| 25UHUT002 | SUSTAINABILITY AND ETHICS IN ENGINEERING | Category | L | T | P | R | Credit | Year of Introduction |
|---|---|---|---|---|---|---|---|---|
| | | HMC | 2 | 0 | 0 | 0 | 2 | 2025 |

**Preamble**: This course is designed to cultivate a holistic perspective in engineering students by integrating professional integrity**,** social equity**,** and environmental stewardship. In an era of rapid technological advancement and climate volatility, technical expertise alone is insufficient; the modern engineer must be a morally conscious decision-maker.

**Prerequisite: Nil**

**Course Outcomes**: After the completion of the course, the student will be able to:

| CO | Course Outcomes | Knowledge Level |
|---|---|---|
| CO1 | Explain fundamental ethical theories to resolve moral dilemmas in personal and professional contexts. | K2 (Understand) |
| CO2 | Outline philosophical perspectives of environmental ethics to protect biodiversity and manage urban environmental impacts. | K2 (Understand) |
| CO3 | Develop strategies for Zero Waste and Circular Economy to mitigate disruptions in the hydrological cycle and resource depletion. | K3 (Apply) |
| CO4 | Illustrate the importance of Renewable Energy technologies in combating the climate crisis in relation to Environmental Regulations and the Sustainable Development Goals (SDGs)**.** | K3 (Apply) |

**Mapping of course outcomes with program outcomes and program specific outcomes**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | - | - | - | - | - | 2 | - | 3 | 2 | 2 | - |
| CO2 | - | - | - | - | - | 3 | - | 2 | 3 | 2 | - |
| CO3 | 1 | 1 | 2 | - | - | 2 | 3 | - | - | - | - |
| CO4 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 1 | - | 2 | 2 |
| Avg | 1.5 | 1.5 | 2.5 | 2 | 2 | 2.25 | 3 | 2 | 2.5 | 2 | 2 |

**Mapping of course outcomes with Knowledge and Attitude Profile (WK)**

| | WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | * | | | | * | | * | | |
| CO2 | * | | | | * | | * | | |
| CO3 | * | * | * | * | * | | * | | * |
| CO4 | * | * | * | * | * | * | * | * | * |

**WKs Mapped with the course**

| WK1 | WK2 | WK3 | WK4 | WK5 | WK6 | WK7 | WK8 | WK9 |
|---|---|---|---|---|---|---|---|---|
| * | * | * | * | * | * | * | * | * |

**Mark Distribution:**

| Total Marks | CIE Marks | ESE Marks | ESE Duration |
|---|---|---|---|
| 100 | 40 | 60 | 2.5 hrs |

**Continuous Internal Evaluation Pattern:**

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

**SYLLABUS**

**Module 1 (7 hrs)**

Fundamentals of ethics -Moral Relativism vs. Objectivity. Consequentialism. Deontology Metaethics. Personal vs. professional ethics, Civic Virtue, Respect for others, Profession and Professionalism, Plagiarism, case studies, Technology and digital revolution, Cybertrust and cybersecurity, High technologies: connecting people and places- Managing conflict, Confidentiality, Codes of Ethics. Basic concepts in Gender Studies, gender, gender spectrum: gender stereotypes, Gender disparity and discrimination in education, Ethical values and practices in connection with gender Gender policy and women/transgender empowerment initiatives.

**Module 2 (7 hrs)**

Introduction to Environmental Ethics: key philosophical theories (anthropocentrism, biocentrism, ecocentrism).Deep Ecology.Intrinsic value.Sustainable Engineering Principles: Definition and scope, triple bottom line, life cycle analysis and sustainability metrics. Ecosystems and Biodiversity: An overview of various ecosystems in Kerala/India, and its significance. Landscape and Urban Ecology: Principles of landscape ecology, Urbanization and its environmental impact, Moral Extensionism

**Module 3 (7 hrs)**

Hydrology and Water Management: water cycle, Environmental flow, disruptions and disasters. Zero Waste Concepts and Practices: Definition of zero waste and its principles, Strategies for waste reduction, Case studies of successful zero waste initiatives. Circular Economy and Degrowth: Differences between linear and circular economies, AI-Driven Energy Optimization**,** Digital Twins**,** Bio-Engineering & Biomimicry**,** Carbon Capture and Storage (CCS)**,** Mobility and Sustainable Transportation: Basic tenets of a Sustainable Transportation design, Integrated mobility systems, E-Mobility.

**Module 4 (7 hrs)**

Renewable Energy and Sustainable Technologies: (solar, wind, hydro, biomass), Challenges and opportunities in renewable energy adoption. Climate Change and Engineering Solutions: Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. Environmental Policies and Regulations: Ethical considerations in environmental policy-making. Case Studies and Future Directions: Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future. The Sustainable Development Goal 17.

**Text Books:**


1. Whitbeck, C. (2011). Ethics in engineering practice and research (2nd ed.). Cambridge University Press.
2. Oakley, J. (2006). Virtue ethics and professional roles. Cambridge University Press.
3. Bakshi, B. R. (2019). Sustainable engineering: Principles and practice. Cambridge University Press.
4. Martin, M. W., & Schinzinger, R. (2014). Ethics in engineering (4th ed.). Tata McGraw-Hill Education.
5. Ahlawat, A. (2019). Sustainable development goals: Directive principles for sustainable India by 2030. Notion Press.


**Reference Books:**


1. Parmar, R. K. (2025). Green technology and sustainable development (1st ed.). ISBN-13 publication.
2. Kosanam, N. (2023). Beyond carbon: Responsible ways to restore ecological balance. ISBN-13 publication.


**END SEMESTER EXAMINATION - MODEL QUESTION PAPER**

| **Course Code** | **25UHUT002** |
|---|---|
| **Course Name** | **SUSTAINABILITY AND ETHICS IN ENGINEERING** |
| **Max. Marks: 60** | **Duration: 2.5 Hours** |

| Part A<br>*(Answer all questions. Each question carries 3 marks)* | | | | |
|---|---|---|---|---|
| **Qn No.** | **Question** | **Marks** | **CO** | **BL** |
| 1. | Differentiate between Moral Relativism and Objectivity in the context of professional decision-making. | 3 | 1 | L2 |
| 2. | Outline the key differences between personal ethics and professional ethics for a practicing engineer. | 3 | 1 | L2 |
| 3. | Explain the concept of 'Intrinsic Value' within environmental philosophy frameworks. | 3 | 2 | L2 |
| 4. | Summarise the three core pillars that constitute the 'Triple Bottom Line' of sustainability | 3 | 2 | L2 |
| 5. | Describe the engineering definition and operational importance of maintaining 'Environmental Flow' in river systems. | 3 | 3 | L2 |
| 6. | Differentiate between a Linear Economy and a Circular Economy using a conceptual pipeline breakdown. | 3 | 3 | L2 |
| 7. | Describe the challenges faced by coastal infrastructure in Kerala due to the ongoing climate crisis. | 3 | 4 | L2 |
| 8. | Outline the overarching objective of Sustainable Development Goal 17 regarding global partnerships. | 3 | 4 | L2 |
| | **Part B**<br>(*Answer any one full question from each Module. Each carry 9 marks*) | | | |
| | **Module I** | | | |
| **Qn No.** | **Question** | **Marks** | **CO** | **BL** |
| 9 | Describe the key principles of Consequentialism and Deontology. Explain their relevance in assessing a workplace confidentiality conflict in engineering practice. | 9 | 1 | L2 |
| | **OR** | | | |
| 10 | Explain the role of gender policies and empowerment initiatives in addressing structural discrimination within educational institutions. | 9 | 1 | L2 |
| | **Module II** | | | |
| **Qn No.** | **Question** | **Marks** | **CO** | **BL** |
| 11 | Describe the key environmental philosophical theories of Anthropocentrism, Biocentrism, and Ecocentrism and their influence on modern industrial development policies. | 9 | 2 | L2 |
| | **OR** | | | |

| | | | | |
|---|---|---|---|---|
| 12 | Explain the key phases of Life Cycle Analysis (LCA) and the sustainability indicators used to evaluate the environmental performance of engineering products. | 9 | 2 | L2 |
| | **Module III** | | | |
| **Qn No.** | **Question** | **Marks** | **CO** | **BL** |
| 13.a | A town experiences frequent water shortages during summer. Apply the concepts of the water cycle and environmental flow to suggest suitable water management measures. | 5 | 3 | L3 |
| 13.b | Describe the concept of Carbon Capture and Storage (CCS) as a climate mitigation strategy. . | 4 | 3 | L2 |
| | **OR** | | | |
| 14.a | A residential colony generates a large amount of household waste. Apply the principles of Zero Waste to recommend two strategies for reducing waste generation. | 5 | 3 | L3 |
| 14.b | Explain the concept of AI-driven energy optimization and its significance in sustainable development. | 4 | 3 | L2 |
| | **Module IV** | | | |
| **Qn No.** | **Question** | **Marks** | **CO** | **BL** |
| 15.a | A coastal community is vulnerable to sea-level rise and flooding. Apply engineering solutions to improve its climate resilience. | 5 | 4 | L3 |
| 15.b | Summarize the opportunities and challenges associated with renewable energy adoption in India. | 4 | 4 | L2 |
| | **OR** | | | |
| 16.a | A proposed industrial project is located near a sensitive ecosystem. Apply environmental policy and ethical principles to identify key considerations before project approval. | 5 | 4 | L3 |
| 16.b | Explain the importance of emerging sustainable technologies in achieving environmental sustainability. | 4 | 4 | L2 |