Ecology and Environment

LTP: 3-0-2 **Credits: 4**

Course Objectives:

1) Understand the fundamental concepts of ecology, including its definition, branches, historical development, and significance in addressing environmental challenges.
2) Explore the dynamics of populations, including growth models, limiting factors, and regulation mechanisms, and analyse trends and challenges related to the human population.
3) Examine the structure and interactions within ecological communities, including species interactions, the role of keystone species, succession processes, and community stability.
4) Analyse the components and functioning of ecosystems, including energy flow, nutrient cycling, and primary productivity, and evaluate human impacts on ecosystems and conservation strategies.
5) Explore factors influencing species distribution and biogeographic realms. Integrate and apply ecological concepts to analyse real-world ecological issues, employ research methodologies, and explore future directions in the field.

Course Outcomes:

1) Demonstrate a thorough understanding of ecological concepts, including levels of organization, population dynamics, community structure, and ecosystem functioning.
2) Critically evaluate ecological theories, research findings, and environmental issues, and apply quantitative and qualitative methods to analyze ecological data, population trends, species interactions, and ecosystem dynamics.
3) Effectively communicate ecological concepts, research findings, and conservation strategies through written reports, presentations, and discussions.
4) Recognize the interdisciplinary nature of ecology and its connections with other scientific disciplines, social sciences, and environmental management.
5) Consider the ethical implications of ecological research and conservation practices, demonstrating awareness of environmental ethics and sustainability principles.

Theory

Unit 1: Introduction to Ecology

Overview of Ecology: Definition, branches, and its significance in understanding ecosystems and environmental issues. Historical Development: Contributions of key figures such as Darwin and Odum to ecological theory. Levels of Organization: Understanding individual, population, community, ecosystem, and biosphere levels. Application in Environmental Issues: Linking ecological principles to real-world challenges like climate change and habitat loss. Habitat and Niche: Understanding habitat and niche, their characteristics, and their importance in species survival and coexistence.

Unit 2: Population Ecology

Population Dynamics: Characteristics of populations, growth models (exponential and logistic), and carrying capacity. Limiting Factors: Understanding factors that limit population

growth and the concept of carrying capacity. Population Regulation: Exploring density-dependent and density-independent regulation mechanisms. Human Population: Trends, implications, and strategies for addressing related challenges.

Unit 3: Community Ecology

Community Structure: Factors influencing structure and understanding ecological communities. Species Interactions: Types of interactions like competition, predation, mutualism, and their examples. Keystone Species: Importance and examples, trophic cascades, and food webs. Succession and Stability: Types of succession, factors affecting it, and its relationship with stability.

Unit 4: Ecosystem Functioning and Biogeography

Ecosystem Introduction: Components, types, energy flow, and nutrient cycling. Primary Productivity: Understanding factors influencing productivity and ecosystem energetics. Human Impact: Threats to ecosystems and biodiversity, consequences, and conservation strategies. Biogeography: Factors influencing species distribution, biogeographic realms, and their characteristics. Synthesis and Application: Integrating concepts, real-world applications, research methodologies, and future directions in ecology.

Practical

1) To investigate the population growth of a model organism under controlled conditions and understand the concepts of exponential and logistic growth models.
2) To examine the effects of different species interactions (competition, predation, mutualism) on community structure and dynamics.
3) To quantify nutrient cycling rates in a terrestrial or aquatic ecosystem and understand the importance of nutrient availability for ecosystem functioning.
4) To determine the habitat preferences of selected species and explore the concept of niche specialization for species survival and coexistence.
5) To observe the effects of trophic cascades on community dynamics and understand the role of keystone species in ecosystem stability.
6) To estimate the carrying capacity of an ecosystem for a particular species and investigate the factors influencing population regulation.
7) To study the process of ecological succession in a disturbed area and analyze the changes in species composition and ecosystem structure over time.
8) To measure primary productivity in a selected ecosystem and assess the factors influencing energy flow and ecosystem energetics.
9) To analyze species distribution patterns in different biogeographic regions and identify the factors shaping species diversity and distribution.
10) To assess the ecological consequences of human activities on local ecosystems and propose conservation strategies to mitigate negative impacts.
11) Field visit

Suggested readings:

1) Molles Jr., M. C. (2014). Ecology: Concepts and Applications. McGraw-Hill Education.