Kolhapur Institute of Technology's

COLLEGE OF ENGINEERING, KOLHAPUR (EMPOWERED AUTONOMOUS)

Gokul Shirgaon, Kolhapur

KOLHAPUR INSTITUTE OF TECHNOLOGY'S
COLLEGE OF ENGINEERING KOLHAPUR
(EMPOWERED AUTONOMOUS)

Curriculum Structure
For
B. Tech. Civil Engineering

Academic Year 2025-2026

Under Graduate Programme

Approved in BoS on 15.03.2025
Approved in Academic Council on 24.04.2025

Semester V

Sr. No	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme		
									Component	Marks	
										Max.	Min. for Passing
1	PC	UCVPC0501	Design of Steel Structures	3	-	-	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
2	PC	UCVPC0502	Theory of Structures	2	-	-	2	2	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
3	PC	UCVPC0503	Geotechnical Engineering	3	-	-	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
4	PEC	UCVPE051*	Program Elective – I	3	-	-	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
5	OE	UCVOE052*	Open Elective I	3	-	-	3	3	ISE1	10	40
									MSE	30	
									ISE2	10	
									ESE	50	20
6	HSSM	UCVEM0504	Construction Project Management	2	-	-	2	2	ESE	50	20
7	PC	UCVPC0531	Geotechnical Engineering Laboratory	-	-	2	2	1	ISE	25	10
									ESE(POE)	25	10
8	PC	UCVPC0532	Water Quality Monitoring Laboratory	-	-	2	2	1	ISE	25	10
									ESE(OE)	25	10
9	VSEC	UCVVS0533	Simulation and Design Laboratory	-	-	2	2	1	ISE	25	10
10	CEP	UCVIL0571	Community Field Project	-	-	2	2	1	ISE	25	10
11	MM	U**MM****	Multi Disciplinary Minor III*	3	-	-	3	3	ESE	100	40
			Total:				**27**	**23**		**800**	

Semester VI

Sr. No	Category	Course Code	Course Name	L	T	P	Hrs. / Week	Credits	Evaluation Scheme		
									Component	Marks	
										Max.	Min. for Passing
1	PC	UCVPC0601	Design of Reinforced Concrete Structures	3	-	-	3	3	ISE1	10	
									MSE	30	
									ISE2	10	
									ESE	50	20
2	PC	UCVPC0602	Engineering Hydrology	2	-	-	2	2	ISE1	10	
									MSE	30	
									ISE2	10	
									ESE	50	20
3	PC	UCVPC0603	Transportation Engineering	3	-	-	3	3	ISE1	10	
									MSE	30	
									ISE2	10	
									ESE	50	20
4	PEC	UCVPE061*	Program Elective - II	3	-	-	3	3	ISE1	10	
									MSE	30	
									ISE2	10	
									ESE	50	20
5	OE	UCVOE062*	Open Elective II	3	-	-	3	3	ISE1	10	
									MSE	30	
									ISE2	10	
									ESE	50	20
6	AEC	UCVAE0631	Business Communication and Value Science	-	-	2	2	1	ISE	50	20
7	PC	UCVPC0632	Design of Steel Structure Laboratory	-	-	2	2	1	ISE	25	10
									ESE(POE)	25	10
8	PC	UCVPC0633	Highway Materials and Traffic Engineering Laboratory	-	-	2	2	1	ISE	25	10
									ESE(OE)	25	10
9	PC	UCVPC0634	Wastewater Monitoring Laboratory	-	-	2	2	1	ISE	25	10
10	FP	UCVIL0671	Mini Project	-	-	2	2	1	ISE	25	10
11	CC	UCVCC0635	Co-curricular Activities III	-	-	2	2	1	ISE	50	20
12	MM	U**MM****	Multi Disciplinary Minor IV*	3	-	-	3	3	ESE	100	40
			Total:				**29**	**23**		**850**	

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Third Year B. Tech
Semester - V

Academic Year 2025-2026

Title of the Course:	**DESIGN OF STEEL STRUCTURE**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPC0501**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Mechanics of Solids, Structural Analysis

Course Description:

This is the first and basic course to introduce concept of structural design and especially for Steel Structures. Number of problems on design of different steel members gives idea about designing process. This course acts as a prerequisite for the advanced design of steel structures.

Course Learning Objectives:

1. To introduce behaviorand design of simple steel structures according to limit state design concept.
2. To impart basic knowledge about the design of steel structural members.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Identify the loads on steel structures as per Indian Standard codes.	3	Apply
CO2	Develop the connection details between different structural elements.	3	Apply
CO3	Asses the strength of structural members as per the Indian Standard codes	5	Evaluate
CO4	Design the members as per the Indian Standard codes.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	1			3			1	1	2
CO2	1	2	3		1	3	1		1	1	
CO3	1	2	3		1	3	1		1	1	
CO4	1	2	3		1	3	1		1	1	

CO	PSO1	PSO2	PSO3
CO1	1	1	2
CO2	3	1	2
CO3	3	1	2
CO4	3	1	2

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment / declared test / quiz / seminar / Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules)
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit: 1	**CO : 1 , CO : 2**	
Introduction: Advantages and disadvantages of steel structures, Design Philosophy, elastic and plastic properties of sections, shape factor, stress distribution under tension, compression, bending and shear, types of steel structures, grades of structural steel, various rolled steel sections, loads and load combinations partial safety factors for load and materials. **Connections:** Types of bolts & welds, analysis and Design of axially and eccentrically loaded bolted and welded connections (subjected to bending only).		**07 Hrs.**
Unit: 2	**CO : 3 , CO : 4**	
Tension Members: Design of axially loaded tension members, Common sections, Net area, Types of tension members, modes of failures, shear lag effect, IS code provisions and design.		**08 Hrs.**

Unit: 3	**CO : 3 , CO : 4**	
Compression Members as Struts: Design of axially loaded compression members, section classifications, effective length, slenderness ratio, simple sections, built-up sections, design of lacings and battens, Single angle and double angle strut.		**08 Hrs.**
Unit: 4	**CO : 3 , CO : 4**	
Columns and Column Bases **Columns:** Design of column subjected to axial and eccentric loading, built up column sections, design of lacing, battening system, column splices. **Column Bases:** Design of slab bases & gusseted base subjected to axial and eccentric load and design of concrete pedestal (dimensions only)		**08 Hrs.**
Unit: 5	**CO : 3 , CO : 4**	
Beams: Flexural members –Types of sections, effective length, design of laterally restrained and unrestrained beams, rolled sections, built-up beams /compound beams, Design for strength and serviceability, web buckling, web crippling, curtailment of flange plates.		**08 Hrs.**
Unit: 6	**CO : 1**	
Gantry Girders: Forces acting on gantry girder, commonly used sections.		**06 Hrs.**

Recommended Textbooks:

1. Design of Steel Structures, by Dr. N. Subramanian, Oxford University Press, New Delhi.
2. Limit State Design of Steel Structures: V. L. Shah and Veena Gore, Structures Publication, Pune.
3. Limit State Design of Steel Structures: S.K. Duggal, Tata Mc-Graw Hill India Publishing House
4. Design of Steel Structures: K.S.Sairam, Pearson
5. Design of steel structure by Limit State Method as per IS: 800-2007:BhavikattiS.S.,IKInternationalPublishingHouse,NewDelhi
6. Limit state design in structural steel: Dr. M.R. Shiyekar, PHI publications.

References Books:

1. IS:800–2007,IS:875(part I, II and III),SP6(1)&SP6(6),IS:816,IS: 808.
2. LRFD Steel Design: William T. Segui, PWS Publishing
3. Design of Steel Structures: Edwin H. Gaylord, Charles N. Gaylord James, Stallmeyer, McGraw-Hill
4. Design of Steel Structures: Mac. Ginely T.

5. Design of Steel Structures: Dayaratnam, Wheeler Publications, New Delhi.
6. Design of Steel Structures: Punmia, A. K. Jain and Arun Kumar Jain, Laxmi Publication
7. Design of Steel Structures: Kazimi S.M. and JindalR.S., PrenticeHall India.
8. Design of Steel Structures: Breslar, Lin Scalzi, John Willey, New York.
9. Steel Structure: Controlling Behaviour through Design, Englekirk, WILEY.

Title of the Course:	THEORY OF STRUCTURES	L	T	P	Credit
Course Code:	UCVPC0502	2	-	-	2

Course Pre-Requisite:

Mechanics of Solids, Structural Analysis

Course Description:

Theory of Structures forms a core course which is especially taught to students of Civil Engineering disciplines of engineering. The study of this course is aimed at developing an application thinking of the basic material behaviour towards the behaviour of complex structures. It aims to develop an approach to solve structural engineering problems.

Course Learning Objectives:

1. Make aware of the concept of determinacy and indeterminacy.
2. Impart different solution techniques to a problem.
3. Analyze indeterminate structures by using different methods.
4. Compare suitability of different methods
5. Make aware of the limitations of the methods of solution and their outcomes

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Identify and classify determinate and indeterminate structures based on degrees of redundancy and degrees of freedom.	2	Understand
CO2	Analyze continuous beams using Clapeyron's Theorem of Three Moments considering different support conditions and varying moments of inertia.	3	Apply
CO3	Solve beams and portal frames using Slope Deflection, Moment Distribution, and Kani's Methods.	3	Apply
CO4	Develop stiffness and flexibility matrices for simple structural systems and analyze indeterminate structures using the Stiffness Matrix Method.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1									1
CO2	3	2			1						1
CO3	3	3			1						1
CO4	3	3		2	3						1

CO	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	2	2	1
CO4	2	2	1

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules)
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit: 1	**CO: 1**	
Concept of determinacy and indeterminacy: Types of Indeterminacies, Degree of redundancy (D.O.R.), Degrees of freedom (D. O. F.), Methods of Analysis. Comparison between the force methods and displacement methods. (No Numerical) **Method of Consistent deformation:** Propped cantilever with uniform section, fixed beam with basic released structure as cantilever or simply supported beam		**6 Hrs.**
Unit: 2	**CO: 2**	
Clapeyron's theorem of three moments: Continuous beams with single or double redundancy.		**4 Hrs.**

Unit: 3	**CO: 3**	
Slope deflection method: General and modified slope deflection equations, application to beams and portal frames without sway and requiring only two equilibrium equations.		**5 Hrs.**
Unit: 4	**CO: 3**	
Moment Distribution Method: Applications to beams and portal frames without sway and with sway.		**5 Hrs.**
Unit: 5	**CO: 3**	
Kani's method: Applications to beams and portal frames without sway.		**5 Hrs.**
Unit: 6	**CO: 4**	
Matrix Methods: Stiffness coefficients, development of stiffness matrix up to 4 x 4. Analysis of beams and portals by stiffness matrix method, Degree of S.I. < 2. Introduction to flexibility matrix, Flexibility coefficients, development of flexibility matrix up to 4 x4. (No numerical on Flexibility matrix.)		**5 Hrs.**

Recommended Textbooks:

1. Basic Structural Analysis: C.S. Reddy, Tata McGraw Hill Publishing House, New Delhi.
2. Mechanics of Structures (Vol-I and II): S. B. Junnarkar H.J. Shah, Charotar Publishers.
3. Analysis of Structures: Vol. I II, Vazirani and Ratwani, Khanna Publishers
4. Structural Analysis: S.S.Bhavikatti, Vikas Publishing House Pvt, ltd.
5. Structural Analysis- Matrix approach by Pandit & Gupta.

References Books:

1. Matrix analysis of structures by Gere & Weaver.
2. Indeterminate structural analysis by C.K. Wang.

Title of the Course:	**GEOTECHNICAL ENGINEERING**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPC0503**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Knowledge of Basic Civil Engineering, Engineering Mechanics, Mechanics of Solids and Engineering Hydraulics.

Course Description:

This course provides a fundamental understanding of geotechnical engineering principles, focusing on the behavior of soils under various loading conditions. Students will learn essential concepts such as soil classification, permeability, seepage, stress distribution, consolidation, and shear strength. The course also covers critical aspects of soil compaction, and earth pressure theories, with applications to retaining structures and foundation design. Emphasis is placed on laboratory and field testing methods, as well as practical engineering solutions for geotechnical challenges. By the end of the course, students will develop the necessary analytical and problem-solving skills required for geotechnical design and construction.

Course Learning Objectives:

1. Equip students with the essential knowledge and skills for soil characterization and shear strength analysis.
2. Introduce the principles of soil compaction and consolidation, including field control techniques and practical applications.
3. Educate students on stress estimation in soil and the analysis of earth pressure on retaining structures under various soil conditions.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Explain soil compaction and its field applications	2	Understand
CO2	Analyze the soil for different types of loading and for different civil engineering structures.	3	Analyze
CO3	Asses the characteristics of soil as per IS standard.	5	Evaluate
CO4	Estimate the flow through soils, consolidation characteristics and shear strength.	5	Evaluate

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	1	2							
CO2	2	1	1	2							
CO3	2	2	2	2							
CO4	2	2	3	3							

CO	PSO1	PSO2	PSO3
CO1	1	3	1
CO2	1	3	1
CO3	1	3	1
CO4	1	3	1

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions/ site visits etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit: 1	**CO: 3**	
Soil properties and classification In Introduction, importance of soil mechanics, soil formation, major soil deposits of India. Soil structure, soil phase system, weight volume relationships. Index properties of soil - unit weight, density, water content, specific gravity, void ratio, porosity, air content, degree of saturation and their relationships, particle size analysis, I. S. classification and different classification systems, soil consistency and indices. Casagrande's plasticity chart.		**8 Hrs.**
Unit: 2	**CO: 4**	
Permeability and Seepage Darcy's law, factors affecting permeability, determination of coefficient of permeability by constant head and falling head method as per IS – 2720. Introduction of field test as per IS – 5529 (part I) - pumping in test and pumping out test. Permeability of layered soils. Concept of effective stress & total stress in soil mass, quick sand condition. Seepage forces, Laplace equation, flow net construction and applications for determination of seepage.		**7 Hrs.**

Unit: 3	**CO: 1 & 4**	
Compaction and Consolidation Compaction phenomenon, factors affecting compaction, standard Proctor test and modified Proctor test as per IS – 2720- dry density and moisture content relationship, zero air void line, Field compaction equipment and methods, field compaction control. Spring analogy, Terzaghi's theory of one dimensional consolidation, Lab consolidation test, determination of coefficient of consolidation-square root of time fitting method and logarithm of time fitting method. Rate of settlement, normally consolidated and over consolidated soils, determination of pre consolidation pressure.		**8 Hrs.**
Unit: 4	**CO: 2**	
Stress Distribution in Soil Boussinesqs theory- point load, strip load, pressure distribution diagram on a horizontal and vertical plane, pressure bulb, introduction to Newmark chart, Westergaard's theory, uniformly loaded rectangular area, contact pressure, approximate stress distribution methods- equivalent point load method and 2:1 load distribution method. Concept-soil-structure interaction.		**7 Hrs.**
Unit: 5	**CO: 4**	
Shear Strength Concept of shear stress and shear strength, Coulomb's theory and failure envelope, total stress approach and effective stress approach, representation of stresses on Mohr's circle, Mohr-Coulomb's envelope for different types of soil- c soil, phi soil and c-phi soil. Determination of shear strength- type of test- box shear test (UU, CU, CD), triaxial compression test (UU, CU, CD), unconfined compression test, vane shear test. Concept-critical state soil mechanics.		**8 Hrs.**
Unit: 6	**CO: 2**	
Earth Pressure Theory Concept, area of application, earth pressure at rest, active and passive condition. Rankines theory of earth pressure - dry/moist, submerged (partially and full), horizontal backfill with surcharge, backfill with inclined surcharge. Introduction to Coulomb's theory of earth pressure.		**7 Hrs.**
Recommended Textbooks: 1. Soil Mechanics and Foundation Engg. By Dr. K.R.Arora, Standard Publishers Distributors, New Delhi. 2. Soil Mechanics and Foundation Engg. by Dr. B.C. Punmia, Er. Ashok K. Jain and De. Arun K. Jain, Laxmi Publications (p) Ltd.		
References Books: 1. Soil Behaviour and Critical States Soil Mechanics: Wood, D. M. 1990 Cambridge University Press, Cambridge.		

2. Soil Mechanics. Concepts and Applications: Powrie, W. 1997 E & FN SPOON, London.
3. Geotechnical Engineering – Prentice Hall, Delhi by Iqbal H Khan.

PROGRAM ELECTIVE-I			
Sr. No.	***Curriculum Component***	***Course Code***	***Course Names***
1	PEC	UCVPE0511	Municipal Wastewater Analysis and Treatment
2	PEC	UCVPE0512	Industrial Waste Treatment
3	PEC	UCVPE0513	Solid And Hazardous Waste Management
4	PEC	UCVPE0514	Open Channel and River Hydraulics

Title of the Course:	**MUNICIPAL WASTEWATER ANALYSIS AND TREATMENT (PE-1)**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPE0511**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Students must have basic ideas about Environmental Problems and issues regarding the application of knowledge of the concepts which are essential for understanding correlation of Engineering and Environmental Issues like water and air pollution and wastewater, solid waste disposal problems.

Course Description:

This course will help the students to understand the importance and seriousness of pollution for Water and designs of Wastewater treatment facilities from Civil Engineering aspects.

Course Learning Objectives:

1. Understand the wastewater quality and the quantity for disposal as per CPCB and MPCB standards.
2. Develop sewerage system for area under consideration.
3. Explain and write about low-cost wastewater treatment processes.
4. Understand the concept of financing and budgeting for engineering activities.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Demonstrate various wastewater characteristics with the help of Streeter Phelp's Equation.	3	Apply
CO2	Analyze the quality for disposal of wastewater as per CPCB and MPCB standards and develop sewerage system for area under consideration.	4	Analyze
CO3	Sequence and design wastewater treatment units for various qualities of wastewater as per mentioned design parameters and calculate the strength of wastewater.	6	Design
CO4	Design low-cost wastewater treatment operations and understand the concept of financing and budgeting.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1		1	2			1		
CO2	2	2	2		2				1		
CO3	2	2	2						1		1
CO4	2	3	2			2	1		2	2	3

CO	PSO1	PSO2	PSO3
CO1	1	1	
CO2	3	2	1
CO3	3	2	2
CO4	3	2	1

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules)
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit: 1	**CO: 1**	
Wastewater: Components of wastewater flows, wastewater sources and flow rate, Variations in flow rates and strength, wastewater constituents, Characteristic of Municipal waste water, Problems on B.O.D. calculations, Quantity of storm water, Ground water infiltration.		**09 Hrs.**
Unit: 2	**CO: 1 and 2**	
Primary Treatment: Screening, comminuting, Grit removal, Oil and Grease trap Primary settling tank. Secondary Treatment: Activated sludge process, Process design and operating parameters, modification of ASP, Operational problems, Concept and design of trickling filter and Secondary Settling Tank Design of activated sludge system for treatment of a ten storey apartment wastewater.		**10 Hrs.**

Unit: 3	**CO: 1 and 2**	
Sludge: Characteristics, Treatment and disposal, Concept of anaerobic digestion, types of reactors. Different types of Sewage Treatment Plants, Membrane Bioreactor , Moving Bed Biofilm Reactor, Sequence Batch Reactor. Concept of zero discharge.		**05 Hrs.**
Unit: 4	**CO: 4**	
Low-cost wastewater treatment methods: Principles of waste stabilization pond. Design and operation of oxidation pond, aerobic & anaerobic Lagoons, Aerated Lagoon, Oxidation ditch. Introduction to Budgeting and financing for Unit No. 1, 2, 3 and 4		**05 Hrs.**
Unit: 5	**CO: 3**	
Stream pollution: Classification, Concept of Self Purification and DO sag curve. Streeter Phelp's Equation. Disposal of wastewater: methods, effluents standards for stream and land disposal as per MPCB and CPCB standards and legislation		**10 Hrs.**
Unit: 6	**CO: 3 and 4**	
Sewerage system: Types, Layout, Types of sewers, Collection system, Appurtenances, Design of sanitary and storm water sewers, Maintenance of sewerage systems Sewage and Sludge pumping, Location, Capacity, Types of pumps, Pumping station design		**06 Hrs.**

Recommended Textbooks:

1. Waste water Engineering, P. N. Modi.
2. Waste Water Engineering By S K Garg
3. Water supply, Waste Disposal and Environmental Engineering, A.K.Chatterjee, Khanna Publishers

References Books:

1. Manual on sewerage and sewage Treatment-Government of India Publication.
2. Masters. G. M. Introduction to Environmental Engineering and Science.
3. Rao. M. N. and Rao H.V. Air pollution, Tata McGraw Hill, 1990.
4. Canter, Environmental Impact Assessment, TMH Publication.
5. Peavey, H. S. Rowe, D.R., Environmental Engineering, McGraw-Hill Book Company.
6. Viessman W. and Hammer M.J. Water supply and pollution Control, Harper Collins College publishers.
7. Hammer M.J. Water and Waste water Technology, Prentice-Hall of India Private Limited.
8. Manual on Municipal Solid Waste Management, Ministry of Urban Development Govt. of India.

Title of the Course:	**INDUSTRIAL WASTE TREATMENT (PE-I)**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPE0512**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Students must aware about present water and wastewater pollution problems and its related environmental problems. Importance of industrial waste treatment and the standards should be well known to students

Course Description:

Students will understand industrial waste treatment such as Water pollution control act, Manufacturing processes in major industries, Different types of waste treatment, Water Quality monitoring ,Waste volume and strength reduction, Use of water in industry

Course Learning Objectives:

1. Interpret knowledge and concepts of characterization and treatment for water and wastewater and sludge.
2. Predict wastewater quality with the help of mathematical models.
3. Understand the codal provision for various industrial treatment processes and pollution control acts.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Explain the quality of Industrial wastewater and qualitative and quantitative treatment process.	2	Understand
CO2	To understand the manufacturing and disposal process of various industries.	2	Understand
CO3	Calculate the wastewater quantity and quality with the help of Streeter-Phelps Equation for prediction.	3	Apply
CO4	Illustrate and compare the codal provision for various industrial treatment processes and pollution control acts.	3	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1			1		2	2	1	1		1
CO2						3	1	1			2
CO3	2	2		2	1		2	1	2	1	1
CO4	2				0	3		1	1	1	2

CO	PSO1	PSO2	PSO3
CO1	2		3
CO2		1	2
CO3	3	1	3
CO4	2	1	3

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules)
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit: 1	**CO: 1**	
Use of water in industry, sources of wastewater, quality and quantity variations in waste discharge, water budgeting, characterization and monitoring of wastewater flow, stream standards and effluent standards.		**9 Hrs.**
Unit: 2	**CO: 1,2**	
Waste volume and strength reduction, in-plant measure, good housekeeping, process change, leakage prevention, segregation and recycling Neutralization, equalization and proportioning of waste		**8 Hrs.**
Unit: 3	**CO: 3**	
Water Quality monitoring of Streams, Self-purification of streams, B.O.D. reaction rate, D.O. sag curve and D.O. deficit calculations		**5 Hrs.**
Unit: 4	**CO: 2,3**	

Different types of waste treatment & their selections, Development of treatment flow diagram based on characteristics of waste Acclimatization of bacteria to toxic wastes, process sensitivity operation and maintenance requirements			**7 Hrs.**
Unit: 5	**CO: 3,4**		
Manufacturing processes in major industries, water requirements, wastewater sources, composition of wastes, Viz. sugar, distillery, dairy, pulps, paper mill, fertilizer, tannery, chemical, steel industry, power plants, textile Treatment flow sheets, factors affecting efficiency of treatment plant			**9 Hrs.**
Unit: 6	**CO: 3,4**		
Water pollution control act, organizational set up of central and state boards for water pollution control, classification of river on water use, minimal national standards, socioeconomic aspects of water pollution control			**7 Hrs.**

Recommended Textbooks:

1. Waste Water Engineering Metcalf Eddy McGraw Hill Publications.
2. Industrial Waste Treatment Nelson Meneroo
3. Industrial Waste Treatment Rao&Datta
4. Khan, I. H., & Ahsan, N. (2012). Textbook of solid waste management. New Delhi: Satish Kumar Jain for CBS Publisher and Distributors.

References Books:

1. Industrial Wastewater manual

Title of the Course:	**SOLID AND HAZARDOUS WASTE MANAGEMENT (PE-I)**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPE0513**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Environmental Chemistry

Course Description:

Problems associated with solid waste management (SWM) in today's society are very complicate because of the quantity and varied nature of wastes. As a result, if SWM is to achieve a skillful approach, the fundamentals aspects need to be identified. Thus, there is need to study the activities from the generation to the disposal point. The six functional elements (generation, handing and separations, storage and processing at source, collection, the transformation of wastes, transfer and transport, and final disposal) for the engineering comparison and treatment need to be understood in detail. The understanding of the functional element is important because it helps in evaluating the impacts of projected changes and technological developments. Solid waste management is an essential part of every society, but it is also one of the most neglected one. Detailed understanding of the subject is required to tackle the current solid waste management problems effectively. This course attempts to teach various steps involved in solid waste management.

Course Learning Objectives:

1. To explain functional elements of SWM, generation rate and characteristics of solid waste.
2. To elaborate appropriate treatment and disposal option for solid waste.
3. To explain sources, characteristics, treatment and disposal options of hazardous waste.
4. To know the environmental legislations for SWM, Hazardous waste management etc.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Explain the solid waste and its types, generation, factors influencing.	2	Understand
CO2	Discuss the disposal of solid waste in various ways.	2	Understand
CO3	Analyzing sources, characteristics, separation and handling of solid waste.	4	Analyze
CO4	Classify legislative details regarding solid waste disposal.	4	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	1		1	3	1		1		2
CO2	2	3	1	2	1	3			1	1	1
CO3	1	3	1	2	3	3			1	1	1
CO4	1	1	2	1	2		1		2	3	3

CO	PSO1	PSO2	PSO3
CO1	1	1	3
CO2	2	1	2
CO3	2	1	2
CO4	3	1	

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules)
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit: 1	**CO: 1**	
Evolution of Solid Waste Management: Types and classification of wastes, Industrial waste, Municipal solid waste, Waste sources and generation rates, Traditional methods of waste collection and disposal, factors influencing waste generation and health hazards.		**5 Hrs.**
Unit: 2	**CO: 1,2**	
Sources/Types and Characteristics of Solid Waste: Waste composition, Waste collection, Characterization of wastes, Waste processing: Size and volume reduction, Waste minimization, waste hierarchy and waste audit.		**10 Hrs.**

Unit: 3	**CO:2, 3**	
Waste Handling, Separation, storage, and Processing: Handling, separation and storage at source, processing at source, primary collection, types of collection system, need and types of transfer station, transport means and methods, material recovery facilities (MRF), recycling and recovery of plastic		**7 Hrs.**
Unit: 4	**CO: 3,4**	
Disposal of solid waste: **a) Biological Treatment:** Composting, Vermicomposting, Biogas production from solid waste. **b) Thermal Treatment:** Incineration/ Combustion Flue gas characteristics and treatment, Solid residue generation, characterization and treatment. **c) Sanitary Land filling:** Site selection and types of landfill, leachate collection and treatment, landfill gas collection and treatment.		**10 Hrs.**
Unit: 5	**CO: 3,4**	
Hazardous waste: Definition, sources, classification, collection and segregation. Hazardous waste characterization, treatment and disposal. Management of Radioactive waste, Bio-medical waste, and E-waste.		**7 Hrs.**
Unit: 6	**CO: 4**	
ISWM and legislation: Integrated solid waste management (ISWM), Introduction to Circular Economy, Solid waste management rules 2016, Hazardous and other waste (management and transboundary movement) rules 2016, Ewaste management rules 2016, Plastic waste management rules 2016, Bio-Medical Waste (Management and Handling) Rules,2016.		**6 Hrs.**
Recommended Textbooks: 1. Solid Waste Management – Dr. A. D. Bhide 2. Hazardous Waste Management - Charles Wentz		
References Books: 1. Integrated solid waste management - Tchobanoglous 2. Handbook and Solid Waste Disposal – George Tchobanoglous and Frank Kreith 3. Solid and Hazardous waste management- M. N. Rao 4. Solid and Hazardous waste management- S. Bhatia 5. CPHEEO Manual on Solid Waste Vol. I,II		

Title of the Course:	**OPEN CHANNEL AND RIVER HYDRAULICS (PE-I)**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPE0514**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

A Student should undergo a course and understanding in subject's viz. Fluid Mechanics, Hydraulics (Basic), Mathematics, Engineering Mechanics, Basic Hydrology

Course Description:

This course explores open channel flow and river hydraulics for designing water infrastructure. Topics include uniform/non-uniform flow, energy-depth relationships, Chezy's and Manning's equations, efficient channels, GVF profiles, hydraulic jumps, discharge structures (weirs, spillways), canals, cross-drainage works (aqueducts, siphons), and river training (embankments, groynes). Integrating hydraulic, geotechnical, and environmental factors, students apply theory, problem-solving, and case studies to analyze systems, design sustainable structures, and address challenges in flood management, irrigation, and river engineering. Prerequisites: fluid mechanics, basic hydraulics, and calculus.

Course Learning Objectives:

1. Apply fundamental principles of open channel flow (Chezy's, Manning's equations) to compute uniform flow conditions and design hydraulically efficient channel sections.
2. Analyze gradually varied flow (GVF) profiles and rapidly varied flow (RVF) phenomena, including hydraulic jumps, to predict water surface profiles and energy dissipation requirements.
3. Design and evaluate hydraulic structures (weirs, spillways, cross-drainage works) for discharge measurement, flood control, and irrigation systems.
4. Integrate hydraulic, geotechnical, and environmental considerations to propose sustainable river training solutions (embankments, groynes) for erosion control and sediment management.
5. Solve real-world challenges in water resource engineering through case studies, numerical modeling, and optimization of open channel systems and river networks.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Use Chezy's and Manning's equations to compute uniform flow parameters (discharge, velocity) and design hydraulically efficient channel sections.	3	Apply
CO2	Classify gradually varied flow (GVF) profiles and interpret hydraulic jump phenomena to predict flow transitions and energy losses.	4	Analyze
CO3	Assess the efficiency and environmental impact of hydraulic structures (weirs, spillways) and river training methods (embankments, groynes) for sustainable design.	5	Evaluate
CO4	Design integrated river and open channel systems addressing flood control, sediment management, and ecological balance using multi-disciplinary principles.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	3							2
CO2	2	3	1	2		2					2
CO3	3	3	2	2							2
CO4	2	3	2	2		2					2

CO	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	1	3	2
CO3	2	3	2
CO4	3	3	2

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), one Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three modules)
- ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit: 1	**CO: 1**	
Introduction Fundamental of open channel flow, Types of open channel flow. Uniform and Non-Uniform flow. Energy and Depth relationships. Geometric Elements, Chezy's and Manning's Formula, Uniform Flow Computations, Hydraulically Efficient Channel section.		**9 Hrs.**
Unit: 2	**CO: 2**	
Gradually varied flow (GVF) Definition, classification of channel slopes, Dynamic equation of GVF (Assumption and equation), and classification of GVF profiles, computation of length of GVF.		**9 Hrs.**
Unit: 3	**CO: 2,3**	
Rapidly varied flow (RVF) Definition, hydraulic jump phenomenon, conjugate depth relationship, characteristics uses and types of hydraulic jumps as an energy dissipater.		**6 Hrs.**
Unit: 4	**CO: 3**	
Notches and Weirs **a)** Types, Derivation of Discharge Equation, Velocity of Approach, Francis Formula, and Errors in Measurement of Discharge Sharp, Broad and Round Crested Weirs, Time of		**7 Hrs.**

Emptying Tank with Weir. Introduction to Ogee spillway.			
Unit: 5	**CO: 3,4**		
Canals and cross drainage work: Need, types of canal, purpose and types of canal lining, canal regulation structures, Canal operation and maintenance, Definition and purpose of cross drainage works, Types (aqueducts, siphons etc.)			**6 Hrs.**
Unit: 6	**CO: 4**		
River training works Purpose and importance of river training works, types of rivers training work viz. flood embankments, Guide Banks, Marginal bunds, and Groynes, Design Considerations for river training works viz. Hydraulic, Geotechnical, Environmental and Economic.			**8 Hrs.**

Recommended Textbooks:

1. "Flow in Open Channels" by K. Subramanya
2. "Open-Channel Hydraulics" by Ven Te Chow
3. "Open Channel Flow" by M. Hanif Chaudhry
4. "Hydraulics of Open Channel Flow" by Hubert Chanson
5. "River Engineering" by R.J. Garde and K.C. Garg

References Books:

1. "Flow in Open Channels" by K. Subramanya
2. "Flow Through Open Channels" by K.G. Ranga Raju
3. "Irrigation and Waterpower Engineering" by B.C. Punmia & Pande B.B.L.
4. "Hydraulics and Fluid Mechanics" by P.N. Modi & S.M. Seth
5. "River Behaviour, Management and Training" by R.K. Sharma
6. "Hydrology and Water Resources Engineering" by S.K. Garg

Title of the Course:	**CONSTRUCTION PROJECT MANAGEMENT**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVEM0504**	**2**	**-**	**-**	**2**

Course Pre-Requisite:

Industrial Engineering Management

Course Description:

Construction Project Management forms a core subject which is taught to students of all non-circuit disciplines of engineering. The study of this subject is aimed at developing a thorough understanding of the Construction Project Management applications to solve engineering problems.

Course Learning Objectives:

1. To explain the importance of Project Management and Project Planning
2. To explain Safety Engineering.
3. To explain the Mechanical v/s manual construction.
4. To explain software use for construction project management.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the importance of Project Management tools.	2	Understand
CO2	Apply Safety and Risk Management in Construction and work study	3	Apply
CO3	Evaluate working of various construction equipment's.	5	Evaluate
CO4	Develop Plan and Schedule the Project by using CPM, PERT and software's.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	2	2	3	3				3	2
CO2	1	2	1	2	3	2	3				1
CO3	2	2	1	1	3						1
CO4	2	3	3	3	3			3	3	1	1

CO	PSO1	PSO2	PSO3
CO1	2	1	
CO2	2	1	2
CO3	2	2	2
CO4	3	3	3

Assessments:

Teacher Assessment:

Assessment	Marks
ESE	50

- ESE: Assessment is based on 100% course content

Course Contents:

Unit: 1	**CO:1,4**	
a) Project Management – Objectives, Agencies, Phases; Work Breakdown Structure. **b) Project Planning** - Bar Chart, Milestone Chart, CPM **c) Development of CPM Network** – Time Estimates, Floats, Critical Path. **d) Network Updating**		**7 Hrs.**
Unit: 2	**CO: 4**	
a) PERT - Concept of Probability, Normal and Beta distribution, time Estimates, Slack, Probability of Project Completion **b) Precedence Network**: Concept only.		**5 Hrs.**
Unit: 3	**CO: 2**	
a) Safety Engineering – Importance of Safety, Classification of Accidents, Causes of Accidents, Safety Policy, Safety Organization, Safety Plan, Safety Training, Various Safety Equipment used on site. **b) Risk Management** –Definition, Types, Risk Identification Process, Sources of Risk, Risk Classification, Risk Mitigation- Risk Reduction, Risk Acceptance, Risk Avoidance.		**3 Hrs.**

Unit: 4	**CO: 3**	
Mechanical v/s manual construction, Excavation in Earth: Earth moving equipment- Tractors, Bulldozers, Scrappers, Power shovel, Hoes, Drag line, Clamshell, Trenchers, Compactors, Tippers, Cranes. Excavation in hard rock: Rippers, Jack Hammers, Drills, Compressors and Pneumatic Equipment		**8 Hrs.**
Unit: 5	**CO: 2**	
Work Study: **a) Definition**, Objectives, basic procedure, method study and work measurement, Work study applications in Civil Engineering. **b) Method study** – Definition, Objective, Procedure for selecting the work, recording facts, symbols, flow process charts, multiple activity charts, string diagrams. **c) Work measurement** – Time and motion studies, Concept of standard time and various allowances, time study, equipment performance rating. Activity sampling, time-lapse.		**4 Hrs.**
Unit: 6	**CO: 4**	
Introduction to software use for construction project management (MSP, Primavera etc.)		**3 Hrs.**

Recommended Textbooks:

1. Project Planning and Control with PERT and CPM – Dr. B. C. Punmia and K. K. Khandelwal.
2. PERT and CPM: Principles and Applications – L. S. Srinath
3. Construction Project Management – K. K. Chitkara
4. Construction Engineering and Management – S. Seetharaman.
5. Construction planning equipment and methods—R.L. Peurifoy
6. Heavy Construction – Planning, Equipment, Methods—Jagman Singh

References Books:

1. Construction Project Management – Kumar Neeraj Jha. Understand the importance of Project Management.
2. Construction Safety Manual Published by National Safety Commission of India

Title of the Course:	**GEOTECHNICAL ENGINEERING LABORATORY**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPC0531**	**-**	**-**	**2**	**1**

Course Pre-Requisite:

Knowledge of Basic Civil Engineering, Engineering Mechanics and Mechanics of Soilds.

Course Description:

This course provides hands-on experience in soil testing and analysis, reinforcing theoretical concepts from geotechnical engineering. Students will conduct laboratory experiments to determine soil properties such as grain size distribution, consistency limits, permeability, compaction characteristics, shear strength, and consolidation behavior. The course emphasizes proper testing procedures, data interpretation, and application of results in geotechnical design. Through practical experimentation, students will develop essential skills for geotechnical investigations and engineering decision-making.

Course Learning Objectives:

1. Conduct Soil Characterization Tests – Identify and classify soils based on physical and index properties using standard laboratory procedures.
2. Interpret Laboratory Test Data – Analyze and interpret experimental data to determine geotechnical parameters for engineering applications.
3. Demonstrate Field Control Techniques – Understand field applications of soil testing methods, including quality control and site investigations.
4. Follow Standard Testing Procedures – Conduct experiments according to IS standards, ensuring accuracy and consistency in results.
5. Enhance Technical Reporting Skills – Prepare clear and concise laboratory reports that present findings, interpretations, and engineering recommendations.
6. Work Effectively in Teams – Collaborate with peers to conduct experiments, analyze data, and discuss results in a professional laboratory environment.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Demonstrate the experiments for characterization of different soils.	3	Apply
CO2	Analyze the soil behavior based upon the experimental test results	4	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2			2							
CO2	2	1		2							

CO	PSO1	PSO2	PSO3
CO1	1		1
CO2			1

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE),

Assessment	MARKS
ISE	25
ESE (POE)	25

- ISE is based on practical performance and laboratory experiment write up submission.
- ESE: Assessment is based on 100% skills and performance on the basis of practical and oral examination.

Course Contents:

Activity: 1	**CO: 1 & 2**	

1. Experiments - Characterization of Soil as per IS 2720. **20 Hrs.**

Experiment 1: Determination of the water content of the given sample by oven drying method.
Experiment 2: Determination of the specific gravity of the given soil sample by pycnometer/ density bottle method.
Experiment 3: Grain size distribution of soil by the mechanical sieve analysis.
Experiment 4: Determination of the Atterberg's limits of the soil sample: liquid limit, plastic limits and shrinkage limit (at least two) of the given soil sample to classify the soil on the basis of plasticity chart.
Experiment 5: Determination of the field density by core cutter / sand replacement method.
Experiment 6: Determination of coefficient of permeability of the given soil sample by constant head/ falling head test.
Experiment 7: Determination of the optimum moisture content by standard Proctor / modified Proctor test.
Experiment 8: To determine the shear strength of the soil by the direct shear test.

Activity: 2	CO: 1 & 2	
2. DEMONSTRATION: - Demonstration of any two of below. 1. Particle size distribution-Sedimentation analysis (hydrometer) 2. Unconfined Compression Test 3. Triaxial shear test. 4. Vane shear test 5. One dimensional consolidation test.		**10 Hrs. each**

Recommended Textbooks:

1. Soil Mechanics and Foundation Engg. By K.R.Arora.
2. Soil Mechanics and Foundation Engg. by B.C. Punmia.
3. Soil Mechanics and Foundation Engg. by V.N.S.Murthy.

References Books:

1. Soil Behaviour and Critical States Soil Mechanics: Wood, D. M. 1990 Cambridge University Press, Cambridge.
2. Soil Mechanics. Concepts and Applications: Powrie, W. 1997 E & FN SPOON, London.
3. Geotechnical Engineering – Prentice Hall, Delhi by Iqbal H Khan.
4. Geotechnical Engineering by P. Purushottam Raj. (Tata Mcgraw Hill Company Ltd. New Delhi).
5. Soil mechanics by Terzaghi and Peak.(John Willey and Sons, New- York).
6. Soil Testing by T.W. Lambe.(Willey Eastern Ltd., New Delhi).
7. Geotechnical Engineering by B. J. Kasamalkar.(Pune Vidyarthi Griha).

Title of the Course:	**WATER QUALITY MONITORING LABORATORY**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPC0532**	**-**	**-**	**2**	**1**

Course Pre-Requisite:

Students must have basic idea about Environmental Problems and issues regarding the application of knowledge of the concepts which are essential for understanding correlation of Engineering and Environmental Issues like water pollution and disposal problems.

Course Description:

This course will help the students to understand the importance and seriousness about pollution of Water and water treatment facilities and Civil Engineering aspects like Green buildings and water supply network.

Course Learning Objectives:

1. To know the drinking water quality
2. To know the water treatment in field.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Evaluate the quality of the given source of water for drinking purpose as per codal provision.	5	Evaluate
CO2	Formulate the water treatment facility in practice with theoretical knowledge.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2		1	1	1	2			1		1
CO2	2	2	1	1	1	2			2		

CO	PSO1	PSO2	PSO3
CO1	2		1
CO2	3	1	2

Assessments:

Teacher Assessment:

- The component In Semester Evaluation (ISE) would consist of continuous evaluation of all experiments performed (70%), design problems of treatment units (10%), Site visit report (20%).

Assessment	MARKS
ISE	25
ESE (OE)	25

- **ESE OE:** Based on practical performance (40%) and oral examination (60%) the evaluation will be carried out.

Course Contents:

1. Experiments - Characterization of Soil as per IS 2720. **Analysis of any 08 of the following test parameters for water** 1. pH 2. Acidity 3. Alkalinity 4. Chlorides content 5. Hardness – Total, temporary and permanent 6. Turbidity 7. Residual Chlorine 8. Total dissolved solids through measurement of electrical conductivity 9. Dissolved Oxygen 10. Most Probable Number 11. Optimum dose of alum by jar test.	**16 Hrs.**
2. Design/ Analysis problems on water treatment unit	**8 Hrs.**
3. Visit to a water treatment plant	**6 Hrs.**

Recommended Textbooks:

1. Water and Waste water Technology by Mark J. Hammer,John Wiely and Sons.
2. Introduction to Environmental Engineering by M. L. Davis and Davis A. Cornwell, Mc Graw Hill.
3. Environmental Engineering: A design approach by A.P. Sincero and G.A. Sincero. Prentice Hall of India.

4. Environmental Engineering by H.S. Peavy, D.R. Rowe. McGraw Hill
5. Water Supply Engineering by Dr. P. N. Modi, Standard Book House, New Delhi.
6. Water Supply Engineering by S. K. Garg, Khanna Publishers, New Delhi
7. Water Supply Engineering by Dr. B. C. Punmia, Laxmi Publishers, New Delhielhi

References Books:

1. Manual of water supply and treatment by Government of India publication.

Note:

The Design shall be as per IS: 10500(2012) Code.

Title of the Course:	SIMULATION AND DESIGN LABORATORY	L	T	P	Credit
Course Code:	UCVVS0533	-	-	2	1

Course Pre-Requisite:

Knowledge of all Structural Engineering courses, Engineering Survey courses, Engineering Hydraulics and Water resources Engineering, and Transportation Engineering. In addition, before the commencement of the VIth semester, students are required to complete a certification course/training on their own for the domains mentioned in the syllabus of this course.

Course Description:

This course aims to make students perform practices followed in civil engineering profession in areas of building permissions, building services, material testing and use of computer aided calculations.

Course Learning Objectives:

1. To make students aware about computational tools being used in industry.
2. To make hands-on experience on the various computational tools.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		Level	Descriptor
CO1	Demonstrate the ability to use software tools for analysis, modeling, and interpretation of engineering systems.	3	Apply
CO2	Develop computational solutions to solve engineering problems using programming languages.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1			3			2	1		3
CO2	1	1			3			2	1		3

CO	PSO1	PSO2	PSO3
CO1	2	3	2
CO2	2	3	2

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), having 50- 50% weights respectively.

Assessment	Marks
ISE 1	10
ISE 2	15

- ISE-1 and ISE- 2 are based activities assigned in contents.

Course Contents:

Problem 1:	
Structural analysis using software (ETABS/STAAD.pro, any other suitable software) – Preparation of Software input, Analysis of a simple 2D problem (a portal frame (single bay-single storey), a three span continuous beam or any similar problem), Result Interpretation & its presentation in the form of tables/graphical, Validation of results with manual calculations.	**10 Hrs.**
Problem 2:	
GIS Open-source introduction (Quantum GIS) - Prepare and compose a shapefile map using any five tools in QGIS. Use of any vector Geo-processing tool or geometry tool in open source QGIS (eg. contour, slope, hillshade, labels, intersect, buffer etc.) for region of your residence.	**10 Hrs.**
Problem 3:	
Application of Python programming language in Civil Engineering – Develop programming language code using Python to solve total three civil engineering problems in three different domains - Structural Engineering, Engineering Hydraulics and Water resources Engineering, and Transportation Engineering.	**10 Hrs.**

For work load calculation minimum load is 1 Hr/week, for one group of Four to Five students. (As per AICTE Guide Lines).

Recommended Textbooks:

1. "Structural Analysis" – Bhavikatti S.S.
2. "Basic Structural Analysis" – C.S. Reddy
3. "Geographical Information System (GIS) for Resource Management" – M. Anji Reddy
4. "Remote Sensing and GIS" – B.C. Punmia, Ashok K. Jain, Arun K. Jain
5. "Starting Out with Python" – Tony Gaddis

Title of the Course:	**COMMUNITY FIELD PROJECT**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVIL0571**	**-**	**-**	**2**	**1**

Course Pre-Requisite:

Course Description:

This course aims to develop essential attributes in students, including analytical and critical thinking, research related skills, teamwork, communication skills, leadership etc. Through hands-on project work, the students will step outside the classroom and study their surroundings using sound scientific methods. The course will guide students through key stages of project development, from identification of case studies, survey plan, fieldwork and data collection, documentation and analysis and report writing.

Course Learning Objectives:

1. Make students able to learn by doing
2. Connect theories and knowledge learned in the classroom to real-world situations
3. Make students able to learn with and from peers through collaborative learning.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	To describe the concerned topic / surrounding reality / system / phenomenon / processes.	2	Understand
CO2	To discuss the learnings through a report & presentation demonstrating documentation skills.	2	Understand
CO3	To tabulate and analyze data gathered from the fieldwork.	4	Analyze
CO4	To design format for data collection, frame questions for survey, and conduct survey.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2					2				1	
CO2		1	2	1	3	2		3	3		
CO3	2	2		1		2			1	2	
CO4		1		1							

CO	PSO1	PSO2	PSO3
CO1			
CO2	2	2	1
CO3	1	1	1
CO4			1

Assessments:

Teacher Assessment:

- One In-Semester Evaluation is to be planned to have continuous assessment - Internal Presentations (Every two (2) weeks), Final Presentation and Report Submis`sion.

Assessment	Marks
ISE	25

Course Contents:

The Community Field Project will involve field work on various technical and social issues related to civil engineering. Students will have the opportunity to explore different areas, including:

1. **Water Resources and Management**
   - Rural and urban water supply assessment
   - Rainwater harvesting feasibility studies
   - Groundwater quality and recharge analysis
   - Irrigation system efficiency in agriculture
   - Wastewater treatment and reuse potential
2. **Transportation and Infrastructure**
   - Road safety audits and accident-prone zone identification
   - Traffic flow analysis in urban and semi-urban areas
   - Pedestrian infrastructure assessment
   - Public transport accessibility and efficiency
   - Rural road conditions and improvement strategies
3. **Housing and Sustainable Construction**
   - Affordable housing challenges in rural and urban areas
   - Green building practices and implementation
   - Structural condition surveys of heritage buildings

4. **Environmental Studies and Waste Management**
   - Solid waste management practices in villages and cities
   - Plastic waste collection and recycling initiatives
   - Air and noise pollution monitoring in urban centers
   - Composting and organic waste management in households
   - Industrial waste disposal and treatment methods
5. **Disaster Resilience and Climate Change**
   - Flood risk assessment and mitigation strategies
   - Landslide-prone areas and preventive measures
   - Emergency preparedness and response evaluation
6. **Community Health and Sanitation**
   - Drinking water quality and contamination studies
   - Sanitation infrastructure assessment in urban and semi-urban areas
   - Impact of air and water pollution on public health
7. **Agriculture and Rural Development**
   - Soil quality analysis and fertility management
   - Adoption of smart irrigation techniques
   - Assessment of agricultural produce storage and market access
   - Role of women in rural economic development
   - Study of cooperative farming and dairy industry in the region
8. **Energy and Renewable Resources**
   - Solar energy implementation in rural households
   - Energy efficiency in public buildings
   - Feasibility of small hydropower projects
   - Awareness of renewable energy policies and incentives
9. **Heritage Conservation and Tourism**
   - Structural assessment of historical monuments in Kolhapur
   - Impact of tourism on local economy and environment
   - Conservation strategies for cultural and natural heritage sites
   - Tourist infrastructure evaluation and improvement suggestions

The list above is suggestive only and does not limit the scope of this course. Any other multidisciplinary areas can be explored to complete a task under community field project.

1. Introduction to Development Needs session (basics of development paradigm and case study pedagogy):

   This is an introductory section of the course. The discussion on current development needs and role of higher education and the pedagogy of experiential learning will be covered.

2. Topic Selection:

   Select the topic in the surrounding involving a small process / operation / system / phenomenon. Select the topic from the service sector, public infrastructure, water supply, waste management etc.

3. Case Study Design:

   Develop the basic domain knowledge, identification of key stakeholders, derive objectives, processes of the study and measurables datasets, secondary datasets, official communications for the case study topic.

4. Survey Plan:

   Design the formats for data collection including questionnaires, measurements and observations that will be required for the study.

5. Fieldwork:

   Collection of primary data, performing interviews of various stakeholders, observations and measurements required for the study, data computation and tabulation.

6. Analysis:

   Data compilation, data analysis (e.g., Descriptive Statistics), understanding patterns, data interpretation, data visualization.

7. Report Writing and Presentation:

   Compilation and documentation of the work, a project report should be well-structured, different sections should have logical coherence, writing should be clear, presentation should be simple and engaging for the audience, presentation should summarize topic, study design, findings and learnings.

For work load calculation minimum load is 1 Hr/week, for one group of Four to Five students. (As per AICTE Guide Lines).

Guidelines:

1. Group Formation:

   The community field project is a group activity, with each group consisting of a minimum of

four (4) students and a maximum of five (5) students.

2. Batch Structure:

   Each batch shall consist of five (5) to six (6) groups. A single faculty member should not be assigned more than one batch. The students can have domain specific faculty working as a guide for the project.

3. Project Selection:

   Students must interact with the course coordinator and conduct a comprehensive topic survey or need analysis to identify a relevant topic. Based on this study, students must define the title, aim, and objectives of the field project.

4. Proposal Submission:

   Students must develop a detailed methodology, specifying the survey tools, field work, software (if any), analysis tools etc. The project proposal must be submitted within the first week of the semester.

5. Project Completion & Report Submission:

   The completed community field project along with detailed documentation in the form of a technical report must be submitted before the end-semester assessment.

6. Presentation Schedule:

   Synopsis Presentation: Initial project proposal presentation.

   Internal Presentations: Every two (2) weeks, student groups must present their progress as part of continuous evaluation.

   Final Presentation: The completed project along with final report, will be presented as part of the In-Semester Evaluation.

Note: The students have flexibility to choose a topic which can be continued in Mini Project in sixth semester & Main Project work in final year of academics.

Title of the Course:	**APPLICATIONS OF AI**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVMM0541**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Basics of Projects and Automation, Instrumentation and Data Analytics

Course Description:

This course is designed to understand applications of Artificial Intelligence for construction projects as a primary requirement to facilitate decision making for controlling cost overruns and delays

Course Learning Objectives:

The objective of learning this course is to identify possible scenarios in construction projects from concept to operation phase which need assistance from AI for making efficient decision making.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Recognize the significance of Applications of AI for construction projects	1	Knowledge
CO2	Identify domains of civil engineering for application of AI	1	Knowledge
CO3	Acquire skills to use AI for construction projects to control cost overruns and delays	3	Apply
CO4	Demonstrate application of AI for decision making in construction projects	3	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2	2	3	2	2	3	3	3	3
CO2	2	2	2	2	3	2	2	3	3	3	3
CO3	2	1	1	3	3		2	2	2	2	3
CO4	2	3	3	2	3	2	2	2	2	2	3

CO	PSO1	PSO2	PSO3
CO1	3	1	3
CO2	3	1	3
CO3	1		2
CO4	1		2

Assessments:

Teacher Assessment:

- ESE: End Semester Examination is based on 100% course content It may include Multi choice questions

Assessment	Weightage (Marks)
ESE	100

Course Contents:

Unit: 1	**CO: 1,2**	
Brief review of history of AI & related fields, Introduction to Artificial Neural Networks, Introduction to fuzzy systems, Introduction to predictive analytics, Introduction to machine Learning (ML)		**07 Hrs.**
Unit: 2	**CO: 1,2**	
Fundamentals of Genetic Algorithm. Genetic algorithm in Civil engineering, Adoption of AI in different fields of Civil Engineering, Challenges of Adoption of AI in Civil Engineering, Different models of AI		**06 Hrs.**
Unit: 3	**CO: 3,4**	
Structural Analysis and Design Optimization, Application of AI in Structural Analysis, Case Studies: Predictive Maintenance and Optimal Design Solutions, Structural health monitoring with AI techniques, Case studies: predictive modeling for structural integrity assessment		**10 Hrs.**
Unit: 4	**CO: 3,4**	
AI and ML in Construction Management, Introduction to construction management, Schedule optimization using ML algorithms, Resource allocation and risk management with AI, Predictive analytics for infrastructure maintenance, Case studies: AI-driven construction project management systems		**10 Hrs.**
Unit: 5	**CO: 3,4**	
Infrastructure Monitoring and Management, Introduction to infrastructure monitoring, IoT and sensor data integration with ML, Implementation of AI and ML algorithms using Python		**06 Hrs.**
Unit: 6	**CO:3,4**	
Integrating AI in design phase, AI applied to BIM, AI applied to sustainable design, AI applied to cost estimation, Ethical considerations in AI and ML applications		**06 Hrs.**

References Books:

1. Kishan Mehrotra, Chilukuri Mohan and Sanjay Ranka, Elements of Artificial Neural Networks, Penram International
2. Machine Learning with Python for Everyone, Mark Fenner, Pearson
3. Neural Networks, Fuzzy Logic, and Genetic Algorithms : Synthesis and Applications By S. Rajshekharan, G. A. Vijayalakshmi Pai, PHI
4. Andries P. Engelbrecht, Computational Intelligence - An Introduction, Wiley Publication

Title of the Course:	**PYTHON FOR DATA SCIENCE**	**L**	**T**	**P**	**Credit**
Course Code:	**UCEMM0541**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Students shall have knowledge of:

- Basic Knowledge of Python Programming.

Course Description:

This course is designed to understand applications of Artificial Intelligence for construction projects as a primary requirement to facilitate decision making for controlling cost overruns and delays

Course Learning Objectives:

This course is intended to understand the basic concepts related to python for data science involved by data manipulation, cleaning, preparation, and visualization.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Identify the need for data science and solve basic problems using Python built-in data types and their methods.	2	Understand
CO2	Identify efficient storage and data operations using NumPy arrays	3	Apply
CO3	Apply powerful data manipulations, data pre-processing and visualization using Pandas.	3	Apply
CO4	Design an application with user-defined modules and packages.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1					3						1
CO2					3						1
CO3					3						1
CO4					3						1

CO	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			

Assessments:

Teacher Assessment:

- ESE: End Semester Examination is based on 100% course content It may include Multi choice questions

Assessment	Weightage (Marks)
ESE	100

Course Contents:

Unit: 1		
Background & Introduction Python for Data Analysis, essential python libraries, Installation and setup of different operating systems, important development environments (IDEs) and text editors, brief background of python, decision structures and Boolean logic, looping, built-in data types, and functions.		**08 Hrs.**
Unit: 2		
Files, Input-Output, Errors, and Exceptions: File objects, file built-in functions, file built-in methods, file built-in attributes, standard files, command-line arguments, file system, file execution, exception in python, detecting and handling exceptions, standard.		**08 Hrs.**
Unit: 3		
Introduction to Numpy: NumPy basics: arrays and vectorized computation- the NumPy ndarray, creating ndarrays, data types for ndarrays, arithmetic with NumPy arrays, basic indexing and slicing, boolean indexing, transposing arrays and swapping axes, universal functions: fast element-wise array functions, mathematical and statistical methods, Sorting, unique and other set logic		**08 Hrs.**
Unit: 4		
Data Manipulation with Pandas: Introduction to pandas data structures: series, data frame, essential functionality- dropping entries, indexing, selection, and filtering, function application and mapping, sorting and ranking, summarizing and computing descriptive statistics, Unique values value counts, and membership, reading and writing data in text format.		**08 Hrs.**
Unit: 5		
Data Cleaning and Preparation: Handling missing data-filtering out missing data, filling in missing data, data transformation-removing duplicates, transforming data using a function or mapping, replacing values, detecting and filtering outliers, string manipulation, vectorized string		**07 Hrs.**

functions in pandas.			
Unit: 6			
Plotting and Visualization: Matplotlib and libraries, figures and subplots, colors, markers and line styles, ticks, labels, and legends, Annotations and drawing on a subplot, saving plots to file, plotting with pandas-line plot, bar plot, histogram and density plots, scatter and point plots.			**06 Hrs.**

References Books:

5. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly, 2ndEdition,2018
6. WesLey J. Chun, "Core Python Programming", Second Edition, Pearson Education, 2010.
7. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly 2017.

Title of the Course:	**INTRODUCTION TO MARKETING MANAGEMENT**	**L**	**T**	**P**	**Credit**
Course Code:	**UCEMM0542**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Students shall have knowledge of:

- Engineering Management, Basics of Human Resource Management

Course Description:

This course provides a comprehensive introduction to the fundamental principles of marketing. It examines consumer behavior, analyzing the factors affecting purchasing decisions across general, industrial, and online consumers. The course also explores the new product development process and its strategic implications. students will gain insights into pricing strategies, distribution channels, and promotional techniques. The course covers pricing objectives and methods, the selection of distribution channels, and the components of the promotion mix, including advertising and other promotional strategies.

Course Learning Objectives:

- To understand the nature and significance of the Marketing Function and the Marketing management process.
- To gain knowledge about the key aspects of the Buying Behavior of consumers and develop an understanding of the STP Process.
- To explain the factors affecting various product, pricing, channel management and Marketing communication decisions.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Identify the marketing functions, environment and segmentation for effective positioning of the products.	2	Understand
CO2	Assess the factors influencing consumer behavior and apply recent marketing trends in business.	2	Understand
CO3	Develop new products and services that are consistent with evolving marketing needs.	3	Apply
CO4	Formulate effective pricing policy, select an appropriate channel of distribution and Promotion mix	4	Analyse

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1										3	1
CO2										3	1
CO3										3	2
CO4										3	1

CO	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			

Assessments:

Teacher Assessment:

- ESE: End Semester Examination is based on 100% course content It may include Multi choice questions

Assessment	Weightage (Marks)
ESE	100

Course Contents:

Unit: 1		
Introduction Nature, Scope and Importance of Marketing – Functions – Marketing Environment- Factors Influencing Marketing Environment – Market Segmentation – Need and basis of Market Segmentation Targeting and Positioning. Selling Vs. Marketing.		**07 Hrs.**
Unit: 2		
Consumer Behaviour Factors Influencing Consumer Behaviour - General Consumers, Industrial Consumers, Online Consumers - Recent Concepts in Marketing – Green Marketing, Digital Marketing, Relationship Marketing.		**08 Hrs.**
Unit: 3		
Product Product –Definition – Levels of Product - Classification of Products – Product Mix: Levels, Hierarchy, Classifications, Mix. Product Lifecycle: The Concept and its Strategic Implications, Significance of Branding, New Product Development Process.		**08 Hrs.**
Unit: 4		
Pricing Price Decisions - Pricing objectives - Pricing policies and constraints - Different pricing method - New product pricing, Product Mix pricing strategies and Price adjustment strategy.		**07 Hrs.**
Unit: 5		

Promotion Promotion Decision - Promotion mix - Advertising Decision, Advertising objectives - Advertising and Sales Promotion – Developing Advertising Programmed – Role of Media in Advertising - Advertisement effectiveness - - Sales force Decision	**07 Hrs.**
Unit: 6	
Distribution Channel Channel Decision - Nature of Marketing Channels –. Types of Channel flows - Channel functions - Functions of Distribution Channel – Structure and Design of Marketing Channels -Channel co-operation, conflict and competition – Retailers and wholesalers.	**08 Hrs.**

Recommended Books:

1. Dr. C B Gupta, Dr. N. Rajan Nair, Marketing Management - Sultan Chand & Sons, New Delhi.
2. Philip Kotler, Marketing Management - Prentice Hall of India Pvt Ltd., New Delhi.

References:

1. R.S.N.Pillai & Bagavathi, Marketing Management, S. Chand Publishing.
2. RajanSexna, Marketing Management, MC Graw Hill Education.
3. Ramaswamy,V.S.,Namakumari,S- Marketing Management: Global Perspective, Sage Publications India Private Ltd, New Delhi.
4. Philip Kotler, HermawanKartajaya, Iwan Setiawan, Marketing 4.0- John Wiley & Sons, Inc., USA. WEB

Third Year B. Tech
Semester - VI

Academic Year 2025-2026

Title of the Course:	**DESIGN OF REINFORCED CONCRETE STRUCTURES**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPC0601**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Engineering Mechanics, Solid Mechanics, Structural Analysis

Course Description:

The Design of Reinforced Concrete Structures course introduces students to the fundamental principles of reinforced concrete (RC) design, including stress-strain behavior, permissible stresses, and different design philosophies. It covers the limit state method for designing beams, slabs, columns, and footings, following IS 456:2000 guidelines.

Course Learning Objectives:

1. Understand the fundamental concepts of stress-strain behavior, permissible stresses, safety factors, and design philosophies in reinforced concrete structures.
2. Apply the principles of the limit state method to analyze and design singly and doubly reinforced beams, slabs, staircases, columns, and footings.
3. Analyze the structural behavior of RC elements under different loading conditions, including shear, bond, torsion, and serviceability requirements.
4. Interpret and implement IS 456:2000 guidelines for designing reinforced concrete structures while considering practical constraints and safety measures.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Explain the fundamental concepts of stress-strain behavior, permissible stresses, design philosophies, and safety factors in reinforced concrete structures.	2	Understand
CO2	Apply the principles of limit state design to analyze reinforced concrete elements such as beams, slabs, columns, and footings.	3	Apply
CO3	Analyze the behavior of reinforced concrete elements under different loads as per IS 456:2000.	4	Analyze
CO4	Design the reinforced concrete structural elements like beams, slabs, columns, and footings for flexure, shear, torsion, and axial loads based on codal provisions.	6	Design

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1									
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	3	3	3	3
CO4	2	3	2	3	3	2	3	3	3	1	2

CO	PSO1	PSO2	PSO3
CO1			
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) have 20%, 30% and 50% weight respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally the last three Units) covered after MSE.

Course Contents:

Unit: 1	**CO: 1**	

Introduction: **7 Hrs.**

Stress-strain behavior of RCC, Permissible stresses in steel and concrete, Different design philosophies, various limits states, Characteristic strength and Characteristic load, Load factor, Partial safety factors.

Unit: 2	**CO: 2,4**	
Limit state of collapse (flexure): Analysis and Design of Singly and Doubly Reinforced rectangular sections, Theory of singly reinforced T and L beams.		**7 Hrs.**
Unit: 3	**CO: 3**	
Limit state of collapse (shear, bond and torsion): Shear failure, Types of Shear reinforcement, Design of Shear reinforcement, Concept of Bond-types, Factors affecting bond Resistance, Concept of development length and torsion. **Limit state of serviceability:** Significance of deflection, IS recommendations.		**7 Hrs.**
Unit: 4	**CO: 2, 4**	
Design of Slabs and Staircase: Simply supported One way slab, one way Cantilever Slab, two-way slab with different support conditions as per IS:456-2000. Design of Simply Supported single flight dog-legged staircase. (Numerical on single flight dog legged staircase only)		**8 Hrs.**
Unit: 5	**CO: 3,4**	
Analysis and Design of Columns: Axially Square, Rectangular and Circular columns, concept of eccentrically (uniaxial) loaded and bi-axially loaded columns and Interaction diagram. Circular column with links and helical reinforcement.		**8 Hrs.**
Unit: 6	**CO: 3,4**	
Design of Footing: Isolated rectangular column footing with constant depth, stepped/trapezoidal section subjected to axial loads, Design of combined rectangular footing.		**8 Hrs.**

Recommended Textbooks:

1. Limit state theory and Design –Karve and Shah, Structures publications, Pune
2. Reinforced Concrete Design – Limit state - A.K. Jain Nem Chand's brothers Roorkee
3. Fundamentals of Reinforced Concrete –Sinha and Roy, S. Chand and company Ltd. Ram Nagar, New Delhi
4. Limit State Design of reinforced concrete P. C. Varghese, Prentice Hall, New Delhi
5. Reinforced Concrete Design- B.C. Punima Laxmi publications New Delhi
6. Reinforced Concrete Design-M. L. Gambhir-Mc Millan India Ltd. New Delhi

References Books:

1. IS 456-2000 - Plain and Reinforced Concrete - Code of Practice

Title of the Course:	**ENGINEERING HYDROLOGY**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPCO602**	**2**	**-**	**-**	**2**

Course Pre-Requisite:

This course requires the basic knowledge of Water Supply Engineering, Fluid Mechanics and Hydraulics

Course Description:

The course mainly deals with Occurrence, circulation and distribution of water and their functioning, components, practical application, and significance.

Course Learning Objectives:

1. To evaluate average rainfall, runoff, evaporation loss and other losses from a reservoir/ watershed,
2. To equip the students with capabilities required for identifying, formulating and management of water resources related issues and problems.
3. To impart the students with knowledge required for groundwater flow and different types of aquifers
4. To understand the basic concepts and importance of evaporation and infiltration process

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the features of the primary hydrological processes	2	Understand
CO2	Apply the knowledge for formulating and management of runoff and groundwater resources and aquifers	3	Apply
CO3	Analyze infiltration indices, analysis of infiltration indices	4	Analyze
CO4	Evaluate the hydrograph and unit hydrographs with respect to runoff of different time intervals	5	Evaluate

CO0PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2				1	1		1	2	1	1
CO2	2	1									
CO3	2		2		2	2	1				
CO4	2	1	2	2			1	1	2	1	

CO	PSO1	PSO2	PSO3
CO1	2		2
CO2		2	
CO3	2		
CO4	0		

Assessments :

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

- ISE 1 and ISE 2 are based on Tutorial/ Assignment/ Declared test/Quiz/Seminar/Group Discussions/ site visit/Assignments on HES-RAC etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course contentwith 60-70% weightage for course content (Normally last three Units) covered after MSE

Course Contents:

Unit: 1	**CO: 1**	

INTRODUCTION Global water budget, India's water budget, Definition and scope, Hydrological Cycle, Terminology and application of hydrology, Modern methods of precipitation measurements and trend analysis	**04 Hrs.**

Unit: 2	**CO: 1**	

PRECIPITATION Definition, Types of precipitation, forms of precipitation, measurement of precipitation: recording and non recording type of rain gauges, analysis of precipitation data mass rainfall curves, mass rainfall curves	**06 Hrs.**

Unit: 3	**CO: 4**	
EVAPORATION Evaporation meaning and definition, factors affecting evaporation, Measurements of evaporation, Types of evaporation pans, and Estimation of evaporation, Transpiration and evapotranspiration		**04 Hrs.**
Unit: 4	**CO: 4**	
INFILTERATION Introduction, Factors affecting infiltration capacity, Measurements of infiltration, Infiltrometers, Infiltration Indices		**04 Hrs.**
Unit: 5	**CO: 2**	
RUNOFF Runoff, Factors affecting runoff, Components of runoff, Runoff rainfall relationships, Runoff Hydrographs, Methods of base flow separation, Unit Hydrograph and its applications		**06 Hrs.**
Unit: 6	**CO: 3**	
GROUNDWATER Occurrence and distribution of ground water, Darcy's Law and permeability, specific yield of aquifers, movements of ground water, safe yield of basin. Hydraulics of well under steady flow condition in confined and unconfined aquifers		**06 Hrs.**

Recommended Textbooks:

1. Engineering Hydrology, by. K . Subramanya, Mc Graw Hill Education (India) Pvt. Ltd

References Books:

1. Engineering Hydrology, by, C.S.P OJHA, R. BERNDTSSON, P. BHUNYA, Oxford University Press
2. Principles of Hydrology, by, Mysooru R. Yadupathy Putty, I.K International Publishing House Pvt. Ltd
3. A Text book of Hydrology, by, Dr. P. Jaya Rami Reddy, Laxmi Publications (p) Ltd

Title of the Course:	**TRANSPORTATION ENGINEERING**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPC0603**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Engineering Mechanics, and Basic Civil Engineering

Course Description:

This course is designed for Third Year B. Tech. Civil Engineering students to introduce them to the field of Transportation Engineering. This course makes students aware of the importance of transportation in nation development and available career options.

Course Learning Objectives:

1. Understand the road development process.
2. Recall the current schemes of highway development in India.
3. Understand the rail infrastructure components.
4. Describe the components of Aviation Infrastructure.
5. Discuss the elements of waterfront structures.
6. Explain the tunnel importance for infrastructure development.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Describe the basic elements of road, railway, aviation, tunnel & water way transportation through detailed illustrations.	2	Understand
CO2	Discuss the modern construction practices adopted for tunnel & dock and harbour engineering through group discussion.	2	Understand
CO3	Calculate the mathematical and formula-based values of geometric elements based on given primary data for road, rail and aviation infrastructure to showcase engineering design.	3	Understand
CO4	Interpret the importance of traffic engineering in highway construction & operations through detailed illustrations and design flexible & rigid pavement as per IRC method.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1			1			2			2		2
CO2					1	3	1			1	1
CO3	3	1	1		1	2			2	1	1
CO4		1	3		1	3			1		2

CO	PSO1	PSO2	PSO3
CO1		1	
CO2			
CO3	2	1	
CO4	2	1	1

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment	Marks
ISE1	10
MSE	30
ISE2	10
ESE	50

- ISE 1 and ISE 2 are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course contentwith 60-70% weightage for course content (Normally last three Units) covered after MSE

Course Contents:

Unit 1: Introduction to Highway Engineering	**CO: 1**	
Brief History of Road Development in India, Current Road Network Statistics. Objects of Planning, Planning Surveys and their Interpretation. Introduction to MoRTH, IRC, NHAI Agency, IAHE, NHIDCL, NHDP Phases. Current schemes of the government such as Bharatmala - I & II, SARDP-NE, LWE. Terrain classification, design speed, vehicular characteristics, highway cross-section elements. Sight distance: Introduction to sight distance, reaction time, analysis of safe sight distance, analysis of overtaking sight distance, intersection sight distance.		**06 Hrs.**
Unit 2: Geometric Design of Highways	**CO: 1 & 3**	
Design of horizontal alignment: Highway alignment & Surveys, horizontal curves, super elevation, radius at horizontal curves, widening of pavements, transition curves.		**09 Hrs.**

Design of vertical alignment: types of gradients, grade compensation, analysis of vertical curves, Safe system approach. Design of Highway Drainage: Objects, Requirements, Importance and Types of Highway Drainage.		
Unit 3: Introduction to Traffic & Pavement Engineering	**CO: 4**	
Introduction to Traffic Engineering: Definition, objectives and scope of Traffic Engineering, Traffic Flow, Statistical Analysis of Traffic Data, Traffic Regulation and Control, Types of intersection, Highway capacity. Introduction to Pavement Engineering: Types of Pavements, Function of Pavement Components, Pavement Design Factors, Design of Flexible Pavement as per IRC 37, Design of Rigid Pavement as per IRC 58, Joints in Rigid Pavements.		**07 Hrs.**
Unit 4: Introduction to Railway Engineering	**CO: 1 & 3**	
Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Track Stress, coning of wheels, creep in rails, defects in rails–Route alignment surveys, conventional and modern methods Geometric design of railways, gradient, super elevation, widening of gauge on curves, Points and Crossings. Electrification of railways, continuous track design, sleeper-less tracks, power requirement, Calculation of Materials required for track laying.		**09 Hrs.**
Unit 5: Introduction to Airport Engineering	**CO: 1 & 3**	
Air transport characteristics, airport classification, airport planning: objectives, components, criteria for airport site selection and typical airport layouts, Runway Design, Orientation, Wind Rose Diagram, Runway length, Passenger Facilities and Services, Runway and Taxiway Markings, Taxiway Design, Pavement and lighting, recent development in International Airports.		**06 Hrs.**
Unit 6: Introduction to Docks, Harbors, and Tunnel Engineering	**CO: 1 & 3**	
Definition of Basic Terms, Planning and Design of Harbors, Requirements, Classification, Harbor Layout and Terminal Facilities, Wave action on Coastal Structures and Coastal Protection Works. Dry dock and wet dock differentiation. Introduction, Size and Shape of The Tunnel, Tunneling Methods in Hard Rock & Soft Material, Tunnel Lining, Tunnel Lighting, Drainage and Ventilation, Tunneling using Tunnel Boring Machine, Trenchless Construction Method (TCM).		**08 Hrs.**

Recommended Textbooks:

1. S K Khanna and CEG Justo," Highway Engineering", Nem Chand Bros, Roorkee
2. L R Kadiyali, "Highway Engineering", Khanna Publishers, New Delhi.
3. Saxena Subhash C and Satyapal Arora, "A Course in Railway Engineering", Dhanpat Rai and Sons, Delhi.
4. Satish Chandra and Agarwal M.M, "Railway Engineering", 2nd Edition, Oxford University Press, New Delhi.

5. Khanna S K, Arora M G and Jain S S, "Airport Planning and Design", Nemchand and Brothers, Roorkee.
6. Bindra S.P., "Docks & Harbor Engineering", Dhanpat Raj Publications, New Delhi.
7. R Shrinivasan, "Harbour, Dock and Tunnel Engineering", Dhanpat Raj Publications, New Delhi.
8. S. C. Saxena, "Tunnel Engineering", Dhanpat Raj Publications, New Delhi.

References Books:

1. S.K. Sharma, "Principles, Practice and Design of Highway Engineering", S. Chand Publishing, New Delhi.
2. Partha Chakraborty and Animesh das, "Principles of Transportation Engineering", Prentice Hall
3. Subramanyam. K.P, "Transportation Engineering", Scitech Publications, Chennai.
4. Relevant IRC codes
5. C Venkatramaiah, "Transportation Engineering, Volume II: Railways, Airports, Docks and Harbours", Universities India Publisher.
6. J.S. Mundrey, "Railways Track Engineering", Tata McGraw Hill, Delhi

PROGRAM ELECTIVE-I			
Sr. No.	***Curriculum Component***	***Course Code***	***Course Names***
1	PEC	UCVPE0611	Ground Improvement & Earth Pressure Theories
2	PEC	UCVPE0612	Geotechnical Foundation Engineering
3	PEC	UCVPE0613	Soil Investigation and Foundation Design

Title of the Course:	**GROUND IMPROVEMENT & EARTH PRESSURE THEORIES (PE-II)**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPE0611**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Knowledge of Basi Civil Engineering, Engineering Mechanics, Mechanics of Solids and Geotechnical Engineering .

Course Description:

This course provides an in-depth understanding of ground improvement techniques and earth pressure theories essential for geotechnical engineering. It covers various ground enhancement methods, including mechanical stabilization, chemical stabilization, grouting, compaction, and reinforcement techniques. The course also explores earth pressure theories, analysing lateral soil pressures acting on retaining structures, stability considerations, and the design implications for foundation and retaining systems. Through theoretical concepts, case studies, and practical applications, students will develop the skills to assess and implement ground improvement solutions effectively.

Course Learning Objectives:

1. Understand Ground Improvement Techniques – Explain the fundamental principles and applications of various ground improvement methods, including mechanical and chemical techniques.
2. Analyze Soil Stabilization Methods – Evaluate different soil stabilization techniques such as compaction, grouting, soil reinforcement, and deep mixing for enhancing ground performance.
3. Apply Earth Pressure Theories – Understand and apply classical earth pressure theories (Rankine and Coulomb) to analyze lateral soil pressures on retaining structures.
4. Design Retaining Structures – Assess the stability and design considerations of retaining walls, sheet piles, and other earth-retaining systems based on soil pressure distribution.
5. Evaluate Ground Performance – Identify and assess soil behaviour under various loading conditions and determine the most suitable ground improvement method for specific geotechnical challenges.
6. Interpret Geotechnical Data – Utilize laboratory and field test results to support decision-making in ground improvement and earth pressure analysis.
7. Solve Practical Engineering Problems – Develop problem-solving skills through case studies and real-world applications of ground improvement and earth pressure theories.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Discuss classical theories of earth pressure.	2	Understand
CO2	Demonstrate the understating of underground construction techniques.	2	Understand
CO3	Analyze the suitable ground improvement techniques for field problem.	4	Analyze
CO4	Evaluate stability of rigid retaining and flexible retaining structures.	4	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	2		1						
CO2	1	2	2		1						
CO3	3	2	1		1						
CO4	3	1	1		1						

CO	PSO1	PSO2	PSO3
CO1		1	1
CO2	1	1	1
CO3		1	1
CO4		1	1

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions/ site visits etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit: 1	**CO: 1**	
Earth Pressure Concept, area of application, Rankin's theory of earth pressure - soil type, surface inclination, loads on surface, soil layers, water level. Coulomb's theory, effects due to wall friction and wall inclination, earthquake effect. Advance methods of construction of retaining structure, diaphragm walls.		**8 Hrs.**
Unit: 2	**CO: 4**	
Rigid and Flexible Retaining Structures Types, material, empirical methods, stability analysis, cantilever sheet piles, anchored bulkheads - free earth method, fixed earth method, moment reduction factors and anchorage.		**8 Hrs.**
Unit: 3	**CO: 2**	
Underground construction Braced Excavation - methods, pressure distribution, stability, seepage. Pipes, conduits, trenchless technology, tunnelling techniques.		**7 Hrs.**

Unit: 4	**CO: 3**	
Ground improvement Concept, need, different types of problematic soils, emerging trends, methods. Mechanical stabilization-principles of compaction, behaviour of compacted soil, shallow and deep compaction methods, compaction control.		**7 Hrs.**
Unit: 5	**CO: 3**	
Ground modification Ground Improvement by drainage and dewatering methods. Preloading, Vertical drains- Design method, vacuum consolidation. Grouting- materials, permeation grouting, compaction grouting, jet grouting, grouting under difficult conditions- case studies.		**7 Hrs.**
Unit: 6	**CO: 3**	
Field methods Soil nailing, rock anchoring, micro-piles, construction techniques. Modification by admixtures- cement, lime, bitumen, Emerging methods. Gabion wall and Reinforce earth wall- Elements, construction methods, external and internal stability.		**8 Hrs.**

Recommended Textbooks:

1. Soil Mechanics and Foundation Engg. By K.R.Arora.
2. Soil Mechanics and Foundation Engg. by B.C. Punmia.
3. Soil Mechanics and Foundation Engg. by V.N.S.Murthy.
4. Foundation Engineering by B.J. Kasamalkar.
5. Bowles J. E., Foundation Analysis and Designs, McGraw-Hill Book Co. 1995.

References Books:

1. Foundation design manual-Dr. N.V. Nayak. Dhanpat Rai and Sons.
2. Clayton C. R. I., Woods R. I. and Milititsky J., Earth Pressure and Earth Retaining Structures, Third Edition, Taylor & Francis, 1995.
3. Terzaghi K. and Peck R. B., Soil Mechanics in Engineering Practice, Wiley and Sons, 1996.
4. Manfired R. Hausmann, Engineering Principles of Ground Modification, McGraw-Hill Pub, Co., 1990.
5. Foundation analysis & design by J. E. Bowles.
6. Foundation design by W.C.Teng.

Title of the Course:	GEOTECHNICAL FOUNDATION ENGINEERING (PE-II)	L	T	P	Credit
Course Code:	UCVPE0612	3	-	-	3

Course Pre-Requisite:

Knowledge of Basi Civil Engineering, Engineering Mechanics, Mechanics of Solids and Geotechnical Engineering

Course Description:

This course provides an in-depth understanding of the principles and applications of geotechnical foundation engineering. It covers the analysis, design, and construction of various foundation systems, including shallow and deep foundations and slope stability. Students will learn about soil exploration, bearing capacity, settlement analysis, slope stability analysis and ground improvement techniques. The course also emphasizes field testing methods, foundation design considerations, and mitigation of geotechnical failures. Practical applications and case studies will be incorporated to enhance problem-solving skills and real-world engineering decision-making.

Course Learning Objectives:

1. Understand Soil Behaviour: Explain the fundamental principles of soil mechanics and their role in foundation engineering.
2. Conduct Site Investigations: Perform soil exploration and testing to determine subsurface conditions for foundation design.
3. Analyse Bearing Capacity: Evaluate the bearing capacity of shallow and deep foundations under different loading conditions.
4. Assess Settlement: Analyse and predict foundation settlement to ensure structural stability and serviceability.
5. Design Foundations: Design appropriate shallow (spread footings, mat foundations) and deep (piles, caissons) foundations based on soil properties and structural requirements.
6. Ensure Slope Stability: Assess and design stable slopes to prevent landslides and soil failures.
7. Apply Geotechnical Solutions: Recommend suitable ground improvement techniques for problematic soils.
8. Interpret Field and Laboratory Tests: Utilize geotechnical field and laboratory data for effective foundation design and construction decisions.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Explain the suitability of different soil exploration methods and various types of foundations.	2	Understand
CO2	Demonstrate an understanding of the fundamental principles, methods and applications of modern foundation and ground improvement techniques.	2	Understand
CO3	Analyze types of foundation and stability of slopes.	4	Analyze
CO4	Estimate the bearing capacity and settlement of foundation for different soils as per IS standard.	5	Evaluate

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	2		1						
CO2	1	2	2		1						
CO3	3	2	1								
CO4	3	1	1								

CO	PSO1	PSO2	PSO3
CO1		1	1
CO2	1	1	1
CO3		1	1
CO4		1	1

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions/ site visits etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit: 1	**CO: 1**	

Soil Exploration — **7 Hrs.**

Necessity, planning, number & depth of bore holes. Exploration Methods- auger boring (hand and continuous flight augers), wash boring, rotary drilling, core drilling. Soil sampling- disturbed and undisturbed. Causes of sample disturbance.

Rock drilling and sampling, mechanical properties of rock, behaviour of rocks in uniaxial compression, tensile strength of rocks, Core barrels, Core boxes, core recovery, rock quality designation (RQD).

Unit: 2	**CO: 4**	

Bearing Capacity Evaluation & Foundation Settlement — **8 Hrs.**

Definitions, modes of failure, Terzaghi's bearing capacity theory, I.S. Code method of bearing capacity evaluation & computation (IS 6403), effect of various factors on bearing capacity (Size & Shape, Depth, WT, Eccentricity). Bearing capacity evaluation by Plate load test, standard penetration test (By I.S. Code method), cone penetration test and pressure meter tests with detailed procedure.

Unit: 3	**CO: 1 & 3**	
Shallow Foundation Types and their selection, minimum depth of footing, assumptions and limitations of rigid design analysis. Design of Isolated, combined, strap footing (Rigid analysis), Raft foundation (elastic analysis), floating foundations (R.C.C. Design is not expected). Concept of total settlement, differential settlement and angular distortion, Effects, Causes and remedial measures, computations from I.S. 8009- 1976 (Part I).		**8 Hrs.**
Unit: 4	**CO: 1 & 3**	
Pile Foundation Classification and applications, single pile capacity evaluation by static and dynamic methods. Pile load test. Group action of piles, design of pile group, Group efficiency, negative skin friction. Pile integrity test- equipment's, output. Under reamed piles – equipment, construction and precautions.		**7 Hrs.**
Unit: 5	**CO: 3**	
Stability of Slope Slope classification, slope failure, modes of failure. Infinite slope in cohesive and cohesion less soil, Taylor's stability number, Swedish slip method and concept of Friction circle method, control and mitigation of Landslides, Effect of Earthquake Force: Pseudo Static and Pseudo dynamic Analysis.		**8 Hrs.**
Unit: 6	**CO: 2**	
Caissons and Ground Improvement Element of wells, types, methods of construction, tilt and shift, remedial measures, sinking method- Sand Island method. Types of caissons, pneumatic caissons, caisson disease. sheet piling, common types of cofferdams. Ground Improvement- stone columns, vibroflotation, preloading technique. Use of Geo-synthetics and geotextiles. Jet Grouting, chemical grouting. RE structure.		**7 Hrs.**

Recommended Textbooks:

1. Soil Mechanics and Foundation Engg. By K.R.Arora.
2. Soil Mechanics and Foundation Engg. by B.C. Punmia.
3. Soil Mechanics and Foundation Engg. by V.N.S.Murthy.
4. Foundation Engineering by B.J. Kasamalkar.

References Books:

1. Foundation design manual-Dr. N.V. Nayak. Dhanpat Rai and Sons.
2. Geotechnical Engineering – Prentice Hall, Delhi by Iqbal H Khan.
3. Foundation Design and Construction by M.J. Tomlinson.
4. Foundation analysis & design by J.E.Bowles.
5. Foundation design by W.C.Teng.
6. Foundation Engineering by S.P.Brahma.
7. Principles of Geotechnical Engg. By Braja Das.
8. Geotechnical engineering – Cengage learning, New Delhi by Das, BM.
9. Basic and applied soil mechanics – New age publication, Delhi by Gopal Ranjan, Rao ASR.

Title of the Course:	SOIL INVESTIGATION AND FOUNDATION DESIGN (PE-II)	L	T	P	Credit
Course Code:	UCVPE0613	3	-	-	3

Course Pre-Requisite:

Knowledge of elements of civil engineering, mechanics, engineering hydraulics and geotechnical engineering.

Course Description:

This course provides an in-depth understanding of soil investigation techniques and foundation design principles for civil engineering applications. Students will learn about soil classification, site exploration methods, soil testing, and interpretation of geotechnical reports. The course covers various types of foundations, including shallow and deep foundations, their design considerations, load-bearing capacity, and settlement analysis. By the end of the course, students will be able to assess soil properties, select appropriate foundation types, and design safe and efficient foundation systems for different structures.

Course Learning Objectives:

1. Understand Soil Properties & Classification-Explain the physical and engineering properties of soil and classify different types of soil based on standard classification systems.
2. Conduct Soil Investigation & Site Exploration-Demonstrate knowledge of various soil exploration techniques, field tests, and laboratory tests used for soil investigation.
3. Analyze Soil Bearing Capacity & Settlement-Evaluate the bearing capacity of different soil types and analyze soil settlement to ensure safe and efficient foundation design.
4. Design Shallow Foundations-Apply engineering principles to design different types of shallow foundations such as isolated, combined, raft, and strip footings.
5. Design Deep Foundations-Assess the necessity of deep foundations and design pile foundations and well foundations for various soil conditions.
6. Apply Codal Provisions & Standards-Utilize relevant codes and standards in soil investigation and foundation design.
7. Conduct Field Applications & Case Studies-Analyze real-world geotechnical problems through case studies and apply practical solutions to foundation-related challenges.

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Level	Bloom's Cognitive Descriptor
CO1	Explain the soil exploration process and its application for foundation design.	2	Understand
CO2	Demonstrate an understanding of the fundamental principles, methods and applications of modern foundation.	2	Understand
CO3	Analyze shallow and pile foundations based on geotechnical considerations.	4	Analyze
CO4	Estimate the bearing capacity and settlement of foundation for different soils as per IS standard.	5	Evaluate

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	2		1						
CO2	1	2	2		1						
CO3	3	2	1		1						
CO4	3	1	1		1						

CO	PSO1	PSO2	PSO3
CO1		1	1
CO2	1	1	1
CO3		1	1
CO4		1	1

Assessments:

Teacher Assessment:

- Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and One End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

- ISE 1 and ISE 2 are based on Tutorial/Assignment/Declared test/Quiz/Seminar/Group Discussions/ site visits etc.
- MSE: Assessment is based on 50% of course content (Normally first three Units)
- ESE: Assessment is based on 100% course content with 60-70% Weightage for course content (Normally last three Units) covered after MSE.

Course Contents:

Unit: 1	**CO: 1**	

Soil Exploration — **7 Hrs.**

Objectives of soil exploration, necessity, planning, depth and extent of soil exploration in different civil engineering projects. Stages in sub surface exploration, problems and phases of foundation investigations. Exploration Methods- Direct methods, Semi-direct methods, Indirect methods, Geophysical, sounding, drilling and accessible explorations

Unit: 2	**CO: 1**	

Soil Sampling and Tests — **8 Hrs.**

Soil sampling- disturbed and undisturbed. Causes of sample disturbance.

Rock drilling and sampling, mechanical properties of rock, behavior of rocks in uniaxial compression, tensile strength of rocks, Core barrels, Core boxes, core recovery, rock quality designation (RQD). Sample preparation, laboratory tests – Triaxial (UU/CU), Consolidation, Swelling pressure. Analysis of results and interpretation, importance of in-situ testing. Performing various in situ tests – File Vane Shear Test, Plate load test, Pile load test, SPT, SCPT, DCPT. Precautions and interpretation. Site evaluation and reporting. Exploration in Rock and Marine Soil Exploration.

Unit: 3	**CO: 4**	
Bearing Capacity Evaluation & Foundation Settlement Definitions, modes of failure, Terzaghi's bearing capacity theory, I.S. Code method of bearing capacity evaluation & computation (IS 6403), effect of various factors on bearing capacity (Size & Shape, Depth, WT, Eccentricity). Bearing capacity evaluation by Plate load test, standard penetration test (By I.S. Code method), cone penetration test and pressure meter tests.		**7 Hrs.**
Unit: 4	**CO: 3 & 4**	
Shallow Foundation Types and their selection, minimum depth of footing, assumptions and limitations of rigid design analysis. Design of Isolated, combined, strap footing (Rigid analysis), Raft foundation (elastic analysis), floating foundations (R.C.C. Design is not expected). Concept of total settlement, differential settlement and angular distortion, Effects, Causes and remedial measures, computations from I.S. 8009- 1976 (Part I).		**8 Hrs.**
Unit: 5	**CO: 3 & 4**	
Pile Foundation Classification and applications, single pile capacity evaluation by static and dynamic methods. Pile load test. Group action of piles, design of pile group, Group efficiency, negative skin friction. Pile integrity test- equipment's, output. Under reamed piles – equipment, construction and precautions.		**8 Hrs.**
Unit: 6	**CO: 2**	
Caissons and Modern foundation technique Element of wells, types, methods of construction, tilt and shift, remedial measures, sinking method- Sand Island method. Types of caissons, pneumatic caissons- construction, working, applications, caisson disease. sheet piling- pressure distribution, application, common types of cofferdams. Pile raft foundation.		**7 Hrs.**

Recommended Textbooks:

1. Soil Mechanics and Foundation Engg. By K.R.Arora.
2. Soil Mechanics and Foundation Engg. by B.C. Punmia.
3. Soil Mechanics and Foundation Engg. by V.N.S.Murthy.
4. Foundation Engineering by B.J. Kasamalkar.

References Books:

1. Foundation design manual-Dr. N.V. Nayak. Dhanpat Rai and Sons.
2. Geotechnical Engineering – Prentice Hall, Delhi by Iqbal H Khan.
3. Foundation Design and Construction by M.J. Tomlinson.
4. Foundation analysis & design by J.E.Bowles.
5. Foundation design by W.C.Teng.
6. Foundation Engineering by S.P.Brahma.
7. Principles of Geotechnical Engg. By Braja Das.
8. Geotechnical engineering – Cengage learning, New Delhi by Das, BM.
9. Basic and applied soil mechanics – New age publication, Delhi by Gopal Ranjan, Rao ASR.

Title of the Course:	**BUSINESS COMMUNICATION AND VALUE SCIENCE**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVAE0631**	**-**	**-**	**2**	**1**

Course Pre-Requisite:

Basics of Communication Skills, LSRW Skills, Grammar etc.

Course Description:

This practical course is designed to build essential communication, emotional, and professional skills among undergraduate engineering students. Through engaging and hands-on activities, role plays, reflections, and presentations, students will enhance their self-awareness, emotional intelligence, intercultural sensitivity, teamwork, and workplace readiness.

Course Learning Objectives:

1. Conduct self-assessments to identify personal strengths and areas for growth.
2. Develop life skills like empathy, resilience, and interpersonal communication.
3. Understand and apply soft skills and ethics in real-life contexts.
4. Demonstrate professional communication in interviews, group tasks, and presentations.
5. Enhance employability quotient through resume writing, group discussion, and mock interviews.
6. Apply emotional intelligence and cross-cultural communication in workplace scenarios.
7. Practice leadership, motivation, and storytelling techniques for professional success.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand the importance of life skills for holistic personality development	2	Understand
CO2	Apply verbal and non-verbal communication skills in presentations and group activities	3	Apply
CO3	Analyze individual personality traits, values, and competencies for self-growth	4	Analyze
CO4	Evaluate cross-cultural cues and use emotional intelligence in workplace situations	5	Evaluate
CO5	Create job-oriented content such as resumes, cover letters, and participate in interviews	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1							2	1	1		2
CO2							3	3	1		2
CO3							3	1	3		2
CO4							2	2	2		2
CO5							2	2	1		2

Assessments:

Teacher Assessment:

Assessment	Marks
ISE	50

- ISE is based on practical performance and laboratory experiment write up submission.

Course Contents:

Practical: 1

Self-awareness and SWOT: **2 Hrs.**

- Understanding personal traits. SWOT and TOWS analysis.
- Presentation on self-strengths and surviving in the VUCA world.
- Reflection journal submission.

Practical: 2

Soft Skills and Workplace Ethics: **2 Hrs.**

- Introduction and importance of Soft Skills.
- Checklist on Soft Skills and action plan for improvement.
- Peer discussion on ethical challenges-Participants will read case studies, discuss, and list down the soft skills

Practical: 3			
Assertive communication and Positive Attitude: • Positive self-talk, attitude, and goal setting. • Checklist on Positive self-talk, Positive Attitude and Self-Esteem, Goal setting, right attitude • Assertiveness Self-assessment Test: https://www.psychologytoday.com/intl/tests/personality/assertiveness-test			**2 Hrs.**
Practical: 4			
Employability Quotient 1: Employment Correspondence Drafting resume, cover letter, and professional email. Formatting, tone, and clarity practice.			**2 Hrs.**
Practical: 5			
Employability Quotient 2: Workplace Expectations • Open discussion on the topic, "Employers' expectations and the need for new skillset for the changing workforce trends." The focus is on raising learning and adaptability through employment perspective. A detailed checklist is provided to the participants to match their skills and employer's expectations.			**2 Hrs.**
Practical: 6			
Employability Quotient 3: Group Dynamics • Participants will be engaged in Group Discussion activity to harness effective communication skills, self-confidence, assertive self-expression, team work and constructive exchange of ideas and thoughts.			**2 Hrs.**
Practical: 7			
Practical 7:Employability Quotient 4: Interview Techniques • Mock interviews with peer and faculty feedback. Tips on etiquette, articulation, and handling stress.			**2 Hrs.**
Practical: 8			
Professional Presentation Skills • Participants will prepare and deliver a presentation on their technical projects/mini-projects. The focus will be on body language, voice modulation, team coordination, engagement with audience, time management, slide design/visuals, technical depth.			**2 Hrs.**

Practical: 9			
Emotional intelligence: • Strategies to hone EI. Video screening and discussion. Extempore based on EI topics. Peer feedback. EQ test and reflection.			**2 Hrs.**
Practical: 10			
Motivation and leadership: • Participants are given few case studies/ video samples to understand motivation. Participants will talk about their favourite leader and motivation through their life.			**2 Hrs.**
Practical: 11			
Cross- cultural communication: • Techniques to facilitate cross-cultural communication. Participants will be provided a set of case scenarios to analyse cross-cultural communication. Participants will attempt a quiz based on different cultures.			**2 Hrs.**
Practical: 12			
Storytelling for business: • Create and present a technical story. Emphasis on narrative, engagement, and audience connection.			**2 Hrs.**

Recommended Textbooks:

1. Dryden, W. & Constantinou, D. (2004). *Assertiveness Step by Step*. Sheldon Press.
2. Goleman, D. (2006). *Emotional Intelligence*. Bloomsbury Publishing.
3. Northouse, P. G. (2021). *Leadership: Theory and Practice*. Sage Publications.
4. Maslow, A. H. (1943). *A Theory of Human Motivation*.
5. Raman, M. & Sharma, S. (2013). *Communication Skills*. Oxford University Press.

References Books (Online):

1. Ted Talk: How to Speak So That Others Want to Listen- https://www.youtube.com/watch?v=eIho2S0ZahI1
2. TEDx talk by Adam Galinsky: How to speak up for yourself- https://www.ted.com/talks/adam_galinsky_how_to_speak_up_for_yourself?language=en
3. https://www.youtube.com/watch?v=FFjGGZecO04
4. Steve Jobs: Connecting the dots- https://news.stanford.edu/2005/06/14/jobs-061505/

Title of the Course:	**DESIGN OF STEEL STRUCTURE LABORATORY**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPC0632**	**-**	**-**	**2**	**1**

Course Pre-Requisite:

CAD lab, Computer Aided Design And Drafting Laboratory, Design of steel structures

Course Description:

This course introduces design of Steel Structures for Industrial shed. This lab course gives student the knowledge of designing of whole structure by hand calculations. It also gives idea of how to use IS codes in design practices. Designing of steel structures done for industrial shed will be checked using standard software.

Course Learning Objectives:

1. To impart design and detail Industrial Shed: Consisting of roof truss, roof sheets, purlin, connections, columns and column bases.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Analyze Industrial shed of steel structures as per Indian Standard codes.	4	Analyze
CO2	Evaluate design forces in members of steel structures	5	Evaluate
CO3	Design Industrial shed of steel structures and develop detailed structural drawing	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	1	1	2	3	1	3	3	1	
CO2	1	2	3	1	2	3	1	3	3	1	
CO3	1	2	3	1	2	3	1	3	3	1	

CO	PSO1	PSO2	PSO3
CO1	1	3	3
CO2	3	3	3
CO3	3	3	3

Assessments:

Teacher Assessment:

- In Semester Evaluation(ISE) and One End Semester Examination (ESE) having 50% weight-age for each.

Assessment	MARKS
ISE	25
ESE (POE)	25

- ISE are based on performance of student in laboratory, analysis and design write-up, presentation, oral, Seminar/Group/Discussions etc.
- ESE: Assessment is based on performance in design write-up, drawing presentation, and oral.

Course Contents:

1. Design & Detailing of Industrial Shed: (CO1, CO2, CO3) The lab work shall consist of structural analysis, design and detailing of the Industrial structure. It shall consist of necessary drawings of roof truss, roof sheets, purlin, connections, columns and column bases. Site visit to a modern steel structure (PEB etc.). Student should write a visit report with detailed sketches. Run analysis of truss on any structural design software (e.g., STAAD Pro, SAP2000, etc.)	**30 Hrs.**

Recommended Textbooks:

1. Design of Steel Structures, by Dr. N. Subramanian, Oxford University Press, New Delhi.
2. Limit State Design of Steel Structures: V. L. Shah and Veena Gore, Structures Publication, Pune.
3. LimitStateDesignofSteelStructures:S.K.Duggal,TataMc-GrawHillIndia Publishing House
4. Design of Steel Structures: K. S. Sairam, Pearson
5. Design of steel structure by Limit State Method as per IS: 800- 2007: Bhavikatti S. S., I K International Publishing House, New Delhi
6. Limit state design in structural steel: Dr. M. R. Shiyekar, PHI publications.

References Books:

1. IS:800–2007,IS:875(partI, II and III),SP6(1), SP6(6), SP6(6), IS:816,IS:808.
2. LRFD Steel Design: William T. Segui, P W S Publishing
3. Design of Steel Structures: EdwinH. Gaylord, Charles N. Gaylord James, Stallmeyer, McGraw-

Hill
4. Design of Steel Structures: Mac. Ginely T.
5. Design of Steel Structures: Dayaratnam, Wheeler Publications, NewDelhi.
6. Design of Steel Structures: Punmia, A. K. Jain and ArunKumar Jain, Laxmi Publication
7. Design of Steel Structures: Kazimi S.M. and Jindal R.S., PrenticeHall India.
8. Design of Steel Structures: Breslar, LinScalzi, John Willey, New York.
9. Steel Structure: Controlling Behaviour through Design, Englekirk, WILEY.

Note:

The Design shall be as per IS: 800–2007 by limit state method.

Title of the Course:	**HIGHWAY MATERIALS AND TRAFFIC ENGINEERING LABORATORY**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPC0633**	**-**	**-**	**2**	**1**

Course Pre-Requisite:

Concrete Technology Lab, and Engineering Mechanics.

Course Description:

Experiments will help students understand the properties of bituminous materials, and their selection for various pavement designs and performance tests. Additionally, the field studies related to traffic engineering will help students understand the significance of heterogenous traffic conditions in Indian context.

Course Learning Objectives:

1. Make the student able to perform experiments as per standard procedure.
2. Draw inference from conducted experiments.
3. Apply the knowledge in real life practices.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Perform and Interpret IS/IRC standard tests on bituminous binders to understand their physical, rheological & safety characteristics for pavement application.	2	Understand
CO2	Analyze traffic characteristics & road safety parameters through field-based traffic engineering studies.	4	Analyze
CO3	Evaluate pavement material performance & subgrade strengthening using standard laboratory tests & mix design principles.	5	Evaluate

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3						1		2
CO2	3	3	2	3				3			
CO3	3	2		1							

CO	PSO1	PSO2	PSO3
CO1	2	1	2
CO2	2	1	

CO3	2	1		

Assessments :

Teacher Assessment:

- Two components of Course Evaluation

Assessment	Marks
ISE	25
ESE (OE)	25

- ISE Internal Marks based on Assignments, Declared test/Quiz/Site Visit Report, Discussions etc.
- ESE OE: Assessment is based on OE.

Course Contents:

Experiment 1: Specific gravity of binder	**2 Hrs**
Experiment 2: Bitumen Penetration	**2 Hrs**
Experiment 3: Softening Point	**2 Hrs**
Experiment 4: Flash Point and Fire Point Test	**2 Hrs**
Experiment 5: Ductility test	**2 Hrs**
Experiment 6: Viscosity of bitumen	**2 Hrs**
Experiment 7: Stripping value of aggregate	**2 Hrs**
Experiment 8: CBR Value Test	**2 Hrs**
Experiment 9: Mix Design using Marshall Machine	**2 Hrs**
Experiment 10: Rolling Thin Film Oven Test	**2 Hrs**
Experiment 11: Skid Resistance Test	**2 Hrs**
ANY TWO OF THE FOLLOWING:	
Experiment 12: Traffic Volume Study	
Experiment 13: Parking Study	
Experiment 14: Accident Study	
Recommended Textbooks:	

1. Khanna and Justo, Highway Engineering Lab manual, Nemchand & Bros., Roorkee.
2. Khistry, C.J.," Transportation Engineering - An Introduction ", Prentice Hall of India Ltd., New Delhi.
3. S.K. Sharma, Highway Engineering
4. All relevant IS and IRC codes.
5. MoRTH 5th Revision.

References Books:

1. Paul H. Wright, "Highway Engineering", 7th Edition WILEY
2. Subramanyam. K.P, "Transportation Engineering", Scitech Publications, Chennai.
3. AASHTO codes

Unit wise Measurable students Learning Outcomes:

ULO	After the completion of the course the student should be able to
ULO1	Determine the specific gravity of binders.
ULO2	Determine the consistency of material and grade the bituminous material.
ULO3	Determine the softening point.
ULO4	Find Flash and Fire point of bituminous binder.
ULO5	Examine ductility value of bituminous binder.
ULO6	Identify viscosity of bituminous binder.
ULO7	Determine stripping value of road aggregates.
ULO8	Determine California Bearing Ratio Value of soil subgrade.
ULO9	Perform mix design of bituminous material using Marshall Apparatus.
UL10	Assess the effect of aging on bituminous binder using the Rolling Thin Film Oven Test.
UL11	Evaluate the skid resistance of pavements to ensure safety and performance.
UL12	Conduct a traffic volume study to analyze traffic patterns and assess roadway capacity.
UL13	Perform a parking study to evaluate parking demand, supply, and utilization for effective management.
UL14	Analyze accident data to identify patterns and propose measures for road safety improvements.

Title of the Course:	**WASTEWATER MONITORING LABORATORY**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVPC0634**	**-**	**-**	**2**	**1**

Course Pre-Requisite:

Students must have basic ideas about Environmental Problems and issues regarding the application of knowledge of the concepts which are essential for understanding correlation of Engineering and Environmental Issues like water and air pollution and wastewater, solid waste disposal problems.

Course Description:

This course will help the students to understand the importance and seriousness about pollution of Water and designs of Wastewater treatment facilities from Civil Engineering aspects.

Course Learning Objectives:

1. Understand the wastewater quality and the quantity for disposal as per CPCB and MPCB standards.
2. Develop sewerage system for area under consideration.
3. Understand secondary treatment with design.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Explain the wastewater quality and assess the quantity for disposal as per CPCB and MPCB standards.	2	Understand
CO2	Design sewerage system for area under consideration.	6	Create
CO3	Design secondary treatment i.e. activated sludge system in detail.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2		1		2	2	3	3	3	3	3
CO2	3	3	2					1	1		
CO3	3	3	2		1		1		1	2	1

CO	PSO1	PSO2	PSO3
CO1	3	1	3
CO2	1		2
CO3	1		2

Assessments:

Teacher Assessment:

- The component In Semester Evaluation (ISE) would consist of continuous evaluation of all experiments performed (40%), Design of activated sludge process residential apartment wastewater (10%), Design of sewerage system and treatment system for a small urban area (30%), and Site visit report (20%).

Assessment	Marks
ISE	25

Course Contents: (CO1, CO2, CO3)

A. Characterization of Municipal Wastewater (Any 5 of the following): 1. pH 2. Alkalinity 3. Solids 4. Chlorides 5. DO 6. BOD 7. COD 8. Sulphates 9. Oil & grease 10. Volatile acids	**10 Hrs**
B. Design of activated sludge process residential apartment wastewater.	**4 Hrs**
C. Design of sewerage system and treatment system for a small urban area.	**12 Hrs**
D. Visit to sewage treatment plant.	**6 Hrs**

Recommended Textbooks:

1. Wastewater Engineering, P. N. Modi.
2. Wastewater Engineering By S K Garg
3. Water supply, Waste Disposal and Environmental Engineering, A.K.Chatterjee, Khanna

Publishers

References Books:

1. Peavey, H. S. Rowe, D.R., Environmental Engineering, McGraw-Hill Book Company.
2. Viessman W. and Hammer M.J. Water supply and pollution Control, Harper Collins College publishers.
3. Hammer M.J. Water and Wastewater Technology, Prentice-Hall of India Private Limited.
4. Manual on Municipal Solid Waste Management, Ministry of Urban Development Govt. of India.

Note:

- The Design shall be as per CPCB and MPCB standards.

Title of the Course:	**MINI PROJECT**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVIL0671**	**-**	**-**	**2**	**1**

Course Pre-Requisite:

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Course Description:

This course aims to develop essential attributes in students, including critical thinking, creativity, teamwork, and effective communication. Through hands-on project work, students will gain practical exposure to the process of transforming an idea into a tangible product. The course will guide students through key stages of project development, from conceptualization and design to execution and presentation, preparing them for real-world engineering challenges.

Course Learning Objectives:

1. Develop critical thinking and problem-solving skills in civil engineering project execution.
2. Foster creativity and innovation in designing practical solutions.
3. Enhance collaboration and teamwork through group-based project work.
4. Improve communication skills for effective project documentation and presentation.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Apply engineering concepts to develop a mini-project from idea to execution.	3	Apply
CO2	Analyze project challenges to develop efficient solutions.	4	Analyze
CO3	Compose comprehensive technical reports and deliver professional presentations to communicate project outcomes effectively.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	1		1			1	1		2
CO2	1	1	1	2	2	2		1	1	3	
CO3								2	3		

CO	PSO1	PSO2	PSO3
CO1	3	1	1
CO2	1	1	1
CO3		1	2

Assessments:

Teacher Assessment:

- One In-Semester Evaluation is to be planned so as to have continuous assessment - Internal Presentations (Every two (2) weeks), Final Presentation and Report Submission.

Assessment	Marks
ISE	25

Course Contents:

The Mini Project will involve practical and experimental work on various technical and social issues related to civil engineering. Students will have the opportunity to explore different areas, including:

- Experimental Studies: Conducting minor experiments to analyze civil engineering problems and propose innovative solutions.
- Computer-Based Analysis and Design: Using software tools for structural analysis, design, and simulation of civil engineering projects.
- Structural Audit and Health Monitoring: Assessing the condition of existing structures, identifying defects, and suggesting maintenance or rehabilitation measures.
- Innovative Civil Engineering Materials: Exploring new materials with improved strength, durability, and sustainability for construction.
- Environmental Impact Assessment: Evaluating the effects of civil engineering projects on the environment and proposing mitigation strategies.
- Water Resource Management: Designing small-scale water supply schemes, irrigation systems, and rainwater harvesting solutions.
- Sanitation and Waste Management: Planning and designing sewerage systems, solid waste management, and wastewater treatment solutions.
- Transportation Engineering: Analyzing and improving road networks, traffic management, and transportation systems for better efficiency and safety.
- The list above is suggestive only and does not limit the scope of this course. Any other areas related to civil engineering can be explored to complete a task under mini project course.

For work load calculation minimum load is 1 Hr/week, for one group of Four to Five students. (As per AICTE Guide Lines).

Guidelines:

1. Group Formation:

   The mini-project is a group activity, with each group consisting of a minimum of four (4) students and a maximum of five (5) students.

2. Batch Structure:

   Each batch shall consist of five (5) to six (6) groups. A single faculty member should not be assigned more than one batch. The students can have domain specific faculty working as a guide for the project.

3. Project Selection:

   Students must interact with the course coordinator and conduct a comprehensive literature survey or need analysis to identify a relevant project topic. Based on this study, students must define the title, aim, and objectives of the mini-project.

4. Proposal Submission:

   Students must develop a detailed methodology, specifying the software requirements, critical issues involved in analysis, design, and implementation. The project proposal must be submitted within the first week of the semester.

5. Software Utilization:

   The use of relevant software tools for analysis and design is encouraged.

6. Project Completion & Report Submission: The completed mini-project along with detailed documentation in the form of a technical report must be submitted before the end-semester assessment.

7. Presentation Schedule:

   a) Synopsis Presentation: Initial project proposal presentation.

   b) Internal Presentations: Every two (2) weeks, student groups must present their progress as part of In-Semester Evaluation-I (ISE-I).

   c) Final Presentation: The completed project along with final report, will be presented as part of the In-Semester Evaluation-II (ISE-II).

Note: The students have flexibility to choose a topic in continuation with topic worked with during Community Field Project in fifth semester & can be continued further in Main Project work in final year of academics.

Title of the Course:	**DIGITAL TWIN AND ASSET MANAGEMENT**	**L**	**T**	**P**	**Credit**
Course Code:	**UCVMM0641**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Basics of Projects and Automation, Instrumentation and Data Analytics, AI Applications

Course Description:

This course is designed to develop understanding about use of digital twin concept for management of various project asset in various phases of projects

Course Learning Objectives:

The objective of learning this course is to apply digital twin interventions in construction projects in its life cycle stages

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Recognize the significance of Digital Twins for its use in asset management	1	Knowledge
CO2	Identify asset management problems in operation of asset	1	Knowledge
CO3	Apply Engineering skills to use digital twin platform as a decision-making tool	3	Apply
CO4	Demonstrate application of Digital Twin for asset management	3	Apply

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2	2	3	2	2	3	3	3	3
CO2	2	2	2	2	3	2	2	3	3	3	3
CO3	2	1	1	3	3		2	2	2	2	3
CO4	2	3	3	2	3	2	2	2	2	2	3

CO	PSO1	PSO2	PSO3

CO1	3	1	3	
CO2	3	1	3	
CO3	1		2	
CO4	1		2	

Assessments:

Teacher Assessment:

- ESE: End Semester Examination is based on 100% course content It may include Multi choice questions

Assessment	Marks
ESE	100

Course Contents:

Unit: 1	**CO: 1,2**	
Definition, concepts, and evolution of Digital Twin, Difference between Digital Model, Digital Shadow, and Digital Twin., Levels of Digital Twin Maturity., Role of Digital Twin in Civil Engineering and Project Automation., Key components: Data, Simulation, Connectivity, and AI., Case studies in the construction and infrastructure sector.		**06 Hrs.**
Unit: 2	**CO: 1,2**	
Definition and importance of asset management., Lifecycle of civil engineering assets., Traditional vs. digital asset management., Asset Information Management (AIM) frameworks., Standards and guidelines: ISO 55000 series for asset management., Challenges in civil asset management.		**06 Hrs.**
Unit: 3	**CO: 3,4**	
Sensors, IoT, and data acquisition for asset monitoring, real-time data processing and cloud computing., Digital Twin-enabled condition monitoring of structures. AI, Machine Learning, and Predictive Analytics in Asset Management, Role of Big Data and Data Lakes in Digital Twins., Software platforms and tools (e.g., Autodesk Tandem, Siemens Mind Sphere, Bentley iTwin).		**10 Hrs.**
Unit: 4	**CO: 3,4**	
Integration of Digital Twin with BIM and GIS., BIM for asset lifecycle management., GIS for geospatial asset monitoring and management., Common Data Environments (CDE) and data interoperability., BIM-GIS-Digital Twin fusion for smart infrastructure., Case studies: BIM and GIS-enabled asset management.		**10 Hrs.**
Unit: 5	**CO: 3,4**	

Concept of predictive maintenance in civil structures., Digital Twin-driven Structural Health Monitoring (SHM)., Condition-based monitoring (CBM) using IoT sensors. Performance assessment and anomaly detection techniques. AI-powered maintenance planning and optimization. Case studies on predictive maintenance in bridges, roads, and buildings			**07 Hrs.**
Unit: 6	**CO: 3,4**		
Digital Twin applications in highways, railways, airports, and water management. Cyber-physical systems and their role in Digital Twin. Challenges in implementation: Data security, interoperability, and cost. Future trends			**06 Hrs.**

References Books:

1. Digital Twin and Smart Infrastructure, Author: Raj M. and M. Usman, Publisher: CRC Press
2. Digital Twin Technologies and Smart Cities, Author: F. J. G. Silva, L. G. Ferreira, and M. C. Azevedo, Publisher: Springer
3. Asset Management for Infrastructure Systems: Energy and Water, Author: Gerd Balzer, Publisher: Springer
4. Internet of Things and Digital Twin Technologies for Smart Cities, Author: Emmanuel Udoh, Publisher: IGI Global

Title of the Course:	**DATA ANALYTICS**	**L**	**T**	**P**	**Credit**
Course Code:	**UCEMM0641**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Students shall have knowledge of:

- Basic Knowledge of Python Programming.
- Basic knowledge of Data Science.
- Basic Knowledge of software's related to Civil and Environmental Engineering like GIS, QGIS

Course Description:

This course is intended to understand the basic concepts related to Data Analytics by data Processing, Tools in Data Analytics, Decision Making, and Case Studies.

Course Learning Objectives:

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand fundamental concepts of data analytics and its applications in Civil and Environmental Engineering include data processing techniques, data cleaning methods, and exploratory data analysis (EDA).	2	Understand
CO2	Demonstrate knowledge of various data analytics tools such as Excel, SQL, Tableau, Power BI, and GIS-based software.	2	Understand
CO3	Analyze time-series and geospatial data for engineering applications such as hydrology, traffic flow and environmental monitoring for decision-making techniques in real-world Civil and Environmental Engineering case studies.	4	Analyze
CO4	Discuss ethical considerations, challenges, and future trends in data analytics for sustainable development.	6	Create

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1		1		1	3				1		1
CO2		1		1	3				1		1
CO3		1		1	3				1		1
CO4		1	1	1	3				1		1

CO	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			

Assessments:

Teacher Assessment:

- ESE: End Semester Examination is based on 100% course content It may include Multi choice questions

Assessment	Weightage (Marks)
ESE	100

Course Contents:

Unit: 1		

Introduction to Data Analytics: Definition, importance, and applications in Civil & Environmental Engineering. Difference between Data Science, Data Analytics, and Business Intelligence. Types of data: structured, unstructured, time-series, geospatial. Data collection methods: IoT, sensors, surveys, GIS.	**08Hrs.**

Unit: 2		

Data Processing and Exploration: Data preprocessing steps: cleaning, transformation, handling missing values. Exploratory Data Analysis (EDA) concepts. Descriptive statistics: mean, median, mode, standard deviation. Introduction to correlation and regression analysis. Tools: Microsoft Excel, SQL, Python (Pandas, NumPy)	**08 Hrs.**

Unit: 3		

Tools and Technologies in Data Analytics: Overview of data analytics tools used in Civil & Environmental Engineering. Introduction to spreadsheet-based analytics (Microsoft Excel, Google Sheets).SQL for data storage, retrieval, and querying. Business Intelligence (BI) tools: Tableau, Power BI.GIS-based tools for spatial data analysis: QGIS, ArcGIS.Cloud platforms for data analytics: Google Cloud, AWS	**08 Hrs.**

Unit: 4		
Time Series and Spatial Data Analysis: Basics of time series analysis: trend, seasonality, forecasting. Applications: rainfall prediction, traffic flow analysis, environmental monitoring. Introduction to geospatial analytics and GIS-based data processing. Tools: QGIS, ArcGIS, Python (Geo Pandas, Folium)		**08 Hrs.**
Unit: 5		
Data-Driven Decision Making: Trees and clustering (K-Means, hierarchical clustering). Risk assessment and uncertainty analysis. Applications in construction management, disaster prediction, water resource management. Tools: Microsoft Excel, Power BI, Tableau.		**06 Hrs.**
Unit: 6		
Applications and Case Studies: Real-world applications in Civil and Environmental Engineering. Data-driven urban planning and infrastructure maintenance. Smart cities, sustainable development, and climate change analytics. Ethical considerations and challenges in data analytics Tools: Various tools based on case study requirements.		**07 Hrs.**

References:

1. Foster Provost, Tom Fawcett, "Data Analytics Fundamentals: O'Reilly Media ,2013.
2. Anil Maheshwari, "Data Analytics Made Accessible", Amazon Kindle Direct Publishing 2017.
3. James B. Pick "GIS and Spatial Data Analysis: Methods and Applications" CRC Press 202.
4. Robert H. Shumway, David S. Stoffer "Time Series Analysis and Its Applications: With R Examples" Springer 2017.

Title of the Course:	**HR PRACTICES IN THE ORGANIZATION**	**L**	**T**	**P**	**Credit**
Course Code:	**UCEMM0642**	**3**	**-**	**-**	**3**

Course Pre-Requisite:

Students shall have knowledge of:

- Engineering Management
- Basics of Human Resource Management

Course Description:

This course provides a comprehensive overview of modern Human Resource (HR) practices, emphasizing their strategic role in business success. Students will explore key HR functions, including talent acquisition, workforce planning, performance management, compensation strategies, learning and development, and employee relations. The course highlights the use of data-driven decision-making, HR technology, and ethical considerations in HR practices. Emerging trends such as AI-driven hiring, remote work models, and HR's role in organizational change are also covered. Through case studies and practical applications, students will gain the skills necessary to implement effective HR strategies in dynamic business environments.

Course Learning Objectives:

- Analyze and apply modern HR practices by evaluating the strategic role of HR in business, ethical considerations, and data-driven decision-making to enhance organizational effectiveness.
- Design effective talent acquisition and workforce planning strategies by implementing job analysis techniques, recruitment methods, AI-driven selection processes, and employer branding to attract and retain top talent.
- Develop and implement performance management and compensation frameworks by utilizing key appraisal methods, performance metrics (KPIs, OKRs), and reward strategies to drive employee engagement and organizational growth.
- Evaluate emerging trends in HR practices by assessing the impact of HR technology, AI automation, and remote work models on the future of workforce management and organizational success.

Course Outcomes:

CO	After the completion of the course the student should be able to	**Bloom's Cognitive**	
		Level	**Descriptor**
CO1	Understand HR practices and the strategic role of HR in decision making process.	2	Understand
CO2	Interpret job analysis techniques, modern recruitment methods, AI-driven selection processes, and performance appraisal frameworks for an organization	2	Understand
CO3	Develop effective learning, career development, and employee engagement strategies	3	Apply
CO4	Analyze emerging HR technologies and trends	4	Analyze

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1										2	1
CO2										2	1
CO3										3	1
CO4										2	1

CO	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			

Assessments:

Teacher Assessment:

- ESE: End Semester Examination is based on 100% course content It may include Multi choice questions

Assessment	Weightage (Marks)
ESE	100

Course Contents:

Unit: 1		

Introduction to HR Practices: Traditional vs. Modern HR Practices, Role of HR in Business Strategy, Importance and Development, Role of Data in HR Decision-Making, Ethical and Legal Considerations in HR Practices.	**04 Hrs.**

Unit: 2		

Talent Acquisition and Workforce Planning: Job Analysis and Job Design: Techniques and Importance, Recruitment Strategies: Internal vs. External, Digital Hiring, Selection Process: Psychometric Testing, AI in Selection, Employer Branding & Employee Value Proposition (EVP), Onboarding and Induction Best Practices	**08 Hrs.**

Unit: 3		
Performance Management and Compensation: Performance Appraisal Methods: 360-Degree Feedback, MBO (Management by Objectives), Key Performance Indicators (KPIs) and Key Performance Indicators (KPIs), Objectives & Key Results (OKRs), Reward and Recognition Programs, Compensation Strategies: Pay-for-Performance, Equity Plans, Employee Motivation and Engagement Models		**08 Hrs.**
Unit: 4		
Learning & Development (L&D) and Career Growth: Training Need Analysis (TNA) and Methods of Training, E-learning and Digital Learning Platforms, Leadership Development Programs, Succession Planning and Career Pathing, Competency Mapping and Skill Gap Analysis		**06 Hrs.**
Unit: 5		
Employee Relations and Workplace Culture: Workplace Diversity and Inclusion, Conflict Resolution and Grievance Handling, Employee Engagement Initiatives, HR Policies for Work-Life Balance and Well-Being, Ethics in HR and Corporate Social Responsibility (CSR)		**07 Hrs.**
Unit: 6		
Emerging Trends in HR Practices: HR Technology and HRIS (Human Resource Information System), Use of AI and Automation in HR, HR in Mergers and Acquisitions (M&A), Future of Work: Remote Work and Hybrid Models		**07 Hrs.**

Recommended Books:

1. Dr. C B Gupta, Dr. N. Rajan Nair, Marketing Management - Sultan Chand & Sons, New Delhi.
2. Philip Kotler, Marketing Management - Prentice Hall of India Pvt Ltd., New Delhi..
3. K. Aswathappa – Human Resource Management
4. Gary Dessler – Human Resource Management
5. V.S.P. Rao – Human Resource Management
6. Subba Rao P. – Essentials of Human Resource Management.

References:

1. Michael Armstrong – A Handbook of Human Resource Management Practice