| | | | |
|---|---|---|---|
| **Course Title:** Ecology and Ecosystems | | | |
| **Course code:** | **No. of credits:** 4 | **L-T-P: 45-0-30** | **Learning hours: 60** |
| | | | **L:** Lectures**; T:** Tutorials**; P:** Practicals |
| **Pre-requisite course code and title (if any):** None | | | |
| **Department:** Natural and Applied Sciences | | | |
| **Course coordinator:** | | **Course instructor:** | |
| **Contact details:** | | | |
| **Course type**: Core | | **Course offered in:** Semester 1 | |

**Course Description**

This course aims to introduce the basic concepts of ecology and ecosystems. The course will essentially be helpful in developing an understanding of various processes and interactions between the biotic components and their physical environment. It includes providing an understanding of the structure and functions of the different ecosystems as well as dynamics and nutrient cycling at different levels. The fundamentals acquired through this course will not only be helpful in developing a deeper appreciation of complexity in natural systems but also help in understanding the core basis of any practical interventions aimed at conservation or rejuvenation of ecosystems.

**Course objectives**

- To build the basic concepts regarding the interactions of the biotic components with the abiotic components.
- To develop an understanding of structure, functions, and ecological efficiency within different ecosystems.
- To provide fundamental knowledge of nutrients uptake and biogeochemical cycling in the environment.

**Course content**

| | Topic | L | T | P |
|---|---|---|---|---|
| 1 | **Module 1: Introduction to Ecology** | | | |
| | This is an introductory module to gain familiarity and build a foundation of some core concepts and their definitions in ecology:<br>Basic concepts and definitions: ecology, landscape, habitat, ecozones, biosphere, ecosystems, trophic organization in ecosystem, ecosystem stability, resistance and resilience; autecology; synecology; major terrestrial biomes. | 5 | | |
| 2 | **Module 2: Ecology of Individual, Population and Communities** | | | |
| | This module focuses on delivering in-depth knowledge of principles of ecology operational at different levels of aggregation i.e., individual, population and community-level. It discusses these principles in a manner to deliver a very dynamic outlook of all the processes operating simultaneously at different levels (or scales) giving rise to transformations within ecosystems. The focus areas covered under this module are:<br>Ecological amplitude; Liebig's law of the minimum; Shelford's law of tolerance; phenotypic plasticity; ecotypes; ecoclines; acclimation; ecological niche and types; | 5 | | |
| | Characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential and logistic. | 4 | | |
| | Community characteristics, keystone species, ecotone and edge effect; species interactions: mutualism, symbiosis, commensalism, amensalism, | 4 | | |

| | | | | |
|---|---|---|---|---|
| | proto-cooperation, predation, competition, parasitism, mimicry, herbivory. Ecological adaptations and factors affecting plant communities (soil, water, wind, fire, temperature) | | | |
| | Ecological succession: Primary and secondary successions, models/process and types of successions, climax community concepts, examples of succession | 4 | | |
| 3 | **Module 3: Ecological System** | | | |
| | After gaining familiarity with the basic concepts and terminologies in ecology, this module follows a systems approach to introduce various ecosystems and the processes within that make these unique entities functional as efficient natural units. The concepts to be discussed under this module include:<br>Concept and types of ecosystems: forest, grassland, lentic, lotic, estuarine, marine, desert, wetlands. | 4 | | |
| | Structure and functions of ecosystem; Ecosystem boundary, ecosystem function; ecosystem metabolism; primary and secondary production, GPP, NPP and trophic efficiency. | 4 | | |
| | Ecosystem connections: food chain, food web; models of energy flow, decomposition processes and detritus pathway of energy flow, ecological efficiencies, ecological pyramids: number, biomass, and energy. | 3 | | |
| 4 | **Module 4: Biogeochemical Cycle and Nutrient Cycling** | | | |
| | The processes that sustain the biosphere through cycling of essential nutrients are to be discussed as part of this module. The module will be essentially connecting the geochemical cycling in nature with the biotic systems that accumulate and propagate the flow of these materials as well as aid in their decomposition, releasing them back into the environment. The contents of this module are as follows:<br>Carbon cycle; nitrogen cycle; phosphorus cycle; sulphur cycle; hydrological cycle; nutrient cycle models; biotic accumulation; ecosystem losses. | 4 | | |
| | Nutrient supply and their uptake, decomposition, and nutrient release; nutrient use efficiency; nutrient budget; nutrient conservation strategies. | 4 | | |
| 5 | **Module 5: Species Invasion** | | | |
| | This module covers an introduction to the concepts associated with invasion of species within ecosystems and the associated changes, as discussed under following topics:<br>Concept of exotics and invasive; invaders: characteristics, stages, and mechanisms of invasions; impacts of invasion on ecosystem and communities. | 4 | | |
| | **Practical** | | | |
| | Determination of minimal quadrat size for the study of herbaceous vegetation in the campus, by species area curve method (species to be listed). [Module 2] | | | 5 |
| | Quantitative analysis of herbaceous vegetation in the campus for frequency and comparison with Raunkiaer's frequency distribution law. [Module 2] | | | 5 |
| | Quantitative analysis of herbaceous vegetation for density and abundance in the campus [Module 2] | | | 5 |
| | To study pyramids of numbers, biomass, and energy. [Module 3] | | | 5 |
| | Study of morphological adaptations of hydrophytes and xerophytes. [Module 3] | | | 5 |
| | Field visit: invasive species identification, terrestrial and aquatic ecosystems | | | 5 |

| | | | | |
|---|---|---|---|---|
| | (forests, grasslands, wetlands, biodiversity parks/to develop a working model of any ecosystem [Module 3, 5] | | | |
| | **Total** | 45 | | 30 |

**Evaluation criteria**

- Minor Test 1: Written test [at the end of teaching of module 2] -- 20%
- Minor Test 2: Written test [at the end of teaching of module 3] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 40%
- Assignments -- 20%

**Learning outcomes**

Upon completion of the course, the students will be able to

- Understand the structure of various ecosystems and the role of individual, population and communities within these ecosystems [Module 1 and 2; Minor Test 1]
- Become familiar with the connections and interactions between various components of the ecosystems [Modules 3; Minor Test 2]
- Understand energy flow, nutrient uptake and recycling in the ecosystems [Module 4; Major Test]
- Develop a general understanding of the impact of invasive species on ecosystems and communities [Module 5; Major Test]

**Pedagogical approach**

- The course will be delivered through lectures and tutorials that focus on developing a clear foundation of the core concepts of ecology, ecosystems, and associated processes.
- The course will also focus on classroom discussions, practical and assignments aimed at appreciating the complexities within natural systems and the need to preserve this delicate balance.

**Reading resources**


Ambasht, R.S., Ambasht, N.K. (2015). A textbook of plant ecology. CBS; 15th edition.

Daubenmire, R.F. (1974). Plants and environment. A textbook of plant autecology, John Wiley & Sons; 3rd edition.

Groom. B., Jenkins. M. (2000). Global biodiversity: Earth's living resources in the 21st century. World Conservation Press, Cambridge, UK.

Gurevitch, J., Scheiner, S.M., Fox, G.A. (2002). The ecology of plants. Sinauer Associates Inc.

Kormondy, E. J. (1996). Stability and change in communities. Concepts of ecology. Cuarta edición, Prentice Hall, New Jersey.

Loreau, M. & Inchausti, P. (2002). Biodiversity and ecosystem functioning: Synthesis and perspectives. Oxford University Press, Oxford, UK.

Odum, E.P. (1971). Fundamentals of ecology. W.B. Sounders.

Singh, J.S., Singh, S.P., Gupta, S.R. (2015). Ecology, environment and resource conservation. Anamaya Publications.

Wilson, E.O. (1985). The biological diversity crisis. Bio Science.

**Student Responsibilities**

The students are required to come prepared with readings that are suggested during the class and ensure timely submission of assignments. They are also expected to participate and further strengthen their understanding of
concepts through the practical sessions and classroom discussions.

**Course Reviewers**

The course is reviewed by following reviewers:

1. Dr. Saloni Bahri, Associate Professor, Department of Botany, Miranda House
2. Dr. Madhu Bajaj, Associate Professor, Department of Botany, Miranda House
3. Dr. Devayani Muley, Associate Professor, Department of Botany, Zakir Hussain College