Kolhapur Institute of Technology's College of Engineering Kolhapur (Empowered Autonomous)

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

Department of Civil and Environmental Engineering

Curriculum and Syllabus for

B. Tech. Emerging Minor in Civil and Environmental Engineering with Specialization in Sustainability Engineering

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

B. Tech. (Emerging Minor) in Civil and Environmental Engineering with Specialization in Sustainability Engineering

Course Code	Course Name	Semester	Hours/Week				Evaluation Scheme		
			L	T	P	Credits	Component	Marks	
								Max	Min for Passing
UCEMNC0361	Sustainable Materials	III	3	1	-	**4**	ESE	100	40
UCEMNC0461	Clean Energy Engineering	IV	3	1	-	**4**	ESE	100	40
UCEMNC0561	Climate Change and Sustainable Development	V	3	1	-	**4**	ESE	100	40
UCEMNC0661	Sustainable Infrastructure Engineering	VI	3	1	-	**4**	ESE	100	40
UCEMNC0761	Environmental Management	VII	2	-	-	**2**	ESE	100	40
			12	**4**	**-**	**18**	**500**		

Total Credits - 18, Total Contact hours – 18

Class: S. Y. B. Tech (Emerging Minor) In Civil and Environmental Engineering with Specialization in Sustainability Engineering **Title of the Course:** Sustainable Materials **Course Code:** UCEMNC0361	**L**	**T**	**P**	**Credit**
	03	01	-	04

Course Pre-Requisite:

Students shall have the knowledge of:

- Basic Civil Engineering
- Engineering Chemistry

Course Description:

- The course comprises of engineering properties of various construction materials
- The course includes details of sustainable materials
- The course also deals with various application of sustainable materials

Course Learning Objectives:

- Aware the student with a wide range of sustainable building materials, their properties and its use in architectural design and construction.
- Aware the student about impact of materials.
- To develop a practical approach in choosing architectural and construction materials based on use, desired results, durability, availability and cost.

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Cognitive Descriptor**
CO.1	Recall key concepts and definitions related to sustainable materials.	Remember (L1)
CO.2	Illustrate importance of concrete & its ingredients in sustainable development.	Understanding (L2)
CO.3	Identify the factors affecting Indoor air quality in building	Apply (L3)
CO.4	Select waste material to be used in construction for sustainability.	Apply (L3)

CO-PO Mapping:

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

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

Assessments :

Assessment	**Weightage (Marks)**
ESE	100

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

Course Contents:

Unit 1:

Introduction: Introduction to sustainability, Embodied energy, Operational energy in Building and Life cycle energy. Ecological footprint, Bio-capacity and calculation of planet equivalent. Operational energy in building, role of materials and thermal conductivity.	**08 Hrs.**
Unit 2: **Role of Material:** Carbon from Cement, alternative cements and cementitious material, Alternative fuel for cements for reduction in carbon emission. Sustainability issues for concrete	**07 Hrs.**
Unit 3: **Sustainable concrete:** Role of quality, minimization of natural resource utilization, High volume fly ash concrete, geo-polymer concrete etc. concrete with alternative material for sustainability, : Reduction in water consumption in concrete, Recycled aggregate, Energy for grinding crushing of cement aggregate etc. and reduction.	**08 Hrs.**
Unit 4: **Finishing materials :**Paints, Adhesive and sealants for use in building, Volatile organic content (VOC), emission issues and indoor air quality for Sustainability and Health hazard	**06 Hrs.**
Unit 5: **Indoor Environment Quality:** Introduction; Low emitting materials; Building and material reuse; Construction waste management; Regional materials; Life cycle cost assessment of building materials and products; Factors affecting indoor environment quality; Ventilation and filtration, Indoor Environment quality best practice	**08 Hrs.**
Unit 6: **Alternate construction materials:** Use of recycled materials in construction, Waste minimization and its importance in construction, Use of bamboo in construction and its advantages. Use of industrial waste in construction and its importance. Cost of sustainable materials.	**08 Hrs.**

Textbooks:

1. Sam Kubba, “Hand book of Green building Design and construction”, Elsevier Architecture Press.
2. Abe Kruger and Carl Seville, “Green building: principals and practice in residential construction”, Cengage Learning.
3. IGBC Green New building rating system (Version 3.0), March 2015. GRIHA Manual Volume-1: Introduction to National Rating System by Ministry of New and

References:

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 Construction - Green Building Design and Delivery by Charles J. Kibert, John Wiley & Sons, 2nd edition, 2008.
4. Sustainable Construction and Design by Regina Leffers, Prentice Hall, 2009.

Class: S. Y. B. Tech (Emerging Minor) In Civil and Environmental Engineering with Specialization in Sustainability Engineering **Title of the Course:** Clean Energy Engineering **Course No.:** UCEMNC0461	**L**	**T**	**P**	**Credit**
	03 hours per week	01	-	4

Course Pre-Requisite:

Students shall have the knowledge of:

- Basic Mathematics
- Basic Physics
- Basic Chemistry

Course Description:

This course provides an introduction to the principles, technologies, and practices involved in the generation and utilization of clean energy. Students will explore various renewable energy sources, including solar, wind, hydro, and biomass, and examine their potential for sustainable development. The course will cover energy conversion processes, efficiency improvements, environmental impacts of clean energy systems and a comprehensive understanding of clean energy technologies and their role in mitigating climate change and promoting environmental sustainability.

Course Learning Objectives:

1. To explain the fundamental principles of clean energy generation and utilization
2. To Interpret various renewable energy sources including solar, wind, hydro, biomass etc. and their potential for sustainable energy production.
3. To Analyze the efficiency, environmental impact, and economic feasibility of different clean energy technologies.
4. To Examine the role of clean energy in reducing greenhouse gas emissions and addressing climate change.

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Cognitive Descriptor**
CO.1	Explain the fundamental principles of clean energy generation and utilization.	Cognitive (Understanding) L2
CO.2	Interpret various renewable energy sources including solar, wind, hydro, biomass etc. and their potential for sustainable energy production.	Cognitive (Understanding) L2
CO.3	Analyse the efficiency, environmental impact, and economic feasibility of different clean energy technologies.	Cognitive (Analysing) L4
CO.4	Examine the role of clean energy in reducing greenhouse gas emissions and addressing climate change.	Cognitive (Analysing) L4

CO-PO Mapping:

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

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

Assessments:

Assessment	Weightage (Marks)
ESE	100

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

Course Contents:

Unit 1: Overview of conventional & renewable energy sources Need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO2 reduction potential of renewable energy- concept of Hybrid systems, Energy and its environmental impacts.	**08 Hrs.**
Unit 2: Solar Energy Heat transfer, estimation and physical conversion, Instruments for measurement. Energy collection and analysis: Flat Plate Collector FPC, Evacuated tube collector ETC, concentrating collectors. Solar energy application: Direct and indirect. Solar photovoltaic technology: Conversion, Systems components, integrations and applications.	**07 Hrs.**
Unit 3:Biomass Energy Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India	**08 Hrs.**
Unit 4: Biofuels Edible, Petro crops – Analysis of Indian nonedible oil sources – Example of biodiesel crop – Jatropha curcas – Tree description – Jatropha curcas for rural development – environmental protection – Bio ethanol – production from conventional as well as unconventional sources. - Bio diesel – Technology for production of bio diesel - Transesterification – Process – Usage of Methanol – Glycerine – Storage and Characterisation of biodiesel – Biodiesel engine development – modification – Environmental and health effects of biodiesel – R&D in biodiesel – disposal of cake – value addition of byproducts	**07 Hrs.**
Unit 5: Wind Energy Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.	**07 Hrs.**
Unit 6: Hydro energy, Geothermal energy and Ocean Energy Small hydro - Tidal energy, Wave energy, Open and closed OTEC Cycles Limitations, Geothermal energy, Geothermal energy sources - Types of geothermal power plants, Applications - Environmental impact. Ocean Energy: Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.	**08 Hrs.**

Textbooks:

1. Renewable Energy Sources I Twidell & Weir - Taylor and Francis - 2nd Special Indian Edition.
2. Non- conventional Energy Sources - G.D. Rai - Dhanpat Ral and Sons.
3. Renewable Energy Resources I Tiwari and Ghosal I Narosa.
4. Non-Conventional Energy Sources by G.D Rai
5. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
6. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi,2012
7. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

Reference Books:

1. Energy Resources Utilization and Technologies -Anjaneyulu & Francis- BS Publications 2012.
2. Principles of Solar Energy - Frank Krieth & John F Kreider - Hemisphere Publications.
3. Non-Conventional Energy - Ashok V Desai I Wiley Eastern.
4. Non-Conventional Energy Systems - K Mittal and Wheeler.
5. Renewable Energy Technologies I Ramesh & Kumar - Narosa.
6. Renewable Energy Resources - Tiwari&Ghosal - Narosa Publisher
7. Principles of Solar Energy – Frank Krieth and John K
8. Non-Conventional Energy – Ashok V Desai

Unit wise Measurable Students Learning Outcomes:

Unit Learning Objectives:

1. To study the summary of conventional & renewable energy sources.
2. To explore Solar energy as clean energy source and its potential for sustainable energy production.
3. To explore Biogas energy as clean energy source and its potential for sustainable energy production.
4. To explore Biofuel energy as clean energy source and its potential for sustainable energy production.
5. To explore Wind energy as clean energy source and its potential for sustainable energy production.
6. To explore Hydro energy, Geothermal energy and Ocean Energy as clean energy source and its potential for sustainable energy production.

Class: T. Y. B. Tech (Emerging Minor) In Civil and Environmental Engineering with Specialization in Sustainability Engineering **Title of the Course:** Climate Change and Sustainable Development **Course No.:** UCEMNC0561	**L**	**T**	**P**	**Credit**
	03 hours per week	01 hour per week	-	4

Course Pre-Requisite:

- Environmental Science
- Basic Knowledge of Ecology
- Environmental Chemistry and Microbiology

Course Description:

This course explores the scientific, social, and economic dimensions of climate change and its intersection with sustainable development. Students will analyse mitigation and adaptation strategies, policy frameworks, and global initiatives like the Paris Agreement. The course emphasizes practical solutions for low-carbon development and resilience planning.

Course Learning Objectives:

1. Explain the scientific basis of climate change, including greenhouse gas dynamics and global warming projections.
2. Evaluate the impacts of climate change on ecosystems, economies, and vulnerable communities.
3. Design mitigation and adaptation strategies aligned with SDGs (e.g., SDG 13: Climate Action).
4. Critique international climate policies (e.g., Paris Agreement, NDCs) and their implementation challenges.

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Cognitive Descriptor**
CO.1	Describe climate science fundamentals and key drivers of global warming.	Cognitive (Understanding) L2
CO.2	Assess climate risks (e.g., sea-level rise, extreme weather) using case studies.	Cognitive (Analyzing) L4
CO.3	Propose sustainable solutions (renewable energy, carbon sequestration).	Cognitive (Applying) L3
CO.4	Analyse climate justice issues and policy gaps in Global North vs. South.	Cognitive (Evaluating) L5

CO-PO Mapping:

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

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

CO.4	1	1

Assessments:

Assessment	Weightage (Marks)
ESE	100

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

Course Contents:

Unit 1: Introduction to Climate Change Understanding climate change: Definition and scope, Climate change science: Greenhouse gases, carbon cycle, and radiative forcing, Natural vs. anthropogenic causes of climate change, Climate feedback mechanisms and tipping points.	**08 hours**
Unit 2: Impacts of Climate Change Environmental impacts: Rising temperatures, melting ice caps, sea-level rise, Effects on biodiversity and ecosystems, Social and economic consequences: Food security, water scarcity, health risks, Climate change and extreme weather events, case studies, physical climate risk assessment.	**07 hours**
Unit 3: Climate Change Mitigation Reducing greenhouse gas emissions: Energy efficiency, renewable energy, Carbon sequestration and carbon capture technologies, Role of industries and businesses in climate action, Circular economy and sustainable production, case studies.	**08 hours**
Unit 4: Climate Change Adaptation Need for adaptation: Risk assessment and vulnerability analysis, Adaptation strategies in agriculture, water resources, and infrastructure, Community-based adaptation and climate-resilient planning, Role of technology and innovation in adaptation	**07 hours**
Unit 5: Sustainable Development and Climate Change Concept and principles of sustainable development, Linkages between climate change and sustainability, UN Sustainable Development Goals (SDGs) and climate action, Sustainable cities, green transportation, and resource management, case studies.	**08 hours**
Unit 6: Climate Policies and Global Initiatives International climate agreements: UNFCCC, Kyoto Protocol, Paris Agreement, National and regional climate policies and action plans, Role of government, NGOs, and civil society in climate governance, Carbon markets and climate finance	**07 hours**

Textbooks:

1. Climate Change: A Very Short Introduction – Mark Maslin
2. Sustainability: A Comprehensive Foundation – Tom Theis, Jonathan Tomkin

References:

1. IPCC Climate Change Assessment Reports
2. The Economics of Climate Change – Nicholas Stern
3. Sustainable Development: Concepts and Practices – John Blewitt

Class: T. Y. B. Tech (Emerging Minor) In Civil and Environmental Engineering with Specialization in Sustainability Engineering **Title of the Course:** Sustainable Infrastructure **Course No.:** UCEMNC0661	**L**	**T**	**P**	**Credit**
	03 hours per week	01 hour per week	-	4

Course Pre-Requisite:

- Basics of Civil and Environmental Engineering
- Fundamentals of Sustainability and Green Technologies
- Principles of Infrastructure Planning

Course Description:

This course provides an in-depth understanding of sustainable infrastructure design, development, and management. It focuses on integrating environmental, social, and economic sustainability principles in urban and rural infrastructure projects. The course covers green building technologies, sustainable transportation, water and energy-efficient systems, and resilient infrastructure planning.

Course Learning Objectives:

1. To introduce the concept of sustainable infrastructure and its significance.
2. To study various sustainability approaches in infrastructure development.
3. To analyze the environmental and social impacts of infrastructure projects.
4. To explore innovative solutions for resource-efficient and climate-resilient infrastructure.
5. To evaluate policies and standards for sustainable infrastructure development.

Course Outcomes:

COs	**After the completion of the course the students will be able to**	**Bloom's Cognitive Descriptor**
CO.1	Explain the principles of sustainable infrastructure and its key components.	Cognitive (Understanding) L2
CO.2	Evaluate sustainable building materials, technologies, and practices.	Cognitive (Evaluating) L5
CO.3	Apply sustainability principles in transportation, water, and energy infrastructure.	Cognitive (Applying) L3
CO.4	Assess policies, frameworks, and global initiatives for sustainable infrastructure.	Cognitive (Evaluating) L5

CO-PO Mapping:

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

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

Assessments:

Assessment	**Weightage (Marks)**

ESE	100

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

Course Contents:

Unit 1: Introduction to Sustainable Infrastructure Definition, need, and significance of sustainable infrastructure, Principles of sustainability in infrastructure planning and design, Environmental, economic, and social dimensions of sustainability, Life cycle assessment of infrastructure projects.	**08 hours**
Unit 2: Sustainable Building and Construction Green building concepts and certification systems (LEED, GRIHA, BREEAM), Energy-efficient building materials and construction techniques, Smart buildings and net-zero energy buildings, Role of automation and IoT in sustainable buildings.	**07 hours**
Unit 3: Sustainable Transportation Systems Concepts of green and smart transportation, Public transport planning and non-motorized transport systems, Electric vehicles and alternative fuels, Sustainable urban mobility planning.	**08 hours**
Unit 4: Water and Waste Management in Infrastructure Water-sensitive urban design and integrated water resource management, Sustainable stormwater management (rainwater harvesting, permeable pavements), Waste reduction strategies in infrastructure development, Circular economy in construction and demolition waste management	**07 hours**
Unit 5: Energy and Climate-Resilient Infrastructure Renewable energy integration in infrastructure projects, Decentralized energy systems and microgrids, Climate adaptation strategies for infrastructure resilience, Disaster-resistant infrastructure design.	**08 hours**
Unit 6: Policies and Global Practices in Sustainable Infrastructure International frameworks: UN-Habitat, SDGs, and climate agreements, National policies and strategies for sustainable infrastructure development, Role of government, private sector, and civil society in sustainable infrastructure, Case studies of successful sustainable infrastructure projects.	**07 hours**

Textbooks:

1. Sustainable Infrastructure: Principles into Practice – Richard Rogers
2. Infrastructure Sustainability and Design – Spiro Pollalis

References:

1. Green Infrastructure: Principles and Practices – Mark Benedict, Edward McMahon
2. Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia – Anthony Townsend
3. Infrastructure Resilience and Environmental Sustainability – Annaka Peirce

Class: B. Tech (Emerging Minor) in Civil And Environmental Engineering With Specialization in Sustainability Engineering	L	T	P	Credit
Title of the Course: Environmental Management **Course No.:** UCEMNC0761	02 hours per week	-	-	2

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

- Sustainable Materials
- Clean Energy Engineering
- Climate Change and Sustainable Development
- Sustainable Infrastructure Engineering

Course Description:

This course focuses on Environmental Management from a sustainability engineering perspective, integrating environmental protection, resource efficiency, climate resilience, and socio-economic considerations into engineering decision-making. The course emphasizes strategic, systems-based, and preventive approaches to managing environmental impacts of projects, industries, and infrastructure. Students will learn how environmental management tools, policies, and frameworks support sustainable development goals, circular economy principles, and responsible engineering practices.

Course Learning Objectives:

- Understand principles and frameworks of environmental management for sustainable development.
- Analyze environmental impacts of engineering systems using management tools and indicators.
- Apply sustainability-oriented strategies for resource, energy, and environmental management.
- Interpret environmental policies and management systems for sustainable engineering practice.

Course Outcomes:

COs	After the completion of the course the students will be able to	Bloom's Cognitive Descriptor
CO.1	Explain principles, objectives, and frameworks of environmental management in the context of sustainability engineering.	Cognitive (Understanding) L2
CO.2	Analyze environmental impacts and risks of engineering activities using management tools.	Cognitive (Analysing) L4
CO.3	Apply sustainable environmental management strategies for resources, energy, and waste systems.	Cognitive (Applying) L3
CO.4	Interpret environmental policies, management systems, and sustainability indicators for decision-making.	Cognitive (Applying) L3

CO-PO Mapping:

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

COs	PSO1	PSO2
CO1	**2**	**1**
CO2	**3**	**2**
CO3	**3**	**2**
CO4	**2**	**1**

Assessments:

Assessment	Weightage (Marks)
ESE	100

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

Course Contents:	
Unit 1: Fundamentals of Environmental Management and Sustainability Concept and evolution of environmental management; relationship between environmental management and sustainability engineering; systems thinking in environmental management; sustainable development goals (SDGs) and engineering practice; preventive vs reactive environmental management; environmental ethics and stewardship; role of engineers in sustainable environmental management.	**07 hours**
Unit 2: Environmental Management Tools and Impact Assessment Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA); life cycle thinking and Life Cycle Assessment (LCA) (conceptual); environmental risk assessment; material and energy flow analysis; sustainability indicators and metrics; environmental auditing and reporting; use of management tools in sustainable infrastructure and industrial projects.	**07 hours**
Unit 3: Resource, Energy, and Waste Management for Sustainability Sustainable resource management; water and energy efficiency strategies; integration of clean and renewable energy in environmental management; circular economy principles; sustainable materials management; waste minimization, reuse, recycling, and recovery; industrial symbiosis; environmental management approaches for climate mitigation and adaptation.	**07 hours**
Unit 4: Environmental Management Systems, Policy, and Governance Environmental Management Systems (EMS) and ISO 14001 (concept and structure); integration of EMS with sustainability and ESG frameworks; environmental laws and policies supporting sustainability; corporate environmental responsibility; stakeholder engagement and public participation; environmental management in urban, rural, and infrastructure projects; case studies on sustainable environmental management.	**07 hours**
Textbooks: 1. Barrow, C. J., Environmental Management for Sustainable Development, Routledge, 3rd Edition, 2016. 2. Jain, R. K., Environmental Management, Khanna Publishers, 4th Edition, 2018.	
ReferenceBooks 1. De Sherbinin, A., Environmental Sustainability and Development, Springer, 1st Edition, 2019. 2. ISO, ISO 14001: Environmental Management Systems – Requirements with Guidance, 2015. 3. UNEP, Global Environment Outlook Reports, United Nations Environment Programme, Latest Edition. 4. World Bank, Environmental Management Frameworks for Sustainable Development, Latest Edition.	