DISCIPLINE SPECIFIC CORE COURSE – 11 (DSC-EVS-11): ENVIRONMENTAL TOXICOLOGY

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 (if any)
		Lecture	Tutorial	Practical/ Practice		
DSC-EVS-11: ENVIRONMENTAL TOXICOLOGY	4	2	0	2	Class XII pass	NA

Learning objectives

The Learning Objectives of this course are as follows:

- Analyze sources, fate, and effects of toxic substances in the environment
- Train in methods relevant to assess and manage environmental risks associated with toxic substances
- Investigate the impact of environmental toxicants on wildlife and ecosystems, including the effects on reproductive success and population dynamics.
- Examine management practices related to the use, disposal, and treatment of hazardous substances and wastes.
- Compare scientific methods and techniques to measure and monitor environmental toxicants in different environmental media.
- Familiarize with emerging issues and technologies in environmental toxicology
- Promote critical thinking and problem-solving skills through case studies and hands-on activities related to environmental toxicology.

Learning outcomes

After this course, students will be able to

- Define and describe the scope and historical background of environmental toxicology.
- Identify, classify, and predict fate and transport of different types of toxic substances in the environment
- Evaluate the risks associated with toxic substances and apply risk assessment and management strategies
- Analyze the effects of toxic substances on wildlife and ecosystems, and propose solutions to mitigate their impacts.
- Compare and contrast the toxicity of different pollutants and their possible mechanisms of action.
- Apply their knowledge of environmental toxicology to current environmental issues and develop potential solutions.

SYLLABUS OF DSC-EVS-11

Theory (02 Credits: 30 lectures)

UNIT – I Introduction to Environmental Toxicology (1 Week) (2 lectures)
Definition, Historical perspective, Types of Toxic substances: types, properties, sources, and fate and transport, biomagnification and bioaccumulation.

UNIT –II Toxicology of Air and Water (2 Weeks) (4 lectures)
Toxic air contaminants, Health effects of air pollution, Acid rain and its impacts, Ozone depletion and its impacts, Water pollution and its sources, Health effects of water pollution, Eutrophication and hypoxia in aquatic ecosystems, Marine pollution and its impacts, Emerging issues in air and water toxicology

UNIT –III Toxicology of Soil and Hazardous Waste (3½ Weeks) (7 lectures)
Sources and types of hazardous waste, Health effects of soil contamination: from heavy metals, metalloids, and organic contaminants; Brownfields and urban redevelopment, Superfund sites and environmental justice, Pesticide and Pharmaceuticals: classification, history of use, distribution in environment, fate and transport, health effects, and ecotoxicology; Emerging issues in environmental toxicology by hazardous waste, pesticides and pharmaceuticals

UNIT –IV Toxicology of Radiation and Nanoparticles (3 Weeks) (6 lectures)
Ionizing and non-ionizing radiation, Health effects of radiation, Radioactive waste and nuclear accidents, Nanoparticles: properties, behavior in the environment, fate and transport, health effects, and ecotoxicology; Emerging issues in radiation and nanoparticle toxicology, Risk assessment and risk management of radiation and nanoparticles

UNIT –V Emerging Issues in Environmental Toxicology (2½ Weeks) (5 lectures)
Endocrine disruption and its impacts, Climate change and toxicology, Emerging contaminants (e.g., microplastics, PFAS), Global perspectives, Ethics in environmental toxicology, Careers in environmental toxicology, Future directions in environmental toxicology research

UNIT –VI Management and regulation of environmental toxicants (1½ Weeks) (3 lectures)
Environmental regulations and policy, Hazardous waste regulations and management, Pesticide and pharmaceutical use and regulation, Ecotoxicology and wildlife toxicology, Risk assessment and risk management, Remediation and restoration of contaminated sites

UNIT –VII Environmental forensics (1½ Weeks) (3 lectures)
Definition, Applications in environmental toxicology, Common techniques (e.g., isotope analysis, DNA fingerprinting), Case studies in identifying sources of contamination, Future developments and potential applications in environmental sustainability.

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. Analyze effects of pH on the toxicity of heavy metals on model organism, such as Daphnia
2-3. Determine toxicity of varying concentration of industrial effluent on common alga and measure its growth and survival rates
4-5. Effects of heavy metal toxicity on plant growth, focussing on different plant parts and physiological characteristics
6. Analyze effects of climate change on the abundance and diversity of pollinators under different climatic conditions
7. Analyze the abundance and diversity of nematodes (e.g., Caenorhabditis elegans) in the background of use of environmental chemicals
8. Effects of herbicides on the abundance and diversity of weed populations in response to the use of different herbicides
9. Test the effects of a target organic contaminant on behaviour and mortality of earthworm
10-11. Measure developmental abnormalities in zebrafish embryos due to toxicity of target environmental chemicals
12-13. Prepare and characterize nanoparticles of selected heavy metal and assess effect of nanoparticles on plant growth
14. Effects of various concentrations of road salt on freshwater organisms (e.g., zooplankton) and measure changes in their behavior and survival

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

- Crosby, D. G. (2019). Environmental toxicology and chemistry (3rd ed.). CRC Press.
- Landis, W. G., Sofield, R. M., & Yu, M.-H. (2019). Introduction to environmental toxicology (4th ed.). CRC Press.
- Lehrer, I., & Poole, J. B. (2019). Principles of environmental toxicology (4th ed.). CRC Press.
- Newman, M. C., Roberts, M. H., Hale, R. C., & Robinson, E. M. (Eds.). (2020).

Environmental Toxicology: Biological and Health Effects of Pollutants (4th ed.). CRC Press.
- Yu, M.-H., & Yan, G. W. S. (2020). Environmental toxicology: Biological and health effects of pollutants (3rd ed.). CRC Press.

Suggestive readings

- Ballantyne, B., Marrs, T. C., & Syversen, T. (2020). Toxicology: The basic science of poisons (4th ed.). CRC Press.
- Kamrin, M. A. (2020). Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes (5th ed.). CRC Press.
- Meyers, R. A. (Ed.). (2018). Environmental toxicology: Selected entries from the Encyclopedia of Sustainability Science and Technology. Springer
- Smart, R. C., & Hodgson, E. (2018). Molecular and biochemical toxicology (5th ed.). John Wiley & Sons.

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