

DISCIPLINE SPECIFIC ELECTIVE (DSE-EVS-8): ENVIRONMENTAL ENGINEERING

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
DSE-EVS-8: ENVIRONMENTAL ENGINEERING	4	2	0	2	Class XII pass	NA

Learning objectives

The Learning Objectives of this course are as follows:

- Gain insights into the principles and practices of environmental engineering and develop skills in the environmental systems and technologies
- Cultivate skills for effective awareness for the environmental impacts of human activities and foster critical thinking in the context of sustainable development
- Evaluate tools and techniques, such as mathematical-, experimental-, and computer-based, used in environmental engineering
- Equip with laboratory techniques for estimating quality of water, air and waste

Learning outcomes:

After the course, students will be able to

- Apply principles of environmental engineering into environmental systems and technologies
- Analyze and design environmental systems for treating water, controlling air pollution and manage waste
- Evaluate the environmental impacts of human activities, and appreciate ethical and professional responsibilities of environmental engineers for sustainability
- Demonstrate proficiency in the use of environmental engineering tools and technologies for sustainable development

SYLLABUS OF DSE-EVS-8

Theory (02 Credits: 30 lectures)

UNIT – I Basics of Environmental Engineering (2 Weeks) (4 lectures)

Environmental Engineering: concept, history and evolution, potential in sustainable development; Green chemistry and life cycle assessment, Ethics and environmental policies and regulations, Chemistry of water, air and soil, Redox reactions and chemical equilibrium,

Biological processes and environmental functioning (photosynthesis, respiration, decomposition, nutrient cycling)

UNIT – II Water and Wastewater Treatment (2½ Weeks) (5 lectures)

Water and wastewater treatment methods: physical, chemical, biological, integrated and advanced methods; Water quality: parameters, standards, and related regulations; Sludge: treatment, use, and disposal; Water reuse and recycling

UNIT – III Air Pollution Control (2½ Weeks) (5 lectures)

Air quality: parameters, standards, and regulations; Air Pollutants: types, sources, dispersion, and their control; Indoor air quality, Emerging air pollutants

UNIT – IV Solid Waste Management (2½ Weeks) (5 lectures)

Solid waste: types, characteristics, collection, transportation, storage, processing, treatment, and disposal or resource recovery and recycling; Integrated solid waste management; Hazardous waste management

UNIT – V Microbial and plant biology and ecology (2½ Weeks) (5 lectures)

Microbial and plant physio-ecological processes and waste treatment, Ecophysiology of microbes and plants, Growth of microbes and plants during waste management, Pathogen control in soil, water, and air by biological methods

UNIT – VI Environmental Impact Assessment (EIA) (1½ Weeks) (3 lectures)

EIA: Process, Statement, and case studies; Social and Economic Impact Assessment, Environmental Management Plan

UNIT – VII Sustainable Energy and Climate Change (1½ Weeks) (3 lectures)

Sustainable Energy and Climate Change: renewable energy sources, energy efficiency, climate change science, case studies, Climate change: mitigation and adaptation strategies, Carbon footprinting

Teaching and learning interface for theoretical concepts

To achieve the course objectives and match with the contents, a wide range of teaching and learning tools will be employed, including (a) Formal lectures; (b) Interactive sessions using visual aid; (c) Case study analyses; (d) Hypothetical scenario building; (e) Group discussion on key topics; and (f) documentary screening and critical analyses.

Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)

- 1-3. Conduct physico-chemical characterization of given water samples (pH, temperature, dissolved oxygen, turbidity, total suspended solids, and NO₃-N or PO₄-P)
4. Characterize the given wastewater sampled from an industry and agricultural field
5. Measure the concentration of particulate matter, NO₂, SO₂, CO, using different methods
6. Characterize solid waste and determine its moisture content, density, and calorific value

7. Visit a landfill site and draw its design and explain the underlying geotechnical principles
8. Based on practical 5, improve and propose a design and justify the improvement in the design
9. Test the ability of given bacteria to tolerate different levels of the selected pollutants
10. Select and evaluate a proposed project or activity using life cycle assessment
11. Perform a life cycle assessment of a selected product or process and determine its possible environmental impacts from cradle to grave
12. Using principles of green chemistry, perform the selected experiment using environmentally friendly methods and reagents

Teaching and learning interface for practical skills

To impart training on technical and analytical skills related to the course objectives, a wide range of learning methods will be used, including (a) laboratory practicals; (b) field-work exercises; (c) customized exercises based on available data; (d) survey analyses; and (e) developing case studies; (f) demonstration and critical analyses; and (h) experiential learning individually and collectively.

Essential/recommended readings

- Chiang, C. Y., & Lin, Y. P. (2021). Sustainable Environmental Engineering: Trends and Innovations. Elsevier.
- Gribb, M., & Banerjee, S. (2021). Environmental Engineering: Principles and Practice. Cambridge University Press.
- Kharaghani, A., & Fazeli, A. (2021). Environmental Engineering and Management: Sustainable Development and Hazard Mitigation. CRC Press.
- Vesilind, P. A., & Morgan, S. M. (2020). Introduction to Environmental Engineering. Cengage Learning.
- Wang, Y. (2020). Environmental Engineering: An Introduction to the Fundamentals. Wiley.

Suggested readings

- Falletti, L., & Paolini, R. (2019). Environmental Remediation Technologies for Metal-Contaminated Soils. Springer.
- Lichtfouse, E. (2020). Environmental Chemistry for a Sustainable World. Springer.
- Shuyler, H. (2021). Sustainability and Engineering: Concepts, Metrics, and Opportunities. Springer.
- Tchobanoglous, G., & Burton, F. L. (2019). Wastewater Engineering: Treatment and Resource Recovery. McGraw-Hill Education.
- Wang, L. K., Hung, Y. T., & Shamas, N. K. (2016). Advanced Treatment Technologies for Urban Wastewater Reuse. Springer.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.