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

Curriculum for

B. Tech Programme

in

Environmental Engineering

Kolhapur Institute of Technology's

College of Engineering (Autonomous), Kolhapur

Teaching and Evaluation scheme for

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

Course Code	Course Name	Curriculum Component	Hours/Week				Evaluation Scheme			
			L	T	P	Credits	Component	Marks		
								Max	Min for passing	
UENV0301	Applied Mathematics	BS	3	1	-	**4**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0302	Environmental Chemistry & Microbiology	BS	4	-	-	**4**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0303	Fluid Mechanics	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0304	Structural Mechanics	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0305	Building Construction Technology	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0361	Audit Course I: Environmental Studies	BS	2	-	-	**-**	ESE	50	20	40
UENV0331	Water Quality Monitoring Laboratory	BS	-	-	2	**1**	ISE	50	20	
							ESE(OE)	25	10	
UENV0332	Fluid Mechanics Laboratory	PC	-	-	2	**1**	ISE	50	20	
							ESE(OE)	25	10	
UENV0333	Strength of Materials Laboratory	PC	-	-	2	**1**	ISE	25	10	
UENV0334	Material Testing Laboratory	PC	-	-	2	**1**	ISE	50	20	
							ESE(OE)	25	10	
UENV0335	Computer Aided Design Laboratory	ES	-	-	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 Environmental Engineering Semester - IV

Course Code	Course N ame	Curriculum Component	Hours/Week				Evaluation Scheme			
			L	T	P	Credits	Component	Marks		
								Max	Min for passing	
UENV0401	Surveying and Geomatics	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0402	Water Resources Engineering	PC	3	1	-	**4**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0403	Building Planning and Design*	PC	2	-	-	**2**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE*	50	20	
UENV0404	Environmental Hydraulics	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV04**	Professional Elective I	PE	3	1	-	**4**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0462	Audit Course II: Environmental Governance	ES	2	-	-	**-**	ESE	50	20	40
UENV0431	Surveying Laboratory	PC	-	-	2	**1**	ISE	50	20	
							ESE (OE)	25	10	
UENV0432	Building Planning and Design Laboratory	PC	-	-	4	**2**	ISE	50	20	
							ESE (OE)	25	10	
UENV0433	Open Channel Hydraulics Laboratory	PC	-	-	2	**1**	ISE	50	20	
							ESE (OE)	25	10	
UENV0434	Computational Laboratory	PC	-	-	2	**1**	ISE	50	20	
UENV0435	Environmental Instrumentation Laboratory	PC	-	-	2	**1**	ISE	25	10	
			16	**2**	**12**	**22**	**500 + 300 = 800 + Audit Course**			

Total Credits - 22, Total Contact hours – 30

*End Semester Examination of 4 hours

Professional Elective – I	
UENV0421	Ecology and Environmental Sanitation
UENV0422	Remote Sensing and GIS
UENV0423	Engineering Geology

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Teaching and Evaluation scheme for
Third Year B. Tech. Program in Environmental Engineering Semester - V

Course Code	Course Name	Curriculum Component	Hrs/Week				Evaluation Scheme			
			L	T	P	Credits	Component	Marks		
								Max	Min for passing	
UENV0501	Water Supply Engineering	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0502	Engineering Management and Economics	HS	3	1	-	**4**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0503	Solid and Hazardous Waste Management	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0504	Geotechnical Engineering	PC	3	1	-	**4**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV05**	Professional Elective II	PE	3	1	-	**4**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0563	Audit Course III: Transportation Engineering	PC	2	-	-	**-**	ESE	50	20	40
UENV0531	Water Treatment Laboratory	PC	-	-	2	**1**	ISE	50	20	
							ESE (OE)	50	20	
UENV0532	Solid Waste Monitoring Laboratory	PC	-	-	2	**1**	ISE	50	20	
							ESE (OE)	25	10	
UENV0533	Geotechnical Engineering Lab	PC	-	-	2	**1**	ISE	50	20	
							ESE (OE)	50	20	
UENV0541	Mini Project Lab	MC	-	-	2	**1**	ISE	25	10	
			17	**3**	**8**	**22**	**500 + 300 = 800 + Audit Course**			

Total Credits - 22, Total Contact hours – 28

Professional Elective – II	
UENV0521	Renewable Energy Engineering
UENV0522	Green Buildings
UENV0523	Noise Pollution and Control

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Teaching and Evaluation scheme for
Third Year B. Tech. Program in Environmental Engineering Semester - VI

Course Code	Course Name	Curriculum Component	Teaching Scheme				Evaluation Scheme			
			L	T	P	Credits	Components	Marks		
								Max	Min for passing	
UENV0601	Waste Water Engineering	PC	3	-	-	**3**	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
UENV0602	Air Pollution and Control	PC	3	-	-	**3**	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
UENV0603	Design of Concrete Structures	PC	4	-	-	**4**	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
UENV06**	Professional Elective III	PE	3	1	-	**4**	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
OEL06**	Open Elective I	OE	2	1	-	**3**	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
UENV0664	Audit Course IV: Research Methodology	PC	2	-	-	**-**	ESE	50	20	40
UENV0631	Waste Water Engineering Laboratory	PC	-	-	2	**1**	ISE	50	20	
							ESE (OE)	50	20	
UENV0632	Air Pollution and Control Laboratory	PC	-	-	2	**1**	ISE	50	20	
							ESE (OE)	25	10	
UENV0633	Design of Concrete Structures Laboratory	PC	-	-	2	**1**	ISE	50	20	
UENV0634	Design & Drawing of Environmental Systems Laboratory	PC	-	-	4	**2**	ISE	50	20	
							ESE (OE)	25	10	
			17	**2**	**10**	**22**	**500 + 300 = 800 + Audit Course**			

Total Credits - 22, Total Contact hours - 29

Professional Elective – III		**Open Elective I**	
UENV0621	Environmental Geotechnology	UOEL0631	Environmental Laws and Policies
UENV0622	Optimization Techniques	UOEL0632	Occupational Health and Safety
UENV0623	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 Environmental Engineering Semester-VII

Course Code	Course Name	Curriculum Component	Teaching Scheme				Evaluation Scheme			
								Marks		
			L	T	P	Credits	Components	Max	Min for passing	
UENV0701	Industrial Waste Treatment	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0702	Advance Water and Wastewater Treatment	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0703	Quantity Surveying and Valuation *	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE *	50	20	
UENV0704	EIA and Environmental Legislation	PC	3	1	-	**4**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
OEL07**	Open Elective II	OE	2	1	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0765	Audit Course V: Environmental Management	PC	2	-	-	-	ESE	50	20	40
UENV0731	Treatability Studies Laboratory	PC	-	-	2	**1**	ISE	50	20	
							ESE (OE)	25	10	
UENV0732	Quantity Surveying and Valuation Laboratory	PC	-	-	2	**1**	ISE	50	20	
							ESE (OE)	50	20	
UENV0741	Seminar and Vocational Training Laboratory	MC	-	-	2	**1**	ISE	50	20	
UENV0751	Project Phase I Laboratory	MC	-	-	2	**1**	ISE	50	20	
			16	**2**	**08**	**20**	**500 + 300 = 800 + Audit Course**			

Total Credits – 20, Total Contact hours – 26

*End Semester Examination of 4 hours

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

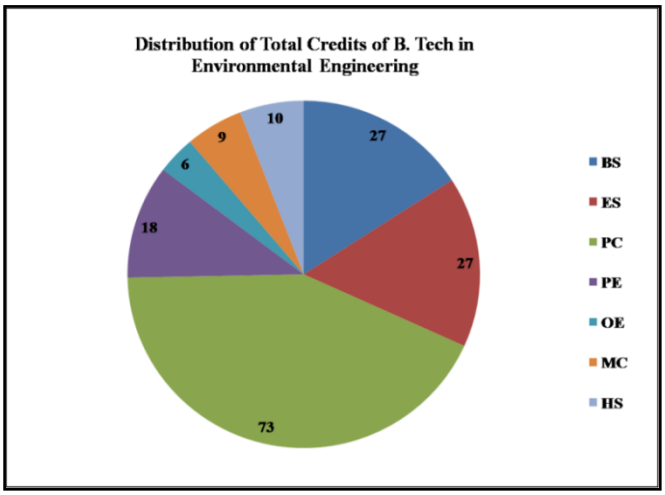
Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Teaching and Evaluation scheme for
Final Year B. Tech. Program in Environmental Engineering Semester-VIII

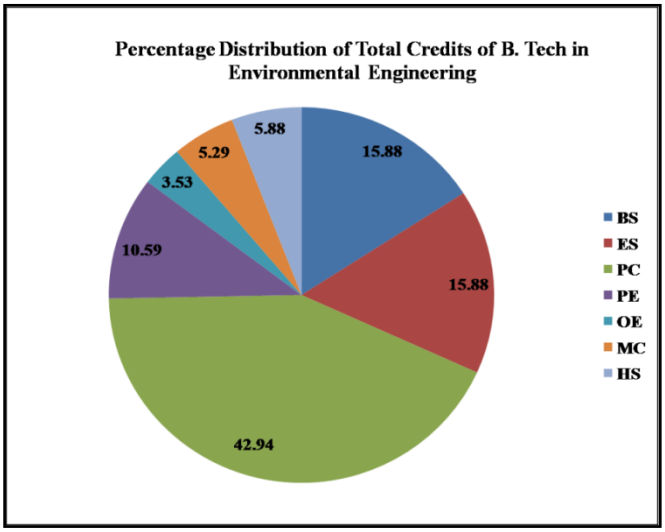
Course Code	Course Name	Curriculum Component	Teaching Scheme				Evaluation Scheme		
			L	T	P	Credits	Components	Marks	
								Max	Min for passing
UENV0852	Project Phase II	MC	-	-	12	**6**	ISE I	75	30
							ISE II	75	30
							ESE (OE)	150	60
UENV08**	Professional Elective IV	PE	3	-	-	**3**	ISE-I	10	20
							ISE-II	10	
							MSE	30	
							ESE	50	20
UENV08**	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**	
UENV0821	Industrial Health and Safety	UENV0824	Environmental Management System
UENV0822	Environmental Modeling and Simulation	UENV0825	Project Management
UENV0823	Design of Environmental Structures	UENV0826	Clean Development Mechanism

Total Credits from S.Y. B. Tech to Final Year B. Tech										
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	9	-	-	-	-	-	27	15.88
Engineering Sciences	13	13	1	-	-	-	-	-	27	15.88
Program Core (PC)	-	-	12	18	13	15	15	-	73	42.94
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	-	-	4	-	-	-	10	5.88
Total	**25**	**25**	**22**	**22**	**22**	**22**	**20**	**12**	**170**	**100**





SYLLABUS

T. Y. B. Tech

Environmental Engineering

SEMESTER - V

Class: T.Y. B. Tech. Environmental Engineering Title of the Course: Water Supply Engineering Course Code: UENV0501	L	T	P	Credits
	3	-	-	3

Course Pre-Requisite:

Students shall have knowledge of:

- Environmental chemistry and microbiology
- Hydraulics and water resource engineering

Course Description:

This course teaches the fundamentals and design concepts of water supply systems and water treatment plants, as well as the processes involved with their operation. Topics covered include water supply systems, water quality issues, and water treatment processes and systems. After completing this course student will be able to design, water collection systems and water treatment plants.

Course Objectives:

During this course students will

1. know sources and characteristic of raw water, quantity and quality of water for drinking purpose.
2. understand concepts of collection and conveyance of water from source.
3. acquire an understanding of the fundamental concepts and detailed technical knowledge of the technologies required for water treatment.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Descriptor
CO 1	**Explain** basic requirements of raw water abstraction, transport, treatment and distribution for drinking water supply systems for urban and rural areas	Cognitive
CO 2	**Select** treatment process based on quality of raw water	Cognitive
CO 3	**Design** raw water abstraction, transport, conventional treatment units and distribution systems	Cognitive

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1	2	
CO2		2
CO3		2

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, quantity and quality of Water: Quantity of water, population forecasting, rate of consumption for various purposes, factors affecting consumption, fluctuation in demand, surface water sources, ground water sources, quality of water, drinking water standards (IS10500), physical; chemical and bacteriological characteristics of water.	**6 Hrs.**
Unit 2 : Collection and conveyance of water: Intake works-types, design of rising main, economic size of rising main, location and design of jack well and pump house.	**4 Hrs.**
Unit 3 : Treatment of water: Objectives and necessity of treatment, study of flow sheet for different sources of water, aeration, two film theory of gas transfer, types of aerators, theory of coagulation and flocculation, rapid mix and slow mix units, design of flash mixer, design of mechanical flocculator, types of settling, design of sedimentation tank, filtration process, classification of filters, design of rapid sand filter, introduction to multimedia filters and pressure filters.	**10 Hrs.**
Unit 4 : Disinfection: Mechanism of Disinfection, Physical & chemical disinfectants, factors affecting disinfection, Characteristics of good disinfectant, chlorination- types, break point chlorination, introduction to UV and ozone disinfection.	**6 Hrs.**
Unit 5: Miscellaneous treatments: Water softening: Lime soda process, recarbonation, ion exchange process, Removal of colour, taste and odour, iron and manganese, fluoridation and defluoridation.	**6 Hrs.**
Unit 6: Water supply schemes: House connection from mains, different valves, meters and hydrants, storage reservoirs, balancing reservoir, detection and prevention of leaks in the distribution systems, maintenance of distribution systems. Necessity of water audit, water Audit in domestic sector, water losses and follow up. Rural water supply systems, selection of sources, quantitative requirements. Pre-feasibility and Feasibility report, Preparation of DPR	**8 Hrs.**

Textbooks:

1. Water Supply & Sanitary Engineering by by Birdie G. S., Birdie J. S., Dhanpatrai Publishing Company.
2. Water Supply Engineering by by Dr. B. C. Punmia, Er. Ashok Kr. Jain, Dr.Arun Kumar Jain

References:

1. Manual of Water Supply and Treatment (3rd ed)- Ministry of Urban Development, New Delhi, 1991.Water Quality and Treatment Handbook -American Water Works Association, McGraw-Hill Pub. 1999.
2. Mark J. Hammer & Mark J. Hammer Jr., Water and Waste Water Technology, Prentice Hall of India Pvt. Ltd., 1998, New Delhi.
3. Fair, Geyer & Okun, Water & Waste Water Engineering, John Wiley, 1966, New York.
4. Ernest W. Steel & Terence J. Mc Ghee, Water Supply & Sewage, McGraw Hill, 1990, New York.

5. Physico Chemical Processes for Water Quality Control – Walter J. Weber Jr. Wiley

Unit wise Measurable students Learning Outcomes:

At the end of course students will be able to

ULO1:Explain the structure of drinking water supply systems for urban and rural areas, including sources, forecasting water demand, water transport, treatment processes and distribution and will be able to analyse water quality and interpret the relevance of these in relation to public health and environmental regulations:

ULO2: Explain & design intake works and rising mains:

ULO3: Select treatment process based on quality of raw water and explain & design various conventional water treatment units:

ULO4: Explain disinfection of water:

ULO5: Demonstrate scientific concepts and detailed technical understanding of the technologies required for specific treatment processes for water:

ULO6: Demonstrate scientific concepts and detailed technical understanding of the technologies required for water distribution system, rural water supply and preparation of reports and design of water distribution system:

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Engineering Management & Economics Subject Code : UENV0502	L	T	P	Credit
	3	1	-	4

Course Pre-Requisite: Students must have knowledge of
Basic Civil Engineering
Engineering Mathematics
Environmental Studies

Course Description:

Students will learn basic principles of management, including their components. Understands the importance of scheduling along with their practical applications. Will able to identify critical activities from various activities also it will enhance the skill of students in material management & decision making.

They will able to analyze the economical viability of the project using various techniques.

This subject introduces students basic Legislation associated with project activity and its importance.

Course Objectives:

1. To explain managerial & leadership roles in engineering projects.
2. To discuss the fundamentals of material management & importance of engineering economics in projects.
3. To discuss fundamentals of project planning & decision making.
4. To elaborate the factors affecting legal aspects of engineering projects.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Descriptor
CO1	Select the managerial & leadership responsibilities in engineering projects.	**Cognitive (Remembering)**- L1
CO2	Solve the problems related to project planning & decision making in engineering projects.	**Cognitive (Applying)**-L3
CO3	Examine the economical viability of engineering projects & apply principles for managing materials at engineering projects.	**Cognitive (Analyzing)**-L4
CO4	Assess the legal procedures of engineering projects.	**Cognitive (Evaluating)**-L5

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1		
CO2		2
CO3		2
CO4		

Assessments :

Assessment	Weightage (Marks)
ISE I	10
ISE II	10
MSE	30
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: Principles of Management (by Henry Fayol). Functions of Management: a) Planning – Nature, Process and Importance of Planning, b) Organizing – Types, Organization Charts, Site Layout, c) Staffing – Introduction, d) Directing, Co-Ordination, Communication, Motivation and Controlling. e) Decision Making: Process, decision Tree (Concept Only)	**7 Hrs.**
Unit 2: Material Management – Purchasing Principles, Stores: Coding System, Function, Responsibilities, Record and Accounting, Inventory Control – An Introduction, Inventory Cost, EOQ Analysis, ABC Analysis, Safety Stocks.	**7 Hrs.**
Unit 3: Engineering Economics – (a) Introduction, Importance, Time Value of Money, Equivalence, Tangible and Intangible Factors, b) Economic Comparisons- Present Worth Method, Equivalent Annual Cost Method, Capitalized Cost Method, Net Present Value, Rate of Return, Payback Method.	**8 Hrs.**
Unit 4: Project Management: Introduction, steps in Project Management – Work Break Down Structure. Project Planning - Bar Chart, Mile Stone Chart, Development, Critical Path Method (CPM): Introduction, Time Estimates, Floats, Critical Path. Crashing of Network.	**7 Hrs.**
Unit 5: Performance Evaluation and Review Techniques (PERT) - Concept of Probability, Normal and Beta Distribution, Time Estimates and Calculations of Project Duration, Slack, Probability of Project Completion, Precedence Network concept.	**7 Hrs.**

Unit 6: Legal Aspects: Child Labour Act., Workmen's Compensation Act, Minimum Wages Act, Factory Act.	**4 Hrs.**

Textbooks:

1. Engineering Management – Stoner
2. Principles of Management – Davar
3. A Text book of Management – A.S.Deshpande

References:

1. Operation Research – S.H.Deshpande
2. Operation Research – Wagner Wikey Easter Ltd., new Delhi

Unit Outcomes (UOs)

Unit 1- Implement principles of management & use tools like, Planning, Controlling, Organizing & Directing. (CO1)

Unit 2- Able to implement procedures like purchasing, coding , recording while managing materials at any Engineering projects .(CO3)

Unit 3- Able to use methods like Present Worth Method, Benefit Cost ratio Etc to study economics of any project.(CO3)

Unit 4- Implement project planning procedures such as Bar chart, Milestone chart & CPM. (CO2)

Unit 5- Able to solve project problems using PERT techniques.(CO2)

Unit 6- Able to select proper site for project and follow legal procedures required. (CO4)

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Solid and Hazardous Waste Management Subject Code : UENV0503	L	T	P	Credit
	3	-	-	3

Course Pre-Requisite: Students must have knowledge of

- Environmental Studies

Course Description:

In this Solid and Hazardous Waste Management Course, we will discuss the processes involved in the management of solid wastes – from waste generation to final disposal.

Course Objectives:

1. To explain components, generation rate & characteristics of solid waste.
2. To elaborate appropriate treatment & disposal option for solid waste.
3. To explain sources, characteristics, treatment & disposal options of hazardous waste.
4. To discuss use of environmental legislation for legal & safe solutions.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Descriptor
CO1	Explain components, generation rate & characteristics of solid waste.	**Cognitive** **Understanding- L2**
CO2	Choose the appropriate treatment & disposal option for solid waste.	**Cognitive** **Applying- L3**
CO3	Identify sources, characteristics, treatment & disposal options of hazardous waste.	**Cognitive** **Applying- L3**
CO4	Make use of environmental legislation for legal & safe solutions.	**Cognitive** **Applying- L3**

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	-	2
CO4	-	-

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 solid waste: Sources, composition, generation rates, collection of waste, separation, transfer and transport of waste. Economic aspects of refuse collection, Source Reduction, segregation and salvage, recovery of bye – products.	6
Unit 2: Processing: Composting: Theory of composting, types of composting, factors governing composting, processing before composting, mechanical composting plant, recovery of Bio – gas energy from organic solid waste, RDF.	6
Unit 3: Landfill Design : operation & management of landfill sites: Sanitary landfill site selection, Disposal site classification, Landfill site design, Landfill operation, maintenance and precautions, leachate and its control, control of contamination of ground water, Water quality monitoring, Operation monitoring. Rehabilitation, Closure & end-use.	7
Unit 4: Introduction hazardous waste: Sources, characterization of hazardous waste, compatibility and flammability of chemicals, fate and transport of chemicals, health effects. Waste generation from nuclear power plants & its disposal options. Defining risk and environmental risk, methods of risk assessment, measures,	7
Unit 5: Processes: Chemical treatment processes for Hazardous Waste (combustion, stabilization and solidification of hazardous wastes). Physico-chemical processes for hazardous wastes (soil vapor extraction, air stripping, chemical oxidation), Concept of incinerator.	7

Unit 6: Legal Aspects: Municipal solid waste rules, hazardous waste rules, biomedical waste handling rules, fly ash rules, recycled plastics usage rules, batteries rules.	6
Textbooks: 1. Handbook and Solid Waste Disposal – George Tchobanoglous 2. Hazardous Waste Management - Charles Wentz 3. Solid Waste Management – Dr. A. D. Bhide	
References: 1. CPHEEO Manual on Solid Waste Vol. I,II	
Unit wise Measurable Students Learning Objectives and Outcomes: UO1- Explain sources, composition & generation rate of solid waste. UO2- Choose proper treatment & disposal for solid waste. UO3- Select appropriate procedures for construction and operation of sanitary landfill. UO4- Explain sources, characteristics & associated risk of the hazardous waste UO5-. Choose proper treatment & disposal for hazardous waste UO6- Recall the legislative procedures for various solid waste.	

Class: T.Y.B. Tech. Environmental Engineering Title of the Course: Geotechnical Engineering Course No.: UENV504	L	T	P	Year
	3	1	-	2019-20

Course Pre-Requisite:

Students shall have knowledge of:

- Algebra and Engineering Mathematics
- Engineering Physics and Chemistry
- Engineering Mechanics
- Fluid Mechanics

Course Description:

The course imparts fundamental knowledge of geotechnical properties and their significance in Civil and Environmental Engineering. The subject covers; interpretation of index and engineering properties, their field relevance as well as estimation of stresses, development of earth pressure, analysis of stability of earth work. The basics and concepts of foundation design and settlement analysis are also dealt.

Course Objectives:

1. To study various soil properties and its methods of determination.
2. To understand applications of soil properties in Civil and Environmental Engineering
3. To study parameters of soil for strength and stability.
4. To understand concepts of foundation design and settlement analysis.

Course Learning Outcomes:

CO	After the completion of the course the will be able to	Bloom's Taxonomy Cognitive Domain
CO1	Explain soil properties and methods for its determination	Understanding L2
CO2	Utilize soil properties for predicting soil performance.	Applying L3
CO3	Analyze shear strength, earth pressure and slope stability.	Analyzing L4
CO4	Evaluate suitability of foundations and estimate settlement	Evaluating L5

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1		-
CO2		-
CO3		2
CO4		2

Assessments :

Assessment	Weightage
ISE - I	10
MSE	30
ISE- II	10
ESE	50

Course Contents:

Unit 1: Properties of Soil: Introduction to Geotechnology and its application areas , Formation of soil, Soil as three phase system, Weight- Volume relationships, Index & Engineering properties of soil, Determination of index properties and its significance, Soil classification and Soil structure.	**8 Hrs.**
Unit 2: Soil hydraulics: Modes of occurrence of water in soil, Darcy's law & its validity, Coefficient of permeability & its determination methods, Factors affecting permeability, Permeability of layered soils. Seepage analysis: Quick sand condition, Uplift pressure, exit gradient, failure due to piping, Flow net - properties and applications, Concept of effective, neutral & total stress in soil mass.	**6 Hrs.**
Unit 3: Compaction & Consolidation: Compaction**:** Theory, Methods of compaction, Standard Proctor test and Modified Proctor test as per IS – 2720. Field compaction equipments and methods, Field control of compaction, Factors affecting compaction, Consolidation**:** Consolidation process - Spring analogy, e- log P curve, Terzaghi's theory of one dimensional consolidation, Lab consolidation test, Determination of coefficient of consolidation, Type of settlement, rate and time of settlement.	**6 Hrs.**
Unit 4: Shear Strength and its measurement: Concept of shear, Principal plane and stresses, Mohr - Coulomb's theory and failure envelope of types of soil, Total stress approach and effective stress approach, Types of shear test – Direct (box) shear test, Triaxial compression test, Unconfined compression test. Drainage conditions:Unconsolidated–Undrained(U-U), Consolidated -Undrained (C-U) and Consolidated –Drained (C-D)	**7 Hrs.**
Unit 5: Earth Pressure Concept, earth pressure at rest, active and passive condition, Rankine's and Coulomb's theory of earth pressure, Estimation of earth pressure in different conditions. **Concept of slope stability:** Slope classification, slope failure modes, Infinite, Finite slope and analysis of stability, Taylor's stability number, slope protection measures.	**7 Hrs.**
Unit 6 : Foundation Engineering: Bearing Capacity Estimation: Terzaghi's bearing capacity equation, I.S. Code method of bearing capacity evaluation, Effect of various factors on bearing capacity, Plate load test, Standard Penetration Test Foundation Settlement: **C**omputations from I.S. 8009-1976 (Part I) approach and from Plate load test observations, consolidation settlement computations, total, differential settlement, Tolerable settlement. Types of foundation: Shallow & Deep, Design concepts & considerations for	**6 Hrs.**

shallow foundations. Introduction to geosynthetics / geotextile.	

TEXT BOOKS & REFERENCE BOOKS

1. Text book of soil mechanics in theory and practice‖ by Dr. Alam Singh (Asian Publishing House, Bombay)
2. Soil mechanics and Foundation engineering‖ by V. N. S. Murthy. (U. B. S. Publishers and distributors New Delhi
3. Soil mechanics and Foundation engineering‖ by B. S. Punmia. (A Saurabh and Company Pvt. Ltd., Madras)
5. Geotechnical Engineering‖ by P. Purushottam Raj.(Tata Mcgraw Hill Company Ltd. New Delhi)
7. Soil mechanics‖ by Terzaghi and Peak. (John Willey and Sons, New- York)
8. Soil Testing by T.W. Lambe. (Willey Eastern Ltd., New Delhi)
9. Geotechnical Engineering by Venkatramiah

Unit wise Measurable Students Learning Objectives and Outcomes:

Unit	Student Learning outcome
Unit 1	Derive functional relationships, determine soil properties and understand soil classification and structure.
Unit 2	Analyze flow problem through soil and estimate seepage and stresses developed in soil.
Unit 3	Establish criteria for field compaction and suitability of compaction equipments. Estimate consolidation of soil layer, thereby probable foundation settlement
Unit 4	Select suitable laboratory method for shear stress parameter determination and interpret soil strength.
Unit 5	Apply theories and calculate magnitude of earth pressure as well as its point of application. Analyse slope stability and design a stable slope.
Unit 6	Evaluate bearing capacity of soil, predict probable settlement and propose suitable foundation type.

Class: T.Y.B. Tech. Environmental Engineering Title of the Course: Renewable Energy Engineering Subject Code (University): Course No.: UENV0521	L	T	P	Year
	3	1	-	2019-20

Course Pre-Requisite:

Students shall have knowledge of:

- Engineering Physics and Chemistry
- Ecology and Environmental Science
- Principles of management

Course Description:

The course emphasizes on studying energy demand, types and potential of renewable energy sources, concepts and technology to harness, its applications and limitations.

Course Objectives:

5. To study energy needs, demand and various renewable alternatives.
6. To understand potential of renewable energy resources.
7. To study technologies to harness the energy.
8. To understand advantages, limitations of resources and energy management.

Course Learning Outcomes:

CO	After the completion of the course the will be able to	Bloom's Taxonomy Cognitive Domain
CO1	Compare conventional and renewable energy resources	Understanding L2
CO2	Identity scope and potential of renewable energy.	Applying L3
CO3	Analyze suitability of renewable energy resource.	Analyzing L4
CO4	Explain energy management principles and strategies.	Evaluating L5

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1		1
CO2		2
CO3		1
CO4		2

Assessments :

Assessment	Weightage
ISE - I	10
MSE	30
ISE- II	10
ESE	50

Course Contents:

Unit 1: Introduction: Energy chains, Energy demand, Energy crises. Worlds production & consumption of energy resources. Renewable energy resources, types & potential	**3 Hrs.**

Unit 2: **Solar Energy:** Introduction, utilization methods, merits & demerits of solar energy utilization, potential of solar energy, solar radiation, data for India, solar thermal collectors, concentrators & reflectors, collector efficiency, application of solar energy, solar cooker, solar water heating, solar dryer, solar distillation, solar photovoltaic systems, solar pond.	**7 Hrs.**
Unit 3: **Hydro Energy:** Introduction**,** India's Hydro reserves, merits & limitations, low head , medium head, high head schemes, hydro turbines, economics **Geothermal Energy:** Introduction, types of geothermal resources, potential of geothermal resources in India & world. Environmental problems in utilization of geothermal resources.	**8 Hrs.**
Unit 4: **Wind Energy:** Introduction, potential & scope, classification & types of wind machines, application of wind energy, merits & limitations of wind energy. Site selection for wind farm, wind map of India, wind energy station in India **Tidal Energy:** Tides, tidal range, tidal power, suitably sites & prospects. Types of tidal power plants, single basin, modulated single basin & double basin schemes, main equipments, energy storage.	**7 Hrs.**
Unit 5 **Ocean thermal energy conversion:** Introduction, principle of OTEC, open cycle & closed cycle OTEC schemes, potential & prospects in India **Wave Energy:** Introduction, power of wave, wave data collection, wave machines(wave energy converters), forces on wave machines and associated structures, merits & demerits of wave energy	**8 Hrs.**
UNIT 6 **Biomass Energy Resources**: Biomass energy, biomass energy from cultivated crops & from waste organic matter, biomass conversion processes, incineration & thermo chemical, biochemical conversion of biomass, energy from plants / projects. **Energy Management & planning:** Energy management principles, Energy & pollution trade off, objectives of energy management, energy strategy & energy planning, Energy audit.	**7 Hrs**
Text and Reference books: 1. Environmental studies: Benny Joseph 2. Environmental Biology: K. C. Agarwal **3.** Environmental Encyclopedia: Cunningham, W. P. Cooper, T. H. Hepworth (Jaico Pub.) 4. Energy & Ecology : David M.Gates (Sinaur Associates) 5. Non Conventional Energy Sources: G.D.Rai 6. Power Technologies : Stephenson 7. Energy Technology: S.Rao & B.B.Parulekar	
Term work: Tutorials based on numerical problems and foundation design problems	

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Green Building Course No.: UENV0522	L	T	P	Year
	3	1		

Course Pre-Requisite:
Building Planning & Design
Knowledge of Building Services,
Basic Civil Engineering

Course Description: The course is imparting fundamental knowledge of Introduction to Sustainable Site Selection, Passive and Active Architecture ,Green Rating of building , Water Efficiency Water Efficient Landscaping, Indoor Environmental Quality ,Recycling of Building materials

Course Objectives:
At the end of the course students will

1. To understand basic knowledge of various parameters of climate and accordingly necessary provision to be made for obtaining comfort condition in building.
2. To adapt techniques of reduction of various natural resources used in building
3. To explain various methods of improving indoor air quality in buildings.
4. To aware of the various rating systems for green building.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Descriptor
1	Study The Various Environmental Parameters For Green Building	Cognitive
2	Design The Various Building Components Of Building Based On Green Concepts	Cognitive
3	Plan Various Energy Systems In The Building	Cognitive
4	Plan Various Systems Of Reducing Natural Resources.	Cognitive
5	Evaluate Indoor Air Quality	Cognitive

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO 2			2									
CO 3	2											
CO 4					2							
CO 5			1									

CO	PSO1	PSO2
CO 1	2	
CO 2	3	
CO 3		2
CO 4	1	
CO 5	2	

Assessments :

Direct Assessment (60 % + 40%)	Weightage
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 Sustainable Site Selection Orientation, Building envelop, Building plan layout, Design of Doors and windows, Natural ventilation, Solar energy, Use of solar energy for water heating, Solar concentrators, Solar photovoltaic panels, Direct and indirect lighting, comparison of various lighting devices- electric tubes, incandescent lamps, CFL and LED lamps, Indirect lighting devices -Light Tubes, Fibre optic, Fresnel lense	10
Unit – 2 Passive and Active Architecture, Natural ventilation and air conditioning, Hybrid system of active and passive refrigeration and air conditioning. Concept of Embodied Energy, Embodied energy of various common building materials, Thermal properties of building components, Thermal storage, emissivity, reflectivity, Selection of materials and surface treatment for improvement in thermal comfort with minimum energy input. Energy audit of building,	5
Unit – 3 Green Rating of building, LEED criteria, USGBS, CIII-Godrej Green rating, CDM and Carbon trading, Environmental clearance of buildings.	5
Unit – 4 Water Efficiency Water Efficient Landscaping –Rain water harvesting, potable water and bore well recharging methods, Minimisation of water use, Dual flush, waterless urinals, smart controlled water taps, Segregation and treatment of wastewater, Various treatment technologies like septic tank, Anaerobic filter, CWTS, biogas plants advanced treatment options like carbon bed, reverse osmosis, electrodialysis, ion exchanger, recycling of treated wastewater for different non potable purpose, Domestic solid waste – Segregation, earthworm composting other options.	6

Unit – 5 Indoor Environmental Quality Low- VOC Emitting Materials - Adhesives & Sealants, Paints & Coatings, Carpet Systems, Composite Wood & Agro-fiber Products like coconut, jute, bamboo and their use as interiors	7
Unit-6 Recycling of Building materials, Existing Walls, Floors & Roof, Interior Non-Structural Elements. Construction Waste Management, Materials Reuse, Recycled Content,, Use of fly ash, foundry sand and other inert solid wastes in buildings Life cycle analysis, Construction phase, operation phase, demolition, Impact on environment and land use.	7
Textbooks: **1. Handbook of energy conscious building**	
References: 1. Handbook of energy conscious building	
Unit wise Measurable Students Learning Objectives and Outcomes: ULO 1 Discuss various sustainable site selection criteria (CO1, CO2) ULO 2 Explain various active & passive architecture (CO2) ULO 3 Discuss various Rating Systems for Building performance.(CO3,CO6) ULO 4 Describe various water conservation as well waste water treatment processes for building effluent.(CO3,CO4) ULO 5 Discuss various LOW Voc material and its associated impacts.(CO5) ULO 6 Explain the Life Cycle Assessment and Embodied energy for various building material. (CO4, CO5)	

Class: T. Y. B. Tech Environmental Engineering Title of the: Noise Pollution and Control Course Code:UENV0523	L	T	P	Credit
	3	1		4

Course Pre-Requisite: Knowledge of engineering physics

Course Description: This course is intended to make students aware about the sourcessound propagation and measurement in outdoor atmosphere, various auditory and non auditory effects, physiological and psychological on human as well as on environment. It also include study of health monitoring with respect to noise, assessment of Noise Induced Hearing Loss ambient and various engineering and non engineering measures for control of noise. The students will be made aware of the ambient and exposure standards w.r.t. noise as well as various legal provisionsfor regulation and control of noise.

Course Objectives:

1) Study the sound transmission and effects of Noise
2) Learn the measurement of noise in industries and community
3) Learn the various techniques of noise control
4) Study the permissible limitsand other legal provisions for control of noise.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain influence of various factors on outdoor transmission of sound	2	Explain
CO2	Calculate various indices like Leq, L_{DN} , L_{NP} based on noise monitoring data	3	Calculate
CO3	Select various measures for control for noise for industries and community	4	Select
CO4	Compare the measured noise level with permissible limit	4	Compare

CO-PO Mapping:

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

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

Assessments :

Teacher Assessment:

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

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three Units)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three Units) covered after MSE.

Course Contents:

Unit 1:---Introduction to noise and sound Definition of noise, noise vs. sound, Sources of noise and classification, Infrasonic and ultrasonic sound, Threshold of hearing, Threshold of pain, Sound characteristics, transmission, in outdoor atmosphere,Factors influencing sound transmission in outdoor atmosphere,Measurement of sound with respect to sound pressure, Sound power and sound intensity, Sound Level Meter,	**7 Hrs.**
Unit 2:---Community noise Characteristics and noise level of sources in community, Measurement of community noise- , Equivalent noise, Average Day & Night noise, Noise Pollution Levels, Noise Percentile, noise contours,	**8Hrs**
Unit 3:--- Impacts of noise Anatomy of human ear and mechanism of hearing, Effects of noise - effects on human health, auditory effects, physiological and psychological effects, effects on animals, plants, and on structures	**5Hrs**
Unit 4:---Industrial noise Characteristics and noise levels generated in various industrial operations, Measurement of industrial noise, OSHA exposure standards, Exposure measurement, Health Monitoring, Procedure of Audiometric testing and Interpretation of Noise Induced Hearing Loss	**7 Hrs.**
Unit 5:---Control of noise Varioustechniques forcontrol of noise, noise reduction at source, acoustical absorbance devices, Enclosure, barrier, Various types of mufflers, Reduction at receiving end, Non engineering control of noise, Active Noise Reduction, Administrative control of noise, Personal protective Equipments for noise, Strategy for control of noise, Control of community noise, Frequency analyzer	**8 Hrs**

and octave band analysis	
Unit 6:---Legal Provision for control of noise Legal provisions for control of noise under Noise Pollution (Regulation & Control) Rules, 2000 and its amendments, Case studies in India and abroad	**5 Hrs.**

Textbooks:

1. Noise Pollution and Control Strategy by S.P. Singhal, Narosa Publishing House, 2005
2. Noise Pollution – S.K.Agrawal- APH Publishing carporation, New Delhi. 2009

References:

1. Handbook of Environmental management and technology by Gwendolyn Holmes, Ben Ramnasiuesingh and Louis Theodore (A Wiley – Enter science publication)
2. Standard Hand book of Environmental Engineering by Robert A. Corbett (McGraw Hill Inc.)
3. Industrial Pollution by N. Irving Sax (Van Nostrand Reinhold Company)
4. Environmental issues and programme by I. Mohan (Ashish publishing house)
5. Environmental Engineering by G.N.Pandey and G.C. Carney (Tata McGraw Hill)
6. Some thought on Environmental and law by C.S. Mehta (RBSA Publisher)
7. IS code for practice for noise reduction in industrial buildings IS: 3483, 1965
8. Soil & Noise pollution: DrB.K.Sharma& Dr. H.Kaur, Goel Publishing House, KrishanaPrakashanmandir, Meerut

Unit wise Measurable students Learning Outcomes:

At the end of the course, the students will be able to

UO 1	Solve problems based on sound measurement and conversion of units
UO 2	Classify sources of noise and explain various effects of noise
UO 3	Develop various indices used for community noise from given data
UO 4	Compare noise exposure of person to permissible exposure standards and identify NIHL
UO 5	Suggest suitable measures for control of noise in industries and community and PPEs
UO 6	Discuss various legal provisions for control of noise

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Audit Course III- Transportation Engineering Course No.: UENV0563	L	T	P	Credit
	02 hours per week	-	-	-

Course Pre-Requisite:

Students shall have the knowledge of:

- Basic Civil Engineering

Course Description:

Transportation Engineering course deals with the branches of civil engineering & requirements of highways engineering, traffic engineering, bridge engineering, railways engineering and airport engineering

Course Learning Objectives:

1. Understand scope of highway engineering & methods of construction.
2. Learn various terminologies related with traffic, bridge and airport engineering.
3. Study the capacity calculation for highways.
4. Understand the level of services provided for urban and rural highways.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	Understand concepts and planning of highway engineering	Cognitive (Understanding) L2
CO.2	Understand the various components involved in airport engineering.	Cognitive (Understanding) L2
CO.3	List the factors affecting design of a various parameters of bridge structures.	Cognitive (Analyzing) L4
CO.4	Interpret Highway capacity and level of service of highways.	Cognitive (Analyzing) L4

CO-PO Mapping:

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

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

Assessments :

Assessment	Weightage (Marks)
ISE-1	--
MSE	--
ISE-2	--
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 Highway Engineering Surveys Involved, Cross Section, Elements of geometric Design, Design Speed, Horizontal Alignment, Vertical Alignment, Sight Distance, Overtaking Lanes, Turning Radius, Super Elevation, Space standards for Rural & Urban Roads.	**04 Hrs.**
Unit: 2 Highway Construction: Highway materials, WMM roads, bituminous roads-BC, SDBC, DBM; concrete roads-DLC, PQC; soil stabilized road, MOST specifications. Highway Drainage: Necessity, surface and subsurface drainage, maintenance and repairs.	**04Hrs.**
Unit: 3 Traffic Engineering: Traffic safety, Accident reporting and recording systems, factors affecting road safety. Transport planning for target group children, adults, handicapped and women. Norms and guidelines for highway landscape. Street lighting types, standards and design considerations. Traffic Engineering: traffic characteristics, traffic studies and analysis, traffic control devices – road marking, traffic sign, traffic signal, intersections.	**05 Hrs.**
Unit: 4 Railway Engineering a) Introduction: Permanent Way, Components, coning of wheels b) Points & Crossing: Terms used, standard points and crossings, design of simple turnout various types of track junctions.	**04 Hrs.**
Unit: 5 Bridge Engineering Classification of bridges, selection of site, Bridge Hydrology: determination of design discharge, linear water way, economical span, location of piers and	**04 Hrs.**

abutments, afflux, scour depth. Construction and maintenance of bridges—Introduction; Recent trends in bridges.	
Unit: 6 Airport Engineering Introduction: Terminology, Airport Classification ICAO, components of an aircraft, aircraft characteristics. Environmental considerations: Air Traffic Control: VFR, IFR, Visual aids, airport lighting and marking. Runways: Orientation, wind rose, Basic runway length.	**05 Hrs.**

Textbooks:

1. C Khanna SK and Justo CEG (2005) Highway Engineering, Nem Chand Jain & Bros Delhi
2. Railway Engineering – K. F. Antia

References:

1. Pavement Analysis and Design -Yang H. Huang Prentice-Hall.
2. Principles of Transportation Engineering –ParthaChakroborty and Animesh Das - Prentice-Hall India, New Delhi. India
3. Wright, Highway Engineering, 7th Edition WILEY.
4. Highway Engineering- S.K. Sharma.
5. Bridge Engineering- S.P. Bindra.
6. Bridge Engineering -Ponnuswamy S -Tata Mcgraw Hill Publications.
7. Airport Planning and Design -Khanna S.K., Arora M.G. and Jain S.S.- Prentice-Hall India, New Delhi.
8. Airport Engineering, Rao G.V, Tata McGraw Hill
9. Transportation Engineering –Dr. L.R. Kadiyali, Publisher: Khanna Publishers,
10. A Text Book Of Railway Engineering- Saxena S.C, Dhanpati Ray publication.
11. Highway & traffic Engineerng- Saxena S.C, Dhanpati Ray publication

Unit Outcomes (UOs):

UO 1: Describe the scope of highway engineering. CO 1

UO 2: Explain the properties of the materials used for highway construction. CO 1

UO3: Interpret the Highway capacity and level of service of rural highways and urban roads. CO 04

UO4: Explain the various components related to railway track. CO 03

UO5: Explain the classification of Bridges and site selection. CO 03

UO6: Describe the environmental Consideration related to Airport engineering. CO 02

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Water Treatment Laboratory Course No.: UENV0531	L	T	P	Credit
	---	---	02 hours per week	1

Course Pre-Requisite:
Students shall have the knowledge of: Water Quality Parameters

Course Description:
The course explores the knowledge and principles of determination of different water quality parameters. It also enables to understand the relationships between different parameters and its effect in water treatment and water quality.

Course Objectives:

1. To understand the knowledge and principles of determination of different water quality parameters
2. To understand the basics of water treatment processes

Course Learning Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO1	Interpret the quality of water after treatment.	Cognitive (Understanding) L2
CO2	Demonstrate the treatment process of water.	Psychomotor (Set) L2

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1				2			2					
CO2				2							2	

Assessments :

Assessment	Weightage (Marks)
ISE	50
ESE (OE)	25

- **ISE:** Based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
- **ESE (OE):** Assessment is based on oral examination.

Course Contents:

Experiment No. 1: Aeration **Learning Outcome:** To determine the rate of aeration	2 Hours
Experiment No. 2: Plain Sedimentation **Learning Outcome:** To determine the effect of detention time on settling process	2 Hours
Experiment No. 3: Coagulation and Flocculation	2 Hours

Learning Outcome: To determine the optimum dose of coagulant for given water	
Experiment No. 4: Filtration **Learning Outcome:** To determine the removal of turbidity from water after filtration	2 Hours
Experiment No. 5: Head Loss in Filter **Learning Outcome:** To determine the Head Loss in Filter	2 Hours
Experiment No. 6: Hardness Removal **Learning Outcome:** To determine the removal of Hardness by various processes	2 Hours
Experiment No. 7: Break Point Chlorination **Learning Outcome:** To determine Break Point Chlorine dose for given water sample	2 Hours
Experiment No. 8: UV Radiation **Learning Outcome:** To determine performance of UV radiation process	2 Hours
Textbooks: 1. Chemistry for Environmental Engineering and Science by Sawyer, McCarty and Parkin	
References: 1. Standard Methods for examination of Water and Wastewater 2. Manual of Water Supply and Treatment (3rd ed)- Ministry of Urban Development, New Delhi, 1991.	

Class: T. Y. B. Tech Environmental Engineering	L	T	P	Credit
Title of the Course: Solid Waste Monitoring Laboratory **Course No.: UENV0532**	---	---	02 hours per week	1

Course Pre-Requisite: Students shall have the knowledge of: Environmental Studies.

Course Description:

The course explores the basic knowledge associated with solid waste composition, characterisation & slandered procedures available for evaluation. The course imparts the experimental skills in identifying various important characteristics of solid waste.+

Course Objectives:

3. To carry out the proximate analysis of solid waste.
   To carry out ultimate analysis of solid waste.

Course Learning Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	Determine the proximate analysis of solid waste.	Cognitive (Evaluating) -L5
CO.2	Determine ultimate analysis of solid waste.	Cognitive (Evaluating)-L5

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1				3	1							
CO2				3	1							

COs	PSO1	PSO2
CO1	-	1
CO2	-	1

Assessments :

Assessment	Weightage (Marks)
ISE	50
ESE (OE)	25

- **ISE:** Based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
- **ESE (OE):** Assessment is based on oral examination.

Course Contents:

Experiment No. 1: Study of Composition of solid waste by Quartering and Coning Sampling Procedure: **Learning Outcome:** To investigate the composition by weight of solid waste.	2 Hours
Experiment No. 2: Study of bulk density of solid waste **Learning Outcome:** To determine density of solid waste.	2 Hours
Experiment No. 3: Determination of moisture content. **Learning Outcome:** To determine the moisture content of solid waste.	2 Hours
Experiment No. 4: Determination of particle size distribution. **Learning Outcome:** To determine the particle size distribution	2 Hours
Experiment No. 5: Determination of calorific value. **Learning Outcome:** To determine the energy content of solid waste component (At least three) by using a laboratory bomb calorimeter.	2 Hours
Experiment No. 6: Determination of proximate analysis **Learning Outcome:** To determine moisture loss, volatile matter, ash and fixed	2 Hours

carbon in solid waste component (At least three).	
Experiment No. 7: Determination of Ultimate analysis **Learning Outcome:** To determine percent availability of carbon, nitrogen, sulphur & hydrogen in solid waste component (At least three).	2 Hours

References:

1. Integrated Solid Waste Management by Tchobanoglous/Theisen/Vigil; Publisher: McGraw Hill
2. CPHEEO Manual on Integrated solid Waste Management.
3. Solid Waste Management – Dr. A. D. Bhide

Class: T. Y. B. Tech Environmental Engineering Semester V Title of the Course: Geotechnical Engineering Laboratory Course No.: UENV0533	L	T	P	Credit
	---	---	02 hours per week	1

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

- Algebra and Engineering Mathematics
- Engineering Physics and Chemistry
- Engineering Mechanics
- Fluid Mechanics

Course Description:
The course helps to develop laboratory skills as well as enhances analytical abilities by performing experiments pertaining to Geotechnical Engineering. The laboratory performance and work; helps to use theoretical concepts in practice, refer standard procedures and IS codes, measure parameters, make interpretations/ judgements and draw valid conclusions by using geotechnical engineering knowledge.

Course Objectives:

4. To introduce the students to laboratory methods for performing experiment in Geotechnical Engg.
5. To interpret observations/readings and draw conclusions.
6. To relate laboratory results to field conditions.

Course Learning Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO1	Explain laboratory methods to determine Index and Engineering properties of soil.	Cognitive (Understanding) L2
CO2	Examine soil for its suitability as construction material.	Cognitive (Analyzing) L4
CO3	Demonstrate the skills to perform experiments individually and in teams to lead to valid conclusions	Psychomotor (Set) L2

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1				3	1					2		
CO2				3	1					2		
CO3				2	1				3	2		

COs	PSO1	PSO2
CO1	-	1
CO2	-	1
CO3	-	1

Assessments :

Assessment	Weightage (Marks)
ISE	50
ESE (OE)	50

- **ISE:** Based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
- **ESE (OE):** Assessment is based on oral examination.

Course Contents:

Experiment No. 1: Specific gravity determination **Learning Outcome:** Interpretation of specific gravity value of given soil and using it for classification of soil.	2 Hours
Experiment No. 2: Water content determination **Learning Outcome:** Determination of natural moisture content and evaluating status of soil.	2 Hours
Experiment No. 3: Grain size analysis **Learning Outcome:** Determination of gradation of soil and its classification	2 Hours
Experiment No. 4: Consistency Limits of soil **Learning Outcome:** Values of consistency limits help to comment on field behaviour of soil and its classification.	2 Hours
Experiment No. 5: Field density determination. **Learning Outcome:** Field density values help to estimate soil performance and strength .	2 Hours
Experiment No. 6: Standard proctor compaction test. **Learning Outcome:** Important parameter for earth work design and construction are determined for field compaction.	2 Hours
Experiment No. 7: Demonstrations **Learning Outcome:** Laboratory methods to determine parameters of soil to evaluate its strength are understood.	6 Hours

TEXT BOOKS & REFERENCE BOOKS

1. Text book of soil mechanics in theory and practice‖ by Dr. Alam Singh(Asian Publishing House, Bombay)
2. Soil mechanics and Foundation engineering‖ by V.N.S.Murthy.(U.B.S. Publishers and distributors,Delhi
3. Soil mechanics and Foundation engineering‖ by B. S. Punmia. (A Saurabh and Company P. Ltd., Madras)
5. Geotechnical Engineering‖ by P. Purushottam Raj.(Tata Mcgraw Hill Company Ltd. New Delhi)
7. Soil mechanics‖ by Terzaghi and Peak. (John Willey and Sons, New- York)
8. Soil Testing by T.W. Lambe. (Willey Eastern Ltd., New Delhi)
9. Geotechnical Engineering by Venkatramiah

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Mini Project Laboratory Course No.: UENV0541	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite:

Students shall have the knowledge of:

- Engineering Physics
- Algebra and Engineering Mathematics

Course Description:

Course Learning Objectives:

1. To acquire knowledge to conduct research
2. Develop experimental set-up to solve problem, do testing and validation of the results

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	Formulate a real world problem and develop its requirements.	Cognitive(Creat) L2
CO.2	Develop a design solution for a set of requirements	Cognitive(Develop) L4
CO.3	Test and validate the conformance of the problem	Cognitive(Evaluating) L5
CO.4	Express technical ideas, strategies and methodologies in written and oral form	Cognitive(Evaluating) L5

CO-PO Mapping:

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

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

Assessments :

Assessment	Weightage (Marks)
ISE	25

ISE-1 and ISE-2: Assessment is based on the efforts by the students for formulating problem, developing design solution, testing and validation of the solution and presentation

Course Contents:

Students are expressed to carry out independent research work on the given topic. It is expected that the student shall do the formulation of the small research problem, development/fabrication of experiment \al set-up (if any/ required) and testing and analysis of results thus obtained.
The students are required to submit the report of mini project

SYLLABUS

T. Y. B. Tech

Environmental Engineering

SEMESTER - VI

Class: T.Y.B.Tech Environmental Engineering Title of the Course: Wastewater Engineering Course Code.:UENV0601	L	T	P	Year
	3	-	-	2019-20

Course Pre-Requisite:

Students shall have knowledge of:

- Environmental chemistry and microbiology
  Hydraulics and water supply engineering

Course Description:

The course reviews collection and conventional treatment of municipal wastewater. Students design sewers and sewage pumping station. Students learn primary and secondary/biological treatment principles and processes. Management of sludge and disinfection of municipal effluents are also covered. This course prepares students for advanced wastewater treatment processes, including industrial wastewater, in further treatment courses.

Course Objectives:

During this course students will be provided with

1. To provide knowledge of sources and flowrates of wastewater and Characteristic of Municipal waste water.
2. To impart necessary skill for the design and operation of wastewater treatment plants.
3. To introduce new developments in the field of wastewater treatment.
4. To prepare students for higher studies and research in the field of wastewater treatment technology.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Descriptor
CO1	**Explain**wastewater collection system, characteristics of wastewater and treatmenttechnologies for wastewater	Cognitive (Understanding) L2
CO2	**Apply**the knowledge of collection system, pollution control technologies, to solve/analyze the problems in wastewater collection and treatment	Cognitive (Applying) L3
CO3	**Evaluate and Design** wastewater collection system and wastewater treatment units.	Cognitive (Evaluating) L5 (Creating) L6

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1	2	
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 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 No. 1 Introduction, Quantity & Quality of Wastewater: Components of Wastewater Flows, Wastewater Sources &Flowrate, Variations in Flowrates& Strength, Characteristics of Wastewater, Quantity of Wastewater, Sewer Design Considerations- Minimum Size of Sewer, Limiting Velocities, Peak Factor Sewage Pumping, Location, Capacity, Pumping Station Design	**5Hrs.**
Unit No. 2 Primary Treatment of Wastewater Physical Unit Operations- Screening, Grit Removal, Oil & Grease Removal, Primary Sedimentation	**5 Hrs.**
Unit No. 3 Secondary Treatment of Wastewater Fundamentals of Biological Treatment, Microbial Metabolism, Bacterial Growth, Suspended & Attached Growth Processes, Activated Sludge Process & its Modifications, Trickling Filters, Secondary Clarification, Aerated Lagoons, Oxidation Ditch, WSP	**10 Hrs.**
Unit No. 4 Anaerobic Treatment of Wastewater Anaerobic Suspended & Attached Growth Processes, Factors affecting Anaerobic Processes, Anaerobic Lagoons, UASB, Septic Tank, Anaerobic Baffled Reactor	**6Hrs.**
Unit No. 5 Sludge Treatment Solid Sources, Characteristics & Quantities, Sludge Pumping, Introduction to mass balance approach, Treatment-Thickening, Stabilization, Design of Sludge Digester, Conditioning, Dewatering, Drying, Ultimate Disposal of Sludge Solids	**6Hrs.**
Unit No. 6 Decentralized wastewater treatmentand Disposal of Wastewater Concept of decentralized wastewater treatment systems, Need of Disinfection, Introduction to tertiary treatment, Self-Purification of water bodies, DO Sag Curve, Streeter Phelp's Model, Stream Classification, Effluent Standards for Discharge into Surface Water & on Land	**8 Hrs.**

Textbooks:

1. Modi, P. N., "Wastewater Engineering," Standard Book House, 1st edition, 2001.
2. Manual on sewerage and sewage Treatment- Ministry of Urban Development, New Delhi (CPHEEO)

References:

1. Metcalf & Eddy, Waste Water Engg. Treatment & Disposal, Tata McGraw Hill (2nd Edition)
2. Peavey, H.S.Rowe, D.R., and Tchobanoglous, Environmental Engineering,McGraw-Hill Book Company.
3. Hammer M.J. Water and Waste water Technology, Prentice-Hall of India P.Ltd.

Unit wise Measurable Students Learning Objectives and Outcomes:

ULO1: Demonstrate scientific concepts and technical knowledge for determination of wastewater quality, design of collection system &domestic wastewater treatment, methods for: CO1, CO3

ULO2: Demonstrate scientific concepts and detailed technical understanding of the technologies required for primary treatment of domestic wastewater and design of primary treatment units: CO1 & CO3

ULO3: Demonstrate scientific concepts and detailed technical understanding of the technologies required for conventional biological wastewater treatment and their design: CO1 & CO3

ULO4: Demonstrate scientific concepts and detailed technical understanding of the technologies required for anaerobic biological wastewater treatment and their design: CO1 & CO3

ULO5: Demonstrate scientific concepts and detailed technical understanding of the technologies required for sludge treatment and their design: CO1 & CO4

ULO6: Understand decentralized wastewater treatment plants and need for advance treatment, Determine wastewater quality fordischarging into rivers, it's effect on river water quality and environmental regulations for discharging treated wastewater: CO2, CO3

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Air Pollution and Control Course Code: UENV0602	L	T	P	Credit
	3	-	-	3

Course Pre-Requisite: Knowledge of engineering mathematics, physics and Environmental chemistry

Course Description: As a comprehensive course, it introduces the sources of air pollution, physical and chemical behavior of pollutants, the effects of air pollutants on human beings and environment, and dispersion in the atmosphere . Also, it covers legislation and regulation; control technologies and future trends toward preventing air pollution.

Course Objectives:

1. Know how to interpret meteorological data for atmospheric stability, transportation and dispersion of air pollutants
2. Present detailed information about the theory, design and operation of various equipments for particulate matter control.
3. Learn the concepts and strategies of control of gaseous pollutants, including adsorption, adsorption, condensation etc.
4. Get an insight into the some of the most widely used commercial and freely available air quality models
5. Articulate current air pollution policies and measures for control of air pollution

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain various air pollution problems and the role of meteorology in transport of pollutants	2	Explain
CO2	Use appropriate dispersion models to estimate air pollutant concentrations	3	Discuss
CO3	Analyze the air pollution problems using the strategies, regulations and policies for management.	4	Use
CO4	Design equipment for control, and prevention of air pollution to with due consideration to economic, environmental, social, ethical, health and safety aspects	4	Design

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1	1	
CO2		3
CO3	3	
CO4		3

Assessments :

Teacher Assessment:

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

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

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three Units)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three Units) covered after MSE.

Course Contents:

Unit 1:---Introduction to Air pollution Sources, types and effects of air pollution, Measurement units, Ambient air quality standards- national and international Current scenario of air pollution at national and global scales, Green house effects, acid rain and ozone layer depletion, Heat island effect, Visibility, Photochemical reaction	**6Hrs.**
Unit 2:---Meteorology and Air Pollution Structure and composition of atmosphere, Wind circulation, Wind rose diagram, Lapse rates, Stability of atmosphere, Inversion and its types, Plume behavior, Maximum Mixing Depth, Cyclones and anticyclones, Precipitation & its relation to removal of air pollutants	**6Hrs.**
Unit 3:---Dispersion of Air Pollutants Gaussian dispersion model, point source, Line source, maximum ground level concentration, Determination of stack height, Plume Rise Box model , Introduction to AERMOD and other soft wares	**8 Hrs.**
Unit 4:---Air Quality management Types of pollutants emitted from automobiles and its control, Alternative fuels, air quality index, indoor air quality monitoring, measures for effective control of air pollution in India, International treaties for control and mitigationof, air pollution	**7 Hrs.**
Unit 5:---Control of Particulate Matter Sources and distribution of SPM, Terminal settling velocity, Particulate removal	**7 Hrs.**

mechanisms, study of working principle and design of Particulate Control Equipments : - Settling chamber, Cyclone separator, Fabric filter, Electrostatic precipitator, Wet collectors,	
Unit 6:---Control of Gaseous pollutants Various options for removal of gaseous pollutants- Principles of absorption and adsorption, condensation and combustion/ incinerationof gaseous pollutants, use of after burners,	**6 Hrs.**

Textbooks:

1) K. Wark, C.F. Warner & W.T. Davis Air Pollution Control: its Origin and Control, Addision-Wesley, (1998).
2) Stern A.C., "Air Pollution Vol. I and II", Allied Publishers Limited, 1st Edition, 1994.
3) 2. Nevers N., "Air Pollution control Engineering" McGraw-Hill, New York, 2nd edition, 1995

References:

1. Martin Crawford, "Air Pollution and Control", Tata McGraw Hill Publication, 1st Edition, 1976.
2. Air Pollution and Control Technologies by Anjaneyulu, D", Allied Publishers, Mumbai, 2002
3. Environmental Pollution Control Engineering by Rao, C.S., Wiley Eastern Ltd., New Delhi, 1996
4. Industrial Air Pollution Control Systems by W.L.Heumann, McGraw-Hill, New York, 1997
5. Environmental Engineering by Peavy S.W., Rowe D.R. and Tchobanoglous G, McGraw Hill, New Delhi, 1985
6. Environmental Engineering Vol. II by Garg, S.K, Khanna Publishers, New Delhi
7. Fundamentals of Air Pollution by Richard W.Boubel, D.L.Fox, D.B.Turner&A.C.Stern, Reed Elsevier India Pvt. Ltd., New Delhi,

Unit wise Measurable students Learning Outcomes:

At the end of the course, the students will be able to

UO1Summarize the various impacts of air pollution at national and global levels

UO2 Describe the role of various meteorological parameters in dispersion of air pollutants

UO3 Predict concentration of air pollutants using various dispersion models

UO4 Assess the air quality status with respect to legal standards , and suggest mitigativemeasures as per legal policies

UO5 Design control equipments for removal of particulate matter

UO6 Describe principle of gaseous pollutants control

Class: T.Y. B.Tech. Environmental Engineering Title of the Course: Design of Concrete Structures Course No.: UENV0603	L	T	P	Year
	4	-	-	2018-19

Course Pre-Requisite:

Students shall have knowledge of:

- Algebra and Engineering Mathematics
- Engineering Mechanics
- Structural Mechanics
- Construction Technology

Course Description:

The course imparts fundamental knowledge on concepts of reinforced concrete, its design philosophies. An Environmental Engineer needs to understand the design of various structural members such as beams, slabs, columns of buildings, treatment plants, and storage tanks as well as apply checks for safety and serviceability. The knowledge of RCC sections is useful in estimating and costing also.

Course Objectives:

9. To study concepts and design philosophies of RCC
10. To understand analysis and design of reinforced concrete sections
11. To know various checks for the designs.
12. To learn designs of specific RCC elements/structures.

Course Learning Outcomes:

CO	After the completion of the course the students will be able to	Bloom's Taxonomy Cognitive Domain
CO1	Explain design philosophies and stress-strain behaviour of Reinforced Cement Concrete.	Understanding L2
CO2	Apply concepts of design and analyse various RCC section.	Applying L3
CO3	Evaluate the design with respect to various checks.	Evaluate L5
CO4	Design specific structural element /component.	Creating L6

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1	-	-
CO2	-	2
CO3	-	2
CO4	-	2

Assessments :

Assessment	Weightage
ISE - I	10
MSE	30
ISE- II	10
ESE	50

Course Contents:

Unit : 1: Introduction- Stress strain behavior of concrete and steel, Behavior of RCC, Permissible stresses in steel and concrete, Design philosophies, Various limits states, Characteristics strength and Characteristic load, Load factor, Partial safety factors.	**07 Hrs.**
Unit 2: Limit state of collapse (flexure): Analysis and Design of Singly and Doubly Reinforced rectangular sections, Singly reinforced T beams.	**07 Hrs.**
Unit 3: Limit state of collapse (shear and bond): Shear failure, Types of Shear reinforcement, Design of Shear reinforcement, Bond-types, Factors affecting bond Resistance, Check for development length. Limit state of serviceability: Significance of deflection, IS recommendations, Cracking-classification and Types of Cracks, Causes mechanism and IS recommendations.	**6 Hrs.**
Unit 4: Design of slabs: One way, Two way with different support conditions as per IS:456, Cantilever slab. Design of staircases; Types of staircases, Design of Simply Supported and Dog legged staircases	**6 Hrs.**
Unit 5: Analysis and Design of axially and eccentrically (uni-axial) loaded circular, rectangular columns, Interaction diagram, Circular column with helical reinforcement	**6 Hrs.**
Unit 6: Design of water tank-design criteria , permissible stresses, design of circular water tank resting on ground with flexible and rigid base, design of rectangular water tank resting on ground by approximate method	**8 Hrs.**

Textbooks / Reference books:

1 IS 456-2000
2. Limit state theory and Design –Karve and Shah, Structures publications , Pune
3. Reinforced Concrete Design – Limit state - A.K. Jain Nem Chand brothers Roorkee
4. Fundamentals of Reinforced Concrete –Sinha and Roy, S. Chand and company Ltd. Ram Nagar, New Delhi
6. Limit State Design of reinforced concrete P.C.Varghese, Prentice Hall, New Delhi
7. Reinforced Concrete Design- B.C. Punmia Laxmi publications New Delhi
8. Reinforced Concrete Design-M. L. Gambhir-Mc millan India Ltd. New Delhi
9. Special publications -16-Bureau of Indian standard

Unit wise Measurable, Students Learning Objectives and Outcomes:

Unit	Students Learning Outcomes
1	Explain concepts, design philosophies of reinforced cement concrete
2	Apply concepts for analysis and design of singly, doubly reinforce rectangular sections and flanged sections
3	Analyze the section for shear and bond stress and design for it
4	Explain concept of design of various types of slabs and staircase.
5	Analyze and Design circular, rectangular columns and helical reinforcement
6	Design of water tank as per design criteria, permissible stresses by approximate method

Class: T.Y.B. Tech. Environmental Engineering Title of the Course: Environmental Geotechnology Course No.: UENV0621	L	T	P	Year
	3	1	-	2019-20

Course Pre-Requisite:

Students shall have knowledge of:

- Algebra and Engineering Mathematics
- Engineering Physics and Chemistry
- Engineering Mechanics
- Fluid Mechanics

Course Description:

The course imparts knowledge of geotechnical aspects relevant to Environmental Engineering. Soil interaction with wastes, landfill compaction, stability analysis in changing environmental conditions, waste control systems and use of geosynthetics is dealt.

Course Objectives:

1. To provide students the necessary knowledge and concepts in the field of Subsurface Contamination, their effects, detection and remedial measures.
2. To familiarize the students with types and properties of geosynthetic materials, their use for various civil engineering functions in general and for solid/slurry waste containment in particular.

Course Learning Outcomes:

CO	After the completion of the course the will be able to	Bloom's Taxonomy Cognitive Domain
CO1	**Explain** and **Classify** various engineering properties of soils, available geosynthetic materials, their properties and suitability	Understanding L2
CO2	**Analyze** stability of landfillsite	Analyzing L4
CO3	**Determine** waste containment and barriers	Evaluating L5

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1		-
CO2		-
CO3		2
CO4		2

Assessments :

Assessment	Weightage
ISE - I	10
MSE	30
ISE- II	10
ESE	50

Course Contents:	
Unit 1: Geoenvironmental Engineering- Introduction, overview of pollution, control and remediation,Soils- Soil as 'Phased System', Soil classification, Various Soil Types with important engineering properties, their suitability for intended purpose,Clay Minerology.	**7Hrs.**
Unit 2: Soil-water-contaminant interaction; Contaminant Transport, Geochemical Attenuation and attenuation capacity of soils. Zones of contaminant plume. Introduction to Detection of polluted zones and Monitoring designed system.	**5 Hrs.**
Unit 3: Various forms of Geosynthetic material (GM, GT, GN, GG, GCL, GP, Geofoam etc.) and their general applications for various engineering functions. Various Geosynthetic material properties. Use of Geosynthetic material in waste containment. Concerns about use.	**6 Hrs.**
Unit 4: **Solid Waste Containment:** Site selection, Typical cross sections of landfills, merits and demerits. Area calculation of landfill site. EPA (MoEF and CPCB) Guidelines.CCL, GCL and composite liners. Compaction quality control. Stability analysis of Landfills: Conventional Slope Stability analysis by method of slices, stability number concept. Stability against sliding of geomembrane over clay (liner stability) and sliding of soil over geomembrane (Cover stability). Assessment of anchorage requirement of GM.	**12 Hrs.**
Unit 5: **Slurry Waste Containment:** Slurry transported wastes, pond layouts, components of pond, embankment construction, staged raising of embankment, Design aspects, environmental impact and control. **Vertical Barriers for Containment**: Various types of Cutoff Walls, Requirements of good vertical barriers, Slurry trench walls using Bentonite and Cement-bentonite slurry, material and construction aspects.	**5 Hrs.**
Unit 6 : Geotechnical Reuse of waste material: Waste reduction, use of waste in geotechnical construction, Waste characteristics for soil replacement, Transport considerations, and engineering properties of waste.	**5 Hrs.**
Textbooks: 1. G L SivakumarBabu, "*Soil Reinforcement and Geosynthetics",*Universities Press (India) Pvt L Hyderabad, 2006. 2. S.K.Gulhati, ManojDatta, *"Geotechnical Engineering"*, Tata McGraw Hill, New Delhi, 2005. 3. Braja Das, *"Principles of Geotech. Engg",* Thomson Asia Pvt. Ltd, 5th Edition, 2002. Fang, H.Y, "*Introduction to Environmental Geotechnology",* CRC Press, 1997.	
Reference books: 1. Donald Coduto, "Geotechnical Engineering Principles and Practices Prentice Hall of India Pvt. Ltd, New Delhi, 2002.	

2. Daniel, D. E, "Geotechnical Practice for Waste Disposal", Chapman and Hall, 1993.
Koerner, R.M.,"Designing with Geosynthetics", Fifth Edition,Prentice Hall, New Jersey, 2005.

Unit wise Measurable Students Learning Objectives and Outcomes:

Unit 1: **Explain and Appraise** the environmental and health related risks, **List and describe** soil properties and behaviour, **Understand** soil-water-contaminant interaction.

Unit 2: **Classify and compare** plume transport

Unit 3: **Describe and Differentiate** various available geosynthetic materials. **Compare** their suitability for general engineering functions.

Unit 4: **Design** liner and cover system, **Perform** area calculations for landfill site, slope stability analysis and stability of liner-cover system.

Unit 5: **Explain and Choose** methods of slurry waste containment, **Explain** methods of vertical barriers.

Unit 6: **Examine and Assess** reuse of waste material.

Class: T. Y. B.Tech Environmental Engineering Title of the Course: Optimization Techniques (PE-III) Course No.: UENV0622	L	T	P	Credits
	3	1	-	4

Course Pre-Requisite:

Students must have knowledge about numerical and mathematical rules and its use in solving problems by correlating constants and parameters with each other.

Course Description:

Optimization Techniques course deals with various methods used for determining the optimum solution in engineering & project management field. It covers the methodology of operation research and its applications in different fields. Various optimization techniques covered in the course are Linear Programming Problems, Job Sequencing, Transportation & Assignment Models, CPM & PERT for project management etc.

Course Objectives:

1. Understand the significance and scope of optimization in Environmental engineering.
2. Study the formulation by correlating parameters of technical, engineering problem in mathematical model.
3. Learn to solve transportation problems, Assignment problems, Job sequencing using modified techniques.
4. Study numerical techniques and genetic algorithm techniques for application in projects of Environmental Engineering to get optimum results.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Descriptor	Level
CO 1	Explain significance and concepts of Optimization Techniques in Environmental Engineering.	Cognitive	Understanding L2
CO 2	Apply the optimization techniques for Linear Programming Problems of profit maximization and waste minimization.	Cognitive	Apply L4
CO 3	Evaluate Transportation Problems, Assignment Problems and Job Sequencing problems.	Cognitive	EvaluateL5
CO 4	Adapt appropriate method of numerical differentiation and integration for Environmental engineering problems.	Cognitive	Create L6

CO-PO Mapping:

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1			1				1					
CO2	2		1											
CO3		2		2				1				1		1
CO4							2				1		2	2

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: Birth of O. R., Methodology, Scope and Limitations. Types of O.R. Models, Applications, Use of computers in O R	**4 Hrs.**
Unit 2: Linear Programming Formulation, graphical method, Simplex algorithm for maximization and minimization problems, sensitivity analysis, duality theory and its use in economic interpretation and decision making.	**8 Hrs.**
Unit 3: Non-linear Programming Non-linear Programming: Unconstrained optimization techniques, Classification of methods, steepest ascent, Newton method, constrained optimization, Separable and quadratic programming. **Dynamic Programming** Dynamic Programming: Multistage decision process, recursive relationships, Principle of optimality, Computational procedure in DP, DP applications, Problem of dimensionality.	**8 Hrs.**
Unit 4: Transportation and Assignment Models Structure, industrial and business applications. Transportation problems: Use of various methods for solving transportation	**4 Hrs.**

problems, degeneracy and its solution. Assignment problems: Solution of various types of problems, Traveling Salesman problem. Sequencing: Sequencing of n jobs and 2 and 3 machines, 2 jobs and m machines.	
Unit5: Numerical differentiation and Numerical integration Numerical differentiation and Numerical integration: Numerical solution of ordinary differential equation, Systems of ordinary differential equations, Runge – Kutta Method, Trapezoidal rule, Simpson's rule, Gauss – Siedel method, Jacobian method	**8 Hrs.**
Unit 6: Genetic Algorithm Genetic Algorithm, Neural Networks and Fuzzy Systems: Introduction, Representation of decision variables, Objective function and constraints, GA operators, neural network based optimization, Optimization of fuzzy systems. Replacement Analysis: With & without time value of money, single item and group replacement.	**8 Hrs.**

Textbooks:

1. Operations Research – Hira & Gupta.
2. Introduction to O.R., 6/e (with floppy disk) – Hamdy A. Taha, (PHI)

References:

1. Quantitative Techniques in Management, 2/e - N.D. Vora. (TMH)
2. Operations Research – J.K. Sharma. (Mac Millan)
3. Operations Research – S.D. Sharma
4. Optimization in Operation Research – Ronald L. Rardin (Pearson education)
5. Quantitative Techniques in Management, 2/e - N.D. Vora. (TMH)
6. Genetic algorithm – Goldberg

Unit wise Measurable students Learning Outcomes: Students will..

Unit-1 Explain significance of optimization in Environmental Engineering. CO1, CO2, CO3

Unit-2 Formulate practical situations and problems in mathematical model and find their solutions. CO1, CO2

Unit-3 Apply non-linear programming and dynamic programming for environmental engineering problems. CO3

Unit-4 Apply effective and economic transportation model for solid waste management and assignment problem.Develop job sequencing model to get optimum efficiency. CO4

Unit-5 Use numerical integration and differentiation techniques for environmental treatment projects. CO4

Unit-6 Develop genetic algorithm for neural network based optimization problems.CO4

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Operation and Maintenance of Environmental Facilities Course No.: UENV0623	L	T	P	Credit
	03 hours per week	01	-	4

Course Pre-Requisite:

- Students shall have knowledge of Water Supply Engineering.
- Students shall have knowledge of Wastewater Engineering.
- Students shall have knowledge of Air Pollution and Control.

Course Description:

Operation and Maintenance of Environmental Facilities deals with the operation of environmental facilities like water supply facilities, water treatment plants, water distribution systems, wastewater treatment plants, wastewater collection systems, air pollution control equipments and their maintenance.

Course Learning Objectives:

At the end of course students will

1. Know the necessity of maintenance of environmental facilities.
2. Study measures to avoid failures in pipe systems.
3. Understand the criteria of operation & its purpose for water treatment plants, wastewater treatment plants and air pollution control equipments.
4. Learn the importance of planning and scheduling in maintenance activities.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO1	Explain the necessity of maintenance, planning and scheduling.	Cognitive (Understanding) L 2
CO2	Illustrate the operation and maintenance requirements of air pollution control equipments.	Cognitive (Understanding) L 2
CO3	Select the appropriate remedies for problems in transmission pipes, water treatment plants and wastewater treatment plants.	Cognitive (Applying) L 3

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	

COs	PSO1	PSO2
CO1		
CO2	2	
CO3	2	

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 Need of O and M, Types of Maintenance - Corrective and Preventive, Data: Detailed Plans, Drawings, Operation Manuals, Log Books, Computer Usage in O and M.	**04 Hrs.**
Unit 2: Water Intakes and Water Treatment Plant O & M of Water Supply Facilities: Intakes, Pumps, Transmission Pipes, Water Treatment Units Maintenance, Quantity and Quality Monitoring.	**08 Hrs.**
Unit 3: Water Distribution Systems Water Distribution System: Maintenance of Water Distribution System; Reservoirs, Loss of Carrying Capacity of Pipes, Pipe Breaks & Leakages, O and M of Appurtenances - Pipe Joints, Water Meters, Energy Audit, Use of SCADA and PLCs.	**08 Hrs.**
Unit 4: Wastewater Treatment Facilities O & M of Wastewater Facilities: Sewerage System and Appurtenances, Inspection Methods, Manual and Television, Cleaning and Rehabilitation, Safety in Sewer Inspection, O and M of Wastewater Treatment Plant- Activated Sludge Process, Bio Towers, Monitoring and Operational Problems, Corrective Measures, Treatment Plant Performance Monitoring,	**08 Hrs.**
Unit 5: Air Pollution Control Facilities Air Pollution Control Facilities: Regular Inspection of Devices, Operation and Maintenance of Particulate Matter Control Equipments, Gravity Settlers, Cyclone Separators, Bag Filters, Scrubbers, Electrostatic Precipitator.	**08 Hrs.**
Unit 6: O & M Planning O and M planning: Organizational Structure, Work Planning, Preparation and Scheduling, Inventory, Cost Estimates, Wastewater Treatment Plant Staff Training	**04 Hrs.**

Textbooks:

1. CPHEEO manual on Water Supply and Treatment
2. CPHEEO manual on Sewerage and Sewage Treatment
3. A manual on Operation and Maintenance of Water Supply Systems by CPHEEO
4. Air Pollution M N Rao, H V N Rao

References:

1. Industrial Air Pollution Control Systems – Neumann
2. O & M of Water treatment plant –Charles R Cox
3. Guidelines for Operation and Maintenance of Effluent Treatment Plants by MPCB

Unit wise Measurable students Learning Outcomes:

At the end of course students will be able to

1.1: Define Corrective and Preventive Maintenance.
1.2: Explain the need of Operation Manuals in maintenance.
2.1: Summarize the maintenance activities of pumps at water intakes.
2.2: Explain the operation and maintenance of water treatment units.

3.1: Interpret the functions of appurtenances in Water Distribution System.
3.2: Summarize the causes of failures and preventive measures for pipelines.
4.1: Recall the measures for maintenance of wastewater treatment plants.
4.2: Explain the functional requirements of advanced wastewater treatment methods.
5.1: Explain the mechanism of pollutant removal in air pollution control equipments.
5.2: Illustrate the maintenance of air pollution control equipments.
6.1: Tell the necessity of planning, scheduling, inventory control in maintenance of treatment plants.
6.2: Plan the scheduling of maintenance activities.

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Environmental Laws and Policies Subject Code : OEL0631	L	T	P	Credit
	2	1	-	3

Course Pre-Requisite Students must have knowledge of

- Environmental Studies

Course Description:

Students will learn various international environmental policies & compare them with Indian policies. They will also learn various international environmental legislation. They will learn various environmental legislation of Govt. of India. Importance of environmental organizations & their functions. Environmental ethics & its importance role of NGO's.

Course Objectives:

1. To explain scope & need of Environment Legislation.
2. To discuss historical prospective & International environmental legislation & coventions.
3. To teach the various Acts in India related to Environment.
4. To elaborate risk associated and importance of economics for environmental components.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	**Blooms Cognitive Discriptor**
CO1	Explain need & scope of environmental legislation.	**Cognitive** **Understanding- L2**
CO2	Summarize historical prospective & international environmental legislation & conventions.	**Cognitive** **Understanding- L2**
CO3	Make use of environmental laws in practical applications.	**Cognitive** **Applying - L3**
CO4	Examine the risk associated and importance of economics for environmental components.	**Cognitive** **Analyzing – L4**

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		

Assessments :

Assessment	Weightage (Marks)
ISE I	10
ISE II	10
MSE	30
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, Need and Necessity, Basic information, Various five year plans and the provision for environment in these plans, Various environmental policies like National plan for cause of aquatic ecosystem, Sustainable developmental policy, National forest policy, and other policies related to environment.	7 Hrs.
Unit 2: Historical development of various environmental legislations, USEPA 1969, Clean Air Act, Clean Water Act, NEPA.	5 Hrs.
Unit 3: Water (Prevention & Control of Pollutants act), 1974 and Rules, Water Cess Act and Rules, Air (Prevention & Control of Pollutants act), 1981 and Rules, Indian Forest Act and Rules.	7 Hrs.
Unit 4: Environmental Protection Act 1986 and Rules, EIA notification and procedure, Rules under EPA. Present status of these rules in India.	7 Hrs.

Unit 5: Functions and powers of ministry of Environment and forest and pollution control Boards in centre and state, Energy Bureau of India, energy audit, Environmental audit, National River action Plan, National Lake action Plan.	5 Hrs.
Unit 6: Case studies of various landmark judgments in Environmental field, Critical Evaluation of current environmental Risk Policy, Environmental Management plans at centre and state. Environmental Economics, Basic concepts in economics, Green rating of industries.	7 Hrs.

Textbooks:

1) Environmental Planning and Management in India - Saxena
2) Introduction to Environmental Law - Shantakumar S.
3) International environmental Law - Lakshman
4) Environmental Policies in India – Singh Shekhar

References:

1) All Environmental Legislations, amendments, rules Published by Ministry of Environment and Forest, Govt of India
2) Handbook of Environmental Law, Acts, Guidelines, Compliances and Standards Vol. I, II - Trivedi R.K.

Unit Outcomes (UOs)

At the end of course students will be able to

Unit 1: Impart their knowledge in Understanding The working of NITI Ayog/ Planning Commission. (CO1)

Unit 2: Indentify the reason behind implementation of Every Environmental Legislation.(CO1,CO2)

Unit 3: Implement procedures for Various Environmental Laws in India.(CO3)

Unit 3: Implement procedures for Various Environmental Laws in India.(CO3)

Unit 4: Able to Identify Functions & Powers of Various Controlling Bodies.(CO3)

Unit 5: Able to Convey the judgments of landmark cases related to Environment.(CO3, CO4)

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Occupational Health and Safety Course No.: OEL0632	L	T	P	Year
	2	1		

Course Pre-Requisite:
There is no any pre-requisite for this course.

Course Description:
Introduction Concept and Need of Safety, Safety and Industries, Introduction to Risk Assessment & Management, Safety Management Systems, Accidents in Industries, Occupational Health and Industrial Hygiene, Various Preventive Methods for Occupational Health Problems, Introduction to legal aspects of Safety, Safety in Engineering industries

Course Objectives:
At the end of the course students will able to,

1. Understand concept and need of safety in industries
2. Study various safety management systems, OSHAS 18001 management system
3. Study cause and impact of accidents
4. Study accident prevention techniques
5. Study industrial hygiene and occupational disease.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Descriptor
CO1	Identify issue related to health and safety in various industries	Cognitive
CO2	Design and implement various safety management systems and OSHAS 18001 management systems for industries	Cognitive
CO3	Investigate and report accidents as well as corrective actions	Cognitive
CO4	Identify and suggest corrective actions for problems related to industrial hygiene.	Cognitive

CO-PO Mapping:

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

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

Assessments :

Direct Assessment	Weightage
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 Safety - Concept and Need of Safety, Safety and Industries - Definition, Various Hazards in Industries, Need of Industrial Safety, Safety Department and its Role	10
Unit – 2 Introduction to Risk Assessment & Management, Safety Management Systems, OSHAS 18001 management system and Auditing, , Product Safety	5
Unit – 3 Accidents in Industries, Definition and Various Causes, Accident Theory, Cost of Accidents, Accident Prevention Techniques, Accident Investigation and Reporting, Accident Statistics	5
Unit – 4 Safety in Industries-, Safe Design and Layout of Plants and Equipments, Machine Guarding, Safe Storage & Handling of Hazardous chemicals, MSDS, Good House Keeping	6
Unit – 5 Job Safety Analysis, Safety Checklists, Safety Inspections, Confined Space Entry, Work Permit System, Lock Out- Tag Out System	7
Unit-6 Occupational Health and Industrial Hygiene - Definition, Objectives, Need, Chronic and Acute Effects, Various Limits of Exposure-, LD50, LC50, TLV(TWA), STEL, OSHA Limits etc. Effects of Various Physical, Chemical and Biological Hazards Present in Industries on Human Health.	7
Unit No 7 Various Occupational Diseases and Causative Agent, Occupational Diseases in Various Industries, Various Personal and Work Place Monitoring Systems	6
Unit No 8 Various Preventive Methods for Occupational Health Problems, Protection of Workers against Harmful Agents and Conditions, LEVs, PPEs, Ergonomics, Health Monitoring and Medicine	6
Unit No 9 Legal aspects of Safety, Safety in Engineering industries, Chemical industries, Construction industries, On site & Off site Emergency Management Plan	5
Textbooks: 1. Occupational Safety and health -by David L. Goetsch, Prentice Hall, Ohio	

2. Safety manual - EDEL Engineering consultancy Pvt. Ltd.
3. Hazardous Material and Hazardous Waste management - by Gayle Woodside, John Wiley & sons Inc.
4. Environmental Health and Safety Auditing Handbook - by Lee Harrison, Mac Graw Hill Inc.
5. Health Hazards of the Human Environment - World Health Organization , Geneva, 1972
6. Textbook of Preventive and Social Medicine - by K. Park, Banarsidas Bhanot Publishers.
7. Industrial and Occupational Safety, Health & Hygiene - by Dr. A.H. Hommadi
8. Introduction to Industrial Safety - by K.T. Kulkarni

References:

1. Occupational Safety and health -by David L. Goetsch, Prentice Hall, Ohio
2. Safety manual - EDEL Engineering consultancy Pvt. Ltd.
3. Hazardous Material and Hazardous Waste management - by Gayle Woodside, John Wiley & sons Inc.

Term work:

A Journal consisting of the following practicals and assignments based on theory
1. At least six assignments based on above theory
2. At least one industrial visit report on
a) Industrial Safety b) Occupational Health

Unit wise Measurable Students Learning Objectives and Outcomes:

ULO 1 Discuss Need of Safety, Safety and Industries along with the role of supervisor as per OSHAS 18001 (CO1, CO2)

ULO 2 Explain various safety management systems along with risk assessment (CO1, CO 3)

ULO 3 Explain Accidents in Industries, Definition and Various Causes.(CO3,)

ULO 4 Describe various Safe Design and Layout of Plants and Equipments (CO2,CO3,CO4)

ULO 5 Discuss various Safety Analysis and various theories to access the risk and its impact (CO3, CO4)

ULO 6 Explain the Occupational Health and Industrial Hygiene in industries (CO4, CO2)

ULO 7 Explain various occupational diseases and its consequences (CO4)

ULO 8 Discuss various PPE's used in industry as well Health Monitoring in industry.(CO4)

Class: T. Y. B.Tech Environmental Engineering	L	T	P	Credits
Title of the Course: Water Conservation and Management(OE-I)	2	1	-	3
Course No.: OEL0633				

Course Pre-Requisite:

Students shall have knowledge of:

- Water crises and impact mismanagement of water usage
- Importance of water usage
- Concept of sustainability

Course Description:

The objective of the course is imparting fundamental knowledge of water crises due to exploitation and overuse natural resources of water. Student will get knowledge of sustainable development with the help of water conservation and management.

Course Objectives:

At the end of the course students will be able to

1. Apply knowledge about concept, necessicity & scope of water conservation and Management.

2. Understand general, scientific &engineering approaches regarding proper planning & utilization of water using different technologies.

3. Develop communication skill so as to create awareness about team work, community participation among society.

4. Enhance skill for conservation & utilization of natural resources such as land, water and air for sustainable development.

5. Inculcate professional and multi disciplinary approach for success in various branches of civil & environmental engineering.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Descriptor	Level
CO1	Explain significance and necessicity of water conservation, Management and sustainable management practices.	Cognitive	Understanding Explain L2
CO2	Apply knowledge of general, scientific &engineering approaches regarding proper planning & utilization of water using different technologies.	Cognitive	(Applying) Apply L2
CO3	Assess Socio – Economic Aspects of Watershed Management through community participation, water legislation and implementations.	Cognitive	(Evaluating) Assess L5
CO4	Analyze standard watershed model based on standard modeling approaches and classifications.	Cognitive	(Analyzing) Analyze L4
CO5	Develop appropriate technology for water conservation and management with low cost.	Cognitive	(Developing) Develop L6

CO-PO Mapping:

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

CO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	1
CO4	-	2
CO5	-	2

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 to water conservation and management: Status in India, historical background, Overview of water resources of India, Present status of water availability, Water shortage and scarcity ,Problems of surface & ground water quantity & quality, Surface water Scenario, Ground Water Scenario	**6Hrs**
Unit 2: Surface water Scenario: Investigation of surface water, data & analysis, utilization of wasted flows, rainwater harvesting, groundwater potential & harvesting, well construction, integrated water resources management. development in Irrigation Sector, , Low Irrigation Efficiency, Industrial & Other Uses, Declining per capita water availability	**8Hrs**
Unit 3: Ground Water Scenario: Ground water states, ground water sources, Types of aquifers, Ground water conservation, soil conservation, soil & soil moisture conservation, conservation measures, rainwater management, Water resources development.	**6Hrs**
Unit 4: Water quality: Domestic sector - urban and rural water supply, Water quality issues of surface and groundwater in India, Pathogenic pollution in both sources, Salinity in both sources, Fluoride, Nitrate and Arsenic problems in Groundwater, Oxygen depletion in Surface water, Eutrophication in Surface water, Toxicity in Ground and Surface water, Ecological Health in surface water	**7Hrs**
Unit 5: Water use management: Agriculture, sustainable agriculture, dry land agriculture, and selection of water use efficiency, crops, irrigation, water losses, Issues and challenges in the water resources development and management, mitigate Gap between demand and availability, wetland management. Advanced Irrigation techniques, IT tools for water distribution, Development of Modeling Tools, Less water consuming gadgets, Water saving Technologies, Research in desalination & wastewater Treatment, Developing water resistant crop varieties, Policy Research	**8Hrs**
Unit 6: Watershed concept – Introduction, Need, characteristics of watershed, proforma for basic data on watershed, watershed management, integrated multidisciplinary approach, administrative aspects. Socio economics, peoples part, awareness, participation, state & integrated approach, pasture and silvipastures, horticulture, tree culture, farm forestry, afforestation, sustainable society, international agencies, future, economic viability. Impact of water shed management: Model watershed, Government watershed, Government projects national projects, World bank projects, ICRISAT, NGOs in water shed management.	**7Hrs**

Textbooks:

1) Hydrology & Soil Conservation Engineering - Ghansham Das , Prentice Hall of India
2) Soil & Water Conservation Engineering - R. Suresh, Standard Punlishers Distributors
3) Manual of Soil & Water Conservation Practices - Gurumal Singh, Oxford & IBH Publishing Company

References:

1) Watershed management - J.V.S.Murthy.
2) Watershed management in India - J.V.S.Murthy
3) Hydrology & Soil Conservation Engineering - Ghansham Das , Prentice Hall of India
4) Soil & Water Conservation Engineering - R. Suresh, Standard Punlishers Distributors
5) Manual of Soil & Water Conservation Practices - Gurumal Singh, Oxford & IBH Publishing Company

Unit wise Measurable Students Learning Objectives and Outcomes:

Unit-1 Explain significance and scope of watershed Management for sustainable development. **CO1, CO2**

Unit-2 Apply concepts of integrated water resources management, conjunctive use of water resources, rainwater harvesting.**CO1, CO3**

Unit-3 Apply Socio–Economic aspects of watershed management through community and Private sector participation, Socio-economy.**CO2, CO3**

Unit-4 Develop standard watershed model based on standard modeling approaches and water quality models.**CO3, CO5**

Unit-5 Assess role of greenery in wetland management, sustainable agriculture, dry land agriculture, selection of water use efficiency. **CO2, CO4**

Unit-6 Understand the procedures of water shed management, Model watershed, Government projects national projects, World bank projects, ICRISAT, NGOs in water shed management. **CO5**

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Research Methodology (Audit Course) Course No.: UENV0664	L	T	P	Credit
	02 hours per week	-	-	2

Course Pre-Requisite:

This course is designed primarily for graduate students in Environmental Engineering who are aware of the domains in the field of Environmental Engineering. The students should have the basic knowledge of basic sciences.

Course Description:

The course is imparting fundamental knowledge of basic research skills and concepts needed to plan, conduct, and analyze data from a research project. Skills including performing literature searches, defining research problem, research methods, scale construction, data collection, analysis, interpretation and report writing will be taught.

Course Learning Objectives:

3. To search the literature and identify research gaps.
4. To form a research question with testable hypotheses.
5. To realize the concepts of reliability, validity, the pros and cons of a variety of research techniques and importance of IPRs.
6. To understand the characteristics of a good research report.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	Define a good research question, hypothesis and aims.	Cognitive (Understanding) L2
CO.2	Identify alternative research methodologies and analytical techniques for a chosen research question.	Cognitive (Identifying) L3
CO.3	Analyze basic techniques of qualitative data gathering.	Cognitive (Analyzing) L4
CO.4	Summarize the study purpose, process, methods and results in preparation of research report.	Cognitive (Evaluating) L5

CO-PO Mapping:

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

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

Assessments :

Assessment	Weightage (Marks)
ESE	50

- **ESE:** Assessment is based on 100% course content.

Course Contents:

Unit 1: **Introduction to Research Methodology:** Meaning and Concept of Research, Research Process, Objectives, Motivation, Ethics in Research, Types of Research – Basic, Applied, Descriptive, Analytical, Conceptual, Empirical, Qualitative and Quantitative.	**05 Hrs.**
Unit 2: **Problem Identification & Formulation –** Introduction, Concept and Need of Research Problem, Literature Survey, hypothesis, characteristics of hypothesis, Steps of Defining a Research Problem, Characteristics of a Good Research Problem, Identifying and Formulating Research Problem.	**05 Hrs.**
Unit 3: **Measurement and Scaling Techniques –** Concept of Measurement, Measurement Scale, Developing Measurement Tools, Basic Criteria of Good Measurement Tools, Errors in Measurement, Concept of Scaling and Types of Scales.	**04 Hrs.**
Unit 4: **Methods of Data Collection –** Concept of Data Collection, Types of Data, Methods of Primary Data Collection, Methods of Secondary Data Collection, Selecting an Appropriate Method of Data Collection.	**04 Hrs.**
Unit 5: **Intellectual Property Rights (IPRs) -** Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs)- A brief summary of: Patents, Copyrights, Trademarks, Industrial Designs, Geographical Indications.	**04 Hrs.**
Unit 6: **Interpretation and Report Writing -** Techniques of interpretation, Structure and components of scientific reports, Layout, structure and language of the report, Illustrations and tables, References and Citations.	**04 Hrs.**

Textbooks:

1. Books: C. R. Kothari, "Research Methodology", New Age international, 2004.
2. Deepak Chopra and Neena Sondhi, "Research Methodology: Concepts and cases", Vikas Publishing House, New Delhi, 2008.
3. Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", 2nd Edition, Sage Publisher, 2011.

References:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Anderson, T. W., An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
6. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications.
7. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
8. Intellectual Property Rights in the Global Economy: Keith Eugene Maskus, Institute for International Economics, Washington, DC, 2000.
9. Subbarau NR-Handbook on Intellectual Property Law and Practice-S Viswanathan Printers and Publishing Private Limited.1998

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Wastewater Engineering Laboratory Course No.: UENV0631	L	T	P	Credit
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Course Pre-Requisite:

Students shall have the knowledge of:

- Environmental Chemistry
- Wastewater treatment

Course Description:

The course is explores the application of basic chemistry and chemical calculations to measure physical, chemical, and bacteriological parameters of wastewater. Laboratory methods and interpretation of results with regard to environmental engineering applications such as design and operation of wastewater treatment processes, and to the control of the quality of natural water.

Course Objectives:

1. To provide hands-on practice for analyzing the quality of wastewater.
2. To study operation of a real life wastewater treatment plant.

Course Learning Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	**Use** physical, chemical and biological methods for wastewater quality analysis.	Cognitive (Applying) L3
CO.2	**Solve** problems on design on various units for wastewater treatment	Cognitive (Applying) L3
CO.3	**Analyze** and **interpret** the experimental results.	Cognitive (Analyzing) L4

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1									2			
CO2			3									
CO3				2		1				1		

COs	PSO1	PSO2
CO1	2	
CO2		2
CO3	2	

Assessments :

Assessment	Weightage (Marks)
ISE	50
ESE (OE)	50

• **ISE:** Based on practical performed/ results analyzed / designs of treatment unit/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc. • **ESE (OE):** Assessment is based on oral examination.	
Course Contents:	
Experiment No. 1: Analysis of domestic wastewater for volatile and fixed solids**.** **Learning Outcome:** To determine volatile and fixed solids and relation between them from domestic wastewater.	02 hours
Experiment No. 2: Analysis of domestic wastewater for BOD**.** **Learning Outcome:** To determine BOD of domestic wastewater.	02 hours
Experiment No. 3: Analysis of domestic wastewater for COD **Learning Outcome:** To determine COD of domestic wastewater	02 hours
Experiment No. 4: Analysis of domestic wastewater for Oil & Grease **Learning Outcome:**To determine Oil & Grease from domestic wastewater	02 hours
Experiment No. 5: Analysis of Sulphates from domestic wastewater **Learning Outcome:**To determine sulphates from domestic wastewater.	02 hours
Experiment No. 6: Analysis of domestic wastewater for TotlaKjeldhal Nitrogen**.** **Learning Outcome:** To determine Ammonia and organic nitrogen from domestic wastewater.	02 hours
Experiment No. 7: Analysis of domestic wastewater for Phosphorous **Learning Outcome:** Determination of Orthophosphates from domestic wastewater	02 hours
Experiment No. 7: Analysis of sludge **Learning Outcome:** Determination of characteristics of sludge such as pH, moisture content, volatile solids	02 hours
Visit to sewage treatment plant	01 Day
References: 2. Chemistry for Environmental Engineering and Science, Clair N Sawyer, Perry L. McCarty, Gene F. Parkin 3. *Standard Methods for the Examination of Water and Wastewater* by American Public Health Association, American Water Works Association, Water Environment Federation 4. IS 3025: Methods of sampling and test (physical and chemical) for water and wastewater	

Class: T. Y. B. Tech Environmental Engineering Title of the Course: Air Pollution and Control Laboratory Course Code:UENV0632	L	T	P	Credit
			2	1

Course Pre-Requisite:
Knowledge of Environmental chemistry

Course Description:
During the course students will be demonstrated with use of equipments in laboratories and hands-on practice in the field for monitoring of various meteorological parameters as well as Ambient Air quality monitoring and stack gas monitoring

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive Descriptor
CO1	Monitor various meteorological parameters needed for air pollution studies	Psychomotor (L-2, Monitor)
CO2	Design and conduct experiments for air quality monitoring	Psychomotor (L-5, Design, Conduct
CO3	Analyze and interpret data acquired from air monitoring	Cognitive(L-4, Analyse)

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1				3	2							
CO2				3	2	1	1					
CO3				4		2	1					

COs	PSO1	PSO2
CO1	1	
CO2	-	2
CO3	3	

Assessments :

Assessment	Weightage (Marks)
ISE	50
ESE (OE)	25

- **ISE:** Based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE (OE): Assessment is based on oral examination.

Course Content

Experiment No. 1: To Measure ambient air temperature, relative humidity and dew point temperature, (CO-1), 2hrs.

Experiment No. 2 To measure wind speed and direction (CO-2), 2hrs.

Experiment No. 3: To study the functioning of Automatic weather station (CO-1), 2hrs.
Experiment No. 4: To Prepare wind rose diagram (CO-1), 2hrs.
Experiment No. 5:To study the functioning of Fine Dust Sampler-FDS (CO-2),, 2hrs.
Experiment No. 6:To determine ambient air quality with respect to SPM, RSPM, Sox and NOx(CO-2, 3), 2hrs.
Experiment No. 7:Demonstration of Stack gas Monitoring KIT (CO-2, 3), 2hrs.
Textbooks: 1. K. Wark, C.F. Warner & W.T. Davis Air Pollution Control: its Origin and Control, Addision-Wesley, (1998). 2. Stern A.C., "Air Pollution Vol. I and II", Allied Publishers Limited, 1st Edition, 1994. **3.** Martin Crawford, "Air Pollution and Control", Tata McGraw Hill Publication, 1st Edition, 1976.
References: 1. Air Pollution and Control Technologies by Anjaneyulu, D", Allied Publishers, Mumbai, 2002 2. Environmental Pollution Control Engineering by Rao, C.S., Wiley Eastern Ltd., New Delhi, 1996 3. Industrial Air Pollution Control Systems by W.L.Heumann, McGraw-Hill, New York, 1997 4. Environmental Engineering by Peavy S.W., Rowe D.R. and Tchobanoglous G, McGraw Hill, New Delhi, 1985 5. Environmental Engineering Vol. II by Garg, S.K, Khanna Publishers, New Delhi **6.** Fundamentals of Air Pollution by Richard W.Boubel, D.L.Fox, D.B.Turner&A.C.Stern, Reed Elsevier India Pvt. Ltd., New Delhi,

Class: T. Y. B. Tech Environmental Engineering	L	T	P	Credit
Title of the Course: Design of Concrete Structures Laboratory **Course No.: UENV0633**	---	---	02 hours per week	1

Course Pre-Requisite:

Students shall have the knowledge of:

- Algebra and Engineering Mathematics
- Engineering Mechanics
- Structural Mechanics
- Construction Technology

Course Description:

The course helps to develop as well as enhance mathematical skills & analytical abilities by using various design philosophies to design various structural components as per IS Code 456:2000 provisions. Students design beams, slabs, columns, environmental structures with varying grades of material, Loading as well as spans. Knowledge of structural members helps in costing and valuation also.

Course Objectives:

7. To use concepts to design structural members and refer IS Code..
8. To apply checks to verify the designs.
9. To understand concept of design of structures related to Environmental Engg..

Course Learning Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO1	Illustrate design philosophies and concepts of Reinforced Cement Concrete design	Cognitive (Understanding) L2
CO2	Examine the design solutions by using various checks.	Cognitive (Analyzing) L4
CO3	Show ability to design structures related to Environmental Engg.	Psychomotor (Set) L2

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1			3		2					1		
CO2			3		2					1		
CO3			3		2					1		

COs	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2

Assessments :

Assessment	Weightage (Marks)
ISE	50

- **ISE:** Based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

Course Contents:	
Experiment No. 1: Stress strain behavior of concrete and steel **Learning Outcome:** Interpretation of behavior of the materials and estimating their permissible values od stress for design..	2 Hours
Experiment No. 2: Use of Limit State method of Collapse (Limit state of flexure) **Learning Outcome:** Design of singly reinforced sections with varying conditions.	2 Hours
Experiment No. 3: Use of Limit State method of Collapse (Limit state of flexure) **Learning Outcome:** Design of doubly reinforced sections with varying conditions.	2 Hours
Experiment No. 4: Use of Limit State method of Collapse (Limit state of flexure) **Learning Outcome:** Design of flanged sections with varying conditions.	2 Hours
Experiment No. 5: Use of Limit State method of Collapse (Limit state of shear & bond) **Learning Outcome:** Verification of design by applying checks for shear & bond	2 Hours
Experiment No. 6: Use of Limit State method of Collapse (Limit state of flexure) **Learning Outcome:** Design of one way slab	2 Hours
Experiment No. 7: Use of Limit State method of Collapse (Limit state of flexure) **Learning Outcome:** Design of two way slab	2 Hours
Experiment No. 8: Use of Limit State method of Collapse (Limit state of flexure) **Learning Outcome:** Design of cantilever slab	2 Hours
Experiment No. 9: Use of Limit State method of Collapse (Limit state of flexure) **Learning Outcome:** Design of staircase.	2 Hours
Experiment No. 10: Use of Limit State method of Collapse (Limit state of bond) **Learning Outcome:** Design of rectangular and circular column	2 Hours
Experiment No. 11: Use of Limit State method of Collapse (Limit state of bond) **Learning Outcome:** Design of rectangular water tank.	2 Hours
Experiment No. 12: Use of Limit State method of Collapse (Limit state of bond) **Learning Outcome:** Design of circular water tank.	2 Hours

Textbooks / Reference books:

1 IS 456-2000
2. Limit state theory and Design –Karve and Shah, Structures publications , Pune
3. Reinforced Concrete Design – Limit state - A.K. Jain Nem Chand brothers Roorkee
4. Fundamentals of Reinforced Concrete –Sinha and Roy, S. Chand and company Ltd. Ram Nagar, New Delhi
6. Limit State Design of reinforced concrete P.C.Varghese, Prentice Hall, New Delhi
7. Reinforced Concrete Design- B.C. Punmia Laxmi publications New Delhi
8. Reinforced Concrete Design-M. L. Gambhir-Mc millan India Ltd. New Delhi
9. Special publications -16-Bureau of Indian standard

Class: T. Y. B. Tech Environmental Engineering Title of the Course: **Design & Drawing of Environmental Systems Laboratory** Course No.: UENV0634	L	T	P	Credit
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Course Pre-Requisite:

Students shall have the knowledge of:

- Engineering graphics
- Water Supply Engineering

Course Description:

This course includes knowledge of design and drawing of different water and wastewater treatment units. Also it covers design of storage reservoirs and sewerage systems

Course Objectives:

1. Understand water and wastewater treatment facilities
2. Learn drawing of water and wastewater treatment units, storage reservoirs and sewerage systems

Course Learning Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO1	**Make use of** AutoCAD for drawing of treatment units of water and waste water	**Cognitive** L-3
CO2	**Design** and draw treatment units for water and waste water, service reservoir and sewer appurtenances.	**Cognitive** L-6

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1					2							
CO2	3	2	2									

COs	PSO1	PSO2
CO1		
CO2	1	

Assessments :

Assessment	Weightage (Marks)
ISE	50
ESE (OE)	25

- **ISE:** Based on practical performed/ drawing sheets/Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc
- **ESE (OE):** Assessment is based on oral examination.

Course Contents:	
Experiment No. 1: Flow sheet of conventional water and waste water treatment plant **Learning Outcomes:** To plan and draw treatment flow sheet of water and waste water treatment plant	2 Hours
Experiment No. 2: Cascade Aerator, Hydraulic Mixing Unit (Parshall Plume) and Flash Mixer **Learning Outcomes:** To design and draw of Cascade Aerator, Hydraulic Mixing Unit and Flash Mixer	4 Hours
Experiment No. 3: Clarifier, Clariflocculator **Learning Outcomes:** To design and draw Clarifier, Clariflocculator	2 Hours
Experiment No. 4: Rapid Sand Filter **Learning Outcomes:** To design and draw Rapid Sand Filter	2 Hours
Experiment No. 4: Service Reservoir **Learning Outcomes:** To design and draw Service Reservoir	4 Hours
Experiment No. 5: Screen chamber and Detritus Pit **Learning Outcomes:** To design and draw Screen Chamber and Detritus Pit	2 Hours
Experiment No. 6: Sewer Profile **Learning Outcomes:** To design and draw Sewer Profile	4 Hours
Experiment No. 7: Hydraulic flow diagram of conventional water and waste water treatment plant using AutoCAD **Learning Outcomes:** To draw hydraulic flow diagram of conventional water and waste water treatment plant using AutoCAD	2 Hours
Experiment No. 8: Water treatment units (any two) using AutoCAD **Learning Outcomes:** To draw water treatment units using AutoCAD	4 Hours

References:

5. Manual on Water Supply and Treatment (3rd Ed) – Ministry of Urban Development, New Delhi, 1991.
6. Manual on Sewerage and Sewage Treatment (2nd Ed) – Ministry of Urban Development, New Delhi, 1993.
7. Manual on Sewerage and Sewage Treatment (Final Draft) – Ministry of Urban Development, New Delhi, 2012