of infiltration rate	4
3	<b>Stream flow measurements:</b> direct measurements, measurement of stage, wire gauge , automatic stage recorder-float gauge recorder, bubble gauge recorder; current meter, area velocity method, moving boat method, , dilution technique, indirect methods-slope area method	4
4	Hydrograph, its application, factor affecting flood hydrograph, base flow separation methods, stream flow hydrograph, direct runoff hydrograph, unit hydrograph, S-Curve technique	5
5	Flood estimation , Rational methods, Empirical formulae, Envelope curve, flood frequency analysis-probability method, Gumbel's method, confidence limits	3
6	<b>Ground water flow :</b> Aquifer characteristics-Specific yield, storage coefficient, coefficient of permeability, confined and unconfined aquifers, aquitards, aquifuge	2
7	Flow through wells: Radial flow into a well under confined and unconfined conditions, tube wells, pumping and recuperation tests, ground water potential.	4
8	<b>Irrigation Engineering:</b> Water requirements of crops, Moisture-crop relationship, Irrigation requirements, duty and delta, Irrigation efficiencies, Design of conventional and modern methods of irrigation, Irrigation of arid lands	6
9	Salinity of soil, Salinity control, Quality of irrigation water, Contaminants and their effects on various crop types, Rain water management, conjunctive use of water, Water logging causes and control, drainage system design.	3
10	<b>Canals :</b> Distribution systems for canal irrigation, canal capacity, canal losses, alignment of main and distributory canals, drainage system	2
11	Alluvial and Non alluvial canals, design of alluvial channels, Kennedy's theory, lacey's theory, regime channels, design of non- alluvial channels, design of lined canals, most efficient section, critical shear stress, bed load, local and suspended load transport, cost analysis of lined and unlined canals, drainage behind lining.	5
	<b>Total</b>	<b>42</b>

**Text Books:**

1. Garg, S. K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 1997.
2. Todd, D. K., Ground water Hydrology, John Willey & Sons, New York, 1995
3. Subramanya, K., Engineering Hydrology, McGraw Hill Education

**Reference books:**

1. Applied Hydrology - Ven T Chow, David R Maidment, Larry W Mays
2. Bharat Singh, Fundamentals of Irrigation Engineering, Nem Chand and Brothers.

**TEACHING METHODOLOGY:** The course will be covered through lectures supported by presentations and video demonstrations.

**EVALUATION SCHEME:**

Instrument	Duration	Marks
Mid term1	1	15
Mid Term2	1.5 hour	25
End term	2 hour	35
Internal Assessment*		25
Total		100

\* Internal Assessment is based on Assignments, Tutorials, Quizzes, and Regularity in Attendance

	Total Nos.	Max. marks
Assignment		10
Attendance		5
Class Quiz 1	5(marks)	10
Class Quiz 2	5 (marks)	
Total		25

**Correlation of COs with POs**

Course Outcomes	Programme Outcomes												Average
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO1	3	2	1	3	2	2	3	2	3	2	2	2	2.3
CO2	3	3	2	1	3	2	3	2	3	2	1	2	2.3
CO3	3	2	2	1	3	2	2	3	2	2	1	2	2.1
CO4	3	3	3	1	3	1	3	2	3	3	2	2	2.4
CO5	3	3	2	2	3	2	2	2	3	2	2	2	2.3
Average	3	2.6	2	1.6	2.8	1.8	2.6	2.2	2.8	2.2	1.6	2	

# Geotechnical Engineering

COURSE CODE:18B11CE411

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:****Course Objectives:**

1. To learn what Geotechnical Engineering is and how it is important to civil engineering.
2. To learn how three phase system is used in soil and how are soil properties estimated using three phase system.
3. The course will explain role of water in soil behavior and how soil stresses, permeability and quantity of seepage including flow net are estimated.
4. The course will impart the knowledge of compaction, estimating the magnitude and time-rate of settlement due to consolidation.
5. Impart knowledge of determining shear parameters and stress changes in soil due to foundation loads, earth pressure theory and slope stability.

**Course Outcomes:**

S. No.	Course Outcomes	Level of Attainment
CO-1	Identify and classify the soil with ability to solve soil mechanics problems using inter relationships and phase diagrams	Familiarity
CO-2	Characterize soil based on index properties, understand phenomena of capillarity and determine effective stress condition, permeability, seepage within soil mass. Also enabling students to use flow - nets for solving problems related to seepage under hydraulic structures and rectification using filters.	Assessment
CO-3	Understand difference between compaction and consolidation, effect of compaction on various soil properties, method and procedure of lab and field compaction. It will also enable students to relate soil structure variation with compaction and comprehend compressibility and index property changes.	Assessment
CO-4	Understand consolidation and derive terzaghi's one – dimensional consolidation, shear strength of soil under different drainage conditions with understanding of total and effective stress conditions, determination of consolidation and shear strength using laboratory testing, estimation of settlement using concepts of vertical stress, consolidation and shear strength.	Usage
CO-5	Solve practical problems related about to earth pressure theory like retaining walls and stability of the slopes both graphically and analytically.	Usage

**Course Contents:**

UNIT	CONTENTS	LECTURES REQUIRED
1	<b>Introduction, soil formation and structure:</b> Introduction to Geotechnical problems in Civil Engineering, Process of soil formation- residual, Transported soil. Formation of fine - grained and coarse – grained, Clay mineralogy.	4
2	<b>Soil properties, index properties and classification:</b> Basic soil properties, volumetric and gravimetric inter-relationships, index properties – water content, specific gravity, grain size distribution, Atterberg’s limits, in – situ density and I.S. classification system.	6
3	<b>Effective stress, permeability and seepage analysis:</b> Capillarity, Total effective and neutral stresses, Darcy’s law, permeability and its factors, seepage, flow- nets, Piping, filters and filter design	8
4	<b>Compaction, Consolidation and Stress distribution:</b> Laboratory compaction and field compaction of soils, effect of compaction on soil properties; Compressibility, Terzaghi’s One-dimension consolidation equation, simple settlement analysis incorporating stress distribution in soils under surface loadings	8
5	<b>Shear strength of soil:</b> Shear strength, total and effective strength parameters and their determination, Unconfined shear strength (UCS), laboratory determination of shear strength parameters using direct shear tests, vane shear test and triaxial tests with different drainage conditions as UU, CU and CD tests. Mohr’s circle for various drainage and stress conditions.	6
6	<b>Earth pressure Theories:</b> Concept Earth pressure: Rankine and Terzaghi’s Classical Theories, graphical charts	5
7	<b>Stability of slopes:</b> Types of Failure: Failure surfaces - Planar surfaces, Circular surfaces, Non-circular surfaces, Limit equilibrium methods, Total stress analysis versus effective Stress analysis, Short term and Long term stability in slopes, slope stability using tables and graphical methods.	5
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Basic and Applied Soil Mechanics by Gopal Ranjan & A.S. Rao, Publisher New Age International (P) Ltd, ISBN:81-224-1223-8
2. Geotechnical Engineering Principle and Practices of Soil mechanics and Foundation Engineering by V. N. S. Murthy, publisher Marcel Dekker Inc.
3. Soil mechanics and Foundations by Dr. B.C. Punmia, Ashok Kumar jain, Arun Kumar Jain, Publisher: Laxmi Publications (P) Ltd, ISSN: 81-7008-081-9

### Suggested Reference Book(s):

1. Modern Geotechnical Engineering by Alam Singh, CBS Publications
2. Soil Engineering (vol.-1) Fundamental & General Principles by AlamSingh, CBS Pub.
3. Soil Engineering (vol.-2) Geotechnical Testing & Instrumentation by Alam Singh & Chowdhary, CBS Publications
4. Soil Mechanics by Lambe& Whitman, Wiley Publications
5. Indian Standards Codes

### Other useful resource(s):

1. Link to NPTEL course content: <https://nptel.ac.in/courses/105103097>
2. Links related to topics of course:\_  
<https://nptel.ac.in/courses/105103097/32>  
<https://nptel.ac.in/courses/105103097/37>  
<https://nptel.ac.in/courses/105103097/43>

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2) -10 Attendance - 5

### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Geotechnical Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	2	2	2	1	1	1	2	2	1	2	1.75
CO-2	3	3	2	3	3	1	1	2	2	2	2	1	2.08
CO-3	2	3	3	2	3	1	2	1	2	2	2	2	2.08
CO-4	3	3	2	3	2	2	1	1	2	3	1	2	2.08
Average	2.75	2.75	2.25	2.5	2.5	1.25	1.25	1.25	2	2.75	1.5	1.75	



## Geotechnical Engineering Lab

COURSE CODE: 18B17CE471

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** None

### Course Objectives:

1. To learn determination of index properties of soils.
2. To estimate shear strength of soils by direct shear test, triaxial shear test, vane shear test & unconfined compressive test
3. Imparting knowledge of and ability to perform laboratory tests needed to determine foundation design parameters
4. To estimate the engineering properties of the soils by in-situ tests

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO1	To classify soil by physical observation of the soils, estimated index and engineering characteristics of soils.	Assessment
CO2	To estimate unconfined compressive strength of soil and shear strength parameters by laboratory vane shear test and derive undisturbed and remoulded shear strength of soil.	Assessment
CO3	To perform and calculate free swelling of expansive soils.	Usage
CO4	To analyze the difference between lab tests and in-situ testing conditions.	Assessment
CO5	To become familiar with new soil testing practices.	Familiarity

### List of Experiments

S.No	Description	Hours
1	Field Identification Test	1
2	Determination of Moisture Content using oven method	1
3	Specific Gravity of soil particles by Pycnometer method and density bottle method	2
4	Particle size distribution of soils (Grain size analysis) by Sieve analysis for coarse-grained soils and hydrometer analysis for fine - grained	2
5	Determination of Atterberg's limits (Consistency limits) (a) Liquid Limit (b) Plastic Limit (c) Shrinkage limit	1
6	Determination of permeability of soils by Constant head and variable head method	2



7	Soil compaction light and Heavy test (Density moisture relations)	1
8	Oedometer test for consolidation of soils	2
9	Determination of swelling index by swelling pressure test	1
10	Determination of shear strength parameters of cohesionless soils by Direct Shear Test	1
11	Determination of shear strength parameters of soil by Unconfined Compressive strength Test	2
12	Determination of shear strength of cohesive soils by Vane Shear Test	2
13	Determination of shear strength parameters by Triaxial Test	2
14	Determination of density of soils by Core cutter method and sand replacement method	2
15	Determination of in – situ shear strength by Standard Penetration test (Demonstration)	2
<b>Total Lab hours</b>		<b>24</b>

### Suggested/Resources:

1. Soil Mechanics laboratory manual by Braja M Das; Publisher: Oxford university press
2. Manual of Soil laboratory Testing (Vol. 1 and Vol. 2) by K. H. Head; Publisher: Pentech Press, London

### Evaluation Scheme:

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Geotechnical Engineering Lab)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Average
CO1	2	3	3	3	2	2	1	2	1	2	1	1	1.92
CO2	3	3	3	3	3	1	2	1	1	1	2	3	2.17
CO3	3	3	2	3	2	3	1	1	2	1	2	1	2.00
CO4	3	2	3	2	3	2	1	1	1	2	1	1	1.83

Average	3	2	3	2	3	3	1	2	1	2	2	1	
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## Fluid Mechanics Lab

COURSE CODE: 23B17CE371

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** None

**Course Objectives:**

1. To get familiar students about the usage and working principle of different instruments used in Fluid Mechanics
2. Application of instruments to calculate various parameter such as Fluid pressure, discharge, losses in pipes etc.
3. Calibration of instruments

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO1	Methods of discharge measurements on open channel flow and closed conduit flow	Assessment
CO2	Calibration flow measuring devices used in pipes, channels and tanks	Assessment
CO3	To calculate losses in flow	Assessment
CO4	Verification and characterization of flow (ex. Bernoulli's Theorem, impulse momentum equation, laminar flow etc.) through experiments	Assessment

**List of Experiments**

S.No	Description	Hours
1	Introduction to various Instruments	2
2	Determination of metacentric height	2
3	Calibration of a venturi meter	2
4	Determination of frictional losses in pipes of different diameters.	2
5	Determination of minor losses in pipes	2
6	Calibration of v- notch and rectangular notch	2
7	Reynolds dye experiment for flow characterization	2
8	Determination of $C_c$ , $C_v$ and $C_d$ of an orifice	2

<b>9</b>	Verification of Bernoulli's theorem	<b>2</b>
<b>10</b>	Calibration of orifice meter	<b>2</b>
<b>11</b>	Verify the impulse momentum equation (impact of jet)	<b>2</b>
<b>Total hours</b>		<b>22</b>

#### Suggested/Resources:

1. Modi and Seth: Fluid mechanics and hydraulic machines, 3rd Edition, Prentice-Hall of India, 2010.
2. R K Bansal: A text Book of Fluid mechanics, - Laxmi Publication, 2010
3. D S Kumar: Fluid mechanics and Fluid power Engineering, 6<sup>th</sup> Edition, 2002

#### Evaluation Scheme:

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

#### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Fluid Mechanics Lab)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	2	2	2	1	1	3	3	1	3	2.25
CO-2	3	3	3	2	3	2	1	1	3	3	1	3	2.33
CO-3	3	3	2	2	2	3	2	1	3	3	2	3	2.41
CO-4	3	3	2	2	3	2	1	1	3	3	1	3	2.25
<b>Average</b>	<b>3</b>	<b>3</b>	<b>2.5</b>	<b>2</b>	<b>2.5</b>	<b>2.25</b>	<b>1.25</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>1.25</b>	<b>3</b>	

## Environmental Studies

COURSE CODE:18B11GE411

COURSE CREDITS: AUDIT

CORE/ELECTIVE: CORE

L-T-P: 2-0-0

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**Pre-requisite:** None

### Course Objectives:

1. Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
2. Estimate the population- economic growth, energy requirement and demand.
3. Analyze material balance for different environmental systems
4. Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
5. Identify the major pollutants and abatement devices for environmental management and sustainable development.
6. Recognizing the major concepts of environmental studies, developing problem solving ability, forecasting the global climate change

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Introducing basic concept of environmental studies, interdisciplinary nature and scope of the subject	Familiarity
CO-2	Understanding ecosystem services and its functioning as well as equitable use of natural resources.	Assessment
CO-3	Understanding Pollution, A threat to the environment and finding its solutions, Pollutant sampling and monitoring of samples.	Assessment
CO-4	Correlating the concept of Biodiversity and its importance to human mankind	Usage
CO-5	Understanding social issues and their impact on environment.	Usage
CO-6	Role of Information Technology in environment and human health	Usage

### Course Contents:

Unit	Contents	Lectures required
1	<b>Unit 1: Multidisciplinary nature of environmental studies:</b> The Multidisciplinary nature of environmental studies: Definition, scope and importance, Need for public awareness, Types of ecosystems, World Biomes, Ecosystem functioning, Biogeochemical cycles.	3

2	<b>Unit 2: Natural resources, their consumption &amp; Protection:</b> Natural resources, their consumption & Protection: Water, Land Energy (Renewable, non-renewable, wind, solar, hydro, Biomass), Mineral, Forest, & Food resources, Role of an individual in conservation of natural resources, Equitable use of resources.	4
3	<b>Unit 3: Pollution- a threat to environment:</b> Pollution- a threat to environment: Air, Water & Land pollution, sources & causes, Space pollution, causes & effects, toxicity limits of pollutants. Critical issues concerning global Environment (Urbanization, population growth, global warming, climate change, acid rain, ozone depletion etc.) and the Roots in: Cultural, Social, Political, Commercial, industrial, territorial domains	4
4	<b>Unit 4: Environmental standards &amp; Quality:</b> Environmental standards & Quality: Air, Water & Soil Quality, Pollutant sampling, pollution control systems. Green Chemistry and its applications	3
5	<b>Unit 5: Biodiversity and its conservation:</b> Biodiversity loss: Diversity of flora and fauna, species and wild life diversity, Biodiversity hotspots, threats to biodiversity	4
6	<b>Unit 6: Social Issues and the Environment:</b> Waste land reclamation, consumerism and waste products, eco-consumerism, dematerialization, green technologies, eco-tourism. Water conservation, rain water harvesting, watershed management. Environment protection act, Air (prevention and control of pollution) act; Water (prevention and control of pollution) act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation National Environmental Policy; Function of pollution control boards (SPCB and CPCB), their roles and responsibilities.	4
7	<b>Unit 7: Human Population and the environment:</b> Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education.HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health. Case Studies.	4
8	<b>Unit 8: Field work:</b> Field Work: Explore the surrounding flora & fauna (Study of common plants, insects, birds document environmental assets), documentation of industries in local region and their possible effects, measure of water, air and land quality, Visit to a local polluted site-Urban/Rural /Industrial / Agricultural, Study of simple ecosystems-pond, river, hill slopes etc	4
<b>Total lectures</b>		<b>30</b>

### Suggested Text Book(s):

1. Environmental Studies By: M. P. Poonia and S.C. Sharma, Khanna Publishers
2. Textbook of Environmental Studies for UG Courses –ErachBharucha, University Press
3. Joseph, B., 2005, Environmental Studies, Tata McGraw Hill, India.

### Suggested Reference Book(s):

1. Nebel, B.J. & Wright, R.T., 1993, Environmental Science, 8th Edition, Prentice Hall, USA.
2. Chiras D D.(Ed.). 2001. Environmental Science – Creating a sustainable future. 6th ed. Jones &Barlett

Publishers.

- David Laurance. 2003. Environment Impact assessment, Wiley publications.
- Chhokar KB, Pandya M & Raghunathan M. 2004. Understanding Environment. Sage publications, NewDelhi.

**Other useful resource(s):**

- Issues of the journal: Down to Earth, published by Centre for Science and Environment.
- Audio visuals from: Discovery, National Geographic etc.
- Rachel Carson 1960. Silent springs

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Environmental Science)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	1.8
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	2.0
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	1.8
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	2.1
CO-5	2	3	3	2	2	1	1	1	1	1	3	2	1.8
CO-6	2	2	2	2	1	1	1	2	2	2	2	2	1.8
Average	2.0	2.5	2.5	2.3	2.2	1	1	1.2	1.8	2.0	1.8	2	



# Structural Analysis

COURSE CODE:18B11CE513

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

**Pre-requisite:** None

## Course Objectives:

1. To find the advantages and disadvantages of indeterminate structure and their indeterminacy.
2. To solve an indeterminate structure by Force Method.
3. To solve an indeterminate structure by Displacement Method.
4. To find deflection in truss, beam and frame by Energy Method.

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Student will able to differentiate between given problems as it comes under determinate or indeterminate problems.	Assessment
CO-2	Student will able to solve simple indeterminate problems by force method and displacement method.	Assessment
CO-3	Student will able to know in what kind of problem force method should be used and for what kind of problem displacement method should be used.	Assessment
CO-4	Student will come to know how to analyze a structure in which footing were settled due to loose soil.	Assessment
CO-5	This course will help the students in reinforced concrete design and steel design as they required moments for designing a structural element.	Usage

## Course Contents:

Unit	Contents	Lectures required
1	<b>Introduction:</b> Concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium	4
2	<b>Indeterminacy:</b> Static and kinematic indeterminacy of beam, frame and truss structures	4
3	<b>Deflection:</b> Deflection of truss, beam and frame structures by energy method.	3
4	<b>Force Method:</b> Solving Indeterminate beam, truss and frame by force method.	7

5	<b>Theorems:</b> Castigliano's theorem, Maxwell-Betti's theorem	2
6	<b>Three Moment equation:</b> Derivation and Application of three moment equation	2
7	<b>Slope Deflection Equation:</b> Derivation and application of slope deflection equation for beams and frames, support settlement and sway of frames	7
8	<b>Moment Distribution Method:</b> Application of Moment Distribution method for beams and frames, support settlement and sway of frames	7
9	<b>Cables:</b> Introduction to cables, General cable theorem and its application.	3
10	<b>Arches:</b> Three hinged arch, Two hinged arch	3
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

1. R.C. Hibbeler: Structural Analysis, Eight Edition., Prentice Hall, 2012
2. C.K. Wang: Intermediate Structural Analysis, 7th Ed., Mc Graw Hill, 2008.

### Suggested Reference Book(s):

1. Aslam Kassimali: Structural Analysis, 4th edition, Cengage Learning, 2011.
2. Devdas Menon: Structural Analysis, Narosa, 2010

### Other useful resource(s):

1. Link to NPTEL course contents: <https://nptel.ac.in/downloads/105101085/#>

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

<b>Course Outcomes (Structural Analysis)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	<b>1.75</b>
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	<b>2</b>
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	<b>1.75</b>
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	<b>2</b>
CO-5	3	2	3	3	2	3	2	1	2	2	3	3	<b>2.4</b>
<b>Average</b>	<b>2.2</b>	<b>2.4</b>	<b>2.6</b>	<b>2.6</b>	<b>2.4</b>	<b>1.4</b>	<b>1.2</b>	<b>1</b>	<b>2</b>	<b>2.2</b>	<b>1.8</b>	<b>2.2</b>	

## Sewage Treatment and Disposal

COURSE CODE:18B11CE512

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** None

### Course Objectives:

1. Learn to understand the basic fundamentals for treatment of municipal wastewater systems and the associated flow-sheets of the different treatment systems.
2. Learn about the operations of the wastewater treatment plant and the fundamental scientific principles involved in the treatment process.
3. Learn to design the unit operations and unit processes for treatment of municipal wastewaters.
4. Learn to design the physico-chemical and biological treatment systems for treatment of municipal wastewaters.
5. Learn to design the fundamentals of sludge treatment and tertiary treatment processes

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Critically analyze the problems arising out of the operation of wastewater treatment plant.	Familiarity
CO-2	Ability to utilize proper design considerations depending upon the selected treatment method for wastewater and their potential limitations.	Assessment
CO-3	Estimate design details for different treatment processes including conventional, low-cost treatment systems and advanced systems.	Assessment
CO-4	Ability to learn apply effective disposal methods for treated waste water (sludge handling).	Usage

### Course Contents:

Unit	Contents	Lectures required
1	<b>Collection of Sewage:</b> Systems of sewerage – separate, combined and partially separate. Quantity of sanitary sewage and variations. Shapes of sewer – circular and egg shaped. Design of sewers, self-cleansing velocity and slopes, Construction and testing of sewer lines. Sewer materials. Joints and appurtenances.	15
2	<b>Sewage Characterization:</b> Quality parameters- BOD, COD, Solids, D.O., Oil & Grease. Indian Standards for disposal of effluents into inland surface sources and on land	4
3	<b>Sewage Treatment:</b> Objectives, sequence and efficiencies of conventional treatment units. Preliminary treatment, screening and grit	18

	removal units. Theory and design aspects of primary treatment, secondary treatment- activated sludge process & its modifications, Trickling filter, sludge digestion and drying beds. Stabilization pond, aerated lagoon, UASB process, septic tank and Imhoff tank.	
<b>4</b>	<b>Disposal of Sewage:</b> Disposal of sewage by dilution – self-purification of streams. Sewage disposal by irrigation (sewage treatment	<b>5</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. J. S Birdie, G S Birdie: Water Supply and Sanitation Engineering, 9<sup>th</sup> Edition, Dhanpat Rai Publications, India, 2014.
2. Garg S.K: Environmental Engineering – Sewage Disposal and Air Pollution Engineering (Volume -2), Khanna Publishers, India, 2015.
3. B.C. Punmia, A.K. Jain, A.K. Jain: Wastewater Engineering (including Air Pollution), 2<sup>nd</sup> Edition, Laxmi Publications. India, 2016

**Suggested Reference Book(s):**

1. H. Peavy, D. Rowe, G.Tchobanoglous "Environmental Engineering", 1<sup>st</sup> Edition, McGraw Higher Education Publications, India, 2017.
2. Metcalf and Eddy Inc: Wastewater Engineering: Treatment and Resource Recovery, 4<sup>th</sup> Edition, McGraw Hill Publications. India, 2014

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105105048/>
2. Link to topics related to course:
  - i. <https://nptel.ac.in/courses/105104102/17>
  - ii. <https://nptel.ac.in/courses/105104102/20#>
  - iii. <https://nptel.ac.in/courses/105104102/23>
  - iv. <https://nptel.ac.in/courses/105104102/26>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Sewage Treatment and Disposal)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	3	2	2	2	1	2	2	2	2	1	2	<b>1.92</b>
CO-2	3	2	2	2	3	2	2	2	2	1	1	1	<b>1.92</b>
CO-3	3	2	3	2	2	2	2	1	2	1	1	2	<b>1.92</b>
CO-4	2	2	2	3	2	2	2	1	2	3	2	2	<b>2.08</b>
<b>Average</b>	<b>2.5</b>	<b>2.25</b>	<b>2.25</b>	<b>2.25</b>	<b>2.25</b>	<b>1.75</b>	<b>2.00</b>	<b>1.50</b>	<b>2.00</b>	<b>1.75</b>	<b>1.25</b>	<b>1.75</b>	

# Construction Technology and Management

COURSE CODE:18B1WCE531

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Building Materials and Construction

## Course Objectives:

1. To impart fundamental knowledge & skills in students by communicating the concept of construction technology management effectively.
2. To promote intellectual & social values in construction engineers
3. To engage students in research & innovation by providing sustainable solution to construction industry..
4. To develop human values & ethics in students & prepare them to be responsible citizens...

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the roles and responsibilities of a project manager, importance of contract document and tender for construction work.	Familiarity
CO-2	Prepare schedule of activities in a construction project finding critical path, cost controlling, resource allocation and updating of the network.	Assessment
CO-3	Identify the equipment used in construction.	Assessment
CO-4	Cost optimization of the construction equipment's, economic life and replacement of the construction equipment's	Usage
CO-5	Understand safety practices in construction industry	Usage

## Course Contents:

Unit	Contents	Lectures required
1	<b>Introduction:</b> Introduction to different types of contracts, owner – contractor relationship, the terms and conditions of a contract.	3
2	<b>PERT and CPM Analysis:</b> Relevance of construction schedules-Bar charts, the programme evaluation review technique method, calculations for critical path scheduling, activity float and schedules.	8
3	<b>Construction Equipment's:</b> Introduction to various operations in construction, execution and management.	3
4	<b>Earth excavating, compacting, finishing and hauling machinery:</b> Standard and special construction equipments, heavy earthmoving equipments, shovels and cranes, crushing plant, batching plant, bitumen plant.	6

Approved in Academic Council held on 28 June 2023

5	<b>Cost control:</b> Selection of construction equipment cost of owning and operating, capacity and utilization, breakdown analysis, economic life, replacement of equipment and sinking fund.	6
6	<b>Resource allocation and Updating:</b> Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.	10
7	<b>Safety measures in construction design:</b> Form works, their design, fabrication and uses. Uses and design of scaffoldings. Steel constructions; fabrication and erection techniques	6
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

1. Punmia and Khandelwal K.K. - Project Planning and Control - Laxmi Publ. Delhi.
2. P. S. Gahlot and B.M. Dhir - Construction Planning and management- New Age international Publ. Delhi
3. Srinath, L.S. - PERT and CPM Principles and Applications - East West Press

### Suggested Reference Book(s):

1. Amit and B.L. Gupta – Construction Management and Machinery – Standard publishers Delhi.
2. Moder. J., C. Phillips and Davis - Project Management with CPM, PERT and Precedence Diagramming - Van Nostrand Reinhold Co.
3. Willis. E.M. - Scheduling Construction projects - John Wiley and Sons.

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignments (10) - 10 Presentation(1) -10 Attendance/Quiz - 5



**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Construction Technology and Management)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	<b>2</b>
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	<b>2</b>
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	<b>1.75</b>
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	<b>2.0</b>
CO-5	2	2	3	3	3	2	2	1	3	2	2	2	<b>2.25</b>
Average	<b>2</b>	<b>2.4</b>	<b>2.6</b>	<b>2.6</b>	<b>2.6</b>	<b>1.4</b>	<b>1.6</b>	<b>1</b>	<b>2.2</b>	<b>2.2</b>	<b>1.6</b>	<b>2</b>	

## Solid Waste Management

COURSE CODE:18B1WCE532

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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**Pre-requisite:** None

### Course Objectives:

1. Identify the physical and chemical composition of waste.
2. Analyze the functional elements for solid waste management.
3. Understand the techniques and methods used in transformation, conservation, and recovery of materials from solid wastes.
4. Identify and design waste containment systems.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Detailed composition of Solid waste both Physical and Chemical	Familiarity
CO-2	Functional elements for solid waste management.	Assessment
CO-3	Familiarity with the techniques and method involved in solid waste management.	Assessment
CO-4	Designing of waste containment landfill system for proper treatment of MSW generated	Usage

### Course Contents:

Unit	Contents	Lectures required
1	<b>Sources and Types:</b> Solid waste: Definitions, Types and Sources of waste, Waste Generation and waste generation rates. Factors affecting the generation rate, Composition characteristics and properties, Methods of sampling, Effects of improper disposal of solid wastes- Public Health and Environmental effects. Elements of solid waste management and financial aspects. Solid waste management rules, 2016, Role of NGO's.	8
2	<b>On-Site Storage and Processing:</b> On-Site Methods-Effect of storage, Materials used for containers- segregation of solid wastes, Public health and economic aspects of open storage, Waste Segregation and storage, Case studies under Indian scenario as well as worldwide, Source reduction of waste, reuse and recycling.	8
3	<b>Collection and Transfer:</b> Methods of Residential and Commercial Waste Collection, Collection Vehicles, Manpower Collection Routes, Analysis of Collection Systems, Transfer Stations – Selection of Location, Operation and	8

	Maintenance, Options Under Indian Conditions, Field Problems Solving.	
<b>4</b>	<b>Off- Site Processing:</b> Objectives of Waste Processing – Physical Processing Techniques and Equipments; Resource Recovery from Solid Waste Composting and Bio- methanation; Thermal Processing Options – Case Studies Under Indian Conditions.	<b>10</b>
<b>5</b>	<b>Land Disposal of Solid Waste; Sanitary Landfills</b> – Site Selection, Design and Operation of Sanitary Landfills – Landfill Liners – Management of Leachate and Landfill Gas- Landfill Bioreactor– Dumpsite Rehabilitation	<b>8</b>
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

1. Tchobanoglous G, Theisen H and Vigil SA \_Integrated Solid Waste Management, Engineering Principles and Management Issues‘ McGraw-Hill, 1993. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.
2. Mantell, C.L., Solid Waste Management, John Wiley, New York, 1975.
3. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, \_Environmental Engineering‘, McGraw Hill Inc., New York, 1985.
4. Chandrappa, Ramesh, Das, D.B., Solid Waste Management: Principles and Practise, Springer, 2012.

### Suggested Reference Book(s):

1. Government of India, —Manual on Municipal Solid Waste Managementl, CPHEEO, Ministry of Urban Development, New Delhi, 2016.
2. Qian X, Koerner RM and Gray DH, \_Geotechnical Aspects of Landfill Design and Construction‘ Prentice Hall, 2002.
3. George Tchobanoglous and Frank KreithlHandbook of Solid waste Managementl, McGraw Hill, New York, 2002.
4. Bhide A.D. And Sundaresan, B.B. —Solid Waste Management Collectionl, Processing and Disposal, 2001.

### Other useful resource(s):

1. [http://www.utdallas.edu/~brikowi/Teaching/Environ\\_Geology/LectureNotes/WasteManagement/wasteManagement.pdf](http://www.utdallas.edu/~brikowi/Teaching/Environ_Geology/LectureNotes/WasteManagement/wasteManagement.pdf)
2. <http://www.csupomona.edu/~fjanger/ce457/ce457.htm>
3. [http://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture\\_notes/env\\_occupational\\_health\\_students/ln\\_solid\\_waste\\_final.pdf](http://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/env_occupational_health_students/ln_solid_waste_final.pdf)
4. <http://www.ilo.org/oshenc/part-vii/environmental-pollution-control/item/514-solid-waste-management-and-recycling>
5. <https://www.youtube.com/watch?v=SSIRzuE78TA>
6. [https://www.youtube.com/watch?v=MFmr6Yapn\\_A](https://www.youtube.com/watch?v=MFmr6Yapn_A)
7. <https://www.youtube.com/watch?v=zchfhZZF7UY>
8. <https://www.youtube.com/watch?v=4552riac7VM>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Solid Waste Management)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	1	1	2	1	2	1	1	-	-	-	1	1.33
CO-2	2	3	2	2	2	2	2	1	-	-	-	2	2
CO-3	3	3	2	2	1	2	2	1	-	-	-	1	1.88
CO-4	3	3	3	2	2	2	2	1	-	-	-	2	2.22
<b>Average</b>	<b>2.5</b>	<b>2.5</b>	<b>2</b>	<b>2</b>	<b>1.5</b>	<b>2</b>	<b>1.75</b>	<b>1</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>1.5</b>	

## Air and Noise Pollution and Control

COURSE CODE:18B1WCE533

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

### Course Objectives:

1. Learn history of air pollution, definition of air pollution, and source and classification of air pollution.
2. Learn the effects of air pollutants on human health, vegetation and materials and major control devices to control air pollution problems.
3. Learn dispersion phenomenon of air pollutants covering diffusion and advection, meteorological components, stability of atmosphere and corresponding plume shapes.
4. Learn an overview of noise pollution including methods for prevention, control, measures and management of the pollution.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Learn the air pollution issues and characterize the elements of air pollution.	Familiarity
CO-2	Solve and design complex problems related to dispersion and air quality modeling.	Assessment
CO-3	Apply relevant techniques and methods for control and prevention of air pollution.	Assessment
CO-4	Develop an overview understanding of the strategies, regulations and policies to manage air and noise pollution.	Familiarity

### Course Contents:

Unit	Contents	Lectures required
1	<b>Introduction:</b> The earth's atmosphere: structure and composition.	3
2	<b>Definition and Elements:</b> Air pollution: definitions: types of pollutants, sources; effect of air pollution on health, environment and materials; air pollution episodes.	5
3	<b>Meteorology:</b> Air pollution meteorology: atmospheric circulation patterns, atmospheric stability and vertical mixing, lapse rate and temperature inversions.	6
4	<b>Dispersion Modelling:</b> Atmospheric dispersions modelling: atmospheric stability classes, Gaussian model, estimation of downwind concentrations, plume rise, tall stacks, and critical wind speed.	8
5	<b>Control of Particulate Matters:</b> Control of particulate Matter:	6

	characteristics of particles drag force, impaction, interception and diffusion. Cyclones, Electrostatic precipitators, Fabric filter, Particulate scrubbers, spray-chambers, cyclone spray chambers, orifice and wet-impingement scrubbers, venturi and venture-jet scrubbers.	
<b>6</b>	<b>Control of Gaseous Emissions:</b> Control of gaseous emissions: gas- liquid and gas solid equilibrium, solubility, absorption and kinetics. Gas absorption: physical and chemical absorption, isotherms, and absorption potentials.	<b>6</b>
<b>7</b>	<b>Legislation and Regulations:</b> Air Pollution Control Act, National Environmental Policy Act, Ambient Air Quality Standards.	<b>4</b>
<b>8</b>	<b>Noise Pollution:</b> Noise pollution definition, prevention and control measures, management of pollution.	<b>4</b>
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

1. H.S. Peavy, D.R. Row and G. Tchobanoglous, Environmental Engineering, Mc Graw Hill International Edition.
2. Air Pollution, M. N. Rao and H.V.N. Rao, Tata Mc Graw Hill.
3. Wark, K., & Warner, C. F. (1981). Air pollution: its origin and control.

### Suggested Reference Book(s):

1. Atmospheric Pollution: History, Science, and Regulation, by Mark Z. Jacobson, Cambridge University Press, Cambridge, 2002.
2. Air Quality, by Thad Godish, 4th Edition, Lewis Publishers, 2003.
3. Atmospheric Chemistry and Physics, by John Seinfeld and Spyros Pandis, John Wiley & Sons, 1997.

### Other useful resource(s):

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105102089/>
2. Link to topics related to course: <https://nptel.ac.in/courses/105104099/>

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Air and Noise Pollution and Control)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	1	1	1	1	1	1	2	x	x	x	2	<b>1.33</b>
CO-2	2	3	3	3	3	2	x	1	2	1	x	1	<b>2.1</b>
CO-3	2	3	3	3	3	2	2	1	2	1	x	1	<b>2.1</b>
CO-4	2	1	1	2	1	1	2	2	2	1	1	2	<b>1.5</b>
<b>Average</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2.25</b>	<b>2</b>	<b>1.5</b>	<b>1.67</b>	<b>1.5</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>1.5</b>	

## Environmental Engineering Lab

COURSE CODE:18B17CE572

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

**Pre-requisite:** None

### Course Objectives:

1. Physical Characteristics of wastewater Sample.
2. Inorganic Constituents of wastewater Sample
3. Biological Characteristics of wastewater Sample.
4. Jar Test.
5. Judge the suitability of water for drinking purposes.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO1	Identify environmental problems arising due to engineering and technological activities and the science behind those problems.	Familiarity
CO2	Determination of various inorganic impurities in wastewater.	Assessment
CO3	Determine physical, chemical and biological characteristics of water and wastewater.	Assessment
CO4	Analyze material balance for different environmental systems.	Usage
CO5	Assess the quality of water and wastewater.	Usage

### List of Experiments:

S.No	Description	Hours
1	Determination of pH and Temperature of water and wastewater sample.	2
2	Determination of total solids, suspended solids and dissolved solids of water and wastewater sample.	2
3	Determination of specific conductivity of water and wastewater sample.	2
4	Determination of turbidity.	2
5	Determination of chlorides of water and wastewater sample.	2
6	Determination of type and extent of alkalinity of water and wastewater sample.	2
7	Determination of type and extent of acidity of water and wastewater sample.	2
8	Determination of temporary and permanent hardness.	2
9	Determination of optimum dose of coagulant.	2
10	Determination of Sulphates of water and wastewater sample.	2



<b>11</b>	Determination of Kjeldahl Nitrogen (Inorganic) of the sample.	<b>2</b>
<b>12</b>	Determination of dissolved oxygen.	<b>2</b>
<b>13</b>	Determination of Biological oxygen demand (BOD).	<b>2</b>
<b>14</b>	Determination of Chemical oxygen demand (COD).	<b>2</b>
<b>Total Lab hours</b>		<b>28</b>

**Suggested/Resources:**

1. Standard methods for the examination of water and wastewater. (2012). 21st Edition, Washington: APHA.
2. Sawyer, C. N., McCarty, P. L., and Perkin, G.F., Chemistry for Environmental Engineering and Science, 5th edition McGraw-Hill Inc., 2002.
3. Kotaiah, B., and Kumara Swamy, N., Environmental Engineering Laboratory Manual, Charotar Publishing House Pvt. Ltd., 1st Ed., 2007.
4. Mathur, R.P., Water and Wastewater testing: A laboratory Manual (2013).

**Evaluation Scheme:**

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Environmental Engineering Lab)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Average
CO1	3	3	3	3	2	2	1	1	1	1	1	1	<b>1.83</b>
CO2	3	3	3	3	3	1	1	1	1	1	1	3	<b>2.00</b>
CO3	3	3	2	3	2	3	2	1	1	1	2	1	<b>2.00</b>
CO4	3	3	3	2	3	2	1	1	1	1	1	1	<b>1.83</b>
<b>Average</b>	<b>2</b>	<b>2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	

## Design of Concrete Structures

COURSE CODE:18B11CE515

COURSE CREDITS: 4

CORE/ELECTIVE: CORE

L-T-P: 3-1-0

**Pre-requisite:** None

### Course Objectives:

1. To understand the design concepts of various structural elements using Limit state method and detailing of reinforcement
2. To understand the design of beam and slab using limit state method.
3. To learn the design and analysis of column in different loading cases.
4. To learn and understand different types of staircases.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To learn different design philosophies and material properties	Familiarity
CO-2	To design beam, slabs and columns	Assessment
CO-3	To design for shear, anchorage, bond and development length.	Assessment
CO-4	To learn different types of staircases and their design	Usage
CO-5	To learn for the design of torsion	Usage

### Course Contents:

Unit	Contents	Lectures required
1	Analysis and design of beams and slabs by Limit state method.	8
2	Limit state of collapse flexure, Limit state of doubly reinforced beam	8
3	Limit state of collapse: Shear	6
4	Design of Slabs: One way, two way and circular slabs	6
5	Design of columns: uniaxial bending, biaxial bending and eccentric column design	8
6	Types and design of different types of staircases	3
7	Design for torsion	3
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006.

**Suggested Reference Book(s):**

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006.

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/downloads/105105104/>
2. Link to topics related to course:
  - i. <https://nptel.ac.in/courses/106104019/1>
  - ii. <https://nptel.ac.in/courses/106104019/4>
  - iii. <https://nptel.ac.in/courses/106104019/26>
  - iv. <https://nptel.ac.in/courses/106104019/2Ev>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course outcomes (Design of Concrete Structures )	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	1.75
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	2
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	1.75

CO-4	2	3	3	3	2	1	1	1	2	3	2	2	<b>2.08</b>
CO-5	2	3	3	3	2	1	1	1	2	3	2	2	<b>2.08</b>
<b>Average</b>	<b>2</b>	<b>2.6</b>	<b>2.6</b>	<b>2.6</b>	<b>2.4</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2.4</b>	<b>1.6</b>	<b>2</b>	

# Highway Engineering

COURSE CODE:18B11CE511

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Surveying

**Course Objectives:**

1. To provide the students with an in-depth knowledge and understanding of the principles governing the geometric design of highways.
2. To develop an understanding of the construction procedure and material specifications of rigid and flexible pavements.
3. To provide them with an opportunity to apply the design procedures to a "real life" highway design & maintenance project.

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	The students will get a diverse knowledge of highway engineering practices applied to real life problems.	Familiarity
CO-2	The student will be able to design highway geometrics, vertical profile of road, factors controlling the alignment and explain sight distances, horizontal and vertical curves.	Assessment and Usage
CO-3	The student will be able to describe properties of highway materials, design flexible and rigid pavements and explain factors to be considered for various type of pavements.	Assessment
CO-4	The student will be able to understand the principles of construction and maintenance of highways	Familiarity and Usage
CO-5	The student will be able to design traffic signals, rotary intersections and prepare traffic management plans, traffic signs, define traffic volume, capacity, speed study and density.	Assessment and Usage

**Course Contents:**

<b>Unit</b>	<b>Contents</b>	<b>Lectures required</b>
<b>1</b>	Importance of transportation, different modes, characteristics & Scope of highway engineering in India.	<b>3</b>
<b>2</b>	Highway development in India, classification of roads, planning surveys, highway planning in India. Highway alignment, engineering surveys, drawings and report, highway projects, Preparation of DPR	<b>3</b>
<b>3</b>	Highway cross section elements, Sight distance, Design of horizontal & vertical alignment	<b>10</b>
<b>4</b>	Traffic characteristics, traffic studies & analysis, flow & roadway capacity, traffic regulation & control, design of road intersections, parking & pedestrian facilities, highway lighting	<b>4</b>
<b>5</b>	Materials used in highway construction, soil, stone aggregates, bituminous binders, bituminous paving mixes, Portland cement & cement concrete	<b>4</b>
<b>6</b>	Flexible pavements: components, functions, stresses, design methods, Rigid pavements: components, functions, factors affecting performance of CC pavements, stresses, design methods	<b>6</b>
<b>7</b>	General features of highway construction, embankment & subgrade, excavation of earth, construction of flexible & rigid pavements	<b>6</b>
<b>8</b>	Flexible & rigid Pavement failures, maintenance of bituminous surfaces, & cement concrete pavements, strengthening of existing pavements, overlay design by Benkelman beam deflection studies, Pavement maintenance management system.	<b>6</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Highway Engineering by \_A.K.Justo & S.K.Khanna‘ Nemchand Publ. Roorkee.(2017)
2. Transportation Engineering, An Introduction by \_C.JotinKhisty&B.KentLall; PHI,
3. IRC codes and Manuals

**Suggested Reference Book(s):**

1. Traffic engineering & transportation planning, L.R.Kadiyali, Khanna Publishers, Delhi (1997)
2. Traffic and Transportation engineering by \_Animesh Das and P. Chakraborty‘, PHI 3.Principles of Urban
3. Transportation System Engineering, B.G.Hutchinson‘, TMG, Publication
4. Principles and practices of Highway engg, L.R.Kadyali&N.B.Lal, , Khanna Publishers, Delhi (2006)
5. Principles of pavement design, Yoder.E.J.&witezac, John wiley&sons ,U.S.A

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes (2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Highway Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	3	2	2	1	2	3	2	2	3	2.42
CO-2	3	3	3	3	2	2	1	2	3	2	2	2	2.33
CO-3	3	3	3	2	2	2	1	2	2	2	2	3	2.25
CO-4	3	3	3	2	2	1	1	2	3	3	2	2	2.25
CO-5	3	2	3	3	3	1	1	3	3	3	3	2	2.5
Average	3	2.8	3	2.6	2.2	1.6	1	2.2	2.8	2.4	2.2	2.2	

## Highway Engineering Lab

COURSE CODE:18B17CE571

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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**Pre-requisite:** None

**Course Objectives:**

1. To provide a platform to undergraduate students for practical implementation of highway materials
2. To study the physical consensus and source properties of aggregate materials.
3. To measure and study the physical properties of bitumen.

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO1	Students will know the principles and procedures of testing Aggregates used in highways	Familiarity and Usage
CO2	Students will know the principles and procedures of testing bitumen used in highways	Familiarity and Usage
CO3	Student will know the techniques to characterize various pavement materials through relevant tests.	Familiarity and Usage
CO4	Students will be able to know the pavement maintenance techniques.	Familiarity and Usage

**List of Experiments:**

Unit	Contents	Lectures required
1	To determine the crushing value of road aggregates.	2
2	To determine the hardness (Abrasion) of aggregates by the Los Angles Abrasion test method.	2
3	To determine the toughness (impact value) of aggregates.	2
4	To determine the flakiness and elongation indices of the given aggregate sample.	2
5	To determine the Specific Gravity and water absorption of aggregate.	2
6	To determine the softening point of bitumen	2



7	To determine the ductility of bituminous material	2
8	To determine the penetration value of Bitumen	2
9	To determine the viscosity of bitumen	2
10	To determine the flash and fire point of given bitumen sample	2
11	To determine the specific gravity of bitumen	2
12	To determine the bitumen content of core sample by centrifugal extractor	2
13	To determine the optimum bitumen content using Marshall Mix Design Method	2
14	Demonstration of rebound deflection of pavement by Benkelman Beam	2
15	Demonstration of MERLIN to determine pavement roughness/unevenness	2
<b>Total no. of hours</b>		<b>30</b>

**Suggested Text Book(s):**

1. Highway Engineering Lab Manual by \_A.K.Justo & S.K.Khanna‘ Nemchand Publ.
2. Highway Engineering by S. K. Khanna &C.E.G.Justo.(2017).
3. IRC codes and Manuals

**Suggested Reference Book(s):**

1. Traffic engineering & transportation planning, L.R.Kadiyali, Khanna Publishers, Delhi (1997)
2. Traffic and Transportation engineering by \_Animesh Das and P. Chakraborty‘, PHI
3. Principles and practices of Highway engg, L.R.Kadyali&N.B.Lal, , Khanna Publishers, Delhi (2006)

**Evaluation Scheme:**

1	Mid Sem. Evaluation	20 Marks
2	End Sem. Evaluation	20 Marks
3	Attendance	15 Marks
4	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Highway Engineering Lab)</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>Average</b>
CO1	3	3	3	3	2	2	1	2	3	2	2	3	<b>2.42</b>
CO2	3	3	3	3	2	2	1	2	3	2	2	2	<b>2.33</b>
CO3	3	3	3	2	2	2	1	2	2	2	2	3	<b>2.25</b>
CO4	3	3	3	2	2	1	1	2	3	3	2	2	<b>2.25</b>
CO5	3	2	3	3	3	1	1	3	3	3	3	2	<b>2.5</b>
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.2</b>	<b>1.6</b>	<b>1</b>	<b>2.2</b>	<b>2.8</b>	<b>2.4</b>	<b>2.2</b>	<b>2.2</b>	

# Foundation Engineering

COURSE CODE:18B11CE514

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** Geotechnical Engineering

## Course Objectives:

1. To provide the students with an in-depth knowledge and understanding of the principles governing the design of foundation systems for structures.
2. To develop an understanding of the strength and settlement behavior of different kinds of foundations on different soils and their relative choice.
3. To provide them with an opportunity to apply the design procedures to a "real life" foundation design project.

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Identify the essential steps involved in a geotechnical site investigation and specify appropriate laboratory test procedures for the characterization of soil materials with respect to strength and compressibility.	Familiarity and Usage
CO-2	Identify the principal types of foundations and describe the factors governing the choice of the most suitable type of foundation for a given situation.	Familiarity
CO-3	Perform: (a) bearing capacity and, (b) settlement analyses for shallow foundations.	Assessment
CO-4	Evaluate (a) end bearing capacity and (b) skin friction for a given type of deep foundations and hence estimate their axial load capacity.	Assessment
CO-5	Prepare a geotechnical engineering report documenting procedures used and findings from site investigation, laboratory characterization of subsurface materials, analysis performed and final recommendations with regard to the optimum design of the foundations system.	Usage

**Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction:</b> Foundation requirement, types and selection of foundation	3
2	<b>Site Investigation and Soil Exploration Techniques:</b> Site Investigation and site survey, Dynamic method of site exploration, Geophysical methods	10
3	<b>Bearing capacity of shallow foundations:</b> Bearing capacity theories, Raft foundation; types, design principle of rigid raft foundation, Plate Load test	9
4	<b>Settlement of foundations:</b> Settlement considerations; allowable, total and differential settlements, estimation of settlement of structures	4
5	<b>Axially and eccentrically loaded footings</b>	4
6	<b>Pile foundation:</b> Types, pile load capacity, static and dynamic formulae, pile load test, pile groups; load capacity and settlement	6
7	<b>Well and Cassion foundation:</b> Introduction to well and cassion foundation, construction and bearing capacity calculation	6
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Geotechnical Engineering by Venkatrammaiah, New Age International Publishers
2. Basic and Applied soil Mechanics by Gopal Ranjan & Rao, New Age International Publishers
3. Soil Mechanics & Foundation Engineering by K R Arora, Standard Publishers New Delhi

**Suggested Reference Book(s):**

1. Foundation Engineering by E. Bowles,
2. Foundation Design and Construction by Tomlinson, Prentice Hall
3. Design Aids in Soil Mechanics & Foundation Engineering by Kaniraj, TMH
4. Geotechnical Engineering by S.K. Gulhati& Datta, TMH

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2

3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course outcomes (Foundation Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	3	2	2	1	2	3	2	2	3	2.42
CO-2	3	3	3	3	2	2	1	2	3	2	2	2	2.33
CO-3	3	3	3	2	2	2	1	2	2	2	2	3	2.25
CO-4	3	3	3	2	2	1	1	2	3	3	2	2	2.25
CO-5	3	2	3	3	3	1	1	3	3	3	3	2	2.5
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.2</b>	<b>1.6</b>	<b>1</b>	<b>2.2</b>	<b>2.8</b>	<b>2.4</b>	<b>2.2</b>	<b>2.2</b>	

# Concrete Technology

COURSE CODE:23B11CE411

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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**Pre-requisite:** None

## Course Objectives:

1. Learn concrete making materials including supplementary cementitious materials
2. Learn Concrete production process.
3. Learn concrete production process and properties and uses of concrete as a modern material of construction.
4. The courses will enable one to make appropriate decision regarding ingredient selection and use of concrete.

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Identify hydration mechanism and testing of concrete making materials.	Familiarity
CO-2	Understand the behavior of fresh and hardened concrete.	Assessment
CO-3	Understand the influence of chemical and mineral admixture.	Assessment
CO-4	Understand the mix design and durability requirements of concrete	Usage
CO-5	Understand the need for special concretes	Usage

## Course Contents:

Unit	Contents	Lectures required
1	<b>Cement:</b> Production, composition, and properties; cement chemistry; Types of cements; special cements.	8
2	<b>Aggregates:</b> Mineralogy; properties, tests and standards	8
3	<b>Chemical and mineral admixtures:</b> Water reducers, air entrainers, set controllers, specialty admixtures - structure properties, and effects on concrete properties. Introduction to supplementary cementing materials and pozzolans. Fly ash, blast furnace slag, silica fume, and metakaolin - their production, properties and effects on concrete properties. Other mineral additives - reactive and inert.	6
4	<b>Concrete mix design:</b> Basic principles; IS method; ACI method; new approaches based on rheology and particle packing.	6
5	<b>Concrete Production &amp; Fresh concrete:</b> Batching of ingredients; mixing, transport, and placement. Consolidation, finishing, and curing	4

	of concrete; initial and final set - significance and measurement. Workability of concrete and its measurement	
6	<b>Engineering properties of concrete:</b> Compressive strength and parameters affecting it. Tensile strength - direct and indirect; Modulus of elasticity and Poisson's ratio. Stress strain response of concrete.	6
7	<b>Dimensional stability and durability:</b> Creep and relaxation - parameters affecting; Shrinkage of concrete - types and significance. Parameters affecting shrinkage; measurement of creep and shrinkage.	4
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

1. A.M.Neville, -Properties of Concrete, English Language Book Society/Longman Pub, 1988.
2. P.K.Mehta and J.M.M.Paulo, —Concrete – Microstructure – Properties and Material, ICI, Indian First Edition, Reprint 1999.
3. Zonghjin Li, —Advanced Concrete Technology, John Wiley & Sons, INC, Newjersy, 2011l.

### Suggested Reference Book(s):

1. Taylor, H. W. F., \_Cement Chemistry, ' Academic Press, Inc., San Diego, CA, 1990.
2. Lea, F. M., \_The Chemistry of Cement and Concrete, ' Chemical Publishing Company, Inc., New York, 1971.
3. Mindess, S., and Young, J. F., \_Concrete, ' Prentice Hall, Inc., NJ, 1981.  
J. Newman and B. S. Choo, Eds., \_Advanced Concrete Technology', Four Volume Set, Elsevier, 2003

### Other useful resource(s):

1. Link to NPTEL course contents: [https://onlinecourses.nptel.ac.in/noc18\\_ce21/](https://onlinecourses.nptel.ac.in/noc18_ce21/)

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Concrete Technology )</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	3	1	2	1	1	3	1	1	2		2	3	<b>1.81</b>
CO-2	1	2	1	2	2	1		2	3	3	1	3	<b>1.91</b>
CO-3	3	3	3	2	1	1	2	3	2		1	3	<b>2.18</b>
CO-4	3	2	1	3	1	2		1	3	2	3	3	<b>2.18</b>
CO-5	2	3	3	3	1	3		1	2	2	3	3	<b>2.36</b>
<b>Average</b>	<b>2.4</b>	<b>2.2</b>	<b>2</b>	<b>2.2</b>	<b>1.2</b>	<b>2</b>	<b>1.5</b>	<b>1.6</b>	<b>2.4</b>	<b>2.33</b>	<b>2</b>	<b>3</b>	



## Advanced Structural Analysis

COURSE CODE:18B1WCE631

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Structure Analysis

### Course Objectives:

1. To impart the knowledge of matrix method to solve determinate and indeterminate structure.
2. To provide basic knowledge of moving loads and influence line.
3. To learn how different design software use matrix method.
4. To learn basics of finite element method.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	The students will be able to solve basic determinate and indeterminate problems from matrix method by using hand calculation.	Assessment
CO-2	Student will able to visualize the principle on which design software works.	Assessment
CO-3	Student will able to determine design loads for a given cross section of structure.	Assessment
CO-4	Student will come to know why earlier methods used for solving indeterminate structure are discarded in this era.	Usage
CO-5	Student will learn basic concept on which Finite Element Method works.	Usage

### Course Contents:

Unit	Contents	Lectures required
1	<b>Introduction:</b> Revision of basics of structure analysis	2
2	<b>Kani's Method:</b> Kani's method to analyze simple portal frames	5
3	<b>Flexibility Method:</b> Derivation of flexibility method, compatibility equation and its application on truss, beams and frames, Flexibility matrix Method.	10
4	<b>Influence Line:</b> Influence line for indeterminate structures, Influence lines for indeterminate beams using Muller Breslau principle. Influence lines for arches and stiffening girders.	8
5	<b>Stiffness Method:</b> Degree of freedom, Derivation of stiffness matrix, transformation matrix for 2d beam, truss and frame, matrix solution for beam, truss and frame.	12
6	<b>Approximate Analysis of frames:</b> Approximate analysis of frames	5

Approved in Academic Council held on 28 June 2023

	for vertical loads and horizontal loads on it.	
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Devdas Menon: Advanced Structural Analysis, Narosa, 2009
2. Ashok kumar Jain: Advanced Structural Analysis, 3rd Edition, Nem Chand & Bros, 2015

**Suggested Reference Book(s):**

1. Aslam Kassimali: Matrix Analysis of Structure, 2nd Edition, Cengage Learning, 2012.
2. C.K, Wang: Intermediate Structural Analysis, 7th Ed., Mc Graw Hill, 2008

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105106050/#>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Advanced Structural Analysis)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	3	3	1	2	2	1	3	3	1	1	2.0
CO-2	2	3	3	2	2	3	2	1	2	1	1	3	2.1
CO-3	3	2	2	2	1	3	1	1	2	2	2	3	2.0
CO-4	3	3	3	2	2	3	2	2	1	1	1	2	2.1
CO-5	3	3	3	2	0	2	1	1	2	1	2	3	1.9
<b>Average</b>	<b>2.8</b>	<b>2.6</b>	<b>2.8</b>	<b>2.2</b>	<b>1.2</b>	<b>2.6</b>	<b>1.6</b>	<b>1.2</b>	<b>1.8</b>	<b>1.6</b>	<b>1.4</b>	<b>2.4</b>	

## Pavement Analysis and Design

COURSE CODE:18B1WCE632

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

### Course Objectives:

1. To develop skills in conducting analysis of pavements by calculating the response due to vehicular loading
2. To perform design of rigid and flexible pavements based on traffic and environmental factors
3. To develop skills in engineering economics (especially life-cycle cost calculations for alternative designs)
4. To develop basic understanding of the principles of pavement management

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	The students will have the opportunity to develop several designs of pavement structures throughout the semester.	Familiarity
CO-2	Through discussion of the topic of pavement management, the students gain an appreciation for the constantly changing nature of engineering decision-making and the impacts of various decisions on an infrastructure network.	Assessment
CO-3	Students will analyze traffic and geotechnical data from real-life projects and theoretical examples.	Assessment
CO-4	The students are required to complete a semester design problem and present their findings to the instructor and other students.	Assessment

### Course Contents:

Unit	Contents	Lectures required
1	<b>Advanced Pavement materials:</b> Waste materials: types, uses in flexible pavement, effect and benefit of utilization of waste material, advance pavement material, Design of bituminous mixes by Marshal method, modified Hubbard –field method, Hveem method, etc.	8
2	<b>Flexible pavement design:</b> Basis of pavement design, Development of various design methods for Highway and Airport Pavements. Layered system concept, Classical methods, Mechanistic-Empirical Method and various damage models, pavement failure study: factors responsible for pavement failure, stress-strain behavior, Current practices in India and across the world.	8
3	<b>Rigid pavement design:</b> Analysis and design parameters, design of slab,	6

	spacing of joints, dowel bars, tie bars and joint details, pavement failure study: factors responsible for pavement failure, stress-strain behavior.	
<b>4</b>	<b>Overlays:</b> Types of overlays, Overlay design, Pavement Evaluation	<b>6</b>
<b>5</b>	<b>Design Software:</b> FPAVE, MXRoads, etc.	<b>8</b>
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

- 1 Yoder, E.J. and Witczak, M.W., —Principles of Pavement Design 2nd Edl, John Wiley & Sons, Inc. (1975)
- 2 O'Flaherty, A. Coleman, -Highways : the Location, Design, Construction and Maintenance of Road Pavementsl, 4th Ed., Elsevier (2006)
- 3 Fwa, T.F., -The Hand Book of Highway Engineeringll, CRC Press Taylor &Francies Group, 2006.
- 4 Khanna, S.K. and Justo, C.E.G., —Highway Engineering Nem Chand Jain & Bros, 2005.
- 5 Papagiannakis, A.T. and Masad, E.A., -Pavement Design and Materials, John Wiley & Sons Inc, 2008.

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Pavement Analysis and Design)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	3	2	2	2	3	2	2	2	2	2.17
CO-2	2	3	2	3	3	1	2	2	2	2	2	2	2.17
CO-3	2	2	2	2	3	1	2	1	2	2	2	2	1.92
CO-4	2	3	2	3	2	2	2	1	2	3	2	2	2.17
<b>Average</b>	<b>2</b>	<b>2.5</b>	<b>2</b>	<b>2.75</b>	<b>2.5</b>	<b>1.5</b>	<b>2</b>	<b>1.75</b>	<b>2</b>	<b>2.25</b>	<b>2</b>	<b>2</b>	

# Industrial Wastewater Treatment

COURSE CODE:18B1WC633

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

## Course Objectives:

1. Learn to understand the basic fundamentals for treatment of industrial wastewater systems and the associated management strategies for its implementation.
2. Learn about the operations of the industrial wastewater treatment plant and the fundamental scientific principles involved in the treatment process.
3. Learn to design the unit operations and unit processes for treatment of industrial wastewaters.
4. Learn to design the physico-chemical and biological treatment systems for treatment of industrial wastewaters.

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To study the fundamentals of utilization of water by different industries and the different pollutants generated in the industrial wastes.	Familiarity
CO-2	To understand the fundamentals of prevention and the control of the pollutants generated in the industrial wastes.	Assessment
CO-3	To study the fundamentals of the treatment of industrial wastes generated including physico-chemical process and biological processes	Assessment
CO-4	To understand the advanced techniques for treatment of industrial wastewater	Assessment
CO-5	To involve case studies for the different manufacturing units and their respective treatment processes for different industries	Usage

## Course Contents:

Unit	Contents	Lectures required
1	Classification of different industrial wastes (like soluble organics, suspended solids, acid/alkali, thermal discharge, inorganics, coloring substances, nutrients, heavy metal etc.) Industrial Waste Survey (possibility of minimization, variation of flow and characteristics, possibility of water conservation and reuse, strength to undergo)	10
	difference wastes like process, cooling, sanitary and in plant wastes.	

2	Techniques for ascertaining character (grab sample, composite sample etc), Neutralization (equalization basin, limestone bed, limestone tower) Equalizations Basin (objective, function, design principles), Flootation technique (gravity and DAF methods).	12
3	Heavy metals (discussion and removal techniques), Cementation/Recovery techniques, chemical oxidation (chlorine, ozone, hydrogen peroxide)	7
4	Biological Treatment of Organic Matter (ASP, TF, SBR, Lagoon, Anaerobic System), fundamentals of anaerobic process	13
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

1. Eckenfelder, W.W. Jr., Industrial Water Pollution Control, 3rd Edition, McGraw Hill International Edition, Singapore, 2000.
2. Arceivala, S.J., Wastewater Treatment for Pollution Control, 2nd Edition, Tata McGraw Publishing Co. Ltd., New Delhi, 1998.

### Suggested Reference Book(s):

1. H. Peavy, D. Rowe, G. Tchobanoglous "Environmental Engineering", 1<sup>st</sup> Edition, McGraw Higher Education Publications, India, 2017.
2. Metcalf and Eddy Inc: Wastewater Engineering: Treatment and Resource Recovery, 4<sup>th</sup> Edition, McGraw Hill Publications. India, 2014.

### Other useful resource(s):

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105106119/36>

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus

4.	Minor Project	25	Entire Semester	Students will present a case study on manufacturing and treatment of wastes generated from surrounding different industries
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#### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Industrial Wastewater Treatment)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	3	1	2	2	3	1	1	2	1.92
CO-2	3	2	3	3	1	2	2	2	2	1	2	2	2.08
CO-3	3	2	3	3	1	1	3	2	2	3	1	2	2.17
CO-4	2	3	3	2	2	2	1	1	1	3	2	2	2.00
CO-5	3	2	2	1	2	2	1	2	3	3	2	2	2.08
<b>Average</b>	<b>2.6</b>	<b>2.2</b>	<b>2.6</b>	<b>2.2</b>	<b>1.8</b>	<b>1.6</b>	<b>1.8</b>	<b>1.8</b>	<b>2.2</b>	<b>2.2</b>	<b>1.6</b>	<b>2</b>	

## Design of Steel Structures

COURSE CODE:23B11CE612

COURSE CREDITS:

3 CORE/ELECTIVE:

CORE L-T-P: 3-0-0

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Pre-requisite: Mechanics of Solids

Course Objectives:

1. Learn to analyze algorithms for Time and Space Complexity
2. To provide a basic understanding of the mechanical properties and types of steels used in civil structures, and to develop technical competence in the design of tension and compression members, beams, and simple bolted and welded connections.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Design bolt and weld connections.	Familiarity
CO-2	Design tension and compression members.	Assessment
CO-3	Design beams and beam columns.	Assessment
CO-4	Design built up members and column base.	Usage
CO-5	Design of Plate Girder and steel truss.	Usage

Course Contents:

Unit	Contents	Lectures required
1	<b>Introduction:</b> General- Types of Steel – Mechanical behavior of steel – Measures of Yielding – Measures of Ductility – Types of Structures – Structural Steel Sections.	2



2	<b>Methods of Structural design:</b> Introduction-Design Philosophies- Working Stress method-Ultimate Strength method-Load and Resistant factor- Limit State Method-Partial safety factor-Load-Load combinations-Classification of Cross sections- General aspects in the design.	2
3	<b>Design of Steel fasteners:</b> Types of fasteners – Riveted connections- Bolted connections- Assumptions- Failure of bolted joints – Strength of bolted joints – Design examples – Design of Welded connections – Butt weld- fillet weld – Design examples. <b>Design of Eccentric Connections:</b> Design of Brackets- Type-1 and Type 2 – Moment Resistant connections - Design Examples	8
4	<b>Design of Tension Members:</b> General – Modes of Failure of Tension member- Analysis of Tension members- Example - Design steps – Design examples – Lug angles – Design.	6
5	<b>Design of Compression Members:</b> Modes of Failure of a Column, Buckling Failure: Euler’s Theory, Effective Length, Slenderness Ratio, Design Formula: I.S. Code Formula, Design of Compression Members, Design of Built-Up Compression Members: Laced and Battened Columns	6
6	<b>Design of Beams:</b> General- Lateral Stability of Beams- Bending Strength of Beams – Plastic Section Modulus - Design Examples	4
7	<b>Design of Beam Columns:</b> Behavior of members under combined loading – Modes of Failures – Design Examples.	4
8	<b>Design of Column Splices and Column Base:</b> Design of Column Splice-Design Examples, Slab Base- Gusseted Base- Design Examples	4
9	<b>Design of Plate Girder:</b> General- Components of Plate Girder- Optimum depth – Bending Strength – Shear Strength – Shear Buckling- Simple Post critical method- Tension Field method- Stiffeners-Bearing- Transverse stiffeners - Design Examples.	4
10	<b>Design of steel truss:</b> General - components of steel truss, design of purlins, moment resisting frames.(added)	2
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Design of steel structures – N Subramanian, Oxford University Press – 2009.
2. Limit State Design of steel structures, S.K. Duggal, Tata McGraw- Hill, 2010.
3. IS - 800:2007.
4. IS – 808:1989.

**Suggested Reference Book(s):**

1. Design of Steel structures by K.S. Sai Ram, Person Education.

- Design of Steel Structures Edwin H. Gaylord, Jr. Charles N. Gaylord and James Stallmeyer Tata McGraw-Hill Education Pvt. Ltd.
- Design of Steel Structures Vol. 1 & 2 – Ramchandra, Standard Publications.
- Design of steel structures, Structures, S.S. Bhavikatti, IK int Publication House, New Delhi, 2010.

**Other useful resource(s):**

- Link to NPTEL course contents:<https://nptel.ac.in/courses/105106112/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (10) - 10 Quizzes(2) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes(POs)**

Course Outcomes (Design of Steel Structures)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	1.75
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	2
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	1.75
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	2
CO-5	3	2	3	3	2	3	2	1	2	2	3	3	2.4
<b>Average</b>	<b>2.2</b>	<b>2.4</b>	<b>2.6</b>	<b>2.6</b>	<b>2.4</b>	<b>1.4</b>	<b>1.2</b>	<b>1</b>	<b>2</b>	<b>2.2</b>	<b>1.8</b>	<b>2.2</b>	

## Transportation Engineering

COURSE CODE:18B1WCE634

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Highway Engineering

### Course Objectives:

1. To learn the fundamentals of railways, airways, water ways & other minor modes of transportation modes. .
2. To provide the students with an in-depth knowledge and understanding of the principles governing the geometric design of railways.
3. To develop an understanding of the concepts related to airport planning & design.
4. To provide fundamental concepts of harbor engineering and other modes of transportation.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To know about the basics and scope of various components of railway and airport engineering.	Familiarity
CO-2	To be able to design the basic elements of railway and airport.	Assessment and Usage
CO-3	To enable the students to apply existing technology to the design, construction, and maintenance of railway physical facilities.	Assessment
CO-4	To learn about the aircraft characteristics, planning and components of airport.	Familiarity and Usage
CO-5	To study about the types and components of docks and harbours.	Familiarity

### Course Contents:

Unit	Contents	Lectures required
1	History of railways in India, alignment and project reports, permanent way and track materials, geometric design, railway points and crossings and junction, track laying, track drainage, station yards, maintenance of track.	14
2	Development of air transport in India ,airport planning, airport design standards, terminal lay out & classification, Design of airport pavements, drainage, marking & lighting, heliports, air traffic control, air cargo, accidents in the air, maintenance of air ports .	13

3	Historical development in India , tides, winds & waves, docks, harbours, break waters, jetties, landing stages & wharves, dry docks, transit sheds, cargo handling, , inland water transport. Maintenance.	9
4	Pipelines, elevators, belt conveyors, aerial rope ways, & under sea transportation.	6
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

1. Railway engineering, Subhash.C.Saxena & Satyapal Arora, Dhanpat rai & sons,
2. Railway, Airport and Harbour Engineering, K.P. Subramanian, Scitech Publication
3. Railways, bridges & tunnels, Vazirani. V.N, Chandola.S.P, Khanna publications, New Delhi

### Suggested Reference Book(s):

1. Airport planning & design, Khanna .S.K, Neem chand publications, Roorkee,
2. Docks & harbors, Levison Francis, Clarendon press,

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Transportation Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	3	2	2	1	2	3	2	2	3	2.42
CO-2	3	3	3	3	2	2	1	2	3	2	2	2	2.33
CO-3	3	3	3	2	2	2	1	2	2	2	2	3	2.25
CO-4	3	3	3	2	2	1	1	2	3	3	2	2	2.25
CO-5	3	2	3	3	3	1	1	3	3	3	3	2	2.5
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.2</b>	<b>1.6</b>	<b>1</b>	<b>2.2</b>	<b>2.8</b>	<b>2.4</b>	<b>2.2</b>	<b>2.2</b>	

Approved in Academic Council held on 28 June 2023

# Traffic Engineering

COURSE CODE:18B1WCE634

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Highway Engineering

## Course Objectives:

1. To have an overall knowledge of the traffic performance on roads through systematic traffic studies
2. To develop a strong knowledge base of traffic regulation, control and its management in any transportation area.
3. To provide knowledge of traffic control devices and its design techniques in transportation interaction

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	The students will be able to understand the importance of traffic engineering in the field of transportation.	Familiarity
CO-2	The student will be able to understand the various traffic components, traffic characteristics, traffic studies & analysis	Familiarity and Usage
CO-3	The student will be able to understand the fundamental principles of traffic flow, roadway capacity, level of service.	Familiarity and Usage
CO-4	The student will be able to understand highway safety operations, traffic regulations and control, road markings.	Familiarity and Usage
CO-5	The student will be able to design traffic signals, rotary intersections and prepare traffic management plans.	Assessment and Usage

## Course Contents:

Unit	Contents	Lectures required
1	Importance of traffic engineering, scope of traffic engineering, traffic characteristics-road user characteristics, vehicular characteristics, Max dimensions and weights of vehicles allowed in India, Effects of traffic characteristics on various design elements of the road.	4

2	Traffic Engineering Studies and Analysis- Traffic volume studies, spot speed studies, speed & delay studies, origin & destination studies, parking studies, their objectives, methods & data presentation, accident studies- Accident surveys. Causes of road accidents and preventive measures.	8
3	Capacity and Level of Service: Fundamental diagram of traffic flow, Relationship between speed, volume and density, Level of service, PCU, Design service volume, Capacity of non-urban roads, IRC recommendations, Brief review of capacity of urban roads.	8
4	Traffic Regulation and control Devices- Traffic control devices: signs, signals, markings and islands. Types of signs, Types of signals. Design of signals, Intersections at grade and grade separated intersections, Design of a rotary, Types of grade separated intersections.	12
5	Design of Parking Lighting and Terminal Facilities: Parking surveys. On street parking, off street parking.	5
6	Traffic Regulation: Need and scope of traffic regulations. Regulation of speed, vehicles and drivers, General traffic regulations, Motor vehicle Act, Scope of traffic management, traffic planning and management.	5
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

1. Principles of Transportation Engineering by Chakroborty & Das, Prentice Hall, India.
2. Highway Engg by S.K.Khanna & C.E.G. Justo, Nem Chand Bros., Roorkee.(2017)
3. Traffic Engg and Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
4. Principles of Transportation and Highway Engineering by G.V.Rao, Tata McGraw-Hill Publishing Co. Ltd.

### Suggested Reference Book(s):

1. Traffic Engg. by Matson, T.M., Smith, W.S. and Hurd, F.W, McGraw- Hill Book Co., New York.
2. Traffic Flow Theory. By Drew, D.R., McGraw- Hill Book Co., New York.
3. Basic Statistics - Simpson and Kafks; Oxford and IBH Calcutta, 1969.
4. Fundamentals of Mathematical Statistics – Gupta, S.C and Kapoor, K.V.Sultanchand

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2

3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Traffic Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	3	2	2	1	2	3	2	2	3	2.42
CO-2	3	3	3	3	2	2	1	2	3	2	2	2	2.33
CO-3	3	3	3	2	2	2	1	2	2	2	2	3	2.25
CO-4	3	3	3	2	2	1	1	2	3	3	2	2	2.25
CO-5	3	2	3	3	3	1	1	3	3	3	3	2	2.5
<b>Average</b>	<b>3</b>	<b>2.8</b>	<b>3</b>	<b>2.6</b>	<b>2.2</b>	<b>1.6</b>	<b>1</b>	<b>2.2</b>	<b>2.8</b>	<b>2.4</b>	<b>2.2</b>	<b>2.2</b>	

## Highway Construction, Maintenance and Management

COURSE CODE:18B1WCE636

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

### Course Objectives:

1. To enhance / develop the skills of professionals working in construction and allied sectors to upgrade their skills in construction contracts management and help them to grow in their career.
2. To perform different method of construction for rigid and flexible pavements based on traffic and environmental factors.
3. To understand the different method of pavement repairing and maintenance.
4. To develop basic understanding of the principles of pavement management.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Students will come to know about the types, working and importance of pavement in different condition (i.e. level or hilly terrain).	Familiarity
CO-2	Through discussion of the topic of highway construction, the students gain an appreciation for the methods and different steps involved in pavement construction.	Assessment
CO-3	Students will analyze different factors which affect the performance of pavement (i.e. environmental or traffic factor) from real-life projects and theoretical examples.	Assessment
CO-4	Students will become familiar with the different methods of pavement maintenance.	Assessment

### Course Contents:

Unit	Contents	Lectures required
1	<b>Highway Construction:</b> Introduction, history of road construction, equipments for the road construction, stages of construction, limitations in pavement construction due to weather. Earthwork: Clearing and grubbing, excavation, embankment construction, replacement of soils, soil stabilization and their types.	8



<b>2</b>	<b>Flexible and Rigid pavement construction:</b> Flexible Pavement: different layers system and their specifications, defects in flexible pavement and their remedies, different types of pavements (i.e. dense bitumen macadam, water bound macadam etc.) and their specifications, different tests for bitumen. Rigid pavement: layer system and specifications, concrete surfacing, provision of different type of joints in rigid pavement, current practices for rigid pavement construction.	<b>8</b>
<b>3</b>	<b>Highway Maintenance:</b> General, distress in pavements (Cracking, patching, rutting, pot holes, stripping and swelling), evaluation of pavement, structural evaluation, pavement maintenance.	<b>6</b>
<b>4</b>	<b>Introduction to Transport Economics:</b> Recycling of pavements: Introduction, selection of road for recycling, methods and equipments for recycling.	<b>6</b>
<b>5</b>	<b>Hill Roads:</b> Alignment, geometrics, design and construction for hill roads, drainage design, maintenance problems in hill roads, slope stability in hill roads, different factors responsible for pavement failure.	<b>8</b>
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

- 1 Hass, R., Hudson, W.R. and Zaniewski, J. –Modern Pavement Management|| Krieger, 1994.
- 2 Fwa, T.F., –The Hand Book of Highway Engineering||, CRC Press, Taylor &Francies Group, 2006.
- 3 Shain, M.Y., —Pavement Management for Airports, Roads and Parking Lots||, Kluwer Academic Publishers Group, 2004.
- 4 Khanna, S.K. and Justo, C.E.G., —Highway Engineering|| Nem Chand & Bros, Roorkee (U.A.) 8<sup>th</sup> Ed, 2005.
- 5 Hudson, W.R., Haas, R. and Uddin, W., –Infrastructure Management||, McGraw Hill, 1997.

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Highway Construction, Maintenance and Management)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	3	2	2	2	2	1	2	2	3	3	2	2.17
CO-2	3	3	3	2	3	3	1	3	2	3	2	2	2.5
CO-3	2	2	2	2	3	2	1	2	2	2	2	2	2
CO-4	3	3	3	3	2	2	1	2	2	2	3	2	2.33
<b>Average</b>	<b>2.5</b>	<b>2.75</b>	<b>2.5</b>	<b>2.25</b>	<b>2.5</b>	<b>2.25</b>	<b>1</b>	<b>2.25</b>	<b>2</b>	<b>2.5</b>	<b>2.5</b>	<b>2</b>	

## Advanced Concrete Technology

COURSE CODE:18B1WCE637

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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**Pre-requisite:** Concrete Technology

### Course Objectives:

1. To prepare the graduates as best civil engineers with an excellent comprehension of fundamentals of concrete structure at micro and macro levels and applications of different types of cement and concretes.
2. To study the mechanism, effect and optimization of dosage of mineral and chemical admixtures to produce Ultra high strength concrete.
3. Study and understand the procedure of mix design for production of ultra-high strength concrete by the use of particle packing concepts.
4. To study the mixing techniques with mineral and chemical admixture to produce polymer concrete and ultra high strength concrete
5. To understand the fundamentals of self-compacting concrete and its testing for different properties.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To study the basic fundamentals, classifications and applications of polymer concrete, fiber reinforced concrete.	Familiarity
CO-2	To study the mechanism, effect and optimization of dosage of mineral and chemical admixtures to produce Ultra high strength concrete.	Assessment
CO-3	Study and Understand the procedure of mix design for production of ultra high strength concrete by the use of particle packing concepts.	Assessment
CO-4	To study the mixing techniques with mineral and chemical admixture to produce polymer concrete and ultra high strength concrete.	Usage
CO-5	To understand the basic fundamentals of self compacting concrete and its testing for different properties.	Usage

**Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction:</b> Introduction to polymer concrete- its classification and applications.	14
2	<b>Ultra high strength concrete:</b> basic fundamentals. Types, application and production.	4
3	<b>Mix design of Polymer concrete and UHPC:</b> Introduction of particle packing concept, optimization of granular mixture and how to design for a mixture to increase the homogeneity of the mixture.	8
4	<b>Self compacting concrete:</b> Mix design, testing, production and application.	4
5	<b>Mineral and chemical admixtures:</b> Optimization and selection of a particular type of mineral and chemical admixture.	12
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. A.M.Neville, –Properties of Concrete, English Language Book Society/Longman Pub, 1988
2. P.K.Mehta and J.M.M.Paulo, —Concrete – Microstructure – Properties and Material, ICI, Indian First Edition, Reprint 1999.

**Suggested Reference Book(s):**

1. Zonghjin Li, —Advanced Concrete Technology, John Wiley & Sons, INC, Newjersey, 2011.
2. A.R. Santhakumar, —Concrete Technolgy, Oxford University press, New Delhi, 2009.
3. N.Krishna Raju, —Design of Concrete Mix, CBS Pub., 1985.
4. Taylor, H. W. F., \_Cement Chemistry, Academic Press, Inc., San Diego, CA, 1990.
5. Lea, F. M., \_The Chemistry of Cement and Concrete, Chemical Publishing Company, Inc., New York, 1971.
6. Mindess, S., and Young, J. F., \_Concrete, Prentice Hall, Inc., NJ, 1981. J. Newman and B. S. Choo, Eds., \_Advanced Concrete Technology, Four Volume Set, Elsevier, 2003

**Other useful resource(s):**

1. Link to NPTEL course contents: [https://onlinecourses.nptel.ac.in/noc18\\_ce21/](https://onlinecourses.nptel.ac.in/noc18_ce21/)

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus

4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5
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**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Advanced Concrete Technology)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	1	2	1	1	3	1	1	2	2	3	3	<b>1.92</b>
CO-2	1	2	3	2	2	1	2	3	3	1	3	2	<b>2.08</b>
CO-3	3	3	3	2	1	1	2	3	2	2	3	2	<b>2.25</b>
CO-4	3	2	1	3	1	2	3	3	2	3	3	2	<b>2.33</b>
CO-5	2	3	3	3	1	3	1	2	2	3	3	2	<b>2.33</b>
<b>Average</b>	<b>2.4</b>	<b>2.2</b>	<b>2.4</b>	<b>2.2</b>	<b>1.2</b>	<b>2</b>	<b>1.8</b>	<b>2.4</b>	<b>2.2</b>	<b>2.2</b>	<b>3</b>	<b>2.2</b>	

# Underground Technology

COURSE CODE:18B1WCE638

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Geotechnical Engineering and Foundation Engineering

## Course Objectives:

1. To impart the knowledge of recognizing the diversity and complexity of underground excavations and associated works such as foundation construction.
2. To provide guidance for support selection of underground openings which is dependent upon the ground conditions, excavation size and shape and excavation method employed.
3. To inculcate the understanding of ground improvement and develop knowledge of different ground improvement techniques.
4. To understand, analyze and design flexible retaining structures
5. To provide knowledge of tunneling and various aspects of tunnel engineering.

## Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Determine the conditions and structures required for underground structure.	Familiarity
CO-2	Stabilize excavation for underground construction using sheet piles, anchored bulkheads, management of ground water conditions and apply dewatering methods.	Assessment
CO-3	Design and understand the construction methodology of deep foundation, analyze side - support systems for underground excavations.	Assessment
CO-4	Solve problems related to required ground conditions, side – support system, lining and design tunnels with its various components.	Usage
CO-5	Understand the construction methodologies for side - support system required for underground excavation , coffer dams, caissons, wells, basement and tunnel construction.	Usage

## Course Contents:

Unit	Contents	Lectures Required
1	<b>Introduction:</b> Introduction to various underground structures, Underground construction methodology & equipments.	5
2	<b>Underground construction:</b> Excavations, soil support methods, diaphragm walls, reinforced earth.	5

3	<b>Ground Water management:</b> Management of groundwater, dewatering methods Cofferdams, Caisson & wells.	6
4	<b>Permanent Support and Temporary Support system:</b> Methods of Basement construction, bracing system.	8
5	<b>Ground Improvement:</b> Grouting, In – situ Densification: Preloading, Compaction Grouting, Dynamic Compaction, Blast densification, Vibro–Compaction and Vibro–Replacement, Compaction piles, Reinforcement of embankments and foundations.	6
6	<b>Tunnels:</b> Introduction, Tunnel stabilization and lining, Cut and Cover Tunnels, Bored Tunnels, Immersed Tube Tunnels, Water Conveyance Tunnels, Micro-tunnels.	6
7	<b>Underground Conduits:</b> Ditch Conduits, Positive Projecting Conduits, Negative Projecting Conduits, Imperfect Ditch Conduits, Tunneled Conduits.	6
<b>Total lectures</b>		<b>42</b>

#### Suggested Text Book(s):

1. Geotechnical Engineering by Gulati and Dutta (TMH)
2. Tunnel Engineering Handbook edited by Bickel, Kuesel and King

#### Suggested Reference Book(s):

1. Foundation Engineering Handbook, edited by Winterkorn & Fang
2. Construction technology by Roy Chudley& Roger Green
3. Advance Construction Technology by Roy Chudley& Roger Green
4. Railway Bridges and Tunnels by Vazirani and Chandola

#### Other useful resource(s):

1. Link to NPTEL course content: <https://nptel.ac.in/courses/105103093/24>
2. Links related to topics of course:
  - <https://nptel.ac.in/courses/105108069/5>
  - <https://freevideolectures.com/course/3269/advanced-foundation-engineering/25>
  - <https://nptel.ac.in/courses/105106055/>

#### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus

4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5
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**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course outcomes (Underground Technology)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	3	3	1	2	2	0	3	3	1	1	2.0
CO-2	2	3	3	2	2	3	2	1	2	1	1	3	2.1
CO-3	3	2	2	2	1	3	1	1	2	2	2	3	2.0
CO-4	3	3	3	2	2	3	2	2	1	1	1	2	2.1
CO-5	3	3	3	2	0	2	1	1	2	1	2	3	1.9
CO-6	2	2	2	2	1	3	3	0	3	2	2	3	2.1
<b>Average</b>	<b>2.67</b>	<b>2.5</b>	<b>2.67</b>	<b>2.17</b>	<b>1.17</b>	<b>2.67</b>	<b>1.83</b>	<b>0.83</b>	<b>2.17</b>	<b>1.67</b>	<b>1.5</b>	<b>2.5</b>	



## Open Channel Flow and Hydraulic Machines

COURSE CODE:18B1WCE639

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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**Pre-requisite:** Fluid mechanics

**Course Objectives:**

1. To familiarize students with the knowledge of open channel and their behaviors
2. To study the various applications, open channels
3. To study different types of turbines and their application
4. To get familiar with working of different types of pumps and its applications

**Course Outcomes:**

S.No.	Course Outcomes	Level of Attainment
CO-1	Knowledge of flow characteristics of open channel flow.	Assessment
CO-2	Learn the different flow regimes in open channels and their characteristics Predict if hydraulic jumps are to occur during flow, and calculate the fraction of energy dissipated during hydraulic jumps	Assessment
CO-3	Methods of discharge measurement, various phenomenon of flow in open channel	Assessment
CO-4	Different types of turbines, and its applications, working principles, efficiencies and problems associated with turbines	Assessment
CO-5	Knowledge of pumps, its applications, working principles, efficiencies and problems associated with pumps	Assessment

**Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction to Open Channel Flow:</b> Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.	4

2	<b>Uniform Flow:</b> Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient, Most economical section of channel. Computation of Uniform flow, Normal depth	7
3	<b>Non-Uniform Flow:</b> Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions, Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer	9
4	<b>Hydraulic Jump:</b> Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump.	5
5	<b>Hydraulic Turbines:</b> Efficiencies & Classification, Pelton wheel turbine: Design , Velocity triangle , Radial flow Reaction turbines: working principles and Design of, Francis and Kaplan Turbine, Velocity Triangles, Draft tube : Types and theory, specific speed, Operating characteristics . Turbines, Selection of Turbines.	9
6	<b>Pumps:</b> Classification, Centrifugal pump Components and working, Velocity triangles, Head Losses and Efficiencies, Minimum starting speed, priming of centrifugal pump, specific speed, Cavitation, selection of pumps, Reciprocating pump, types, Components and working, slip, Indicator diagram, Air vessel.	8
<b>Total lectures</b>		<b>42</b>

#### Suggested Text Book(s):

1. Modi, P.N. and Seth, S.M., Hydraulic and Fluid Machines, Standard book house New Delhi, 1995.
2. K. Subramanya, Flow in Open Channels, Tata Mc. Graw Hill, 2009
3. K.G. Rangaraju, Flow through Open Channels, Tata Mc. Graw Hill, 2013

#### Suggested Reference Book(s):

1. M.H Chaudhury: Open Channel Flow, Prentice Hall of India, 2008
2. V.T Chow: Open Channel Hydraulics, Mc Graw Hill, 2009.
3. Terry W. Sturm, Open Channel Hydraulics, Tata Mc. Graw Hill, 2009.
4. Richard H. French, Open Channel Hydraulics, Mc Graw Hill, 1985

#### Other useful resource(s):

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105103096/>  
<https://nptel.ac.in/courses/112104117/33>

<https://nptel.ac.in/courses/105103021/1>

2. Link to topics related to course: \_

<https://nptel.ac.in/courses/105103096/1-24>

<https://nptel.ac.in/courses/105103021/40-43>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (5) - 10 Quizzes(2) - 10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Open Channel Flow and Hydraulic Machine)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	2	2	2	3	x	x	1	1	1	3	2
CO-2	3	3	2	2	2	3	x	x	2	1	1	3	2.2
CO-3	3	3	3	2	2	2	x	x	2	2	1	3	2.3
CO-4	3	3	3	3	3	2	x	x	2	2	3	3	2.7
CO-5	3	3	3	3	3	2	x	x	2	2	3	3	2.7
Average	3	2.8	2.6	2.4	2.4	2.4	0	0	1.8	1.6	1.8	3	

## Computer Aided Planning and Costing

COURSE CODE:18B17CE671

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

L-T-P: 0-0-4

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**Pre-requisite:** Engineering Drawing

### Course Objectives:

- 1 To learn the fundamentals of planning, designing and estimation of different types of civil engineering structures using software like MS Excel and estimator.
2. Develop expertise in comprehending construction site drawings and generate bar bending schedules for same.
3. Learn to prepare detailed reports for construction projects.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To acquire knowledge in material quantity estimation and costing by applying mathematical methods such as Long Wall/ Short Wall method and Centre-line method.	Familiarity
CO-2	To learn quantity estimation and costing for various materials used in residential buildings, masonry tanks, culverts bridges etc.	Assessment
CO-3	Gain practical experience in using MS Excel and estimator software for making worksheets of various estimates.	Assessment
CO-4	To make the estimates for earthwork for making embankments and cuts for plain and mountainous region roads.	Usage
CO-5	To develop proficiency in making the bar-bending schedules.	Usage
CO-6	To study legal issues related to construction and prepare detailed reports.	Usage
CO-7	To acquire knowledge in material quantity estimation and costing by applying mathematical methods such as Long Wall/ Short Wall method and Centre-line method.	Usage

**List of Experiments:**

S.No.	Description	Hours
1	Introduction and estimation of quantities of materials from a plan of a residential building floor using Short wall and Long wall method using MS Excel Software.	6
2	Prepare section for a given Plan and hence Calculate quantities by Central Line method and Compare it with Long Wall /Short Wall Methods using MS Excel.	4
3	Estimation of an underground masonry tanks and staircase	4
4	Estimation of road works, culverts, bridges, wells, and irrigation works.	10
5	Introduction to bar bending schedule, preparation of bar bending schedule for sketches given.	4
6	Quantity estimation of residential building, culverts, bridges and road works.	10
7	Cost analysis of residential building (Single Storey) as per latest CPWD rate analysis manual.	4
8	Cost estimation of road works, culverts, bridges, wells, and irrigation works using estimator software as per latest CPWD rate analysis manual.	8
9	Cost estimation of steel used in any project as per bar bending schedule using MS Excel.	2
10	Introduction to contracts, Tenders, Bids and Legal Issues related to construction works.	2
11	Preparation of different types estimation reports for various PWD works in MS Word.	2
<b>Total Lab hours</b>		<b>56</b>

**Suggested/Resources:**

1. Estimating and Costing in Civil Engineering: Theory and Practice Including Specifications and valuation by B.N Dutta UHS publishers.
2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning,2002.
3. Construction Management and Planning by B. Sengupta & H. Guha .

**Evaluation Scheme:**

1	Mid Sem. Evaluation	20 Marks
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<b>2</b>	End Sem. Evaluation	20 Marks
<b>3</b>	Attendance	15 Marks
<b>4</b>	Lab Assessment	45 Marks
	Total	100 marks

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Computer Aided Planning and Costing)</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>	<b>Average</b>
<b>CO1</b>	3	3	3	3	2	2	1	2	3	2	1	3	<b>2.33</b>
<b>CO2</b>	3	3	3	3	1	3	x	x	1	1	3	2	<b>1.92</b>
<b>CO3</b>	3	3	3	3	2	1	2	1	2	2	1	3	<b>2.00</b>
<b>CO4</b>	2	3	1	3	2	x	2	1	x	1	x	3	<b>1.50</b>
<b>CO5</b>	3	2	3	2	x	1	3	x	1	1	1	3	<b>1.67</b>
<b>CO6</b>	3	3	3	3	2	2	x	2	3	3	3	3	<b>2.50</b>
<b>Average</b>	<b>2.83</b>	<b>2.83</b>	<b>2.67</b>	<b>2.83</b>	<b>1.50</b>	<b>1.50</b>	<b>1.00</b>	<b>1.00</b>	<b>1.67</b>	<b>1.67</b>	<b>1.50</b>	<b>2.8</b>	

## Finite Element Method and Its Applications to Civil Engineering

COURSE CODE:18B1WCE731

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Basic knowledge of structural analysis, conventional approaches to analyse a structure, and matrix method.

### Course Objectives:

1. To learn basic concept of finite element method.
2. To learn how it is used in different software's and in different field of engineering.
3. To apply FEM in different civil engineering problems.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the basic aspects of finite element methods, engineering problem solution formulation, discretization, and type of elements along with their application.	Familiarity
CO-2	Develop an engineering solution for 1-D (spring) element using finite element approaches and application of these methods on spring assemblage.	Assessment
CO-3	Develop an engineering solution for axial (truss) element and truss assemblage using finite element approaches in linear, plane and space coordinate system.	Assessment
CO-4	Develop an engineering solution for flexural (beam) element and assemblage using finite element approaches in linear, plane and space coordinate system with and without axial extensibility.	Usage
CO-5	Understand the basic characteristic of constant stress/strain element and able to apply in general civil engineering problems.	Usage

**Course Contents:**

<b>Unit</b>	<b>Contents</b>	<b>Lectures required</b>
<b>1</b>	<b>Introduction:</b> Brief History, Application of FEM (Structural and Non-structural), Advantages and Disadvantages of FEM, Matrix Theory and Notations, Vector Analysis, Coordinate System, Classification of 1-D, 2-D, and 3-D Elements, Shape Function, Discretization, Degree of Freedom, Force/Displacement Analysis. General Steps Involved in FE Analysis (in Detail)	<b>8</b>
<b>2</b>	<b>Spring Element and Spring Assembly:</b> Development of a Spring Stiffness Matrix, Development of Spring Assembly by Direct Equilibrium Method, Work/Energy Method, Methods of Weighted Residuals- Galerkin's Method, and Variational Method, Development of Force-Displacement Relation, Strain-Displacement Relation, Calculation of Elemental Reaction Force and Nodal Displacement.	<b>8</b>
<b>3</b>	<b>Axial Element and Assembly:</b> Development of Bar Element Stiffness Matrix, Vector Transformation in Different Coordinate System, Displacement Transformation, Displacement Transformation Matrix for 1, 2, and 3-Dimensional Coordinate System, Generation of global stiffness matrix for an Element and Assembly, Computation of Stress in an Element, Use of Similar Methods to Develop Elemental Equations. Comparison of FEM solution with Exact Solution (Standard Examples).	<b>9</b>
<b>4</b>	<b>Flexural Element and Assembly:</b> Development of Differential Equation for Beam Element, Selection of Displacement Function, Development of Element Stiffness Matrix, Stiffness Matrix Assemblage, Application of Boundary Conditions, Evaluation of Response Under Different Kind of Loading, use of similar Methods to Develop Elemental Equations. Comparison of FEM solution with Exact Solution (Standard Examples).	<b>8</b>
<b>5</b>	<b>Linear and Plane Strain/Stress Analysis:</b> Linear Element Analysis, Development of Constant Strain Triangular (CST) Element, Plane Stress and Plane Strain Equation, Application of Constant Stress and Strain in Civil Engineering.	<b>6</b>
<b>6</b>	<b>Two Dimensional Elements:</b> Introduction to Axisymmetric and Isoparametric Elements and Applications.	<b>4</b>
<b>7</b>	<b>Commercial Packages:</b> ABAQUS, ANSYS, NISA, SAP2000 etc. extensibility	<b>1</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Kalus Jurgen Bathe, Finite Element Procedures, PHI Learning Private Limited.
2. J. N. Reddy, An Introduction to the Finite Element Method, McGraw Hill Education.
3. P. Seshu, Textbook of Finite Element Analysis, PHI Learning Private Limited.



**Other useful resource(s):**

1. <https://nptel.ac.in/courses/105105041/>
2. <https://nptel.ac.in/courses/105106051/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Finite Element Method and Its Applications to Civil Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2.0	1.0	2.0	1.0	2.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0
CO-2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0
CO-3	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	1.0	3.0	3.0
CO-4	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0
CO-5	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0
Average	2.6	2.4	2.4	2.2	2.6	2.8	2.6	3.0	3.0	2.0	1.8	2.6	

## Environmental Management and Impact Assessment

COURSE CODE:18B1WCE732

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

### Course Objectives:

1. Learn the basic objectives necessary to conduct EIA.
2. Learn the various national and international regulations and acts pertaining to EIA.
3. Learn the steps and methodologies involved in conducting EIA for different projects and environments.
4. Understand and predict the impacts of different activities on several environmental factors.
5. Understand the concept of risk management.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Recognize the need for EIA of potential projects.	Familiarity
CO-2	Demonstrate familiarity with regulations pertaining to EIA.	Assessment
CO-3	Demonstrate the use of methodologies in assessment of impacts of potential projects.	Assessment
CO-4	Comprehend risk management	Usage

### Course Contents:

Unit	Contents	Lectures required
1	<b>Environmental Impact Assessment:</b> Definition of Environmental Impact Assessment(EIA), Environmental Assessment(EA) and Environmental Impact Statement(EIS); National Environmental Policy Act (NEPA); National Goals of Environmental Policy; Council on Environmental Quality (CEQ); Draft, Supplemental and Final EIS; Environmental Inventory; Objectives of EIA	8
2	<b>EIA in India:</b> Administrative arrangements of EIA in India; Impact Assessment Agency(IAA) in MOEF-CC, GOI, India; Expert committee for administering EIA; Screening and Scoping; Requirements of prior environmental clearance; SEIAA; Category A and Category B projects.	8

3	<b>EIA Methodologies:</b> Interaction matrices, Checklists, Networks, Adhoc Procedures, Overlay techniques; Simple interaction matrix and Stepped matrix; Application of various methodologies	6
4	<b>Environmental Indicators and Indices:</b> Definition of Environmental Indicator and Environmental Index; Biological Indicators; Procedures involved in calculation of Air Quality Index (AQI), Water Quality Index(WQI)and Noise Index; Similarity and Diversity Index	6
5	<b>EIA Study – Air Environment:</b> Definition of Air Pollution; Projects which contribute to air pollution; Basic steps for prediction and assessment of air pollution <b>Water Environment:</b> Basic Steps; Spatial and Temporal Phases; Operational Impacts of alternatives <b>Biological Environment:</b> Basic Steps <b>Cultural Environment:</b> Basic Steps	6
6	<b>Planning and Management of Impact Studies:</b> Conceptual Approach; Proposal Development; Interdisciplinary Team Formation; Team Leader Selection; General Study Management; Fiscal Control	6
7	<b>Risk Assessment:</b> Definition of Risk according to EPA; Risk Management; Human Health Risk Assessments; Ecological Risk Assessments	2
<b>Total lectures</b>		<b>42</b>

### Suggested Text Book(s):

1. Larry W Canter: Environmental Impact Assessment, Mc Graw Hill Publishers.
2. Anjaneyulu, Y and Valli Manickam: Environmental Impact Assessment Methodologies, 2<sup>nd</sup> Edition, BS Publications, 2007.

### Suggested Reference Book(s):

1. Peter Wathern, "Environmental Impact Assessment: Theory and Practice ", Routledge, 1998

### Other useful resource(s):

1. Link to NPTEL course contents:[www.epa.gov/risk](http://www.epa.gov/risk)

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2

3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(1) -10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Environmental Management and Impact Assessment)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	1.75
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	2.00
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	1.75
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	2.08
Average	2	2.5	2.5	2.5	2.5	1	1	1	2	2.25	1.5	2	

## Advanced Foundation Engineering

COURSE CODE:18B1WCE733

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Foundation Engineering

### Course Objectives:

1. To impart the knowledge of foundation design involving advance analysis and design techniques.
2. This course serves as an addition to the foundation engineering concepts, taking it beyond the traditional foundation design into machine and reinforced earth concept.
3. To impart understanding of the mechanics between the soil and foundation system.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Ability to learn the basic requirements of consultancy like preliminary survey, report writing and how the site for the construction is investigated, the testing techniques before the design and the equipments required for the sampling and testing.	Familiarity and Usage
CO-2	Acquisition of complete knowledge of various foundation design procedures, elastic analysis of foundations and the application of types of foundations.	Usage
CO-3	Development of a thorough understanding of deep foundations which will involve the design and analysis of laterally loaded piles and well foundations.	Usage
CO-4	Understanding of foundation design in expansive soils and stabilization of the slopes and cuts using materials like geotextiles, geogrids and geonet.	Usage
CO-5	Ability to design and analyze the foundation system for a machine and to apply the dynamics for analysis of motion of machine foundations.	Assessment and Usage

### Course Contents:

Unit	Contents	Lectures required
1	<b>Introduction:</b> Revision of foundation engineering, introduction to soil exploration, interpretation of soil exploration data.	3

2	<b>Mat Foundations:</b> Bearing capacity of mat foundations, Mat settlement, Design of rigid and flexible mats.	5
3	<b>Pile Foundations:</b> Design of piles and pile groups, Design of pile caps, laterally loaded piles, Settlement of pile and pile groups.	8
4	<b>Well and Caisson Foundation:</b> Bearing capacity, Settlement, Lateral Stability analysis.	4
5	<b>Foundations on Expansive Soils:</b> Introduction to expansive soils, swell measurement, foundation consideration, construction on expansive soils.	5
6	<b>Reinforced Earth:</b> Design Principals, Methods of constructions and applications.	6
7	<b>Machine Foundations:</b> Soil dynamics, Analysis of machine foundation, dynamic soil constants and their determination, Indian standards on design and construction of foundation for reciprocating and impact type of machines.	6
8	<b>Soil-structure interaction:</b> Idealized soil, foundation and interface behavior, Elastic models of soil behavior; Beams and plates on elastic foundation.	5
<b>Total lectures</b>		<b>42</b>

#### Suggested Text Book(s):

1. V.N.S. Murthy: Advanced Foundation Engineering, CBS Publishers and Distributors, 2010
2. Braja M. Das: Principles of Foundation Engineering, PWS Publishing Company, 2017
3. Joseph Bowles: Foundation Analysis and Design, McGraw Hill Book Company, 2017

#### Suggested Reference Book(s):

1. Literature on Advanced foundations Bureau of Indian Standard codes on foundations.

#### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus

4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5
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**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Advanced Foundation Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	3	3	2	1	3	2	3	2	1	2	<b>2.36</b>
CO-2	3	3	1	2	3	2	2	3	3	2	2	2	<b>2.33</b>
CO-3	3	1	2	3	3	2	3	3	2	2	1	2	<b>2.25</b>
CO-4	3	2	2	3	3	2	1	2	3	3	2	2	<b>2.33</b>
CO-5	3	3	3	1	3	1	2	2	3	2	3	2	<b>2.33</b>
Average	<b>3</b>	<b>2.4</b>	<b>2.2</b>	<b>2.4</b>	<b>2.8</b>	<b>1.6</b>	<b>2.2</b>	<b>2.4</b>	<b>2.8</b>	<b>2.2</b>	<b>1.8</b>	<b>2</b>	

## Earthquake Engineering

COURSE CODE:18B1WCE734

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Static and dynamic analysis of structural member

### Course Objectives:

1. To impart basic knowledge of Earthquake and reason for its happening.
2. To design a building which can sustain earthquake load along with dead load and live load.
3. To know about different zones in India for earthquake.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	To expose the students to earthquake hazards and earthquake engineering principles, earthquake disaster management.	Familiarity
CO-2	To impart to the latest earthquake resistant design philosophies, codal design and design philosophies beyond code, so that the students can independently tackle earthquake engineering problems and they can handle the earthquake hazard mitigation projects.	Assessment
CO-3	To introduce basic principles and importance of earthquake in civil engineering applications.	Assessment
CO-4	To understand the behaviour of a structure or a system under earthquake exaction.	Usage
CO-4	To analyse the influence of active and passive control system on structure experiencing earthquake loading.	Usage
CO-5	To expose the students to earthquake hazards and earthquake engineering principles, earthquake disaster management.	Usage



**Course Contents:**

Unit	Contents	Lectures required
1	<b>Introduction</b> - Characterization of ground motion, Earthquake intensity and magnitude; Recording instruments and base line correction, Predominant period and amplification through soil.	5
2	<b>Earthquake Spectra analysis</b> - Earthquake spectra for elastic and inelastic systems	7
3	<b>Structural Behaviour</b> - Idealization of structural systems; Lateral force evaluation by mode superposition and direct integration; Effect of foundation/soil on earthquake response; Analysis for torsion.	12
4	<b>Damage Assessment</b> - Review of damages during past earthquakes and remedial measures; Reinforcement detailing for members and joints detailing; Codal provisions.	10
5	<b>Vibration Control</b> - Introduction of Vibration Control; Active and Passive Control System.	8
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Anil Kumar Chopra, Dynamics of Structures Theory and Applications of Earthquake Engineering, Pearson Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.
2. Mario Paz and William Leigh, Structural Dynamics Theory and Computation, Kluwer Academic Publishers.
3. Ray W. Clough, Joseph Penzien, Dynamics of Structure, CBS Publishers and Distributors Private Limited

**Other useful resource(s):**

1. <https://nptel.ac.in/courses/105106151/>
2. <https://nptel.ac.in/courses/105101006/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Earthquake Engineering)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	1	1	1	2	3	1	1	2	2	1	2	<b>1.58</b>
CO-2	3	3	3	2	2	3	2	2	3	2	1	3	<b>2.42</b>
CO-3	3	3	2	3	3	3	2	3	3	2	1	3	<b>2.58</b>
CO-4	3	2	3	3	3	3	2	3	3	2	1	3	<b>2.58</b>
CO-5	3	3	3	3	3	3	2	3	3	3	1	3	<b>2.75</b>
<b>Average</b>	<b>2.8</b>	<b>2.4</b>	<b>2.4</b>	<b>2.4</b>	<b>2.6</b>	<b>3</b>	<b>1.8</b>	<b>2.4</b>	<b>2.8</b>	<b>2.2</b>	<b>1</b>	<b>2.8</b>	

## Design of Prestressed Concrete Structures

COURSE CODE:18B1WCE735

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite: Mechanics of Solids and Design of Concrete Structures**

### Course Objectives:

1. To impart knowledge on basic concepts about prestressing and how prestressed concrete is different from normal cement concrete
2. To impart knowledge about analysis of prestressed members for flexural. Different methods correlation
3. Losses in Prestress part I, Losses in Prestress part II and Losses in Prestress part III
4. To learn how to design prestressed concrete members.
5. Calculation of deflection and crack width.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the concepts of pre-stressing in concrete structures and identify the materials for pre-stressing.	Familiarity
CO-2	Analysis of different types of Pre-stressed Concrete sections	Assessment
CO-3	Estimate losses of pre-stressing.	Assessment
CO-4	Design of pre-tensioned and post tensioned girders for flexure and shear	Assessment
CO-5	Design continuous pre-tensioned and post tensioned beams	Assessment

### Course Contents:

Unit	Contents	Lectures required
<b>1</b>	<b>Introduction to Prestressed Concrete:</b> Basic concepts, Brief History and Development of building Materials. Types of Prestressing, different definitions, Advantages and Limitations, types of prestressing. Pre tensioning System and devices, stages, advantages and disadvantages, Devices manufacturing of railway sleepers. Post tensioning system and devices, stages, advantages and disadvantages, devices, Manufacturing of post tensioning bridge girders. Prestressing steel, forms, types properties and codal provisions.	<b>8</b>

<b>2</b>	<b>Analysis of prestressed members for flexure:</b> Flexural strength – Simplified procedures as per codes. Analysis of member under axial load, at transfer, at service conditions, permissible stress, assumptions, variations of internal forces. Analysis of flexural members based of stress concept. Analysis of flexural members based of force concept. Analysis of flexural members based on load balancing concept. Numerical solving.	<b>10</b>
<b>3</b>	<b>Losses in prestress:</b> Losses in Prestress part I, why losses are to be considered, Elastic shortening. Losses in Prestress part II, Difference between losses in pre tensioning and post tensioning, friction loss, and anchorage slip. Losses in Prestress part III, Creep of concrete, steel relaxation, shrinkage of concrete, time dependent losses.	<b>6</b>
<b>4</b>	<b>Design of Prestressed Concrete members:</b> Design of sections for flexure part I, Design of sections for flexure part II and Design of sections for flexure part III.	<b>10</b>
<b>5</b>	<b>Calculation of deflection and crack width:</b> Calculation of deflection, total deflection, limits as per IS Code, span to depth ratio, Numerical solving. Calculation of crack width, Different methods, limits of crack widths.	<b>8</b>
<b>Total lectures</b>		<b>42</b>

#### Suggested Text Book(s):

1. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, New Delhi, 1998.
2. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Co.Pvt. Ltd. 1997.
3. Rajagopalan, N, —Prestressed Concretel, Alpha Science, 2002

#### Other useful resource(s):

1. Link to NPTEL course contents:<https://nptel.ac.in/courses/105106117/>
2. Link to topics related tocourse:
  - i. <https://nptel.ac.in/courses/105106117/1>
  - ii. <https://nptel.ac.in/courses/105106117/2>
  - iii. <https://nptel.ac.in/courses/105106117/4>
  - iv. <https://nptel.ac.in/courses/105106117/6>

#### Evaluation Scheme:

<b>S. No</b>	<b>Exam</b>	<b>Marks</b>	<b>Duration</b>	<b>Coverage / Scope of Examination</b>
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus

4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5
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**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Design of Prestressed Concrete Structures)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	1.75
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	2
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	1.75
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	2.08
CO-5	2	3	3	3	2	1	1	1	2	3	2	2	1.75
<b>Average</b>	<b>2</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2.25</b>	<b>1.5</b>	<b>2</b>	

## **Dams and Reservoir Design**

COURSE CODE:18B1WCE736

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Water Resource Engineering, Geotechnical Engineering

### **Course Objectives:.**

1. To introduce the students to the basic knowledge of dams and their appurtenances.
2. To develop an understanding regarding selection of a suitable dam for a particular site.
3. Impart knowledge about the construction, design and maintenance of various dams.
4. Train the students to analyze various dams to check their stability and safety.
5. To apply the principles of water resource and irrigation engineering and excel the students in the computation of the reservoir capacity which is indispensable for deciding the inundation area and demand pattern for any dam.
6. To enable the students to apply their knowledge of mechanics to calculate the critical stresses and various forces(static and dynamic) to ensure the proper design and stability of the dam.
7. To introduce the students to the various modern techniques and various challenges of dam construction by exposing them to real field conditions incorporating modern pedagogical methods of learning.
8. To train the students to use software tools for the modeling and analysis of various dams.

### **Course Outcomes:**

<b>S.No.</b>	<b>Course Outcomes</b>	<b>Level of Attainment</b>
CO-1	Select the suitable site for construction of different dams and suggest the type of dam required as per the topographical, functional, economical and ecological considerations.	Familiarity
CO-2	Know about the various components of a dam, their functions and types.	Familiarity
CO-3	Calculate the reservoir capacity based on demand (outflow) and supply (inflow) patterns.	Assessment/ Usage
CO-4	Calculate the forces and stresses coming on gravity and earthen dams due to static and dynamic forces prevalent in nature	Assessment
CO-5	Analyze the dam for its safety against various forms of failure and suggest the preventive measures.	Assessment/ Usage

**Course Contents:**

<b>Unit</b>	<b>Contents</b>	<b>Lectures required</b>
<b>1</b>	<b>Introduction and project planning:</b> Dams and their historical emergence, requirement and types of dams, dam appurtenances. Planning of project, Purpose of development, Project study, Ecological and environmental considerations, Flood studies, Economic consideration, Physical factor governing selection of type, legal, economic, aesthetic considerations, and foundation and construction materials. Investigation, Source of information, Surface exploration, sampling, Field and laboratory tests.	<b>12</b>
<b>2</b>	<b>Reservoir studies:</b> Types of reservoir, inflow and outflow study into the reservoir, capacity determination by various techniques	<b>6</b>
<b>3</b>	<b>Concrete gravity dam:</b> Introduction, Origin and development, Forces acting on dam, Requirements for stability, Dams on pervious foundations	<b>9</b>
<b>4</b>	<b>Earthfill dams:</b> Origin, Selection of type, Design principles, Foundation design, Embankments, Embankment details.	<b>9</b>
<b>5</b>	<b>Rockfill dams:</b> Origin and usage, Definition and types, Foundation design, Embankment design, Membrane design.	<b>6</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. S.K. Garg: Irrigation Engineering and Hydraulic Structures, 19th Edition, Khanna Publishers, 2005.
2. W.P.Creager, J.D.Justin and J.Hinds: Engineering for dams, Wiley, 2007.

**Suggested Reference Book(s):**

1. Trevor Turpin: Dams, First edition, Reaktion Books Publication, 2008.
2. S.K. Ukarande: Irrigation and Hydraulic structures, Third Edition, Ane Books Pvt. Limited, 2017.
3. I.H. Siddhiqui: Dams and Reservoirs: Planning and Engineering, First Edition, OUP Pakistan, 2008

**Evaluation Scheme:**

<b>S. No</b>	<b>Exam</b>	<b>Marks</b>	<b>Duration</b>	<b>Coverage / Scope of Examination</b>
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2

3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Dams and Reservoir Design)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	3	1	3	1	2	2	2	2	2	2	<b>2.09</b>
CO-2	3	1	3	2	2	3	2	3	2	2	1	2	<b>2.17</b>
CO-3	3	2	3	2	3	2	1	3	1	2	1	2	<b>2.08</b>
CO-4	3	3	3	2	3	3	2	3	3	3	2	2	<b>2.67</b>
CO-5	3	2	2	3	3	3	2	2	3	3	2	2	<b>2.50</b>
<b>Average</b>	<b>3</b>	<b>2</b>	<b>2.8</b>	<b>2</b>	<b>2.8</b>	<b>2.4</b>	<b>1.8</b>	<b>2.6</b>	<b>2.2</b>	<b>2.4</b>	<b>1.6</b>	<b>2</b>	



## Advanced Reinforced Concrete Design

COURSE CODE:18B1WCE831

COURSE CREDITS 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Design of concrete structures

### Course Objectives:

1. To understand the design concepts of various structural elements using working stress method and detailing of reinforcement
2. To understand the design of beam and slab using Yield line theory.
3. Underground and elevated liquid retaining structures. To study the design of material storage structures
4. To understand the design concept of cantilever and counterfort types of retaining walls

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Analysis and design of beams and slabs by working stress method	Familiarity
CO-2	Yield line Theory of slabs and Methods of Analysis	Assessment
CO-3	Design of underground and elevated water tanks	Assessment
CO-4	Design cantilever and counterfort retaining walls	Assessment
CO-5	Analysis and design of Foundation	Assessment

### Course Contents:

Unit	Contents	Lectures required
1	<b>Analysis and design of beams and slabs by working stress method:</b> Introduction to working stress method of design. Assumptions in the theory of simple bending, Concept of transformed or equivalent sections, Analysis of singly reinforced section and doubly reinforced sections.	8
2	<b>Yield line Theory of slabs and Methods of Analysis:</b> Introduction to yield line theory, Properties of yield lines, Methods of analysis, one way slabs, two way slabs, yield line analysis of slabs	10
3	<b>Design of underground and elevated water tanks:</b> Design principles of underground and elevated water tanks, Detailed design of rectangular and circular elevated water tanks as per IS 3370,	12

	Design of Ring Beam and staging for elevated water tanks, Detailed Design of Intz Tanks.	
<b>4</b>	<b>Design cantilever and counterfort retaining walls:</b> Principles of Cantilever and counterfort type retaining walls, Detailed design of cantilever type of retaining walls	<b>9</b>
<b>5</b>	<b>Analysis and design of Foundations:</b> Types of foundations and its needs. Analysis and design of a isolated footing	<b>3</b>
<b>Total lectures</b>		<b>42</b>

#### Suggested Text Book(s):

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006

#### Suggested Reference Book(s):

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2007.
2. Punmia B.C. Ashok Kumar Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Design), 10th Edition, Lakshmi Publishers, 2006

#### Other useful resource(s):

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/106104019/>
2. Link to topics related to course:
  - i. <https://nptel.ac.in/courses/106104019/1>
  - ii. <https://nptel.ac.in/courses/106104019/4>
  - iii. <https://nptel.ac.in/courses/106104019/26>
  - iv. <https://nptel.ac.in/courses/106104019/2Ev>

#### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus

4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5
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**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Advanced Reinforced Concrete Design)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	2	2	2	2	1	1	1	2	2	2	2	<b>1.75</b>
CO-2	2	3	3	3	3	1	1	1	2	2	1	2	<b>2</b>
CO-3	2	2	2	2	3	1	1	1	2	2	1	2	<b>1.75</b>
CO-4	2	3	3	3	2	1	1	1	2	3	2	2	<b>2.08</b>
CO-5	2	3	3	3	2	1	1	1	2	3	2	2	<b>1.75</b>
<b>Average</b>	<b>2</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>2.25</b>	<b>1.5</b>	<b>2</b>	

## Advanced Highway Material and Construction

COURSE CODE:18B1WCE832

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** None

### Course Objectives:

1. To understand the scope, application potential, evaluation, and performance expectation of the new highway materials.
2. To get familiar with the innovative application concepts of the conventional or the modern materials.
3. Usage of modern materials in highway construction and their innovative application
4. Introduction to new technology used in highway construction

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Students will come to know about the scope, application potential, evaluation, and performance expectation of the new highway materials	Familiarity
CO-2	The students will gain an appreciation for the innovative application concepts of the conventional or the modern materials	Assessment
CO-3	Students will analyze how to use and the benefits of modern materials in highway construction	Assessment
CO-4	Students will become familiar with the new technology used in highway construction	Assessment

### Course Contents:

Unit	Contents	Lectures required
1	<b>Aggregates:</b> Classification, physical and strength characteristics, Proportioning of aggregates, Aggregate texture and skid resistance, polishing of aggregates.	6
2	<b>Soil:</b> Classification, Structural and Constructional problems in soil subgrade, Identification and strength tests, Soil-moisture movement, Sub-soil drainage, Soil stabilization	8
3	<b>Bitumen:</b> Bitumen sources and manufacturing, Bitumen constituents, structure and Rheology, Mechanical and engineering properties of	6

	bitumen, Tests on bitumen, Emulsions – Properties, types, modifications, Durability of bitumen, Adhesion of bitumen, Modified bitumen.	
<b>4</b>	<b>Mixes:</b> Desirable properties of mixes, Design of bituminous mixes, Tests on bituminous mixes, Fillers, Theory of fillers and specifications	<b>6</b>
<b>5</b>	<b>Cement Concrete:</b> Constituents and their requirements, Physical, plastic and structural properties of concrete, Factors influencing mix design, Design of concrete mixes	<b>8</b>
<b>6</b>	<b>Road Construction:</b> Bituminous road construction procedures and specifications, Quality control requirements. Concrete Road construction: Construction methods, Quality control requirements, Joints in cement concrete pavements, reinforced cement concrete road construction.	<b>8</b>
<b>Total Lecture</b>		<b>42</b>

#### Suggested Text Book(s):

- 1 Krebs, Robert D. And Walker, R. D., —Highway Materialsl, McGraw Hill Book Co., New York, 1971.
- 2 Her Majesty’s Stationery Office, —Soil Mechanics for Road Engineersl, Ministry of Transport, Road Research Laboratory, UK, 1966.
- 3 Her Majesty’s Stationery Office, —Bituminous Materials in Road Constructionl, Ministry of Transport, Road Research Laboratory, UK, 1966.
- 4 Her Majesty’s Stationery Office, —Concrete Roads Design and Constructionl, Ministry of Transport, Road Research Laboratory, UK, 1966.
- 5 Read, J. And Whiteoak, D., —The Shell Bitumen Handbookl, Fifth edition, Shell Bitumen, Thomas Telford Publishing, London, 2003.

#### Evaluation Scheme:

<b>S. No</b>	<b>Exam</b>	<b>Marks</b>	<b>Duration</b>	<b>Coverage / Scope of Examination</b>
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

<b>Course Outcomes (Advanced Highway Material and Construction)</b>	<b>PO-1</b>	<b>PO-2</b>	<b>PO-3</b>	<b>PO-4</b>	<b>PO-5</b>	<b>PO-6</b>	<b>PO-7</b>	<b>PO-8</b>	<b>PO-9</b>	<b>PO-10</b>	<b>PO-11</b>	<b>PO-12</b>	<b>Average</b>
CO-1	2	3	2	2	2	2	1	2	2	3	3	2	<b>2.17</b>
CO-2	3	3	3	2	3	3	1	3	2	3	2	2	<b>2.5</b>
CO-3	2	2	2	2	3	2	1	2	2	2	2	2	<b>2</b>
CO-4	3	3	3	3	2	2	1	2	2	2	3	2	<b>2.33</b>
<b>Average</b>	<b>2.5</b>	<b>2.75</b>	<b>2.5</b>	<b>2.25</b>	<b>2.5</b>	<b>2.25</b>	<b>1</b>	<b>2.25</b>	<b>2</b>	<b>2.5</b>	<b>2.5</b>	<b>2</b>	

# Hydropower Engineering

COURSE CODE:18B1WCE833

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisite:** Fluid Mechanics

## Course Objectives:

1. To get familiar with the various types of hydro power plants
2. To impart the knowledge of design of different hydraulic components of HP plant
3. To gain Knowledge about different types of steps involved in planning of water resource project

## Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Knowledge of Various types of HP plants, turbines and its selection criteria.	Assessment
CO-2	Principles and design of various types of hydraulic structures required in HP Scheme.	Assessment
CO-3	Understanding of Economics of Power Generation.	Assessment
CO-4	They will develop understanding of special features of mini, micro hydel plants.	Assessment

## Course Contents:

Unit	Contents	Lectures required
1	<b>Introduction:</b> purpose served by HP projects, Functional requirements in multiple purpose projects, compatibility, steps involved in planning of water resource project, financial analysis of a project, site investigations, Hydrological investigations, assessment of Hydropower potential, water availability, installed capacity determination.	8
2	<b>Principles of hydropower development:</b> Application, advantage and disadvantages of schemes, classification of hydropower schemes and their layouts, Principal components of Hydro-electric scheme	8

<b>3</b>	<b>Hydraulic turbines:</b> Classification and selection of turbines, governing of turbines	<b>7</b>
<b>4</b>	<b>Design of civil works:</b> Diversion structures, water conductor systems, desilting tanks, cross drainage structures, forebay, Surge tanks and hydraulic transients, Penstocks and pressure shafts, Intakes, penstock, powerhouse, and tailrace.	<b>5</b>
<b>5</b>	<b>Economics of Power Generation:</b> Terms and definitions, cost analysis, combined operation of different power plants, Operation of power plants for peaking and base load, principles of power plant design, location of power plant, economics in plant selection, factor affecting economics of generation and distribution of power Tariff for electrical energy.	<b>8</b>
<b>6</b>	<b>Mini, micro, hydel plants:</b> Special features of mini, micro hydel plants, civil works of medium and high for mini, micro, hydel plants, different types of turbines	<b>7</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Rajput RK Text Book of Power Plant Engineering, Laxmi Publications Pvt. Ltd., 2007.
2. Modi, P.N. and Seth, S.M., Hydraulic and Fluid Machines, Standard book house New Delhi, 1995.
3. Dandekar, M. M. and Sharma, K. N.: water power Engineering, Vikas Publishing House, 2005.

**Other useful resource(s):**

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105105110/35-37>

**Evaluation Scheme:**

<b>S. No</b>	<b>Exam</b>	<b>Marks</b>	<b>Duration</b>	<b>Coverage / Scope of Examination</b>
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5



### Course Outcomes (COs) contribution to the Programme Outcomes (POs)

Course Outcomes (Hydropower Engineering)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	2	2	2	2	3	3	3	1	1	2	3	2.25
CO-2	3	3	3	3	2	3	3	3	2	1	3	3	2.67
CO-3	3	3	3	3	2	2	2	2	2	2	3	3	2.5
CO-4	3	3	3	3	3	2	2	2	2	3	2	3	2.58
Average	3	2.75	2.75	2.75	2.25	2.5	2.5	2.5	1.75	1.75	2.5	3	

# OPTIMIZATION TECHNIQUES

COURSE CODE: 18B1WCE640

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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## Course Objectives:

1. To provide optimal solutions to a particular engineering problem.
2. To impart understanding of mathematical tools for solution of engineering problems.
3. To apply modern computer aided tools for solution of optimization problems.

## Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Understanding the fundamentals of application of Optimization Techniques to Engineering Problems.	Assessment
CO-2	Application of Mathematical modeling to render complex engineering problems solvable.	Assessment
CO-3	Utilization of computer/software tools to solve optimization problems.	Assessment

## Course Contents:

Unit	Contents	Lectures required
1.	Optimization technique's introduction	2
2.	Linear Programming Problems (LPP): Definition of LPP, Simplex Method, Artificial Variable Method, Two Phase Method, using MS-EXCEL, reverse simplex, dual problems, Sensitivity analysis	10
3.	Study of Mathematical Models, Graphical Solutions of Linear Programming Problems (LPP), Random variables, Binomial,	8

	Poisson, Exponential and Normal Distribution	
4.	Non- Linear Programming Problems (NLP). Quadratic programming,	2
5.	Geometric programming, Goal programming, Resource allocation, Integer programming, dynamic programming, Game theory	8
6.	Transportation Problems: Introduction to Transportation Model, Matrix Form of TP, Applications of TP Models, Basic Feasible Solution of a TP, Degeneracy in TP, Formation of Loops in TP, Solution Techniques of TP, Different Methods for Obtaining Initial Basic Feasible Solutions Viz. Matrix Minima Method, Row Minima Method, Column Minima Methods, Using MS_EXCEL	8
7.	Evolutionary algorithms for optimization and search, Multi objective optimization – Weighted and constrained methods; Multi level optimization	4
TOTAL		42

**Suggested Text Book(s):**

1. Taha, Hamdy A., Operation Research: An Introduction, Prentice Hall.
2. Rao S.S, Engineering Optimization, theory and practice, New age International

**Suggested Reference Book(s):**

1. E Polak, Computational Methods in Optimization, Academic Press, New York
2. P E Gill, W Murray and M H Wright, Practical Optimization, Academic Press, New York
3. S J Gass, Linear Programming, McGraw Hill Book Co. New York
4. LjungLennant, System identification: theory for the users, Prentice Hall, India
5. Vedula and Mujumdar Water Resources System Analysis TMH.
6. Deb Kalyanmony, Optimization for engineering design, Prentice Hall, India

**Other useful resource(s):**

1. Link to NPTEL course: <https://nptel.ac.in/courses/105/108/105108127/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Throughout the Semester	Assignment (4) – 10 Quizzes(2)-10 (Best Score) Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Optimization Techniques)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	2	3	2	2	3	1	2	1	2	3	2.25
CO-2	3	3	3	3	3	3	3	2	3	1	2	3	2.67
CO-3	3	3	3	2	3	2	3	2	3	1	3	3	2.58
Average	3	3	2.67	2.67	2.67	2.33	3	1.67	2.67	1	2.33	3	

## FINITE ELEMENT METHOD

COURSE CODE: 18B1WCE737 COURSE

CREDITS: 3 CORE/ELECTIVE:

ELECTIVE

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: 3-0-0

### Course Objectives:

1. To learn basic concept of finite element method.
2. To learn how it is used in different software's and in different field of engineering.
3. To apply FEM in different engineering problems.

### Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Understand the basic aspects of finite element methods, engineering problem solution formulation, discretization, and type of elements along with their application.	Familiarity
CO-2	Develop an engineering solution for 1-D (spring) element using finite element approaches and application of these methods on spring assemblage.	Assessment
CO-3	Develop an engineering solution for axial (truss) element and truss assemblage using finite element approaches in linear, plane and space coordinate system.	Assessment
CO-4	Develop an engineering solution for flexural (beam) element and assemblage using finite element approaches in linear, plane and space coordinate system with and without axial extensibility.	Usage
CO-5	Understand the basic characteristic of constant stress/strain element and able to apply in general civil engineering problems.	Usage

**Course Contents:**

<b>Unit</b>	<b>Contents</b>	<b>Lectures required</b>
	<b>Introduction:</b> Brief History, Application of FEM (Structural and Non- structural), Advantages and Disadvantages of FEM, Matrix Theory and Notations, Vector Analysis, Coordinate System, Classification of 1-D, 2-D, and 3-D Elements, Shape Function, Discretization, Degree of Freedom, Force/Displacement Analysis. General Steps Involved in FE Analysis (in Detail)	<b>8</b>
<b>2</b>	<b>Spring Element and Spring Assembly:</b> Development of a Spring Stiffness Matrix, Development of Spring Assembly by Direct Equilibrium Method, Work/Energy Method, Methods of Weighted Residuals- Galerkin's Method, and Variational Method, Development of Force-Displacement Relation, Strain-Displacement Relation, Calculation of Elemental Reaction Force and Nodal Displacement.	<b>8</b>
<b>3</b>	<b>Axial Element and Assembly:</b> Development of Bar Element Stiffness Matrix, Vector Transformation in Different Coordinate System, Displacement Transformation, Displacement Transformation Matrix for 1, 2, and 3-Dimensional Coordinate System, Generation of global stiffness matrix for an Element and Assembly, Computation of Stress in an Element, Use of Similar Methods to Develop Elemental Equations. Comparison of FEM solution with Exact Solution (Standard Examples).	<b>9</b>
<b>4</b>	<b>Flexural Element and Assembly:</b> Development of Differential Equation for Beam Element, Selection of Displacement Function, Development of Element Stiffness Matrix, Stiffness Matrix Assemblage, Application of Boundary Conditions, Evaluation of Response Under Different Kind of Loading, use of similar Methods to Develop Elemental Equations. Comparison of FEM solution with Exact Solution (Standard Examples).	<b>8</b>
<b>5</b>	<b>Linear and Plane Strain/Stress Analysis:</b> Linear Element Analysis, Development of Constant Strain Triangular (CST) Element, Plane Stress and Plane Strain Equation, Application of Constant Stress and Strain in Engineering.	<b>6</b>
<b>6</b>	<b>Two Dimensional Elements:</b> Introduction to Axisymmetric and Isoparametric Elements and Applications.	<b>4</b>
<b>7</b>	<b>Commercial Packages:</b> ABAQUS, ANSYS, NISA, SAP2000 etc. extensibility	<b>1</b>
<b>Total lectures</b>		<b>42</b>

**Suggested Text Book(s):**

1. Kalus Jurgen Bathe, Finite Element Procedures, PHI Learning Private Limited.
2. J. N. Reddy, An Introduction to the Finite Element Method, McGraw Hill Education.
3. P. Seshu, Textbook of Finite Element Analysis, PHI Learning Private Limited.

**Other useful resource(s):**

1. <https://nptel.ac.in/courses/105105041/>
2. <https://nptel.ac.in/courses/105106051/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered upto T-1
2	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Assignment (2) - 10 Quizzes(2)-10 Attendance - 5

**Course Outcomes (COs) contribution to the Programme Outcomes (POs)**

Course Outcomes (Finite Element Method)	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2.0	1.0	2.0	1.0	2.0	3.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0
CO-2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0
CO-3	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	2.0	1.0	3.0	3.0
CO-4	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0
CO-5	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0	2.0	3.0	3.0
Average	2.6	2.4	2.4	2.2	2.6	2.8	2.6	3.0	3.0	2.0	1.8	2.6	

# Perennial Power Structures

COURSE CODE: 22B1WCE731

COURSE CREDITS: 3

CORE/ELECTIVE: OPEN ELECTIVE

L-T-P: 3-0-0

~~Pre-requisite: None~~

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## Course Objectives:

1. To understand the electric power grids.
2. To understand the working mechanisms of power plants of different renewable energy sources.
3. To understand the efficiency of a power plant and factors affecting it.
4. To understand planning, construction, and maintenance of a power plant.
5. To evaluate the environmental impact of power plant projects.

## Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	To understand the electric power grids.	Assessment
CO-2	To understand the working mechanisms of power plants of different renewable energy sources.	Assessment
CO-3	To understand the efficiency of a power plant and factors affecting it.	Assessment
CO-4	To understand planning, construction, and maintenance of a power plant.	Familiarity
CO-5	To evaluate the environmental impact of power plant projects.	Assessment



**Course Contents:**

<b>Unit</b>	<b>Contents</b>	<b>Lecture Required</b>
<b>1.</b>	<b>Introduction, Various types of energy sources:</b> Renewable & Non-Renewable, Conventional & Non-Conventional. Utilization of various energy resources in the World and India. Effect of using various energy sources on the environment. Advantages and disadvantages of power generation from different types of energy sources. Conditions for using different energy sources.	<b>1</b>
<b>2.</b>	<b>Economics of Electric Power Grid:</b> Power contribution from each type of plant in an area, cost analysis of power plants.	<b>2</b>
<b>3.</b>	<b>Hydropower:</b> Working and favorable conditions for a hydropower plant; Efficiency of Hydropower; Firm Power, Secondary Power, Types of Hydropower Scheme, Types of Turbines, Environment Impact Assessment Planning, Construction practices, and Maintenance protocols of Hydropower project via case study.	<b>10</b>
<b>4.</b>	<b>Tidal:</b> Working and favorable conditions for a tidal plant; Efficiency of Tidal power plant; Environment Impact Assessment; Planning, Construction practices, and Maintenance protocols of Tidal Power project via case study.	<b>9</b>
<b>5.</b>	<b>Wind:</b> Working and favorable conditions for a Wind Power plant; Efficiency of Wind power; Environment Impact Assessment; Planning, Construction practices, and Maintenance protocols of Wind Power project via case study.	<b>10</b>
<b>6.</b>	<b>Solar:</b> Working and favorable conditions for a Solar plant; Efficiency of Solar power; Environment Impact Assessment; Planning, Construction practices, and Maintenance protocols of Solar Power project via case study.	<b>10</b>
<b>TOTAL</b>		<b>42</b>

**Suggested Textbook(s):**

1. Rajput, R.K., Power Plant Engineering, Laxmi Publications Pvt. Ltd.
2. Twidell, J., Weir, T., Renewable Energy Sources, Routledge.
3. Nelson, V., Introduction to Renewable Energy (Energy and the Environment), CRC Press.

**Suggested Reference Book(s):**

1. US Department of Energy, Introduction to Renewable Energy Technology: A Year Long Science and Technology Course, Createspace Independent Pub.

**Evaluation Scheme:**

S. No.	Exam	Marks	Duration	Coverage/Scope of Examination
1.	T-1	15	1 Hour.	Syllabus covered up to T-1
2.	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Throughout the Semester	Assignments (20) Attendance (5)

**Course Outcomes (COs) contribution to the Program Outcomes (POs)**

Course Outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	1	2	3	3	3	1	2	1	2	3	2.25
CO-2	3	3	0	1	3	3	3	1	1	1	2	3	2
CO-3	3	3	0	1	3	3	3	1	1	1	2	3	2
CO-4	3	3	2	2	3	3	3	3	3	2	3	3	2.75
CO-5	3	3	3	2	2	3	3	2	1	2	1	2	2.25
Average	3	3	1.2	1.6	2.8	3	3	1.6	1.6	1.4	2	2.8	

# Disaster Risk Analysis and Management

Course Code: 22B1WCE831

Course Credits: 3 Core/Elective:

Open Elective L–T–P: 3–0–0

**Pre–requisite:** Engineering Mathematics, Introduction to Statistics

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## Course Objectives:

After occurrences of disasters such as Nepal Earthquake, Tsunami and Earthquake in 2011 in Japan, it has become obvious that all communities should be prepared for disasters across the world. An approach which uses concepts of Information Technology to understand, assess, and manage various disasters is the new way forward. In this course, students will understand application of basics of data analysis in real–life Civil Engineering problems and further develop strategic plans to manage various types of disasters including earthquakes, floods, pandemics, wars, cyber theft, etc.

## Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO–1	To understand the practical applications of probability and statistics in engineering problems.	Assessment
CO–2	To understand the various types of disasters/hazards and assessing the risk of their occurrences.	Assessment
CO–3	To understand and analyze the fragility of various systems subjected to hazards.	Assessment
CO–4	To be able to use information technology in disaster planning, management, and response.	Application

## Course Contents:

S. No.	Contents	Lectures Required
1.	Introduction to Risk Assessment and Information Technology concepts required for the course	2
2.	<b>Probability and Statistics Basics Revision:</b> Set Theory, Probability Concepts: Understanding of Probability, Conditional Probability, Baye’s Theorem, Total Probability Theorem, Evaluation of Mean, Median, Standard Deviation, Variability), Random Variables, Discrete Random Variables, Continuous Random Variables, Probability Distributions, Confidence Intervals, Hypothesis Testing, Regression and Correlation, Monte Carlo Simulation, Goodness of Fit	6

3.	<b>Hazards:</b> Introduction to Disasters and Catastrophic events (Seismic, Flood, Tsunami, Hurricane, Industrial Disaster, Economic Crisis, Pandemics, Cyber Security Threat, War), Risk/Hazard Assessment, Multi-Hazard Risk Assessment	10
4.	<b>Probabilistic Risk Assessment:</b> Risk Assessment of Systems subjected to a hazard, Fault Tree and Event Tree Analysis, Fragility Analysis, Failure Probabilities & Initiating Events, Uncertainties (Epistemic & Aleatory), Uncertainty Quantification	10
5.	<b>Disaster Planning:</b> Disaster Preparedness by planning and placement of IT components in an area, Disaster Mitigation by setting monitoring networks and protocol, Risk Assessment of IT components in various hazards.	10
6.	<b>Disaster Management:</b> Introduction to Disaster Management, Disaster Response of all stakeholders.	4
<b>TOTAL</b>		<b>42</b>

**Suggested Textbook(s):**

1. Biswal, Purna Chandra, Probability and Statistics, Prentice Hall.
2. Devore, J.L., Probability and Statistics for Engineers, Thomson Asia Pte. Ltd.
3. Rao S.S, Engineering Optimization, theory and practice, New Age International
4. Pandey, Mrinalini, Introduction to Disaster Management, Wiley India

**Suggested Reference Book(s):**

1. Nikolaidis, E., Engineering Design Reliability Handbook, CRC Press

**Other useful resource(s):**

1. Link to NPTEL course: <https://nptel.ac.in/courses/111/104/111104146/>

**Evaluation Scheme:**

S. No.	Exam	Marks	Duration	Coverage/Scope of Examination
1.	T-1	15	1 hr	Syllabus up to T-1
2.	T-2	25	1.5 hrs	Syllabus up to T-1 (5 marks) Syllabus up to T-2 (20 marks)
3.	T-3	35	2 hrs	Syllabus up to T-1 (5 marks) Syllabus up to T-2 (5 marks) Syllabus up to T-3 (25 marks)
4.	Teaching Assessment	25	Throughout the Semester	Course Project (20) Attendance (5)

**Course Outcomes (COs) Contributions to the Program Outcomes (POs):**

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	3	3	2	1	2	2	0	0	1	1	1	3	1.6
CO-2	3	3	3	2	2	3	0	0	1	2	1	3	1.9
CO-3	3	3	1	3	3	3	1	0	1	2	1	3	2
CO-4	3	3	3	3	3	3	3	2	3	3	3	3	2.9
<b>Average</b>	3	3	2.25	2.25	2.5	2.75	1	0.5	1.5	2	1.5	3	

# REMOTE SENSING AND GEOMATICS

COURSE CODE: 22B1WCE731

COURSE CREDITS: 3

CORE/ELECTIVE: OPEN ELECTIVE

L-T-P : 3-0-0

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**Pre-requisites:** None

## **Course Outline:**

With development of various hard and soft technologies in last two decades, advanced mapping techniques have evolved. It gives a paradigm shift as conventional surveys are superseded by advanced surveying techniques, which are not only accurate and flexible but require minimum time to acquire large amount of 3D data. Therefore, these techniques have been extensively used in many areas of engineering by students, researchers, and industries. On the other hand, the fundamental concepts of most of the advanced surveying techniques are not clear to all users. This course will introduce the students to the state-of-the-art concepts and practices of modern surveying, remote sensing and GIS. It starts with the fundamentals of surveying and remote sensing and GIS and subsequently advanced methods will be covered.

## **Course Objectives:**

1. To familiarize students with the modern methods of collection and processing of topological data.
2. To introduce the students to the fundamentals of satellite-based surveying.
3. To enable the students to carry out detailed survey of any location using satellite data and advanced image processing techniques.

## **Course Outcomes:**

S. No.	Course Outcomes	Level of Attainment
CO-1	Understanding of the need and concepts of modern surveying	Understanding
CO-2	Application of Remote Sensing and GIS to collect topological data.	Application
CO-3	Analysis of satellite data using digital image processing to get details of topology	Analysis

## Course Contents:

Unit	Contents	Lectures Required
1.	<p><b>Fundamentals of Remote Sensing</b> – Principle and Components, Energy Source and Interactions, EM Radiation and EM Spectrum, Elements of Remote Sensing, Platforms, Types of RS</p> <p><b>Photogrammetry</b> Classification, Aerial photographs, Aerial cameras, Relief Displacement, Flight planning, Global Positioning System</p> <p><b>Image Interpretation</b> Principles, interpretation keys, Elements of special and spectral Identification, Generation of thematic maps, Radar image interpretation</p>	10
2.	<p><b>Digital Image Processing</b> Image rectification, enhancement, transformation and classification, data merging and GIS Integration, Geometric corrections</p> <p>Co-registration of Data, Ground Control Points (GCP) Atmospheric corrections, Solar illumination corrections, Concept of color, Color composites</p>	9
3.	<p>Satellites and orbits, Polar orbiting satellites, Spectral, radiometric and spatial resolutions, Temporal resolution of satellites</p> <p>Multispectral, thermal and hyper spectral sensing, Some remote sensingsatellites and their features</p>	5
4.	<p><b>Fundamental Concepts of GIS</b> Definition, GIS architecture, components, Operations, Objectives, Data exploration, Thematic layering, Topology</p> <p><b>GIS Data Modals</b> spatial, vector, raster, image, attribute data models, digital elevation model</p>	5
5.	<p><b>Data Acquisition</b> Digitizers, data processing, functions of GIS, spatial data relationships</p> <p><b>Maps and map projections</b> Types, scale, characteristics</p> <p>Coordinate system, Application of GIS</p>	6
6.	<p><b>ARC GIS</b> Introduction, mapping the real world with vector and raster data, Mapping Locations with Coordinate Systems, flattening the earth with map projections, application of ARC GIS</p>	7
– TOTAL		42

### Suggested Textbook(s):

1. Gopi S., Sathikumar R. and Madhu N., “Advance Surveying”, third edition, 2010, Pearson.
2. Burrough, P.A., and McDonnell, R.A., ‘Principles of Geographical Information Systems’, 2nd Edition, Oxford University Press, 1998.

- Demers, M. N., Fundamentals of Geographic Information Systems, John Wiley & Sons, 3rd Edition, 2002.

### Suggested Reference Book(s):

- 'Remote Sensing and Image Interpretation', T.M. Lillesand and R.W. Kiefer, John Wiley & Sons, Singapore, 2002.
- 'Introduction to Remote Sensing', J.B. Cambell, Taylor & Francis, UK, 2002.
- 'Remote Sensing - Principles and Interpretation', F.F. Sabins Jr, W.H. Freeman & Co., New York, 1986.
- 'Remote Sensing - Models and Methods for Image Processing', R.A. Schowengerdt, Elsevier India Pvt. Ltd., New Delhi, 2006.

### Other useful resource(s):

Link to NPTEL courses:

- [h https://nptel.ac.in/courses/105/103/105103176/](https://nptel.ac.in/courses/105/103/105103176/)
- [h https://nptel.ac.in/courses/105/104/105104100/](https://nptel.ac.in/courses/105/104/105104100/)
- [h https://nptel.ac.in/courses/105/101/105101206/](https://nptel.ac.in/courses/105/101/105101206/)
- [h https://nptel.ac.in/courses/121/107/121107009/](https://nptel.ac.in/courses/121/107/121107009/)
- [h https://nptel.ac.in/courses/105/103/105103193/](https://nptel.ac.in/courses/105/103/105103193/)

### Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1.	T-1	15	1 Hour.	Syllabus covered upto T-1
2.	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Throughout the Semester	Assignment (4) – 10 Quizzes (2)-10 (Best Score) Attendance - 5

### Course Outcomes (COs) contribution to the Program Outcomes (POs)

Course Outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	1	1	2	2	3	1	1	1	2	2	1	2	1.583
CO-2	2	2	2	2	3	2	1	1	2	1	1	2	1.75
CO-3	2	3	3	3	3	2	1	1	2	2	1	2	2.083
Average	1.667	2	2.333	2.333	3	1.667	1	1	2	1.667	1	2	



## Introduction to Sustainable Engineering and Energy Efficient Buildings

COURSE CODE: 22B1WCE832

CREDITS: 3

CORE/ELECTIVE: OPEN

ELECTIVEL-T-P: 3-0-0

**Pre-requisites:** None

### Course Objectives:

1. Understanding the concept of Sustainability
2. Introduction to various kinds of Pollutions and Global Environmental issues.
3. Understanding fundamentals Life Cycle Analysis.
4. Understanding the concept of EIA in India EMS and ISO 14001.
5. Introducing green Rating Systems and Energy Efficient Buildings.

### Course Outcome

S. No.	Course Outcomes	Level of Attainment
CO-1	Introduction to the concept of Sustainability	Familiarity
CO-2	Introduction to various kinds of Pollutions and Global Environmental issues.	Familiarity
CO-3	Understanding fundamentals Life Cycle Analysis	Usage and Assessment
CO-4	Understanding the concept of EIA in India EMS and ISO 14001.	Familiarity
CO-5	Introducing green Rating Systems and Energy Efficient Buildings.	Usage and Assessment

### Course Content

Unit	Concept	Lectures
1	<b>Understanding the concept of Sustainability</b> Introduction of the concept of Sustainability; Sustainable Development; Nexus between Technology and sustainable development; challenges to sustainable development; multilateral environmental agreements and protocols; clean development mechanism; Environmental legislations in India;	6

	Various measures adopted to promote sustainability; Carbon Credits and Carbon trading footprints.	
<b>2</b>	<b>Understanding about Pollution and Various Environmental Issues</b> Air Pollution; Effects of Air pollution; Water Pollution; Solid waste Management; Concept of Zero Waste; 3R concept; Global Environmental Issues; Global Warming; Ozone Depletion; Regional and Local Environmental Issues.	<b>7</b>
<b>3</b>	<b>Overview of LCA; EIA and EMS.</b> Environmental Management Standards; ISO 14000 series; Life Cycle Analysis; Environmental Impact Assessment; Procedures for EIA in India	<b>7</b>
<b>4</b>	<b>Understanding of Sustainable Materials</b> Concept of Sustainable Materials; Material Selection for sustainable design; Components of embodied energy, calculation of embodied energy for materials.	<b>5</b>
<b>5</b>	<b>Energy Efficient Systems and green building systems</b> Green buildings rating Systems Heating and ventilation design- Human thermal comfort, climatological factors, material specifications and heat transfer principles, Thermal performance evaluation, Heat loss from buildings, design of artificial ventilation system, design of insulators. Design audits & economic optimization- Concept of cost/benefit of energy conservation & carbon footprint estimation. Energy efficient lighting system design: Basic terminologies and standards, day lighting and artificial lighting design. Life Cycle energy use. Control of energy use in building, of LEED and TERI GRIHA ratings. Role of insulation and thermal properties of construction materials, influence of moisture content and modeling. Performance ratings of green buildings. Zero energy building.	<b>17</b>
<b>Total lectures</b>		<b>42</b>

## NPTEL

<https://nptel.ac.in/courses/105/102/105102175/>  
<https://nptel.ac.in/courses/105/102/105102175/>  
<https://nptel.ac.in/courses/105/105/105105157/>  
<https://nptel.ac.in/courses/127/105/127105018/>

## Textbooks

1. National Building code
2. Energy Efficiency and Management Mehmet Kanoglu; Yunus A Cengel
3. Larry W Canter: Environmental Impact Assessment, Mc Graw Hill Publishers.
4. Introduction To Sustainability Environmental Social And Personal Perspectives 2Nd Edition by Martin Mulligan, Taylor & Francis

## Evaluation Scheme

S. No.	Exam	Marks	Duration	Coverage/Scope of Examination
1.	T-1	15	1 Hour.	Syllabus covered upto T-1
2.	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	Quiz (Best of 3) – 15 Marks Quiz (1) 5 Attendance - 5

## Course Outcomes (COs) contribution to the Program Outcomes (POs)

Course Outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	2	1	2	2	2	3	3	3	1	2	3	3	2
CO-2	2	2	2	2	2	3	3	2	2	2	3	3	2
CO-3	3	2	2	2	2	3	3	3	2	1	2	3	2
CO-4	2	2	2	2	2	2	3	3	2	2	3	3	2
CO-5	2	1	2	2	2	2	3	2	2	2	2	3	2
Average	2	1	2	2	2	2	3	2	1	2	2	3	

# GEOINFORMATICS

COURSE CODE: 23B1WCE531

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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**Pre-requisites:** Knowledge of surveying, map reading and basic mathematics

## Course Objectives:

1. To apply the concepts of Photogrammetry and its applications.
2. Understand the basic concept of Remote Sensing and know about different types of satellite and sensors.
3. To understand Energy interactions with atmosphere and with earth surface features, Interpretation of satellite and top sheet maps
4. Understand different components of GIS and Learning about map projection and coordinate system.

## Course Outcomes:

S. No.	Course Outcomes	Level of Attainment
CO-1	Understand the concepts of Photogrammetry	Understanding
CO-2	Understand the principles of aerial and satellite remote sensing and to comprehend the energy interactions with earth surface features	Understanding
CO-3	Understand the spatial and non spatial data features in GIS and understand the map projections and coordinates systems	Analysis
CO-4	Apply knowledge of GIS and understand the integration of Remote Sensing and GIS	Familiarity

## Course Contents:

Unit	Contents	Lectures Required
1.	<b>Introduction</b> – Basic concepts and foundation of Remote Sensing elements, Data information, Remote sensing data collection, Electromagnetic spectrum, Energy interaction with the atmosphere and with earth surface features, Types of Platforms and Sensors, Imaging Systems; Non-Imaging Sensors; Across Track and Along Track Scanners	8
2.	<b>Image Interpretation</b> – Principles, interpretation keys, Elements of special and spectral Identification, Generation of thematic maps, Radar image interpretation, Supervised and Unsupervised classification	6
3.	<b>Microwave Remote Sensing</b> – Scattering of Microwaves, Synthetic Aperture Radar, SAR vs RAR, understanding RAR imagery	6
4.	<b>Geographical Information System:</b> Introduction to GIS, Components of GIS, Geospatial data: Spatial Data – Attribute Data- Joining Spatial and Attribute Data, GIS Operations: Spatial Data input- Attribute Data Management-Data Display-Data Exploration-Data Analysis.	7
5.	<b>Vector data model</b> - Representation of simple features- Topology and its importance: coverage and its data structure, shape file:, data models for composite features Object Based Vector Data Model; Classes and their Relationships <b>Raster data model</b> - Elements of Raster data model: Types of Raster data: Raster data structure: Data conversion, Integration of Raster and Vector data.	8
6.	<b>Introduction to QGIS</b> – Interface, creating shape file, creating basic map, raster and vector analysis	7
<b>TOTAL</b>		<b>42</b>

### Suggested Textbook(s):

1. George Joseph, 'Fundamentals of Remote Sensing', 2<sup>nd</sup> edition, 2013.
2. Gopi S., Sathikumar R. and Madhu N., "Advance Surveying", third edition, 2010, Pearson.
3. Burrough, P.A., and McDonnell, R.A., 'Principles of Geographical Information Systems', 2nd Edition, Oxford University Press, 1998.
4. Demers, M. N., Fundamentals of Geographic Information Systems, John Wiley & Sons, 3rd Edition, 2002.

### Suggested Reference Book(s):

1. 'Remote Sensing and Image Interpretation', T.M. Lillesand and R.W. Kiefer, John Wiley & Sons, Singapore, 2002.
2. 'Introduction to Remote Sensing', J.B. Campbell, Taylor & Francis, UK, 2002.
3. 'Remote Sensing - Principles and Interpretation', F.F. Sabins Jr, W.H. Freeman & Co., New York, 1986.

- 'Remote Sensing - Models and Methods for Image Processing', R.A. Schowengerdt, Elsevier India Pvt. Ltd., New Delhi, 2006

**Other useful resource(s):**

Link to NPTEL courses:

- <https://nptel.ac.in/courses/105/103/105103176/>
- <https://nptel.ac.in/courses/105/104/105104100/>
- <https://nptel.ac.in/courses/105/101/105101206/>
- <https://nptel.ac.in/courses/121/107/121107009/>
- <https://nptel.ac.in/courses/105/103/105103193/>

**Evaluation Scheme:**

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1.	T-1	15	1 Hour.	Syllabus covered upto T-1
2.	T-2	25	1.5 Hours	Syllabus covered upto T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Throughout the Semester	Assignment (4) – 10 Quizzes (2)-10 (Best Score) Attendance - 5

**Course Outcomes (COs) contribution to the Program Outcomes (POs)**

Course Outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	Average
CO-1	1	2	2	3	3	1	1	3	2	2	2	2	2
CO-2	2	2	2	2	3	2	1	1	2	2	2	2	1.9
CO-3	2	3	3	3	2	2	1	3	2	2	1	2	2.16
CO-4	1	1	2	2	3	2	2	3	2	3	2	3	2.16
Average	1.5	2	2.25	2.5	2.75	1.75	1.25	2.5	2	2.25	1.75	2.25	