SHIVAJI UNIVERSITY, KOLHAPUR
416 004, MAHARASHTRA
PHONE : EPABX – 2609000, BOS Section – 0231-2609094, 2609487
Web : www.unishivaji.ac.in Email: bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४, २६०९४८७
वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in

Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SU/BOS/Sci & Tech/ 316 **Date: 23/05/2025**

To,

The Director,
School of Engineering and Technology,
Shivaji University, Kolhapur.

Subject: Regarding revised syllabus of **B. Tech.** Part - III (Sem - V & VI) degree **Programme (Deparment of Technolgy)** under the Faculty of Science and Technology as per NEP 2020.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, Nature of Question paper and equivalence of B. Tech. Part - III (Sem - V & VI) under the Faculty of Science & Technology as per NEP 2020.

No.	Course Syllabus
1	Civil Engineering
2	Mechanical Engineering
3	Computer Science and Technology
4	Chemical Engineering
5	Electronics and Telecommunication Engineering
6	Food Technology

This Syllabus, shall be implemented from the academic year **2025-26** onwards. A soft copy containing the syllabus is attached herewith and it is available on university website **www.unishivaji.ac.in NEP-2020@suk (Online Syllabus).**

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October/ November 2025 & March / April 2026. These chances are available for repeater students, if any

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dr. S. M. Kubal
Dy. Registrar

Copy to: for Information and necessary action

1	The I/c Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations & Evaluation	7	Affiliation Section (T.1) (T.2)
3	The Chairpersan, Respective Board of Studies	8	P.G.Admission Section, /P.G Seminar Section
4	OE 4 Exam Section,	9	Computer Centrev/ IT Cell
5	Eligibility Section,	10	Internal Quality Assorance Cell (IQAC)

Shivaji University, Kolhapur

Department of Technology

Third Year B. Tech. (Civil Engineering), Semester- V, AY 2025-26

Teaching and Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation Scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Programme Core Course	PCC 311 (L) VSEC 331 (P)	Design of Reinforced Concrete Structures	03	01	02	06	04(PCC) 01(VSEC)	30:70	00:50
2.	Programme Core Course	PCC 312	Transportation Engineering	03	-	02	05	04	30:70	00:50
3.	Programme Core Course	PCC 313	Environmental Engineering	03	-	02	05	04	30:70	00:50
4.	Programme Core Course	PCC 314	Water Resources Engineering	03	-	-	03	03	30:70	50:00
5.	Programme Elective Course	PEC 315	Program Elective-I	03	-	-	03	03	30:70	50:00
6.	MDM Course	MDM 311	Multidisciplinary Minor Course II*	03	-	-	03	03	30:70	00:00
7.	Humanities and Social Sciences, Management: Ability Enhancement Courses	HSSM (AEC 311)	Introduction to Foreign Language	01	-	-	01	01	-	50:00
							-	**23**	**600**	**300**
8.	Mandatory Audit Course	MAC 312	Aptitude Enhancement Course II	-	01	-	01	ISE at Course in charge end		
9.	Experiential Learning Courses: Common Engg. Projects/Field visits	ELC (CEP/FP 311)	Mini Project III and Industrial Visit	-	-	02	02	ISE at Course in charge end		
			Total Hours	19	02	08	**29**	-		

Shivaji University, Kolhapur

Department of Technology

Third Year B.Tech. (Civil Engineering), Semester- VI, AY 2025-26

Teaching and Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation Scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1.	Programme Core Course	PCC 321 (L) VSEC 321 (P)	Design of Steel Structure	03	-	02	05	03 (PCC) 01(VSEC)	30:70	00:50
2.	Programme Core Course	PCC 322	Estimating, Costing and Valuation	03	-	02	05	04	30:70	00:50
3.	Programme Elective Course	PEC 321	Programme Elective - II	03	-	-	03	03	30:70	50:00
4.	Programme Elective Course	PEC 322	Programme Elective - III	03	-	-	03	03	30:70	50:00
5.	Vocational Skill Enhancement Course	VSEC 322	Computer Applications in Civil Engineering	-	-	02	02	02	-	50:00
6.	Open Elective Course	OEC 321	Open Elective -I	03	-	-	03	03	30:70	00:00
7.	MDM Course	MDM 321	Multidisciplinary Minor Course III*	03	-	-	03	03	30:70	00:00
8.	Experiential Learning Course: Project	ELC (PR 321)	Major Project Work - I	-	-	02	02	01	00:00	00:50
							-	**23**	**600**	**300**
9.	Mandatory Audit Course	MAC 321	Research Methodology	01	-	-	01	ISE at Course in charge end		
10.	Mandatory Audit Course	MAC 322	Aptitude Enhancement Course III	-	01	-	01	ISE at Course in charge end		
			Total Hours	19	01	08	**28**			

List of Electives:

Specialization	**Structural Engineering**	**Water Resources and Environmental Engineering**	**Construction Management**	**Soil Mechanics**	**Transportation and Land Planning**
Program Elective -I	Theory of Structures	Municipal Solid Waste	Construction Planning & Control	Foundation Engineering	History & Theory of Urban Planning
Program Elective –II	Advanced Structural Analysis	Open Channel Hydraulics and Hydraulic Machines	Human Resource Management in Construction	Ground Improvement Techniques	Advanced Transportation Systems
Program Elective –III	Advanced Design of RCC Structures	Integrated Waste Management for a Smart City	Construction Methods and Equipment Management	Soil Exploration and Investigation Techniques	Airport Engineering
Program Elective –IV	Design of Bridges	Design of Dams & Reservoirs	Construction Quality & Safety Management	Foundation Engineering	Design and Construction of Docks, Harbours, Offshore Structures
Program Elective –V	Prestressed Concrete Design	Advanced Water and Wastewater Treatment	Disaster Management and Mitigation Measures	Soil Dynamics and Structures	Traffic Engineering and Management
Program Elective –VI **(May vary depending upon availability of MOOC)**	Finite Element Analysis	Introduction to Piping and Plumbing Engineering / Ground Water Hydrology / Surface Water Hydrology	Construction Software	Remote Sensing and GIS Applications	Laws in Relation to Planning

***The elective is offered to a batch of minimum students of 15 or 50% of the strength of the class whichever is less.**

Open Elective is to be chosen from faculty other than that of Major Discipline.

List of Open Electives:

Open Elective – I	Optimization Techniques, Solid Waste Management, Green Building, Development Engineering,
Open Elective – II	Remote Sensing and GIS Applications, Air Pollution, Health Care Building Services, Intelligent Transportation Systems
**Open Elective – III	Finite Element Analysis, Environmental Ethics, Introduction to Piping and Plumbing Engineering
**Open Elective -IV	Disaster Management, Natural Hazards and Its Mitigation

(Open Elective-III and Open Elective –IV may vary depending upon availability of MOOC)**

Year, Program, semester	T.Y. Civil Engineering, semester V						
Course Code	PCC 311						
Course Category	Programme Core Course						
Course title	**Design of Reinforced Concrete Structures**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	03	01	-	04		04	
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**IE**	**EE**	**Total**
	30	70		--	–	--	--	100
Pre-requisites (if any)	Engineering Mechanics, Concrete Technology, Structural Analysis.						
Course Objectives	1. To develop a basic understanding of reinforced concrete as a construction material. 2. To develop understanding of various design philosophies and their differences. 3. To understand behavior of RCC elements under flexure, shear and axial stresses. 4. To prepare the structural drawing of various RCC elements using the guidelines in design codes.						
Course Outcomes	After the completion of the course, student should be able to – 1. Classify the different design philosophies as per the provisions made in is 456-2000 2. Appraise various reinforced concrete components for shear, bond, development length etc. 3. Analysis and design of various reinforced concrete components for flexure, shear, compression and torsion etc. and prepare structural drawings using relevant IS codes.						

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	2	2		1	1	1	1	1	
CO2	3	3	3	3	2			1	1			
CO3	3	3	3	2	2	1	2	1	1			1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Design philosophies** Working stress method, Ultimate load method and Limit state method- Assumptions, merits and demerits, factor of safety, material properties, and stress- strain curve. Limit state design- Different limit states, concept of strength, serviceability and durability.	5
II	**Design of Beams** Analysis and design of Singly and doubly reinforced rectangular beams, Moment of resistance, Under-reinforcement, over-reinforcement and balanced sections. Analysis and design of T and L beams.	8
III	**Shear, Bond and Torsion** i) Design for shear- Shear failure, factors affecting shear strength, types of shear reinforcements, Design of shear reinforcements. ii) Concept of bond- Factor affecting bond strength, concept of development length iii) Design for torsion- IS 456-2000 recommendations for design of beams under torsion.	5

IV	**Design of slabs and staircase** i) Simply supported and restrained slab- structural behaviour. Load calculations. One way and two way actions. ii) Simply supported slabs- Design of single span and continuous slabs (One way and two way) using coefficients for shear and bending iii) Restrained slab- Design of slab using IS 456-2000 coefficients, iii) IS 456-2000 design guidelines for torsion in restrained slab. iv) Design of dog legged stair	8
V	**Analysis and Design of Column** Short and long columns, permissible stresses in the materials. Axially loaded columns. Load carrying capacity. Design of rectangular columns, circular columns with and without helical reinforcement Eccentrically loaded columns- Minimum eccentricity, design of uniaxial and biaxial loaded columns, interaction diagram.	8
VI	**Design of Isolated Footing** Design of axial loaded footing- Critical sections for Shear and bending, reinforcement detailing, soil pressure diagrams. Design of eccentric footings.	8
Text Books		
1.	Limit state theory and design - Karve And Shah, Structures publications, Pune.	
2.	Reinforced Concrete Design - Pillai S.U. Menon D., Tata McGraw Hill Education Private Limited, New Delhi	
3.	RCC Designs ,Dr. B.C.Punamia, A.K. Jain, Laxmi Publication	
4.	Reinforced Concrete Design ,S.N.Sinha, Tata McGrawhill	
Reference Books		
1.	Design of Concrete Structures, A.K.Jain; Nemchand Publication	
2.	IS: 456(2000) Plain and Reinforced Concrete - Code of. Practice	
3.	IS 875 (Part 1, 2,) code of practice for design loads (other than earthquake) for buildings and structures.Part1Dead Load. Part2 Imposed load.	
4.	SP 16	
Useful web links		
1.	http://www.cdeep.iitk.ac.in/nptel	
2.	http://www.nptel.iitm.ac.in	
3.	https://archive.nptel.ac.in/courses/105/105/105105105/	

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2										1
CO2	3	2										1
CO3	3	2										1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	**Course Content**	**Hours**
List of Practicals / Tutorials		
1.	Full Design of building components slab, beam, column and footing with detailing in A2 size drawing sheet covering all required details in structural drawing.	4
2	Preparation of EXCEL Worksheets for the design of various structural components of building and/or other structures of the syllabus.	4
3.	Design of G+1 building (design manually and design with software)	4
4.	Prepare at least one drawing set (Centre line, ground plinth beams,floor slab and beam) in any CAD software for design of structures conducted in the syllabus.	4

Year, Program, semester	T.Y. Civil Engineering, semester V					
Course Code	VSEC331(P)					
Course Category	Programme Core Course					
Course title	**Design of Reinforced Concrete Structures**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	-	-	02	02		01
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	-	-		--	50	50
Pre-requisites (if any)	Engineering Mechanics, Concrete Technology, Structural Analysis.					
Course Objectives	1. To develop the basic understanding of preparation of RCC drawings with reinforcement detailing as per the code 2. To learn various design software.					
Course Outcomes	After the completion of the course, student should be able to – 1. Apply the principles, procedures and current Indian code requirements to the analysis and design of RC structures 2. Prepare layout, determined loads, analyse, design and detail various structural elements for RC framed structure up to G+3. 3. Prepare design report covering design basis, structural calculations, structural drawings					

Text Books	
1.	Limit state theory and design - Karve And Shah, Structures publications, Pune.
2.	Reinforced Concrete Design - Pillai S.U. Menon D., Tata McGraw Hill Education Private Limited, New Delhi
3.	RCC Designs, Dr. B.C. Punamia, A.K. Jain, Laxmi Publication
4.	Reinforced Concrete Design ,S.N. Sinha, Tata McGrawhill
Reference Books	
1.	Design of Concrete Structures, A.K.Jain; Nemchand Publication
2.	IS: 456(2000) Plain and Reinforced Concrete - Code of. Practice
3.	IS 875 (Part 1, 2,) code of practice for design loads (other than earthquake) for buildings and structures.Part1Dead Load.Part2 Imposed load.
4.	SP 16 Design Aids for Reinforced Concrete to IS 456:1978
Useful web links	
1.	http://www.cdeep.iitk.ac.in/nptel
2.	http://www.nptel.iitm.ac.in
3.	https://archive.nptel.ac.in/courses/105/105/105105105/

Year, Program, Semester	T.Y. Civil Engineering, Semester V				
Course Code	PCC 312				
Course Category	Professional Core Course				
Course title	**Transportation Engineering**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	3	-	-	3	3
Evaluation Scheme	**ISE**	**ESE**	**IE**	**EE**	**Total**
	30	70	---	--	100
Pre-requisites (if any)	Geotechnical Engineering.				
Course Rationale	The course deals with the fundamental knowledge of highway engineering and planning, Pavement design, Highway construction materials.				
Course Objectives	1. To give exposures to highway planning and designing of geometric elements of roads. 2. To comprehend geometric standards and various practices adopted for construction of roads. 3. To develop skills of construction and maintenance and traffic management of highways.				
Course Outcomes	Upon completion of this course, student should be able to – 1. Explain and apply the principles of planning and designing of various geometric elements of highways. 2. Apply knowledge for selection of construction materials and select appropriate methods of construction and maintenance for roads. 3. Analyse and adopt various techniques for traffic management of highways and assess the geometric standards of pavements.				

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3		1		1						1	
CO 2			3			1					2	1
CO 3		3	3	2				1			2	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Highway Developments** Role and importance of infrastructure development, Various modes of transportation, characteristics and suitability, history of highway engineering, development plans, various organizations involved in highway development, their setups and working, finance options.	6
II	**Highway Alignment:** Basic requirements for an ideal alignment, factors governing highway alignment, highway location surveys and studies.	7
III	**Geometric Design-I:** Cross sectional elements, sight distance, reaction time, analysis of safe sight distance, and analysis of overtaking sight distance, intersection sight distance	6

IV	**Geometric Design-II:** Horizontal, vertical and transition curves, super elevation, widening, requirements as per IRC, Basic concepts and methods of pavement design.	7
V	**Highway Construction:** Materials – Stone aggregates, soil, cement, bitumen properties and their testing. Construction methods for various types of flexible and rigid pavements, Drainage, repairs and maintenance.	7
VI	**Traffic Engineering:** Traffic Surveys, traffic flow and capacity, traffic regulation and control; design of road intersections and parking facilities, Webster method of traffic signal design, Introduction to Traffic Safety	6
Text Books		
1.	Justo C. E. G., Khanna S. K., Veeraragavan A., "Highway Engineering" , Nemchand & Bros (10th Edition). 2015	
2.	Kadiyali L. R. and Lal N. B., "Principles and Practices of Highway Engineering", Khanna Publishers (7^{th} Edition). 2013	
3.	Kadiyali L. R., "Traffic Engineering and Transport Planning", Khanna Publishers, (9^{th} Edition)	
4.	Bindra S. P., "A Course in Highway Engineering", Dhanpat Rai Publications, 5th Edition 2012	
Reference Books		
1.	Chakroborty P. and Das A., "Principles of Transportation Engineering", PHI Learning Pvt. Ltd., (2^{nd} Edition). 2017	
2.	Kadiyali L. R., "Transportation Engineering", Khanna Publishers. 2016.	
3.	Wright P. H. and Dixon K., "Highway Engineering", Wiley India Pvt. Ltd., (7th Edition). 2009	
Reference Codes		
1.	IRC: 76-1979 – Tentative Guidelines for Structural Strength Evaluation of Rigid Airfield Pavement - Indian Roads Congress -IRC, New Delhi.	
2.	IRC: 85-1983 – Code of Practice for Accelerated Strength Testing and Evaluation of Concrete Road and Airfield Constructions- Indian Roads Congress -IRC, New Delhi.	
3.	IRC: 37-2001 – Guidelines for the Design of Flexible Pavements for Highways-Indian Roads Congress-IRC, New Delhi.	
4.	Indian Roads Congress -IRC, New Delhi.	
5.	IRC: 58-2002 (Second Revision) – Guidelines for the Design of Rigid Pavements for Highways.	
Useful web links		
1.	https://nptel.ac.in/courses/105/101/105101087/	
2.	https://nptel.ac.in/courses/105/101/105101008/	
3.	https://nptel.ac.in/courses/105/105/105105107/	
4.	NPTEL Course – Civil Engineering – Maintenance and Repairs of Concrete Structures – Radhakrishnan G. Pilla, IIT Madras – https://nptel.ac.in/courses/105/106/105106202/	
5.	NPTEL Course – Civil Engineering – Mechanical Characterization of Bituminous Materials – Multi – Facuty, IIT Madras – https://nptel.ac.in/courses/105/106/105106203/	
6.	NPTEL Course – Civil Engineering – Geo-informatics in Transportation Engineering – Ashish Verma , IISc, Banglore – https://nptel.ac.in/courses/105/108/105108073/	

Year, Program, Semester	T.Y. Civil Engineering, Semester V					
Course Code	PCC 312					
Course Category	Professional Core Course					
Course title	**Transportation Engineering**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	-	-	2	2		01
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	-	-		---	50	50
Pre-requisites (if any)	Geotechnical Engineering.					
Course Rationale	This course is to possess the knowledge of highway pavement materials, design of pavement.					
Course Objectives	1. Familiarize students to procedure about the conducting test on highway materials 2. Learn the objectives of conducting various tests on highway materials.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Aware about the procedure adopted for conducting tests on highway materials. 2. Learn the objectives of conducting various tests on highway materials.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1				3					1	1		
CO 2			3	3					1	1		

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	List of Experiments		Hours
A	**Test on Aggregates**		
	1	Specific Gravity and Water Absorption Test.	2
	2	Impact Value.	2
	3	Abrasion Test.	2
	4	Crushing Test.	2
B	**Test on Bituminous Materials**		
	1	Specific Gravity	2
	2	Bitumen Penetration Test.	2
	3	Softening Point.	2
	4	Flash Point and Fire Point Test.	2
	5	Ductility test.	2
	6	Viscosity Test.	2
C	**Industrial visit with report**		
	1	Visit to the Hot mix plant.	
	2	Visit to Road construction work.	
Suggested Text Books/ Reference Books/Manual			
1.	Sayed Danish Hasan. “Civil Engineering Materials and their Testing”, Narosa Publishing House.		

Year, Program, Semester	T.Y. Civil Engineering, Semester V					
Course Code	PCC 313					
Course Category	Professional Core Course					
Course title	**Environmental Engineering**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		---	–	100
Pre-requisites (if any)	Engineering Chemistry, Fluid Mechanics					
Course Rationale	This course teaches the fundamentals regarding quality and quantity of water and sewage generation. The course focuses on design concepts of unit operations and processes required for treatment of water and sewage. The course includes study of drinking water quality standards and effluent standards.					
Course Objectives	1. To know sources, characteristics, quantity and quality of raw water and sewage. 2. To Understand concepts of collection and conveyance of water and sewage from source 3. To acquire an understanding of the fundamental concepts and detailed technical knowledge of the various unit operations and processes required for treatment of water and sewage.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Summarize the sources and characterization of water and sewage. 2. Identify the drinking water quality standards and effluent standards. 3. Explain the working principle of various unit operations and processes required for water and sewage treatment. 4. Design various units of conventional water and Sewage treatment plants.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3											
CO 2	3					2						
CO 3	3	3	2									
CO 4	3	2	3									

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	General outline of water supply; Sources of water; Features and elements of a water distribution systems, Concept of water demand; Estimation of water demand; Factors affecting demand; Demand fluctuations; Population forecasting methods Water Intake and storage: Intake of water; Types of intake; Conveyance and intake conduits; Pumps; Economic diameter of water supply pipes	5
II	Water Quality and Treatment: Water quality standards; Philosophy of treatment; Unit operations and unit processes; Theory and operations of aeration, Coagulation and flocculation; Sedimentation: types of settling, design of sedimentation tank	7
III	Filtration: Slow and rapid gravity filter, Design of Rapid Sand Filter, Disinfection: Disinfection through chlorination and other methods, Water Distribution: Layouts of Distribution Network; Water Losses and Control in water supply systems; storage reservoirs, balancing reservoir	7

IV	Introduction to wastewater treatment: Sources of wastewater, quantity estimation, wastewater characterisation, effluent standards, Effect of oxygen demanding wastes on rivers, Estimation of organic content of the wastewater, Self-purification of natural streams, Factors affecting self-purification, Evaluation of sewage discharge, Design period, Hydraulic formulae for determining flow velocities, Minimum velocity: Self-cleansing velocity, Maximum velocity or Non-scouring velocity, Hydraulic characteristics of circular sewer running full or partially full, Materials for sewers, Sewer appurtenances, Sewage pumping stations,	7
V	Classification of wastewater treatment methods, process flow sheet of conventional domestic wastewater treatment plant, Screening: Types of screens, design of bar screen, Grit chamber: Settling velocity of the particles, Horizontal flow rectangular grit chamber, Design of grit chamber. Primary sedimentation tank: working principle of PST, design of PST	7
VI	Biological wastewater treatment: Aerobic suspended growth treatment of wastewater: Activated sludge process; various design parameters of ASP, SVI, Sludge bulking, Oxygen requirement. Aerobic attached growth treatment of wastewater: Trickling filter, Various parameters of trickling filter, Rankine's formula. Anaerobic treatment process: Mechanism of anaerobic digestion, Factors affecting anaerobic digestion. Onsite sanitation: working principle of septic tank, Subsurface disposal of septic tank effluent.	6

Text Books	
1.	Mark J. Hammer & Mark J. Hammer Jr., "Water and WasteWater Technology", Prentice Hall of India Pvt. Ltd., 1998, New Delhi...
2.	Birdie G. S., Birdie J. S., "Water Supply & Sanitary Engineering", Dhanpatrai Publishing Company.
3.	Donald R. Rowe, George Tchobanoglous, and Howard S. Peavy, "Environmental Engineering", McGraw Hill Education
Reference Books	
1.	Manual on Water Supply and Treatment (3rd revised and updated) - Ministry of Urban Development, New Delhi, 1999.
2.	Dr. B. C. Punmia, Er. Ashok Kr. Jain, Dr.Arun Kumar Jain, "Water Supply Engineering", Laxmi Publication, New Delhi Wheeler Publishing
3.	Water Quality and Treatment Handbook -American Water Works Association, McGraw-Hill Pub. 1999.
4.	Fair, Geyer & Okun., "Water & Waste Water Engineering", John Wiley, 1966, New York.
5.	Ernest W. Steel & Terence J. Mc Ghee, "Water Supply & Sewage", McGraw Hill, 1990, New York.
6.	Walter J. Weber Jr. Wiley, "Physico Chemical Processes for Water Quality Control", Interscience, New York (1972)
7.	Manual On Sewerage And Sewage Treatment (Part A: Engineering) - Ministry of Urban Development, New Delhi, 2012.
8.	Metcalf and Eddy, "Wastewater Engineering: Treatment and Reuse", McGraw Hill Education
9.	Dr. B. C. Punmia, Er. Ashok Kr. Jain, Dr.Arun Kumar Jain, "Wastewater Engineering", Laxmi Publication, New Delhi Wheeler Publishing
Useful web links	
1.	https://archive.nptel.ac.in/courses/105/105/105105201/
2.	https://nptel.ac.in/courses/105106119
3.	https://nptel.ac.in/courses/105104102
4.	https://archive.nptel.ac.in/courses/105/105/105105048/
5.	https://archive.nptel.ac.in/courses/105/105/105105178/

Year, Program, semester	T.Y. Civil Engineering, Semester V				
Course Code	PCC 313				
Course Category	Professional Core Course				
Course title	**Environmental Engineering**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	-	-	2	2	1
Evaluation Scheme	**ISE**	**ESE**	**IE**	**EE**	**Total**
	-	-	--	50	50
Pre-requisites (if any)	Engineering chemistry				
Course Rationale	The course explores the knowledge and principles of determination of different water quality parameters and parameters required for characterization of sewage. It also focuses on the relationships between different parameters and their effects in treatment of water and sewage.				
Course Objectives	1. To understand the knowledge and principles of determination of different water and sewage quality parameters. 2. To understand the basics of water and sewage treatment process				
Course Outcomes	Upon completion of this course, student should be able to – 1. Interpret the quality of water and sewage before and after treatment. 2. Demonstrate the treatment process of water and sewage				

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3		1	2			2					
CO 2	3		2	2	2							

Level of Mapping as: Low 1, Moderate 2, High 3

Experiment No.	**Experiment title**	**Hours**
	Any 8 Experiments from Given List	
1.	Determination of Turbidity of water sample	2
2.	Determination of Total Solids, Total Dissolved Solids and Total Suspended Solids present in water sample	2
3.	Determination of Dissolved Oxygen present in water sample	2
4.	Determination of Residual Chlorine of water sample	2
5.	Determination of Total Bacterial Count of water sample	2
6.	Determination of Solids Content of Sewage	2
7.	Determination of Biochemical Oxygen Demand of sewage	2
8.	Determination of Chemical Oxygen Demand of sewage	2
9.	Determination of Sludge Volume Index	2
10.	Determination of Optimum Coagulant dose by using Jar Test Apparatus	2
11.	Visit to Water Treatment Plant to study various treatment units	2
12.	Visit to Sewage Treatment Plant to study various treatment units	2
Text Books		
1.	Sawyer, McCarty and Parkin., “Chemistry for Environmental Engineering and Science”, McGraw Hill Education, Indian Edition.	

Reference Books	
1.	American Public Health Association. "Standard Methods for the Examination of Water and Wastewater", Legare Street Press.
2.	Manual on Water Supply and Treatment (3rd revised and updated) - Ministry of Urban Development, New Delhi, 1999.
3.	Manual On Sewerage And Sewage Treatment (Part A: Engineering) - Ministry of Urban Development, New Delhi, 2012
Useful web links	
1.	https://cpcb.nic.in/water-quality-criteria/
2.	https://cpcb.nic.in/wqstandards/

Year, Program, Semester	T.Y. Civil Engineering, Semester V					
Course Code	PCC 314					
Course Category	Professional Core Course					
Course title	**Water Resources Engineering**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	-	150
Pre-requisites (if any)	Mathematics, Fluid Mechanics, Soil mechanics.					
Course Rationale	Impart the basic knowledge of the importance of Hydrology and irrigation in water resources development.					
Course Objectives	1. To evaluate average rainfall, runoff, evaporation loss and other losses from a reservoir and Crop Water requirement. 2. To know various hydro meteorological parameters and their estimation. 3. To impart the students with knowledge required for planning design, and development of different types of dams and reservoirs. 4. To understand the basic concepts and importance of river engineering works.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Understand the features of the primary hydrological processes and various hydraulic structures; and explain various terms related to irrigation engineering. 2. Apply the knowledge of estimation of hydro meteorological parameters 3. Adopt suitable methods for planning, design, and development of different types of dams and reservoirs. 4. Evaluate water requirement for irrigation work and analysis of runoff, flood flow					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	1	2			1	2					
CO 2	3	2	2								2	
CO 3	3	3	1	1		1					3	
CO 4	3	2	2	1		1					1	

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Introduction of Hydrology:** Definition, Importance and scope of hydrology, hydrological cycle. **Precipitation**: Forms and types of precipitation, Methods of measurement, Graphical representation of rainfall –Mass, rainfall curves, Hyetograph. Determination of average precipitation over the catchment. **Evaporation**: Process, factors affecting, measurement and control of evaporation. Evapo-transpiration. **Infiltration**: Process, Factors affecting and measurement of Infiltration	8
II	**Runoff:** Factors affecting runoff, Determination of annual runoff, Rainfall runoff relationship. **Hydrograph:** Storm hydrograph, Base flow and Separation of base flow, direct runoff hydrograph, Unit hydrograph – theory – assumptions and limitations. Hydrograph analysis, S-curve hydrograph. **Stream gauging:** Selection of site, discharge measurement by Area velocity method, slope Area method. **Floods:** Estimation of peak flow- empirical equations, rational method, Importance of Design flood, standard project flood,.	6
III	**Ground water hydrology:** Occurrence, distribution and classification of groundwater, Darcy's law, Aquifer parameters, Permeability, specific yield, specific retention, porosity, storage coefficient, Transmissibility. Hydraulics of well under steady flow conditions in confined and unconfined aquifers, Specific capacity of well, Recuperation Test, constructional features of Tube wells and Open wells.	6
IV	**Introduction to irrigation:** Definition and necessity of irrigation, ill-effects of irrigation, Surface, Sub-surface, Sprinkler irrigation, Drip Irrigation, lined and unlined canals, cross drainage structures. **Water requirement of crops:** Principal crops and crop seasons, cropping pattern and crop rotation, Classes and availability of soil water, depth and frequency of irrigation, Duty, Delta, Base Period and their relationship, factors affecting duty, methods of improving duty. Assessment and efficiency of irrigation water.	7
V	**Reservoir:** Types, selection of site, estimation of required storage and safe yield, mass curve, reservoir sedimentation. **Dam:** Types of Dams, Choice of dam, earthen dam, causes of failure of earth dam, various components of dam, Forces acting on gravity dam, stress analysis of dam, failure of gravity Dams. Types, Design and drawing of spillways and energy dissipaters, weirs, and barrages. Pipe Irrigation Network, Cross drainage works: need, types, canal regulatory work. River training works:	7

VI	**Spillway:** Types, Design and drawing of spillways and energy dissipators, weirs, and barrages. Pipe Irrigation Network, Cross drainage works: need, types, canal regulatory work. River training works: **Lift irrigation schemes** - Various components and their design principles. General features of Hydro-power, general layouts of different types	5

Text Books	
1.	Garg. S. K., "Irrigation Engineering",Khanna Publishers, Delhi.
2.	Dr Punmia and Dr.Pande ,"Irrigation and Water Power Engineering", Laxmi Publications,Delhi
3.	Dr. Subramanya. K., "Engineering Hydrology", Tata McGraw Hill, New Delhi.
4.	Dr Modi. P.N. , "Irrigation, Water Resources and Water Power Engineering"
Reference Books	
1.	Varshney, Gupta and Gupta, "Theory and design of irrigation", structures vol. I and II and III,
2.	Ghanshyam Das., "Water and Soil Conservation".
3.	R.K.Sharma, "Hydrology and water resources", Dhanpatrai and sons, New Delhi.
4.	"Design of M.I. and Canal Structure", Satyanarayan and R. Murthy.
5.	Michael, "Irrigation Theory and practice", Vikas Publications House.
Useful web links	
1.	https://www.youtube.com/watch?v=geem8iwwhkM&list=PLjtQ3BMex7huGfWeDWUiRVFRmgzoDtMZ6
2.	https://www.youtube.com/watch?v=3R6NnPc-Q9Y&list=PLjtQ3BMex7huGfWeDWUiRVFRmgzoDtMZ6&index=2
3.	https://www.youtube.com/watch?v=VUBnlvh86T4&list=PLjtQ3BMex7huGfWeDWUiRVFRmgzoDtMZ6&index=5
4.	https://www.youtube.com/watch?v=mKtT2BmOa_c&list=PLjtQ3BMex7hvA0Ma83tGqB5y-xiK9hLw-
5.	https://www.youtube.com/watch?v=3f-BuJmG1wY

Year, Program, semester	T.Y. Civil Engineering, semester V					
Course Code	PEC 315					
Course Category	Program Elective I					
Course title	**Theory of Structures**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	03	-	-	03		03
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	--	150
Pre-requisites (if any)	Engineering mechanics, Structural analysis					
Course Objectives	1. To understand application of displacement methods for the analysis of indeterminate structures 2. To learn the concepts and use of matrix method in structural analysis 3. To understand structural behavior of three and two hinged arches					
Course Outcomes	Upon completion of this course, student should be able to – 1. Analyse indeterminate structures using force and displacement methods. 2. Compute internal forces using energy based theorems. 3. Analyse beams and frames using matrix methods of analysis.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2										1
CO2	3	2										1
CO3	3	2										1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Arches** Types of arches, supports, internal forces. Analysis of two and three hinged arches	7
II	**Deflection of Redundant frames** Deflection of statically indeterminate frames. Castigliano's theorem, frames with one and more than one degree of redundancy	5
III	**Analysis of continuous beams** Clapeyron's three moment theorem, application to prismatic and non-prismatic sections of a continuous beams, continuous beams with end fixed and with overhang, yielding of supports	7
IV	**Energy theorems- Analysis of frames and trusses** Bettis's theorem, Castigliano's theorem, analysis of indeterminate frames Unit load method, externally redundant trusses, truss with errors in lengths of members, support sinking and temperature variations etc.	7
V	**Matrix method of analysis- Stiffness matrix method** Stiffness matrix characteristics, generation of stiffness matrix, stiffness matrix method- equilibrium equitation, application to beams and portal frames (SI=2)	7
VI	**Matrix method of analysis- Flexibility matrix method** Flexibility matrix characteristics, generation of flexibility matrix, flexibility matrix method- equilibrium equitation, application to beams and portal frames (SI=2)	7
Text Books		
1.	S.S. Bhavikatti, "Structural Analysis" , Vol.I and Vol.II, New Age Publisher	
2.	Vazirani, Ratwani and Duggal, "Analysis of Structures, vol. II)", Khanna Publishers, Delhi	

3.	Reddy C. S., "Basic Structural Analysis", Tata McGraw Hill Publication Company Ltd.,
4.	S. Ramamrutham and R. Narayan, "Theory of Structures", Dhanapat Rai Publishing company, New Delhi.
Reference Books	
1.	Gere and Weaver, "Matrix Analysis of Structures", Second Edition, CBS Publishers, New Delhi
2.	R.C. Hibbeler, "Structural Analysis", 9th Edition, Pearson Education India
3.	Devdas Menon "Structural Analysis", Narosa Publication
4.	C.K. Wang, "Indeterminate Structural Analysis", Tata McGraw-Hill Publishing Company
Useful web links	
1.	http://www.digimat.in/nptel/courses/video/105105166/L45.html
2.	http://www.digimat.in/nptel/courses/video/105101086/L01.html
3.	https://www.youtube.com/watch?v=8nGgpKz07yk

Year, Program, Semester	T.Y. Civil Engineering, Semester V					
Course Code	PEC 315					
Course Category	Program Elective I					
Course title	**Municipal Solid Waste Management**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	---	150
Pre-requisites (if any)	Environmental Studies					
Course Rationale	This course teaches the fundamentals of generation, sources, collection of municipal solid waste management. This course deals with study of various waste processing techniques and disposal of MSW.					
Course Objectives	1. Provide knowledge on functional elements of MSWM. 2. Impart basic skills for design and operation of MSWM systems. 3. Have overview of MSW rules and Government initiatives.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Recognize fundamental elements of MSW and outline practices for effective MSW management. 2. Apply the fundamental elements of MSWM to analyse collection, transportation, and processing of MSW. 3. Evaluate processing and disposal system for MSW. 4. Summarize rule and regulation implemented by Indian government for MSWM					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2					2							
CO 2	3		3											
CO 3	3				2							1		
CO 4	1					3								

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Sources, Types, Composition, Physical, Chemical and Biological properties. Solid Waste Management: Objectives, Functional elements, Environmental impact of mismanagement, Present Indian Scenario of municipal solid waste management system.	6
II	Solid Waste Generation Rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Collection components, Types of collection systems and its design, Transportation of solid waste: Means and methods, Routing of vehicles. Transfer station: Need, Types, factors affecting Capacity, Location and economic Viability.	7
III	Waste Processing Techniques: Purpose, Mechanical volume and size reduction, component separation techniques. Material Recovery and Recycling: Objectives, Recycling program elements, Commonly recycled materials and processes. Energy recovery from solid waste: Parameters affecting, Fundamentals of thermal processing, Pyrolysis, Incineration, Refuse derived fuels, Energy recovery, case studies under Indian conditions.	7
IV	Composting: Benefits, Processes, Stages, Technologies, and Factors affecting properties of compost. Vermicomposting and Bio-methanation.	6

V	Landfills: Site selection, Types, Principle, Processes, Land filling methods, Leachate and landfill gas management, Design of a landfill facility, closure, post-closure plans, and rehabilitation of dumpsites.	7
VI	Waste Management legislation in India, Municipal Solid Waste Management Rules 2016, Role of CPCB and SPCB in management of municipal solid waste. Biomedical and Construction & Demolition Waste Management: generation, sources, classification, management technologies.	6
Text Books		
1.	A D Bhide .,"Solid waste management in developing countries", New Delhi Indian National Scientific Documentation Centre 1983	
2.	Tchobanoglous, G., Theisen and Vigil., "Integrated Solid Waste Management: Engineering Principles and Management Issues", McGraw Hill, 1993	
3.	Tchobanoglous, G. and Kreith, F., "Handbook Of Solid Waste Management", McGraw Hill, 2002, 2nd Edition	
Reference Books		
1.	Municipal Solid Waste Management Manual, 2016 by CPHEEO	
2.	Christensen, H. T, "Solid Waste Technology & Management", Wiley, 2010, Volume 1 & 2	
3.	T V Ramachandra, "Management of Municipal Solid Waste", TERI Press	
4.	Nicholas P Cheremisinoff, "Handbook of Solid Waste Management and Waste Minimization Technologies", Butterworth Heinemann An imprint of Elsevier	
5.	Donald R. Rowe, George Tchobanoglous, and Howard S. Peavy, "Environmental Engineering", McGraw Hill Education	
Useful web links		
1.	https://archive.nptel.ac.in/courses/105/103/105103205/	
2.	https://archive.nptel.ac.in/courses/120/108/120108005/	
3.	https://archive.nptel.ac.in/courses/105/106/105106056/	

Year, Program, Semester	T.Y. Civil Engineering, Semester V				
Course Code	PEC 315				
Course Category	Programme Elective – I				
Course title	**Construction Planning and Control**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	3	-	-	3	3
Evaluation Scheme	**ISE**	**ESE**	**IE**	**EE**	**Total**
	30	70	50	---	150
Pre-requisites (if any)	Elements of Civil Engineering, Building Construction				
Course Rationale	-------				
Course Objectives	1. To understand importance, necessity and steps involved in Project Management of construction organization 2. To learn the techniques used for planning, scheduling and control of construction projects. 3. To learn value management, project management and control system related to construction projects. 4. To understand use of different software's for the planning, scheduling and control of construction projects.				
Course Outcomes	Upon completion of this course, student should able to 1. Learn various aspect of management. 2. Apply different techniques for planning, scheduling and control of construction projects. 3. Apply cost and value management techniques for different projects. 4. Apply software tools for the planning, scheduling and control of construction projects.				

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	2	1	2								1	1
CO 2	2	3	3	2	3	2	2	1	1	2	1	1
CO 3	2	2	2	2	3	1	1	1		2	2	1
CO 4	2	2	2	2	2	1	2			2	1	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Introduction to Project Management:** Construction project, importance of construction and construction industry, Indian construction industry, construction project management and its relevance, participants and stakeholders of construction project, Project Organization, Construction Company, forms of business organization, structure of construction organization, organizing for project management, management levels, traits of a project manager, important traits of a project coordinator, ethical conduct for engineers, factors behind success of a construction organization.	07

II	**Construction Planning:** Introduction, types of Project Plans, Work Breakdown Structure, Planning Techniques, BAR CHARTS, Preparation of Network Diagram, PERT, CPM, Ladder Network, Precedence Network, Network Techniques Advantages	08
III	**Project Scheduling and Resource Levelling:** Introduction, Resource Levelling and Allocation, importance of Project scheduling, other schedules derived from project schedules, Network Crashing and cost time trade off	08
IV	**Project Cost and Value Management:** Project Cost management, collection of cost related information, cost codes, cost statement, value management in construction, steps in the application of value engineering, description of the case, Value: Engineering application in the case project	06
V	**Project Monitoring and Control System:** Introduction, updating, project control, schedule/time/progress control, cost control, control of schedule, cost and technical performance – earned value method, illustration of cost control system, Management Information System	06
VI	**Computer Application:** Introduction, Popular Project Management Software, Functions , Illustration of MS PROJECT, Illustration of PRIMAVERA	04
Text Books		
1.	Saleh Mubarak , “Construction Project Scheduling and Control”, Prentice Hall of India	
2.	Dr.S.Seetharaman, “Construction Engineering and Management”, UMESH Publication	
3.	B.C.Punmia, “Project Planning and Control with PERT and CPM”, Laxmi Publication	
Reference Books		
1.	GD. Oberlender, “Project Management for Engineering and Construction”, McGraw-Hill Publication	
2.	Kumar Neeraj Jha, “Construction Project Management”, Pearson Publication	
3.	MT., Quackenbush, DG. and Rowings, JE., “Construction Project Scheduling” McGraw-Hill Publication	
4.	R. H. Clough, “Construction Project Management”, John Wiley & Sons	
Useful web links		
1.	https://archive.nptel.ac.in/courses/105/103/105103093/	
2.	https://onlinecourses.nptel.ac.in/noc22_ce56/preview	

Year, Program, Semester	T.Y. Civil Engineering, Semester VI				
Course Code	PEC 315				
Course Category	Programme Elective – I				
Course title	**Foundation Engineering**				
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**
	3	-	-	3	3
Evaluation Scheme	**ISE**	**ESE**	**IE**	**EE**	**Total**
	30	70	50	---	150
Pre-requisites (if any)	---				
Course Rationale	The study of this course is aimed to develop a thorough understanding of the basic of soil exploration and types of foundation and its design.				
Course Objectives	Course teacher will 1. Provide basic information about various types of foundation and exploration methods. 2. Demonstrate basic information about modern foundation and ground improvement techniques 3. Explain types of foundation and its stability. 4. Explain bearing capacity evaluation and settlement evaluation for different soils.				
Course Outcomes	Students will able to 1. Explain suitability of different soil exploration methods and various types of foundation. 2. Analyse stability of slopes and to apply various ground improvement techniques. 3. Analyse types of foundation and its stability. 4. Estimate bearing capacity and settlement of foundation for different soils as per IS standards.				

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	3	2	2		1	1	1	1		
CO 2	3	3	3	2	2	1	1	1				1
CO 3	3	3	2	2	1	1	1	1				1
CO 4	3	3	2	1	2		1	1		1		1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Soil and Rock Exploration** Necessity, Planning, No and depth of bore holes, Exploration methods - auger boring (hand and continuous flight augers), and wash boring, rotary drilling, percussion drilling. Soil sampling - Disturbed and undisturbed, Rock drilling and sampling, Types of sampler. Mechanical properties of rock, Behavior of rocks in uniaxial compression, Tensile strength of rocks Types of rock failure, Core barrels, Core boxes, Core recovery, Rock quality designation	7
II	**Bearing Capacity Evaluation** Definitions, Modes of failure, Terzaghi's bearing capacity theory, Meyerhof's bearing capacity, I.S. Code method of bearing capacity evaluation and computation (IS 6403) Effect of various factors on bearing capacity (Size and Shape, Depth, WT)	7

	Bearing capacity evaluation from Plate Load Test, S.P.T. (By I.S. Code method), Static cone penetration test and Menards pressure meter tests with detailed procedure.	
III	**Shallow Foundation and Foundation Settlement** 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) Immediate settlement -computations from I.S. 8009 - 1976 (Part I) approach, Consolidation Settlement computations, Concept of total settlement, Differential settlement and angular distortion.	7
IV	**Pile Foundation** Classification and their uses, Single pile capacity evaluation by static and dynamic methods for cohesive and cohesion less soil, Pile load test. Negative skin friction Group action piles, Spacing of piles in group, Group efficiency. Under reamed piles - equipment, construction and precautions.	7
V	**Analysis of Slope Stability** Slope classification, Slope failure, Modes of failure. Infinite slope in cohesive and cohesion less soil Taylor's stability number, Swedish slip method, Method of slices and concept of friction circle method, Landslide.	7
VI	**Well Foundations, Coffer Dam and Ground Improvement Techniques** Element of wells, Types, Methods of construction, Tilt and shift, Remedial measures. Pneumatic Caissons: Sinking method - Sand island method, Caisson disease. Types and material used for sheet piling Common types of cofferdams, Braced cofferdam. Stone columns, Vibro-flotation, Preloading technique, Civil engineering application of geo synthetics, Geotextile and geomembrane	4
Text Books		
1.	"Soil Mechanics in Engineering Practice" - Karl Terzaghi, Ralph B. Peck and Gholamreza Mesri, Wiley India Pvt. Ltd.	
2.	"Basic and Applied Soil Mechanics" - Gopal Ranjan and A S Rao, G. K. Publications Pvt. Ltd.	
3.	"Soil Mechanics and Foundation Engineering" - V. N. S. Murthy, B. S. Publications (3rd Edition)	
4.	"Soil Mechanics and Foundation Engineering" - B. C. Punmia, Laxmi Publishing Co., New Delhi	
5.	"Geotechnical Engineering" - Dr. B. J. Kasmalkar, Pune Vidyarthi Griha Prakashan.	
Reference Books		
1.	"Foundation Analysis and Design" - Joseph E Bowles, McGraw Hill Publications	
2.	"Soil Mechanics" - Lambe and Whitman, S. Chand Publications (SI Version).	
3.	"Geotechnical Engineering" – Prentice Hall, Delhi by Iqbal H Khan	
Useful web links		
1.	https://onlinecourses.nptel.ac.in/noc22_ce25/preview	

Year, Program, Semester	T.Y. Civil Engineering, Semester V					
Course Code	PEC 311					
Course Category	Programme Elective – I					
Course title	**History and Theory of Urban Planning**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	--	150
Pre-requisites (if any)						
Course Rationale	Building construction, Town & Country Planning					
Course Objectives	1. Understand the evolution of human settlements and the philosophies guiding the early and modern Town and Country Planning with case studies 2. Explain the systems of City planning in pre-& post-industrial periods. 3. Understand the various schools of thought guiding the theories on settlements and urban & regional planning.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Observe and appreciate the application of various theories of planning in the cities historically and contemporarily 2. Apply theories of planning to the practice.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	2	1	2	1	1	1	1	2	2	1
CO 2	3	2	2	2	1	2	2	2	1	1	1	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Role of Infrastructure in Development – Elements of Infrastructure (physical, social, utilities and services); Basic definitions, concepts, significance and importance; Data required for provision and planning of urban networks and services; Resource analysis, provision of infrastructure, and land requirements; Principles of resource distribution in space; Types, hierarchical distribution of facilities, Access to facilities, provision and location criteria, Norms and standards, etc. Familiarizing to CPHEEO Manual and Guidance.	7
II	Planning and Management of Water, Sanitation and Storm Water – Water – sources of water, treatment and storage, transportation and distribution, quality, networks, distribution losses, water harvesting, recycling and reuse, norms and standards of provision, institutional arrangements, planning provisions and management issues; Sanitation – points of generation, collection, treatment, disposal, norms and standards, grey water disposal, DEWATS, institutional arrangements, planning provisions and management issues. Storm water – rainfall data interpretation, points of water stagnation, system of natural drains, surface topography and soil characteristics, groundwater replenishment, storm water collection and disposal, norms and standards, institutional arrangements, planning provisions and management issues.	8
III	Planning and Management of Municipal Wastes – Municipal and other wastes – generation, typology, quantity, collection, storage, transportation, treatment, disposal, recycling and reuse, wealth from waste, norms and standards, institutional arrangements, planning provisions and management issues.	7

IV	Planning and Management of Power and Fire – Power – Sources of power procurement, distribution networks, demand assessment, norms and standards, planning provisions and management issues. Fire – History of fire hazards, vulnerable locations, methods of fire fighting, norms and standards, planning provisions and management issues.	7
V	City Development and Mobility Infrastructure Planning Management and Design - Role of transport, types of transport systems, evolution of transport modes, transport problems and mobility issues; Urban form and Transport patterns, land use – transport cycle, concept of accessibility; Hierarchy, capacity and geometric design elements of roads and intersections.	4
VI	City Development and Mobility Infrastructure Planning Management and Design - Basic principles of Transport infrastructure design; Traffic and transportation surveys and studies, traffic and travel characteristics; Urban transport planning process – stages, study area, zoning, data base, concept of trip generation Transport, environment and safety issues; principles and approaches of traffic management, transport system management.	6
Text Books		
1.	Planning Theory, Healey P., Pergamon Press	
2.	Planning Theory, Allmendinger Philip, Palgrave MacMillan - 2017	
3.	Cities of the World: World Regional Urban development, Brunn S.D.et all. -2003	
4.	City Assembled: The Elements of Urban form through History, Kostof Spiro, Thames and Hudson 2005	
5.	Contemporary Urban Planning, Levy John M, Longman -2016	
Reference Books		
1.	Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century, Hall Peter - 2002	
2.	Urban and Regional Planning Since Independence: Retrospect and Prospect: Technical papers, National Town and Country Planners Congress, Mysore, Ministry of Urban Affairs and Employment	
3.	The City in History: Its Origins, Its Transformations, and Its Prospects; Lewis Mumford; Mariner Books – 1968	
4.	The Oxford Handbook of Urban Planning, Weber Rachel et all, Oxford University Press -2012	
5.	Urban Pattern: City Planning and Design, Gallion, Arthur B. and Eisner Simon, CBS Publishers – 2003	
Useful web links		
1.	https://archive.nptel.ac.in/courses/124/107/124107158/	
2.	https://archive.nptel.ac.in/courses/109/104/109104047/	
3.	https://onlinecourses.nptel.ac.in/noc21_ar12/preview	

<table>
<tr><td>Year, Program, Semester</td><td colspan="5">Third Year B. Tech (Civil Engineering), Part 3, Semester V</td></tr>
<tr><td>Course Code</td><td colspan="5">CC221</td></tr>
<tr><td>Course Category</td><td colspan="5">Co-curriculum Courses</td></tr>
<tr><td>Course title</td><td colspan="5">Introduction to Foreign Language</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>01</td><td>-</td><td>-</td><td>01</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="3"></td><td>IE: 50</td><td>Total = 50</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">--</td></tr>
<tr><td>Course Rationale</td><td colspan="5">This course provides a competitive edge for engineering graduates in their career choices. They will be able to communicate in a second language. The course enhances listening, reading skills and memory. Our graduates may be able to participate more effectively and responsibly in a multi-cultural world if they know another foreign language in addition to the English.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">1. Help students to understand basics and deepen their knowledge in a chosen foreign language
2. Guide them to communicate and translate in the chosen foreign languages
3. Help them describe, narrate, and ask/answer questions in the foreign language in the present time about a variety of topics related to family, daily activities, eating, and traveling
4. Comprehend the foreign language with sufficient ability to grasp the main idea and some supporting details in short conversations (spontaneous or recorded) that pertain to the topics mentioned above
5. Explain how to write sentences and short paragraphs on familiar topics relating to personal interests and practical needs
6. Narrate on how the foreign language functions with awareness and understanding of the language culture</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">1. Learn alphabets and acquire knowledge of basic grammar of the foreign language, common words and phrases therein
2. Learn to read the simple texts in foreign language
3. Speak a little using the greetings, well wishes etc. in Foreign Language
4. Count numbers, answer to the questions like, what is your name, surname, tell age, and can initiate little communication in Foreign Language
5. Translate both verbally and written, simple sentences in the foreign language
6. Achieve institute’s mission with respect to global education and foreign language education</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						3			1	2	1	1
CO 2						3			1	2	1	1
CO 3						3			1	2	1	1
CO 4						3			1	2	1	1
CO 5						3			1	2	1	1
CO 6						3	1		1	2	1	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
1	General Information on Basic Grammar of the foreign language, Introduction to alphabets	2
2	Gender of Noun, Number of Noun, Pronouns, Adjectives, Verbs and their usage in simple sentences, Numbers (up to 10), Simple Greetings in foreign language	2
3	General Questions in foreign language, like What is your name/surname? Who/What is this? etc.	2
4	Simple narration about self/family/friend/University in foreign language chosen for studies. Practicing the learnt topics in the class itself.	2
5	Formation of simple sentences using Parts of Speech, Information on Cases, One or Two simple lessons from any book.	2
6	Basic information on Country & Culture of language under study.	2
General Instructions: The assessment shall be done based on the 50 marks internal written examination.		
Reference Books		
1	Based on the language chosen, the suitable text and reference books may be selected.	
Important web references		
1	https://swayam.gov.in/	
2	https://nptel.ac.in/	

<table>
<tr><td>Year, Program, Semester</td><td colspan="4">T.Y. B.Tech (Civil Engineering) , Part III, Semester V</td></tr>
<tr><td>Course Code</td><td colspan="4">MAC312</td></tr>
<tr><td>Course Category</td><td colspan="4">Mandatory Audit Course</td></tr>
<tr><td>Course title</td><td colspan="4">Aptitude Enhancement Course II</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td></tr>
<tr><td>-</td><td>01</td><td>-</td><td>01</td></tr>
<tr><td>Evaluation Scheme</td><td colspan="4">IE at Course in charge end</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="4">Basic Mathematical Concepts</td></tr>
<tr><td>Course Objectives</td><td colspan="4">The Course is aimed to-
1. Understand key concepts such as HCF, LCM, decimal fractions, square roots, and cube roots, to build a strong base for problem-solving.
2. Enhance skills in simplifying complex mathematical expressions and perform efficient computations using the principles of simplification, surds, and logarithms.
3. Learn to solve practical problems involving percentages, profit-loss scenarios, and partnership calculations.
4. Grasp the principles and formulas used in solving problems related to time and work, pipes and cisterns, and time and distance.
5. Sharpen the ability to analyze and solve problems involving analogies, classifications, series, and coding-decoding sequences.
6. Develop problem-solving skills related to blood relations, direction sense tests, puzzles, and logical Venn diagrams.</td></tr>
<tr><td>Course Outcomes</td><td colspan="4">Upon completion of this course, student should be able to –
1. Demonstrate an ability to solve problems related to number systems, including HCF, LCM, decimal fractions, square roots, and cube roots, accurately.
2. Solve complex problems involving simplification, surds, and logarithms more efficiently, and improve calculation speed and accuracy.
3. Apply knowledge of percentages, profit and loss, ratio and proportion, and partnership to real-life scenarios and mathematical problems.
4. Solve time, work, and distance-related problems, including pipes and cisterns, with a clear understanding of concepts and application of formulas.
5. Solve questions involving analogies, classifications, series completions, and coding-decoding with greater confidence.
6. Demonstrate enhanced ability to solve puzzles, directional sense, blood relation, and logical Venn diagram problems with precision and logical deduction.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1								1		1
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	1								1		1
CO5	1									1		1
CO6	1									1		1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Quantitative Aptitude 1** Number System, H.C.F. and L.C.M. of Numbers, Decimal Fractions, Simplification, square Roots and Cube Roots.	2
II	**Quantitative Aptitude 2** Average, Problems on Numbers, Problems on Ages, Surds and Indices, Logarithms.	2
III	**Quantitative Aptitude 3** Percentage, Profit and Loss, Ratio and Proportion, Partnership.	2
IV	**Quantitative Aptitude 4** Chain Rule, Pipes and Cisterns, Time and Work, Time and Distance.	2
V	**Logical Reasoning 1** Analogy, classification, series completion, coding and decoding.	2
VI	**Logical Reasoning 2** Blood relation, Puzzle test, direction sense test, logical Venn diagram.	2

General Instructions:
Each Student has to write at least 6 assignments on entire syllabus.

Reference Books	
i)	Dr. R S Aggarwal — Quantitative aptitude, S. Chand Publication.
ii)	R V Praveen — Quantitative aptitude and logical reasoning, 2nd Edition, PHI Publication.
Assessment	
	Assessment will be done by Course Teacher. MCQ Test can be conducted based on the syllabus.

<table>
<tr><td>Year, Program, semester</td><td colspan="6">Third Year B. Tech. (Civil Engineering), Semester- V, AY 2025-26 onwards</td></tr>
<tr><td>Course Code</td><td colspan="6">ELC (CEP/FP 311)</td></tr>
<tr><td>Course Category</td><td colspan="6">Experiential Learning Courses: Common Engg. Projects/Field visits</td></tr>
<tr><td>Course title</td><td colspan="6">Mini Project III and Industrial Visit</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Total Contact Hours</td><td colspan="2">Total Credits</td></tr>
<tr><td>-</td><td>-</td><td>02</td><td>02</td><td colspan="2">-</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td>ISE</td><td colspan="2">ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td>ISE at Course in charge end</td><td colspan="2">-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="6">Basic Sciences, Engineering Sciences, Mathematics, Program Core Courses</td></tr>
<tr><td>Course Rationale</td><td colspan="6">Both mini projects and industrial visits play a crucial role in enhancing a student’s technical knowledge, practical skills, and career readiness.</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Expose students to industry practices: understand real-time industrial processes and workflows.
2. Bridge the gap between theory and application: see how classroom learning is applied in a professional setting.
3. Understand modern technologies and trends: learn about emerging technologies and industry standards.
4. Develop career awareness: get insights into different job roles and career paths.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">At the end of the course, the students will be-
1. Apply theoretical knowledge in practical scenarios: utilize classroom concepts to develop real-world solutions.
2. Enhance problem-solving skills: develop critical thinking and analytical skills to tackle technical challenges.
3. Understand industry workflows and operations: gain insights into industrial processes, management, and best practices.
4. Bridge the gap between academia and industry: see how theoretical concepts are applied in real-world settings.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2										
CO 2		3	2									
CO 3	2											2
CO 4	2		3									

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content	Hours
The student works on a topic based on following list I. Concrete technology: Concrete materials, mixing process, types of concrete, challenges in the world of concrete. I. Soil mechanics and foundations: Types of soils, engineering properties of soil, foundation related problems, soil stabilization. I. Building planning and constructions: Planning aspects, eco-friendly buildings, sustainable design	One hour weekly

V.Structural design- Steel and concrete designs, related software's. V.Infrastructures design and constructions- Roads, bridges, flyovers, pile foundations, bullet train airports I.Environmental Engineering: design of WTP and STP, Design of low cost treatment options for water and wastewater. Also, student has to prepare a comprehensive mini project report after completing the work and industrial visit to the satisfaction. **Any** mini project related to Civil Engineering is acceptable.	
Course Assessment Method	
Assessment is based on presentations showcasing the efforts of the mini project for formulating the problem, developing/designing the solutions, testing and validating the solution, with submission of project report.	

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	PCC 321(L)					
Course Category	Professional Core Course					
Course title	**Design of Steel Structures**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		---	---	100
Pre-requisites (if any)	Theory of structures					
Course Rationale	The course deals with design of steel structures using "Limit State Design Method". The design methodology is based on the latest Indian Standard Code of Practice for general construction (IS: 800-2007). The course aims at imparting knowledge and skill of all the necessary components such as material specifications, connections, analysis and elementary design of structural members for designing the steel structures.					
Course Objectives	1. Clarify the concept of limit state method based on Indian Standards 2. Demonstrate the design of bolted and welded connections 3. Illustrate the design of tension and compression members of steel structures 4. Explain the design of beam and gantry girder					
Course Outcomes	Upon completion of this course, student should be able to – 1. Comprehend the concept of limit state method based on Indian Standards 2. Design of bolted and welded connections 3. Design of tension and compression members of steel structures, columns and column bases 4. Design of beam and gantry girder					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	2	3										
CO 2		3										
CO 3		3	2									
CO 4		3	2									

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Introduction to structural design, Structural systems, Roll of the designer, Advantages of steel as a structural material, Types of structural steel, Mechanical properties of steel, various rolled steel sections, structural pipe (tubes) sections and their properties. Codes and specifications. Design philosophies, Limit state method. Design of truss for an industrial building: Roofing materials, Types of trusses, Loading on roof trusses	6
II	i) Bolted connections: Behaviour of bolted joints. Design strength of ordinary black bolts, Design strength of ordinary black bolts, Design of simple connections, Beam to beam, beam to column, framed connections. ii) Welded connections: Types and properties of welds, Types of joints, Design of simple connections, Beam to beam, beam to column, framed connections.	7

III	Design of Tension members: Types of tension members, Slenderness ratio, Behaviour of tension members, Modes of failure, Design of angle sections for tension.	6
IV	Design of Compression Members: Behaviour of compression members, Modes of failure, Classification of cross section, Effective length of compression members, Design strength, Compression members in trusses	7
V	Design of columns subjected to axial loads, Laced and Battened columns. Column bases: Slab base and Gusseted base.	6
VI	Design of beams: Laterally restrained and unrestrained simply-supported beams. Design of Gantry Girder, Design of Plate Girder	7
Text Books		
1.	Duggal S. K., "Design of Steel Structures", Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2008, 3rd Edition.	
2.	Bhavikatti S.S., "Design of Steel Structures by Limit State Method", I.K International Publishing	
Reference Books		
1.	Arya A.S. and Ajamani J.L., "Design of Steel Structures", Nemchand and Brothers, Roorkee, 1996, 2nd Edition.	
2.	Dayaratnam, "Design of Steel Structures", Wheeler Publishing, New Delhi, 2006, 3rd Edition.	
3.	Gaylord E.H. and Gaylord C.N., "Design of Steel Structures", Mc-Graw Hill, New York, 2008, 3rd Edition.	
4.	Lothers J.E., "Design in Structural Steel Vol.-I", Prentice Hall New Jersy.	
5.	Punmia B.C., Jain and Jain, "Design of Steel Structures", Laxmi Publication, New Delhi, 2008, 2nd Edition.	
6.	Ram Chandra, "Design of Steel Structures, Vol - I and Vol – II", Standard Book House, New Delhi, 2007, 2nd Edition.	
7.	Salmon C.G. and Johnson J.E., "Steel Structures: Design and Behavior", Harper and Row, New York, 1995.	
8.	Subramanian N., "Design of Steel Structures", Oxford University Press, New Delhi, 2008.	
9.	Vazirani and Ratwani, "Design of Steel Structures", Mc-Graw Hill, New York, 2000, 2nd Edition.	
10.	"Teaching Resource in Design of Steel Structures", IIT Madras, SERC Madras, Anna University, INSDAG, 2007.	
Reference Codes		
1.	IS: 800-2007, Indian Standard code of Practice for use of structural steel in general building construction, BIS – New Delhi (Third Revision).	
2.	IS: 875 (Part 1) (1987, Reaffirmed 2008): Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures. Part 1: Dead Loads - Unit Weights of Building Materials and Stored Materials (Second Revision).	
3.	IS: 875 (Part 2) (1987, Reaffirmed 2008): Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures. Part 2: Imposed Loads (Second Revision).	
4.	IS: 875 (Part 3) (2015): Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures. Part3: Wind Loads (Third Revision).	
5.	IS Handbook No. 1- Properties of structural Steel Rolled Section	
6.	Steel Table	
Useful web links		
1.	https://nptel.ac.in/courses/105105162	
2.	https://archive.nptel.ac.in/courses/105/106/105106216/	

Year, Program, semester	T.Y. Civil Engineering, Semester V					
Course Code	VSEC 321 (P)					
Course Category	Vocational and Skill Enhancement Course					
Course title	**Design of Steel Structures**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	-	-	2	2		1
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	---	---		---	50	50
Pre-requisites (if any)	Theory of structures					
Course Rationale	The course aims at imparting knowledge and skill of all the necessary components such as material specifications, connections, analysis and elementary design of structural members for designing the industrial steel structures and preparation of drawings.					
Course Objectives	1. To make the students familiar with the relevant IS codes to be used in design of steel structures. 2. Demonstrate the determination of loads on steel structure 3. Illustrate the analysis and design of the steel structure 4. Guide to prepare detailed structural drawings of a steel structure					
Course Outcomes	Upon completion of this course, student should be able to – 1. Understand the use of IS Codes related to structural design of steel structures 2. Calculate loads on steel structure 3. Analyze and design the steel structures like gantry girder, Industrial structures 4. Prepare detailed structural drawings of a steel structure					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	2	3										
CO 2		3							1			
CO 3		3							2			
CO 4		3							2	3		

Level of Mapping as: Low 1, Moderate 2, High 3

Experiment No.	**Experiment title**	**Hours**
	The laboratory work should include the following:	4
1.	Design of any **ONE** structure as per IS: 800- 2007 a) Industrial building with roof supported by steel trusses. b) Pedestrian bridge c) Design of Pre Engineered Building	4
2.	Design of any **ONE** structure a) Design of plate girder (welded) b) Design of Gantry Girder	4
3.	The Report should include Brief Technical design project report involving Introduction, assumptions, load calculations, analysis, preferably using suitable software such as STAAD.Pro, ETABS and detailed design.	2

4.	Drawings Structural plan and detailed structural drawings (using software) of the designed structure.	2
5.	Report of a site visit mentioning structural details with relevant sketches of structural connections.	2
Text Books		
1.	Duggal S. K., "Design of Steel Structures", Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2008, 3rd Edition.	
Reference Books		
1.	Ram Chandra, "Design of Steel Structures, Vol - I and Vol – II", Standard Book House, New Delhi, 2007, 2nd Edition.	
Reference Codes		
1.	IS: 800-2007, Indian Standard code of Practice for use of structural steel in general building construction, BIS – New Delhi (Third Revision).	
2.	IS: 875 (Part 1) (1987, Reaffirmed 2008): Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures. Part 1: Dead Loads - Unit Weights of Building Materials and Stored Materials (Second Revision).	
3.	IS: 875 (Part 2) (1987, Reaffirmed 2008): Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures. Part 2: Imposed Loads (Second Revision).	
4.	IS: 875 (Part 3) (2015): Code of Practice for Design Loads (Other than Earthquake) For Buildings and Structures. Part 3: Wind Loads (Third Revision).	
5.	IS Handbook No. 1- Properties of structural Steel Rolled Section.	
6.	Steel Table	
Useful web links		
1.	https://nptel.ac.in/courses/105105162	
2.	https://archive.nptel.ac.in/courses/105/106/105106216/	

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	PCC 322					
Course Category	Professional Core Course					
Course title	**Estimating, Costing and Valuation**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		--	-	100
Pre-requisites (if any)	Building Construction, Building Planning and Computer aided Civil Engineering Drawing, Design of Reinforced Concrete Structures.					
Course Rationale	To provide the student with the ability to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works, and also to equip the student with the ability to do rate analysis, fill tenders, prepare contract, valuation of properties and preparation of reports for estimation of various items.					
Course Objectives	1. To provide students necessary knowledge and skills in estimation of civil works. 2. To draft detailed specification and work out rate analysis according to material, labor requirements as per specified norms. 3. To understand procedure of contracts and Tenders 4. To carry out valuation of civil engineering structures.					
Course Outcomes	Upon completion of this course, student should be able to – 1. To understand the concept of estimates and types of estimates for various Civil Engineering works. 2. To understand Specification if work and Calculate rates for various items of construction. 3. To prepare actual contract forms and fill Tenders. 4. Prepare valuation report for residential building.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	1	3							1	
CO 2	1	3	2	2								
CO 3	1	3	2	1							1	
CO 4	2	1	1	1								

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Introduction:** Purpose of quantity estimates, Types of estimates, Various items to be included in estimates, Modes of measurement and units of measurement as per codal provision IS1200, Administrative approval and Technical sanction to estimates, Introduction to SSR (State Schedule Rate), Prime cost, Provisional sum and provisional quantities	6
II	**Specifications:** Purpose, basic principles, general and detailed specifications for various items related to building. Approximate estimates, purpose, Various methods used for buildings and other civil engineering works.	4

III	**Measurement of Quantities:** Long wall- Short wall method and Center line method, measurement sheet and abstract sheet. Analysis of rates, Factors affecting cost of an item work, materials, sundries, labour, tools and plant, overheads and profit. Task work- Definition and factors affecting task work. Analysis of rates of items related to building, Price Escalation.	6
IV	**Detailed Estimation:** Methods of computation of volume of earthwork such as mean area method, mid-sectional area method, Prismoidal formula, and Trapezoidal formula, Spot level method etc. & numerical based on methods. Mass haul diagram & its necessity, Terms like lead & lift etc. Bar Bending Schedule & its necessity, preparation of bar bending schedule of various structural elements as per code IS2502.	8
V	**Tenders (Bids):** Meaning, Categories, Tender notice, Notification in press and media, procurement, ,National Building Code (NBC) Corrigendum, Preparation and Submission of tenders, Tenders form and information, EMD and SD, revocation of tenders, opening of tenders, qualification of contractors, Scrutiny of tenders, unbalanced tenders, acceptance of tenders, running bills and final bills. E-Tendering. General idea, Types of contracts viz: lump-sum, item rate, percentage rate, cost plus, Engineering Procurement Construction (EPC).	8
VI	**Valuation** : Difference between cost, price & value. Types of value, Valuation & its purposes. Various terms such as depreciation, sinking fund, capitalized value, years purchase, Annualized value etc. Methods for calculating depreciation of building. B. Methods of valuation such as Rental method, land & building method, Belting method etc. C. Real estate, rent fixation, Tenure of land, Freehold Properties, Leasehold Properties, Easement rights. D. Numerical based on valuation.	7

Text Books	
1.	A Textbook of Estimating and Costing (Civil), D.D. Kohli and R. C. Kohli, S. Chand & company, New Delhi.
2.	Civil Engineering Contracts and Estimates, B. S. Patil, Universities press
3.	A Text Book of Estimating and Costing for Civil Engineering, G.S. Birdie, Dhanpat Rai Publishing Company
4.	Valuation of Real Properties by S.C. Rangwala, Ketki B. Dalal, Charotar Publishing house, 9th edition, 2013”
Reference Books	
1.	Estimating and Costing in Civil Engineering: Theory and Practice, B.N. Dutta and S. Dutta, 28th revised edition, CBS Publishers and distributors.
2.	Valuation Principles and Procedures, Ashok Nain, Dew point Publication.
3.	Estimating and Costing, R. C. Rangwala, Charotar Publishing House Pvt Ltd, Anand..
4.	IS 1200: --- (Part 1 to 25): Methods of Measurement of Building & Civil Engineering Works, Bureau of Indian Standards, New Delhi

5.	PWD Schedule of Rates – Latest
Useful web links	
1.	https://www.youtube.com/watch?v=NlnxoQ-EVfc&list=PLDruByDs-j8EEgUrLEhktjk5nIWUvULsf
2.	https://www.youtube.com/watch?v=gsLP_zgSq4w&list=PLDruByDs-j8EEgUrLEhktjk5nIWUvULsf&index=3
3.	https://www.youtube.com/watch?v=c0ilOdlLBy0&list=PLDruByDs-j8EEgUrLEhktjk5nIWUvULsf&index=4
4.	https://www.youtube.com/watch?v=fWH9BoN5Aq0&list=PLDruByDs-j8EEgUrLEhktjk5nIWUvULsf&index=6
5.	https://www.youtube.com/watch?v=VoSuGMulGps&list=PLDruByDs-j8EEgUrLEhktjk5nIWUvULsf&index=7

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	PCC 322					
Course Category	Professional Core Course					
Course title	**Estimating, Costing and Valuation**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	0	-	2	2		1
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	-	-		–	50	50
Pre-requisites (if any)	Building Construction, Building Planning and Computer aided Civil Engineering Drawing, Design of Reinforced Concrete Structures.					
Course Rationale	To provide the student with the ability to estimate the quantities of item of works involved in buildings, water supply and sanitary works, road works and irrigation works, and also to equip the student with the ability to do rate analysis, fill tenders, prepare contract, valuation of properties and preparation of reports for estimation of various items.					
Course Objectives	1. To provide students necessary knowledge and skills in estimation of civil works. 2. To draft detailed specification and work out rate analysis according to material, labor requirements as per specified norms. 3. To understand procedure of contracts and Tenders 4. To carry out valuation of civil engineering structures.					
Course Outcomes	Upon completion of this course, student should be able to – 1. To understand concept of estimates and types of estimate for various for Civil Engineering works. 2. To understand Specification if work and Calculate rates for various items of construction. 3. To prepare actual contract form and fill Tenders. 4. Prepare valuation report for residential building.					

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	1	3							1	
CO 2	1	3	2	2							2	
CO 3	1	3	2	1							2	
CO 4	2	1	1	1								

Course Outcome and Program Outcome Mapping

Level of Mapping as: Low 1, Moderate 2, High 3

Experiment No.	Experiment title (Any 8 set of experiments)	Hours
1.	Writing detailed specifications for items of work from various civil engineering works. (each from Building, Roads, Irrigation works, Water supply and sanitation and sewer from buildings)	4
2.	Detailed rate analysis for items of work from various civil engineering	4

	works. (at least 10 items)	
3.	Schedule of reinforcement for the following: Beams, Slab, Staircase, Column and Footing	4
4.	Preparing detailed estimate for G + 1 building with framed structure. (in a group of 4-5 students with separate plan for each group)	2
5.	Preparing detailed estimate for civil structures other than building such as Earthwork for road construction, estimate of road/highway works, estimate of steel roof truss, estimate of a culvert, water tank (elevated storage tank).(any one)	2
6.	Preparing tender notice and schedule - B'(BOQ) for G + 1 building for which the detailed estimate is prepared.	2
7.	Preparing tender document for G + 1 building for which the detailed estimate is prepared.	2
8.	Preparing detailed valuation report for residential/commercial/ industrial building using standard form O-1.	2
9.	Site Visit and Report	2
Text Books		
1.	Estimating, Costing, Specification & Valuation In Civil Engineering by M. Chakraborti	
2.	Estimating and Costing in Civil Engineering: Theory and Practice, B.N. Dutta and S. Dutta, 28th revised edition, CBS Publishers and distributors.	
3.	A Text Book of Estimating and Costing for Civil Engineering, G.S. Birdie, Dhanpat Rai Publishing Company	
Reference Books		
1.	Valuation Principles and Procedures, Ashok Nain, Dew point Publication.	
2.	Estimating and Costing, R. C. Rangwala, Charotar Publishing House Pvt Ltd, Anand..	
3.	Valuation of Real Properties by S.C. Rangwala, Ketki B. Dalal, Charotar Publishing house, 9th edition, 2013"	
4.	Civil Engineering Contracts and Estimates, B. S. Patil, Universities press	
Reference Codes		
1.	IS 1200: --- (Part 1 to 25): Methods of Measurement of Building & Civil Engineering Works, Bureau of Indian Standards, New Delhi	
2.	PWD Schedule of Rates – Latest	
3.	Standard specifications volumes I and II (PWD Maharashtra) Govt. of Maharashtra	
4.	National Building Code of India – Guidelines for regulating the building construction activities.	
Useful web links		
1.	https://www.youtube.com/watch?v=UWfu9ShqYak&list=PL_rcwK265X9e0vzfTGBKdnGacEJmAyDEl	
2.	https://www.youtube.com/watch?v=E5PfgatSM5M&list=PL_rcwK265X9e0vzfTGBKdnGacEJmAyDEl&index=3	

Year, Program, semester	T.Y. Civil Engineering, semester VI					
Course Code	PEC 321					
Course Category	Programme Elective Course II					
Course title	**Advanced Structural Analysis**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	**-**	**-**	**03**		**03**
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	--	150
Pre-requisites(if any)	Theory of structures					
Course Rationale	The objective in advanced structural analysis is 1. To expose the students to advanced levels of structural analysis using special methods of analysis. 2. The learn special methods of analysis focused to estimate the displacements and internal forces using displacement based approach rather than force based approach.					
Course Objectives	1. To impart the knowledge of advanced methods of structural analysis 2. To provide knowledge for analysing special types of structures. 3. To prepare students to develop computer programs by using matrix methods of structural analysis.					
Course Outcomes	1. **Apply** advanced methods for analysis of structures. 2. **Calculate** forces and displacements for special structures. 3. **Formulate** program by using matrix methods of structural analysis for field applications.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2										1
CO2	3	2										1
CO3	3	2										1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Influence line Diagrams for Indeterminate Structures:** Concept of ILD, ILD for propped cantilever, fixed and continuous beams.	7
II	**Beams Curved in Plan:** Structural behaviour of curved beam. Analysis of determinate and indeterminate beams curved in plan, bent beams.	7
III	**Analysis of fixed arch:** Elastic centre method, analysis of parabolic and semi-circular shape arches subjected to UDL and point loads.	7
IV	**Beam Columns:** Concept of geometric and material nonlinearity, governing differential equations. Analysis of beam-columns subjected to different loadings and support conditions. Buckling of frames–symmetrical and unsymmetrical, stiffness and carry-over factors for beam-columns, fixed end actions due to various loads.	7

V	**Beams on Elastic Foundations:** Basic concept of beams on elastic foundation, analysis of infinite, semi-infinite and finite beams, governing differential equation, soil pressure distribution diagrams, Bending moment, shear force, deflection and slope distribution diagrams.	7
VI	**Matrix method of analysis: Stiffness Methods:** Element approach, stiffness matrix, equivalent loads, applications to beams, frames and trusses, direct stiffness method	6
Text Books		
1.	V.N. Vazirani. and M.M. Ratwani, "Advanced Theory of Structures and Matrix Methods of Analysis (Textbook for Engineering Students", Khanna Publishers, 2008.	
2.	Negi, L. S. and Jangid, R.S. (2003)," *Structural Analysis"*, Tata McGraw-Hill Publishing Company Limited, New Delhi, ISBN 0-07-462304-4	
3.	Timoshenko. S. P. and Gere. J. M., "Theory of Elastic Stability", Tata McGraw-Hill Publishing company Ltd., 2nd Edition, 1985.	
4.	Gere. J. M. and Weaver. W., "Matrix Analysis of Framed Structures", CBS Publishers and Distributor, 2nd Edition, 2004.	
5.	Krishna Raju N., "Advanced Mechanics of Solids and Structures", McGraw-Hill Education, 08-Nov-2018 - Technology and Engineering.	
Reference Books		
1.	Armenakas, A. E. (1988)," Classical Structural Analysis – A Modern Approach", McGraw-Hill Book Company, NY, ISBN 0-07-100120-4.	
2.	Hibbeler, R. C. (2002)," *Structural Analysis*," Pearson Education (Singapore) Pte. Ltd., Delhi, ISBN 81-7808-750-2	
3.	Mcquire and Gallghar. R. H. "Matrix Structural Analysis", John Wiley, 2nd Edition, 2000	
4.	Beaufit F.W et al. "Computer Methods of Structural Analysis", Prentice Hall, illustrated,1970	
5.	John L. and Meek, "Matrix Structural Analysis", McGraw Hill Book Company, illustrated,1971	
6.	Pandit G. and Gupta S., "Structural Analysis - A Matrix Approach2008",McGraw Hill Education; 1st edition	
Useful web links		
1.	https://nptel.ac.in/courses/105/105/105105108/	
2.	https://nptel.ac.in/courses/105/101/105101086/	
3.	http://engineeringvideolectures.com/course/281?pn=0#videolist	
4.	https://nptel.ac.in/courses/105/105/105105109/	

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	PEC 321					
Course Category	Program Elective Course II					
Course title	**Open Channel Hydraulics and Hydraulic Machines**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	-	150
Pre-requisites (if any)	Mathematics, Fluid Mechanics, Soil mechanics, Water Resources Engineering.					
Course Rationale	The course basically focuses on uniform flow in open channel, steady and uniform flow, depth energy relationship in open channel flow, gradually varied flow, rapidly varied flow, spatially varied flow, notches and weirs, impact of jet &hydraulic turbines & centrifugal pump is taught in this course.					
Course Objectives	1. Effectively impart fundamental concepts in hydraulics to recognize the physical description and hydraulic illustrations of open channel flow systems 2. To apply basic principles in fluid flow problems. 3. To study velocity and discharge measurement devices 4. To study the impact of jet, Pumps and turbines.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Identifying, formulating and management of water resources related issues and problems. 2. Develop the Principle and equation for pressure flow and momentum analysis. 3. Apply the flow measurement techniques and modern methods of velocity, discharge of open channel flow 4. Apply the performance characteristic curves and commercial manuals to choose the suitable efficient Hydraulic Machines					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	1	1	1								
CO 2	1	3	2	2		1					2	
CO 3	1	2	2	3							1	
CO 4	2	1	2	2								

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**A. Uniform Flow in Open Channel :** Introduction, Difference between Pipe Flow & Open Channel Flow. Types of Open Channels, Types of Flows in Open Channel, Geometric Elements, Velocity Distribution, Measurement of Velocity- (Pitot Lube, Current Meter) **B. Steady and Uniform Flow :** Chezy's and Manning's Formula, Uniform Flow Computations, Hydraulically Efficient Section (Rectangular, Triangular, Trapezoidal) **C. Depth Energy Relationship in Open Channel Flow :**	7

	Specific Energy (Definition and Diagram, Critical, Sub-Critical, Super-Critical Flow).	
II	**Gradually Varied Flow (GVF):** Definition, Classification of Channel Slopes, Dynamic Equation of GVF (Assumption and Derivation), Classification of GVF Profiles-Practical Examples, Direct Step Method of Computation of GVF Profiles	6
III	**A. Rapidly Varied Flow (RVF) :** Definition, Hydraulic Jump- Phenomenon, Conjugate Depth Relationship, Characteristics, Uses and Types of Hydraulic Jump, Hydraulic Jump as an Energy Dissipater **B. Spatially Varied Flow :** Basic Principles and Assumptions, Dynamic Equation and Analysis of Flow Profiles, Isoclinal Method, Spatially Varied Steady & Unsteady Surface Flows.	6
IV	**Notches and Weirs :** Types, Derivation of Discharge Equation, Velocity of Approach, Francis Formula, Calibration of Notches, Errors in Measurement of Discharge, Sharp, Broad & Round Crested Weirs, Calibration of Weir, Time of Emptying Tank with Weir.	8
V	**Impact of Jet**: Impulse Momentum Principle, Impact of Jet on Vanes- Flat, Curved (Stationary and Moving), Inlet and Outlet Velocity Triangles, Series of Flat, Curved Vanes Mounted on Wheel.	5
VI	**A. Hydraulic Turbines :** Importance of Hydro-Power, Classification of Turbines- Pelton, Francis and Kaplan Turbine (Detailed Design Need Not to Be Dealt with), Unit Quantities, Specific Speed, Performance Characteristics, Selection of Type of Turbine, Concept of Draft Tube. **B. Centrifugal Pump :** Classification, Component Parts, Working of Centrifugal Pump, Performance Characteristics, Common Pump Troubles and Remedies, Net Positive Suction Head (NPSH).	7
Text Books		
1.	Modi/Seth, “Fluid Mechanics – Hydraulic and Hydraulic Mechanics”, Standard Book House, Delhi	
2.	A.K. Jain, “Fluid Mechanics”, Khanna Pub., Delhi.	
3.	K. Subramanyam, “Fluid Mechanics”, Tata McGraw-Hill Pub. Co., Delhi	
4.	K. L. Kumar, “Fluid Mechanics”, Eurasia Publication House, Delhi	
Reference Books		
1.	K. Subramanyam, “Flow in open channel”, Tata McGraw-Hill Pub. Co., Delhi.	
2.	R.C. Hibbeler, “Fluid Mechanics”, Pearson Publication.	
3.	Rangaraju, “Open Channel flow”, Tata McGraw-Hill Pub. Co., Delhi.	
4.	Streeter, “Fluid Mechanics”, McGraw-Hill International Book Co., Auckland	
5.	V. T. Chaw, “Flow in open channel”, McGraw-Hill International Book Co., Auckland	
Useful web links		
1.	https://www.youtube.com/watch?v=5CDt3NT0ThM&list=PLfkr9NYCSyHyeg6VEFA_KtNmsJWihrc_m	
2.	https://www.youtube.com/watch?v=YV8I0FhaxB8&list=PLfkr9NYCSyHyeg6VEFA_KtNmsJ	

	Wihrc_m&index=2
3.	https://www.youtube.com/watch?v=w5oCLkAelF0&list=PLfkr9NYCSyHyeg6VEFA_KtNmsJWihrc_m&index=4
4.	https://www.youtube.com/watch?v=2Puu0Qp0nz0&list=PLfkr9NYCSyHyeg6VEFA_KtNmsJWihrc_m&index=6
5.	https://www.youtube.com/watch?v=a5YsNtFItFQ

Year, Program, Semester	T.Y. Civil Engineering, Semester V					
Course Code	PEC 321					
Course Category	Programme Elective – II					
Course title	**Human Resources Management In Construction**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	---	150
Pre-requisites (if any)	Elements of Civil Engineering, Building Construction					
Course Rationale	Course is prepared to give focus on understanding on quality planning, quality assurance, quality control and safety management					
Course Objectives	1. To learn various aspects of human resource management 2. To study current practices and challenges in HRM 3. To analyse employee performance and their contribution to organization. 4. To learn various techniques of development of employability skills.					
Course Outcomes	Upon completion of this course, student will be able to 1. Plan and manage key human resource functions within organizations. 2. Analyse current issues, trends, practices, and challenges in HRM. 3. Manage employee performance and contribute to organizational effectiveness. 4. Develop employability skills.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	1	1	2			1	1	1		
CO 2	3	2		1	2	1	1	1	1	1	1	1
CO 3	3	2		1	2	1	1	1	1	1	1	1
CO 4	3	2	1	1	1		1	1	1	2	1	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**MANPOWER PLANNING :** Manpower planning and forecasting–Recruitment, selection process-Sources-Induction, Orientation and Training-Manpower Planning process-Organising, Staffing, directing, and controlling—Factors influencing supply and demand of human resources–Role of HR manager, Personnel Principles	7
II	**ORGANIZATION:** Elements of an organisation-Management process in organisations, Planning, Organising, Staffing-Directing, Controlling, Delegation of authority, responsibility, accountability, lines and staff organisation Workforce, diversity-international dimensions of organisation-Organisational structure-determinants of organisational design	7

III	**HUMAN RELATIONS AND ORGANISATIONAL BEHAVIOUR :** Basic individual psychology, Approaches to job design and job redesign, Self managing work teams, Intergroup, Conflict in organizations, Leadership, Engineer as Manager, aspects of decision making, Significance of human relation and organizational, Individual in organization, Motivation, Personality and creativity, Group dynamics, Team working, Communication and negotiation skills.	7
IV	**DIVERSITY, WORK LIFE BALANCE & EMPLOYMENT LEGISLATIONS:** Workforce Diversity, Equal Opportunities in construction, Work- life Balance (Case study Discussion). Employee welfare and Employment legislations: Workplace health and safety hazards, employment legislations.	7
V	**WELFARE MEASURES** : Establishing Pay plans-Basics of compensation-factors determining pay rate-Current trends in compensation, Job evaluation, Incentives, Practices in Indian organizations, Statutory benefits-non statutory (voluntary) benefits, Insurance benefits-retirement benefits and other welfare measures to build employee commitment, Laws related to welfare measures.	7
VI	**COMPUTER APPLICATION:** Need, essential components, scheduling, time tracking, compliance and safety, payroll and benefits, on-board and training, performance management, different software's and its application	4
Text Books		
1.	Martin Loosemore, Andrew Dainty, Helen Lingard, "Human Resource Management in Construction Projects: Strategic and Operational Approaches", Taylor and Francis, 2014	
2	Dessler, G., & Varkkey, B., "Human Resource Management, India", Pearson Education, 2020.	
3	Akhilesh Srivastava, "Digital Construction Management", Young Global Publications	
4	Dr. S. Seetharaman, "Construction Engineering and Management", UMESH Publication	
Reference Books		
1.	David Langford, R.F. Fellows, M. R. Hancock. "Human Resource Management in Construction", Routledge, 2014.	
2.	David A. Decenzo and Stephens P. Robbins, "Human Resource Management", John Wiley & Sons, 2015.	
3.	Venkata Ratnam C. S. & Srivatsava B. K. "PERSONNEL MANAGEMENT AND HUMAN RESOURCES", Tata Mc-Graw Hill, NewDelhi	
4.	Aswathappa, "HUMAN RESOURCE MANAGEMENT", Tata McGraw Hill, NewDelhi, 2010	
Useful web links		
1.	https://www.youtube.com/watch?v=Fa8E3tCDIpo&list=PL2FC06CE7BB3D8BC6	

Year, Program, Semester	T.Y. Civil Engineering, Semester V					
Course Code	PEC 321					
Course Category	Programme Elective – II					
Course title	**Ground Improvement Techniques**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	--	150
Pre-requisites (if any)	Geotechnical Engineering, Foundation Engineering					
Course Rationale	The soils at construction sites are not always totally suitable for supporting physical infrastructure such as buildings, bridges, highways, tunnels and dams. Under these conditions, soil needs to be treated using ground improvement techniques. Similarly specific types of soil improvement techniques are required in the case of expansive soils and collapsible soil and in the case of earthquake prone areas. The course addresses various ground improvement techniques along with principles, design issues and construction procedures.					
Course Objectives	1. To understand the need of ground improvement techniques. 2. To know about the different techniques involved in densifying the soils					
Course Outcomes	Upon completion of this course, student should be able to – 1. Explain the need and objective of ground improvement techniques. 2. List the different techniques that are available for improvement. 3. Choose the suitable technique depending upon the condition of soil and requirements. 4. Know different methods that are available for compaction or densifying the soils and identify the type of techniques required for various soils.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	2	3	2		1		1		2	2
CO 2	2	3	2	3	2	2	2	2	1	2	2	2
CO 3	2		2	2	2	1	1	2		1		2
CO 4	2	2	2			2	1		1	1		2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Introduction -** Need for Ground Improvement, Different types of problematic soils, Emerging trends in ground Improvement.	3
II	**Mechanical stabilization -** Shallow and deep compaction requirements, Principles and methods of soil compaction, Shallow compaction and methods. Properties of compacted soil and compaction control, Deep compaction and Vibratory methods Dynamic compaction.	8

III	**Hydraulic modification -** Ground Improvement by drainage, Dewatering methods. Design of dewatering systems, Preloading, Vertical drains, vacuum consolidation, Electro-kinetic dewatering, design and construction methods.	8
IV	**Modification by admixtures -** Cement stabilization and cement columns, Lime stabilization and lime columns. Stabilization using bitumen and emulsions, Stabilization using industrial wastes Construction techniques and applications.	8
V	**Grouting -** Permeation grouting, compaction grouting, jet grouting, different varieties of grout materials, grouting under difficult conditions.	4
VI	**In situ soil treatment methods -** Soil nailing, rock anchoring, micropiles, design methods, construction techniques. Case studies Case studies of ground improvement projects.	8
Text Books		
1.	Manfired R. Hausmann, Engineering Principles of Ground Modification, McGraw-Hill Pub, Co., 1990.	
2.	Koerner, R. M., Designing with geosynthetics, Prentice Hall Inc. 1998.	
3.	M C. R. Davies, F.Schlosser Ground improvement geosystems	
Reference Books		
1.	Ground Improvement Techniques by P Purushothama Raj	
2.	Engineering Principles of Ground Modifications by Manfred R. Hausmann	
3.	Principle and Practice of Ground Improvement by Jie Han	
Useful web links		
1.	https://archive.nptel.ac.in/courses/105/108/105108075/	
2.	https://archive.nptel.ac.in/courses/105/105/105105210/	
3.	https://onlinecourses.nptel.ac.in/noc23_ce78/preview	

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	PEC 321					
Course Category	Program Elective - II					
Course title	**Advanced Transportation Systems**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	--	150
Pre-requisites (if any)	Geotechnical Engineering					
Course Rationale	The course deals with the development of planning for rural Society.					
Course Objectives	1. To impart knowledge of metro construction and impart the fundamentals of the LRT system. 2. To impart the construction techniques of at grade and grade separators geometrical features. 3. To know the underground construction of structures and its complexity.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Understand the structural needs for the elevated structures. 2. Examine the methods and requirements for bridge construction. 3. Narrate the various erection and construction methods of elevated structures. 4. Apply the procedures and safeguards for underground constructions Justify the necessity of tunnel lighting, ventilation and safety					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3		1		1					1	2	2
CO 2	3		2		3	2	2	2	1	2	2	2
CO 3	2		2		2	1	1	2	1			2
CO 4	3		2			2		1	1	1	1	2
CO5	3	3	2	2	1			1	1	1	1	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Introduction to elevated structures for Railway/Metro Designing, Choice of Foundation for Piers and Abutments, Types of Bridges and Loading Standards, Setting out for Piers and Abutments, Open Foundation, Pile Foundations, Well Foundation - Case Studies, Piers and Abutments, Superstructure - Design Aspects, Superstructure – Construction, Inspection of Bridges, Maintenance of Bridges – Substructure, Maintenance of superstructure – Girders.	8
II	Bridge bearings and flooring, Requirements of good flooring, factors affecting choice of flooring material, types of floors, flooring material, drainage of floor-Purpose and functions of bearings, importance of bearings, free and fixed bearings, bearing types.	8
III	Construction and Erection methods, General aspects of construction procedures, selection of method for construction, erection of steel girders, erection of steel truss bridges, erection of suspension bridges, RCC and pre-stressed bridges, formwork,	8

	failures of bridge, testing and strengthening of bridge/elevated structure, repairs and maintenance of elevated structures.	
IV	Underground constructions, Methods and safeguards (Tunnelling) Tunnel Engineering: Necessity, planning of tunnels, site investigation for tunnels, types of tunnels, tunnel alignment and grade, size and shape of a tunnel, Method of constructions, methods of tunnelling in hard rocks - full face method – heading and bench method - drift method - different methods of tunnelling in soft soils including compressed air and shield tunnelling -	6
V	Shafts in tunnels - ventilation of tunnels and various methods - lining of tunnels - drainage and lighting of tunnels, problems in tunnel constructions, boom tunnelling machines, full face tunnel boring machines.	3
VI	Tunnel lighting, ventilation, and safety, Tunnel lighting and types of tunnel lighting, spacing of lights, ventilation, methods of ventilation, permanent ventilation and noise pollution, dust control methods, pre drainage and dewatering in tunnels, permanent drainage, safety precautions in tunnelling, health protection in tunnel construction.	6
Text Books		
1.	S.P. Bindra, Principles and Practice of Bridge Engineering, Edition 5 (1996), Dhanpat Rai & Sons, New Delhi	
2.	S.C. Saxena, Tunnel Engineering, Dhanpat Rai & Sons, New Delhi (1996)	
3.	D.J. Victor, Essential of Bridge Engineering, Oxford & IBH Pub. Co. Ltd, 1980	
Reference Books		
1.	Ponnuswamy, Bridge Engineering, Delhi.	
2.	V N Gharpure, Bridge Engineering.	
3.	A.D. Kerr, , Fundamentals of Railway Track Engineering, Simmons Boardman Pub	
Standard Code		
1.	Indian Railways Establishment Manual Volume-I	
2.	Indian Railways Establishment Manual Volume-II	
3.	Indian Railway Commercial Manual Volume-I	
Useful web links		
1.	https://onlinecourses.nptel.ac.in/noc24_ce81/preview#	
2.	https://digitalskills.iitmpravartak.org.in/course_details.php?courseID=180&cart=	
3.	https://archive.nptel.ac.in/courses/105/105/105105212/	
4.	https://onlinecourses.nptel.ac.in/noc21_ce76/preview	

Year, Program, Semester	Third Year B. Tech. Civil Engineering, Semester VI					
Course Code	PEC 322					
Course Category	Program Elective III					
Course title	**Reinforced and Prestressed concrete design**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	---	150
Pre-requisites(if any)	Engineering Mechanics, Concrete Technology, Structural Analysis, Design of Reinforced Concrete Structures.					
Course Rationale	The objective in RCC structure design is to produce a structure capable of resisting all applied loads without failure during its intended life. The objective can be fulfilled by: 1. Understanding the strength and deformation characteristics of concrete and steel, 2. Following the clearly defined standards for materials, production, workmanship and maintenance, and use of structures in service, 3. Adopting measures needed for durability.					
Course Objectives	1. To illustrate basic concepts and systems of prestressing. 2. To provide knowledge for design of Prestressed concrete structures using relevant IS codes. 3. To analyze and design structures like retaining wall, combined footing, water tanks under flexure, shear and axial stresses.					
Course Outcomes	Students will able to 1. Estimate losses of prestress due to various causes. 2. Verify appropriate section using flexure, shear, torsional design approach for prestressed concrete structures 3. Design various structural RC elements like beam, column, footing, walls and water tanks under different service loads using relevant codes. 4. Prepare the structural drawing of various RCC elements using 5. The guidelines in design codes.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	3	3	2	2		1	1	1	1	1	
CO 2	3	3	3	3	2			1	1			
CO 3	3	3	3	2	2	1	2	1	1			1
CO 4	3	3	3	2	2	1	1	1	1	2	1	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Prestressed Concrete Design- Basics :** Basics of pre-stressed concrete, Material properties: steel, allowable stresses, relaxation, fatigue. Stages of prestressing.	7

	Stress and strength concept and load balancing concept, systems of prestressing, loss of prestress. Analysis of rectangular sections under flexure at ultimate loads: equations of equilibrium and compatibility and constitutive models, stress block for concrete, solution procedure, minimum and maximum amount of prestressed reinforcement.	
II	**Unit II- Prestressed concrete design of continuous beam :** Prestressed concrete design: Cantilever beams and Continuous beams, Cantilever beams: choice of cable profile, determination of limiting zone. Continuous beams: advantages and disadvantages, choice of cable profile, analysis for bending moment. Principle of linear transformation, principle of concordant cable.	6
III	**Unit III: Design of multi-storeyed RC building :** Design of multi-storeyed buildings under gravity and lateral loads using relevant design code provisions.	7
IV	**Unit IV- Design of RC retaining wall :** Design of cantilever and counterfort retaining wall with and without surcharge loads.	6
V	**Unit V- Design of Combined footing :** Design of combined footings: Proportioning of footing, soil bearing pressure. Rectangular footing and Trapezoidal shape footing. Reinforcement detailing.	7
VI	**Unit VI- Design of Water tank resting on ground :** Design guidelines in IS 3370-2009-part I and II code. Circular water tank- Joint rigid and joint flexible, Rectangular water tanks, base slab, reinforcement detailing.	6
Text Books		
1.	Krishna Raju N., “Advanced Design of Structures”, 6th edition, McGraw Hill Education.	
2.	Lin T. Y., “Design of Prestressed Concrete Structures”, 3rd edition, Wiley India Private Limited	
3.	Roy and Sinha, “Design of R. C. Structures”, S. Chanda and Co, New Delhi.	
4.	Shah V.L. and Karve S.R., “Design of Multistoried Buildings (G+3)”, Structures publications, Pune.	
Reference Books		
1.	P.C. Varghese, “Limit State Design of reinforced concrete”, Prentice-hall of India Pvt. Ltd, 2nd Edition, 2004.	
2.	M. L. Gambhir and McMillan, “Reinforced Concrete Design”, PHI learning Pvt. Ltd, 4th Edition, 2006.	
Reference Design Codes		
1.	IS 456 (2000), Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standards, New Delhi	
2.	IS:1893 (2016), Indian Standard Criteria For Earthquake Resistance of Structures (Part I):General Provisions and Building (Sixth Revision), Bureau of Indian Standards, New Delhi	
3.	I.S. 875- Part3 (2015),Design loads (other than earthquake) for buildings and structures, Bureau of Indian Standards, New Delhi	
4.	IS 3370-2(2009), Concrete structures for storage of liquids — Code of practice, reinforced concrete structures, first revision, bureau of Indian standards, New Delhi	
Useful web links		
1.	https://nptel.ac.in/courses/105105105	

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	PEC 322					
Course Category	Program Elective-III					
Course title	**Integrated Waste Management for A Smart City**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	---	150
Pre-requisites (if any)						
Course Rationale	This course teaches the fundamental concepts of generation, management and disposal of solid, C & D and E-waste. This course also focuses on various regulations related to management of waste in cities.					
Course Objectives	1. To know the generation and characteristics of solid waste. 2. To know concepts of management of C & D and E-waste. 3. To acquire an understanding of the regulations implemented for management of various waste for smart cities					
Course Outcomes	Upon completion of this course, student should be able to – 1. Understand the generation and characterization of solid waste. 2. Explain various rules related to SWM, C & D waste and E-waste management. 3. Summarize Swachh Bharat Mission and Smart City Mission of India. 4. Outline various components, processing and recycling of C & D waste 5. Summarize the necessity and concept of E-waste management.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3											
CO 2	2					2						
CO 3	1		1				2					
CO 4	2	2	2				2					
CO 5	2	2	2				2					

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	History of Solid waste, waste management hierarchy, solid waste management, elements of waste management system, Integrated Waste Management: Source reduction, recycling, reuse, waste to energy, landfills	7
II	Solid waste characterization: Regulatory, By source or generator, Physical Characteristics, Component Composition, Chemical Composition, biodegradability. waste sample processing, chemical analysis, instrumental analysis, quality control/quality assurance,	7
III	Waste Management Rules, 2016: Duties of waste generators, Ministry of Urban Development, Ministry of Power, Ministry of Agriculture, Ministry of New and Renewable Energy Sources , the Secretary–in-charge (Urban/Rural Development), Duties of CPCB, Duties of SPCB, the industrial units, manufacturers or brand owners, Criteria for setting-up SW processing and treatment facility, Criteria for	6

	waste to energy process, Time frame for implementation, Action Plans for implementation of SWM 2016 rules	
IV	Swachh Bharat Mission: Mission Objectives, Mission Components, Mission Strategy, Special focus groups, Mission Outlay. Smart City Mission: features of smart city, Core Infrastructure elements, steps for city selection, financing for smart cities, mission monitoring: State Level, National Level, City Level	6
V	C&D waste management: Major Components of C&D Waste, C&D Waste Compositions in India, Options for Managing C&D: On-Site Management, Processing and Recovery at a Central Recycling Facility, Land Disposal, C&D Waste Recycling Approaches, Challenges to C&D Debris Recycling, C&D Waste Management Rules 2016: Areas of Application, Duties of waste generators, service provider and their contractors, local authority, SPCB, CPCB, Bureau of Indian Standards and Indian Roads Congress	7
VI	Electronic Waste Management in India: Introduction, Categories in E waste, Composition of E-waste (Indian Scenario), State Wise E-Waste Generation (in Tonnes), Facts & Figure, Environmental and Health Hazards, Hazard due to Improper Disposal, Management of E-Waste, Top E-WASTE Management Companies in India, Steps followed by the company for recycling, E-Waste Management case study	6
Text Books		
1.	Tchobanoglous, G., Theisen and Vigil., “Integrated Solid Waste Management: Engineering Principles and Management Issues”, McGraw Hill, 1993	
2.	Tchobanoglous, G. and Kreith, F., “Handbook Of Solid Waste Management”, McGraw Hill, 2002, 2nd Edition	
3.	Donald R. Rowe, George Tchobanoglous, and Howard S. Peavy, “Environmental Engineering”, McGraw Hill Education	
Reference Books		
1.	Christensen, H. T, “Solid Waste Technology & Management”, Wiley, 2010, Volume 1 & 2	
2.	Nicholas P Cheremisinoff, “Handbook of Solid Waste Management and Waste Minimization Technologies”, Butterworth Heinemann An imprint of Elsevier	
3.	Donald R. Rowe, George Tchobanoglous, and Howard S. Peavy, “Environmental Engineering”, McGraw Hill Education.	
Useful web links		
1.	https://archive.nptel.ac.in/courses/105/105/105105160/	

Year, Program, Semester	T.Y. Civil Engineering, Semester V					
Course Code	PEC 322					
Course Category	Programme Elective Course - III					
Course title	**Construction Methods and Equipment Management**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	---	150
Pre-requisites (if any)	Building Planning and Design					
Course Rationale	The course deals with various techniques used in construction projects. This course aims to understand students to manage appropriate no. of equipment on the site. It also aware students about the safety measures to prevent accidents on the construction site and aware about disaster management. It also aware the students about advanced construction techniques.					
Course Objectives	1. Explain construction planning of a Civil Project. 2. Estimate the production of earth-moving, excavation equipment and illustrate to determine selection of right machine for the right job. 3. Aware the students about construction methods adopted for construction of diaphragm walls, erection of steel structures, roads, etc. 4. Describe the safety measures to prevent accidents on the construction site and aware about disaster management					
Course Outcomes	Upon completion of this course, student should be able to – 1. Explain of construction planning of a Civil Project. 2. Estimate the product of various earth-moving, excavation equipment determine selection of right machine for the right job. 3. Acquainted with construction methods adopted for construction of diaphragm walls, erection of steel structures, roads, etc. 4. To be aware the safety measures to prevent accidents on the construction site and know about disaster management.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1		3										
CO 2		3										
CO 3		3										
CO 4		3										

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Introduction - Conceptual planning of new project, site access and services, Mechanical v/s Manual construction Excavation in Earth: Earth moving equipment‘s - Tractors, Bulldozers, Scrappers, Power shovel, Hoes, simple numerical problems based on cycle time and production rates.	7
II	Excavation in Earth: Drag line, Clamshell, Trenchers, Compactors- types and performance, operating efficiencies, lifting capacities, Floating and dredging equipment.	6

III	Excavation in hard rock: Rippers, jack hammers, drills, Blasting explosives, detonators, fuses, Drainage in excavation – necessity and methods of dewatering	6
IV	Diaphragm Walls – Purpose and Construction Methods, Piles and Pile driving equipment, Steel construction: Planning and field operations, Lifting Equipment: Cranes, Slip formwork, Asphalt mixing and batching plant (Hot mix plant), Sensor Paver for rigid roads, Crushing plants, Concreting Equipment.	7
V	a) Safety measures in construction, prevention of accidents b) Introduction to Disaster management c) Rehabilitation and Strengthening of Structures	7
VI	3D printing technique in civil construction work, Application of Artificial Intelligent in the field of Civil Engineering	6
Text Books		
1.	Peurifoy R.L., "Construction, Planning, Equipment and methods", McGraw hill book co New Delhi.	
2.	Stubbs, "Hand Book of Heavy Construction", McGraw Hill Inc, 1971	
3.	Wedel, "Concrete Construction Hand Book", McGraw Hill Higher Education; 2nd edition,1974	
Reference Books		
1.	Singh Jagman, "Heavy Construction – Planning, Equipment and Methods", Oxford and IBH publishers, New Delhi 9.	
2.	Ataev S. S., "Construction Technology", Mir Publishers, Mascow.	
3.	Baron Thomas, "Erection of Steel Structures", ILIFFE, London.	
4.	Boyes R.G.H., "Structural and cut off Diaphragm walls", Applied Science Publishers Ltd., London.	
5.	Varma Mahesh, "Construction Equipment, Metropolitan", New York.	
6.	Hajnal I, I Marton, F. Regele A. Wiley, "Construction of Diaphragm Walls", Inter-science Publication, John Wiley and Sons.	
7.	Quin, "Planning and Construction of Docks and Harbors"	
Useful web links		
1.	https://onlinecourses.nptel.ac.in/noc21_ce21/preview	

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	PEC 322					
Course Category	Program Elective Course – III					
Course title	**Soil Exploration and Investigation Techniques**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	---	150
Pre-requisites (if any)	Geotechnical Engineering / Soil Mechanics, Foundation Engineering					
Course Rationale	This course introduces the fundamental concepts, advanced principles and application of foundation analysis and design to the undergraduate students of civil engineering.					
Course Objectives	1. To study subsurface exploration, shallow foundations - ultimate bearing capacity, safe bearing pressure, settlement analysis. 2. To design of combined and raft foundations, design of retaining walls, sheet pile walls, braced cuts, pile foundations, drilled piers and caissons. 3. To understand Machine Foundations, Concept of reinforced earth.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Understand the subsurface properties and bearing capacity. 2. Apply the knowledge for design depends to foundation types. 3. Comprehend the machine foundation and concept of reinforced earth.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	1	1	3	1						1	1
CO 2	1	3	3	2	2	2	2	2	1	2	2	1
CO 3	2		2	2	1	1	1	1				1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Subsurface Exploration: Boring, Sampling, SPT, CPT, Geophysical methods, Bore log and soil report. Shallow Foundations: Terzaghi's, Meyerhoff, Hansens bearing capacity theories, based on SPT, layered soils, eccentric and inclined loads. Bearing capacity on slopes, Foundation settlements.	8
II	Design of Combined and Raft Foundations: Design of combined footings by Conventional and elastic line methods. Design of Retaining walls: Lateral earth pressure, Retaining wall stability.	7
III	Sheet Pile Walls: Cantilever and Anchored sheet pile walls. Braced Cuts: Pressure envelopes and design of various components.	5
IV	Pile Foundations: Load transfer mechanism, Pile capacity in various soil types, negative skin friction, group action, settlements, laterally loaded vertical piles.	7
V	Drilled Piers and Caissons: Design considerations, bearing capacity equations, Settlements, Lateral loads, Types of caissons, stability analysis.	4

VI	Machine Foundations: Free and forced vibration with and without damping, Elastic half space for rigid footings. Vibration analysis of foundations subjected to vertical, sliding and rocking modes, Design criteria for m/c foundations. Reinforced Earth: Materials and general considerations, Design and Stability.	8
Text Books		
1.	Joseph Bowles, "Foundation Analysis and Design", McGraw-Hill Book Company.	
2.	Braja M. Das, "Principles of Foundation engineering", PWS Publishing Company.	
3.	V.N.S. Murthy, "Advanced Foundation Engineering", CBS Publishers and Distributors.	
Reference Books		
1.	Physical and Geotechnical Properties of Soil, McGraw-Hill Book Company, 1985. Bowles	
2.	J.E., ASTM D 5882 – 07, Standard Test Method for Low Strain Impact Integrity Testing of Deep Foundations, American society for Testing and Materials.,	
3.	Dunnicliff, J. and Green, G.E, Geotechnical Instrumentation for Monitoring Field Performance, John Wiley & Sons, 1982.	
Useful web links		
1.	https://nptel.ac.in/courses/105108069	
2.	https://archive.nptel.ac.in/courses/105/103/105103182/	
3.	https://onlinecourses.nptel.ac.in/noc23_ce69/preview	
4.	https://nptel.ac.in/courses/105101083	

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	PEC 322 (L)					
Course Category	Program Elective - III					
Course title	**Airport Engineering**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		50	--	150
Pre-requisites (if any)	Geotechnical Engineering					
Course Rationale	The course deals with the development of planning for rural Society.					
Course Objectives	1. To know the fundamentals of Airport Engineering. 2. To determine the runway orientation, design of runway 3. To plan geometric design, and construction of various facilities. 4. To know the operational management of the Airport.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Develop the knowledge of Airport Engineering in the context of regional mass transportation systems 2. Design of Air transportation systems along with infrastructures required for Airports. 3. Estimate the environmental and other impacts impeded due to Airport projects. 4. Design of runway, taxiway, aprons and cargo facilities with pavement design.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	2	2	2	1				1	2	2
CO 2	2	3	3	3	3	2	2	2	1	2	2	2
CO 3	2	2	2	3	2	1	1	2				2
CO 4	2	2	2	1		2		1		1	1	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Introduction of Airport and Aircraft -** Characteristics of the aircraft, Airport requirements, site selection, layout plan and financial plan, Number of hours characteristics of Air Transportation, structure and organization, challenges and the issues, Airport master plan	6
II	**Demand Forecasting -** Forecasting air travel demand, Air freight demand.	5
III	**Geometric Design -** Geometric design of runway, taxiway, aprons, Design of passenger terminal, analysis of flow through terminals.	9
IV	**Pavement and Drainage Design -** Design of air cargo facilities, Airfield pavement and drainage design	9

V	**Lighting and Signalling -** Air traffic control lighting and signing. Configurations of airport, parking and apron –	5
VI	Airport capacity and configuration, parking configurations and apron facilities and Environmental Impacts Assessment of Airports.	5
Text Books		
1.	Khanna S.K., Arora M.G., Jain S.S., Airport Planning & Design, Nemchand Bros., Roorkee	
2.	Horenjeff Robert, The planning & Design of Airports, McGraw Hill Book	
3.	De Neufille Richard and Odoni Amedeo, Airport Systems Planning and Design, McGraw Hill	
Reference Books		
1.	Ashford Norman. J., Mumayiz Sakleh.A and Wright Paul.H., Airport Engineering Planning Design and Development of 21st Century Airports, John Wiley and sons	
2.	Wells, Alexander; Young, Seth, Airport Planning & Management, McGraw Hill	
Useful web links		
1.	http://acl.digimat.in/nptel/courses/video/105107123/L30.html	
2.	www.scilab.org	
3.	https://ocw.mit.edu/courses/transportation-courses	
4.	http://www.digimat.in/nptel/courses/video/105107123/L36.html	
5.	http://www.digimat.in/nptel/courses/video/105107123/L35.html	

Year, Program, semester	T.Y. Civil Engineering, semester VI						
Course Code	VSEC 322						
Course Category	Vocational Skill Enhancement Course						
Course title	**Computer Applications in Civil Engineering**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	--	-	02	02		02	
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**IE**	**EE**	**Total**
	--	-		50	--			50
Pre-requisites (if any)	--						
Course Objectives	1. To introduce students to computational methods and software applications relevant to civil engineering. 2. To enhance problem-solving skills using computer-based tools. 3. To familiarize students with the application of software in structural analysis, design, project management, and other civil engineering areas.						
Course Outcomes	Upon completion of this course, student should be able to – 1. Apply computer-based tools for analyzing and designing civil engineering structures. 2. Utilize software for project planning, scheduling, and management. 3. Develop simulations and models for various civil engineering applications. 4. Interpret and analyze data using appropriate computational methods.						

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1				3							1
CO2	1				3							1
CO3	1				3							1
CO4	1				3							1

Level of Mapping as: Low 1, Moderate 2, High 3

List of practical's (assignments)

Assignment **ONE** is compulsory and from remaining complete any ONE.

i) Computer-Aided Design (CAD) Software- **AutoCAD Architecture**

ii) Structural Analysis and Design Software- Etabs, STADD. Pro, SAP2000 (any ONE)

iii) Project Management and Estimation Software- **Primavera P6, Microsoft Project,** CostX (Any ONE)

iv) Interior and Visualization Software – **Lumion,** V-Ray, Enscape GIS and Land Planning Software

Assessment

Students should create models using modelling tools and commands, should learn the basic features. A brief report, drawings should be submitted at the end of the project and assessments will be based on the written documents submitted and the performance in internal oral examinations.

Recommended Books

1. Computer Applications in Civil Engineering" by S. P. Gupta and S. S. Gupta.
2. "Civil Engineering Applications of Remote Sensing and Geographic Information Systems" by A. M. Chandra and S. K. Ghosh.
3. "Structural Analysis and Design Software Documentation" (e.g., STAAD.Pro, ETABS manuals).
4. "Project Management Using Primavera" by P. K. Joy.
5. "AutoCAD Civil 3D for Engineers and Designers" by Prof. Sham Tickoo.

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	OEC 321					
Course Category	Open Elective –I					
Course title	**Optimization Technique**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		---	---	100
Pre-requisites (if any)						
Course Rationale	The purpose of this course is to develop a knowledge in the field of optimization techniques their basic concepts, principles. linear programming and queuing theory					
Course Objectives	Course teacher will 1. Impart knowledge on theory of optimization and conditions for optimality for unconstraint and constraint optimization problems 2. Inculcate modeling skills necessary to describe and formulate optimization problems in design and manufacturing 3. Familiarize with the working principle of optimization algorithms used to solve linear and non-linear problems 4. Train the students to solve optimization problems using software tools					
Course Outcomes	Students will able to 1. Formulate the engineering problems as an optimization problem. 2. Apply necessary and sufficient conditions for a given optimization problem for optimality 3. Select appropriate solution methods and strategies for solving an optimization problem and interpret and analyse the solution obtained by optimization algorithms 4. Solve Engineering Design and Manufacturing related optimization problem using software tools.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	3	1	2	2	2	1			1	1	1
CO 2	3	3	1	2	2	2	1			1	1	1
CO 3	3	3	2	2	3	1	2	1	1	1	1	1
CO 4	3	3	2	2	3	1	1	1	1	1	1	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**INTRODUCTION :** Concept of optimization – classification of optimization – problems	7
II	**LINEAR PROGRAMMING :** Examples of linear programming problems – formulation simplex methods variable with upper bounds – principle- duality -dual simplex method -	7

	sensitivity analysis – revised simplex procedure – solution of the transportation problem – assignment – network minimization – shortest route problem – maximal two problem – L.P. representation of networks.	
III	**QUEUING THEORY:** Queuing Model, poison and exponential distributions -Queues with combined arrivals and departures-random and series queues.	7
IV	**UNCONSTRAINED OPTIMIZATION :** Maximization and minimization of convex functions. Necessary and sufficient conditions for local minima – speed and order of convegence – unibariate search – steepest and desent methods- metcher reeves method -conjugate gradient method.	7
V	**CONSTRAINED OPTIMIZATION :** Necessary and sufficient condition – equality constraints, inequality constraints -kuhu – tucker conditions – gradient projection method – penalty function methods – cutting plane methods of sibel directions.	6
VI	**COMPUTER APPLICATION :** Implementing optimization algorithms in Matlab / R/ Python/MS Excel environment and solving linear, non-linear, multi- objective un constrained and constrained optimization problems.	5
Text Books		
1.	Rao S.S,"Optimization – Theory and applications", Wiley Easter Ltd., 1979.	
Reference Books		
1.	David G.Luerbeggan, "Introduction to Linear and Non Linear Programming", Addison Wesley Publishing Co. 1973.	
2.	Hadley G. "Nonlinear and – dynamic programming" Addison Wesley Publishing Co. 1964.	
3.	Cordan C.C. Beveridge and Robert S. Schedther, "Optimization, Theory and Practice" McGraw Hill Co.1970	
4.	HarndyA.Tahh. "operations Research, An Introduction", Macmillan Publishers Co.NewYork, 1982.	
5.	Beightferand S. others, "Foundations of Optimization Pill", New Delhi, 1979.	
Useful web links		
1.	https://onlinecourses.nptel.ac.in/noc21_ce60/preview	

Year, Program, Semester	T.Y. Civil Engineering, Semester V					
Course Code	OEC 321					
Course Category	Open Elective I					
Course title	**Solid Waste Management**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		---	---	100
Pre-requisites (if any)	Environmental Studies					
Course Rationale	This course deals with problems related to waste management and an overview of municipal solid waste, industrial waste and plastic waste management. Students will be able to explain planning and engineering principles needed to address the growing and increasing problems of refuse. Students will understand different treatment technologies for waste to energy and disposal options. Students will be able to describe various legislations in waste management.					
Course Objectives	1. Understand importance of waste management for sustainable development. 2. Know consequences of various types of pollutions, and effects of it on human health, Socio economic problems, climate and marine environment. 3. Know utilization of waste effectively by applying waste to energy concept.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Discuss various sources, types, classification of solid waste, importance of waste management, waste suitable for energy production 2. Explain waste generation, storage, collection, separation, transportation and processing of waste. 3. Describe characteristics of solid waste and different treatment methods to recover energy from waste, densification of solids 4. Summarize various legislations in waste management and integrated waste management system.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1			2	2					2		2	
CO 2		2					2					
CO 3						2	2					
CO 4						2				2	2	

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Definition of waste and importance of waste management, Classification and types of solid waste, Important quality parameters of solid wastes, Solid waste suitable for energy recovery.	5
II	Solid waste generation, storage, collection, segregation and processing, transfer and transport, disposal methods of waste.	7

III	Characterization of solid wastes: Physical, Chemical, Proximate analysis, Leaching properties, Energy content, Heating value.	8
IV	Waste to Energy Technologies: Need of energy recovery from wastes, Routes of energy production from waste, Energy production from Organic Waste: Composting, Vermicomposting, Anaerobic digestion and biogas production from organic waste, anaerobic digester and types.	7
V	Energy recovery: Plastic waste generation and need for proper management of plastic, Classification of plastic, Suitability for energy production, Common steps for converting waste plastic to fuels. E-waste: E-waste Management overview, Recovery of materials, Recovery of Metals, E-waste regulatory frameworks in India, Overview of Electronics and LCA	6
VI	Integrated Solid Waste Management (ISWM) Integrated solid waste management, Principles of waste hierarchy, Waste prevention and reduction, Reuse, Recycling. Swachh Bharat Abhiyan, Legislations in Waste Management: Solid Waste Management Rules 2016, Hazardous solid Wastes Management, Plastic Waste Management Rules 2016, Extended Producer's Responsibility	6
Text Books		
1.	Tchobanoglous, G. and Kreith, F., "Handbook Of Solid Waste Management", McGraw Hill, 2002, 2nd Edition	
2.	Tchobanoglous, G., Theisen and Vigil., "Integrated Solid Waste Management: Engineering Principles and Management Issues,", McGraw Hill, 1993	
3.	Ni –Bin Chang., "Sustainable solid waste management: A Systems Engineering Approach" ,Wiley 1st ed, 2015	
Reference Books		
1.	Donald R. Rowe, George Tchobanoglous, and Howard S. Peavy, "Environmental Engineering", McGraw Hill Education.	
2.	Christensen, H. T, "Solid Waste Technology & Management", Wiley, 2010, Volume 1 & 2	
3.	Nicholas P Cheremisinoff, "Handbook of Solid Waste Management and Waste Minimization Technologies", Butterworth Heinemann An imprint of Elsevier	
4.	Municipal Solid Waste Management Manual, 2016 by CPHEEO	
Useful web links		
1.	https://archive.nptel.ac.in/courses/105/105/105105160/	
2.	https://archive.nptel.ac.in/courses/105/105/105105184/	
3.	https://archive.nptel.ac.in/courses/105/105/105105169/	

Year, Program, Semester	T.Y. Civil Engineering, Semester V					
Course Code	OEC 321					
Course Category	Open Elective I					
Course title	**Green Building**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		---	---	100
Pre-requisites (if any)	Elements of Civil and Electrical Engineering, Environmental Studies					
Course Rationale	The course is imparting fundamental knowledge of sustainable site selection, passive and active architecture, green rating of building, water efficiency, water efficient landscaping, indoor environmental quality, recycling of building materials					
Course Objectives	1. To understand the importance and necessity of green building. 2. To study various technologies for waste management. 3. To identify materials and technologies to improve energy efficiency of building. 4. To learn the various rating systems for green building.					
Course Outcomes	Upon completion of this course, student should be able to – 1. Explain the importance and necessity of green building 2. Identify the recent techniques of water conservation and waste management. 3. Choose materials and technologies to improve energy 4. Interpret the various rating systems for green building.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3						3					
CO 2	2	1										2
CO 3	3	2	2									
CO 4						3						

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Introduction: Concept of green building, History of green building, Need of green building in present scenario, Importance of green building, merits and demerits. Green Rating of building: LEED India and GRIHA (Green Rating for Integrated Habitat Assessment), Introduction to IGBC (Indian Green Building Council) standard, Study of existing green buildings. Concept of CDM and Carbon trading, Energy audit and Water Audit of building, Concept of Life cycle analysis	6
II	Sustainable Site Selection: Soil erosion and pollution control measures, alternate transportation strategies, storm water management, reduction of heat island effect, minimizing night sky pollution. Concept of Passive and Active Architecture: Natural ventilation and air conditioning, Hybrid system of active and passive air conditioning.	7
III	Indoor Environmental Quality for Occupant Comfort and Wellbeing: Day lighting, air ventilation, exhaust systems, low VOC paints and adhesives Alternate energy sources: Significance and utilization of solar energy, wind energy, biomass and bio-fuel for Green rating system of building.	7

	Comparison of various lighting devices: electric tubes, incandescent lamps, CFL and LED lamps.	
IV	Water conservation and efficiency: Water Efficient Landscaping –Rain water harvesting, potable water and bore well recharging methods. Minimization of water use: Dual flush, waterless urinals, smart controlled water taps, low-flow fixtures	6
V	Segregation and treatment of wastewater: on-site treatment systems, greywater recycling, constructed wetlands, bio retention system Domestic solid waste: Segregation, earthworm composting and various options for solid waste management.	7
VI	Building materials: Concept of Embodied Energy, Embodied energy of various common building materials, Thermal properties of building components: Thermal storage, emissivity, reflectivity. Selection of materials and surface treatment for improvement in thermal comfort with minimum energy input. Green building materials and products: Bamboo, Rice husk ash concrete, plastic bricks, Bagasse particle board etc Use of materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, foundry sand, other inert solid wastes in buildings, Reuse of waste and salvaged materials	6
Text Books		
1.	Miki Cook, Doug Garrett., "Green Home Building: Money-Saving Strategies for an Affordable, Healthy, High-Performance Home", New Society Pub	
2.	Charles J. Kibert., "Sustainable Construction: Green Building Design and Delivery, 5th Edition", Wiley / BSP Books	
Reference Books		
1.	IGBC., "Introduction to Green Buildings & Built Environment", BS Publications / BSP Books	
2.	Mili Majumdar., "Energy-efficient buildings in India", TERI press	
3.	Indian Railways Institute Of Civil Engineering. "Fundamentals Of Building Orientation And Green Building Features John Wiley, 1966, New York.	
4.	Sam Kubba., "Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes" , Butterworth-Heinemann	
Useful web links		
1.	https://archive.nptel.ac.in/courses/105/102/105102195/	
2.	https://archive.nptel.ac.in/courses/124/107/124107011/	

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	OEC 311 (L)					
Course Category	Open Elective - I					
Course title	**Developments in Engineering**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**
	3	-	-	3		3
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	30	70		---	--	100
Pre-requisites (if any)	Building Planning and Design.					
Course Rationale	The course deals with the development of planning for rural Society.					
Course Objectives	1. To familiarise the characteristics of rural Society and the Scope, Nature and Constraints of rural Development 2. To provide an exposure to implications of 73rdCAA on Planning, Development and Governance of Rural Areas 3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals 4. To familiarise the Nature and Type of Human Values relevant to Planning Institutions					
Course Outcomes	Upon completion of this course, student should be able to – 1. Demonstrate understanding of knowledge for Rural Development. 2. Prepare solutions for Management Issues. 3. Take up Initiatives and design Strategies to complete the task 4. Develop acumen for higher education and research.					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3	2	1	3	2						2	2
CO 2	2	3	3	3	3	2	2	2	1	2	2	2
CO 3	2		2	3	2	1	1	2				2
CO 4	2	2	2			2					1	2

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Introduction Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development. Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	8
II	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	6

III	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Database for local planning; Need for decentralized planning; Sustainable rural development	7
IV	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	4
V	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom	9
VI	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	5
Text Books		
1.	ITPI, Village Planning and Rural Development, ITPI, New Delhi.	
2.	Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai.	
3.	GoI, Constitution (73rdGoI, New Delhi Amendment) Act, GoI, New Delhi.	
4.	Planning Commission, Five Year Plans, Planning Commission.	
5.	Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi.	
6.	Planning Guide to Beginners.	
Reference Books		
1.	Weaver, R.C., The Urban Complex, Doubleday.	
2.	Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington	
3.	How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150	
4.	Watson, V. Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407	
Useful web links		
1.	https://archive.nptel.ac.in/courses/106/106/106106156/	
2.	https://nptel.ac.in/courses/112107217	

Year, Program, Semester	T.Y. Civil Engineering, Semester VI					
Course Code	ELC (PR 321)					
Course Category	Experiential Learning Course: Project					
Course title	**Major Project –I (Project)**					
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**	
	-	-	2	2	1	
Evaluation Scheme	**ISE**	**ESE**		**IE**	**EE**	**Total**
	---	---		---	50	---
Pre-requisites (if any)	The prerequisite for this course is to possess the fundamental knowledge of Civil Engineering					
Course Rationale	The projects help students in different ways like the formation of groups, understanding group behavior, improving communication skills, learning in-depth within minimum time, interaction with the guide and outside agencies and arriving at the best technical solution.					
Course Objectives	1. To carry out extensive literature survey on the research topic 2. To identify the problem statement for the research work. 3. To decide methodology for the research work. 4. To carry out initial mathematical modeling or experimental set up.					
Course Outcomes	1. perform extensive literature survey and identify research topic of work 2. identify the problem statement for the research work 3. Decide methodology for the research work. 4. carry out mathematical modeling or experimental program for the proposed work					

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3		1	1	2	2	1	1	1	2	1	
CO 2				2	2	2	2	1	1	2	1	1
CO 3		1	2	3	3	2	3	3	1	3	1	3
CO 4	3	3	3	3	3	2	3	3	3	3	3	3

Level of Mapping as: Low 1, Moderate 2, High 3

Sr. No.	Course Content
I	**Project Topics**: Project topics should preferably focus on design, development, design aids, experimental analysis and interdisciplinary areas, with an emphasis on eco-friendly, sustainable solutions and addressing societal problems. The projects should aim at training the students in going through all important phases of project studies starting from establishing the need through collection of data, analysis, design, development, drawing, cost estimates and project reports, where appropriate some alternatives which meet the same needs should also be considered and evaluated using appropriate evaluation criteria.

II	A project group shall consist of a minimum of three and a maximum of five students. The group is required to conduct a literature survey, formulate the problem, and develop a methodology to arrive at a solution. During the first stage of the project, students will identify a topic related to engineering and carry out a necessary literature review. Based on this review, students will prepare a report that includes a review of literature, problem formulation, and the methodology to be adopted. The synopsis/report will be presented in a seminar and evaluated at the end of the term by a panel of internal and external examiners. The project work may include the following components: 1. Problem Formulation 2. Literature Survey 3. Experimental Investigation / Data Collection 4. Design and Fabrication of a Model 5. Industrial Assignment
III	The Internal Continuous Assessment shall be conducted once during the semester. A committee comprising three examiners, including the project guide, nominated by the coordinator, will review the project work once before the finalization of the synopsis. The project assessment will be conducted at the end of the semester by a committee consisting of one external expert, one faculty member from the department, and the project guide. Students will present their project work before this committee. A minimum ten-page typed report**,** excluding photographs, based on the work done, must be submitted in the prescribed format to the assessing committee. The committee will evaluate the individual students and award marks accordingly. Each project guide shall be allotted a maximum of two groups for supervision. For workload calculations, a minimum of 2 hours per week is allocated for guiding one group of four to five students, as per AICTE guidelines**.**

<table>
<tr><td>Year, Program, Semester</td><td colspan="6">T.Y. Civil Engineering, Semester VI</td></tr>
<tr><td>Course Code</td><td colspan="6">MAC 321</td></tr>
<tr><td>Course Category</td><td colspan="6">Mandatory Audit Course</td></tr>
<tr><td>Course title</td><td colspan="6">Research Methodology (Theory)</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td>Total Credits</td></tr>
<tr><td>1</td><td>-</td><td>-</td><td colspan="2">1</td><td>1</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td colspan="2">ESE</td><td>IE</td><td>EE</td><td>Total</td></tr>
<tr><td colspan="2">---</td><td colspan="2">---</td><td>---</td><td>---</td><td>---</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="6">--</td></tr>
<tr><td>Course Rationale</td><td colspan="6">This course introduces students to key aspects of research, emphasizing the details of formal research practices and addressing common misconceptions. By completing the course, students will develop a structured and systematic approach to conducting research from the outset.</td></tr>
<tr><td>Course Objectives</td><td colspan="6">1. Develop a clear understanding of research concepts, including literature review, experimental design, data analysis, and modeling techniques, to conduct systematic and well-structured research.
2. Improve technical writing and presentation abilities to effectively communicate research findings through reports, papers, and presentations.
3. Cultivate creativity in research while adhering to ethical principles, ensuring responsible conduct in experimental work, data handling, and intellectual property rights.
4. Explore research applications in civil engineering, including experimental skills, design of experiments, and domain-specific challenges, to develop problem-solving and innovation capabilities.</td></tr>
<tr><td>Course Outcomes</td><td colspan="6">Upon completion of this course, student should be able to –
1. Develop a clear understanding of research concepts, including literature review, experimental design, data analysis, and modeling techniques, to conduct systematic and well-structured research.
2. Improve technical writing and presentation abilities to effectively communicate research findings through reports, papers, and presentations.
3. Cultivate creativity in research while adhering to ethical principles, ensuring responsible conduct in experimental work, data handling, and intellectual property rights.
4. Explore research applications in civil engineering, including experimental skills, design of experiments, and domain-specific challenges, to develop problem-solving and innovation capabilities.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO 1	3		1	1	2	2	1	1	1	2	1	
CO 2				2	2	2	2	1	1	2	1	1
CO 3		1	2	3	3	2	3	3	1	3	1	3
CO 4	3	3	3	3	3	2	3	3	3	3	3	3

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	A group discussion on what is research; Overview of research	2

II	Literature survey, Experimental skills, Data analysis, Modelling skills	3
III	Technical writing; Technical Presentations	2
IV	Creativity in Research, Ethics in Research Week	2
V	Design of Experiments	2
VI	Intellectual Property, Civil Engineering specific research discussions	2
Text Books		
1.	Kumar, R., 2019, Research Methodology: A Step-by-Step Guide for Beginners, SAGE Publications, 78-9389093014.	
2.	Kothari, C. R. Garg, G., Research Methodology: Methods and Techniques, 5th Edition, New Age Int. Publisher, 978-9389802559.	
Reference Books		
1.	Neuman, W. L., 2013, Social Research Methods: Qualitative and Quantitative Approaches. Pearson, 978-0205914191.	
2.	Bryman, A., & Bell, E., 2015, Business Research Methods, Oxford University Press, 978-0199668649.	
3.	Creswell, J. W., & Creswell, J. D., 2017, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications, 978-1506386763.	
Useful web links		
1.	https://onlinecourses.nptel.ac.in/noc24_ge21/preview	
2.	https://www.researchgate.net/topic/Research-Methodology	
3.	https://www.coursera.org/learn/research-methods	
4.	https://www.socialresearchmethods.net/kb	

Year, Program, Semester	T.Y. B.Tech (Civil Engineering) , Part III, Semester VI			
Course Code	MAC322			
Course Category	Mandatory Audit Course			
Course title	**Aptitude Enhancement Course III**			
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**
	-	**01**	**-**	**01**
Evaluation Scheme	IE at Course in charge end			
Pre-requisites (if any)	Basic Mathematical Concepts			
Course Objectives	The Course is aimed to- 1. Equip students with techniques for solving quantitative aptitude problems like interest and mixture. 2. Enhance logical reasoning abilities, including decision-making and assertion-reason analysis. 3. Develop skills to calculate and apply geometric areas, volumes, and surface areas in problem-solving. 4. Introduce fundamental concepts of probability and statistics for solving quantitative problems. 5. Strengthen abilities to solve time-based problems, improving speed and accuracy. 6. Train students to recognize and solve logical sequences and patterns in reasoning and mathematics.			
Course Outcomes	Upon completion of this course, student should be able to – 1. Solve quantitative aptitude problems related to Boats and Streams, Trains, Mixtures, and Interest calculations effectively. 2. Develop logical reasoning skills for problems like decision-making, number ranking, and time sequence tests. 3. Calculate areas, volumes, and surface areas of geometric shapes and apply them to practical problems. 4. Apply probability and statistical analysis in solving real-world problems like stocks, shares, and series. 5. Solve time-based problems involving calendars, clocks, and distances, enhancing time management skills. 6. Master advanced techniques in Permutations, Combinations, and other mathematical concepts for higher-level exams.			

Course Outcome and Program Outcome Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1								1		1
CO 2	3	1								1		1
CO 3	3	1								1		1
CO 4	3	1								1		1
CO5	1									1		1
CO6	1									1		1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Quantitative Aptitude 1 :** Boats and Streams, Problems on Trains, Allegation or Mixture, Simple Interest.	2
II	**Quantitative Aptitude 2 :** Compound Interest, Area, Volume and Surface Area, Races and Games of Skill.	2
III	**Quantitative Aptitude 3 :** Calendar, Clocks, Stocks and Shares, Permutations and Combinations.	2
IV	**Quantitative Aptitude 4 :** Probability, True Discount, Banker's Discount, Heights and Distances, Odd Man Out and Series.	2
V	**Logical Reasoning 1 :** Number ranking and time sequence test, Decision making, Assertion and reason, Situation reaction Test.	2
VI	**Logical Reasoning 2 :** Mathematical Operations, Inserting the missing one, logical sequence of words.	2
General Instructions: Each Student has to write at least 6 assignments on entire syllabus.		
Reference Books		
i)	Dr. R S Aggarwal — Quantitative aptitude, S. Chand Publication.	
ii)	R V Praveen — Quantitative aptitude and logical reasoning, 2nd Edition, PHI Publication.	
Assessment		
	Assessment will be done by Course Teacher. MCQ Test can be conducted based on the syllabus.	

Shivaji University

VidyaNagar, Kolhapur, Maharashtra 416004

Department of Technology

As per NEP2020 guidelines

B.Tech. (Civil Engineering Minors (Multi-disciplinary) Curriculum Structure
2024-25 onwards

Multidisciplinary Minor
In
Plumbing Technology
For
B.Tech. (Civil Engineering)

Shivaji University, Kolhapur
Department of Technology

B.Tech. (Civil Engineering), Multidisciplinary Minor in Plumbing Technology

Teaching and Evaluation Scheme

S.N.	Category	Code	Course Title	Hours per week			Contact Hours	Credits	Evaluation Scheme	
									Theory	Practical
				L	T	P			ISE:ESE	IE:EE
1	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	MDM-1.1 (MDM 221)	Plumbing Terminology and Hydraulics (Sem IV)	03	-	-	03	03	30:70	00:00
2		MDM-1.2 (MDM 311)	Pumps and Hydro Pneumatic System (Sem V)	03	-	-	03	03	30:70	00:00
3		MDM-1.3 (MDM 321)	Plumbing Estimating and Costing (Sem VI)	03	-	-	03	03	30:70	00:00
4.	Minor Program Based Internship	MDM 1.4	Plumbing Industry Internship*	One Month Internship				03	-	50:50
5.	Project Based Learning	MDM 1.5	Mini Project*	-	-	-	-	02	-	50:50
				-	-	-	-	**14**	**300**	**200**
			Total Hours	**09**	**00**	**00**	**09**	-	-	-

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

Multidisciplinary Minor I: Plumbing Technology

Year, Program, Semester	Multidisciplinary Minor I, Semester IV						
Course Code	MDM 1.1 (MDM 221)						
Course Category	Specialization Minor Program Core						
Course title	**Plumbing Terminology and Hydraulics (Theory)**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	3	-	-	-		3	
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	30	70		---	---	---	---	---
Pre-requisites (if any)	The prerequisite for this course is to possess the fundamental knowledge of Hydraulics plumbing drawings pressure calculation.						
Course Rationale	This course prepares students for successful careers in the plumbing industry and related fields. It ensures that they have the essential knowledge and skills to perform their roles effectively and safely, contributing to their overall professional development and the integrity of the plumbing trade.						
Course Objectives	1. To provide students necessary knowledge and skills in Terminology related to Plumbing systems. 2. To carry out design of various plumbing items 3. To understand procedure of Plumbing systems design and execution.						
Course Outcomes	Upon completion of this course, student should be able to – 1. Design of plumbing projects 2. Prepare layouts of various plumbing engineering works and calculate flow rates for various items of plumbing. 3. Prepare water distribution and sanitary works report for plumbing engineering works.						

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3										1	1
CO 2	1	3	3	3	3	2	2	2	1	2	2	1
CO 3	2		2	3	1	1	1	1				1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Introduction**: Introduction to Plumbing Terminology viz. Bleed, Brass, Branch Drain, Effluent, Fitting, Flow Rate, Gallons per Flush (GPF), Gray Water, KiloPascal (kPa), Maximum Containment Level (MCL), Non-Ferrous, Potable, Pressure Head, Riser, Sediment, Soil Pipe, Trap Seal, Trap Weir, Water Hammer, Aerator, Ball Check Valve, Closet Bend, Closet Flange, Flow Control Valve, Gasket, Interceptor, Main, Manifold, O-Ring, Scald Guard, Shutoff Valve, Tee, Trap, Valve Seat, Vent, Water Hammer Arrestor, Wye Fitting, ABS, Auger, Blowbag, CPVC, Dope, Polybutylene (PB), Polyethylene (PE), PEX, Plumber's Putty, Plunger, PVC, Snake, Teflon Tape, Absorption Field, Leach Line, Septic Tank.	7

II	**Pressure and related factors in Plumbing** : friction factor, pressure drop for flow of non-compressible and compressible fluids (Newtonian Fluids), pipe line sizing, economic velocity. Pipeline networks and their analysis for flow in branches, restriction orifice sizing. Non-Newtonian fluids – types with examples, pressure drop calculations for Non-Newtonian fluids.	7
III	**Basics of Water supply & Distribution**: Preliminary Information, Identify Possible source, Water Treatment, Water Storage tank, Water Supply System, Water Supply Requirements for Buildings, Probable simultaneous demand, Hydro Pneumatic system, Over Head Tank Distribution, The Distribution system in respect of Gravity system for a Multi storeyed Building, Distribution system in respect of Hydro-Pneumatic system for a Multi-storeyed Building.	7
IV	**Water Supply and Distribution Systems:** Hot and Cold water systems, Identification of Potable and Non-potable water systems, Unacceptable Connections, Atmospheric Vacuum Breaker (AVB), Hose Connection Backflow Preventer, Parallel water Distribution, Pressure Reducing Valves, Water and Sewer line separation, Water hammer and Air Chamber air cushion depletion.	6
V	**Plumbing Fixtures, Fittings, Appliances and Appurtenances :** Plumbing Fixtures, Maximum Flow rate, Water Closet and Urinal Integral Traps, Types of Water Closets, Squatting Pans (Asian/Indian WC), Squatting Pan Trap, Bidet, Urinals, Non-water Urinals, Wash Basin, Shower, Bath Tubs, Trough Urinals, Plumbing Fittings, Metered Faucets, Emergency Showers, Standard Heights, Modern Installations, Appliances, Cloth Washer and Dishwasher, Valves.	6
VI	**Sanitary Drainage :** One pipe - partially vented system, tem- One pipe fully vented system, Two pipe system, Single stack system, Single Stack With Sovent, Materials for drainage piping, Plastic DWV Fittings, Clay Pipe, Stainless steel pipe and fittings, Cast-iron pipe and fittings, Cast Iron Joining Methods, Drainage Fixture units (DFU), Emergency Use Floor Drain, Receptor (Floor Sink), Kitchen Sink, Fixture Connections, Cleanouts, Grade of Horizontal Drainage Piping, Gravity Flow To Sewer, Back Water Valve, Testing The piping of the plumbing drainage, Smoke Test, Water Test.	6
Text Books		
1.	"Water Supply And Sanitary Engineering", By Rangwala,- Charotar Publishing house, 30th Edition 2022.	
2.	Prof. Subhash Patil- Jain Book Depot " Plumbing Engineering"	
3.	A Guide To Good Plumbing Practices- India Plumbing Association.	
4.	Plumbing Design & Practice, 2nd Edition-By : S.G. Deolalikar Publisher : McGraw-Hill Education.	
Reference Books		
1.	Standard specifications volumes I and II (PWD Maharashtra) Govt. of Maharashtra	
2.	CPWD Specifications	
3.	CPWD Schedules of Rates	
4.	PWD Hand Book and Red Book	
5.	RETS (Railway Engineering Technical Society)-Plumbing and Pipe Line Work.	
Reference Codes		
1.	India Plumbing Association 2017 Uniform Illustrated Plumbing Code	
2.	National Building Code of India – Guidelines for regulating the building construction activities	

Useful web links	
1.	https://www.youtube.com/watch?v=kQ871qgdsm4
2.	http://swayam.gov.in/

Year, Program, Semester	Multidisciplinary Minor I, Semester V							
Course Code	MDM 1.2 (MDM 311)							
Course Category	Specialization Minor Program Core							
Course title	**Pumps and Hydro Pneumatic System (Theory)**							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**		
	3	-	-	-		3		
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	30	70		---	---	---	---	---
Pre-requisites (if any)	The prerequisite for this course is to possess the fundamental knowledge of Hydraulics plumbing drawings pressure calculation.							
Course Rationale	This course prepares students for successful careers in the plumbing and water supply industries. It ensures that they possess the advanced knowledge and skills required to design, install, maintain, and troubleshoot these critical systems, fostering their professional development and contributing to the overall efficiency and sustainability of water distribution networks.							
Course Objectives	1. To provide students necessary knowledge and skills in selection of pump for different types of plumbing works. 2. To carry out selection of pumps for various plumbing items 3. To understand procedure of design of Hydro Pneumatic system.							
Course Outcomes	Upon completion of this course, student should be able to – 1. Selection of pumps based on requirement on site. 2. Prepare design for various plumbing engineering works by using Hydro Pneumatic system. 3. Prepare project report for pump requirement in plumbing engineering works.							

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	1	1	1						1	1
CO 2	1	3	3	1	1						2	1
CO 3	2		2	2	2	2	2	2	2	2	2	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	**Various Types of Pumps for Water Supply along with their merit and demerit :** Submersible Pumps, ,Vertical Pumps, Grinder, Slicer and Vortex Pumps, Dry Well Pumps, End-Suction Centrifugal Pumps, Condensate Return Pumps, Diaphragm pumps, Hydraulic pumps, Reciprocating pumps, Positive displacement pump, Dynamic pumps, Booster pumps, Peristaltic pumps, Axial-flow pump.	7
II	**Various Types of Pumps for waste water dewatering and sewage along with their merit and demerit.**: centrifugal, progressive cavity, and positive displacement, Mobile Dewatering/Flood Control Unit, Vertical Inline Pump, Submersible Sewage Dewatering Pump, Non-clog Submersible Pump.	7

III	Pressure boosting and Hydro-pneumatic systems: Definition and operating principles. Necessity operation and benefits deriving from the use of pressure boosters. Simple Design of Hydro-pneumatic system.	7
IV	**Accessories and controls of Pumping Systems:** Pressure Relief Valve, Float switch, Foot Valve, Strainer, Pressure gauge, Nozzle, Pressure regulators, Anti-Siphon Injection Valve, In-Line Check Valve, Feed Indicator.	6
V	**Design of Pumps and calculating pump Capacities :** System Characteristics, Pump Curves, Factors Affecting Pump Performance, Effect of over sizing the pump, Energy loss in throttling, Effect of speed variation, Energy Conservation Opportunities in Pumping Systems,	6
VI	**Design of different types of pumping systems** required on basis of application for multistoried residential Building (G+7).	6
Text Books		
1.	Bureau of Energy Efficiency- Pumps And Pumping System	
2.	Prof. Subhash Patil- Jain Book Depot " Plumbing Engineering"	
3.	A Guide To Good Plumbing Practices- India Plumbing Association.	
4.	Pumps: Theory, Design and Applications- by Sahu G.K.-New Age International, Publishers.	
Reference Books		
1.	National Building Code of India – Guidelines for regulating the building construction activities	
2.	Bureau of Energy Efficiency- Energy performance Assessment Of water Pumps.	
3.	ASHRAE Handbook -- HVAC Systems and Equipment Chapter: Centrifugal Pumps.	
Reference Codes		
3.	National Building Code of India – Guidelines for regulating the building construction activities	
Useful web links		
1.	http://acl.digimat.in › nptel › courses › video	
2.	http://swayam.gov.in/	

Year, Program, Semester	Multidisciplinary Minor I, Semester VI						
Course Code	MDM 1.3 (MDM 321)						
Course Category	Specialization Minor Program Core						
Course title	**Plumbing Estimating and Costing (Theory)**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	3	-	-	-		3	
Evaluation Scheme	**ISE**	**ESE**	**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	30	70	---	---	---	---	---
Pre-requisites (if any)	The prerequisite for this course is to possess the fundamental knowledge of Plumbing material specifications, building/structural/Plumbing drawings.						
Course Rationale	This course prepares students for successful careers in the plumbing industry. It ensures they possess the advanced knowledge and skills required to accurately estimate project costs, prepare competitive bids, manage project budgets, and control costs, thereby contributing to the financial success and sustainability of plumbing projects and businesses.						
Course Objectives	1. To provide students necessary knowledge and skills in estimation of Plumbing works 2. To carry out rate analysis of various plumbing items 3. To understand procedure of tenders and contracts						
Course Outcomes	Upon completion of this course, student should be able to – 1. take out of quantities for various plumbing projects 2. prepare estimates for various plumbing engineering works and calculate rates for various items of construction 3. draft specifications and tender notice 4. prepare valuation report for plumbing engineering works						

Course Outcome and Program Outcome Mapping

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	1	3	1						1	1
CO 2	1	3	3	3	3	2	2	2	1	2	2	1
CO 3	2		2	3	1	1	1	1				1
CO 4	2	1	2			1	1	1	1	1	1	1

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Introduction**: Purpose of quantity estimates, Types of estimates, Various items to be included in estimates, Modes of measurement and units of measurement as per codal provision IS1200,** 2017 Uniform Illustrated Plumbing Code – India and National Building Code (NBC). Administrative approval and Technical sanction to estimates, Introduction to DSR (District Schedule Rate) and CSR(Common Schedule of Rates) **Specifications**: Purpose, basic principles, general and detailed specifications for various items related to plumbing.	7
II	**Measurement of Quantities**: Measurement sheet and abstract sheet of water supply and sanitary items including fitting and fixtures used in Plumbing engineering.	7

	Analysis of rates, Factors affecting cost of an item work, materials, sundries, labour, tools and plant, overheads and profit. Task work- Definition and factors affecting task work. Analysis of rates of items related to plumbing. Prime cost, Provisional sum and provisional quantities	
III	**Detailed Estimation**: Water supply line, Rising main, distribution network, waste water line, septic tank, GSR- Ground storage Reservoir, ESR-Elevated storage Reservoir, Culverts, earthwork for canals. Roads including hill roads and other plumbing engineering works.	7
IV	**Tenders (Bids):** Meaning, Categories, Tender notice, Notification in press and media, e-procurement	6
V	**Contracts:** General idea, Types of contracts viz: lump-sum, item rate, percentage rate, cost plus	6
VI	**Advanced Plumbing and Sanitary gadgets and their costing –** Vacuum toilets, Jacuzzi, Rain Shower, compact savage treatment plants, water efficient faucets, copper piping.	6
Text Books		
1.	S. C. Rangwala, "Elements of Estimating and Costing", Charotar Publishing house, 4th edition, 2014.	
2.	B.N. Dutta, "Estimating and costing", Dhanpat Rai and sons, 28th edition, 2016.	
3.	P.L. Bhasin and S. Chand, "Quantity Surveying", 3rd Revised edition, 1987.	
4.	B.S. Patil "Civil Engineering Contracts and Estimates", Universities Press Private Ltd, 4th edition, 2015.	
5.	G.S. Birdie, "Estimating and Costing", Dhanpat Rai and Sons, 6th edition, 2005.	
6.	Prof. Subhash Patil- Jain Book Depot " Plumbing Engineering"	
Reference Books		
1.	Standard specifications volumes I and II (PWD Maharashtra) Govt. of Maharashtra	
2.	CPWD Specifications	
3.	CPWD Schedules of Rates	
4.	PWD Hand Book and Red Book	
5.	PWD Schedule of Rates – Latest	
Reference Codes		
1.	India Plumbing Association 2017 Uniform Illustrated Plumbing Code	
2.	National Building Code of India – Guidelines for regulating the building construction activities	
Useful web links		
1.	http://swayam.gov.in/	

Year, Program, Semester	Multidisciplinary Minor I, 4th Semester onwards						
Course Code	MDM 1.4						
Course Category	Program Based Internship						
Course title	**Plumbing Industry Internship**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**	**Total Credits**		
	One Month				03		
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	The Industrial Internship course caters specifically to B.Tech Civil Engineering students pursuing additional specialization through the B.Tech Minor program in areas such as Plumbing Engineering. This course offers practical exposure to industry settings aligned with their chosen sub-specialization, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in specialized sectors of Civil engineering.						
Course Objectives	The course teacher will 1. Help expose students to the 'real' working environment. 2. Promote hands-on experience to the students' in their related field. 3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society. 4. Assist in providing the opportunity for students to test their interest in a particular career before permanent commitments are made. 5. Elaborate the dynamic and challenging nature of industrial environments.						
Course Outcomes	Upon completion of this course, student should be able to 1. Understand industrial processes and operations related to their minor sub-specializations. 2. Apply theoretical concepts to solve practical problems in the industry. 3. Communicate effectively with industry professionals, colleagues, and supervisors. 4. Collaborate efficiently in team environments to complete tasks and projects. 5. Adapt to the dynamic and challenging nature of industrial environments. 6. Reflect on internship experiences for personal and professional growth.						

Course Outcome and Program Outcome Mapping

CO/PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	3
CO6	-	-	-	-	-	-	-	-	-	-	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content	Hours
The course consists of a one-month internship in a relevant specialized industry. Students will be placed in companies or organizations that align with their chosen sub-specialization within the field of Civil engineering. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots 4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.
The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
  - Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.
  - Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.
- **External Evaluation (50 marks):**

Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.

The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

Reference Books

1.	India Plumbing Association 2017 Uniform Illustrated Plumbing Code
2.	National Building Code of India – Guidelines for regulating the building construction activities

Year, Program, Semester	Multidisciplinary Minor I, 4th Semester onwards						
Course Code	MDM 1.5						
Course Category	Project Based Learning						
Course Title	**Mini Project**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	-	-	-	-		02	
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.						
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this mini project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena in green aspects of Industry.						
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.						
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.						

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content

Specialization Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets pertaining to application of Green Technology.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:

• Rubric-based assessment for the project work and its report.

• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.

The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.

Multidisciplinary Minor
In
Artificial Intelligence and Machine Learning
For
B.Tech. (Civil Engineering)

Shivaji University, Kolhapur
Department of Technology

Multidisciplinary Minor in Artificial Intelligence and Machine Learning

Teaching & Evaluation Scheme										
Sr. No.	**Category**	**Code**	**Course Title**	**Hours per week**			**Contact Hours**	**Credits**	**Evaluation scheme**	
									Theory	**Practical**
				L	**T**	**P**			**ISE:ESE**	**IE:EE**
1.	Preferably on SWAYAM (NPTEL) or any other MOOCs (Minor Program Core) Or In a Face-to-Face mode	MDM 2.1 (MDM 221)	Introduction to AI & Machine Learning (Sem IV)	03	-	-	03	03	30:70	00:00
2.		MDM 2.2 (MDM 311)	Introduction to Data Analytics (Sem V)	03	-	-	03	03	30:70	00:00
3.		MDM 2.3 (MDM 321)	Deep Learning and Neural Network (Sem VI)	03	-	-	03	03	30:70	00:00
4.	Program Based Internship	MDM 2.4	AI ML Related Internship	One Month			-	03	-	50:50
5.	Project Based Learning	MDM 2.5	Mini Project	-	-	-	-	02	-	50:50
				-	**-**	**-**	**-**	**14**	**300**	**200**
			Total Hours	**09**	**00**	**00**	**09**	**-**	**-**	**-**

Note: MDM Program's Internship and Mini Project need to be planned during winter or summer vacation days after 4th semester while respective evaluations will be the part of 7th and 8th Semesters of the B.Tech Major structure.

Multidisciplinary Minor II: Artificial Intelligence and Machine Learning

Year, Program, Semester	Multidisciplinary Minor II , Semester IV							
Course Code	MDM-2.1 (MDM 221)							
Course Category	Minor Program Core							
Course title	**Introduction to AI & Machine Learning**							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**		
	03	-	-	03		03		
Evaluation Scheme	ISE		ESE	IOE	IPE	EOE	EPE	Total
	30		70	-	-	-	-	100
Pre-requisites (if any)	Mathematical concepts such as statistics, calculus, probability, and linear algebra.							
Course Objectives	The Course is aimed to 1. To review and strengthen important mathematical concepts required for AI &ML. 2. Introduce the concept of learning patterns from data and develop a strong 3. Theoretical foundation for understanding state of the art Machine Learning algorithms.							
Course Outcomes	Upon completion of this course, student should be able to 1. Design and implement machine learning solutions to classification, regression and clustering problems. 2. Evaluate and interpret the results of the different ML techniques. 3. Design and implement various machine learning algorithms in a range of Real-world applications.							

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	3	-	-	-	-	-	-	-
CO2	2	-	2	-	3	-	-	-	-	-	-	-
CO 3	-	-	2	-	2	-	-	-	-	-	-	-

Level of Mappings: Low1, Moderate2, High3

Unit No.	Course Content	Hours
I	Defining Artificial Intelligence, Defining AI techniques, Using Predicate Logic and Representing Knowledge as Rules, Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming, Mathematical foundations: Matrix Theory and Statistics for Machine Learning.	9
II	Idea of Machines learning from data, Classification of problem–Regression and Classification, Supervised and Unsupervised learning.	8
III	Linear Regression: Model representation for single variable, Single variable Cost Function, Gradient Decent for Linear Regression, Gradient Decent in practice.	8
IV	Logistic Regression: Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Overfitting.	8
V	Discussion on clustering algorithms and use-cases cantered around clustering and classification.	6
Text / Reference Books		
1.	Saroj Kaushik, Artificial Intelligence, Cengage Learning,1st Edition 2011	
2.	AninditaDasBhattacharjee,"PracticalWorkbookArtificialIntelligenceandSoftComputing for beginners, Shroff Publisher-Xteam Publisher.	
3.	Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packet Publishing Limited, 2017.	
4.	Tom Mitchell, Machine Learning, McGraw Hill, 2017.	
5.	Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011.	
6.	T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2011.	

Note: Though it's a theory course, there will be classes on computers for hands on practice. The activity content for the same is as follows.

- Implementation of logical rules in Python
- Using any data apply the concept of: Liner regression, Gradient decent, Logistic regression
- To add the missing value in any data set.
- Perform and plot under fitting and over fitting in a dataset.
- Implementation of clustering and classification algorithms.

Year, Program, Semester	Multidisciplinary Minor II , Semester V							
Course Code	MDM-2.2 (MDM 311)							
Course Category	Minor Program Core							
Course title	**Introduction to Data Analytics**							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**			**Total Credits**	
	03	-	-	03			03	
Evaluation Scheme	ISE		ESE	IOE	IPE	EOE	EPE	Total
	30		70	-	-	-	-	100
Pre-requisites (if any)	Solid foundation in basic mathematics, including algebra, calculus, and probability.							
Course Objectives	The Course is aimed to 1. Provide the knowledge and expertise to become a proficient data scientist 2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science 3. Produce Python code to statistically analyses a dataset 4. Critically evaluate data visualizations based on their design and use for communicating stories from data.							
Course Outcomes	Upon completion of this course, student should be able to 1. Explain how data is collected, managed and stored for data science. 2. Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists. 3. Implement data collection and management scripts using MongoDB.							

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	3	-	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	-	-	-	-
CO3	-	-	2	2	-	-	-	-	-	-	-	-

Level of Mapping as: Low 1, Moderate 2, High 3

Unit No.	Course Content	Hours
I	Introduction to Data Science, Different Sectors using Data science, Purpose and Components of Python in Data Science.	7
II	Data Analytics Process, Knowledge Check, Exploratory Data Analysis (EDA), EDA-Quantitative technique, EDA-Graphical Technique, Data Analytics Conclusion and Predictions.	7
III	Feature Generation and Feature Selection (Extracting Meaning from Data)-Motivating application: user (customer) retention-Feature Generation (brainstorming, role of domain expertise, and place for imagination)-Feature Selection algorithms.	9
IV	Data Visualization- Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects-Exercise: create your own visualization of a complex dataset.	9
V	Applications of Data Science, Data Science and Ethical Issues-Discussions on privacy, security, ethics- A look back at Data Science- Next-generation data scientists.	7

Text / Reference Books	
1.	Joel Grus, Data Science from Scratch, Shroff Publisher Publisher / O' Reilly Publisher Media
2.	Annalyn Ng, Kenneth Soo, Numsense, Data Science for the Layman, Shroff Publisher
3.	Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly PublisherMedia.
4.	Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets.v2.1, Cambridge University Press.
5.	Jake Vander Plas, Python Data Science Handbook, Shroff Publisher / O'Reilly Publisher Media
6.	Philipp Janert, Data Analysis with Open Source Tools, Shroff Publisher / O'Reilly Publisher Media.

Note: Though it's a theory course, there will be classes on computers for hands on practice. The activity content for the same is as follows.

- Python Environment setup and Essentials.
- Mathematical computing with Python (NumPy).
- Scientific Computing with Python (SciPy).
- Data Manipulation with Pandas.
- Prediction using Scikit-Learn
- Data Visualization in python using matplotlib

Year, Program, Semester	Multidisciplinary Minor II , Semester VI						
Course Code	MDM-2.3 (MDM 321)						
Course Category	Minor Program Core						
Course title	**Deep Learning and Neural Network**						
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**	
	03	-	-	03		03	
Evaluation Scheme	ISE	ESE	IOE	IPE	EOE	EPE	Total
	30	70	-	-	-	-	100
Pre-requisites (if any)	Basic Mathematics, matrix arithmetic, probability.						
Course Objectives	The Course is aimed to 1. Strengthen important Mathematical concepts required for Deep learning and neural network. 2. Get a detailed insight of advanced algorithms of neural networks. 3. Introduce different deep learning network.						
Course Outcomes	Upon completion of this course, student should be able to 1. Design and implement Artificial Neural networks. 2. Decide when to use which type of NN. 3. Implement and analyze various deep learning architectures						

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	2	-	2	-	-	-	-	-	-	-
CO2	-	2	-	-	2	-	-	-	-	-	-	-
CO3	-	2	3	-	3	-	-	-	-	-	-	-

Level of Mapping as: Low1, Moderate2, High 3

Unit No.	Course Content	Hours
I	Information flow in a neural network, understanding basic structure and ANN	8
II	Training a Neural network, how to determine hidden layers, recurrent neural network	8
III	Convolutional neural networks, image classification and CNN.	8
IV	RNN and LSTMs. Applications of RNN in real world.	8
V	Creating and deploying networks using tensor flow and keras	7

Text / Reference Books	
1.	John Paul Mueller, Luca Massaron, Deep Learning for Dummies, John Wiley & Sons.
2.	Adam Gibson, Josh Patterson, Deep Learning, A Practitioner's Approach, Shroff Publisher/O'Reilly Publisher Media.
3.	Christopher M. Bishop, Neural Networks for Pattern Recognition, Oxford.
4.	Russell Reed, Robert J Marks II, Neural Smithing: Supervised Learning in Feed forward Artificial Neural Networks, Bradford Book Publishers

Note: Though it's a theory course, there will be classes on computers for hands on practice. The activity content for the same is as follows.

- Introduction to Kaggle and how it can be used to enhance visibility.
- Build general features to build a model for text analytics.
- Build and deploy your own deep neural network on a website using tens or flow.

<table>
<tr><td>Year, Program, Semester</td><td colspan="7">Multidisciplinary Minor II, 4th Semester onwards</td></tr>
<tr><td>Course Code</td><td colspan="7">MDM 2.4</td></tr>
<tr><td>Course Category</td><td colspan="7">Program Based Internship</td></tr>
<tr><td>Course Title</td><td colspan="7">AI ML Related Internship</td></tr>
<tr><td rowspan="2">Teaching Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td colspan="2">Total Contact Hours</td><td colspan="2">Total Credits</td></tr>
<tr><td colspan="5">One Month</td><td colspan="2">03</td></tr>
<tr><td rowspan="2">Evaluation Scheme</td><td colspan="2">ISE</td><td>ESE</td><td>IOE</td><td>IPE</td><td>EOE</td><td>EPE</td><td>Total</td></tr>
<tr><td colspan="2">00</td><td>00</td><td>50</td><td>-</td><td>50</td><td>-</td><td>100</td></tr>
<tr><td>Pre-requisites(if any)</td><td colspan="7">Basics of unit processes and unit operations.</td></tr>
<tr><td>Course Rationale</td><td colspan="7">The course caters specifically to B.Tech. Civil Engineering students as the part of multidisciplinary Minor with respect to AI & ML applications in Chemical and allied Engineering. This course offers practical exposure to industry settings aligned with their chosen discipline, aiming to bridge the gap between theoretical knowledge and practical application. By engaging in a one-month internship, students gain firsthand experience, essential skills, and insights crucial for their future careers in additional sector of industry.</td></tr>
<tr><td>Course Objectives</td><td colspan="7">The course teacher will
1. Help expose students to the 'real' working environment;
2. Promote hands-on experience to the students’ in their related field;
3. Develop synergetic collaboration between industry and the university in promoting a knowledgeable society;
4. Assist in providing the opportunity for students to test their interest in a particular career before permanent commitments are made.
5. Elaborate the dynamic and challenging nature of industrial environments.</td></tr>
<tr><td>Course Outcomes</td><td colspan="7">Upon completion of this course, student should be able to
1. Understand industrial processes and operations related to their minor sub-specializations.
2. Apply theoretical concepts to solve practical problems in the industry.
3. Communicate effectively with industry professionals, colleagues, and supervisors.
4. Collaborate efficiently in team environments to complete tasks and projects.
5. Adapt to the dynamic and challenging nature of industrial environments.
6. Reflect on internship experiences for personal and professional growth.</td></tr>
</table>

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	2	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	3
CO6	-	-	-	-	-	-	-	-	-	-	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content	Hours
The course consists of a one-month internship with respect to applications of AI & ML. Students will be placed in companies or organizations that align with the particular requirement. During the internship, students will engage in various activities, including but not limited to: 1. Shadowing industry professionals to observe and learn about different processes and operations. 2. Assisting with ongoing projects or research initiatives within the organization. 3. Participating in hands-on tasks related to their minor sub-specialization, under the guidance of experienced mentors. 4. Attending training sessions, workshops, and seminars conducted by the industry to enhance their knowledge and skills. 5. Engaging in discussions and meetings with supervisors and colleagues to gain insights into industry practices, challenges, and innovations. 6. Documenting their internship experience through reports, presentations, or reflective journals. The period of one month for this internship will be during the winter or summer vacations, any such slots 4th Semester onwards.	4 weeks

Course Evaluation Method

This particular evaluation will be the part of the structure of 7th Semester.
The evaluation for the Industrial Internship course will be conducted as follows:

- **Internal Evaluation (50 marks):**
  - Assessment by course teachers based on students' performance during the internship, including attendance, participation, attitude, and contribution to assigned tasks.
  - Evaluation by industrial supervisors on students' professional conduct, technical skills, problem-solving abilities, and overall performance in the workplace.
- **External Evaluation (50 marks):**
  - Evaluation by an external examiner appointed by the institute, who will assess students' internship reports, presentations, or any other documentation submitted at the end of the internship period.
  - The external examiner will review the quality of students' reflections on their internship experience, their ability to apply theoretical knowledge to practical situations, and the depth of their understanding of industry practices and challenges.

The final grades for the Industrial Internship course will be determined based on the combined assessment from both internal and external evaluations.

Year, Program, Semester	Multidisciplinary Minor II, 4th Semester onwards							
Course Code	MDM 2.5							
Course Category	Project Based Learning							
Course Title	**Mini Project**							
Teaching Scheme and Credits	**L**	**T**	**P**	**Total Contact Hours**		**Total Credits**		
	-	-	-	-		02		
Evaluation Scheme	**ISE**	**ESE**		**IOE**	**IPE**	**EOE**	**EPE**	**Total**
	00	00		50	-	50	-	100
Pre-requisites(if any)	Basics of unit processes and unit operations.							
Course Rationale	This course aims to provide students with practical exposure and hands-on experience in real-world industrial settings, fostering a deeper understanding of theoretical concepts through application. By engaging in this field project, students will develop essential skills such as problem-solving, teamwork, and communication, preparing them for future challenges in the professional arena for AI ML applications.							
Course Objectives	The course teacher will 1. Facilitate application of theoretical knowledge. 2. Guide the students about enhancement of practical skills. 3. Explain about development of industry-relevant competencies.							
Course Outcomes	Upon completion of this course, student should be able to 1. Demonstrate application of theoretical concepts with instructor guidance. 2. Collaborate effectively in instructor-led team-based projects. 3. Communicate findings and insights professionally under instructor supervision.							

Course Outcome and Program Outcome Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	-	-	2	-	-	-	2	-	-	-
CO 2	-	-	3	-	-	-	-	-	3	-	2	1
CO 3	-	-	-	-	-	-	-	-	-	3	-	2

Level of Mapping as: Low 1, Moderate 2, High 3

Course Content

Minor Program Based Mini Project is a dynamic course designed to bridge the gap between classroom learning and real-world application. All the students will engage themselves in a series of tasks and challenge that will enable them to apply theoretical concepts learned in previous courses to solve practical problems. The project work need to be carried out independently covering a range of topics relevant to their field of study, allowing them to explore different facets of the particular discipline and develop versatile skill sets with respect to application of AI & ML.

This activity may be planned after 4th Semester and can be completed prior to 8th Semester of their Major studies.

Course Assessment Process

This particular evaluation will be the part of 8th Semester of the major structure.

The course evaluation for the internals will be at the course teacher end while there will also be the external evaluation of the Project work.

The teachers will follow the instructions as below:

Evaluation Format: The evaluation may be conducted using a combination of assessment methods, including:

• Rubric-based assessment for the project work and its report.

• Peer evaluation for project.
• Instructor-led discussions or presentations to evaluate communication skills and critical thinking.
• Overall course grading based on a weighted average of individual assessments and participation.

The evaluation format should be transparent, fair, and aligned with the course objectives and outcomes. Regular feedback and communication with students will ensure that the evaluation process remains supportive of their learning journey.