

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. TECH (CIVIL ENGINEERING) 1st SEMESTER

S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Humanities & Social Science	18B11HS111	English and Technical Communication	2	0	0	2	2
2	Humanities & Social Science	18B17HS171	English and Technical Communication Lab	0	0	2	1	2
3	Basic Science Courses	18B11MA111	Engineering Mathematics -I	3	1	0	4	4
4	Basic Science Courses	18B11PH111	Engineering Physics-I	3	1	0	4	4
5	Basic Science Courses	18B17PH171	Engineering Physics Lab - I	0	0	2	1	2
6	Engineering Science Course	18B11CI111	Programming for Problem Solving	3	0	0	3	3
7	Engineering Science Course	18B17CI171	Programming for problem solving Lab	0	0	2	1	2
8	Engineering Science Courses	18B17GE173	Engineering Graphics OR	0	0	3	1.5	3
		18B17GE171	Workshop Practice					
9		18B17GE172	Mandatory Induction Program	-	-	-	-	-
				Total			17.5	22

B. TECH (CIVIL ENGINEERING) 2nd SEMESTER

S.No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Engineering Science Courses	18B11EC211	Electrical Science	3	1	0	4	4
2	Engineering Science Courses	18B17CI211	Data Structure & Algorithms	3	1	0	4	4
3	Basic Science Courses	18B11MA211	Engineering Mathematics -II	3	1	0	4	4
4	Basic Science Courses	18B11PH211	Engineering Physics-II	3	0	0	3	3
5	Basic Science Courses	18B17PH271	Engineering Physics Lab -II	0	0	2	1	2
6	Engineering Science Courses	18B17EC271	Electrical Science Lab	0	0	2	1	2
7	Engineering Science Courses	18B17CI271	Data Structure & Algorithms Lab	0	0	4	2	4
8	Engineering Science Courses	18B17GE171	Workshop Practice OR	0	0	3	1.5	3
		18B17GE173	Engineering Graphics					
				Total			20.5	26

B. TECH (CIVIL ENGINEERING) 3rd SEMESTER								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Engineering Science Courses	18B11CE315	Engineering Mechanics	3	0	0	3	3
2	Professional Core Courses	18B17CE373	Concrete Technology Lab	0	0	2	1	2
3	Professional Core Courses	18B11CE313	Building Materials & Construction	3	0	0	3	3
4	Professional Core Courses	18B11CE312	Surveying	3	0	0	3	3
5	Professional Core Courses	18B11CE314	Water Supply Engineering	3	0	0	3	3
6	Professional Core Courses	18B17CE372	Surveying Lab	0	0	2	1	2
7	Basic Science Courses	18B11CE311	Chemistry	3	0	0	3	3
8	Basic Science Courses	18B17CE371	Chemistry Lab	0	0	2	1	2
9	Basic Science Courses	18B11MA311	Numerical Methods	3	0	0	3	3
10	Humanities & Social Science	18B11HS311	Interpersonal Dynamics, Values and Ethics	3	0	0	3	3
				Total			24	27

B. TECH (CIVIL ENGINEERING) 4th SEMESTER								
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	18B11CE412	Fluid Mechanics	3	0	0	3	3
4	Professional Core Courses	18B11CE414	Water Resources 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	18B17CE472	Fluid Mechanics Lab	0	0	2	1	2
8	Humanities & Social Science	18B11HS411	Finance and Accounts	3	0	0	3	3
9	Mandatory Courses	18B11GE411	Environmental Studies	2	0	0	0	2
				Total			18	23

B. TECH (CIVIL ENGINEERING) 5th 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) 6th SEMESTER								
S. No.	Category Code	Subject Code	Name of the Subjects	Course Hours			Credits	Total Hours
				L	T	P		
1	Professional Core Courses	18B11CE611	Concrete Technology	3	0	0	3	3
2	Professional Elective Courses		Elective -2	3	0	0	3	3
3	Professional Core Courses	18B11CE612	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. TECH (CIVIL ENGINEERING) 7th SEMESTER

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	0	1
				Total			18	25

B. TECH (CIVIL ENGINEERING) 8th SEMESTER

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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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
						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

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	0	0	3	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	0	0	3	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	0	0	3	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
	Total credits		160
Credit breakup for B.Tech (CE)			
S.No.	Semester	Proposed Credits	Credit breakup for B.Tech (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	
	Total	160	

B.TECH. CIVIL ENGINEERING
SYLLABUS

Engineering Graphics

COURSE CODE: 18B17GE173

COURSE CREDITS: 1.5

CORE/ELECTIVE: CORE

L-T-P: 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
Total Lab hours		36

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
	Total	100 marks

Workshop Practices

COURSE CODE:18B17GE171

COURSE CREDITS: 1.5

CORE/ELECTIVE: CORE

L-T-P: 0-0-3

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

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	Introduction to Engineering Mechanics: 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	Plane truss and Space truss: Perfect, Deficient and Redundant Trusses, Assumptions, Nature of Forces in Members, Methods of Analysis, Method of Joints, Method of Section.	8
3	Distributed forces, center of gravity and moment of inertia: 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.	8
4	Simple stresses and strains: 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.	9
5	Beams: 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.	9
Total lectures		42

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:

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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
Total hours		30

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:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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	Bricks: Classification, properties and selection criteria of bricks, burning of bricks, tests for bricks.	2
2	Stones: Stone classification, characteristics of good building stone, common building stones in India, Limestone.	1
3	Timber: Characteristics of good timber, defects in timber, seasoning of timber, plywood.	2
4	Miscellaneous Materials: Cement, Concrete, steel, glass, plastics, P.V.C., paint, varnish, adhesive materials, bitumen, ceramics.	7

5	Buildings and Walls: Classification of buildings, types of walls	1
6	Brick Masonry: Technical terms, types of bonds, strength of brick masonry, defects in brick masonry, reinforced brickwork	2
7	Stone Masonry: Technical terms, stones, cutting and dressing, lifting of stones, joints in stone masonry, classification of stone masonry, selection of stone for masonry	1
8	Plastering and Pointing: 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	Roofs and Floors: Types and construction of roofs, features, necessity, arches, lintels, types & construction of ground floor, upper floor, floor finishes	3
10	Doors and Windows: Location, Technical terms of door & window, door frame, size, designation of door and window, types of door & window	2
11	Damp Proofing and Termite Proofing: Causes, effects, various methods and material used for damp proofing and termite proofing	3
12	Stairs: Technical terms, requirements, dimension of step, types and classification of stairs	3
13	Paints, Distemper, White wash and Color wash: Paints and Paintings, characteristics of ideal paint, Constituents of paint, defects in paintings, painting on different surfaces, classification and type of paints, Distemping & process of distemping, white washing & color washing	5
14	Scaffolding: Components and types of scaffolding	2
15	Sound and Fire proof construction: 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, characteristics of fire resisting materials, fire alarms, fire extinguishing equipments.	4
Total lectures		42

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,11th Edition, Lakshmi Publications,2016.
3. M.L Gambhir, Neha Jamwal, Building Materials, Mc Graw Hill, 2014

Suggested Reference Book(s):

1. Rangwala, Building Construction, 33rd 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)

Course Outcomes (Building Materials and Construction)	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	3	2	2	3	3	1	2	2	2	2	2.17
CO-2	3	1	3	3	3	1	3	3	3	3	2	3	2.58
CO-3	2	2	3	1	3	2	2	2	2	2	1	2	2
CO-4	3	3	3	3	2	3	1	2	3	1	3	3	2.5
Average	2.5	2	3	2.25	2.5	2.25	2.25	2	2.25	2	2	2.25	

Surveying

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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. These plans form the basis for the design of the construction, and so the reliability of the design depends heavily on the attention to detail with which the survey is carried out.
2. To determine the required areas and volumes of land and materials needed during construction.
3. To ensure that the construction takes place in the correct relative and absolute position on the ground.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Perform a boundary survey and preparation of engineering maps.	Familiarity
CO-2	Basic principles of various methods of surveying, and related problems.	Assessment
CO-3	To determine the required areas and volumes of land and materials needed during construction.	Assessment
CO-4	Will be able to get correct relative and absolute position on the ground where construction is required.	Assessment
CO-5	Basic knowledge of modern survey equipments, Implement procedures for its use and care of field equipment.	Assessment
CO-6	Apply various corrections in different measurement and methods.	Assessment

Course Contents:

Unit	Contents	Lectures required
1	Introduction: Classification of Surveying, Principles of Surveying,	1
2	Chain Surveying: 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	Compass surveying: Instruments (prismatic and surveyor compass), bearing and angles, magnetic declination, local attractions.	3
4	Leveling: 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	Contouring: Contours, contour interval, contour gradient, characteristics of contours, methods of locating contours and their interpretation, uses of contour maps.	4
6	Plane Table Surveying: Instruments, principle and methods of plane-tableing, three-point problem, two-point problem, errors in plane tabling, advantages and disadvantages.	4
7	Tacheometric and Theodolite: Surveying: transit and non-transit, definition and terms, measurement of horizontal and vertical angles, instruments and tachometric method	5
8	Modern Field Survey Systems: 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	Curves: 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	Remote Sensing: 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.	5
11	Photographic Surveying: Principles, advantages of aerial photography	4

Total lectures	42
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Suggested Text Book(s):

1. S K Duggal: Surveying, 3rd Edition, Tata McGraw-Hill Publishing Company , 2012
2. A.M.Chandra: Plane Surveying, 2nd 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, 7th Edition, Pearson Education Asia, 2006
2. A.M.Chandra: Higher Surveying 2nd Edition, New Age International Publishers New Delhi, 2006
3. Clark David: Plane and Geodetic surveying for Engineers, vol-1 & vol-2, 6th 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:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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

2	<p>Treatment of water: 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>Water softening: Importance of water softening; lime- soda process; zeolite process.</p> <p>Miscellaneous treatment methods: Removal of color, odor and taste, iron and manganese; fluoridation and de-fluoridation.</p>	12
3	<p>Disinfection: Methods of disinfection; chlorination and its types.</p>	5
4	<p>Collection and Distribution of water: 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>Pipes-Joints-Fittings: various types of conduits; testing and inspection; joints in pipes; valves in pipe line.</p> <p>Pumps and pumping stations: Types of pumps and their choice; pumping stations; economical diameter of rising main; hand pumps; pump testing; Water hammer and its control measures.</p>	15
Total lectures		42

Suggested Text Book(s):

1. J. S Birdie, G S Birdie: Water Supply and Sanitation Engineering, 9th 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, 2nd Edition, Laxmi Publications. India, 2016

Suggested Reference Book(s):

1. H. Peavy, D. Rowe, G. Tchobanoglous "Environmental Engineering", 1st 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	2.08
CO-2	3	2	2	2	3	2	2	2	3	1	1	2	2.08
CO-3	3	2	3	2	3	3	2	3	3	1	2	1	2.33
CO-4	2	3	3	2	3	2	3	2	3	1	2	1	2.25
Average	2.5	2.5	2.5	2	3	2.25	2.25	2.25	3	1.25	1.5	1.25	

Surveying Lab

COURSE CODE:

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
Total Lab hours		22

Suggested/Resources:

1. S K Duggal: Surveying, 3rd Edition, Tata McGraw-Hill Publishing Company , 2012
2. A.M.Chandra: Plane Surveying, 2nd 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
CO4	3	3	3	2	3	2	1	3	3	3	3	3	2.67
Average	2	2	3	3	3	3	1	2	3	3	2	3	

Chemistry

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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	Chemical Bonding and Characteristics of solids: 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	Physical Chemistry: 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	Applied Chemistry: 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	Chemistry of Materials: Polymers, Introduction, Specific uses of important polymers, ceramics, Types of ceramics, Refractories, Glasses, Types of glasses, Zeolites, Clay minerals.	6
5	Environmental Chemistry: Atmospheric pollution, Composition of the atmosphere, Residence times, Sources and reactions of some of its constituents and pollutants, (CO ₂ , NO _x , So _x ,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
Total lectures		42

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	1.4
CO-2	2	3	3	3	3	-	2	1	2	2	-	2	1.91
CO-3	3	3	3	3	3	1	2	-	3	-	2	1	2.0
CO-4	2	3	3	3	3	-	1	1	2	2	-	1	1.75
CO-5	2	3	3	3	3	1	1	1	2	2	1	1	2.0
CO-6	3	3	3	3	3	1	-	1	3	3	-	2	2.08
Average	2.5	2.83	2.83	2.83	2.83	1.0	1.6	1.0	2.4	1.8	1.5	1.3	

Chemistry Lab

COURSE CODE:

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
Total Lab hours		22

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

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
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	

Mechanics of Solids

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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	Mechanics of Deformable Solids: Definition of stress and strain. Hooke's law for axial loads. Constants of elasticity: Young's modulus, shear modulus, Poisson's ratio.	7
2	Axial load: 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	Torsion of circular bars: Computation of shear stress, Hooke's law for shear; design of circular bars. stress distributions in beams.	3
4	Complex Stresses: 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	Shear Force and Bending Moment Diagram: Relationships between loads, shear force and bending moment. Shear force and bending moment diagram for different beams and their application.	5
6	Bending Stress: 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	Slope and deflection of beams: Differential equation of the deflection curve, double integration method, Macaulay's method, moment area method and conjugate beam method.	7
8	Buckling of columns: The ideal pin-ended column; Euler buckling load; the effect of end conditions on column buckling.	3
Total lectures		42

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
Average	3	2.8	3	2.6	2.2	1.6	1	2.2	2.8	2.4	2.2	2.2	

Computer Aided Civil Engineering Drawing

COURSE CODE:

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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

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:

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

Fluid Mechanics

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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.

Course Outcomes:

S.No.	Course Outcomes	Level of Attainment
CO-1	Knowledge of basic fundamental of fluid and fluid flow characteristics.	Familiarity
CO-2	The students will understand basic methods to determine pressure measurement of fluid	Assessment
CO-3	They will understand various principles of pipe flow	Assessment
CO-4	Understanding of principles of basic fluid flow measurement instruments and techniques.	Assessment
CO-5	They will develop understanding of methods of dimensional analysis & modeling criteria.	Assessment
CO-6	The students will be able to use the subject knowledge in real life problems	Assessment

Course Contents:

Unit	Contents	Lectures required
1	Properties of fluid: mass density, specific weight, specific volume, specific gravity; Viscosity, Newton's Law of viscosity, Types of Fluids, Surface tension and Capillarity.	4
2	Pressure and its Measurement: Pascal's Law, Pressure variation in a fluid at rest, Measurement of pressure: Manometers	4

3	Hydrostatic forces on surfaces: Total pressure and centre of pressure, Pressure measurement on Vertical plane surface, horizontal plane surface, curved surface and Inclined surface	4
4	Buoyancy and Flotation: Buoyancy, Metacentre, Metacentric height, Experimental method of determination of metacentric height	3
5	Kinematics of fluid flow: 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.	5
6	Dynamics of fluid flow: Euler's equation, Bernoulli's equation & its applications, Impulse-momentum equation & its applications, Flow measurements: Venturimeter, Pitot-tube, Orifice-meter	6
7	Dimensional analysis: methods of analysis, Rayleigh's method, pie-Buckingham theorem, Dimensionless numbers.	4
8	Forces on submerged bodies: drag and lift force, Expression for drag and lift, Drag on a sphere, Drag on a cylinder, Karman vortex trail	4
9	Flow through pipes: 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.	8
Total lectures		42

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)

Course Outcomes (Fluid 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	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
Average	3	3	3	2.67	2.33	2.5	0	0	1.67	1.8	1.67	3	

Water Resource Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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 ground water.
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

Course Contents:

Unit	Contents	Lectures required
1	Engineering Hydrology: Hydrological cycle, ground and surface water resource, single and multipurpose projects, precipitation, snowfall and snowmelt, evaporation, transpiration, depression storage, infiltration, overland flow, stream flow measurements, hydrograph, flood frequency analysis, flood estimation	20
2	Ground water: Specific yield, storage coefficient, coefficient of permeability, confined and unconfined aquifers, aquitards, radial flow into a well under confined and unconfined conditions, tube wells, pumping and recuperation tests, ground water potential	6
3	Irrigation Engineering: 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, 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.	9
4	Canal system: Distribution systems for canal irrigation, canal capacity, canal losses, alignment of main and distributary canals, most efficient section, lined canals, their design, regime theory, critical shear stress, bed load, local and suspended load transport, cost analysis of lined and unlined canals, drainage behind lining.	7
Total lectures		42

Suggested Text Book(s):

1. S. K.Garg: Irrigation Engineering and Hydraulic Structures, Khanna Publishers, 2005.
2. K.Subramanya: Engineering Hydrology, McGraw Hill Education, 2005.
3. S. K.Garg: Hydrology and Water Resources Engineering, Khanna Publishers, 2005

Suggested Reference Book(s):

1. Ven T Chow, David R Maidment, Larry W Mays: Applied Hydrology, McGraw Hill Education, 1988.

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 Resource 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	1	3	2	2	3	2	3	1	1	2	2.08
CO-2	3	3	2	1	3	2	3	2	3	1	1	1	2.08
CO-3	3	2	2	1	3	2	2	3	2	1	1	2	2.00
CO-4	3	3	3	1	3	1	3	2	3	1	1	1	2.08
CO-5	3	3	2	2	3	2	2	2	3	1	1	1	2.08
Average	3.00	2.60	2.00	1.60	2.80	1.80	2.60	2.20	2.80	1.00	1.00	1.40	

Geotechnical Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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	Introduction, soil formation and structure: 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	Soil properties, index properties and classification: 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	Effective stress, permeability and seepage analysis: Capillarity, Total effective and neutral stresses, Darcy's law, permeability and its factors, seepage, flow- nets, Piping, filters and filter design	8
4	Compaction, Consolidation and Stress distribution: 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	Shear strength of soil: 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	Earth pressure Theories: Concept Earth pressure: Rankine and Terzaghi's Classical Theories, graphical charts	5
7	Stability of slopes: 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
Total lectures		42

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:

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 course-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
Total Lab hours		24

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	

Fluid Mechanics Lab

COURSE CODE:

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

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, 6th 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
Average	3	3	2.5	2	2.5	2.25	1.25	1	3	3	1.25	3	

Environmental Science

COURSE CODE:

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

L-T-P: 2-0-0

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	Unit 1: Multidisciplinary nature of environmental studies: The Multidisciplinary nature of environmental studies: Definition, scope	3

	and importance, Need for public awareness, Types of ecosystems, World Biomes, Ecosystem functioning, Biogeochemical cycles.	
2	Unit 2: Natural resources, their consumption & Protection: 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	Unit 3: Pollution- a threat to environment: 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	Unit 4: Environmental standards & Quality: Environmental standards & Quality: Air, Water & Soil Quality, Pollutant sampling, pollution control systems. Green Chemistry and its applications	3
5	Unit 5: Biodiversity and its conservation: Biodiversity loss: Diversity of flora and fauna, species and wild life diversity, Biodiversity hotspots, threats to biodiversity	4
6	Unit 6: Social Issues and the Environment: 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 population) 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	Unit 7: Human Population and the environment: 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	Unit 8: Field work: 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
Total lectures		30

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

Other useful resource(s):

1. Issues of the journal: Down to Earth, published by Centre for Science and Environment.
2. Audio visuals from: Discovery, National Geographic etc.
3. 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:

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	Introduction: Concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium	4

2	Indeterminacy: Static and kinematic indeterminacy of beam, frame and truss structures	4
3	Deflection: Deflection of truss, beam and frame structures by energy method.	3
4	Force Method: Solving Indeterminate beam, truss and frame by force method.	7
5	Theorems: Castigliano's theorem, Maxwell-Betti's theorem	2
6	Three Moment equation: Derivation and Application of three moment equation	2
7	Slope Deflection Equation: Derivation and application of slope deflection equation for beams and frames, support settlement and sway of frames	7
8	Moment Distribution Method: Application of Moment Distribution method for beams and frames, support settlement and sway of frames	7
9	Cables: Introduction to cables, General cable theorem and its application.	3
10	Arches: Three hinged arch, Two hinged arch	3
Total lectures		42

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)

Course Outcomes (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	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
Average	2.2	2.4	2.6	2.6	2.4	1.4	1.2	1	2	2.2	1.8	2.2	

Sewage Treatment and Disposal

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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	Collection of Sewage: 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	Sewage Characterization: Quality parameters- BOD, COD, Solids, D.O., Oil & Grease. Indian Standards for disposal of effluents into inland surface sources and on land	4
3	Sewage Treatment: Objectives, sequence and efficiencies of conventional treatment units. Preliminary treatment, screening and grit removal units. Theory and design aspects of primary treatment, secondary treatment- activated sludge process & its modifications, Tricking filter, sludge digestion and drying beds. Stabilization pond, aerated lagoon, UASB process, septic tank and Imhoff tank.	18
4	Disposal of Sewage: Disposal of sewage by dilution – self-purification of streams. Sewage disposal by irrigation (sewage treatment)	5
Total lectures		42

Suggested Text Book(s):

1. J. S Birdie, G S Birdie: Water Supply and Sanitation Engineering, 9th 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), 2nd Edition, Laxmi Publications. India, 2016

Suggested Reference Book(s):

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

Course Outcomes (Sewage Treatment and Disposal)	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	2	1	2	2	2	2	1	2	1.92
CO-2	3	2	2	2	3	2	2	2	2	1	1	1	1.92
CO-3	3	2	3	2	2	2	2	1	2	1	1	2	1.92
CO-4	2	2	2	3	2	2	2	1	2	3	2	2	2.08
Average	2.5	2.25	2.25	2.25	2.25	1.75	2.00	1.50	2.00	1.75	1.25	1.75	

Construction Technology and Management

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Introduction: Introduction to different types of contracts, owner – contractor relationship, the terms and conditions of a contract.	3
2	PERT and CPM Analysis: Relevance of construction schedules-Bar charts, the programme evaluation review technique method, calculations for critical path scheduling, activity float and schedules.	8

3	Construction Equipment's: Introduction to various operations in construction, execution and management.	3
4	Earth excavating, compacting, finishing and hauling machinery: Standard and special construction equipments, heavy earthmoving equipments, shovels and cranes, crushing plant, batching plant, bitumen plant.	6
5	Cost control: Selection of construction equipment cost of owning and operating, capacity and utilization, breakdown analysis, economic life, replacement of equipment and sinking fund.	6
6	Resource allocation and Updating: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.	10
7	Safety measures in construction design: Form works, their design, fabrication and uses. Uses and design of scaffoldings. Steel constructions; fabrication and erection techniques	6
Total lectures		42

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)

Course Outcomes (Construction Technology and 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	2	2	2	2	1	1	1	2	2	2	2	2
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	2.0
CO-5	2	2	3	3	3	2	2	1	3	2	2	2	2.25
Average	2	2.4	2.6	2.6	2.6	1.4	1.6	1	2.2	2.2	1.6	2	

Solid Waste Management

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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	Sources and Types: 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	On-Site Storage and Processing: 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	Collection and Transfer: Methods of Residential and Commercial Waste Collection, Collection Vehicles, Manpower Collection Routes, Analysis of Collection Systems, Transfer Stations – Selection of Location, Operation and Maintenance, Options Under Indian Conditions, Field Problems Solving.	8
4	Off- Site Processing: 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.	10
5	Land Disposal of Solid Waste; Sanitary Landfills – Site Selection, Design and Operation of Sanitary Landfills – Landfill Liners – Management of Leachate and Landfill Gas- Landfill Bioreactor– Dumpsite Rehabilitation	8
Total lectures		42

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. Chandrupa, 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 Management, 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 Kreith, Handbook of Solid waste Management, McGraw Hill, New York, 2002.
4. Bhide A.D. And Sundaresan, B.B. —Solid Waste Management Collection, Processing and Disposal, 2001.

Other useful resource(s):

1. http://www.utdallas.edu/~brikowi/Teaching/Environ_Geology/LectureNotes/WasteManagement/wasteManagement.pdf
2. <http://www.csupomona.edu/~fjjanger/ce457/ce457.htm>
3. 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
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
Average	2.5	2.5	2	2	1.5	2	1.75	1	-	-	-	1.5	

Air and Noise Pollution and Control

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Introduction: The earth's atmosphere: structure and composition.	3
2	Definition and Elements: Air pollution: definitions: types of pollutants, sources; effect of air pollution on health, environment and materials; air pollution episodes.	5
3	Meteorology: Air pollution meteorology: atmospheric circulation patterns, atmospheric stability and vertical mixing, lapse rate and	6

	temperature inversions.	
4	Dispersion Modelling: Atmospheric dispersions modelling: atmospheric stability classes, Gaussian model, estimation of downwind concentrations, plume rise, tall stacks, and critical wind speed.	8
5	Control of Particulate Matters: Control of particulate Matter: 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.	6
6	Control of Gaseous Emissions: Control of gaseous emissions: gas-liquid and gas solid equilibrium, solubility, absorption and kinetics. Gas absorption: physical and chemical absorption, isotherms, and absorption potentials.	6
7	Legislation and Regulations: Air Pollution Control Act, National Environmental Policy Act, Ambient Air Quality Standards.	4
8	Noise Pollution: Noise pollution definition, prevention and control measures, management of pollution.	4
Total lectures		42

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)

Course Outcomes (Air and Noise Pollution and Control)	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	1	1	1	1	2	x	x	x	2	1.33
CO-2	2	3	3	3	3	2	x	1	2	1	x	1	2.1
CO-3	2	3	3	3	3	2	2	1	2	1	x	1	2.1
CO-4	2	1	1	2	1	1	2	2	2	1	1	2	1.5
Average	2	2	2	2.25	2	1.5	1.67	1.5	2	1	1	1.5	

Environmental Engineering Lab

COURSE CODE:

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

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	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
Average	2	2	3	3	3	3	1	1	1	1	1	1	

Design of Concrete Structures

COURSE CODE:

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
Total lectures		42

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	2.08
CO-5	2	3	3	3	2	1	1	1	2	3	2	2	2.08
Average	2	2.6	2.6	2.6	2.4	1	1	1	2	2.4	1.6	2	

Highway Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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:

Unit	Contents	Lectures required
1	Importance of transportation, different modes, characteristics & Scope of highway engineering in India.	3
2	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	3
3	Highway cross section elements, Sight distance, Design of horizontal & vertical alignment	10
4	Traffic characteristics, traffic studies & analysis, flow & roadway capacity, traffic regulation & control, design of road intersections, parking & pedestrian facilities, highway lighting	4
5	Materials used in highway construction, soil, stone aggregates, bituminous binders, bituminous paving mixes, Portland cement & cement concrete	4
6	Flexible pavements: components, functions, stresses, design methods, Rigid pavements: components, functions, factors affecting performance of CC pavements, stresses, design methods	6
7	General features of highway construction, embankment & subgrade, excavation of earth, construction of flexible & rigid pavements	6
8	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.	6
Total lectures		42

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‘, PHI3.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:

COURSE CREDITS: 1

CORE/ELECTIVE: CORE

L-T-P: 0-0-2

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
Total no. of hours		30

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)

Course Outcomes (Highway Engineering Lab)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	Average
CO1	3	3	3	3	2	2	1	2	3	2	2	3	2.42
CO2	3	3	3	3	2	2	1	2	3	2	2	2	2.33
CO3	3	3	3	2	2	2	1	2	2	2	2	3	2.25
CO4	3	3	3	2	2	1	1	2	3	3	2	2	2.25
CO5	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	

Foundation Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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

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
Average	3	2.8	3	2.6	2.2	1.6	1	2.2	2.8	2.4	2.2	2.2	

Concrete Technology

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

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	Cement: Production, composition, and properties; cement chemistry; Types of cements; special cements.	8
2	Aggregates: Mineralogy; properties, tests and standards	8

3	Chemical and mineral admixtures: 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	Concrete mix design: Basic principles; IS method; ACI method; new approaches based on rheology and particle packing.	6
5	Concrete Production & Fresh concrete: Batching of ingredients; mixing, transport, and placement. Consolidation, finishing, and curing of concrete; initial and final set - significance and measurement. Workability of concrete and its measurement	4
6	Engineering properties of concrete: 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	Dimensional stability and durability: Creep and relaxation - parameters affecting; Shrinkage of concrete - types and significance. Parameters affecting shrinkage; measurement of creep and shrinkage.	4
Total lectures		42

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, 2011.

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/

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 (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	1.81
CO-2	1	2	1	2	2	1		2	3	3	1	3	1.91
CO-3	3	3	3	2	1	1	2	3	2		1	3	2.18
CO-4	3	2	1	3	1	2		1	3	2	3	3	2.18
CO-5	2	3	3	3	1	3		1	2	2	3	3	2.36
Average	2.4	2.2	2	2.2	1.2	2	1.5	1.6	2.4	2.33	2	3	

Advanced Structural Analysis

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Introduction: Revision of basics of structure analysis	2
2	Kani's Method: Kani's method to analyze simple portal frames	5
3	Flexibility Method: Derivation of flexibility method, compatibility equation and its application on truss, beams and frames, Flexibility matrix Method.	10

4	Influence Line: Influence line for indeterminate structures, Influence lines for indeterminate beams using Muller Breslau principle. Influence lines for arches and stiffening girders.	8
5	Stiffness Method: Degree of freedom, Derivation of stiffness matrix, transformation matrix for 2d beam, truss and frame, matrix solution for beam, truss and frame.	12
6	Approximate Analysis of frames: Approximate analysis of frames for vertical loads and horizontal loads on it.	5
Total lectures		42

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
Average	2.8	2.6	2.8	2.2	1.2	2.6	1.6	1.2	1.8	1.6	1.4	2.4	

Pavement Analysis and Design

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Advanced Pavement materials: 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	Flexible pavement design: Basis of pavement design, Development of various design methods for Highway and Airport Pavements.	8

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

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 Engineeringl, 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
Average	2	2.5	2	2.75	2.5	1.5	2	1.75	2	2.25	2	2	

Industrial Wastewater Treatment

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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
Total lectures		42

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", 1st Edition, McGraw Higher Education Publications, India, 2017.
2. Metcalf and Eddy Inc: Wastewater Engineering: Treatment and Resource Recovery, 4th 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
Average	2.6	2.2	2.6	2.2	1.8	1.6	1.8	1.8	2.2	2.2	1.6	2	

Design of Steel Structures

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: CORE

L-T-P: 3-0-0

Pre-requisite: Mechanics of Materials

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.	Usage

Course Contents:

Unit	Contents	Lectures required
1	Introduction: General- Types of Steel – Mechanical behaviour of steel – Measures of yielding – Measures of Ductility – Types of Structures – Structural steel sections.	2
2	Methods of Structural design: Introduction-Design Philosophies-Working Stress Method-Ultimate Strength method-Load and Resistant factor- Limit State Method-Partial safety factor-Load-Load combinations-Classification of coss sections- General aspects in the design.	2

3	Design of Steel fasteners: 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. Design of Eccentric Connections: Design of Brackets- Type-1 and Type 2 – Moment Resistant connections - Design Examples	10
4	Design of Tension Members: General – Modes of failure of tension member, Analysis of Tension members, Example - Design steps, Design examples: Lug angles.	6
5	Design of Compression Members: 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	Design of Beams: General- Lateral Stability of Beams- Bending Strength of Beams – Plastic Section Modulus - Design Examples	4
7	Design of Beam Columns: Behavior of members under combined loading – Modes of Failures – Design Examples.	4
8	Design of Column Splices and Column Base: Design of Column Splice-Design Examples, Slab Base- Gusseted Base- Design Examples	4
9	Design of Plate Girder: 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
Total lectures		42

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

Other useful resource(s):

1. 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
Average	2.2	2.4	2.6	2.6	2.4	1.4	1.2	1	2	2.2	1.8	2.2	

Transportation Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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,	13

	air cargo, accidents in the air, maintenance of air ports .	
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
Total lectures		42

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
Average	3	2.8	3	2.6	2.2	1.6	1	2.2	2.8	2.4	2.2	2.2	

Traffic Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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
Total lectures		42

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
Average	3	2.8	3	2.6	2.2	1.6	1	2.2	2.8	2.4	2.2	2.2	

Highway Construction, Maintenance and Management

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Highway Construction: 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
2	Flexible and Rigid pavement construction: 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.	8
3	Highway Maintenance: General, distress in pavements (Cracking, patching, rutting, pot holes, stripping and swelling), evaluation of pavement, structural evaluation, pavement maintenance.	6
4	Introduction to Transport Economics: Recycling of pavements: Introduction, selection of road for recycling, methods and equipments for recycling.	6
5	Hill Roads: 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.	8
Total lectures		42

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.) 8th 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)

Course Outcomes (Highway Construction, Maintenance and 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	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
Average	2.5	2.75	2.5	2.25	2.5	2.25	1	2.25	2	2.5	2.5	2	

Advanced Concrete Technology

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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	Introduction: Introduction to polymer concrete- its classification and applications.	14
2	Ultra high strength concrete: basic fundamentals. Types, application and production.	4
3	Mix design of Polymer concrete and UHPC: 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	Self compacting concrete: Mix design, testing, production and application.	4
5	Mineral and chemical admixtures: Optimization and selection of a particular type of mineral and chemical admixture.	12
Total lectures		42

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 Materials, ICI, Indian First Edition, Reprint 1999.

Suggested Reference Book(s):

1. Zonghjin Li, —Advanced Concrete Technology, John Wiley & Sons, INC, New Jersey, 2011.
2. A.R. Santhakumar, —Concrete Technology, 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/

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 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	1.92
CO-2	1	2	3	2	2	1	2	3	3	1	3	2	2.08
CO-3	3	3	3	2	1	1	2	3	2	2	3	2	2.25
CO-4	3	2	1	3	1	2	3	3	2	3	3	2	2.33
CO-5	2	3	3	3	1	3	1	2	2	3	3	2	2.33
Average	2.4	2.2	2.4	2.2	1.2	2	1.8	2.4	2.2	2.2	3	2.2	

Underground Technology

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Introduction: Introduction to various underground structures, Underground construction methodology & equipments.	5

2	Underground construction: Excavations, soil support methods, diaphragm walls, reinforced earth.	5
3	Ground Water management: Management of groundwater, dewatering methods Cofferdams, Caisson & wells.	6
4	Permanent Support and Temporary Support system: Methods of Basement construction, bracing system.	8
5	Ground Improvement: 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	Tunnels: Introduction, Tunnel stabilization and lining, Cut and Cover Tunnels, Bored Tunnels, Immersed Tube Tunnels, Water Conveyance Tunnels, Micro-tunnels.	6
7	Underground Conduits: Ditch Conduits, Positive Projecting Conduits, Negative Projecting Conduits, Imperfect Ditch Conduits, Tunneled Conduits.	6
Total lectures		42

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

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
Average	2.67	2.5	2.67	2.17	1.17	2.67	1.83	0.83	2.17	1.67	1.5	2.5	

Open Channel Flow and Hydraulic Machines

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: Elective

L-T-P: 3-0-0

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	Introduction to Open Channel Flow: 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	Uniform Flow: 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	Non-Uniform Flow: 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	Hydraulic Jump: 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	Hydraulic Turbines: 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	Pumps: 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
Total lectures		42

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:

COURSE CREDITS: 2

CORE/ELECTIVE: CORE

L-T-P: 0-0-4

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
Total Lab hours		56

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

Finite Element Method and Its Applications to Civil Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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:

Unit	Contents	Lectures required
1	Introduction: 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)	8
2	Spring Element and Spring Assembly: 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.	8
3	Axial Element and Assembly: 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).	9
4	Flexural Element and Assembly: 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).	8
5	Linear and Plane Strain/Stress Analysis: 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.	6
6	Two Dimensional Elements: Introduction to Axisymmetric and Isoparametric Elements and Applications.	4
7	Commercial Packages: ABAQUS, ANSYS, NISA, SAP2000 etc. extensibility	1
Total lectures		42

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:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Environmental Impact Assessment: 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	EIA in India: 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	8

	and Category B projects.	
3	EIA Methodologies: Interaction matrices, Checklists, Networks, Adhoc Procedures, Overlay techniques; Simple interaction matrix and Stepped matrix; Application of various methodologies	6
4	Environmental Indicators and Indices: 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	EIA Study – Air Environment: Definition of Air Pollution; Projects which contribute to air pollution; Basic steps for prediction and assessment of air pollution Water Environment: Basic Steps; Spatial and Temporal Phases; Operational Impacts of alternatives Biological Environment: Basic Steps Cultural Environment: Basic Steps	6
6	Planning and Management of Impact Studies: Conceptual Approach; Proposal Development; Interdisciplinary Team Formation; Team Leader Selection; General Study Management; Fiscal Control	6
7	Risk Assessment: Definition of Risk according to EPA; Risk Management; Human Health Risk Assessments; Ecological Risk Assessments	2
Total lectures		42

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, 2nd 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

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:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Introduction: Revision of foundation engineering, introduction to soil exploration, interpretation of soil exploration data.	3

2	Mat Foundations: Bearing capacity of mat foundations, Mat settlement, Design of rigid and flexible mats.	5
3	Pile Foundations: Design of piles and pile groups, Design of pile caps, laterally loaded piles, Settlement of pile and pile groups.	8
4	Well and Caisson Foundation: Bearing capacity, Settlement, Lateral Stability analysis.	4
5	Foundations on Expansive Soils: Introduction to expansive soils, swell measurement, foundation consideration, construction on expansive soils.	5
6	Reinforced Earth: Design Principals, Methods of constructions and applications.	6
7	Machine Foundations: 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	Soil-structure interaction: Idealized soil, foundation and interface behavior, Elastic models of soil behavior; Beams and plates on elastic foundation.	5
Total lectures		42

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	2.36
CO-2	3	3	1	2	3	2	2	3	3	2	2	2	2.33
CO-3	3	1	2	3	3	2	3	3	2	2	1	2	2.25
CO-4	3	2	2	3	3	2	1	2	3	3	2	2	2.33
CO-5	3	3	3	1	3	1	2	2	3	2	3	2	2.33
Average	3	2.4	2.2	2.4	2.8	1.6	2.2	2.4	2.8	2.2	1.8	2	

Earthquake Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Introduction - Characterization of ground motion, Earthquake intensity and magnitude; Recording instruments and base line correction, Predominant period and amplification through soil.	5
2	Earthquake Spectra analysis - Earthquake spectra for elastic and inelastic systems	7
3	Structural Behaviour - 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	Damage Assessment - Review of damages during past earthquakes and remedial measures; Reinforcement detailing for members and joints detailing; Codal provisions.	10
5	Vibration Control - Introduction of Vibration Control; Active and Passive Control System.	8
Total lectures		42

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)

Course Outcomes (Earthquake 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	1	1	1	2	3	1	1	2	2	1	2	1.58
CO-2	3	3	3	2	2	3	2	2	3	2	1	3	2.42
CO-3	3	3	2	3	3	3	2	3	3	2	1	3	2.58
CO-4	3	2	3	3	3	3	2	3	3	2	1	3	2.58
CO-5	3	3	3	3	3	3	2	3	3	3	1	3	2.75
Average	2.8	2.4	2.4	2.4	2.6	3	1.8	2.4	2.8	2.2	1	2.8	

Design of Prestressed Concrete Structures

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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
1	Introduction to Prestressed Concrete: 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.	8

2	Analysis of prestressed members for flexure: 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.	10
3	Losses in prestress: 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.	6
4	Design of Prestressed Concrete members: Design of sections for flexure part I, Design of sections for flexure part II and Design of sections for flexure part III.	10
5	Calculation of deflection and crack width: 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.	8
Total lectures		42

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 Concrete, Alpha Science, 2002

Other useful resource(s):

1. Link to NPTEL course contents: <https://nptel.ac.in/courses/105106117/>
2. Link to topics related to course:
 - 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:

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 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
Average	2	2.5	2.5	2.5	2.5	1	1	1	2	2.25	1.5	2	

Dams and Reservoir Design

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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:

S.No.	Course Outcomes	Level of Attainment
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:

Unit	Contents	Lectures required
1	Introduction and project planning: 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.	12
2	Reservoir studies: Types of reservoir, inflow and outflow study into the reservoir, capacity determination by various techniques	6
3	Concrete gravity dam: Introduction, Origin and development, Forces acting on dam, Requirements for stability, Dams on pervious foundations	9
4	Earthfill dams: Origin, Selection of type, Design principles, Foundation design, Embankments, Embankment details.	9
5	Rockfill dams: Origin and usage, Definition and types, Foundation design, Embankment design, Membrane design.	6
Total lectures		42

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:

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 (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	2.09
CO-2	3	1	3	2	2	3	2	3	2	2	1	2	2.17
CO-3	3	2	3	2	3	2	1	3	1	2	1	2	2.08
CO-4	3	3	3	2	3	3	2	3	3	3	2	2	2.67
CO-5	3	2	2	3	3	3	2	2	3	3	2	2	2.50
Average	3	2	2.8	2	2.8	2.4	1.8	2.6	2.2	2.4	1.6	2	

Advanced Reinforced Concrete Design

COURSE CODE:

COURSE CREDITS 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Analysis and design of beams and slabs by working stress method: 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	Yield line Theory of slabs and Methods of Analysis: 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	Design of underground and elevated water tanks: 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.	
4	Design cantilever and counterfort retaining walls: Principles of Cantilever and counterfort type retaining walls, Detailed design of cantilever type of retaining walls	9
5	Analysis and design of Foundations: Types of foundations and its needs. Analysis and design of a isolated footing	3
Total lectures		42

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	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
Average	2	2.5	2.5	2.5	2.5	1	1	1	2	2.25	1.5	2	

Advanced Highway Material and Construction

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Aggregates: Classification, physical and strength characteristics, Proportioning of aggregates, Aggregate texture and skid resistance, polishing of aggregates.	6
2	Soil: Classification, Structural and Constructional problems in soil subgrade, Identification and strength tests, Soil-moisture movement, Sub-soil drainage, Soil stabilization	8
3	Bitumen: 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.	
4	Mixes: Desirable properties of mixes, Design of bituminous mixes, Tests on bituminous mixes, Fillers, Theory of fillers and specifications	6
5	Cement Concrete: Constituents and their requirements, Physical, plastic and structural properties of concrete, Factors influencing mix design, Design of concrete mixes	8
6	Road Construction: 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.	8
Total Lecture		42

Suggested Text Book(s):

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

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 Highway Material and Construction)	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	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
Average	2.5	2.75	2.5	2.25	2.5	2.25	1	2.25	2	2.5	2.5	2	

Hydropower Engineering

COURSE CODE:

COURSE CREDITS: 3

CORE/ELECTIVE: ELECTIVE

L-T-P: 3-0-0

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	Introduction: 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	Principles of hydropower development: Application, advantage and disadvantages of schemes, classification of hydropower schemes and their layouts, Principal components of Hydro-electric scheme	8

3	Hydraulic turbines: Classification and selection of turbines, governing of turbines	7
4	Design of civil works: 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.	5
5	Economics of Power Generation: 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.	8
6	Mini, micro, hydel plants: Special features of mini, micro hydel plants, civil works of medium and high for mini, micro, hydel plants, different types of turbines	7
Total lectures		42

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:

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 (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	