DISCIPLINE SPECIFIC CORE COURSE – 9 (DSC-EVS-9): MARINE ECOLOGY

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		
MARINE ECOLOGY	4	2	0	2	Class XII pass	NA

Learning objectives

The Learning Objectives of this course are as follows:

- Gain insights into the dynamic processes that affect oceans, i.e., water, seafloor, and abundant life forms
- Identify the role being played by ocean-atmosphere interaction in the climate processes.
- Investigate the role of ocean processes in coastal and marine landform creation.

Learning outcomes

After this course, students will be able to

- Analyze the role of physical processes in the dynamic process of ocean circulation.
- Formulate solutions ailing the current state of the coastal and marine environment in terms of chemical and biological interactions.
- Implement the knowledge base to promote ocean awareness in light of human exploitation of its resources.
- Assess the impacts of environmental and anthropogenic variables on marine ecosystems and biodiversity with time and space
- Use ecological data to predict the impact of a given factor on marine biodiversity and ecology

SYLLABUS OF DSC-9

Theory (02 Credits: 30 lectures)

UNIT – I Introduction (4 Hours)

A short history of the oceans and continents, History of marine ecology, Morphologic and tectonic domains of the ocean floor; Ocean basins, Ocean sediments; Composition of seawater, carbon dioxide-carbonate system; Atmospheric circulation, Ocean circulation, Life in the ocean, Pelagic communities, Benthic communities, Uses and abuses of the ocean.

UNIT – II Geography and physical forcing of Marine Ecosystems: (4 Hours)

Climate and Circulation of the World Ocean, Geostrophic flow and the central ocean gyres, Convergence zones and fronts, Thermohaline circulation and the origins of deep-water coasts, shallows, and their consequences; Global distribution of ocean productivity, Vertical structure of the pelagic water column, The spring bloom, High-nitrogen low-chlorophyll (HNLC) regions

UNIT – III Biodiversity and biogeography of Ocean (6 Hours)

Magnitude of Biodiversity; Biodiversity on Land and Sea, Phylogenetic Classification of Marine Biodiversity, Functional Organization of Pelagic and Benthic Life, Major Patterns in the Distribution of Marine Life (Spatial, latitudinal, longitudinal, depth, bottom type); Biogeography of Functional Traits, Evidence for Island Biogeography, Integrative Models of Marine Diversification, Biogeographic Classifications of the Ocean, Biogeography of the Anthropocene Ocean.

UNIT – IV Macro- and trait-based ecology of marine organisms (6 Hours)

Species Interactions, Functional groups of phytoplankton, benthic macrophytes, and grazers; Pelagic food webs, microbial loop, Metabolic scaling and life history, Abundance and the energetic equivalence rule, Macroecology of range size Specialization and resource partitioning, Nonequilibrium dynamics; Biological pump and the global carbon cycle, Trophic control in pelagic ecosystems.

UNIT – V Anthropocene Ocean (5 Hours)

Marine populations in the Anthropocene, Marine defaunation and trophic skew, Empirical evidence for regime shifts in marine ecosystems, Mechanisms of marine regime shifts, Ocean Warming and its effects on community and sea level rise, Ocean Acidification and its effects on organisms and communities, Ecological stoichiometry, Climate change and redistribution of global marine fauna, Tropicalization, The Arctic opening

UNIT – VI Ocean Conservation and Management (5 Hours)

Maximum sustainable yield in fisheries, Strategic conservation of vulnerable life stages, Life history and the effectiveness of marine reserves, Organismal Fitness and Adaptation to the Environment, Dispersal, Recruitment, and Metapopulations, Tagging and tracking, Geochemical tags.

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. Construct microcosm for marine ecology studies
2-3. Determine environmental partitioning of target chemicals in the constructed microcosm
4-5. Determine physico-chemical properties of given sediment sample
6-7. Examine methods to analyze phytoplankton and zooplanktons in the given water samples and its application in analyzing marine ecology
8. Analyze relationships between soil particle characteristics and biological properties of sediment
9. Analyze oceanographic data by GIS and identify ecologically-relevant oceanographic data using remote sensing
10. Isolate bacteria from the freshwater river and estimate their growth in

seawater

11. Determine microbial density in a given marine water sample
12. Compare the biodiversity of freshwater bodies and marine ecosystems by examining a review/research paper
13. Analyze plate tectonic theory and understand the variations in global marine ecosystems
14. Evaluate merit and demerits of ocean acidification manipulation experiments conducted globally
15. Compare and contrast the benefits of using a storage tank, mixing tank, header tank and experimental tank to understand marine ecology

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

- Arias, A.H. and Menendez, M.C. eds., 2013. Marine Ecology in a Changing World. CRC Press.
- Garrison, T.S., 2014. Essentials of Oceanography. Cengage Learning.
- Kennish, M.J., 2019. Practical Handbook of Marine Science. CRC Press.
- Kaiser, M.J., Jennings, S., Thomas, D.N. and Barnes, D.K., 2011. Marine Ecology: Processes, Systems, and Impacts. Oxford University Press.
- Mann, K.H. and Lazier, J.R., 2013. Dynamics of Marine Ecosystems: Biological-Physical Interactions in the Oceans. John Wiley & Sons.
- Speight, M.R. and Henderson, P.A., 2013. Marine Ecology: Concepts and Applications.
- Thrush, S., Hewitt, J., Pilditch, C. and Norkko, A., 2021. Ecology of Coastal Marine Sediments: Form, Function, and Change in the Anthropocene. Oxford University Press.

Suggestive readings

- Gray, J.S. and Elliott, M., 2009. Ecology of Marine Sediments: from Science to Management. Oxford University Press.
- Miller, C.B., 2009. Biological Oceanography. John Wiley & Sons.
- Pittman, S.J. ed., 2017. Seascape Ecology. John Wiley & Sons.
- Riley, J.P. and Chester, R. eds., 2016. Chemical Oceanography. Elsevier.
- Talley, L.D., 2011. Descriptive Physical Oceanography: An Introduction. Academic press.

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