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

Structure for

B.Tech in

Civil and Environmental Engineering

(To be Implemented w.e.f. Academic Year 2022-23)

Department of Civil and Environmental Engineering

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

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Kolhapur

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

Syllabus for

B.Tech (Hons.) Civil and Environmental Engineering with Specialization in Green Technology and Sustainability Engineering

Department of Civil and Environmental Engineering

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

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

VISION AND MISSION OF INSTITUTE

VISION:

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

MISSION:

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

VISION AND MISSION OF DEPARTMENT

VISION

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

MISSION

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

PROGRAM EDUCATION OBJECTIVES (PEOs)

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

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

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

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

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

PROGRAM OUTCOMES (POs)

Civil and Environmental Engineering Graduates will be able to:

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

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

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

MAPPING OF PROGRAM OUTCOMES TO PROGRAM EDUCATION OBJECTIVES

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

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

B. Tech. (Hons.) in Civil and Environmental Engineering with Specialization in GreenTechnology and Sustainability Engineering

Course Code	Course Name	Semester	Hours/Week				Evaluation Scheme		
			L	T	P	Credits	Component	Marks	
								Max	Min for passing
UCEH0301	Environmentally Sustainable Materials	III	3	1	-	**4**	ESE	100	40
UCEH0401	Energy Technologies and Management	IV	3	1	-	**4**	ESE	100	40
UCEH0501	Faecal Sludge and Septage Management	V	3	1	-	**4**	ESE	100	40
UCEH0601	Environmental Economics	VI	3	1	-	**4**	ESE	100	40
UCEH0751	Mini Project	VII	-	-	4	**2**	ESE (OE)	100	40
			12	**4**	**4**	**18**	**500**		

Total Credits - 18, Total Contact hours – 20

Program: B.Tech (Hons.) in Civil and Environmental engineering with Specialization in Green Technology and Sustainability Engineering **Class:** S.Y.B.Tech Civil and Environmental Engineering **Semester:** III **Title of the Course:** Environmentally Sustainable Materials **Course Code:** UCEH0301	**L**	**T**	**P**	**Credits**
	03 hours per week	01 hour per week	-	04

Course Pre-Requisite:

Students shall have the knowledge of:

- Engineering Physics
- Engineering Chemistry
- Basic Civil Engineering

Course Description:

The objective of this course is to expose the students to the concepts of sustainability in the context of building and conventional engineered building materials, such as concrete. Exposing the student to concepts of embodied, operational and life cycle energy, minimizing energy consumption. The course also intends to make student aware of recycle and reuse of waste materials. Students will be exposed to various case studies related with sustainable developments..

Course Learning Objectives:

1. To understand basic Concepts of sustainability engineering, LCA energy and embodied energy.
2. To understand various components of sustainability engineering.
3. To explain various methods of improving energy efficiency of building materials.
4. To understand the importance of reuse and recycle of waste materials.

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Cognitive Descriptor**
CO.1	Illustrate the concept of sustainability.	Cognitive Understanding (L2)
CO.2	Interpret the lifecycle energy and embodied energy concept.	Cognitive Understanding (L2)
CO.3	Select the sustainable materials.	Cognitive Applying (L3)
CO.4	Analyze the importance of reuse and recycle of waste construction materials.	Cognitive Analyzing (L4)

CO-PO Mapping:

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

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

Assessments :

Assessment	Weightage (Marks)
ESE	100

- **ESE:** Assessment is based on the End Semester Examination on 100% course content.

Course Contents:

Unit 1: Introduction to Sustainability: Introduction to the concept of sustainability (Sustainability and Building Industry), Embodied energy concept, embodied energy involved in various construction materials	06 Hours
Unit 2: Components of Sustainability: Operational energy in Building and Life cycle energy. Ecological foot print, Bio-capacity and planet equivalent Ecofriendly materials:- Introduction, Properties, Types, Potential ecofriendly material & Techniques	07 Hours
Unit 3: Sustainable Concrete: Carbon from Cement, alternative cements and cementitious material, Alternative fuel for cements for reduction in carbon emission, Sustainability issues for concrete, Minimization of natural resource utilization, High volume fly ash concrete, geo-polymer concrete etc. concrete with alternative material for sustainability**.**	08 Hours
Unit 4: Modern Sustainable Materials: Concept of Living Roof, Applications limitation & Benefits, Smart glass, Solar tiles. Use Bio Composites, Cross Laminated timber	07 Hours
Unit 5: Recycle & Reuse of Materials Concept of Resource reuse, Recycled content, Regional materials, Rapidly renewable materials – Fly ash bricks, Recycled Steel, Bamboo based products, Construction debris	06 Hours
Unit 6: Case Studies: Use of recycled & waste materials in construction industry- Case studies	06 Hours

Text Books:

1. The Philosophy of Sustainable Design by Jason F. McLennan, Ecotone Publishing Co., 2004.
2. Green Building Fundamentals by Mike Montoya, Pearson, 2nd edition, 2010.
3. Sustainable Building Materials by J. M. P. Q. Delgado, Springer 2020.
4. Sustainable Construction - Green Building Design and Delivery by Charles J. Kibert, John Wiley & Sons, 2nd edition, 2008.
5. Sustainable Construction and Design by Regina Leffers, Prentice Hall, 2009.

Reference Books:

1. Newman, J. and Choo, Ban Sang, Advanced Concrete Technology-Processes, 1 st Edition, Elsevier, 2003
2. Newman, J. and Choo, Ban Sang, Advanced Concrete Technology-Constituent Materials, 1st Edition, Elsevier, 2003
3. Kubba, S, LEED Practices, Certification, and Accreditation Hand book, 1st ed. Elsevier, 2010.
   Ministry of Power, Energy Conservation Building Code 2018, Revised Version, Bureau of Energy Efficiency, 2018
4. Architectural Energy Corporation, Building Envelope Stringency Analysis, International

Institute for Energy Conservation, 2004
5. Indian Building Congress, Practical Handbook on Energy Conservation in Buildings, 1 st ed. Nabhi Publication, 2008.
6. McQuiston, F.C., and Parker, J.D. Heating, Ventilating, and Air Conditioning, Analysis and Design, Fourth Ed. John Wiley & Sons, Inc,1994.
7. Clarke, J.A., Energy Simulation in Building Design, Adam Hilger Ltd. 1985.
8. TERI-Griha's Green Design practices (www.teriin.org/bcsd/griha/griha.htm)
9. Leadership in Energy and Environmental Design (www.usgbc.org/LEED)
10. Article on Residential Green Choice(www.austinenergy.com)
11. Venkatarama Reddy, B. V., and. Jagadish, K., S. "Embodied energy of common and alternative building materials and technologies". Energy and Buildings., 35, 129-137,2003
12. Chani, P. S., Najamuddin., and Kaushik, S.K. "Comparative Analysis of Embodied Energy Rates for Walling Elements in India". Energy and Buildings., 84, 47- 50. 2003
13. Andrew, H., Buchanan., and Brian, G. "Energy and carbon dioxide implications of building construction", Energy and Buildings., 20, 205-217. 1994
14. Sartori, I., and Hestnes, A. G. "Energy use in the life cycle of conventional and low-energy buildings: A review article", Energy and Buildings., 20, 249-257.2007
15. Green Building Basics, California Integrated Waste Management Board (www.ciwmb.ca.gov/GREENBUILDING/Basics.htm#What)
16. Huberman, N., Pearlmutter, D. "A life-cycle energy analysis of building materials in the Negev desert".b Energy and Buildings.40, 837-848.2007.
17. CatarinaThormark. "A low energy building in a life cycle—its embodied energy, energy need for operation and recycling potential", Building and Environment. 37, 429-435.2001.

Unit wise Measurable Students Learning Outcomes:

Unit Learning Objectives:

Unit Outcomes:

At the end of course students will

- ULO 1.1: Understand the concept of sustainability.
- ULO 1.2: Know the various types energies involved in construction project.
- ULO 2.1: Understand the concept of ecological footprint.
- ULO 2.2: Learn various eco friendly materials and their properties.
- ULO 3.1: Know the various types of alternate fuel.
- ULO 3.2: Understand sustainable concrete.
- ULO 4.1: Understand properties of various modern sustainable materials.
- ULO 5.1: Understand concept of recycle & reuse.
- ULO 5.2: Selection of potential recyclable and reusable construction materials.
- ULO 6.1: Know the various case studies in successful usage of Sustainable materials.

Unit Learning Outcomes (UOs)

At the end of course students will be able to

- UO 1.1: Explain the concept of sustainability.
- UO 1.2: Define the energy utilization in construction process.
- UO 2.1: Select eco friendly materials.
- UO 3.1 Select alternative type of fuels
- UO 3.2: Select the eco friendly method for concreting.
- UO 4.1: Select modern sustainable materials
- UO 5.1: Explain the significance of recycle & reuse of construction waste materials.
- UO 6.1: Understand various case studies related to sustainable development.

Program: B.Tech (Hons.) in Civil and Environmental engineering with Specialization in Green Technology and Sustainability Engineering **Class:** S.Y.B.Tech Civil and Environmental Engineering **Semester:** IV **Title of the Course:** Energy Technologies and Management **Course Code:** UCEH0401	**L**	**T**	**P**	**Credits**
	03 hours per week	01 hour per week	-	4

Course Pre-Requisite:

Students shall have the knowledge of:

- Engineering Physics
- Engineering Chemistry
- Building Construction and Materials

Course Description:

The course cover forms of energy, significance of energy in economic development, global and national energy scenario, aspects of energy management, significance of energy audit, energy action planning as well as energy conservation. It also deals with green building rating system, significance and potential renewable energy.

Course Learning Objectives:

1. To understand forms of energy and its impact on economy.
2. To study global, national energy scenario, requirements and impact.
3. To understand principles of energy management, significance of energy planning and energy audit.
4. To know green building rating system and renewable energy options.

Course Outcomes:

COs	**After the completion of the course students will be able to**	**Bloom's Cognitive Descriptor**
CO 1	Explain energy, power and role of energy in economic development.	Cognitive (Understanding) L2
CO2	Identify objectives of energy management.	Cognitive (Applying) L3
CO 3	Examine the system for energy audit and energy conservation.	Cognitive (Analyzing) L4
CO 4	Explain energy rating system, energy efficiency and need of renewable energy.	Cognitive (Evaluating) L5

CO-PO Mapping:

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

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

Assessments:

Assessment	Weightage (Marks)
ESE	100

- **ESE:** Assessment is based on the End Semester Examination on 100% course content.

Course Contents:

Unit 1: Introduction to Energy Definition and units of energy, power, Forms of energy, Commercial and non-commercial forms of energy, Energy flow diagram to the earth. Impact of exponential rise in energy consumption on global economy, GDP, GNP, HDI etc. Role of energy in economic development and social transformation.	6 Hours
Unit 2: Global and Indian conventional energy scenario Global and Indian energy consumption and production (Coal, Oil, Gas, Hydro, Nuclear, etc.) Energy consumption in various sectors, projected energy consumption for the twenty first century, Environmental aspects of energy production and utilization.	6 Hours
Unit 3: Energy Management Need and importance of Energy Management, Objectives of Energy Management, The Energy Conservation Act, 2001 and its features, Duties and responsibilities of energy managers, Organizing the management: location of energy management, top management support, managerial function, accountability; Motivation of employees, Training and planning. Energy conservation with respect to IAQ and IEQ.	7 Hours
Unit 4: Energy audit Energy audit concepts: Need of energy audit, Types and Methodology; Energy Audit Reporting Format, Fuel and Energy Substitution; Types of energy audit – Duties and responsibilities of energy auditors- Energy audit instruments, Procedures and Techniques Energy management (audit) approach – Understanding energy costs – Bench marking – Energy performance – Matching energy use to requirement – Maximizing system efficiencies -Optimizing the input energy requirements.	6 Hours
Unit 5: Energy conservation in buildings& energy rating systems Green building rating systems – GRIHA, IGBC and LEED, Overview of the criteria as per these rating systems. Energy Efficiency: Environmental impact of constructions, Concepts of embodied energy, operational energy and life cycle energy. Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero Ozone Depleting Potential (ODP) materials, energy metering and monitoring, concept of net zero buildings.	8 Hours
Unit 6: Renewable energy resources: Significance and potential Concept, significance and advantages of renewable energy resources, Classification of renewable energy resources and potential, Solar, Wind energy, Ocean energy- Wave energy, Tidal Energy, Ocean thermal energy, Geothermal energy, Bioenergy, Alternative fuels for vehicles- electricity, fuel cells, hydrogen	6 Hours

Textbooks:

1. Energy Audit Professional by Dheungel
2. Energy Management and Audit- Bureau of Energy Efficiency
3. Handbook on Energy Audit & Environment Management, (TERI Press, 2006): YP Abbi & Shashank Jain
4. Non-conventional energy sources by G.D. Rai, Khanna Publishers

Reference Books:

1. Energy for a sustainable world: Jose Goldenberg, Thomas Johansson, A.K.N. Reddy (Wiley Eastern).
2. Principles of Energy Conversion: A.W. Culp (McGraw Hill International edition.)
3. Energy Management Handbook:WC Turner Seventh Edition, (Fairmont Press Inc., 2007)
4. Guide to energy management by BL Capehart, WC Turner, WJ Kennedy

Unit wise Measurable Students Learning Outcomes:

Unit Learning Objectives:

1. To study energy, power and role of energy in economic development
2. To know global and Indian energy consumption, production in various sectors, environmental degradation due to energy production and utilization.
3. To study various aspects of energy management.
4. To understand concept of energy audit, its types and instruments.
5. To study methods of energy conservation in buildings, green rating system and energy efficiency.
6. To understand need, potential of renewable energy and new alternative fuels for vehicles.

Unit Outcomes:

Students will be able to

1. **Explain** role of energy in economic development.**(CO 1)**
2. **Make use of** proper fuel alternative in accordance with availability and environmental factors.**(CO 2)**
3. **Identify** objectives of energy management, duties and responsibilities of manager.**(CO 2)**
4. **Categories** energy audits and **list** techniques, procedure and instruments.**(CO 3)**
5. **Inspect** buildings for green rating and energy efficiency.**(CO 3)**
6. **Explain** significance of renewable energy and new energy options.**(CO 4)**

Program: B.Tech (Hons.) in Civil and Environmental engineering with Specialization in Green Technology and Sustainability Engineering **Class:** T.Y.B.Tech Civil and Environmental Engineering **Semester:** V **Title of the Course:** Faecal Sludge and Septage Management **Course Code.:** UCEH0501	**L**	**T**	**P**	**Credit**
	03 hours per week	01 hour per week	-	4

Course Pre-Requisite:

Students shall have the knowledge of:

- Environmental Chemistry and Microbiology
- Fluid Mechanics
- Hydraulics

Course Description: This course aims to build students' capacity to plan, design, and implement non-sewered decentralized sanitation solutions with a specific focus on feacal sludge and septage management (FSSM). Decentralized faecal septage treatment plants (FSTP) are emerging as solutions to the challenge of addressing safe treatment and disposal of septage.

Course Learning Objectives:

Course Outcomes:

COs	**After the completion of the course, the students will be able to**	**Bloom's Cognitive Descriptor**
CO.1	Describe the Need for faecal sludge and septage management.	Cognitive (Understanding) L2
CO.2	Analyze various Government missions, policies, rules and challenges related to faecal sludge and septage management.	Cognitive (Analysing) L4
CO.3	Design integrated faecal sludge and septage treatment technologies.	Cognitive (Evaluating) L5
CO.4	Develop the planning strategies for suggested faecal sludge and septage treatment technologies	Cognitive (Applying) L3

CO-PO Mapping:

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

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

Assessments:

Assessment	**Weightage (Marks)**
ESE	100

- **ESE:** Assessment is based on end semester examination with 100% course content.

Course Contents:	
Unit 1: Urban Sanitation Urbanization, Urbanisation trends and estimates in major regions of the world, Urban Sanitation in India, The Challenge of Water Supply and Sanitation in the Context of Urbanisation, introduction to faecal sludge and septage, Need for faecal sludge and septage management (FSSM), characterization and quantification of faecal sludge and septage.	**06 Hrs.**
Unit 2: History of Sanitation Efforts and the Shifting Paradigm towards FSSM Jawaharlal Nehru National Urban Renewal Mission (JNNURM), National Urban Sanitation Policy (NUSP), Swachh Bharat Mission (Urban), National Policy on Faecal Sludge and Septage Management(FSSM), Jal Jeevan Mission-Urban (JJM-U) Mission, The Atal Mission for Rejuvenation and Urban Transformation (AMRUT) mission.	**07 Hrs.**
Unit 3: Existing Situation and Challenges in FSSM Sanitation service chain, sanitation value chain (User Interface, Collection/Storage/ Treatment, Emptying and Conveyance), Gender, Caste, and Class Dimensions of Urban Sanitation, FSSM Enabling Compliance for Ending Manual Scavenging	**08 Hrs.**
Unit 4: On-site treatment Technology options for FSSM Different on-site containment systems--Twin pit for pour flush toilet, Septic Tank, Anaerobic Baffled Reactor, Anaerobic up-flow filter, different conveyance methods or techniques of Faecal Sludge and Septage- Human-powered Emptying, Motorised Emptying, and Transport, Transfer Stations	**07 Hrs.**
Unit 5: Integrated Faecal Sludge and Septage Management (IFSM) Treatment Chain of Integrated Faecal Sludge and Septage Management (IFSM), Criteria for selection of treatment options, Treatment methods--Co-treatment of FS in STP, Deep Row Entrenchment, Anaerobic Digestion, Imhoff Tanks, Planted and unplanted sludge drying beds, Sludge incineration, Thermal Drying, and Pelletising.	**06 Hrs.**
Unit 6: Planning of FSSM factors and decisions guiding the planning of septage (generation and its conveyance and treatment) management, Assessment of Financing Requirement Across the FSSM Value Chain, Potential Sources of Financing for Capex and Opex, Some case studies on FSSM from India and abroad.	**06 Hrs.**
Textbook: 1. Integrated Faecal Sludge and Septage Management modules (2019) by National Institute of Urban Affairs, New Delhi India.	
Reference Book: 1. Faecal Sludge and Septage Treatment A guide for low- and middle-income countries (2018) by Kevin Tayler, Practical Action Publishing Ltd Rugby, Warwickshire, UK 2. https://scbp.niua.org/?q=training-modules	
Unit Learning Objectives: At the end of the course, students will be able to • **ULO1**: Understand the Need for faecal sludge and septage management. • **ULO2:** Understand and analyze the history and efforts taken for faecal sludge and septage management in the Indian context. • **ULO3:** Understand the existing situation and challenges in faecal sludge and septage management in the Indian context. • **ULO4:** Recommend on-site faecal sludge and septage treatment technologies. • **ULO5:** Recommend integrated faecal sludge and septage treatment technologies. • **ULO6:** Plan faecal sludge and septage management strategies.	

Program: B.Tech (Hons.) in Civil and Environmental engineering with Specialization in Green Technology and Sustainability Engineering **Class:** T.Y.B.Tech Civil and Environmental Engineering **Semester:** VI **Title of the Course:** Environmental Economics **Course Code:** UCEH0601	**L**	**T**	**P**	**Credit**
	03 hours per week	01 hour per week	-	4

Course Pre-Requisite:

Students shall have the knowledge of:

- Environmentally Sustainable Materials
- Engineering Mathematics

Course Description:

This course aims to provide a comprehensive introduction to the economic analysis of issues arising from interactions between the natural environment and the human economy. It focuses on ecosystem services and discusses the challenges arising due to externalities, public good character, and non-tradability of such services. It focuses on the nature of market failure along with issues for social welfare.

Course Learning Objectives:

1. To understand the basic principles of environmental hydraulics for the analysis and design of water and sewerage systems.
2. To recognize the physical description and hydraulic illustrations of flow systems.
3. To study types of open channel flow, depth energy relationships, and flow profiles.
4. To learn the basic principles and assumptions of dynamic equations applied to fluid flow systems.
5. To identify the rational approaches for the determination of flow characteristics and forces acting on plates and vanes.

Course Outcomes:

COs	**After the completion of the course, the students will be able to**	**Bloom's Cognitive Descriptor**
CO.1	Explain the environmental issues in relation to the theory of public goods and welfare	Cognitive (Understanding) L2
CO.2	Identify the true value of environmental goods and services and growth-related issues	Cognitive (Applying) L3
CO.3	Examine the cost-benefit analysis and risk associated with environmental degradation	Cognitive (Analysing) L4
CO.4	Determine the lifecycle analysis of goods and services.	Cognitive (Evaluating) L5

CO-PO Mapping:

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

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

Assessments:

Assessment	Weightage (Marks)
ESE	100

- **ESE:** Assessment is based on end semester examination with 100% course content.

Course Contents:

Unit 1: Overview of Environmental Economics Introduction, Nature-environment interaction, Material balance approach, Economic perspective of the environment.	**06 Hrs.**
Unit 2: Environmental Valuation Practical valuation techniques, Valuation of environmental goods and services, analytical approaches for pollution control policies.	**07 Hrs.**
Unit 3: Methods of Valuation Hedonic estimation technique, travel cost method, contingent valuation, total valuation (use-value and non-use-value).	**08 Hrs.**
Unit 4: Growth and General Economic Aspects of Growth Exponential growth, Meadow's study on limitation of growth, limits on growth, population growth (regional world model).	**07 Hrs.**
Unit 5: Cost-Benefit Analysis Introduction, cost of environmental burdens, stress on the environment, risk assessment, goals and objectives of risk assessment, and risk management, Cost of Environmental Disasters	**06 Hrs.**
Unit 6: Life Cycle Analysis Introduction, general aspects of life cycle analysis, methods of life cycle analysis.	**06 Hrs.**

Textbooks:

1. "Environmental Economics" by Madhu Raj , Ivy publication house, Delhi

Reference Book:

1. "Handbook of Environmental Economics", by KARL-GÖRAN MÄLER and JEFFREY R. VINCENT, (2003), Elsevier publication.

Unit wise Measurable Students Learning Outcomes:

Unit Learning Outcome: Students will be able to

1. Introduce concept of environmental economics, its significance, and scope.
2. Understand analytics of the valuation of environmental goods and services (air, water, soil, etc.)
3. Understand and applying various valuation techniques for environmental goods and services.
4. Introduce to the concept of growth and various growth modeling techniques and their limitations.
5. Understand the cost-benefit analysis in terms of the environmental impacts of a certain project.
6. Understand the concept of life cycle analysis and various tools used for it.

Program: B.Tech (Hons.) in Civil and Environmental engineering with Specialization in Green Technology and Sustainability Engineering **Class:** Final Year B.Tech Civil and Environmental Engineering **Semester:** VII **Title of the Course:** Mini Project **Course Code.:** UCEH0751	**L**	**T**	**P**	**Credit**
	-	-	04 hours per week	2

Course Pre-Requisite:

Students shall have the knowledge of:

- Basic Sciences
- Engineering Sciences
- Applied Mathematics
- Program Core Courses
- Program Elective Courses

Course Description:

The mini project is designed to help students to develop practical ability and knowledge about practical tools/ techniques in order to solve real life problems related to the industry, academic institutions and research. This course is one that involves practical work for understanding and solving problems in the field of Green Technology and Sustainability Engineering. It provides the opportunity for students to demonstrate the application of their fundamental, analytical and research skills, and to apply their knowledge to complex and real world problems.

Course Learning Objectives:

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

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Cognitive Descriptor**
CO1	Undertake research work using theoretical studies, experimentations and computer simulations.	Psychomotor (Readiness to Act) L2
CO2	Establish findings for describing the work undertaken, results and conclusions within the specified time frame.	Psychomotor (Ability to Perform) L5

CO-PO Mapping:

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

COs	**PSO1**	**PSO2**
CO.1	2	1
CO.2	1	2

Assessments :

Assessment	**Weightage (Marks)**
ESE (OE)	100

ESE: Assessment is based on the efforts by the students for formulating problem, developing design solution, testing and validation of the solution, presentation as well as performance in the Oral Examination.

Course Contents:
Students are expected to carry out independent research work on the selected topic. It is expected that the student formulate the research problem, development/ fabrication of experimental set-up (if any) and testing and analysis of results thus obtained. The students are required to submit the report of mini project work and present their findings during the oral presentations.