DISCIPLINE SPECIFIC ELECTIVE COURSE (DSE- 09): Biodiversity Informatics

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		
Biodiversity Informatics **DSE-09**	**4**	**2**	**0**	**2**	Semester VI	Nil

Learning Objectives:

To introduce students to an integrated area of study where concepts learnt under different courses in previous semesters are to be utilised. The field of Biodiversity informatics integrates information on systematics, ecosystems to curate, analyse and develop an information management system to provide sound scientific bases for policy decisions.

Learning Outcomes:

- Assess knowledge on basic principles of Ecology, Conservation, Restoration, Biodiversity, Genetics, Molecular biology.
- Introduce applications of Remote Sensing and Geographical Information System as well as Informatics.
- Provide an opportunity to learn principles of Data Capture systems, basic elements of digitisation of Biological data, some key elements of Information Science along with creation/curation of Biological Databases (collection, storage & retrieval)
- Emphasise the importance of field collection, maintenance of herbaria & specimen collections.
- Introduce relevant National and International Biodiversity Laws.

Theory : **30 hours**

Unit 1. Understanding Biodiversity and Informatics **05 hours**

Introduction to Global & National movements for conservation, institutions (including National Biodiversity Authority of India, NBPGR and others) and other non-Governmental organisations (NGO s) and networks involved in biodiversity informatics. Ecapitulating Basic principles of Ecology & Biodiversity - Geological Time scale and evolution of life forms, Five major

extinctions, Ecosystems & Ecosystems diversity: biomes, mangroves, coral reefs, wetlands and terrestrial diversity. Biodiversity Hotspots & factors of endemism. Levels of Biodiversity: Community diversity (alpha, beta and gamma biodiversity), Gradients of Biodiversity (latitudinal, insular).

Unit 2. Measuring/Estimating Biodiversity **08 Hours**

i. Magnitude of biodiversity (Global and Indian data). Introduction to Diversity Indices (Simpson, Shannon) and estimation of Species diversity: richness and evenness, loss of species.

ii. Introduction to Metagenomics, use of ancient DNA (aDNA) for estimation of biodiversity loss.

iii. Estimating Threats to natural Biodiversity: Habitat loss and fragmentation Disturbance and pollution; Introduction of exotic species; Human intervention and Biodiversity loss; Consequences of monotypic agricultural practice

iv. Global Environmental changes, land and water use changes ; Impacts of Climate Change on Biological systems.

Unit 3. Informatics Resources and Methods **11 hours**

i. National & International efforts in Conservation, databases GBIF, IUCN categorized-endangered, threatened, vulnerable species.

ii. Red data book and related documentation.

iii. Categories of Biodiversity informatics databases and tools based on target life cycle step : data planning and collection, data quality and fitness, data description, data preservation and publication, data discovery and integration, computational modeling and analysis.(few databases example can be chosen to explain the steps - BRAHMS, Genbank, Catalog of Life, DataOne, GBIF, BioCollections)

iv. Remote Sensing/Geographical Information Systems and its applications.

v. Data capture – citizen science, uploading information on portals (e.g. www.indiabiodiversityportal.org).

vi. Key parameters for conservation (populations reproductive ecology)

vii. Essential management practices in in-situ and ex-situ Biodiversity Management :

a. Management of - Biosphere reserves, National Parks, Sanctuaries, Sacred groves etc.

b. Management of Botanical gardens, Zoological gardens, Gene banks, Pollen, seed and seedling banks, tissue culture and DNA banks etc.

Unit 4. Applications of Biodiversity Informatics **06 Hours**

i. Modeling Ecosystems & Predictions, conservation plans for species/taxa/ecosystem.

ii. Definitions and concepts of system, sub-system, variables and parameters, systems analysis, modeling and simulation ((Lotka-Voltera model).

iii. Legal issues in Biodiversity Management & Conservation; Rules for exchange of genetic materials; Case studies -National & International. (This is important for IPR perspective, gives the student and faculty options for assignments/ assessments, case studies

iv. Legal issues in Biodiversity Management & Conservation; Rules for exchange of genetic materials; Case studies -National & International.

v. Designing & implementing ecological restorations.

PRACTICALS: 60 hours

1. Measurement of species diversity (calculation of Diversity Indices - from data collected on plant species in different areas of the campus.
2. Use of molecular markers for estimating biodiversity (DNA Barcoding).

   (Simple case studies and wherever possible experiments can be performed to teach the concept).
3. Blast analyses of selected DNA sequences from the International Gene Banks.
4. Introduction to simulations based on various environmental models.
5. Applications of RS/GIS techniques for species distribution models.
6. Experiential Learning Module: Visit to Biodiversity Parks, study the management and species diversity, based on that prepare a proposal for enhancement/ creation of local Biodiversity Park/Community outreach activities and other attributes.

Suggested Readings:

- Groom MJ, Meffe GK, Carroll CR (2006) Principles of Conservation Biology, 3rd edition, Sinauer Associates.
- Tandon U, Parasaran M, Luthra S (2018) Biodiversity : Law, Policy and Governance, Routledge, India
- Wilson, Edward O., 1993, Diversity of Life. Harvard University Press, Cambridge, MA.
- Wheater CP, Bell JR, Cook PA (2011) Practical field Ecology: A Project guide, Wiley-Blackwell
- IUCN RED DATA BOOK - https://portals.iucn.org/library/node/16746
- http://biodiversity-informatics-training.org/bi-curriculum/
- https://www.tdwg.org/standards/
- https://methodsblog.com/2015/05/26/beta_diversity/

Additional Resources:

- Saha, G.K. and Mazumdar, S. (2017). Wildlife Biology: An Indian Perspective. PHI learning Pvt. Ltd. ISBN: 8120353137, 978-812035313
- Sinclair, A.R.E., Fryxell, J.M. and Caughley,G. (2006). Wildlife Ecology, Conservation and Management. Wiley-Blackwell, Oxford, UK.
- Singh, S.K. (2005). Text Book of Wildlife Management. IBDC, Lucknow.
- Banerjee, K. (2002). Biodiversity Conservation in Managed and Protected Areas. Agrobios, India.
- Sharma, B.D. (1999). Indian Wildlife Resources Ecology and Development. Daya Publishing House, Delhi.
- www.indiabiodiversityportal.org
- www.johnkyrk.com/evolution.swf
- Magurran,A.E. 2013. Measuring Biological Diversity, John Wiley.
- Primack, R.B. (1998). Essentials of Conservation Biology. Sinauer Associates, Inc. Sunderland, MA.
- Rachel Carson (1962) A Silent Spring, Houghton Mifflin Company .

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