DISCIPLINE SPECIFIC ELECTIVE (DSE-EVS-10): ECOSYSTEM MONITORING

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-10: ECOSYSTEM MONITORING	4	2	0	2	Class XII pass	NA

Learning objectives

The Learning Objectives of this course are as follows:

- Introduce principles and practices of monitoring ecological systems for designing and implement monitoring programmes
- Provide knowledge of the importance of monitoring for conservation and management of natural resources.
- Impart skills in data analysis and interpretation and provide with hands-on experience in monitoring programmes
- Encourage to communicate the results of monitoring programs effectively and promote ethical principles in monitoring

Learning outcomes

After the course, the students will be able to

- Explain the principles of ecosystem monitoring and design and implement monitoring programmes
- Analyze and interpret data from monitoring programmes and identify specific monitoring methods for conservation and management of natural resources
- Conduct monitoring programmes and communicate the results effectively
- Apply ethical and scientific principles in monitoring programmes

SYLLABUS OF DSE-EVS-10

Theory (02 Credits: 30 lectures)

UNIT – I Introduction to Ecosystem Monitoring (2½ Weeks) (05 lectures)

Introduction to ecosystem monitoring, Principles of ecosystem monitoring, Importance of monitoring for conservation and management, Types of monitoring programmes, Steps in designing a monitoring programme, Sampling methods, Data analysis and interpretation, Communication of monitoring results, Ethics in monitoring, Case studies in ecosystem monitoring

UNIT – II Ecological Indicators (3 Weeks) (06 lectures)

Definition and types of ecological indicators, Commonly used ecological indicators in different ecosystems (e.g., terrestrial, aquatic, marine), Measurement techniques for ecological indicators (e.g., field sampling, remote sensing, citizen science), Interpretation of ecological indicators and their relationship to ecosystem health and function, Applications of ecological indicators in environmental management and policy

UNIT – III Sampling Techniques (4 Weeks) (08 lectures)

Different types of sampling techniques and their advantages and limitations, Sampling design and planning for ecosystem monitoring (e.g., sample size, spatial and temporal scales), Sampling protocols and techniques for climate and different types of ecosystem components, (e.g., soil, water, air, biota), Quality assurance and quality control in ecosystem monitoring sampling, Data management and analysis considerations for sampling data

UNIT – IV Data Analysis and Visualization (3½ Weeks) (07 lectures)

Types of data collected in ecosystem monitoring (e.g., continuous, discrete, categorical), Statistical techniques and software for analyzing ecosystem monitoring data (e.g., regression analysis, multivariate analysis, machine learning), Data visualization techniques for ecosystem monitoring data (e.g., charts, graphs, maps), Communicating monitoring results to stakeholders (e.g., reports, presentations, online platforms), Ethical considerations in the analysis and visualization of ecosystem monitoring data

UNIT – V Ecosystem Monitoring in Practice (2 Weeks) (04 lectures)

Overview of a specific ecosystem monitoring program (e.g., the National Ecological Observatory Network, Long-Term Ecological Research sites), Planning and design of an ecosystem monitoring project, Analysis of a case study of ecosystem monitoring with respect to different practices mentioned in other units, Reflection on the challenges and opportunities of implementing ecosystem monitoring programs in practice.

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. Measure plant diversity using different methods to assess species richness, diversity indices, and community structure
2. Survey nearby ecosystem to identify and monitor invasive species and its possible impact
3. Analyze remote sensing data for ecosystem monitoring, including satellite imagery and aerial photographs
4. Learn different soil sampling methods and monitor soil properties
5. Measure potential carbon sequestration by trees of a nearby area
6. Analyze climate data, including temperature, precipitation, and atmospheric carbon dioxide concentrations
7. Hands-on experience in testing water quality parameters such as pH, dissolved oxygen, and nutrients using rapid methods
8. Conduct bird surveys and identify common bird species of nearby ecosystem
9. Hands-on experience in setting up and monitoring wildlife camera traps, and identifying common wildlife species
10. Design and conduct social surveys to understand public perceptions, attitudes, and behaviors related to ecosystem (wetland, etc.) monitoring
11. Record and monitor leaf-out, flowering, and fruiting of selected species of nearby ecosystem
12. Survey amphibians in ecosystems by method of your choice including visual surveys or call surveys or capture-mark-recapture
13. Sample and identify insects in a nearby area, including sweep netting or pitfall traps or light traps
14. Engage citizen scientists in ecosystem monitoring programme, including data collection, quality assurance, and community engagement

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

- Bartram, J., & Ballance, R. (2017). Water Quality Monitoring: A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programs. CRC Press.
- Becker, C. G., Bastos, R. P., & Silvano, D. L. (2021). Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians. Smithsonian Institution Press
- Burden, F. R., & Pitt, R. F. (2013). Environmental Monitoring Handbook. McGraw Hill.
- Lindenmayer, D., Gibbons, P., & Bennett, A. (2019). Monitoring ecosystems: Interdisciplinary approaches for evaluating ecoregional initiatives. CSIRO Publishing
- Stenseth, N. C., & Furevik, T. (2016). Principles and Methods of Ecosystem-based Management. CRC Press.

Suggestive readings

- Aronson, J. (2017). The Practice of Ecosystem Services Evaluation: An Introduction. Springer.
- Ferretti, M., & Fischer, R. (2013). Forest Monitoring: Methods for Terrestrial Investigations in Europe with an Overview of North America and Asia. Elsevier.
- Kobayashi, T., Yang, W., & Qi, Y. (2020). Remote sensing of ecosystem health with prism and modis data. CRC Press.
- Krkosek, M., & Bateman, A. (2019). Wildlife Population Monitoring: Some Practical Considerations. Oxford University Press.
- Rees, Y., Brazeau, M., & Santos, L. F. (2021). Environmental monitoring using UAVs. Springer.
- Schulin, R., & Kutílek, M. (2017). Soil Monitoring: Early Detection and Surveying of Soil Contamination and Degradation. Springer.

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