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

Curriculum for

B. Tech Programme

in

Environmental Engineering

VISION AND MISSION OF INSTITUTE

VISION:

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

MISSION:

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

VISION AND MISSION OF DEPARTMENT

VISION

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

MISSION

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

PROGRAMME EDUCATION OBJECTIVES

PEO 1: Solve Environmental Engineering problems and pursue higher studies using solid foundation in mathematics, science & technology.
PEO2: Design and operate various environmental systems in industries as well as other related fields through participative education.
PEO3: Develop skills to communicate effectively and work in a team in multidisciplinary areas.
PEO4: Respond to the challenges of environmental issues through research and development.

PROGRAM OUTCOMES

Environmental Engineering graduates will be able to:

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

PROGRAMME SPECIFIC OUTCOMES

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

MAPPING OF PROGRAM OUTCOMES TO PROGRAM EDUCATION OBJECTIVES

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

Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Teaching and Evaluation scheme for
Second Year B. Tech. Program in 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	100	40	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	100	40	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	100	40	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	Wastewater 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	
UOEL06**	Open Elective I	OE	3	-	-	**3**	ISE-I	10		40
							ISE-II	10		
							MSE	30		
							ESE	50	20	
UENV0664	Audit Course IV: Research Methodology	PC	2	-	-	-	ESE	100	40	40
UENV0631	Wastewater 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 and Drawing of Environmental Systems Laboratory	PC	-	-	4	**2**	ISE	50	20	
							ESE (OE)	25	10	
			18	**1**	**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			
			L	T	P	Credits	Components	Marks		
								Max	Min for passing	
UENV0701	Industrial Wastewater Treatment	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0702	Advance Water and Wastewater Treatment	PC	3	1	-	**4**	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	Environmental Impact Assessment and Environmental Legislation	PC	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UOEL07**	Open Elective II	OE	3	-	-	**3**	ISE I	10		40
							MSE	30		
							ISE II	10		
							ESE	50	20	
UENV0765	Audit Course V: Environmental Management	PC	2	-	-	-	ESE	100	40	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	
			17	**1**	**08**	**20**	**500 + 300 = 800 + Audit Course**			

Total Credits – 20, Total Contact hours – 26

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

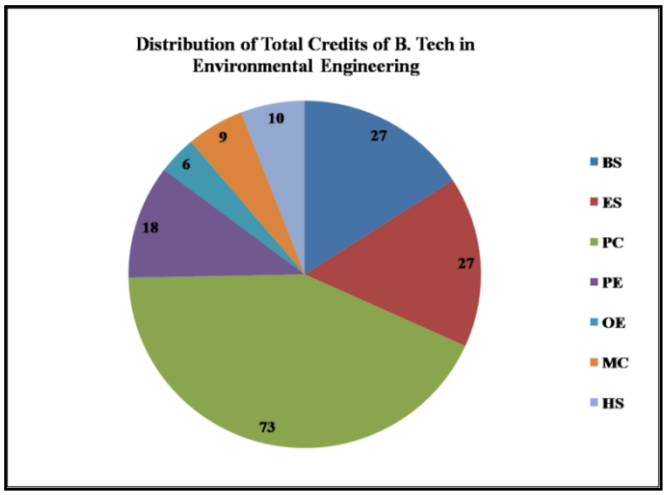
Kolhapur Institute of Technology's
College of Engineering (Autonomous), Kolhapur
Teaching and Evaluation scheme for
Final Year B. Tech. Program in Environmental Engineering Semester-VIII

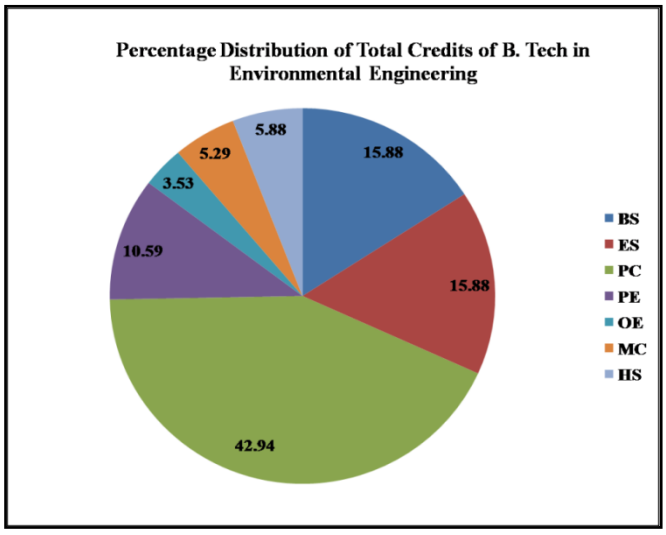
Course Code	Course Name	Curriculum Component	Teaching Scheme				Evaluation Scheme		
			L	T	P	Credits	Components	Marks	
								Max	Min for passing
UENV0852	Project Phase II	MC	-	-	12	**6**	ISE I	75	30
							ISE II	75	30
							ESE (OE)	150	60
UENV08**	Professional Elective IV	PE	3	-	-	**3**	ISE-I	10	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	Advanced Concrete Structures	UENV0826	Environmental Sustainability

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

B. Tech

Environmental Engineering

SEMESTER – VII

Class: B.Tech. Environmental Engineering **Title of the Course:** Industrial Wastewater Treatment **Course Code:** UENV0701	**L**	**T**	**P**	**Credits**
	03	**-**	**-**	**03**

Course Pre-Requisite:
Environmental chemistry and microbiology, water & wastewater engineering.

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

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

Course Outcomes:

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

CO-PO Mapping:

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

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

Assessments :

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

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

- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:

Unit 1: Use of water and impact of untreated industrial wastewater Industrial scenario in India, General water requirements in industry, Water budget, Environmental impacts of untreated industrial wastewater, Characterization and treatability studies, Effluent standards	2 Hrs.
Unit 2: **Waste Minimization and Treatment options** Methods of waste volume and strength reductions, Waste minimization - 4 R concepts, zero discharge concept, Classification of treatment and development of treatment flow sheets, Unit operations and unit processes, Pretreatment of industrial waste - Neutralization, Equalization, Proportioning, Concept of Common Effluent Treatment Plant- Objectives, Types of CETP, Technical and financial aspects	8 Hrs.
Unit-3 Agro-based Industries Manufacturing processes, Water usage, Sources, quantities and characteristics of effluents (process stream and combined), Pollution effects, Alternative methods of treatment, Waste Reduction/Byproduct recovery for various Agro- based industries: Sugar, Distillery, Pulp and paper mill, Dairy and Textile industries, visit to any two industries with report writing	10 Hrs.
Unit-4 Non agro-based industries Manufacturing processes, Water usage, Sources, quantities and characteristics of effluents (process stream and combined), Pollution effects, Alternative methods of treatment, Waste Reduction/Byproduct recovery, and disposal for various Non agro- based industries:, Tannery, Petroleum and Oil refineries, Meat processing and food processing industries	8 Hrs.
Unit 5: **Engineering and Chemical industries** Manufacturing processes, Water usage, Sources, quantities and characteristics of effluents (process stream and combined), Pollution effects, Alternative methods of treatment, Waste Reduction/Byproduct recovery, and disposal for - Steel and Engineering industries, Fertilizer and pesticide industries, organic & inorganic manufacturing industries	8Hrs.
Unit 6: **Treatment for removal of specific pollutants** Removal Cyanide, Treatment for radioactive wastes, Treatment of black liquor and spent tanning liquor, treatment of spent wash for zero discharge- Multiple effect evaporators and Reverse osmosis, Biological treatment for Toxic waste, Acclimatization of bacteria,	4Hrs.

Textbooks:

1. Patwardhan. A.D., Industrial Wastewater Treatment", Prentice Hall of India, New Delhi 2010. ISBN-978-81-203-5332-9
2. Rao M. N. & Dutta A. K. , "Wastewater Treatment", Oxford – IBH Publication, 1995.

References:

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

Unit wise Measurable Students Learning Outcomes:

ULO 1.1: Explain use of water in industries and effects of untreated industrial wastewater
ULO 2.1 : Select suitable waste minimization measures for different industries
ULO 2.2 : Classify the treatment and develop treatment flow sheets for industrial wastewater
ULO 3.1 : Summarize manufacturing processes, sources and characteristics of wastewater, treatment options and waste minimization in Various agro-based industries
ULO 4.1 : Summarize manufacturing processes, sources and characteristics of wastewater, treatment options and waste minimization in Various non agro-based industries
ULO 5.1 : Summarize manufacturing processes, sources and characteristics of wastewater, treatment options and waste minimization for chemical and engineering industries
ULO 6.1: Describe specific treatment required for highly polluted wastes from different industries

Class: B.Tech Environmental Engineering **Title of the Course:** Advance Water and Waste Water Treatment **Course Code.:** UENV0702	**L**	**T**	**P**	**Credits**
	03	**01**	**-**	**04**

Course Pre-Requisite:

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

Course Description:

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

Course Learning Objectives:

The objectives of the course are

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

Course Outcomes:

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

CO-PO Mapping:

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

CO	**PSO1**	**PSO2**
CO1		1
CO2	2	
CO3		1

Assessments :

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

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

Course Contents:

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

Textbook:

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

References:

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

Unit wise Measurable Students Learning Outcomes:

ULO1: Explain and applyscientific concepts to demonstrate the need for advanced treatment and scientificknowledgeof reactors and reaction kinetics and modelling of biological treatments: CO1, CO3

ULO2:Explain, analyze the concept and design of settling and filtration processes: CO1 & CO3

ULO3:Explain, analyze the concept and design of ion exchange and adsorption process: CO1, CO2& CO3

ULO4: Explain, analyze the concept of biological wastewater treatment for the removal of nitrogen and phosphorous. CO1, CO2& CO3

ULO5:Explain and apply the principles of physic-chemical processes for removal of inorganic solids: CO1

ULO6:Explain, analyze the concept and design of natural treatment systems: CO1, CO2, andCO3

Class: B.Tech Environmental Engineering **Title of the Course:** Quantity Surveying and Valuation **Course Code :** UENV0703	**L**	**T**	**P**	**Credits**
	03	**-**		**03**

Course Pre-Requisite:

Students must have knowledge about numerical and mathematical applications in solving problems of area and volume measurements. Also students must be having knowledge of mode of measurement for various building components.

Course Description:

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

- Estimation of quantities of various building components
- Calculate quantity of materials and labours for various building components
- Calculate rates of various building items and detailed estimate.
- Do the valuation of different construction projects.

Course Learning Objectives:

At the end of the course students will be able to

1. Estimate quantities of various components of buildings and environmental structures.
2. Do rate analysis for various items in the building.
3. Understand the various concepts in valuation.
4. Calculate market value of building by different methods.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Descriptor**
CO1	Select the method for calculating the quantities of building and environmental structures.	Cognitive (Remembering) L1
CO2	Explain the various concepts in valuation.	Cognitive (Understanding) L2
CO3	Estimate the materials, labors and rates required for various works.	Cognitive (Evaluating) L5
CO4	Evaluate various items for valuation of different works as per standards and specifications.	Cognitive (Evaluating) L5

CO-PO Mapping:

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

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

Assessments :

Assessment	**Weightage (Marks)**
ISE I	10
MSE	30
ISE II	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: a) Introduction: General Introduction to Quantity surveying, purpose of estimates types of estimates, various items to be included in estimate. Mode of measurement of various items, IS 1200, Administrative approval and Technical sanction to estimates, Prime cost, Provisional sums and provisional quantities b) Specifications: Purpose and basic principles of general and detailed specifications, specifications for different items of work for building, water supply and sewerage works	7 Hrs.
Unit2: a) Estimation of residential building; Estimate of different items of buildings b) Analysis of Rates: Factors affecting the cost. Materials, Labour, task work schedule as basis of labour cost, rates of various machinery, tools and plants, overhead charges, Rates for various items of construction of civil Engineering works, standard schedule of Rates, DSR and use of DSR for estimating	6 Hrs.
Unit3: Approximate Estimates: Purpose, various methods used for building and other Civil Engg. Works water supply, Drainage, irrigation and Road projects. Different methods for executing work like contract method, Departmental, Organizational set-up of various govt. bodies like PWD, Water Supply Departments and general idea about its working and delegation of power, classification of works, Methods for carrying out work . Measurement books, mode of payment, bill forms, Global contractors, local competitive bidding	7 Hrs.
Unit4: a)Contracts: Essentials of legally valid contract. Different types of contracts. Suitability of different types of contracts. b) Tender Procedure: Various types of tenders, preparing tender papers, invitation of tenders, tender notice, submission, scrutiny and Acceptance of tenders, conditions of contracts, right and responsibilities of the parties to contract. c) Introduction to Arbitration	5 Hrs.
Unit5: a) Principles of valuation: Definition of value, unit price and cost attributes of values. Different types of value b) Valuer and his duties, purpose of valuation and its function. Factors affecting the valuation of properties, Tangibles and intangibles, Landed properties, freehold and lease hold properties. Different type of Lease. c) Various methods of valuation: Rental Method, belting method of Valuation, valuation for water supply and sewerage schemes.	9 Hrs.
Unit 6: a) Depreciation: Different methods of calculating depreciation: declining balance method, sinking fund method, depreciated cost, factors for obsolescence. b) Sinking Fund: Definition, purpose, calculation of sinking fund, Sinking fund calculations for various equipments and machinery used in water supply and sewerage schemes. d) BOT: Concepts of execution of works by the methods like BOT.	6 Hrs.

Textbooks:

1. Estimating and Costing –B. N.Datta, 24th edition, UBS publishers Pvt Ltd.
2. Estimating, costing and specifications in civil engineering – Chakraborty M., Publications: M. Chakraborty, ISBN-10 818530436X
3. Estimating and Costing –G.S. Birdi, DhanpatRai publishing company.

Reference Books:

1. District Schedule of Rates for PWD, MJP
2. Quantity Surveying – P. L. Bhasin
3. Elements of estimating and costing – S. C. Rangawala.
4. Civil Engg. Contracts and Estimates – B. S. Patil
5. Professional Practice – RoshanNamavati (Estimating and Valuation)
6. Bombay P. W. D. volumes I and II
7. Valuation of real properties – S. C. Rangawala

Class: B. Tech Environmental Engineering **Title of the Course:** Environmental Impact Assessment and Environmental Legislation **Course No.:** UENV0704	**L**	**T**	**P**	**Credit**
	03	**-**	**-**	**03**

Course Pre-Requisite:

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

Course Description:

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

Course Learning Objectives:

At the end of course students will

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

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Cognitive Descriptor**
CO1	Explain the process and requirements for EIA.	Cognitive (Understanding) L 2
CO2	Interpret various methods for assessment of Environmental Impacts.	Cognitive (Understanding) L 2
CO3	Identify the legal requirements and provisions applicable under environmental laws in India.	Cognitive (Applying) L 3

CO-PO Mapping:

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

COs	**PSO1**	**PSO2**
CO1		
CO2		2
CO3		

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 : concept of EIA, necessity and objectives of EIA, History of EIA, Components of EIA studies, Types of impacts, planning & management of EIA studies, EIA implementation in India, EIA Notifications 1994, EIA Notification 2006 and its provisions, EIA Procedure with reference to Notification 2006 – stages, Public Consultation, Public Hearing Procedure, Post Environmental Clearance Monitoring, Schedule for categorization of projects with general and specific condition, Procedure for Appraisal.	08 Hrs.
Unit 2: Methodology: Baseline Data Collection, Interaction Matrix Methodologies, Network Methodologies, Checklist Methodologies, Description of Environmental Settings, Conceptual Framework, Various indices like WQI, AQI, Impact Assessment: Mass Balance Approach, Box Model Approach, Air Quality Dispersion Modelling, Assessment of Impact and Mitigation Measures, Comprehensive Environmental Pollution Index in India (CEPI).	08 Hrs.
Unit 3: Documentation for EIA - Contents of Form I and Form I –A, Generic Structure of EIA, Summary of EIA.	04 Hrs.
Unit 4: Historical Development of various Environmental Legislations, USEPA 1969, Clean Air Act, Clean Water Act, NEPA, Water (Prevention & Control of Pollution) Act, 1974 and Rules, Water (Prevention & Control of Pollution) Cess Act, 1977 and Rules, Air (Prevention & Control of Pollution) Act, 1981 and Rules.	08 Hrs.
Unit 5: Environment (Protection) Act, 1986 and Rules, Plastic Waste Management Rules 2016, E- Waste (Management) Rules 2016, Construction and Demolition Waste Management Rules 2016, Batteries (Management and Handling) Rules 2001, Atomic Energy (Safe Disposal of Radioactive Wastes) Rules, 1987, Fly Ash Notification	08 Hrs.
Unit 6: Guidelines for Coastal Regulation Zones (CRZ) and Eco Sensitive Zones (ESZ), Concept of Strategic Environmental Assessment (SEA), Comparison of EIA and SEA	04 Hrs.

Textbooks:

1. Environmental Impact assessment - Canter L.W.; McGraw Hill Publishers
2. Manual of Environmental Impact Assessment - Govt. of India Publication
3. Handbook of Environmental Impact assessment - Kulkarni V.S, Kaul N, Trivedi R.K. , Scientific Publishers
4. Technical EIA Guidance Manual for Industrial Estates for MOEF Govt. of India by IL & FS Ecosmart Ltd., Hyderabad
5. All Environmental Legislations, amendments, rules published by MoEFCC.

Reference Books:

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

Unit wise Measurable students Learning Outcomes:

At the end of course students will be able to

1.1: Explain the component of EIA studies.
1.2: Explain the requirements for EIA study.
2.1: Interpret the use of methods for impact identification and assessment.
2.2: Interpret procedures for water quality and air quality indices.
3.1: Explain the contents of various forms used in EIA process.
3.2: Explain the structure of EIA report.
4.1: Identify the requirements under Water (Prevention and Control of Pollution) Act, 1974.
4.2: Identify the requirements under Air (Prevention and Control of Pollution) Act, 1981.
5.1: Identify the requirements under Environment (Protection) Act, 1986.
5.2: Identify the requirements under Environment (Protection) Rules.
6.1: Interpret the guidelines for CRZ and ESZ.
6.2: Interpret the purpose of SEA.

Class: B.Tech Environmental Engineering **Title of the Course:** Disaster Management and Risk Analysis (Open Elective – II) **Course Code:** UOEL0731	**L**	**T**	**P**	**Credits**
	03	**-**	**-**	**03**

Course Pre-Requisite: Environmental Studies.

Course Description:

The course will describe & explains types of disaster. It help students to understand risk and vulnerability analysis associated with disaster. It will assist students to understand procedures of disaster preparedness & response. Course also explains the rehabilitation, reconstruction and recovery process to be carried out after any disaster.

Course Learning Objectives:

1. To explain types of disasters.
2. To describe the risk and vulnerability associated with any disaster.
3. To demonstrate the preparedness & response procedures with any disaster.
4. To illustrate the rehabilitation, reconstruction and recovery process required after any disaster.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Taxonomy Descriptor**
CO1	Recall types of disaster.	Cognitive (Remembering) L1
CO2	Explain the risk and vulnerability associated with any disaster.	Cognitive (Understanding) L2
CO3	Predict the preparedness and response procedures with any disaster	Cognitive (Applying) L-3
CO4	Analyze the rehabilitation, reconstruction and recovery process required after any disaster.	Cognitive (Analyze) L3

CO-PO Mapping:

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

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

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 on Disaster Different Types of Disaster : Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc, Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea,Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc. Causes, effects and practical examples for all disasters.	8 Hrs
Unit 2: Risk and Vulnerability Analysis Risk : Its concept and analysis, Steps in Risk Assessment, Risk Reduction. Vulnerability: Its concept and analysis, Strategic Development for Vulnerability Reduction, Steps to Vulnerability Assessment, Types of Vulnerability Assessment.	6 Hrs
Unit 3 : Risk Management Risk based decision making, , Risk Cost Benefit optimization, Emergency Preparedness Plans, Design of risk management programs, risk communication ,risk based remediation, adaptive management, precaution and stake holder involvement.	6 Hrs.
Unit 4: Disaster Preparedness Preparedness- Disaster Preparedness: Concept and Nature, Disaster Preparedness Plan, Prediction, Early Warnings and Safety Measures of Disaster, Role of Information, Education, Communication, and Training, Role of Government, International and NGO Bodies, Role of IT in Disaster Preparedness, Role of Engineers on Disaster Management.	8 Hrs.
Unit 5: Disaster Response Response- Introduction, Disaster Response Plan, Communication, Participation, and Activation of Emergency Preparedness Plan, Search, Rescue, Evacuation and Logistic Management, Psychological Response and Management (Trauma, Stress, Rumor and Panic), Relief and Recovery, Medical Health Response to Different Disasters.	7 Hrs.
Unit 6: Rehabilitation, Reconstruction and Recovery Reconstruction and Rehabilitation as a Means of Development, Damage Assessment, Post Disaster effects and Remedial Measures, Creation of Long-term Job Opportunities and, Livelihood Options, Sanitation and Hygiene, Education and Awareness.	5 Hrs.

References:

1. Disaster Management by Dr. Mrinalini Pandey, Published by Wiley India Pvt. Ltd.
2. Disaster Management: Future Challenges & opportunities by Jagbir Singh, published by K W Publishers Pvt. Ltd.
3. Disaster Science and Management by Tushar Bhattacharya, published by McGraw Hill Education (India) Pvt. Ltd.
4. Risks and Decisions for Conservation and environmental management, Mark Burman, Cambridge University Press.
5. Susan L Cutter, Environmental Risks and Hazards, Prentice Hall of India, New Delhi, 1999.

Class: B.Tech. Environmental Engineering **Title of the Course:** Waste Management (Open Elective – II) **Course Code:** UOEL0732	**L**	**T**	**P**	**Credits**
	03	**--**	**--**	**03**

Course Pre-Requisite:

Students should have knowledge about current environmental issues, various types of pollutions due to solid, liquid and hazardous wastes. Concept of sustainable development.

Course Description:

There is a great need in understanding the importance of waste management for a healthy world. Students will recognize principles of integrated solid waste management and will provide an overview of municipal solid waste, industrial waste and hazardous waste management. They can explain the planning and engineering principles needed to address the growing and increasingly intricate problem of controlling and processing the refuse created by urban societies. The students can discuss options such as landfilling, composting and incineration from engineering, social, and regulatory perspectives. Students will understand federal regulations, public participation processes and innovative management practices associated with solid, liquid and hazardous wastes.

Course Learning Objectives:

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

1. Understand importance of waste management, to protect the earth.
2. Know consequences of various pollutions, if not managed wisely face the problem of affecting human health, socio economic problems, climate and marine environment.
3. Utilize the resources effectively by increasing growth.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Taxonomy Descriptor**
CO1	Identify generation, treatment and disposal of wastes.	Cognitive (Applying) L3
CO2	Choose recycling and reuse options.	Cognitive (Applying) L3
CO3	Select the relevant regulations that apply for facilities used for disposal, and destruction of waste.	Cognitive (Understanding) L3
CO4	Develop communication skills necessary to effectively convey technical and social information related to waste management.	Cognitive (Applying) L3

CO-PO Mapping:

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

CO	**PSO1**	**PSO2**
CO1		2
CO2		2
CO3		
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 No 1: Introduction to wastes Definition of waste and their classification, Important quality parameters of different types of wastes, Wastes suitable for energy production, Solid wastes and their classification, Waste water and their classification, Routes for solid waste management,	6 Hrs
Unit No 2: Elements of waste management system Waste generation, storage, collection, separation & processing, transfer and transport, disposal. **Integrated waste management using waste hierarchy** Principles of the waste hierarchy**,** waste prevention or reduction, reuse, recycling/composting, energy recovery and disposal	7 Hrs.
Unit No 3: Sustainability and Life cycle assessment Definition and concept of sustainability, triple bottom line solutions, sustainable development, definition and concept of life cycle assessment, Life-cycle approaches to waste management, cradle to grave concept, product life cycle thinking, life cycle thinking and pollution prevention.	7 Hrs
Unit No 4: Characterization of wastes Characterization of solid wastes- Physical, Chemical, Proximate analysis, Ultimate analysis, Fusing point of ash, Leaching properties, Energy content, Heating value, Characterization of waste water- Physical, Chemical.	7 Hrs.
Unit No 5: Waste to energy Need of energy production from wastes, Routes of energy production from waste, **Energy production from organic waste-** Anaerobic digestion and biogas production, types of anaerobic digestion process, anaerobic digester and their types, operation of anaerobic digester. **Energy production from waste plastic-** Classification of plastics, code for recyclable plastics, plastic types, their monomers and suitability for energy production, plastic waste generation and its need for proper management, options for management of plastic wastes and recycling through pyrolysis, common steps for converting waste plastic to fuels. **Densification of solids-** Fundamentals of densification, types of briquetting, Briquetting process and their comparison, Briquette characteristics, application of briquettes. **Efficiency improvement of power plant-** power generation flow sheet, performance of waste based power plant, factors influencing power efficiency	9 Hrs.
Unit No 6: Waste Management Policies and its legislation Need for appropriate and updated legislation, Public concern and education, Municipal Solid Waste Management Rules, 2016, The water (prevention and control of pollution) Act, 1974, Role of Central Pollution Control Board and Maharashtra Pollution Control Board in management of waste from various sources.	4 Hrs.

Textbooks:

1. Sincero, A. P. and Sincero, G. A., Environmental Engineering: A Design Approach, Prentice-Hall India, 1999
2. Bhide A. D. Solid Waste Management, Indian National Scientific Documentation Centre, New Delhi Ed 1983
3. Henze, M., Harremoes, P., Jansen, J. C. and Arvin, E., Wastewater Treatment: Biological and Chemical Processes, 3rd Ed., Springer Verlag, 2002

4. Vesilind, P. A., Worrel, W. A. and Reinhart, D. R., Solid Waste Engineering, Thomson Brooks/Cole, 1st Ed., 2002.
5. Bhide, A. D. and Sundaresan, B. B. (2001). Solid Waste Management – Collection, Processing and disposal. Mudrashilpa offset printers, Nagpur.

References:

1. R.B. Baird, A.D. Eaton,E.W. Rice (2017) Standard methods for the examination of water and wastewater: American Water Works Association (AWWA, WEF and APHA); 23 edition
2. Droste, R. L., Theory and Practice of Water and Wastewater Treatment, John Wiley & Sons,1996.
3. Peavy, H. S., Rowe, D. R. and Tchobanoglous, G. (1985) Environmental Engineering, McGraw-Hill Book Company, Singapore.
4. Weber, W. J., Physico-Chemical Processes for Water Quality Control, Wiley Inter Science, 1972.
5. Metcalf and Eddy Inc., Wastewater Engineering – Treatment and Reuse, Tata McGraw Hill India, 2003, 4th Edition.
6. Abbasi, S.A. (1988) Environmental Pollution and its Control. Cogent International, Pondicherry.
7. Arceivala, S. J., Wastewater Treatment for Pollution Control, Tata McGraw Hill, 1999
8. Aarve, V. P., William, A. W. and Debra, R. R. (2002). Solid Waste Engineering. Cengage reading, USA.
9. CPHEEO, Manual on Municipal Solid Waste Management, Government of India,2014
10. Tchobanoglous, G., Theisen and Vigil, Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill, 1993
11. George, T. and Frank, K. (2002). Handbook of solid waste management: (Second Edition). McGraw Hills.
12. Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products, (2012) Scrivener Publishing LLC.
13. Handbook of Sustainable Development, 2nd Ed, (2014),Edward Elgar publishing
14. Peter Rogers, Kazi F. Jalal, John A. Boyd, "An Introduction to Sustainable Development"(2007) Routledge; 1st Ed.

Class: B.Tech Environmental Engineering **Title of the Course:** Environmental Management (Audit Course – V) **Course Code:** UENV0765	**L**	**T**	**P**	**Credit**
	02	**-**	**-**	**Audit Course**

Course Pre-Requisite:

- Environmental Studies.
- Environmental Governance.

Course Description:

The course will describe the importance of environmental management in developing countries along with important Principles & Protocols associated with it. The policy making and analysis process. It will explain the use of various tools available for environmental management. Describe use of Environmental Economics in developmental activity.

Course Learning Objectives:

1. To convey knowledge of Principles & Protocols Environmental Management.
2. To demonstrate use of Policy Statements & Environmental Management Plan in Environmental Management.
3. To discuss the tools available for Environmental Management.
4. To explain importance of Environmental Economics in various developmental activities.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Taxonomy Descriptor**
CO1	Explain Principles & Protocols of Environmental Management.	Cognitive (Remembering) L1
CO2	Discuss the use of Policy Statements & Environmental Management Plan in Environmental Management.	Cognitive (Understanding) L2
CO3	Identify scope of different tools available for Environmental Management.	Cognitive (Applying) L3
CO4	Make use of Environmental Economics for engineering projects	Cognitive (Applying) L3

CO-PO Mapping:

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

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

Assessments :

Assessment	**Weightage (Marks)**
ESE	100

ESE: Assessment is based on 100% course content

Course Contents:

Unit 1: Definition of Environmental Management, Principles of Environmental Management, Corporate and international charters and protocols, Environmental regulations and policies.	8 Hrs.

Unit 2: Environmental Policy Analysis- Methods of Policy Analysis, steps involved, Environmental Management Plan (EMP), Components of EMP, Preparation of EMP, and Case Study.	6 Hrs.
Unit 3: Environment Risk assessment; Industrial ecology, Pollution prevention and Waste minimization; Sustainable development; Life cycle assessment; Environmental auditing; Eco-labeling of products; Performance indicators..	6 Hrs.
Unit 4: Introduction to Environmental Economics, Need & Importance of Valuation, Travel cost & Market price method of valuation, Marginal Costs and Benefits, Cost of Environmental Burden, Cost-Benefit Analysis.	8 Hrs.

References:

1. Environmental Management by Bala Krishnamoorthy.
2. Competitive Advantage of Environmental Management, St. Louis Press, Florida, 1996. Graedel, T.E. and Allenby
3. Environmental Law and Policy in India: Cases, Materials and Statutes, Tripathi Pvt. Ltd, Bombay, 1992.
4. Environmental Management: Principles And Practice By C.J.Barrow (Kindle Edition - Mar 14, 2007) - Kindle Book.

Class: B.Tech Environmental Engineering **Title of the Course:** Treatability Studies Laboratory **Course No.:** UENV0731	**L**	**T**	**P**	**Credit**
	---	---	02	01

Course Pre-Requisite:

Students shall have the knowledge of:

- Environmental chemistry, instrumentation and microbiology
- Processes for water and wastewater treatment

Course Description:

The course provides exposure to the techniques for the design and conduct of the experiments different types of wastewater.

Course Learning Objectives:

1. To develop skills to extract information pertinent to plan, design and conduct experiments.
2. To impart knowledge for analysis of complex environmental systems.

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Cognitive Descriptor**
CO.1	Develop (Plan, design, and conduct) experiments using appropriate techniques and tools to demonstrate research skill individually/groups.	Cognitive (Application) L3
CO.2	Analyze and interpret the experimental results.	Cognitive Analyze L4

CO-PO Mapping:

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

COs	**PSO1**	**PSO2**
CO1		
CO2	1	2

Assessments :

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

- **ISE:** Based on experiment developed/conducted/analyzed.
- **ESE (OE):** Assessment is based on oral examination.

Course Contents:

Experiment No. 1: Determination of gas transfer coefficient.	02 Hrs
Experiment No. 2: Determination of BOD rate constant for domestic wastewater**.**	04 Hrs
Experiment No. 3: Development of break through curve for ion exchange process.	06 Hrs
Experiment No. 4: Development of adsorption isotherm.	02 Hrs
Experiment No. 5: To determine BOD to COD ratio for different types of wastewater.	04 Hrs
Experiment No. 6: Determination of MLSS, MLVSS and SVI.	02 Hrs
Experiment No. 7: Determination of F/M.	02 Hrs
Experiment No. 8: Determination of volatile fatty acid.	02 Hrs

References:

1. Wastewater Engineering treatment and reuse – Metcalf and Eddy, Published by TMH.
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 (2005)
4. IS 3025: Methods of sampling and test (physical and chemical) for water and wastewater

Class: B.Tech Environmental Engineering **Title of the Course:** Quantity Surveying and Valuation Laboratory **Course No.:** UENV0732	**L**	**T**	**P**	**Credit**
	-	-	02	01

Course Pre-Requisite:

- Students must have knowledge about numerical and mathematical applications in solving problems of area and volume measurements
- Students must be having knowledge of mode of measurement for various building components.
- Students must be able to plan & design G+1 structures

Course Description:

The course explores the basic knowledge and fundamental of estimation of various Civil & Environmental structures. The course imparts the skills in measurement of various components of structures, estimation of various items required for construction work. Also it imparts skill of valuation of existing structures with standard format.

Course Learning Objectives:

1. To learn units of measurement for various civil engineering items
2. To perform cost estimation for entire civil & environmental projects
3. To understand the various valuation methods.

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Cognitive Descriptor**
CO.1	Analyze rates of various items, materials and labours of Civil and Environmental Engineering Works.	Cognitive (Analyzing) L4
CO.2	Estimate quantities of items and labour requirements for Civil and Environmental Engineering Works.	Cognitive (Evaluating) L5
CO.3	Determine cost estimate and valuation of Civil and Environmental Engineering Works.	Cognitive (Evaluating) L5

CO-PO Mapping:

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

Cos	**PSO1**	**PSO2**
CO1	-	2
CO2	-	2
CO3	-	2

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:

Assignment No. 1: Rate Analysis of ten items of Civil and Environmental Engineering works. 1. Earthwork 2. Cement Mortar 3. Concrete Work	4 Hours

4. Brick Work 5. Stone work 6. Plastering 7. Steel work 8. Flooring 9. Wood Work 10. White Washing	
Assignment No. 2: Detailed specification for minimum ten items of Civil and Environmental Engineering works. 1. Excavation 2. Plain and R.C.C. Work 3. Masonry Work 4. Centering and Formwork 5. Wood Work, Doors, Windows 6. Roof Covering 7. Water Supply 8. Plumbing and Sanitary Fittings 9. Drainage and Sewerage 10. Miscellaneous Building Items.	4 Hours
Assignment No. 3: Detailed Estimate of a Residential building	6 Hours
Assignment No. 4: Preparing detailed estimate for any one of the following- 1. Water treatment plant or sewage treatment plant 2. Water supply line 3. Sewerage line 4. 1 KM of road 5. 1 KM of Canal	4 Hours
Assignment No. 5: Preparation of Bar bending Schedule	4 Hours
Assignment No. 6: Valuation report for G+1 Building.	4 Hours
Assignment No. 7: Assignment based upon use of Microsoft Excel in quantity surveying.	2 Hours
Textbooks: 1. Estimating and Costing – B,N, Datta, 24th edition, UBS publishers Pvt Ltd. 2. Estimating, costing and specifications in civil engineering – Chakraborty M., Publications: M. Chakraborty, ISBN-10 818530436X 3. Estimating and Costing – G.S. Birdi, DhanpatRai publishing company.	
References: 1. District Schedule of Rates for PWD, MJP 2. Quantity Surveying – P. L. Bhasin 3. Elements of estimating and costing – S. C. Rangawala. 4. Civil Engg. Contracts and Estimates – B. S. Patil 5. Professional Practice – RoshanNamavati (Estimating and Valuation) 6. Bombay P. W. D. volumes I and II 7. Valuation of real properties – S. C. Rangawala	

Class: B. Tech Environmental Engineering **Title of the Course:** Seminar and Vocational Training Laboratory **Course No.:** UENV0741	**L**	**T**	**P**	**Credit**
	-	**-**	**02**	**01**

Course Pre-Requisite:

- Students shall have knowledge of Literature Survey and Report Writing.
- Students shall have knowledge of Industrial Pollution Control practices.

Course Description:

Seminar and Vocational Training Laboratory course deals with report preparation and presentation activity for seminar topic as well as vocational training. For seminar, students are expected to search relevant upcoming topic in the field for Environmental Engineering and prepare & present a seminar.

For vocational training, students should undergo training for a minimum period of 21 Days. They are expected to prepare and present a report on training at organizations related to Environmental Engineering applications. Such report will include scope of organization, various measures taken for pollution control and tasks given to students during training.

Course Learning Objectives:

At the end of course students will

1. Know the various measures taken by organizations for pollution control.
2. Understand the use of information sources for Literature.
3. Learn the requirements for report preparation.

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Cognitive Descriptor**
CO1	Perform literature review on environmental issues.	Psychomotor (Perception) L1
CO2	Present a seminar report on environmental issue.	Affective (Organization) L4
CO3	Demonstrate the operation of environmental systems in the organization underwent for training.	Psychomotor (Set) L2
CO4	Share the environment management practices of the organization underwent training.	Affective (Receiving) L1

CO-PO Mapping:

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

COs	**PSO1**	**PSO2**
CO1	2	
CO2		2
CO3	2	
CO4	2	

Assessments :

Assessment	**Weightage (Marks)**
ISE	50

ISE: Assessment of 50 Marks is based on at Presentations divided into two parts: Part A: Seminar Assessment (30 Marks) and Part B: Vocational Training Assessment (20 Marks).

Class: B.Tech Environmental Engineering **Title of the Course:** Project Phase – I Laboratory **Course Code:** UENV0751	**L**	**T**	**P**	**Credits**
	-	-	02	01

Course Pre-Requisite:

Students shall have the knowledge of:

- Fundamentals and Applications in Environmental Engineering,
- Professional Communication,
- Research Methodology

Course Description:

Project offers an opportunity to apply and extend knowledge gained throughout the program. In contrast to the majority of courses studied elsewhere in the program, projects are undertaken individually or in small groups. The strength of each batch shall not exceed maximum of four students. This necessarily introduces the dimension of project work management into the program to enable completion of a large, relatively unstructured "assignment" over the course of the semester. This course is based on a project work including literature studies according to the research plan. The research plan will be written by the student(s) under the guidance of research supervisor and which serve as a project description. This course is intended to represent the first half (initiation phase) of a project. It is a project-based course which requires students to demonstrate technical skills and personal attributes at levels which are appropriate with professional engineering practices. The project work is to be based on any problem pertaining to Environmental Engineering. The same project work will be continued during Project Phase – II in Semester – VIII at the (i) Parent Institution or (ii) Industry or (iii) Research Institution or (iv) Incubation Centre at Parent Institution for detailed study, experimentations, modelling, results, discussions and conclusions. Assessment of Project Phase – I will be done by means of a presentation, submission of a research synopsis and progress report of work done.

Course Learning Objectives:

The Course Objectives are to give an opportunity to students to,

1. Acquire the ability to make links across different areas of knowledge.
2. Develop collaborative skills to present ideas clearly and coherently.
3. Formulate new scientific questions that came up during project performance.
4. Learn on their own to evaluate ideas and take appropriate actions.
5. Show a professional attitude regarding time planning, collaboration, innovation and ethical issues.

Course Outcomes:

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

CO-PO-PSO Mapping:

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

CO	PSO1	PSO2
CO1		
CO2	2	
CO3		2
CO4		
CO5		

Assessments :

Assessment	Weightage (Marks)
ISE	50

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

Course Content:

The work to be completed shall consist of:

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

Term work:

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

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

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

SYLLABUS

B. Tech

Environmental Engineering

SEMESTER – VIII

Class: B.Tech Environmental Engineering **Title of the Course:** Project Phase – II **Course Code:** UENV0852	**L**	**T**	**P**	**Credits**
	-	-	12	06

Course Pre-Requisite:

Students shall have the knowledge of:

- Engineering Mathematics,
- Environmental Chemistry and Microbiology,
- Professional Communication,
- Research Methodology

Course Description:

This course requires the implementation of the engineering knowledge learnt in the theoretical and practical classes. This course will be conducted largely as an individual or small group project under the direct supervision of research supervisor. The specific project topic undertaken, research objectives and work plan will reflect the common interests and expertise of the student(s) and research supervisor. The project decided in B.Tech Semester – VII will be continued in B.Tech Semester – VIII for further study. Project work may be carried out at the (i) Parent Institution or (ii) Industry or (iii) Research Institution or (iv) Incubation Centre at Parent Institution. Students will be required to:

1. Carry out a extended literature search to review current knowledge, developments in the chosen technical area as well as inconsistencies in the domain;
2. Take on detailed technical work in the chosen area using one or more of theoretical studies, experimental analysis, modeling and simulation using analytical and / or computational methods;
3. Fabricate progress reports to establish work completed, and to schedule additional work within the time frame specified for the project;
4. Prepare an interim report describing the work done and results obtained; and
5. Present the work in a forum involving oral and / or poster presentation on the work done, findings, specific contributions to that field, limitations and future scope.

Course Learning Objectives:

The Course Objectives are to give an opportunity to students to,

1. Acquire the ability to make links across different areas of knowledge.
2. Develop collaborative skills to present ideas clearly and coherently.
3. Formulate new scientific questions that came up during project performance.
4. Learn on their own to evaluate ideas and take appropriate actions.
5. Show a professional attitude regarding time planning, collaboration, innovation and ethical issues.

Course Outcomes:

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

CO-PO-PSO Mapping:

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

CO	PSO1	PSO2
CO1		
CO2	2	
CO3		2
CO4		
CO5		

Assessments :

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

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

Course Content:

The work to be completed shall consist of:

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

Term work:

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

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

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

Class: B.Tech. Environmental Engineering **Title of the Course:** Industrial Health and Safety (Professional Elective – IV) **Course Code:** UENV0821	**L**	**T**	**P**	**Credits**
	03	**-**	**-**	**03**

Course Pre-Requisite:

Knowledge of

a. Engineering Chemistry
b. Engineering Mechanics
c. Engineering Management
d. Building Planning & drawing
e. EIA & Environmental Legislation

Course Description:

Human resource required in industry need to have multidisciplinary background. The principle of ergonomics, housekeeping and adherence to legal aspects plays a vital role to maintain safe work environment in industry. The course imparts adequate knowledge of accidents & its prevention, hazards and risks, safety, safety management systems, PPE, occupational hazards, exposure conditions along with legislative provisions and acts for various industries.

The course develops entry level skills in industrial safety, health, and environmental awareness. The course will help the students to understand requirements of variety of safety-related fields such as accident investigation, monitoring and enforcement of codes, ergonomics, and Safety management system: ISO 45001: 2018 provisions.

Course Learning Objectives:

1. To understand industrial work environment in accordance with the health & safety at the workplace.
2. To understand aspects of accidents and safety in industry..
3. To study hazard and safety management systems.
4. To study Occupational Health, Industrial Hygiene and legislation enacted for the protection of employees.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Taxonomy Descriptor**
CO 1	Explain causes and consequences of industrial accidents and need of safety.	Cognitive (Understanding) L2
CO 2	List hazards, risks and its control by following principles of safety.	Cognitive (Analyzing) L4
CO 3	Explain safety management systems and aspects of Occupational Health and Industrial Hygiene.	Cognitive (Evaluating) L5
CO 4	Discuss legislative provisions on occupational health and safety issues.	Affective (Responding) L2

CO-PO Mapping:

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

CO	**PSO1**	**PSO2**
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	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: Accident Theories, Investigation and Reporting a. Principles of Accident Prevention: Accident, Types, Causes, Consequences, Accident Statistics, Unsafe Acts and Unsafe Conditions, Cost of Accident (Direct and Indirect), Basic Activities in Accident Prevention, Accident Investigation and Reporting, Investigators Qualification, Investigation Strategy, Benefits, Documentation and Contents of Good Report. b. Theories of Accident Causation: Errors and Mistakes, Types of Errors, Decision Making, Heinrich Domino Theory, Accident/Incident Theory, Human Factors Theory, Human Behavior Theory, System Theory, Combination Theory	6 Hrs
Unit 2: Safety Management and Training a. Management of Safety and Health: Safety, Need, Parameters Associated with Safety, Theory of Safety, Principles of Safety, Three, E's, Safety Audit, Checklist Analysis, What-If Analysis, Safety Review, Safety Warning System b. Training for Safety and Health, Identifying Training Needs - Organizational Needs, Job-Related Needs, Individual Needs, Identifying Training Objectives and Methods, Training Evaluation and Feedback, Relationships within the Organization and Outside the Organization, Motivation.	6 Hrs
Unit 3: Hazard Management and Plant Layout a. Hazard Management Process, Hazard Identification, Workplace Inspection, Consultation, Risk Assessment, Risk Assessing Tools, Concept of Risk Priority Number, Risk Control Techniques, Machine Guarding Techniques, Types of Guards, Housekeeping Issues, Concept of 5-S. b. Plant and Machine Layout for Safety: Objectives, Site Selection, Factors Affecting Layout, Selection and Design, Requirements, Types of Plant Layout (Process Oriented and Product Oriented Layout), Need for Re-layout, Lockout -Tag out (LOTO) System, Personal Protective Equipments, Types, Need and Selection.	6 Hrs
Unit 4: Health and Safety Management Fundamentals of Health and Safety Management System: Importance, Key Elements of Health and Safety Management System, Key Steps in Health and Safety Model, Audits and Reviews- Key Requirements, Benefits and Practical Aspects. Measurement of Individual and Organizational Performance, Safety management system: ISO 45001: 2018. Global Harmonization System (GHS)	6 Hrs
Unit 5: Occupational Health and Industrial Hygiene: Objectives, Need, Chronic and Acute Effects, Various Exposure Limits, LD-50, LC-50, TLV, TWA, STEL, Effects of Various Harmful Agents and Conditions - Physical, Chemical, Biological and Ergonomic, Protection of Workers, Personal and Work Place Monitoring Systems, Hazards and Requirements of Safety - Confined Space Entry-Working Underground, Working at Height, Hot Work Permit and Cold Work Permit, On-Site and Off-Site Emergency Management Plans.	7 Hrs
Unit 6: Industry Specific Safety Management and Acts a. Construction and Cement Industry: Safety Parameters in construction such as site planning and layout, safe access, safety work permit and checklist. Safety in the use of construction machinery and equipment. b. Chemical Industries: Types of Chemical Hazards & Controls, Storage Hazards &	9 Hrs

controls, Transportation and Storage of Hazardous Chemicals, Material Storage Data Sheet, Material- Process , Inspection, Testing & Maintenance c. Petroleum Refinery: Petroleum classification, hazards due to petroleum products, Hazard and control during manufacturing process. Hazards of bulk storages, and control measures. d. Brief study of : Factories Act, 1948, Workman's Compensation Act, 1943, Employees State Insurance Act, 1948, Mines Act, Air (Prevention and control) Pollution Act, 1981, Water (Prevention and Control) Pollution Act, 1974, Boiler Vessels Act, Child Labour and Women Employee Act. Explosive Act, Petroleum Act, Manufacture, Storage and Import of Hazardous Chemical Rules, 1989	

Textbooks:

1. Occupational Safety and health -by David L. Goetsch, Prentice Hall, Ohio
2. Safety manual - EDEL Engineering consultancy Pvt. Ltd.
3. Handbook of Environmental Health and Safety: Herman Koren and Michel Bisesi, Jaico Publishing House, Delhi (1999).
4. Handbook of Environmental Risk Assessment and Management: Peter Calow, Blackwell Science Ltd. USA (1998)
5. Textbook of Preventive &Social Medicine - by K. Park, Banarsidas Bhanot Publishers.

References:

1. Hazardous Material & Waste management- by Gayle Woodside, John Wiley & sons Inc.
2. Environmental Health &Safety Auditing Handbook - by Lee Harrison, Mac Graw Hill Inc.
3. Health Hazards of the Human Environment - World Health Organization, Geneva, 1972
4. Industrial and Occupational Safety, Health & Hygiene - by Dr. A.H. Hommadi. 5.Introduction to Industrial Safety - by K.T. Kulkarni
6. R. K. Jain and Sunil S. Rao , Industrial Safety, Health and Environment Management Systems, Khanna publishers, New Delhi (2006)
7. Slote L. Handbook of Occupational Safety and Health, John Willey and Sons, NewYork
8. Frank P. Lees, Loss of prevention in Process Industries, Vol. 1 and 2, Butterworth-Heinemann Ltd., London (1991). 12. Industrial Safety -National Safety Council of India. 8. 9. The Factories Act with amendments 1987, Govt. of India Publications , Mumbai
10. Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)
11. Industrial Safety and pollution control handbook: National Safety Council and Associate publishers Pvt. Ltd, Hyderabad (1993).

Class: B.Tech Environmental Engineering **Title of the Course:** Environmental Modeling and Simulation (Professional Elective – IV) **Course Code:** UENV0822	**L**	**T**	**P**	**Credits**
	03	**--**	**--**	**03**

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. Also students must be aware of concept and units for preparing mathematical model and correlated concepts of Environmental engineering.

Course Description:

The objective of the course is to impart fundamental knowledge and importance of formulation of mathematical model for various processes in the environmental engineering. They will study the pollution caused by disposal of waste in surface, sub surface water as well as on ground. The syllabus also includes Ph model, BOD model, and Modeling of Toxicity.

Course Learning Objectives:

At the end of the course students will be able to

1. Understand the concepts of modeling and simulation in Environmental engineering.
2. Study the concepts of various mathematical models of physical systems related to water quality.
3. Learn to correlate parameters for modeling in surface water quality of rivers, streams, lakes, reservoirs.
4. Understand modeling for underground water quality, pH modeling and transport of contaminants in river, lakes, ground water and soil.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Descriptor**
CO1	Explain fundamental concept of modelling and simulation in Environmental Engineering.	Cognitive (Understanding) L2
CO2	Analyze parameters with the help of various mathematical models for water quality monitoring	Cognitive (Analyzing) L3
CO3	Asses water quality by simulating models for field conditions	Cognitive (Assessing) L4
CO4	Imitate the mathematical model for surface and subsurface water quality.	Psychomotor (Imitate) L6

CO-PO Mapping:

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

CO	**PSO1**	**PSO2**
CO1	-	-
CO2	1	-
CO3	2	-
CO4	3	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 1: Introduction to Modeling and Simulation Fundamentals: Mass transfer, Mass balance principle, Reaction kinetics (types of reaction, rate and order of reaction, Effect of temperature), Analysis of experimental data, Determination of rate constants. Modeling Water quality in Environment: Transport phenomena, Advection, diffusion, dispersion, Dispersion and mixing in streams, Air/water interface, Gas transfer (agitated and stagnant), pH modeling.	8 Hrs.
Unit 2: Surface water quality modeling-, Water quality in rivers & streams, Point and non-point sources, BOD model, Point source Streeter –Phelps equation, Carboneous BOD modeling Nitrogenous BOD modeling, Sediment oxygen demand, Stream quality modeling using QUAL2E.	7 Hrs.
Unit 3: Water quality of lakes & reservoirs- Hydraulic behavior, Effect of physical processes on water quality, modeling of lakes & reservoirs, stratified lake model, Vertical modeling, Ecological modeling, Significance, Eutrophication in lakes, Eutrophication in flowing water.	5 Hrs.
Unit 4: Subsurface water quality modeling: Transport of non-reactive& reactive contaminant in Ground water, Vadoze zone modeling, Gaussian plume model.	6 Hrs.
Unit 5: Microbe / Substrate modeling: bacteria growth, substrate utilization, Microbial kinetics, batch and CSTR, toxicant modeling in flowing water, Toxics substance model in CSTR, Bio-concentration and Bioaccumulation model.	8 Hrs.
Unit 6: Introduction to software for Network modeling using EPANET, WATERGEM, SEWERGEM, Software for modeling water quality in rivers, lakes, estuaries areas, canals, Water Quality Analysis Simulation Program (WASP), JalTantra for water network optimization.	6 Hrs.

Textbooks:

1. Surface water quality modeling - Steven Chopra, McGraw hill
2. Water quality modeling; modification - Tchobanoglous (Addision& Wesley Edward Schroedar)
3. Environmental Engineering - Sincero and Sincero
4. Metcalf & Eddy. Waste Water Engg. Treatment & Disposal, Tata McGraw - Hill Pub.

References:

1. Surface water quality modeling - Steven Chopra, McGraw hill
2. Water quality modeling; modification - Tchobanoglous (Addision& Wesley Edward Schroedar)
3. Environmental Engineering - Sincero and Sincero
4. USEPA: www.epa.gov.in QUAL2E model
5. Metcalf & Eddy. Waste Water Engg. Treatment & Disposal, Tata McGraw - Hill Pub.
6. USEPA: www.epa.gov.in QUAL2E model

Class: B. Tech Environmental Engineering **Title of the Course:** Advanced Concrete Structures (Professional Elective – IV) **Course Code:** UENV0823	**L**	**T**	**P**	**Credits**
	03	**-**	**-**	**03**

Course Pre-Requisite:

1. Engineering Mechanics
2. Structural Mechanics
3. Design of Concrete Structures

Course Description:

The course contents are pertaining to analysis and design of components of storage structures such as on ground water tank, underground water tanks, elevated water tanks, liquid holding units of treatment plant. The objective of the course is to impart knowledge regarding structural design of units required for water - wastewater treatment schemes as well as footings and foundations for them.

Course Learning Objectives:

1. To analyze structural components and units related to Environmental Engineering.
2. To explain and illustrate the concepts of structural analysis and design.
3. To make use of IS Code provision for design of foundations and types of tanks.

Course Outcomes:

CO	**After the completion of the course the student will be able to**	**Bloom's Taxonomy Descriptor**
CO 1	Explain significance of analysis and structural design of Environmental Engineering systems.	Cognitive (Understanding) L2
CO 2	Apply concepts and criteria for analysis of structural components.	Cognitive (Applying) L3
CO 3	Design the liquid retaining units and footings by use of relevant IS codes.	Cognitive (Creating) L6

CO-PO Mapping:

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

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: Types of footings and foundations, Design concepts of Isolated column footings, Combined footings, Raft Foundation- types, design concepts and methods, Concept and suitability of Pile foundations.	7 Hrs.
Unit 2: Permissible stresses for water retaining structures, Methods of design of water tanks with flexible joint and rigid joint, IS Codes provisions for design of water retaining structures.	6 Hrs.
Unit 3: Design of underground water tank- Design criteria, Permissible stresses, Design of underground R.C.C circular and rectangular water tank in full and empty conditions.	7 Hrs.
Unit 4: Design criteria and design of units of water treatment plant: Flash mixer, flocculater, and clarifier.	6 Hrs.
Unit 5: Design of service reservoir: R.C.C. design of Ground service reservoir and Elevated service reservoir, Introduction to concept and design of Intz tank and tall chimney	7 Hrs.
Unit 6: Design of units of wastewater treatment plant: R.C.C. design of primary settling tank and other units of sewage/ effluent treatment plant, Design criteria for digester.	7 Hrs.

Textbooks:

1. Limit state theory and Design –Karve and Shah, Structures publications , Pune
2. Reinforced Concrete Design – Limit state - A.K. Jain Nem Chand brothers Roorkee
3. Fundamentals of Reinforced Concrete –Sinha and Roy, S. Chand and company Ltd.

References:

1. Reinforced Concrete Design- Sushil Kumar Laxmi Publications New Delhi
2. Reinforced Concrete Design- B.C. Punmia Laxmi publications New Delhi
3. Reinforced Concrete Design-M. L. Gambhir-Mc millan India Ltd. New Delhi
4. Limit State Design of reinforced concrete P.C.Varghese, Prentice Hall, New Delhi
5. IS 456-2000,
6. IS 3370
7. Special publications -16-Bureau of Indian standards

Unit wise Measurable Students Learning Objectives and Outcomes:

Unit-1 Understand the significance of structural analysis and design of various types of footings, foundations required for Environmental structures. CO1

Unit- 2 Know permissible stresses for water retaining structures, Methods of design of water tanks and IS Codes for design of water retaining structures. CO1,3

Unit-3 Understand permissible stresses, design criteria of underground water tank, circular and rectangular water tank in full and empty condition. CO2,3

Unit-4 Know design of water treatment units of treatment plant. CO2,3

Unit-5 Understand design of Ground storage reservoir and Elevated storage reservoir. CO2,3

Unit-6 Know the design of wastewater treatment units. CO2,3

Class: B. Tech. Environmental Engineering **Title of the Course:** Environmental Management System (Professional Elective – V) **Course Code:** UENV0824	**L**	**T**	**P**	**Credit**
	03	**-**	**-**	**03**

Course Pre-Requisite:

Students shall have knowledge of:

- Environmental legislations
- Activities related to environment in industries
- Best practices for environmental management

Course Description:

Environmental Management Systems course deals with the implementation of effective environmental management system in organizations managing the various environmental aspects. The course emphasizes on the requirements prescribed in ISO 14001:2015. ISO 14001:2015 standard is an International Standard followed worldwide for the environmental management in organizations.

Course Learning Objectives:

At the end of the course students will

4. Understand the scope of ISO 14001:2015 Environmental Management System standard.
5. Learn the requirements of ISO 14001: 2015 Environmental Management System standard.
6. Understand the requirements & procedures for EMS audit.

Course Outcomes:

CO	**After the completion of the course the student will be able to**	**Bloom's Cognitive Descriptor**
CO 1	Explain the terms used in context with ISO 14001 and ISO 19011 standards.	Cognitive (Understanding) L2
CO 2	Illustrate the process and requirements of EMS audit as per ISO 19011 standard.	Cognitive (Understanding) L2
CO 3	Summarize the requirements of ISO 14001 standard.	Cognitive (Understanding) L2

CO-PO Mapping:

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

CO	**PSO1**	**PSO2**
CO 1		
CO 2		
CO 3		

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).
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- **ESE:** Assessment is based on 100% course content with 30% weightage for course content covered before MSE and 70% weightage for course content covered after MSE.

Course Contents:

Unit 1: Introduction to ISO, ISO History, Need of International Standards, Standard	6 Hrs.

Development Process, Benefits of ISO Standards, Environmental Management System (EMS) and Sustainable Development, Concept of Life Cycle Analysis, Aim of EMS, Deming's PDCA Cycle, Scope of ISO 14001:2015 Standard, Terms and Definitions.	
Unit 2: Leadership and Commitment, Environmental Policy, Organizational Roles, Responsibilities and Authorities, Planning, Actions to address Risks and Opportunities, General Requirements, Environmental Aspects, Environmental Impacts, Environmental Aspects – Impacts Analysis, Compliance Obligations, Environmental Objectives, Planning Actions to achieve Environmental Objectives.	8 Hrs.
Unit 3: Support – Resources, Competence, Awareness, Communication – Internal and External Communication, Documented Information – Creating and Updating, Control of Documented Information, Operation – Operational Planning and Control, Emergency Preparedness and Response.	6 Hrs.
Unit 4: Performance Evaluation – Monitoring, Measurement, Analysis and Evaluation, Evaluation of Compliance, Checklists, Calibration and Records, Standard Operating Procedures, Work Instructions.	6 Hrs.
Unit 5: Internal Audit, Internal Audit Programme, Terms and Definitions, Principles of Auditing, Managing Audit Programme, Audit Activities, Audit Checklists and Reports, Competence and Evaluation of Auditors.	8 Hrs.
Unit 6: Management Review - Need, Role of Management Representative, Role of Top Management, Improvement, Nonconformity and Corrective Action, Continual Improvement.	6 Hrs.
Textbooks: 1. International Standard ISO 14001:2015 – Environmental Management Systems – Requirements with Guidance for Use 2. International Standard ISO 14004:2016 - Environmental Management Systems - General guidelines on implementation 3. International Standard ISO 19011 – Guidelines for Environmental Management System auditing.	
References: 1. Environmental Management Systems Auditors Course Manual by Confederation of Indian Industries.	
Unit Learning Objectives (ULOs) At the end of course students will ULO 1.1: Understand PDCA cycle & its elements. ULO 1.2: Learn the scope & general requirements of EMS. ULO 2.1: Understand the requirements to develop environmental policy. ULO 2.2: Learn aspect - impact analysis & need of objectives – targets. ULO 3.1: Study the requirements under resources, competence and awareness. ULO 3.2: Understand the role of operational control & emergency preparedness plan. ULO 4.1: Understand the need of monitoring & measurement. ULO 4.2: Learn the requirements evaluation of compliance. ULO 5.1: Learn the prerequisites required for the conduct of EMS audit. ULO 5.2: Understand the procedures & steps in EMS audit. ULO 6.1: Learn the necessity of management review. ULO 6.2: Understand the role of management representative in management review.	

Unit Outcomes (UOs)
At the end of course students will be able to

UO 1.1: Explain the scope & benefits of EMS standard.- CO 1
UO 1.2: Explain PDCA cycle. –CO 1

UO 2.1: Summarize the requirements of environmental policy. – CO 3
UO 2.2: Summarize requirements of an aspect impact analysis. – CO 3

UO 3.1: Summarize the requirements under resources, competence and awareness. – CO 3
UO 3.2: Summarize the elements of emergency preparedness plan.- CO 3

UO 4.1: Summarize the requirements of monitoring & measurement. – CO 3
UO 4.2: Summarize the requirements of operational control. – CO 3

UO 5.1: Illustrate the various terms used in EMS audit.- CO 2
UO 5.2: Illustrate the contents of audit report.- CO 2

UO 6.1: Summarize the requirements of management review. – CO 3
UO 6.2: Summarize the role of management representative in management review. – CO 3

Class: B.Tech Environmental Engineering **Title of the Course:** Project Management (Professional Elective - V) **Subject Code:** UENV0825	**L**	**T**	**P**	**Credits**
	03	**-**	**-**	**03**

Course Pre-Requisite:

- Engineering Management and Economics

Course Description:

Project management theory, terms and concepts are introduced in this course. Project Management is the course of carefully projecting or planning, organizing motivating and controlling resources to achieve specific goals and meet specific success criteria. The course covers key components of project management including phases of project management, project analysis and selection, project planning, budgeting, monitoring, controlling, evaluation and termination. Course also imparts knowledge of project risk management and some miscellaneous topics.

Course Learning Objectives:

The Course Objectives are to give an opportunity to students to,

1. Understand the importance to project objectives and overall management of a project.
2. Impart project management knowledge and processes to manage project cost, quality, and delivery.
3. Employ strategies to align critical resources for effective project implementation.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Taxonomy Descriptor**
CO1	Apply the Project Management knowledge and processes to initiate, plan, execute, monitor and control.	Cognitive (Applying) L3
CO2	Analyze project risk, including identifying, analyzing and responding to risk.	Cognitive (Analyzing) L4
CO3	Assess project management practices in a variety of settings.	Cognitive (Evaluating) L5

CO-PO Mapping:

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

CO	**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 to Projects:** Project management, Project manager and his responsibilities, Project management as a profession, selection of a project manager, Fitting projects into the	6 Hrs.

parent Organization, project management team, project model, Project environment, the 7S of Project management.	
Unit 2: **Project Analysis and Selection:** Generation and Screening of Project ideas, Procedure for Idea Generation, Project Initiation and resource allocation, Market analysis and Demand analysis, Technical Analysis, Monitoring the Environment, Project Rating Index.	7 Hrs.
Unit 3: **Project Planning:** Time planning, Contents of Project plan, planning process, Work breakdown structure, process mapping. **Project Budgeting:** Financial Projections, time value of money, cost of capital, Appraisal criteria.	7 Hrs.
Unit 4: **Monitoring and Controlling:** Plan monitor, project monitoring tools, control cycle, data collection and reporting, Project control. **Evaluation and termination:** Evaluation, Project Review and Administrative Aspects, Project auditing, Project termination.	7 Hrs.
Unit 5: **Project Risk Management:** Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks and Safety Engineering in Environmental projects.	6 Hrs.
Unit 6: **Miscellaneous topics:** Managing E-business Projects, Future of Project management, Regulatory framework of Projects, Conflict and Negotiation, The Nature and Type of Negotiation, Stakeholder Management.	7 Hrs.
Textbooks: 1. K. Nagarajan, Project Management, Third Edition, New Age International 2. P.C.K. Rao, Project Management and Control, Sultan Chand & Sons 3. Jack Gido, James P Clements, Project Management, Cengage Learning India Pvt. Ltd., 2nd Reprint 2011, ©2007	
References: 1. Clements/Gido, Effective Project Management, Thomson 2. Clifford F. Gray and Erik W. Larson, Project Management, Tata McGraw Hill 3. Dennis Lock, Project Management, Ninth Edition, Publication: Gower 4. Prasanna Chandra, Projects–Planning, Selection, Financing, Implementation, and Review, Sixth Edition, Tata McGraw Hill 5. Vasant Desai, Project Management, Second Revised Edition, Himalaya Publishing House	

Class: B.Tech Environmental Engineering	**L**	**T**	**P**	**Credit**
Title of the Course: Environmental Sustainability (Professional Elective – V) **Course Code :** UENV0826	**03**	**-**	**-**	**03**

Course Pre-Requisite:

- Environmental Studies.
- Environmental Governance.
- Ecology and Environmental Sanitation.
- Environmental Management.

Course Description:

The aim of this module is to provide both an introduction to sustainable development, including a general approach to thinking sustainably, and a review of the principles and practices of sustainability. The course introduces the concept of sustainability, sustainable development framework and sustainable development goals, various engineering tools, role of technology towards sustainability, social responsibility and strategies to promote environmentally sustainable development.

Course Learning Objectives:

1. To provide basic introduction to sustainable development concepts, challenges of sustainable development and boundaries of sustainable development.
2. To give a basic understanding of sustainable development framework, its pillars and application.
3. To aware the students about various issues related to environmentally sustainable urban environment and different engineering tools to assess and design them.
4. To update students about the individual and social responsibilities and role of government towards sustainable development.

Course Outcomes:

CO	**After the completion of the course the student should be able to**	**Bloom's Taxonomy Descriptor**
CO1	Explain the basics about sustainable development and its concepts.	Cognitive (Understanding) L2
CO2	Summarize different dimensions of environmental sustainability as well as its different applications.	Cognitive (Understanding) L2
CO3	Identify the issues and strategies to endorse environmental sustainability.	Cognitive (Applying) L3
CO4	Analyze behavior change and social and environmental responsibility towards sustainable development.	Cognitive (Analyzing) L4

CO-PO Mapping:

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

CO	**PSO1**	**PSO2**
CO1		
CO2		
CO3		
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:** Evolution and History of sustainability, Brundtland commission report, Principles of sustainable development, Objectives, Conceptualization of sustainability, Boundaries of sustainable development.	6 Hrs.
Unit 2: **Sustainable development framework:** Pillars of sustainable development, Impediments to achieving sustainability, Concept of environmentally sustainable development, Environmental dimensions of sustainability, Frameworks to measure sustainable development.	8 Hrs.
Unit 3: **Issues of environmentally sustainable urban environment:** Sustainable urban transport, Sustainable transport indicators, Engineering tools for assessment and design for environment and sustainability.	6 Hrs.
Unit 4: **Strategies for promoting environmentally sustainable development**: Sustainable Development Goals (SDG), Capacity Building, Human Rights and Intergenerational Equity, Environmental and Human Health, Sustainable Cities.	6 Hrs.
Unit 5: **Social and environmental responsibilities:** Responsibilities towards environmentally sustainable development, Role of local Government, Steps for adopting sustainability approach, sustainable sanitation approaches, behavior change communication, community led sanitation, Corporate Social Responsibility (CSR).	8 Hrs.
Unit 6: **Green Energy And Sustainable Development:** biodiversity and ecosystem services and their implications for sustainable development, global warming, greenhouse gas emissions, impacts, mitigation and adaptation, clean - green energy technologies.	6 Hrs.

Reference Books:

1. Abdul Malik, Elisabeth Grohmann. Environment protection strategies for sustainable development by. ISBN 978-94-007-1591-2.
2. Sylvie Faucheux, Martin O' Corner Jan van der strateen. Sustainable development: concepts, rationalities, and strategies, ISBN 978-94-017-3188-1.
3. Jennifer A. Elliott. An introduction to sustainable development. ISBN-13: 978- 0415590730.
4. LEAD India (Editor) Rio to Johannesburg: India's Experience in Sustainable Development, Orient Longman, Hyderabad, 2002.
5. Chopra, K., and Kadekodi, G.K. (1999), Operationalizing Sustainable Development, Sage Publication, New Delhi.