DISCIPLINE SPECIFIC CORE COURSE – 14 (DSC-EVS-14): ORGANISMAL & EVOLUTIONARY BIOLOGY

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-14: ORGANISMAL & EVOLUTIONARY BIOLOGY	4	2	0	2	Class XII pass	NA

Learning objectives

The Learning Objectives of this course are as follows:

- Gain insights into principles of evolution and its significance in shaping biological diversity on Earth
- Familiar with classification of organisms from different domains of life and their unique structure and function
- Equip with scientific methods to investigate and understand nuances of organismal and evolutionary biology
- Appreciate the linkages among ecology, conservation biology, and evolutionary biology

Learning outcomes

After this course, students will be able to

- Explain the ecological and molecular processes contributing to evolution, including natural selection, genetic drift, gene flow, and mutation
- Identify and characterize organisms belonging to different domains of life based on their major characteristics and functions
- Design and conduct experiments for better understanding on organismal and evolutionary biology
- Evolve better strategies for biodiversity conservation and improving ecosystem health while taking into account their evolutionary biology

SYLLABUS OF DSC-EVS-14

Theory (02 Credits: 30 lectures)

UNIT – I History of life on Earth and theory of evolution (3½ Week) (7 lectures)

Paleontology and evolutionary History; evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multi cellular organisms; major groups of plants and animals; stages in primate evolution

including Homo.

Lamarck's concept of evolution; Darwin's Evolutionary Theory: variation, adaptation, struggle, fitness, and natural selection; Mendelism; spontaneity of mutations; The Evolutionary Synthesis.

UNIT – II Evolution of unicellular life (2½ Week) (5 lectures)
Origin of cells and unicellular evolution and basic biological molecules; abiotic synthesis of organic monomers and polymers; Oparin-Haldane hypothesis; study of Miller; the first cell; evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes; anaerobic metabolism, photosynthesis and aerobic metabolism.

UNIT – III Evolution of multicellular organisms (2½ Week) (5 lectures)
Origin of multicellularity, Cellular differentiation and specialization, Developmental biology and body plans, Evolution of cell-to-cell communication, Emergence of tissues and organs, Evolution of organ systems, Evolution of life cycles and reproductive strategies, Evolution of multicellular organisms (protists, plants and animals) and their ecological interactions

UNIT – IV Geography of evolution (1½ Week) (3 lectures)
Biogeographic evidence of evolution; patterns of distribution; historical factors affecting geographic distribution; evolution of geographic patterns of diversity.

UNIT – V Molecular evolution (2 Week) (4 lectures)
Neutral evolution; molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification; protein and nucleotide sequence analysis; origin of new genes and proteins; gene duplication and divergence.

UNIT – VI Fundamentals of population genetics (3 Week) (6 lectures)
Concepts of populations, gene pool, gene frequency; concepts and rate of change in gene frequency through natural selection, migration and genetic drift; adaptive radiation; isolating mechanisms; speciation (allopatric, sympatric, peripatric and parapatric); convergent evolution; sexual selection; co- evolution; Hardy-Weinberg Law.

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 diversity of pollinators
7. Determine the impacts of environmental chemicals on the abundance and diversity of nematodes (e.g., *Caenorhabditis elegans*)
8. Ascertain the possible impacts of herbicides on weed populations
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

15. 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

- Futuyma, D. J., & Kirkpatrick, M. (2017). Evolution (4th ed.). Sunderland, MA: Sinauer Associates.
- Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2018). Brock Biology of Microorganisms (15th ed.). London, UK: Pearson.
- Primack, R. B., & Rodricks, R. V. (2021). Essentials of Conservation Biology (7th ed.). Sunderland, MA: Sinauer Associates.
- Raven, P. H., Evert, R. F., & Eichhorn, S. E. (2022). Biology of Plants (9th ed.). New York, NY: W. H. Freeman.
- Sodhi, N. S., Gibson, L., & Raven, P. H. (2021). Conservation Biology for All. Oxford, UK: Oxford University Press.
- Stearns, S. C., & Hoekstra, R. F. (2021). Evolution: An Introduction (3rd ed.). Oxford, UK: Oxford University Press.
- Zimmer, C., & Emlen, D. J. (2021). Evolution: Making Sense of Life. New York, NY: Macmillan Learning.

Suggestive readings

- Deacon, J. (2019). Fungal Biology (5th ed.). Hoboken, NJ: John Wiley & Sons.
- Haviland, W. A., Prins, H. E. L., Walrath, D., & McBride, B. (2021). Evolution and Prehistory: The Human Challenge (11th ed.). Boston, MA: Cengage Learning.
- Herron, J. C., & Freeman, S. (2020). Evolutionary Analysis (6th ed.). Hoboken, NJ: Pearson.

- Pough, F. H., Janis, C. M., & Heiser, J. B. (2018). Vertebrate Life (10th ed.). London, UK: Pearson.
- Raven, P. H., Johnson, G. B., Mason, K. A., Losos, J. B., & Singer, S. R. (2021). Biology (12th ed.). New York, NY: McGraw-Hill Education.
- Ruppert, E. E., Fox, R. S., & Barnes, R. D. (2021). Invertebrate Zoology: A Functional Evolutionary Approach. Boston, MA: Cengage Learning.

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