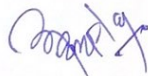


KOLHAPUR INSTITUTE
OF TECHNOLOGY'S
**COLLEGE OF
ENGINEERING**
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KOLHAPUR

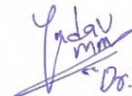
Curriculum for
Final Year B.Tech in
Civil and Environmental Engineering
(To be Implemented w.e.f. Academic Year 2023-24)
(Under 170 Credits System)


Department of Civil and Environmental Engineering
Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur,
Maharashtra, INDIA




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Department of Civil and Environmental Engineering

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College of Engineering (Autonomous), Kolhapur,
Maharashtra, INDIA

**Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

VISION AND MISSION OF INSTITUTE

VISION:

- To be the Centre of Excellence in technical education and preferred choice of Faculty, Students, Industry and Society.

MISSION:

- To empower the faculty, staff and aspiring Engineers with essential technical knowledge and skills.
- To develop competence towards serving the ever changing needs of industry and society.
- To inculcate social and ethical values amongst the Students and Employees.
- To strengthen collaborative Research and Consulting Environment with industry and other institutions.

VISION AND MISSION OF DEPARTMENT

VISION

- To develop as a center of excellence in Civil and Environmental Engineering Education.

MISSION

- To impart essential technical knowledge, skills and Environmental ethics.
- To develop professional capabilities to meet changing societal and industrial needs.
- To build up base for Research and Consultancy activities.

PROGRAM EDUCATION OBJECTIVES (PEOs)

PEO 1: Solve Civil and Environmental Engineering problems and pursue higher studies using solid foundation in mathematics, science and technology.

PEO2: Design, execute and operate various Civil and Environmental Systems in related fields through participative education.

PEO3: Develop skills to communicate effectively and work in a team in multidisciplinary areas.

PEO4: Respond to the challenges of issues of Civil and Environmental Engineering through research and development.

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

PROGRAM OUTCOMES (POs)

Civil and Environmental Engineering Graduates will be able to:

1. Apply the knowledge of mathematics, Science and Engineering fundamentals for solution of problems of Civil and Environmental Engineering.
2. Identify, formulate, review research literature and analyze Civil and Environmental Engineering problems using fundamentals of mathematics, sciences and engineering.
3. Develop solutions for Civil and Environmental Engineering problems and design system components and processes to meet the specified needs with appropriate consideration for the public health and safety.
4. Make use of their knowledge to interpret the data by experimental analysis to provide valid conclusions.
5. Select and apply various engineering and IT tools and models to solve Civil and Environmental Engineering problems.
6. Assess societal, health, safety and legal issues by applying Civil and Environmental Engineering knowledge.
7. Assess the impact of Civil and Environmental Engineering solutions in Societal and Environmental context for Sustainable Development.
8. Practice ethical principles to fulfill responsibilities as Civil and Environmental Engineer.
9. Function effectively as an individual, and as member or leader in multidisciplinary areas.
10. Discuss effectively issues of Civil and Environmental Engineering and solutions through written and oral presentations to engineering communities and society.
11. Demonstrate knowledge and understanding of the engineering and management principles to manage Civil and Environmental Engineering projects.
12. Practice the need of lifelong learning through updating technical knowledge in the context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Identify and analyze the pollution related problems generated due to urbanization and industrialization.
2. Interpret the data using various tools and techniques to provide effective and applicable solutions.

Kolhapur Institute of Technology's
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DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

MAPPING OF PROGRAM OUTCOMES TO PROGRAM EDUCATION OBJECTIVES

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

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Teaching and Evaluation scheme for

Second Year B. Tech. Program in Civil and Environmental Engineering Semester-III

Course Code	Course Name	Curriculum Component	Hours/Week				Evaluation Scheme				
			L	T	P	Credits	Component	Marks			
								Max	Min for passing		
UCEE0301	Applied Mathematics	BS	3	1	-	4	ISE I	10	20	40	
							MSE	30			
							ISE II	10			
							ESE	50			
UCEE0302	Surveying	PC	3	-	-	3	ISE I	10	20	40	
							MSE	30			
							ISE II	10			
							ESE	50			
UCEE0303	Fluid Mechanics	PC	3	-	-	3	ISE I	10	20	40	
							MSE	30			
							ISE II	10			
							ESE	50			
UCEE0304	Solid Mechanics	PC	4	-	-	4	ISE I	10	20	40	
							MSE	30			
							ISE II	10			
							ESE	50			
UCEE0305	Building Materials and Concrete Technology	PC	3	-	-	3	ISE I	10	20	40	
							MSE	30			
							ISE II	10			
							ESE	50			
UCEE0361	Audit Course I: Environmental Studies	BS	2	-	-	-	ESE	100	40	40	
UCEE0331	Surveying Laboratory	PC	-	-	2	1	ISE	50	20		
							ESE(OE)	50	20		
UCEE0332	Fluid Mechanics Laboratory	PC	-	-	2	1	ISE	25	10		
							ESE(OE)	25	10		
UCEE0333	Strength of Materials Laboratory	PC	-	-	2	1	ISE	50	20		
UCEE0334	Concrete Technology Laboratory	PC	-	-	2	1	ISE	25	10		
							ESE(OE)	25	10		
UCEE0335	Building Drawing Laboratory	PC	-	-	2	1	ISE	50	20		
			18	1	10	22	500 + 300 = 800 + Audit Course				

Total Credits - 22, Total Contact hours – 29

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Teaching and Evaluation scheme for

Second Year B. Tech. Program in Civil and Environmental Engineering Semester - IV

Course Code	Course Name	Curriculum Component	Hours/Week				Evaluation Scheme			
			L	T	P	Credits	Component	Marks		
								Max	Min for passing	
UCEE0401	Environmental Chemistry and Microbiology	BS	3	-	-	3	ISE I	10	20	40
							MSE	30		
							ISE II	10		
							ESE	50		
UCEE0402	Hydrology and Water Resources Engineering	PC	3	-	-	3	ISE I	10	20	40
							MSE	30		
							ISE II	10		
							ESE	50		
UCEE0403	Structural Analysis	PC	3	-	-	3	ISE I	10	20	40
							MSE	30		
							ISE II	10		
							ESE*	50		
UCEE0404	Hydraulics	PC	3	-	-	3	ISE I	10	20	40
							MSE	30		
							ISE II	10		
							ESE	50		
UCEE04**	Professional Elective I	PE	3	1	-	4	ISE I	10	20	40
							MSE	30		
							ISE II	10		
							ESE	50		
UCEE0462	Audit Course II: Surveying and Geospatial Technology	PC	2	-	-	-	ESE	100	40	40
UCEE0431	Environmental Chemistry and Microbiology Laboratory	BS	-	-	2	1	ISE	25	10	
							ESE (OE)	25	10	
UCEE0432	Building Planning and Design Laboratory	PC	-	-	4	2	ISE	50	20	
							ESE (OE)	50	20	
UCEE0433	Open Channel Hydraulics Laboratory	PC	-	-	2	1	ISE	25	10	
							ESE (OE)	25	10	
UCEE0434	Spreadsheets Laboratory	PC	-	-	2	1	ISE	50	20	
UCEE0435	Geospatial Laboratory	PC	-	-	2	1	ISE	50	20	
			17	1	12	22	500 + 300 = 800 + Audit Course			

Total Credits - 22, Total Contact hours – 30

Professional Elective – I	
UCEE0421	Ecology and Environmental Sanitation
UCEE0422	Green Buildings
UCEE0423	Construction Practices

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Teaching and Evaluation scheme for

Third Year B. Tech. Program in Civil and Environmental Engineering Semester - V

Course Code	Course Name	Curriculum Component	Hrs/Week				Evaluation Scheme			
			L	T	P	Credits	Component	Marks		
								Max	Min for passing	
UCEE0501	Water Supply Engineering	PC	3	-	-	3	ISE I	10	20	40
							MSE	30		
							ISE II	10		
							ESE	50		
UCEE0502	Highway and Traffic Engineering	PC	3	-	-	3	ISE I	10	20	40
							MSE	30		
							ISE II	10		
							ESE	50		
UCEE0503	Solid and Hazardous Waste Management	PC	3	-	-	3	ISE I	10	20	40
							MSE	30		
							ISE II	10		
							ESE	50		
UCEE0504	Geotechnical Engineering	PC	3	1	-	4	ISE I	10	20	40
							MSE	30		
							ISE II	10		
							ESE	50		
UCEE05**	Professional Elective II	PE	3	1	-	4	ISE I	10	20	40
							MSE	30		
							ISE II	10		
							ESE	50		
UCEE0563	Audit Course III: Engineering Management and Economics	HS	2	-	-	-	ESE	100	40	40
UCEE0531	Water Treatment Laboratory	PC	-	-	2	1	ISE	50	20	
							ESE (OE)	50	20	
UCEE0532	Transportation Engineering Laboratory	PC	-	-	2	1	ISE	25	10	
							ESE (OE)	25	10	
UCEE0533	Geotechnical Engineering Laboratory	PC	-	-	2	1	ISE	25	10	
							ESE (OE)	25	10	
UCEE0534	Solid Waste Analysis Laboratory	PC	-	-	2	1	ISE	50	20	
UCEE0541	Mini Project	MC	-	-	2	1	ISE	50	20	
			17	2	10	22	500 + 300 = 800 + Audit Course			

Total Credits - 22, Total Contact hours – 29

Professional Elective – II	
UCEE0521	Renewable Energy Resources
UCEE0522	Irrigation and Hydraulic Structures
UCEE0523	Noise Pollution and Control
UCEE0524	Design of Steel Structures

**Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur**

Teaching and Evaluation scheme for

Third Year B. Tech. Program in Civil and Environmental Engineering Semester - VI

Course Code	Course Name	Curriculum Component	Teaching Scheme				Evaluation Scheme			
			L	T	P	Credits	Component s	Marks		
								Max	Min for passing	
UCEE0601	Wastewater Engineering	PC	3	-	-	3	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
UCEE0602	Air Pollution and Control	PC	3	-	-	3	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
UCEE0603	Design of Concrete Structures	PC	4	-	-	4	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
UCEE06**	Professional Elective III	PE	3	1	-	4	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
UOEL06**	Open Elective I	OE	3	-	-	3	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
UCEE0664	Audit Course IV: Transportation Infrastructure	PC	2	-	-	-	ESE	100	40	40
UCEE0631	Wastewater Engineering Laboratory	PC	-	-	2	1	ISE	50	20	
							ESE (OE)	50	20	
UCEE0632	Air Pollution and Control Laboratory	PC	-	-	2	1	ISE	25	10	
							ESE (OE)	25	10	
UCEE0633	Design of Concrete Structures Laboratory	PC	-	-	2	1	ISE	50	20	
UCEE0634	Design and Drawing of Environmental Systems	PC	-	-	4	2	ISE	50	20	
							ESE (OE)	50	20	
			18	1	10	22	500 + 300 = 800 + Audit Course			

Total Credits - 22, Total Contact hours – 29

Professional Elective – III		Open Elective I	
UCEE0621	Environmental Geotechnology	UOEL0631	Environmental Laws and Policies
UCEE0622	Optimization Techniques	UOEL0632	Occupational Safety and Health
UCEE0623	Operation and Maintenance of Environmental Facilities	UOEL0633	Water Conservation and Management

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Teaching and Evaluation scheme for

Final Year B. Tech. Program in Civil and Environmental Engineering Semester-VII

Course Code	Course Name	Curriculum Component	Teaching Scheme				Evaluation Scheme			
			L	T	P	Credits	Components	Marks		
								Max	Min for passing	
UCEE0701	Environment, Health and Safety	PC	3	-	-	3	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UCEE0702	Advanced Water and Wastewater Treatment	PC	3	1	-	4	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UCEE0703	Quantity Surveying and Valuation	PC	3	-	-	3	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE *	50	20	
UCEE0704	Environmental Impact Assessment and Environmental Legislation	PC	3	-	-	3	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UOEL07**	Open Elective II	OE	3	-	-	3	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UCEE0765	Audit Course V: Foundation Engineering	PC	2	-	-	-	ESE	100	40	40
UCEE0731	Treatability Studies Laboratory	PC	-	-	2	1	ISE	50	20	
							ESE (OE)	50	20	
UCEE0732	Quantity Surveying and Valuation Laboratory	PC	-	-	2	1	ISE	50	20	
							ESE (OE)	50	20	
UCEE0741	Seminar	MC	-	-	2	1	ISE	50	20	
UCEE0751	Project Phase I	MC	-	-	2	1	ISE	50	20	
			17	1	08	20	500 + 300 = 800 + Audit Course			

Total Credits – 20, Total Contact hours – 26

Sr. No.	Open Elective II
UOEL0731	Disaster Management and Risk Analysis
UOEL0732	Waste Management

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Teaching and Evaluation scheme for

Final Year B. Tech. Program in Civil and Environmental Engineering Semester-VIII

Course Code	Course Name	Curriculum Component	Teaching Scheme				Evaluation Scheme		
			L	T	P	Credits	Components	Marks	
UCEE0852	Internship and Project Phase II	MC	-	-	12	6	ISE I	75	30
							ISE II	75	30
							ESE (OE)	150	60
UCEE08**	Professional Elective IV	PE	3	-	-	3	ISE-I	10	20
							ISE-II	10	
							MSE	30	
							ESE	50	20
UCEE08**	Professional Elective V	PE	3	-	-	3	ISE-I	10	20
							ISE-II	10	
							MSE	30	
							ESE	50	20
			6	-	12	12	300 + 100 + 100 = 500		

Total Credits - 12, Total Contact hours – 18

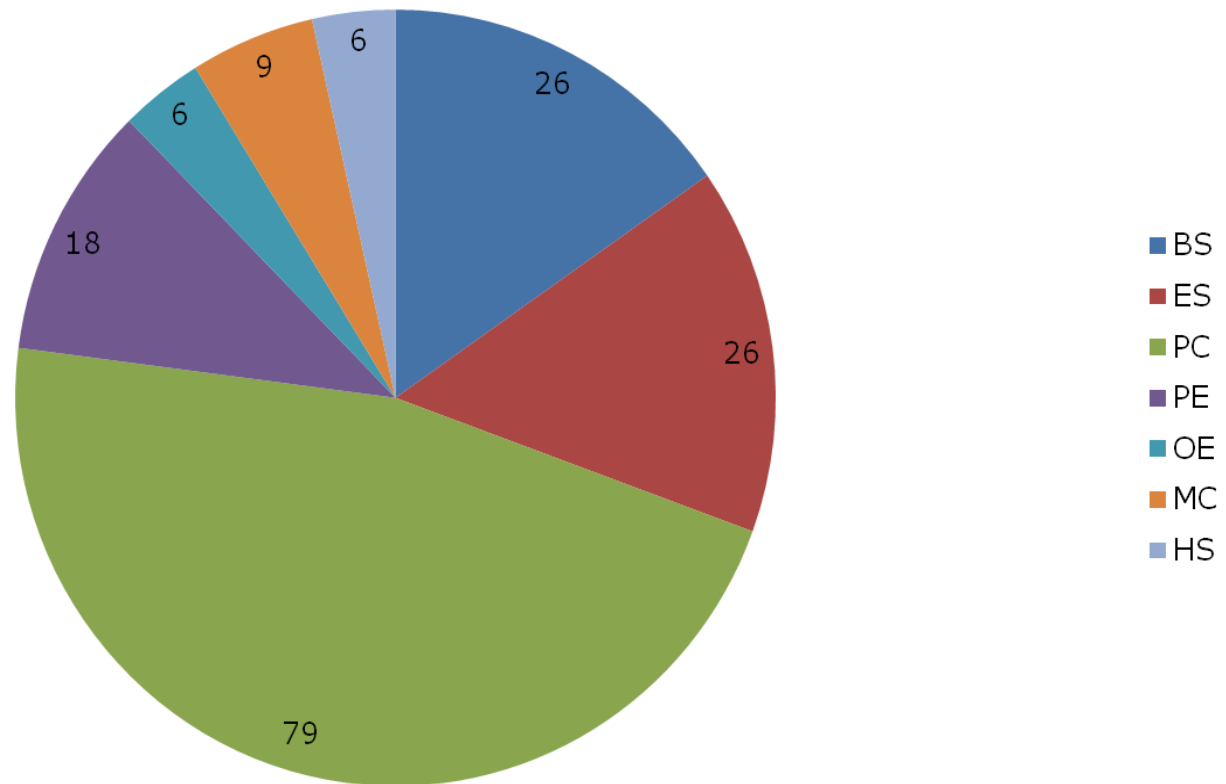
Professional Elective – IV		Professional Elective – V	
UCEE0821	Industrial Wastewater Treatment	UCEE0824	Environmental Management System
UCEE0822	Project Management	UCEE0825	Advanced Construction Technology
UCEE0823	Urban Infrastructure and Smart Cities	UCEE0826	Environmental Sustainability

**Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
B. Tech. Program in Civil and Environmental Engineering**

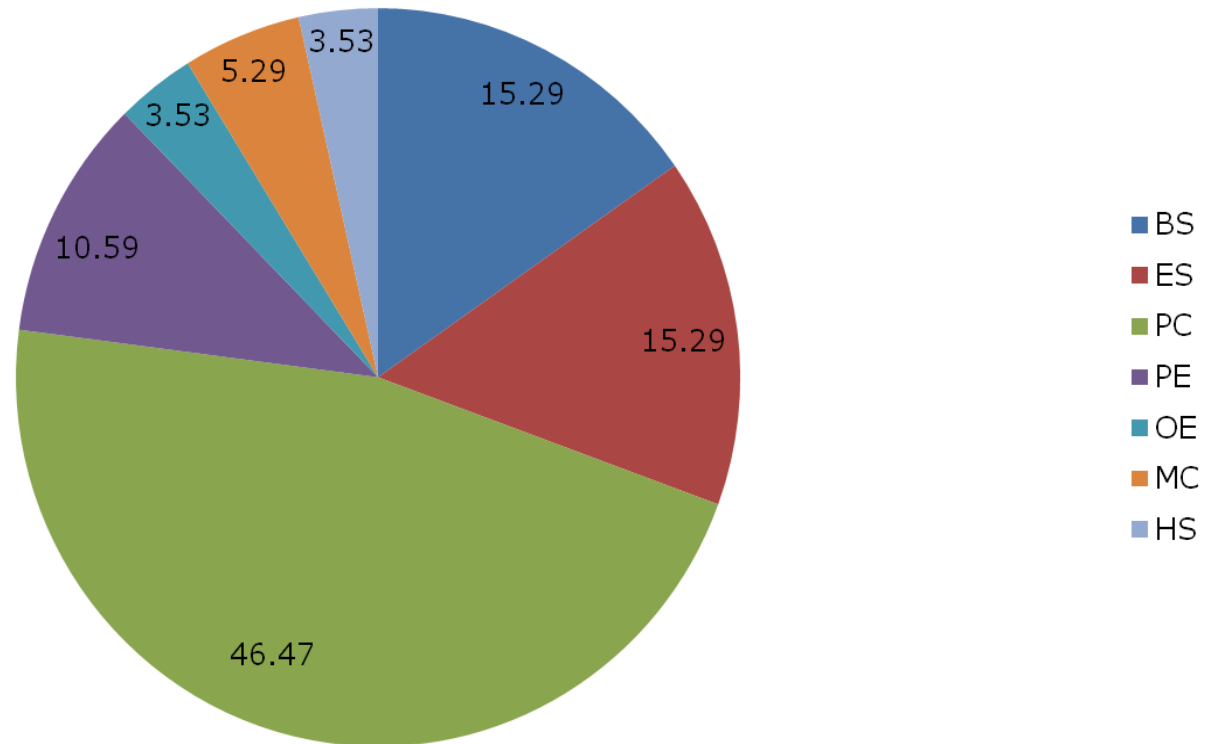
Total Credits Distribution from F.Y.B.Tech to Final Year B.Tech in Civil and Environmental Engineering

Component	F.Y.B.Tech		S.Y.B.Tech		T.Y.B.Tech		Final Year B.Tech		Total	% age
	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Sem VII	Sem VIII		
Basic Sciences (BS)	9	9	4	4	-	-	-	-	26	15.29
Engineering Sciences (ES)	13	13	-	-	-	-	-	-	26	15.29
Program Core (PC)	-	-	18	14	17	15	15	-	79	46.47
Professional Elective (PE)	-	-	-	4	4	4	-	6	18	10.59
Open Elective (OE)	-	-	-	-	-	3	3	-	6	3.53
Mandatory Course (MC)	-	-	-	-	1	-	2	6	9	5.29
Humanities (HS)	3	3	-	-	-	-	-	-	6	3.53
Total	25	25	22	22	22	22	20	12	170	100

**Total Credits Distribution from F.Y.B.Tech to Final Year B.Tech in
Civil and Environmental Engineering**



**Total Credits (%) Distribution from F.Y.B.Tech to Final Year
B.Tech in Civil and Environmental Engineering**



SYLLABUS
Final Year B. Tech
Civil and Environmental Engineering
SEMESTER – VII

Class: Final year B.Tech Civil and Environmental Engineering		L	T	P	Credits							
Title of the Course: Environment, Health and Safety		03	---	---	03							
Course No.: UCEE0701												
Course Pre-Requisite: Students shall have the knowledge of: <ul style="list-style-type: none">• Engineering Chemistry• Engineering Mechanics• Engineering Management• EIA & Environmental Legislation												
Course Description: The course is designed as per the standards and needs of the Safety Industry. It is introduced for enhancement of core competencies, skills, knowledge, and awareness related to industrial safety to the students. The course is based on Environment, Health and Safety management, Safety Engineering, Safety Legislation, and Occupational Health & Industrial Hygiene. The course will help students to understand importance of Environment, Health and Safety in industry.												
Course Learning Objectives: <ol style="list-style-type: none">1. To understand industrial work environment in accordance with the health & safety at the workplace.2. To know aspects of accidents and safety in industry.3. To study hazard and safety management systems.4. To study occupational Safety, Health and various legislations made for the protection of employees.												
Course Outcomes:												
COs	After the completion of the course the students will be able to	Bloom's Cognitive										
		Descriptor										
CO.1	Discuss various legislative provisions on Environment, Health and Safety.	Cognitive (Understanding) L2										
CO.2	Explain causes and consequences of industrial accidents and need of safety.	Cognitive (Understanding) L2										
CO.3	Describe hazards, risks and its control by following principles of safety.	Cognitive (Understanding) L2										
CO.4	Explain Safety management system and environmental management system and aspects of occupational health and industrial hygiene	Cognitive (Understanding) L2										
CO-PO Mapping:												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO.1						3		1	2			
CO.2						3		2	1			
CO.3									2			
CO.4								2		3		

	COs	PSO1	PSO2	
	CO.1	2	2	
	CO.2	1	2	
	CO.3	-	2	
	CO.4	-	2	
Assessments:				
Assessment			Weightage (Marks)	
ISE-1			10	
MSE			30	
ISE-2			10	
ESE			50	
<ul style="list-style-type: none">• ISE-1 and ISE-2: Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc. (For each ISE two different tools are to be used).• MSE: Assessment is based on 50% of course content (Normally first three Units)• ESE: Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.				
Course Contents:				
Unit 1: Environment, Safety Rules and Legislations The Factories Act, 1948 (Amended) and Rules, Environment Protection Act 1986 (Amended) and Rules, Employees State Insurance Act, 1948, Child Labour and Women Employee Act, Manufacture, Storage & import of Hazardous Chemicals Rules, 1989, Fly Ash Utilization Notification, Introduction to Health and safety management system: ISO 45001:2018				06 Hours
Unit 2: Accident Theories, Investigation and Reporting a. Principles of Accident Prevention: Accident, Types, Causes, Consequences, Accident Statistics, Unsafe Acts and Unsafe Conditions, Cost of Accident (Direct and Indirect), Basic Activities in Accident Prevention, Accident Investigation and Reporting, Investigators Qualification, Investigation Strategy, Benefits, Documentation and Contents of Good Report. b. Theories of Accident Causation: Errors and Mistakes, Types of Errors, Decision Making, Heinrich Domino Theory, Accident/Incident Theory, Human Factors Theory, Human Behavior Theory, System Theory, Combination Theory				07 Hours
Unit 3: Safety Management and Training a. Management of Safety and Health: Safety, Need, Parameters Associated with Safety, Theory of Safety, Principles of Safety, Three, E's, Safety Audit, Checklist Analysis, What-If Analysis, Safety Review, Safety Warning System, Safety in construction work b. Training for Safety and Health, Identifying Training Needs - Organizational Needs, Job- Related Needs, Individual Needs, Identifying Training objectives and methods, Training Evaluation and Feedback, Relationships within the Organization and Outside the Organization, Motivation.				07 Hours
Unit 4: Hazard Management and Plant Layout a. Hazard Management Process, Hazard Identification, Workplace Inspection, Consultation, Risk Assessment, Risk Assessing Tools, Concept of Risk Priority Number, Risk Control Techniques, HAZOP, fire hazard, fire safety b. Machine Guarding Techniques, Types of Guards, Housekeeping Issues, Concept of 5-S c. Plant and Machine Layout for Safety: Objectives, Site Selection, Factors Affecting Layout, Types of Plant Layout, Lockout -Tag out (LOTO) System, Personal Protective Equipments, Types, Need and Selection				07 Hours

Unit 5: Environment, Health and Safety Management Fundamentals of Environment, Health and Safety Management System: Importance, Key Elements of Environment, Health and Safety Management System, Audits and Reviews- Key Requirements, Benefits and Practical Aspects, Measurement of Individual and Organizational Performance,	06 Hours
Unit 6: Occupational Health and Industrial Hygiene a. Objectives, Need, Chronic and Acute Effects, Various Exposure Limits, LD-50, LC-50, TLV, TWA, STEL, Effects of Various Harmful Agents and Conditions - Physical, Chemical, Biological and Ergonomic, Protection of Workers, Personal and Work Place Monitoring Systems, Hazards and Requirements of Safety - Confined Space Entry-Working Underground, Working at Height, Hot Work Permit and Cold Work Permit, On-Site and Off-Site Emergency Management Plans, Introduction to OHSAS 18001 for health and safety management system b. Types of Chemical Hazards & Controls, Storage Hazards & controls, Transportation and Storage of Hazardous Chemicals, Material Safety Data Sheets, Material- Process , Inspection, Testing & Maintenance	07 Hours
Textbooks: 1. Occupational Safety and health -by David L. Goetsch, Prentice Hall, Ohio 2. Handbook of Environmental Health and Safety: Herman Koren and Michel Bisesi, Jaico Publishing House, Delhi (1999) 3. Handbook of Environmental Risk Assessment and Management: Peter Calow, Blackwell Science Ltd. USA (1998) 4. Introduction to Industrial Safety - by K.T. Kulkarni	
Reference Books 1. Environmental Health & Safety Auditing Handbook - by Lee Harrison, Mac Graw Hill Inc. 2. Health Hazards of the Human Environment - World Health Organization, Geneva, 1972 3. Industrial and Occupational Safety, Health & Hygiene - by Dr. A.H. Hommadi. 4. Slote L. Handbook of Occupational Safety and Health, John Willey and Sons, New York 5. Grimaldi and Simonds, Safety Management, AITBS Publishers, New Delhi (2001) 6. Industrial Safety and pollution control handbook: National Safety Council and Associate publishers Pvt. Ltd, Hyderabad	

Class: Final Year B.Tech Civil and Environmental Engineering	L	T	P	Credits
Title of the Course: Advanced Water and Wastewater Treatment	03	01	-	04
Course Code.: UCEE0702				

Course Pre-Requisite:

- Students shall have knowledge of conventional water and wastewater treatment.

Course Description:

Advanced water and wastewater treatment processes are increasingly sought out due to their ability to produce superior quality water compared to conventional treatment processes. Especially with the identification of emerging pollutants, the rapid growth of population and industrial activities, and lessening availability of water resources, conventional treatment processes are becoming more challenged. Practitioners in the field need to establish best practices in handling water and wastewater from different sources to combat the modern challenges in the industry. This subject focuses on educating students on how to design an advanced water and wastewater treatment processes. The subject brings both science (chemistry, physics, and biology) and engineering together on a number of levels, such as in terms of learning from nature and applying engineering and design solutions.

Course Learning Objectives:

The objectives of the course are

- To provide review of conventional treatment and the need for advanced water and wastewater treatment.
- To provide in-depth knowledge of advances in Physico-chemical and biological processes useful for the treatment of water & wastewater.
- To inculcate the qualities of critical thinking and independent judgement to evaluate and design advanced treatment processes for water and wastewater.

Course Outcomes:

CO	After the completion of the course, the student should be able to	Bloom's Descriptor
CO1	Explain and apply advances in Physico-chemical and biological processes.	Cognitive (knowledge) Applying L3
CO2	Analyze Physico-chemical and biological systems for the treatment of water and wastewater.	Cognitive (knowledge) Analyze L4
CO3	Design the advanced water and wastewater treatment systems.	Cognitive (knowledge) Creating L6

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2		2		1								
CO3			3									

CO	PSO1	PSO2
CO1		1
CO2	2	
CO3		1

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- **ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions/STP visit report etc. (For each ISE two different tools are to be used).
- **MSE:** Assessment is based on 50% of course content (Normally first three Units)
- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:

Unit 1: Need & Basics of Advanced Treatment Review of conventional water treatment, need for advanced water and wastewater treatment, reclamation and reuse of wastewater, Reactors and reaction kinetics: types of reactions and reaction kinetics, types of reactors and principles of reactor design. Microbial growth kinetics, Modeling suspended and attached growth treatment processes.	7 Hrs.
Unit 2: Settling & Filtration Types of Settling: Hindered and Compression Settling, Filtration: Design and operation of Dual media filter, head loss calculations for depth filtration Membrane Filtration: Terminology, Process Classification, Membrane configuration, specific membrane problems such as fouling and its control, application of membranes, Electrodialysis: Theory, Design	7 Hrs.
Unit 3: Ion Exchange, Adsorption Ion Exchange: Process, Ion exchange resins, exchange capacity, ion exchange chemistry and reactions, Design of ion exchange units, Disposal of concentrate waste streams. Adsorption: types of adsorption, adsorption isotherms, activated carbon adsorption kinetics, analysis and design of adsorption column.	6 Hrs.
Unit 4: Biological Removal of Nitrogen & Phosphorous Forms of nitrogen in wastewater, Suspended growth processes for biological nitrification and denitrification, Processes for biological nitrogen removal, Biological phosphorous removal- Process description, processes for BPR.	7 Hrs.
Unit 5: Chemical Precipitation, Disinfection & Disposal of Contaminants Nitrogen Removal by Physical and Chemical Processes, Chemical precipitation for removal of phosphorous, Chemical precipitation for removal of heavy metals and dissolved inorganic substances, Removal of Refractory organics, Removal of dissolved inorganic substances, Ultimate disposal of contaminants.	6 Hrs.
Unit 6: Natural Treatment Systems Constructed wetland and aquatic treatment systems; Types- free water surface and subsurface constructed wetlands, selection of plants, removal mechanisms, applications, design procedure for constructed wetlands, Management of constructed wetlands.	6 Hrs.

Textbook:

1. Wastewater Engineering treatment and reuse – Metcalf & Eddy, Inc., George Tchobanoglous, Franklin Burton, H. David Stensel, Tata McGraw-Hill Education, 2002

References:

1. Environmental Engineering- Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, McGraw-Hill, 1985
2. Physicochemical processes: for water quality control – W. J. Weber, Wiley Interscience, 1972
3. Wastewater Treatment for Pollution Control – Soli J. Arceivala and Shyam R. Asolekar, Tata McGraw-Hill Education, 2017
4. Theory and Practice of Water and Wastewater Treatment – Ronald Droste, John Wiley, 2019
5. Manual- Constructed Wetlands Treatment of Municipal Wastewaters- USEPA, 2000

Class: Final Year B.Tech Civil and Environmental Engineering						L	T	P	Credits				
Title of the Course: Quantity Surveying and Valuation						03	---	---	03				
Course No.: UCEE0703													
Course Pre-Requisite: Students must have knowledge about numerical and mathematical applications in solving problems of area and volume measurements. Also, students must be having knowledge of mode of measurement for various building components.													
Course Description: The objective of the course is imparting fundamental knowledge in the following concern <ul style="list-style-type: none">• Estimation of quantities of various building components• Calculate quantity of materials and labours for various building components• Calculate rates of various building items and detailed estimate.• Do the valuation of different construction projects.													
Course Learning Objectives: At the end of the course students will be able to <ul style="list-style-type: none">1. Estimate quantities of various components of buildings and environmental structures.2. Do rate analysis for various items in the building.3. Understand the various concepts in valuation.4. Calculate market value of building by different methods..													
Course Outcomes:													
COs		After the completion of the course the students will be able to						Bloom's Cognitive Descriptor					
CO.1		Select the method for calculating the quantities of building and environmental structures.						Cognitive (Remembering) L1					
CO.2		Explain the various concepts in valuation						Cognitive (Understanding) L2					
CO.3		Estimate the materials, labors and rates required for various works.						Cognitive (Evaluating) L5					
CO.4		Evaluate various items for valuation of different works as per standards and specifications.						Cognitive (Evaluating) L5					
CO-PO Mapping:													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	
CO.1	3	2			2								
CO.2	2			1	2						2		
CO.3	3	2	1										
CO.4	1				1						2	2	

Assessments:	
Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50
<ul style="list-style-type: none"> ISE-1 and ISE-2: Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc. (For each ISE two different tools are to be used). MSE: Assessment is based on 50% of course content (Normally first three Units) ESE: Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE. 	
Course Contents:	
Unit 1: a) Introduction: General Introduction to Quantity surveying, purpose of estimates types of estimates, various items to be included in estimate. Mode of measurement of various items, IS 1200, Administrative approval and technical sanction to estimates, Prime cost, Provisional sums and provisional quantities b) Specifications: Purpose and basic principles of general and detailed specifications, specifications for different items of work for building, water supply and sewerage work	05 Hrs.
Unit: 2 a) Estimation of residential building; Estimate of different items of buildings b) Analysis of Rates: Factors affecting the cost. Materials, Labour, task work schedule as basis of labour cost, rates of various machinery, tools and plants, overhead charges, Rates for various items of construction of civil Engineering works, standard schedule of Rates, DSR and use of DSR for estimating	07 Hrs.
Unit: 3 Approximate Estimates: Purpose, various methods used for building and other Civil Engg. Works water supply, Drainage, irrigation and Road projects. Different methods for executing work like contract method, Departmental, Organizational set-up of various govt. bodies like PWD, Water Supply Departments and general idea about its working and delegation of power, classification of works, Methods for carrying out work. Measurement books, mode of payment, bill forms, Global contractors, local competitive bidding.	06 Hrs.
Unit :4 a) Contracts: Essentials of legally valid contract. Different types of contracts. Suitability of different types of contracts. b) Tender Procedure: Various types of tenders, preparing tender papers, invitation of tenders, tender notice, submission, scrutiny and Acceptance of tenders, conditions of contracts, right and responsibilities of the parties to contract. c) Introduction to Arbitration	06 Hrs.
Unit :5 a) Principles of valuation: Definition of value, unit price and cost attributes of values. Different types of value b) Valuer and his duties, purpose of valuation and its function. Factors affecting the valuation of properties, Tangibles and intangibles, Landed properties, freehold and lease hold properties. Different type of Lease. c) Various methods of valuation: Rental Method, belting method of Valuation, valuation for water supply and sewerage schemes	06 Hrs.

Unit :6 a) Depreciation: Different methods of calculating depreciation: declining balance method, sinking fund method, depreciated cost, factors for obsolescence. b) Sinking Fund: Definition, purpose, calculation of sinking fund, sinking fund calculations for various equipment's and machinery used in water supply and sewerage schemes. c) BOT: Concepts of execution of works by the methods like BOT , PPP(Public – Private-Partnership)	06 Hrs.
Textbooks: <ol style="list-style-type: none"> 1. Estimating and Costing –B. N.Datta, 24th edition, UBS publishers Pvt Ltd. 2. Estimating, costing and specifications in civil engineering – Chakraborty M., Publications: M. Chakraborty, ISBN-10 818530436X 3. Estimating and Costing –G.S. Birdi, DhanpatRai publishing company. 	
References: <ol style="list-style-type: none"> 1. District Schedule of Rates for PWD, MJP 2. Quantity Surveying – P. L. Bhasin 3. Elements of estimating and costing – S. C. Rangawala. 4. Civil Engg. Contracts and Estimates – B. S. Patil 5. Professional Practice – RoshanNamavati (Estimating and Valuation) 6. Bombay P. W. D. volumes I and II 7. Valuation of real properties – S. C. Rangawala. 7. PWD manuals 	

Class: Final Year B.Tech Civil and Environmental Engineering	L	T	P	Credit
Title of the Course: Environmental Impact Assessment and Environmental Legislation	03	-	-	03
Course No.: UCEE0704				

Course Pre-Requisite:

- Students shall have knowledge of Industrial Processes and Practices.
- Students shall have knowledge of Environmental Governance.
- Students shall have knowledge of Environmental Studies.

Course Description:

EIA and Environmental Legislation course deals with various requirements under India Legislation to be followed by organizations and projects. EIA (Environmental Impact Assessment) is a study conducted before execution of any project to analyse probable environmental impacts and to suggest control measures. Environmental legislation component of this course deals with various environmental legislation provisions and requirements applicable in India.

Course Learning Objectives:

At the end of course students will

1. Learn importance of Environmental Impact Assessment
2. Know the necessity of EIA and Environmental Legislation.
3. Understand the process and requirements of EIA study.
4. Learn the provisions and requirements towards Environment protection.

Course Outcomes:

CO	After Completion of Course Students will be able to	Blooms Cognitive Descriptor
CO1	Tell the importance of EIA	Cognitive (Remembering) L1
CO2	Explain the process and requirement of EIA	Cognitive (Understanding) L2
CO3	Interpret various methods of assessment of environmental impacts.	Cognitive (Understanding) L2
CO4	Identify the legal requirements and provisions applicable under environmental laws in india	Cognitive (Applying) L3

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					2		2					
CO2					2		2		2			
CO3					2		2		2			
CO4						2			2			

COs	PSO1	PSO2
CO1		
CO2		
CO3		2
CO4		2

Assessment:	
Assessment	Weightage (Marks)
ISE-I	10
MSE	30
ISE-II	10
ESE	50
<ul style="list-style-type: none"> • ISE-1 and ISE-2: Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc. (For each ISE two different tools are to be used). • MSE: Assessment is based on 50% of course content (Normally first three Units) • ESE: Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE. 	
Course Contents:	
Unit 1: Introduction : concept of EIA, necessity and objectives of EIA, History of EIA, Types & Components of EIA studies, Types of impacts, planning & management of EIA studies, EIA implementation in India, EIA Notifications 1994, EIA Notification 2006 and its provisions, EIA Procedure with reference to Notification 2006 – stages, Public Consultation, Public Hearing Procedure, Post Environmental Clearance Monitoring, Schedule for categorization of projects with general and specific condition, Procedure for Appraisal.	08 Hrs
Unit 2: Methodology: Baseline Data Collection, Interaction Matrix Methodologies, Network Methodologies, Checklist Methodologies, Description of Environmental Settings, Conceptual Framework, Various indices like WQI, AQI, Impact Assessment: Mass Balance Approach, Box Model Approach, Air Quality Dispersion Modelling, Assessment of Impact and Mitigation Measures, Comprehensive Environmental Pollution Index in India (CEPI).	08 Hrs
Unit 3: Documentation for EIA - Contents of Form I and Form I –A, Generic Structure of EIA, Summary of EIA.	04 Hrs
Unit 4: Historical Development of various Environmental Legislations, USEPA 1969, Clean Air Act, Clean Water Act, NEPA, Water (Prevention & Control of Pollution) Act, 1974 and Rules, Water (Prevention & Control of Pollution) Cess Act, 1977 and Rules, Air (Prevention & Control of Pollution) Act, 1981 and Rules.	08 Hrs
Unit 5: Environment (Protection) Act, 1986 and Rules, E- Waste (Management) Rules 2016, Construction and Demolition Waste Management Rules 2016, Batteries (Management and Handling) Rules 2001, Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987, Fly Ash Notification	08 Hrs.
Unit 6: Guidelines for Coastal Regulation Zones (CRZ) and Eco Sensitive Zones (ESZ), Concept of Strategic Environmental Assessment (SEA), Comparison of EIA and SEA, Requirements for Marine EIA	04 Hrs.
Textbooks: <ol style="list-style-type: none"> 1. Environmental Impact assessment - Canter L.W.; McGraw Hill Publishers 2. Manual of Environmental Impact Assessment - Govt. of India Publication 3. Handbook of Environmental Impact assessment - Kulkarni V.S, Kaul N, Trivedi R.K., Scientific Publishers 	

4. Technical EIA Guidance Manual for Industrial Estates for MOEF Govt. of India by IL & FSEcosmart Ltd., Hyderabad
5. All Environmental Legislations, amendments, rules published by MoEFCC.

Reference Books:

1. Environmental Planning and Management in India – Saxena
2. Handbook of Environmental Law, Acts, Guidelines, Compliances and Standards Vol. I, II -Trivedi R.K.
3. Environmental Law - Tripathi S.C.
4. Environmental Law Case book - Leelakrishnan P.
5. Environmental Management, Kulkarni V and Ramachandra T V, 2009. TERI Press, NewDelhi

Class: Final Year B. Tech Civil & Environmental Engineering	L	T	P	Credit
Title of the Course: Disaster Management & Risk Analysis (Open Elective – II)	03	-	-	03
Course Code : UOEL0731				

Course Pre-Requisite: Environmental Studies

Course Description:

Disaster management refers to the conservation of lives and property during natural or man-made disasters. Disaster management address the issues such as floods, hurricanes, fires, mass failure of utilities, rapid spread of disease and droughts. Human are vulnerable to natural disasters because of its geo-climatic condition, having recurrent floods, droughts, cyclones, earthquakes, and landslides. Development cannot be sustained unless mitigation is built into the development process. Mitigation must be multi-disciplinary, spanning across all sectors of development.

Various aspects of disaster management and risk assessment such as disaster preparedness, disaster response, recovery, rehabilitation, risk assessment and vulnerability are covered in this course.

Course Learning Objectives:

1. To learn the concepts of earth's atmosphere.
2. To understand the types of disasters and its causes.
3. To know role of government and other agencies in disaster management
4. To study means of recovery, rehabilitation and risk analysis.

Course Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Taxonomy	
		Cognitive Domain	
		Descriptor	Level
CO 1	Tell the concepts of Earth's Atmosphere	Remembering	L1
CO 2	Explain the types of disasters and its causes	Understanding	L2
CO 3	Identify role and responsibilities various agencies in disaster management	Applying	L3
CO4	Plan means of disaster response, rehabilitation, recovery and analyzing risk	Applying	L3

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2			2			
CO2						3			2			
CO3						3			2			
CO4						2			3			3

	CO	PSO1	PSO2	
	CO1			
	CO2			
	CO3		2	
	CO4			
Assessment:				
Assessment		Weightage (Marks)		
ISE-I		10		
MSE		30		
ISE-II		10		
ESE		50		
<ul style="list-style-type: none">• ISE-1 and ISE-2: Assessment is based on Assignment/Declared Test/Quiz/Seminar/GroupDiscussions etc. (For each ISE two different tools are to be used).• MSE: Assessment is based on 50% of course content (Normally first three Units)• ESE: Assessment is based on 100% course content with 30% weightage for course contentcovered before MSE and 70% weightage for course content covered after MSE.				
Course Contents:				
Unit 1: Climate, Weather and Climate Change Overview of Earth’s Atmosphere; Layers of Atmosphere– Temperature, Radiation and Variation; – Heat- Balance of Earth Atmosphere- Time and Temperature Extremes, Heat waves, Hydrologic cycle– Climate Variability like Floods, Droughts, Drought Indicators, Kyoto Protocol, Montreal protocol and IPCC Scenarios, Difference between climate change and climate variability, Role of countries and citizens in containing in global warming.				6 Hrs
Unit 2: Introduction on Disaster Different Types of Disaster: Natural Disaster: such as Flood, Cyclone, Earthquakes, Tsunami, Landslides etc, Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures (Building and Bridge), War & Terrorism etc. Causes, effects , health and sanitation in emergency situations and practical examples for all disasters.				8 Hrs
Unit 3: Disaster Preparedness Disaster Preparedness: Concept and Nature, Disaster Preparedness Plan, Prediction, Early Warnings and Safety Measures of Disaster, Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies, Role of IT in Disaster Preparedness, disaster prediction agencies, mock exercises , Role of Engineers on Disaster Management.				6 Hrs.
Unit 4: Disaster Response Introduction, Disaster Response Plan, Communication, Participation, and Activation of Emergency Preparedness Plan, Search, Rescue, Evacuation and Logistic Management, Psychological Response and Management (Trauma, Stress, Rumor and Panic), Relief and Recovery, Medical Health Response to Different Disasters.				8 Hrs.

Unit 5: Rehabilitation, Reconstruction and Recovery Reconstruction and Rehabilitation as a Means of Development, Damage Assessment, Post Disaster effects and Remedial Measures, Creation of Long-term Job Opportunities and, Livelihood Options, Disaster Resistant House Construction Sanitation and Hygiene, Education and Awareness.	7 Hrs.
Unit 6: Risk and Vulnerability Analysis Risk : Its concept and analysis, Risk Reduction, Vulnerability : Its concept and analysis, Strategic Development for Vulnerability Reduction.	5 Hrs.
References: <ol style="list-style-type: none"> 1. Jepma, C.J., and Munasinghe, M., Climate Change Policy - Facts, Issues and Analysis, Cambridge University Press, 1998. 2. Disaster Management by Dr. Mrinalini Pandey, Published by Wiley India Pvt. Ltd. 3. Disaster Management : Future Challenges & opprtunities by Jagbir Singh, published by K W Publishers Pvt. Ltd. 4. Disaster Science and Management by Tushar Bhattacharya, published by McGraw Hill Education(India) Pvt. Ltd. 	

Class: Final Year B. Tech Civil & Environmental Engineering		L	T	P	Credits
Title of the Course: Waste Management (Open Elective – II)		03	-	-	03
Course No.: UOEL0732					
Course Pre-Requisite: Students shall have knowledge of: Current environmental issues, various types of pollutions due to solid and hazardous wastes. Concept of sustainable development.					
Course Description: Understanding importance of waste management is need of current scenario. After studying the course students will know problems related to waste management and will be able to grasp an overview of municipal solid waste, industrial waste and hazardous 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 Learning 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:					
COs	After the completion of the course the students will be able to		Bloom's Cognitive		
			Descriptor		
CO.1	Discuss various sources, types, classification of solid waste, importance of waste management, waste suitable for energy production etc.		Cognitive (Understanding) L2		
CO.2	Explain waste generation, storage, collection, separation, transportation and processing of waste.		Cognitive (Understanding) L2		
CO.3	Describe characteristics of solid waste and different treatment methods to recover energy from waste, densification of solids.		Cognitive (Understanding) L2		
CO.4	Grasp various legislations in waste management and integrated waste management system.		Cognitive (Remembering) L1		

CO-PO Mapping:												
COs	PO1	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	

	COs	PSO1	PSO2	
	CO.1		2	
	CO.2		2	
	CO.3			
	CO.4			

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

- ISE-1 and ISE-2:** Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc. (For each ISE two different tools are to be used).
- MSE:** Assessment is based on 50% of course content (Normally first three Units)
- ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:

Unit 1: Introduction: Definition of waste and importance of waste management, classification and types of solid waste, Important quality parameters of wastes, Waste suitable for energy production.	06 Hrs.
Unit 2: Elements of waste management system: Waste generation, storage, collection, segregation and processing, transfer and transport, disposal methods of waste.	07 Hrs.
Unit 3: Characterization of wastes: Characterization of solid wastes- Physical, Chemical, Proximate analysis, Leaching properties, Energy content, Heating value.	08 Hrs.
Unit 4: Waste to Energy Technologies: Need of energy production 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.	07 Hrs.
Unit 5: Energy production from Plastic- Plastic waste generation and need for proper management of plastic, classification of plastic, various types of plastics and suitability for energy production, common steps for converting waste plastic to fuels. Densification of solids- Fundamentals of densification, types of briquetting, Briquetting process and their comparison, Briquette characteristics, application of briquettes.	06 Hrs.
Unit 6: Integrated Solid Waste Management (ISWM) Integrated solid waste management, Principles of waste hierarchy, waste prevention and reduction, reuse, recycling. Swachh Bharat Abhiyan	06 Hrs.

<p>Legislations in Waste Management: Solid Waste Management Rules 2016, Hazardous and Other Wastes (Management and Transboundary movement) Rules, 2016, Plastic Waste Management Rules 2016, Extended Producer's Responsibility</p>	
<p>Textbooks:</p> <ol style="list-style-type: none"> 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 Somerset: Wiley 1st ed, 2015 	
<p>References:</p> <ol style="list-style-type: none"> 1. Municipal Solid Waste Management Manual, 2016 by CPHEEO. 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 Science. 	

Class: Final Year B. Tech Civil & Environmental Engineering	L	T	P	Credits
Title of the Course: Audit Course V: Foundation Engineering	02	---	---	---
Course No.: UCEE0765				

Course Pre-Requisite:

Elements of Civil Engineering & Mechanics; Engineering Hydraulics, Structural analysis, Engineering Geology and Geotechnical Engineering.

Course Description:

Foundation engineering forms a core course and study of this course is aimed at developing an application thinking of the basic foundation engineering terminologies and design philosophies. It aims at developing an approach to solve weak and compressible soil problems.

Course Learning Objectives:

1. To provide students necessary knowledge and skill required for interpretation of bearing capacity and settlement of foundations
2. To introduce students the process of soil compaction and consolidation with field control and application.
3. To provide students' knowledge and skills required to design shallow and pile foundation.
4. To understand basics of ground improvement techniques and its importance.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	Explain the suitability of different soil exploration methods and various types of foundations.	Cognitive (Knowledge) L1
CO.2	Select and design type of shallow foundation.	Cognitive (Analyse) L4
CO.3	Classify pile and well foundation with respect to their suitability.	Cognitive (Apply) L3
CO.4	Demonstrate the understanding of the basic information about modern foundation and ground improvement techniques	Cognitive (Understand) L2

CO-PO Mapping:

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

COs	PSO1	PSO2
CO.1	-	2
CO.2	-	2
CO.3	-	2
CO.4	-	2

Assessments:	
Assessment	Weightage (Marks)
ESE	100
<ul style="list-style-type: none"> ESE: Assessment is based on 100% course content. 	
Course Contents:	
Unit 1: Soil & Rock Exploration Necessity, Planning, No & depth of bore holes, Exploration Methods auger boring (hand and continuous flight augers), wash boring, rotary drilling, core drilling. Soil sampling- disturbed and undisturbed. Causes of sample disturbance, Rock drilling and sampling, Mechanical properties of rock, behavior of rocks in uniaxial compression, tensile strength of rocks, Core barrels, Core boxes, core recovery, RQD	06 Hrs.
Unit 2: Bearing Capacity Evaluation Definitions, Modes of failure, Terzaghi 's bearing capacity theory, I.S. Code method of bearing capacity evaluation & computation (IS 6403), Effect of various factors on bearing capacity (Size & Shape, Depth, WT, Eccentricity), Bearing capacity evaluation from Plate load test, S.P.T. (By I.S. Code method)	05 Hrs.
Unit 3: Shallow Foundation Types and their selection, minimum depth of footing, Assumptions & limitations of rigid design analysis. Design of Isolated, combined, strap footing (Rigid analysis), Raft foundation (elastic analysis), floating foundations (R.C.C. Design is not expected), Concept of total settlement, differential settlement and angular distortion. Effects, Causes and remedial measures. Computations from I.S. 8009-1976 (Part I)	05 Hrs.
Unit 4: Pile Foundation -I Classification and their uses, single pile capacity evaluation by static and dynamic methods, pile load test. Negative skin friction, Group action of piles.	04 Hrs.
Unit 5: Pile Foundation -II Design of pile group, Group efficiency. Pile integrity test- equipment's, output, Under reamed piles – equipment, construction and precautions	04 Hrs.
Unit 6: Well Foundations Different shapes of wells, components of well, sinking of well, tilts and shifts, principles of analysis and design, seismic influences, IRC guidelines	04 Hrs.
Textbooks: <ol style="list-style-type: none"> Foundation Engineering by B.J. Kasamalkar Soil Mechanics and Foundation Engg. by V.N.S.Murthy Soil Mechanics and Foundation Engg. By K.R.Arora Soil Mechanics and Foundation Engg. by B.C. Punmia 	
References: <ol style="list-style-type: none"> Geotechnical Engineering – Prentice Hall, Delhi by Iqbal H Khan Foundation Design and Construction by M.J. Tomlinson Foundation analysis & design by J.E.Bowles Foundation design by W.C.Teng Foundation design manual-Dr. N.V. Nayak. Dhanpat Rai and Sons National Building Code. 	

Class: Final Year B. Tech Civil & Environmental Engineering								L	T	P	Credit										
Title of the Course: Treatability Studies Laboratory								---	---	02	01										
Course No.: UCEE0731																					
Course Pre-Requisite: Students shall have the knowledge of: <ul style="list-style-type: none">Environmental chemistry, instrumentation and microbiologyProcesses for water and wastewater treatment																					
Course Objectives: <ol style="list-style-type: none">To develop skills to extract information pertinent to plan, design and conduct experiments.To impart knowledge for analysis of complex environmental systems.																					
Course Learning Outcomes:																					
COs		After the completion of the course the students will be able to							Bloom's Cognitive Descriptor												
CO.1		Develop (Plan, design, and conduct) experiments using appropriate techniques and tools							Cognitive (Application) L3												
CO.2		Analyze and interpret the experimental results.							Cognitive (Analyze) L4												
CO-PO Mapping:																					
CO	1	2	3	4	5	6	7	8	9	10	11	12									
CO1		2	2	3																	
CO2		2	1	3																	
						<table><tr><td>COs</td><td>PSO1</td><td>PSO2</td></tr><tr><td>CO1</td><td></td><td></td></tr><tr><td>CO2</td><td>1</td><td>2</td></tr></table>	COs	PSO1	PSO2	CO1			CO2	1	2						
COs	PSO1	PSO2																			
CO1																					
CO2	1	2																			
Assessments:																					
<table><tr><td>Assessment</td><td>Weightage (Marks)</td></tr><tr><td>ISE</td><td>50</td></tr><tr><td>ESE (OE)</td><td>50</td></tr></table>						Assessment	Weightage (Marks)	ISE	50	ESE (OE)	50										
Assessment	Weightage (Marks)																				
ISE	50																				
ESE (OE)	50																				
<ul style="list-style-type: none">ISE: Based on experiment developed/conducted/analyzed.ESE (OE): Assessment is based on oral examination.																					
Course Contents:																					
Experiment No. 1: Determination of gas transfer coefficient.										2											
Learning Outcome: To determine gas transfer coefficient of aeration process.																					
Experiment No. 2: Determination of BOD rate constant for domestic wastewater.										4											
Learning Outcome: To determine BOD rate constant and calculate ultimate BOD.																					
Experiment No. 3: Development of break through curve for ion exchange process.										6											
Learning Outcome: To determine exchange capacity of resin and resin requirement to treat water.																					
Experiment No. 4: Development of adsorption isotherm.										2											
Learning Outcome: To determine applicable isotherm for given carbon and carbon requirement for treatment of water.																					
Experiment No. 5: Determination of MLSS, MLVSS and SVI.										2											
Learning Outcome: To determine condition of activated sludge process.																					
Experiment No. 6: Determination of F/M.										2											
Learning Outcome: To check F/M ratio of the ASP																					

Experiment No. 7: Determination of volatile fatty acid and alkalinity.	2
Learning Outcome: To determine operating condition of anaerobic process.	
References: <ol style="list-style-type: none"> 1. Wastewater Engineering treatment and reuse – Metcalf & Eddy, Inc., George Tchobanoglous, Franklin Burton, H. David Stensel, McGraw-Hill Education, 2002 2. Chemistry for Environmental Engineering and Science, Clair N Sawyer, Perry L. McCarty, Gene F. Parkin, McGraw-Hill Education, 2003 3. Standard Methods for the Examination of Water and Wastewater by American Public Health Association, American Water Works Association, Water Environment Federation, 2005 4. IS 3025: Methods of sampling and test (physical and chemical) for water and wastewater 	

Class: Final Year B. Tech Civil & Environmental Engineering		L	T	P	Credits							
Title of the Course: Quantity Surveying and Valuation Laboratory		---	---	02	01							
Course No.: UCEE0732												
Course Pre-Requisite: <ul style="list-style-type: none">Students must have knowledge about numerical and mathematical applications in solving problems of area and volume measurementsStudents must be having knowledge of mode of measurement for various building components.Students must be able to plan & design G+1 structures												
Course Description: <p>The course explores the basic knowledge and fundamental of estimation of various Civil & Environmental structures. The course imparts the skills in measurement of various components of structures, estimation of various items required for construction work. Also it imparts skill of valuation of existing structures with standard format.</p>												
Course Learning Objectives: <ol style="list-style-type: none">To learn units of measurement for various civil engineering itemsTo perform cost estimation for entire civil & environmental projectsTo understand the various valuation methods.												
Course Outcomes:												
COs	After the completion of the course the students will be able to				Bloom's Taxonomy							
					Descriptor							
CO1	Analyze rates of various items, materials and labours of Civil and Environmental Engineering Works.				Cognitive (Analyzing) L4							
CO2	Determine cost estimate and valuation of Civil and Environmental Engineering Works.				Cognitive (Evaluating) L5							
CO-PO Mapping:												
COs	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2			2							1
CO2	2				2				1			3
						COs	PSO1	PSO2				
						CO1	-	2				
						CO2	-	2				
Assessments:												
						Assessment		Weightage (Marks)				
						ISE		50				
						ESE (OE)		50				
<ul style="list-style-type: none">ISE: Based on experiment developed/conducted/analyzed.ESE (OE): Assessment is based on oral examination												
Course Contents:												
Assignment No. 1: Rate Analysis of ten items of Civil and Environmental Engineering works. <ol style="list-style-type: none">EarthworkCement MortarConcrete Work						4 Hours						

4. Brick Work 5. Stone work 6. Plastering 7. Steel work 8. Flooring 9. Wood Work 10. White Washing	
Assignment No. 2: Detailed specification for minimum ten items of Civil and Environmental Engineering works. 1. Excavation 2. Plain and R.C.C. Work 3. Masonry Work 4. Centering and Formwork 5. Wood Work, Doors, Windows 6. Roof Covering 7. Water Supply 8. Plumbing and Sanitary Fittings 9. Drainage and Sewerage 10. Miscellaneous Building Items. 11. Electrical Specifications	4 Hours
Assignment No. 3: Detailed Estimate of a Residential building	6 Hours
Assignment No. 4: Preparing detailed estimate for any one of the following 1. Water treatment plant or sewage treatment plant 2. Water supply line 3. Sewerage line 4. 1 KM of road 5. 1 KM of Canal	4Hours
Assignment No. 5: Preparation of Bar bending Schedule	4 Hours
Assignment No. 6: Valuation report for G+1 Building	2 Hours
Assignment No. 7: Assignment based upon use of Microsoft Excel in quantity surveying	2 Hours
Textbooks: <ol style="list-style-type: none"> 1. Estimating and Costing –B. N.Datta, 24th edition, UBS publishers Pvt Ltd. 2. Estimating, costing and specifications in civil engineering – Chakraborty M., Publications: M. Chakraborty, ISBN-10 818530436X 3. Estimating and Costing –G.S. Birdi, DhanpatRai publishing company. 	
References: <ol style="list-style-type: none"> 1. District Schedule of Rates for PWD, MJP 2. Quantity Surveying – P. L. Bhasin 3. Elements of estimating and costing – S. C. Rangawala. 4. Civil Engg. Contracts and Estimates – B. S. Patil 5. Professional Practice – RoshanNamavati (Estimating and Valuation) 6. Bombay P. W. D. volumes I and II 7. Valuation of real properties – S. C. Rangawala. 	

Class: Final Year B. Tech Civil and Environmental Engineering Title of the Course: Seminar Course No.: UCEE0741	L	T	P	Credits															
	---	---	02	01															
Course Pre-Requisite: Students shall have the basic knowledge of: <ul style="list-style-type: none">Students shall have knowledge of Literature Survey and Report Writing.Students shall have knowledge of presentation software like MS office.																			
Course Description: The objective of the course is to learn how to find out good quality research materials for showcasing literature review for concerned seminar topic related to Civil and Environmental Engineering. The course is organized largely around working on the research paper, with the goal of making it a conference-presentable and journal-publishable work.																			
Course Learning Objectives: <ul style="list-style-type: none">1. Understand the use of information sources for Literature review.2. Learn the requirements for report preparation and presentation.																			
Course Outcomes:																			
COs	After the completion of the course the students will be able to			Bloom's Taxonomy															
				Descriptor															
CO.1	Illustrate literature review on selected seminar topic.			Cognitive (Understanding) L2															
CO.2	Present a seminar report on literature review.			Affective (Evaluating) L5															
CO-PO Mapping:																			
CO	1	2	3	4	5	6	7	8	9	10	11	12							
CO1		2																	
CO2							2												
					<table><tr><td>COs</td><td>PSO1</td><td>PSO2</td></tr><tr><td>CO1</td><td>2</td><td></td></tr><tr><td>CO2</td><td></td><td>2</td></tr></table>			COs	PSO1	PSO2	CO1	2		CO2		2			
COs	PSO1	PSO2																	
CO1	2																		
CO2		2																	
Assessments:																			
<table><tr><td>Assessment</td><td>Weightage (Marks)</td></tr><tr><td>ISE</td><td>50</td></tr></table> <ul style="list-style-type: none">ISE: Assessment is based on the presentation showcasing the efforts of the student for identifying the seminar topic, literature survey, giving solution, testing and validating the solution, with submission of seminar report.					Assessment	Weightage (Marks)	ISE	50											
Assessment	Weightage (Marks)																		
ISE	50																		

Class: Final Year B. Tech Civil and Environmental Engineering		L	T	P	Credits
Title of the Course: Project Phase – I		-	-	02	01
Course Code: UCEE0751					
Course Pre-Requisite: Students shall have the knowledge of: <ul style="list-style-type: none"> Fundamentals and Applications in Environmental Engineering, Professional Communication, Research Methodology 					
Course Description: Project offers an opportunity to apply and extend knowledge gained throughout the program. In contrast to the majority of courses studied elsewhere in the program, projects are undertaken individually or in small groups. The strength of each batch shall not exceed maximum of four students. This necessarily introduces the dimension of project work management into the program to enable completion of a large, relatively unstructured "assignment" over the course of the semester. This course is based on a project work including literature studies according to the research plan. The research plan will be written by the student(s) under the guidance of research supervisor and which serve as a project description. This course is intended to represent the first half (initiation phase) of a project. It is a project-based course which requires students to demonstrate technical skills and personal attributes at levels which are appropriate with professional engineering practices. The project work is to be based on any problem pertaining to Environmental Engineering. The same project work will be continued during Project Phase – II in Semester – VIII at the (i) Parent Institution or (ii) Industry or (iii) Research Institution or (iv) Incubation Centre at Parent Institution for detailed study, experimentations, modelling, results, discussions and conclusions. Assessment of Project Phase – I will be done by means of a presentation, submission of a research synopsis and progress report of work done.					
Course Learning Objectives: The Course Objectives are to give an opportunity to students to, <ol style="list-style-type: none"> Acquire the ability to make links across different areas of knowledge. Develop collaborative skills to present ideas clearly and coherently. Formulate new scientific questions that came up during project performance. Learn on their own to evaluate ideas and take appropriate actions. Show a professional attitude regarding time planning, collaboration, innovation and ethical issues. 					
Course Outcomes:					
CO	After the completion of the course the student should be able to	Bloom's Cognitive Descriptor			
CO1	Perform a literature review to identify, formulate the research problem and enlist expected outcomes.	Psychomotor (Perception) L1			
CO2	Undertake research work using theoretical studies, experimentations and computer simulations.	Psychomotor (Readiness to Act) L2			
CO3	Establish findings for describing the work undertaken, results and conclusions within the specified time frame.	Psychomotor (Ability to Perform) L5			
CO4	Synthesize knowledge for creatively evaluating ideas and information to apply it to real life situations.	Psychomotor (Origination) L7			
CO5	Present the research work in a forum involving oral and/ or poster presentations.	Affective (Organization) L4			

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3				3		2	2			
CO2				2	2				2			
CO3					2		1		2		1	
CO4								1	2			2
CO5								2	3	2	1	

CO	PSO1	PSO2
CO1		
CO2	2	
CO3		2
CO4		
CO5		

Assessments:

Assessment	Weightage (Marks)
ISE	50

- **ISE:** Assessment of 50 Marks is based on at least two Internal Oral and/ or Poster Presentations divided into Part A (25 Marks) and Part B (25 Marks).

Course Content:

The work to be completed shall consist of:

- Literature Review, Research Gap and Content.
- Objectives and Motivation.
- Research Design, Process, Methodology, Data Collection.
- Development and evaluation of links across different areas.
- Pre-tests, Results, Discussions, Findings and Limitations.

Term work:

The internal assessment and evaluation shall be based on at least two presentations highlighting following points:

- Theoretical background and literature review,
- Significance and relevance,
- Proposed objectives, work plan and research design,
- Extent of work performed and findings of the research work,
- Interdisciplinary approach,
- Application utility and
- Social, economic, technical aspects.

The internal assessment and evaluation for per batch shall be done by a committee consisting of the Head of the Department, two Senior Faculty Members (Subject Experts) of the Department, Research Supervisor and Co-Research Supervisor (if any). Each project batch shall submit soft copies and hard copies of their research synopsis and progress report duly signed by the Research Supervisor, Co-Research Supervisor (if any), two Senior Faculty Members (Subject Experts) of the Department, Head of the Department and Head of the Institution to the Research Supervisor, Co-Research supervisor (if any), Department and Examination Section.

SYLLABUS
Final Year B. Tech
Civil and Environmental Engineering
SEMESTER – VIII

Class: Final Year B.Tech Civil and Environmental Engineering Title of the Course: Internship and Project Phase – II Course Code: UCEE0852	L	T	P	Credits
	-	-	12	06
Course Pre-Requisite: Students shall have the knowledge of: <ul style="list-style-type: none"> • Engineering Mathematics, • Environmental Chemistry and Microbiology, • Professional Communication, • Research Methodology 				
Course Description: This course requires the implementation of the engineering knowledge learnt in the theoretical and practical classes. This course will be conducted largely as an individual or small group project under the direct supervision of research supervisor. The specific project topic undertaken, research objectives and work plan will reflect the common interests and expertise of the student(s) and research supervisor. The project decided in B.Tech Semester – VII will be continued in B.Tech Semester – VIII for further study. Project work may be carried out at the (i) Parent Institution or (ii) Industry or (iii) Research Institution or (iv) Incubation Centre at Parent Institution. Students will be required to: <ol style="list-style-type: none"> 1. Carry out a extended literature search to review current knowledge, developments in the chosen technical area as well as inconsistencies in the domain; 2. Take on detailed technical work in the chosen area using one or more of theoretical studies, experimental analysis, modeling and simulation using analytical and / or computational methods; 3. Fabricate progress reports to establish work completed, and to schedule additional work within the time frame specified for the project; 4. Prepare an interim report describing the work done and results obtained; and 5. Present the work in a forum involving oral and / or poster presentation on the work done, findings, specific contributions to that field, limitations and future scope. 				
Course Learning Objectives: The Course Objectives are to give an opportunity to students to, <ol style="list-style-type: none"> 1. Acquire the ability to make links across different areas of knowledge. 2. Develop collaborative skills to present ideas clearly and coherently. 3. Formulate new scientific questions that came up during project performance. 4. Learn on their own to evaluate ideas and take appropriate actions. 5. Show a professional attitude regarding time planning, collaboration, innovation and ethical issues. 				

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Descriptor
CO1	Perform a literature review to identify, formulate the research problem and enlist expected outcomes.	Psychomotor (Perception) L1
CO2	Undertake research work using theoretical studies, experimentations and computer simulations.	Psychomotor (Readiness to Act) L2
CO3	Establish findings for describing the work undertaken, results and conclusions within the specified time frame.	Psychomotor (Ability to Perform) L5
CO4	Synthesize knowledge for creatively evaluating ideas and information to apply it to real life situations.	Psychomotor (Origination) L7
CO5	Present the research work in a forum involving oral and/ or poster presentations.	Affective (Organization) L4

CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3				3		2	2			
CO2				2	2				2			
CO3					2		1		2		1	
CO4								1	2			2
CO5								2	3	2	1	

CO	PSO1	PSO2
CO1		
CO2	2	
CO3		2
CO4		
CO5		

Assessments:

Assessment	Weightage (Marks)
ISE – I	75
ISE – II	75
ESE (OE)	150

- **ISE – I and ISE – II:** Assessment of 150 Marks is based on at least two Internal Oral and/ or Poster Presentations divided into Part A (75 Marks) and Part B (75 Marks).
- **ESE (OE):** Assessment of 150 Marks is based on Project/ Viva-voce/ Oral Examination.

Course Content:

The work to be completed shall consist of:

- Literature Review, Research Gap and Content.
- Objectives and Motivation.
- Research Design, Process, Methodology, Data Collection.

- Development and evaluation of links across different areas.
- Pre-tests, Results, Discussions, Findings and Limitations.

Term work:

The internal assessment and evaluation shall be based on at least two presentations highlighting following points:

- Theoretical background and literature review,
- Significance and relevance,
- Proposed objectives, work plan and research design,
- Extent of work performed and findings of the research work,
- Interdisciplinary approach,
- Application utility,
- Social, economic, technical aspects and
- Limitations and future scope.

The internal assessment and evaluation for per batch shall be done by a committee consisting of the Head of the Department, two Senior Faculty Members (Subject Experts) of the Department, Research Supervisor and Co-Research Supervisor (if any). Each project batch shall submit soft copies and hard copies of their thesis duly signed by the Research Supervisor, Co-Research Supervisor (if any), two Senior Faculty Members (Subject Experts) of the Department, Head of the Department and Head of the Institution to the Research Supervisor, Co-Research supervisor (if any), Department and Examination Section. For a pass in a Project/ Viva-voce/ Oral Examination, a student shall secure a minimum of 40% of the maximum marks prescribed for the End Semester Examination.

Class: Final Year B. Tech Civil and Environmental Engineering	L	T	P	Credits
Title of the Course: Industrial Wastewater Treatment (Professional Elective – IV)	03	-	-	03
Course Code: UCEE0821				

Course Pre-Requisite:

Environmental chemistry and microbiology, water & wastewater engineering.

Course Description:

The course is designed to provide an understanding of the alternate processes available to treat wastewaters from industrial activities prior to its disposal as well as for potential reuse and recycling. As the characteristics of wastewater differ from industry to industry, knowledge of manufacturing process is necessary to understand specific treatment needed to meet the stipulated standards as per the consent. The common effluent treatment plants are very useful to ensure full-fledged treatment of wastewater from small scale industries with potential reuse and recycling.

Course Learning Objectives:

1. Impart knowledge on industrial manufacturing process, characteristics and impact of wastewater on receiving bodies
2. Provide understanding of benefits and techniques of waste minimization in industries
3. Develop skill to prepare alternate treatment flow sheets for industrial wastewaters

Course Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Descriptor
CO 1	Summarize manufacturing process and pollution aspects of various industries	Cognitive (Understanding) L-2
CO 2	Explain concepts of pollution prevention and common effluent treatment in industries	Cognitive (Understanding) L-2
CO3	Select various techniques for waste minimization in industries	Cognitive (Applying) L-3
CO4	Develop various treatment flow sheets for industrial wastewater to meet stipulated disposal standards	Cognitive (Applying) L-3

CO-PO Mapping:

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

CO	PSO1	PSO2
CO 1	3	
CO 2		3
CO 3		2
CO 4		3

Assessments:	
Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50
<ul style="list-style-type: none"> ISE-1 and ISE-2: Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc. (For each ISE two different tools are to be used). MSE: Assessment is based on 50% of course content (Normally first three Units) ESE: Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE. 	
Course Contents:	
Unit 1: Use of water and impact of untreated industrial wastewater Industrial scenario in India, General water requirements in industry, Water budget, Environmental impacts of untreated industrial wastewater, Characterization and treatability studies, Effluent standards	2 Hrs.
Unit 2: Waste Minimization and Treatment options Methods of waste volume and strength reductions, Waste minimization - 4 R concepts, zero discharge concept, Classification of treatment and development of treatment flow sheets, Unit operations and unit processes, Pre-treatment of industrial waste - Neutralization, Equalization, Proportioning, Concept of Common Effluent Treatment Plant- Objectives, Types of CETP, Technical and financial aspects	8 Hrs.
Unit-3 Agro-based Industries Manufacturing processes, Water usage, Sources, quantities and characteristics of effluents (process stream and combined), Pollution effects, Alternative methods of treatment, Waste Reduction/By-product recovery for various Agro- based industries: Sugar, Distillery, Pulp and paper mill, Dairy and Textile industries, visit to any two industries with report writing	10 Hrs.
Unit-4 Non agro-based industries Manufacturing processes, Water usage, Sources, quantities and characteristics of effluents (process stream and combined), Pollution effects, Alternative methods of treatment, Waste Reduction/By-product recovery, and disposal for various Non agro-based industries:, Tannery, Petroleum and Oil refineries, Meat processing and food processing industries	8 Hrs.
Unit 5: Engineering and Chemical industries Manufacturing processes, Water usage, Sources, quantities and characteristics of effluents (process stream and combined), Pollution effects, Alternative methods of treatment, Waste Reduction/By-product recovery, and disposal for - Steel and Engineering industries, Fertilizer and pesticide industries, organic & inorganic manufacturing industries	8Hrs.
Unit 6: Treatment for removal of specific pollutants Removal of Heavy metals, Cyanide, Treatment for radioactive wastes, Concept and Techniques for zero discharge of spent wash- Multiple effect evaporators, incineration and Reverse osmosis, Biological treatment for Toxic waste, Acclimatization of bacteria,	4Hrs.
Textbooks: <ol style="list-style-type: none"> Patwardhan. A.D., Industrial Wastewater Treatment”, Prentice Hall of India, New Delhi 2010. ISBN-978-81-203-5332-9 Rao M. N. & Dutta A. K. , “Wastewater Treatment”, Oxford – IBH Publication, 1995. 	

References:

1. "Theories and Practices of Industrial Waste Treatment", Nelson Nemerow, Wiley Publication Company.
2. "Wastewater Engineering Treatment and Reuse", Metcalf And Eddy, Tata McGraw Hill Publication.
3. Eckenfelder W.W. Jr., "Industrial Water Pollution Control", McGraw Hill Book Company, New Delhi, 2000.
4. "Pollution Prevention: Fundamental & Practice", Bishop, P.L., McGraw-Hill, 2000.

Class: Final Year B. Tech Civil and Environmental Engineering	L	T	P	Credits
Title of the Course: Project Management (Professional Elective – IV)	03	---	---	03
Course No.: UCEE0822				

Course Pre-Requisite:

Students must have basic knowledge about fundamentals of science. Basic mathematical ability, units & fundamentals of engineering projects.

Course Description:

The purpose of the course is imparting fundamental knowledge in the following concern

- Understanding various components of project management
- Applications of planning & organizing in Project Planning
- Understanding use of various techniques in project planning & scheduling.

Course Learning Objectives:

1. Acquire knowledge of essentials of Project Management.
2. Learn the Components of Project Management.
3. Identification & Analysis of Risk
4. Learn planning & organizing in Project Planning.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	Extend their knowledge in the field of project Management.	Cognitive (Remember) L1
CO.2	Identify respective components of Project Management & apply them in practice.	Cognitive (Understand) L2
CO.3	Identify and analysis of risk in a Project.	Cognitive (Understand) L2
CO.4	Solve project management related Case studies	Cognitive (Analyse) L3

CO-PO Mapping:

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

COs	PSO1	PSO2
CO.1	-	-
CO.2	-	2
CO.3	-	2
CO.4	-	1

Assessments:	
Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50
<ul style="list-style-type: none"> ISE-1 and ISE-2: Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc. (For each ISE two different tools are to be used). MSE: Assessment is based on 50% of course content (Normally first three Units) ESE: Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE. 	
Course Contents:	
Unit: 1 Basics of Project Management Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), phases of Project management, Impact of Delays in Project Completions, understanding the difference between projects and programs. Types of projects.	05 Hrs.
Unit: 2 Project Identification a) Project Identification and Selection: Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point b) Project Planning Introduction, Project Planning, Need of Project Planning, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)	07 Hrs.
Unit: 3 Resources Considerations in Projects Introduction, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, Cost Forecasts	06 Hrs.
Unit :4 Project Risk Management Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks	06 Hrs.
Unit :5 Project Quality Management and Value Engineering Introduction, Quality, Quality Concepts: - Quality Control & Assurance, TQM in construction, Value Engineering	06 Hrs.
Unit :6 Project Execution and Control Introduction, Project Execution, Project Control Process, Purpose of Project Execution and Control. Introduction to lean construction & BIM in construction sector Case Studies in Project Management	06 Hrs.
Textbooks: <ol style="list-style-type: none"> 1. Project Management & Control by P.C.K.RAO 2. Project Management by S.Chaudhary. 3. Jack Gido, James P Clements, Project Management, Cengage Learning India Pvt. Ltd., 2nd Reprint 2011, ©2007 	
References: <ol style="list-style-type: none"> 1. Project Management by William G Ramroth 2. Project Management by Harvey Maylor 3. Project Management by Paul Roberts 	

Class: Final Year B. Tech Civil and Environmental Engineering	L	T	P	Credits
Title of the Course: Urban Infrastructure and Smart Cities (Professional Elective – IV)	03	---	---	03
Course No.: UCEE0823				

Course Pre-Requisite:

Students shall have the knowledge of:

- Basic Civil Engineering
- Highway & Transportation Engineering
- Transportation Infrastructure

Course Description:

This course will help the students to understand various concepts involved in urban infrastructure planning. Also, students will know about various government schemes & policies involved in development of urban infrastructure. Students will learn about fundamental, importance & systems involved in smart cities.

Course Learning Objectives:

1. To understand the fundamental of town planning
2. To understand different laws, policies & missions of urban development in India
3. To understand the concept of smart city and challenges involved in implementing smart city concept.
4. To understand the importance of smart system used in smart cities.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	Explain various concepts involved in town planning.	Cognitive (Knowledge) L1
CO.2	Extend their knowledge about various laws and policies involved in urban infrastructure development.	Cognitive (Understanding) L2
CO.3	Identify components of smart city infrastructure.	Cognitive (Understanding) L2
CO.4	Illustrate various smart systems.	Cognitive (Analyse) L3

CO-PO Mapping:

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

COs	PSO1	PSO2
CO.1	2	-
CO.2	2	-
CO.3	-	2
CO.4	-	2

Assessments:	
Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50
<ul style="list-style-type: none"> ISE-1 and ISE-2: Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc. (For each ISE two different tools are to be used). MSE: Assessment is based on 50% of course content (Normally first three Units) ESE: Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE. 	
Course Contents:	
Unit: 1 a) Necessity and scope and principles of Town Planning, Present status of town planning in India. b) Contribution of town planners in modern era such as Sir Patrick Geddes. Sir Ebenezer Howard. Clarence stein, Sir Patrick Abercrombie, Le Corbusier.	05 Hrs.
Unit: 2 a) Growth pattern of towns-Natural and Planned, Elements of town, Types of zoning and importance, Urban roads- traffic problem in cities, various road networks (Grid iron pattern, shoe string development, etc.), b) Town aesthetics, Urban landscaping, landscape architecture (Suitability of trees. Treatment of traffic islands, open spaces, walks ways, public sit-outs, and continuous park system. Green ways), Rehabilitation of slum and urban renewal	07 Hrs.
Unit: 3 a) Development control rules with respective to town planning. b) Different town planning works with reference to M.R.T.P. Act. (Brief idea about various provisions) c) Land acquisition act – necessity and procedure of acquisition. d) Multilevel planning, Decentralization concepts, Rural developments- Growth center approach, Area Development approach, Integrated rural development approach.	06 Hrs.
Unit :4 Policies & Missions in India and Maharashtra a) National Urban Transport Policy, National Land-utilization policy, National Housing Policy National Energy Policy, The Street Vendors Act, 2014 b) Atal Mission for Rejuvenation and Urban Transformation, Shyama Prasad Mukherjee Rurban Mission, Pradhan Mantri Awas Yojna	06 Hrs.
Unit :5 Introduction to Smart cities a) Concept, Principal stakeholders, key trends in smart cities developments b) Smart city planning and development c) India “100 Smart Cities” Policy and Mission d) Dimensions of Smart City a) Advantages of Smart city	06 Hrs.
Unit :6 Smart Systems in Smart Cities a) Mass Transport systems: - Metros, Buses, Tramways, Monorails etc. b) Smart Infrastructure: - Smart buildings, Net Zero energy Buildings, Road systems c) Case studies of Smart Cities	06 Hrs.

Textbooks:

1. Town Planning by Rangwala K. S. and Rangwala P. S Charotar Publishing House, 15th Edition, 1999
2. Fundamentals of Town Planning by G.K Hirasker Dhanpat Rai Publications, 2018
3. Rural development Planning – Design and method: Misra S.N., Satvahan Publications New Delhi

References:

1. A Guide to site and Environmental planning by Harvey M. Rubenstein
2. Urban and regional planning by Ramegowda K A
3. A city for all: valuing differences and working with diversity by Jo Beall (1997), Zed books limited, London (ISBN: 1-85649-477-2)
4. Urban Planning and cultural identity by William J. V. Neill (2004) Routledge, London (ISBN: 0-415-19747-3)
5. Draft Concept Note on Smart City Scheme, Government of India - Ministry of Urban Development

Class: Final Year B. Tech. Civil and Environmental Engineering		L	T	P	Credits															
Title of the Course: Environmental Management System (Professional Elective – V)		03	---	---	03															
Course No.: UCEE0824																				
Course Pre-Requisite: Students shall have the knowledge of: <ul style="list-style-type: none">• Environmental legislations• Activities related to environment in industries• Best practices for environmental management																				
Course Description: Environmental Management Systems course deals with the implementation of effective environmental management system in organizations managing the various environmental aspects. The course emphasizes on the requirements prescribed in ISO 14001:2015. ISO 14001:2015 standard is an International Standard followed worldwide for the environmental management in organizations.																				
Course Learning Objectives: <ol style="list-style-type: none">1. Understand the scope of ISO 14001:2015 Environmental Management System standard.2. Learn the requirements of ISO 14001: 2015 Environmental Management System standard.3. Understand the requirements & procedures for EMS audit.																				
Course Outcomes:																				
COs	After the completion of the course the students will be able to				Bloom’s Cognitive Descriptor															
CO1	Explain the terms used in ISO 14001 and ISO 19011 standards.				Cognitive (Understanding) L2															
CO2	Outline requirements of planning and implementation in EMS.				Cognitive (Understanding) L2															
CO3	Illustrate the process and requirements of EMS Audit as per ISO 19011.				Cognitive (Understanding) L2															
CO4	Summarize the requirements of checking and management review in EMS.				Cognitive (Understanding) L2															
CO-PO Mapping:																				
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12								
CO1	-	-	-	-	-	-	-	-	2	-	2	-								
CO2	-	-	-	-	-	-	-	-	2	-	2	-								
CO3	-	-	-	-	-	-	-	-	2	-	2	-								
CO4	-	-	-	-	-	-	-	-	2	-	2	-								
<table><tr><td>COs</td><td>PSO1</td><td>PSO2</td></tr><tr><td>CO1</td><td>-</td><td>-</td></tr><tr><td>CO2</td><td>-</td><td>-</td></tr><tr><td>CO3</td><td>-</td><td>-</td></tr><tr><td>CO4</td><td>-</td><td>-</td></tr></table>						COs	PSO1	PSO2	CO1	-	-	CO2	-	-	CO3	-	-	CO4	-	-
COs	PSO1	PSO2																		
CO1	-	-																		
CO2	-	-																		
CO3	-	-																		
CO4	-	-																		
Assessments:																				
Assessment				Weightage (Marks)																
ISE-1				10																
MSE				30																
ISE-2				10																
ESE				50																

<ul style="list-style-type: none"> • ISE-1 and ISE-2: Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc. (For each ISE two different tools are to be used). • MSE: Assessment is based on 50% of course content (Normally first three Units) • ESE: Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE. 	
Course Contents:	
Unit 1: Introduction to ISO, ISO History, Need of International Standards, Standard Development Process, Benefits of ISO Standards, Environmental Management System (EMS) and Sustainable Development, Concept of Life Cycle Analysis, Aim of EMS, Deming's PDCA Cycle, Scope of ISO 14001:2015 Standard, Terms and Definitions.	06 Hours
Unit 2: Leadership and Commitment, Environmental Policy, Organizational Roles, Responsibilities and Authorities, Planning, Actions to address Risks and Opportunities, General Requirements, Environmental Aspects, Environmental Impacts, Environmental Aspects – Impacts Analysis, Compliance Obligations, Environmental Objectives, Planning Actions to achieve Environmental Objectives.	08 Hours
Unit 3: Support – Resources, Competence, Awareness, Communication – Internal and External Communication, Documented Information – Creating and Updating, Control of Documented Information, Operation – Operational Planning and Control, Emergency Preparedness and Response.	06 Hours
Unit 4: Performance Evaluation – Monitoring, Measurement, Analysis and Evaluation, Evaluation of Compliance, Checklists, Calibration and Records, Standard Operating Procedures, Work Instructions.	06 Hours
Unit 5: Internal Audit, Internal Audit Programme, Terms and Definitions, Principles of Auditing, Managing Audit Programme, Audit Activities, Audit Checklists and Reports, Competence and Evaluation of Auditors.	08 Hours
Unit 6: Management Review - Need, Role of Management Representative, Role of Top Management, Improvement, Nonconformity and Corrective Action, Continual Improvement.	06 Hours
Textbooks: <ol style="list-style-type: none"> 1. International Standard ISO 14001:2015 – Environmental Management Systems – Requirements with Guidance for Use 2. International Standard ISO 14004:2016 - Environmental Management Systems - General guidelines on implementation 3. International Standard ISO 19011 – Guidelines for Environmental Management System auditing. 	
Reference Books: <ol style="list-style-type: none"> 1. Environmental Management Systems Auditors Course Manual by Confederation of Indian Industries. 	

Class: Final Year B. Tech. Civil and Environmental Engineering	L	T	P	Credits
Title of the Course: Advanced Construction Technology (Professional Elective – V)	03	---	---	03
Course No.: UCEE0825				

Course Pre-Requisite: Students shall have the knowledge of:

- Basic Civil Engineering
- Concrete Technology

Course Description:

This course will help the students to understand technologies involved in construction sector. This course will cover various technologies involved in construction of various structure, their standard procedures, suitability, significance, advantages and disadvantages.

Course Learning Objectives:

1. To understand various technologies used in construction sector.
2. To understand different types of temporary structures.
3. To understand advance concrete processes.
4. To understand different methods of excavation.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	Explain techniques involved in underwater construction.	Cognitive (Knowledge) L1
CO.2	Select appropriate type of temporary structure for various construction project.	Cognitive (Understanding) L2
CO.3	Demonstrate techniques involved in concrete technology.	Cognitive (Apply) L3
CO.4	Corelate various techniques and equipment's involved in excavation of earth.	Cognitive (Analyse) L4

CO-PO Mapping:

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

COs	PSO1	PSO2
CO.1	-	2
CO.2	-	2
CO.3	-	2
CO.4	-	2

Assessments:

Assessment	Weightage (Marks)
ISE-1	10
MSE	30
ISE-2	10
ESE	50

<ul style="list-style-type: none"> • ISE-1 and ISE-2: Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc. (For each ISE two different tools are to be used). • MSE: Assessment is based on 50% of course content (Normally first three Units) • ESE: Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE. 	
Course Contents:	
Unit: 1 Underwater Construction a) Cofferdams: Introduction, definition, types of coffer dams, selection of coffer dams, design features of coffer dams, leakage prevention and economical height of cofferdam. b) Control of Ground water in Excavations: Introduction, methods: pumping, well points, bore wells, electro-osmosis, chemical, freezing process, vibro-flotation.	05 Hrs.
Unit: 2 Temporary Works a) Form work for R.C.C. Wall, slab, beam and column, centering for arches of large spans, design features for temporary works, slip formwork. b) Scaffolding: Requirements, terminology, types, erections	07 Hrs.
Unit: 3 Advance concrete technology Sprayed concrete; underwater concrete; grouts, grouting and grouted concrete; mass concrete; pumped concrete; concrete for liquid retaining structures; vacuum process; concrete coatings and surface treatments, RMC	06 Hrs.
Unit :4 Pavement Construction Construction of concrete pavement by techniques like vacuum processing, vibrated concrete, Roller –compacted concrete. Use of techniques like slip form paving in pavement construction; using Wet MIX macadam in Road. Advanced Techniques, vacuum dewatering in concrete slab construction,	06 Hrs.
Unit :5 Excavation work a) Mechanical v/s manual construction, Excavation in Earth: Earth moving equipment- Tractors, Bulldozers, Scrappers, Power shovel, Hoes Types. b) Drag line, Clamshell, Trenchers, Compactors, Tippers, Cranes c) Quantity evolution of any equipment	06 Hrs.
Unit :6 Excavation in hard rock a) Excavation in hard rock: Rippers, Jack Hammers, Drills, Compressors and Pneumatic Equipment. b) Blasting Explosives, Detonators, Fuses, Drainage in excavation –Necessity and Methods of Dewatering.	06 Hrs.
Textbooks: <ol style="list-style-type: none"> 1. Developing New Entrepreneurs - Entrepreneurship Development Institute of Formwork design and construction---- Wynn 2. Concrete Technology--- M.S. Shetty S.Chand publication 	
References: <ol style="list-style-type: none"> 1. Handbook of Composite construction Engg--- G.M. Sabanis 2. Formwork design and construction---- Wynn 3. Bridge Engineering--- Raina 4. Bridge engineering Punnuswamy 	

Class: Final Year B. Tech Civil and Environmental Engineering Title of the Course: Environmental Sustainability (Professional Elective – V) Course No.: UCEE0826	L	T	P	Credits								
	03	---	---	03								
Course Pre-Requisite: Students shall have the knowledge of: <ul style="list-style-type: none">• Environmental Studies.• Environmental Governance.• Ecology and Environmental Sanitation.• Environmental Management.												
Course Description: The aim of this module is to provide both an introduction to sustainable development, including a moral approach to thinking sustainably, and a review of the principles and practices of sustainability. The course introduces the concept of sustainability, sustainable development framework and sustainable development goals, various engineering tools, role of technology towards sustainability, social responsibility strategies to promote environmentally sustainable development.												
Course Learning Objectives: <ol style="list-style-type: none">1. To provide basic introduction to sustainable development concepts, challenges of sustainable development and boundaries of sustainable development.2. To give a basic understanding of sustainable development framework, its pillars and application.3. To aware the students about various issues related to environmentally sustainable urban environment and different engineering tools to assess and design them.4. To update students about the individual and social responsibilities and role of government towards sustainable development.												
Course Outcomes:												
COs	After the completion of the course the students will be able to		Bloom’s Cognitive									
			Descriptor									
CO.1	Explain the basics about sustainable development and its concepts		Cognitive (Understanding) L2									
CO.2	Summarize different dimensions of environmental sustainability as well as its different applications.		Cognitive (Understanding) L2									
CO.3	Identify the issues and strategies to endorse environmental sustainability.		Cognitive (Applying) L3									
CO.4	Analyse behaviour change and social and environmental responsibility towards sustainable development.		Cognitive (Analysing) L4									
CO-PO Mapping:												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO.1							3		2			
CO.2							2		2			
CO.3							2		2			2
CO.4						3	3		2			2

	COs	PSO1	PSO2	
	CO.1			
	CO.2			
	CO.3			
	CO.4			
Assessments:				
Assessment			Weightage (Marks)	
ISE-1			10	
MSE			30	
ISE-2			10	
ESE			50	
<ul style="list-style-type: none">• ISE-1 and ISE-2: Assessment is based on Assignment/Declared Test/Quiz/Seminar/Group Discussions etc. (For each ISE two different tools are to be used).• MSE: Assessment is based on 50% of course content (Normally first three Units)• ESE: Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.				
Course Contents:				
Unit 1: Introduction: Evolution and History of sustainability, Brundtland commission report, Principles of sustainable development, Objectives, Conceptualization of sustainability, Boundaries of sustainable development.			07 Hours	
Unit 2: Sustainable development framework: Pillars of sustainable development, Impediments to achieving sustainability, Concept of environmentally sustainable development, Environmental dimensions of sustainability, Frameworks to measure sustainable development.			07 Hours	
Unit 3: Sustainable Transportation: Sustainable urban transport, Sustainable transport indicators, Electric vehicles and their impact on sustainability, Engineering tools for assessment and design for environment and sustainability.			06 Hours	
Unit 4: Strategies for promoting environmentally sustainable development: Sustainable Development Goals (SDG), Capacity Building, Human Rights and Intergenerational Equity, Environmental and Human Health, Sustainable Cities. Five frameworks for sustainability reporting: Global Reporting Initiative (GRI), Global Real Estate Sustainability Benchmark (GRESB), Sustainable Development Goals Disclosure (SDGD), Task Force on Climate-Related Financial Disclosures (TCFD), Sustainability Accounting Standards Board (SASB).			08 Hours	
Unit 5: Social and environmental responsibilities: Responsibilities towards environmentally sustainable development, Role of local Government, Steps for adopting sustainability approach, sustainable sanitation approaches, behavior change communication, community led sanitation, Corporate Social Responsibility (CSR).			06 Hours	

Unit 6: Green Energy and Sustainable Development: biodiversity and ecosystem services and their implications for sustainable development, global warming, greenhouse gas emissions, impacts, mitigation and adaptation, clean - green energy technologies.	06 Hours
Reference Books: <ol style="list-style-type: none"> 1. Abdul Malik, Elisabeth Grohmann. Environment protection strategies for sustainable development by. ISBN 978-94-007-1591-2. 2. Sylvie Faucheux, Martin O' Corner Jan van der strateen. Sustainable development: concepts, rationalities, and strategies, ISBN 978-94-017-3188-1. 3. Jennifer A. Elliott. An introduction to sustainable development. ISBN-13: 978- 0415590730. 4. LEAD India (Editor) Rio to Johannesburg: India's Experience in Sustainable Development, Orient Longman, Hyderabad, 2002. 5. Chopra, K., and Kadekodi, G.K. (1999), Operationalizing Sustainable Development, Sage Publication, New Delhi. 	