ENVIRONMENTAL SCIENCE MINOR SYLLABUS

(UNDER NEP 2020)

Course Code: ENSG(6T)

Credits: 4 (Theory 3 + Practical 1)

Total Marks: 100 (Theory: 40 + IA: 20; Practical: 20+ IA: 20)

Course VI : Environmental Science: Applications and Management

Course Objectives

Upon completion of this course, the student will be able to:

1) Understand the principles and steps of scientific research methodology specific to environmental studies.
2) Apply computer tools and software for environmental data analysis, visualization, and research presentation.
3) Analyze the structure, functions, and valuation of various ecosystem services and their relevance to human well-being.
4) Evaluate the causes, consequences, and management strategies for human-wildlife conflict and wildlife conservation.

Course Outcomes (COs)

CO1	Design a basic research framework, including hypothesis formulation, sampling, and data collection for an environmental problem.
CO2	Utilize appropriate computer applications (GIS, statistical software, graphing tools) to process and represent environmental data.
CO3	Critically assess the linkages between ecosystem processes, the services they provide, and sustainable development.
CO4	Propose integrated management plans to mitigate human-wildlife conflict while promoting conservation goals.

Unit-wise Detailed Content

Unit 1	**Number of Lecture 20**	**Title of unit:** Research Methodology in Environmental Science
		Introduction to Scientific Inquiry: Basic vs. applied research. **Defining Research Problem:** Formulation of objectives and hypotheses. **Research Design:** Descriptive, exploratory, and experimental designs in environmental contexts.

		Data Collection Methods: Field surveys, questionnaires, interviews, participatory rural appraisal (PRA), and secondary data sources. **Sampling Techniques:** Random, stratified, systematic, and purposive sampling for air, water, soil, and biological parameters. **Data Analysis & Interpretation:** Basic statistical concepts (mean, SD, correlation), introduction to significance testing. **Research Ethics and Report Writing**: Structure of a scientific report (abstract, introduction, methodology, results, discussion, conclusion, references).
Unit 2	**Number of Lecture 20**	**Title of unit:** Computer Application in Environmental Science and Research
		Introduction to Environmental Informatics. **Data Management & Analysis:** Using spreadsheet software (MS Excel/LibreOffice Calc) for environmental data: sorting, filtering, creating pivot tables, and basic statistical functions. **Statistical Software:** Introduction to software like SPSS/Statistica or PSPP for performing t-tests, ANOVA, and correlation analysis. **Graphical Representation:** Creating professional graphs (line, bar, scatter, pie charts), histograms, and box plots for research reporting. **Geospatial Technology:** Introduction to Geographic Information Systems (GIS) and Remote Sensing (RS) concepts. Use of open-source GIS software (e.g., QGIS) for creating thematic maps (land use, soil, drainage). **Presentation Tools:** Effective use of software (MS PowerPoint/LibreOffice Impress) for scientific presentation.
Unit 3	**Number of Lecture 20**	**Title of unit:** Ecosystem Services
		Concepts: Definitions of ecosystem functions, processes, and services. **Classification:** Provisioning (food, water, timber), Regulating (climate, flood, disease), Cultural (recreational,

		spiritual), and Supporting services (soil formation, nutrient cycling). **Valuation of Ecosystem Services:** Introduction to economic (market and non-market) and socio-cultural valuation methods. **Case Studies:** Valuation of wetland services, carbon sequestration by forests, coastal protection by mangroves. **Ecosystem Services and Human Well-being:** The Millennium Ecosystem Assessment (MA) and IPBES frameworks. **Threats and Sustainability:** Impact of land-use change, pollution, and climate change on ecosystem service flows.
Unit 4	**Number of Lecture 20**	**Title of unit:** Conservation, Wildlife Conflict and Wildlife Management
		Concepts in Wildlife Management: Goals, principles, and historical perspective. **Human-Wildlife Conflict (HWC):** Definition, scope, and drivers (habitat loss, fragmentation, resource competition). **Case Studies of HWC:** Human-Elephant conflict, big cat predation on livestock, crop raiding by primates and ungulates. **Mitigation and Management Strategies:** Physical barriers (fences, trenches), biological methods, community-based participation, compensation schemes, and early warning systems. **Wildlife Conservation Approaches:** Protected Area networks (National Parks, Sanctuaries), corridors, ex-situ conservation, and the role of legislation (Wildlife Protection Act, 1972). **Emerging Issues:** Climate change impacts on wildlife, zoonotic diseases, and eco-tourism as a conservation tool.

Suggested Reading :

1) Kothari, C. R. (2019). Research Methodology: Methods and Techniques. New Age International.
2) Kumar, R. (2019). Research Methodology: A Step-by-Step Guide for Beginners. SAGE Publications.
3) Jaiswal, P.C. (2018). Environmental Studies. New Age International.
4) Singh, J.S., Singh, S.P., & Gupta, S.R. (2015). Ecology, Environmental Science and Conservation. S. Chand Publishing.
5) Daily, G. C. (Ed.). (1997). Nature's Services: Societal Dependence on Natural Ecosystems. Island Press.
6) Woodroffe, R., Thirgood, S., & Rabinowitz, A. (Eds.). (2005). People and Wildlife: Conflict or Coexistence?. Cambridge University Press.
7) Gotelli, N.J., & Ellison, A.M. (2013). A Primer of Ecological Statistics. Sinauer Associates.
8) Heywood, I., Cornelius, S., & Carver, S. (2011). An Introduction to Geographical Information Systems. Pearson.

PRACTICAL SYLLABUS

Course Code: ENSG(6P)

Title: Practical in Environmental Science Applications and Management

Course Objectives:

Upon completion of the practical course, the student will be able to:

1) Design and execute a structured data collection plan for a local environmental issue.
2) Process, analyze, and visualize environmental data using computer software.
3) Quantify and map key ecosystem services in a given landscape.
4) Develop a field-based assessment and proposal for managing a specific human-wildlife conflict scenario.

Course Outcomes (COs)

CO1	Prepare a structured research proposal and questionnaire/survey sheet for environmental data collection.
CO2	Generate statistical summaries, graphs, and simple thematic maps from raw environmental datasets.
CO3	Prepare an inventory and assessment report of ecosystem services for a selected site (e.g., campus, local park, water body).
CO4	Analyze case data and design a mitigation plan for a given human-wildlife conflict situation.

Practical 1: Formulate a research hypothesis on a local environmental issue (e.g., "Water quality of X pond varies with seasons"). Design a detailed methodology including sampling strategy and a structured data recording sheet.

Practical 2: Computer Application: Take a provided dataset (e.g., air/water quality parameters across locations). Use spreadsheet software to calculate descriptive statistics (mean, median, standard deviation) and perform a correlation analysis between two key variables. Present the results using appropriate graphs.

Practical 3: Ecosystem Services Inventory: Select a local ecosystem (e.g., urban park, campus, nearby forest patch). Identify and categorize observable provisioning, regulating, and cultural services. Prepare a qualitative assessment report.

Practical 4: Computer Application (Mapping): Using toposheets/satellite images and QGIS, delineate the boundary of a water body/forest patch. Create a simple land use/land cover map of the surrounding area and write a brief on how changes in LULC might affect key ecosystem services.

Practical 5: Case Study Analysis: Analyze provided data (news articles, forest department reports) on a specific Human-Wildlife Conflict (e.g., leopard sightings in a village). Identify the probable causes and list possible short-term and long-term mitigation measures.

Practical 6: Computer Application (Presentation): Based on Practical 5, create a detailed PowerPoint presentation aimed at a village committee. The presentation should explain the conflict, propose a community-involved management plan, and include maps, graphs, and simple icons for effective communication.

Suggested Reading for Practical

1) Shah, C. M. (2017). Practical Environmental Analysis. Campus Books.
2) Kumar, A., & Singh, P. (2020). Handbook of Environmental Analysis. TERI Press.
3) QGIS Development Team. (2023). QGIS User Guide. (Available online at docs.qgis.org)
4) Crawley, M. J. (2012). The R Book. Wiley.
5) Winston, W. L. (2016). Microsoft Excel Data Analysis and Business Modeling. Microsoft Press.
6) Manuals and Guidelines from the MoEFCC (Ministry of Environment, Forest and Climate Change) and WII (Wildlife Institute of India) on field techniques and conflict management.