

B.Sc. (Basic/Hons.) Semester 4

Title of the Course: **ES 4T1 – BIODIVERSITY, WILDLIFE AND CONSERVATION**

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
4	52	2	52

Programme Specific Objectives

- PSO 1 To develop competency in understanding biodiversity and wildlife.
- PSO 2 To instill a knowledge about human interactions with uncultivated varieties and develop necessary analytical skills to appreciate these interactions.
- PSO 3 To motivate and inspire to acquire contemporary understanding and skills leading to issue identification and conservation.
- PSO 4 To inculcate creativity and innovative spirit in identifying appropriate conservation tools and their timely implementation.

Programme Outcomes

- PO 1 Demonstrate competence in understanding the ecological, social and legal dimensions of biodiversity and wildlife.
- PO 2 Demonstrate the ability to carry out data collection procedures and analysis in field conditions/laboratories and make appropriate interpretations.
- PO 3 Ability to understand and appreciate the role of biodiversity in specific natural habitats and agroecosystems.
- PO 4 Be able to develop competence and academic skills in contributing towards biodiversity and wildlife conservation.

Content of Theory Course 4	52Hours
Unit – 1	14
Biodiversity: Definition: Levels of Biodiversity - genetic diversity, species diversity and ecosystem diversity. Values of Biodiversity: Direct uses - consumptive use value, productive use value; Non-consumptive values - social value, ethical value, aesthetic value, option values and ecosystem service value. Biodiversity Hotspots: Global and Indian centers. Biogeography of India. Biodiversity profile of India: Forests and Grasslands; Wetlands and Riverine ecosystems; Marine and coastal diversity; Agro-biodiversity; Urban Biodiversity; Invasive Alien species. Threats to biodiversity: Over exploitation, Habitat destruction, fragmentation, urbanization, agriculture extension, river valley projects, industrialization, deforestation, invasive species, pollution, acidification of soil and water, mining activities, desertification and climate change. Traditional Knowledge and ethics in conservation of biodiversity. A locally relevant case study on biodiversity related aspects. People's Biodiversity Register. Bio-piracy. The Biological Diversity Bill, 2000 and The Biological Diversity (Amendment) Bill, 2021. Convention on Biological Diversity and Agenda 21. National Biodiversity Action Plan (NBAP).	

Unit – 2	14
<p>Wildlife: Definition. Wildlife of India. Values of wildlife. Values of wildlife: - <i>Physical utility, economic/monetary value, recreational value, scientific value, ecological value, existence value.</i> - <i>Wildlife damage, human animal conflict, loss of economic productivity, wildlife diseases to man and competition effect.</i></p> <p>Importance of wildlife: Ecological, economic, socio-cultural, investigatory, medicinal, conservation of biological diversities, importance in agriculture. Threats to wildlife: Over exploitation, habitat loss, encroachment and fragmentation, disease, pollution, invasive and exotic species, Illegal trapping and poaching, agricultural/unrestricted/ over grazing, urbanization and climate change. Endangered species – Definition, characteristics and reasons for engendering. <i>Species with a narrow (or single) geographic range, Species with only one or few populations, Species with a small population size, Species with a declining population size, Species hunted or harvested by people, Species with low reproductive ability and/or germplasm-dispersal-ability, Species that require specialised habitat and niche conditions.</i> Endangered species of India. Endemic species – Concept, types, characteristics, theories of endemism. Endemic Wildlife Species of India. Wildlife (Protection) Act, 1972.</p>	
Unit - 3	14
<p>Ecosystem Services: Concept and Definition. Regulating services: <i>Purification of water and air; Carbon sequestration and climate regulation; Waste decomposition and detoxification; Regulation of prey populations; Pollination; Biological pest and disease control; Disturbance regulation (Flood protection).</i> Provisioning services: <i>Food (crops, wild foods and spices); Raw materials (Timber, fuelwood, organic matter, fodder, and fertiliser); Genetic resources (crop improvement genes, and health care); Biogenic minerals; Medicinal resources (Pharmaceuticals, chemical models, and bioassay organisms); Energy (Hydropower, biomass fuels); Ornamental resources (Fashion, handicrafts, jewelry, pets, worship, decoration, and souvenirs).</i> Cultural services: <i>Cultural (Nature motifs in books, film, painting, folklore, national symbols, advertising); Aesthetics, spiritual and historical (Art, religious and heritage value); Recreational experiences (Ecotourism, outdoor sports and recreation); Science and education (Academic excursions and scientific discovery); Therapeutic (Ecotherapy, social forestry and animal assisted therapy).</i> Supporting services: <i>Nutrient cycling, Soil formation, Primary production and Habitat provision.</i></p>	
Unit - 4	14
<p>Conservation (Biodiversity and Wildlife): Definition, need and significance. Conservation vs. Preservation. Conservation goals - Habitat conservation, Prevention of deforestation, Preventing species from extinction, Sustainable harvest of biological resources and climate change mitigation. Terminologies of conservation significance: <i>Keystone species, Foundation species, Umbrella Species and Flagship species, Edge species, Critical link species, Indicator species, Priority species and Rare species.</i> IUCN Red Listed species - <i>Data Deficient, Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild and Extinct.</i> In-situ conservation: <i>Protected areas – Sanctuaries -</i></p>	

National Parks – Biosphere Reserves - Project Tiger and Project Elephant; Ramadevarabetta Vulture Sanctuary. Community Conserved Areas – case studies on Black Buck, Snow leopard, Amur falcon and Sarus Crane. Ex-situ conservation: Captive breeding (Botanical gardens, zoological parks, seed banks). Case study of *Ailuropodamelanoleuca* (Giant panda), *Ramosmaniaheterophylla* and *Madhuca insignis*. Cryopreservation, pollen storage, tissue culture, genetic engineering, field gene banks. Case study of Indian rhinoceros and black rhinoceros. International conservation efforts - Ramsar Convention, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on the Conservation of Migratory Species of Wild Animals (CMS), Trade Records Analysis of Flora and Fauna in Commerce (TRAFFIC). Reducing Emissions from Deforestation and Forest Degradation (REDD) and REDD⁺.

References

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- Goutam Kumar Saha, Subhendu Mazumdar. 2017. *Wildlife Biology - An Indian Perspective*. Prentice Hall India Pvt., Limited
- Grunewald, K., & Bastian, O. (Eds.). (2015). *Ecosystem services—concept, methods and case studies*. Springer.
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- Nandini, N., Sunitha N., & Sucharita Tandon (2019). A text book on Environmental Studies (AECC). Sapna Book House, Bengaluru.
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- Tandon, U., Parasaran, M., & Luthra, S. (Eds.). (2017). *Biodiversity: Law, Policy and Governance*. Taylor & Francis.
- Weathers, K. C., Strayer, D. L., & Likens, G. E. (Eds.). (2021). *Fundamentals of ecosystem science*. Academic Press.

Formative Assessment – Continuous Internal Assessment = 40% (40 Marks)	
Assessment Occasion/ type	Weightage in Marks
End Semester Examination	60% (60 Marks)
Total	100% (100 Marks)

Content of Practical Course 4: List of Experiments to be conducted
ES 4P1 – BIODIVERSITY ASSESSMENT AND ECOSYSTEM SERVICES

(Total Teaching Hours = 52; Total Credits = 2)

1. Documentation and assessment of tree diversity– Census method/Point-centered quarter method
2. Documentation and assessment of avian faunal diversity – Line transect method
3. Documentation and assessment of winged insect fauna – Light trap/Sticky trap method
4. Documentation and assessment of Butterflies –Visual encounter /Photographic survey
5. Documentation and assessment of soil fauna – Pitfall trap method
6. Documentation and assessment of crop diversity – Sampling method
7. Identification and documentation of aquatic macroflora – Visual encounter survey
8. Estimation of animal population size – Mark, Release and Recapture method
9. Assessment of regulatory services offerrestrial ecosystems (Green spaces) – Comparison method (air temperature, relative humidity and solar influx).
10. Assessment of provisional services ofwetland ecosystems – Questionnaire survey method.
11. Introduction to global biodiversity databases – Global Biodiversity Information Facility (GBIF), Integrated Biodiversity Assessment Tool (IBAT-alliance)
12. Hands-on experience with biodiversity assessment software - Paleontological Statistics Software Package for Education and Data Analysis (PAST). *Note: Data from experiment No 1 to 8 can be used for analysis.*
13. Mapping of International, National and State-wise biodiversity and wildlife conservation sites – Hotspots, Ramsar convention sites, Biosphere reserves, National parks, Sanctuaries, Protected areas and Ecologically significant zones.

References

- Henderson, P. A., & Southwood, T. R. E. (2016). *Ecological methods*. John Wiley & Sons.
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- Sutherland, W. J. (Ed.). (2006). *Ecological census techniques: a handbook*. Cambridge university press.

Formative Assessment – Practical Internal Assessment = 50% (25 Marks)	
Assessment Occasion/ type	Weightage in Marks
End Semester Examination	50% (25 Marks)
Total	100% (50 Marks)

ES 4OE4: ENVIRONMENT AND SUSTAINABLE AGRICULTURE

Number of Theory Credits
3

Number of lecture hours/semester
42

Content of OPEN ELECTIVE Theory Course 4	42Hours
Unit – 1	14
Environment – Definition, scope and significance. Agriculture – Definition, scope and significance. Environmental basis for agriculture and food. Agricultural patterns in India. Socio-economic pressures on agriculture. Food security and food scarcity. Types of agriculture – rain-fed cultivation and irrigation – water intensive agriculture – Reservoirs and ground water exploitation. Conventional and mechanized agriculture. Natural and chemical agriculture. Subsistence and commercial agriculture. Environmental effects of land use and landscape changes.	
Unit - 2	14
Environmental determinants of agriculture – role of rainfall, humidity, wind, topography and edaphic factors in crop selection. Animal husbandry – Dairy and poultry – role of transboundary species of cattle in Indian scenario. Pisciculture – Environmental effects of intensive pisciculture. Agricultural biodiversity: Crop diversity – Definition and significance. Poly culture and mono culture. Influences of green revolution on modern agricultural practices of India – Loss of agrobiodiversity – Influence of transboundary crops. Agricultural biotechnology – Genetically Modified Crops – Influence on environment. Pollination crisis. Integrated pest management.	
Unit - 3	14
Environmental impacts of agriculture – Loss of biodiversity – soil salinity – fertilizer and pesticide pollution, Climate change and global warming. Erosion and problems of deposition in irrigation systems. Desertification. Bio-magnification – Case studies. Contemporary issues and management – Farmer distress – market mechanisms – natural farming methods/organic farming. Urban agriculture and hydroponics. Ecological principles of farming – Sustainable agriculture – Significance of indigenous crops and cattle varieties. Watershed management. Agricultural policies of India.	

References

- Altieri, M. A. (2018). *Agroecology: the science of sustainable agriculture*. CRC Press.
- Campanhola, C., & Pandey, S. (Eds.). (2018). *Sustainable food and agriculture: An integrated approach*. Academic Press.
- de Zeeuw, H., & Drechsel, P. (Eds.). (2015). *Cities and agriculture: Developing resilient urban food systems*. Routledge.
- Eric Lichtfouse, Mireille Navarrete, Philippe Debaeke, Souchere Véronique, Caroline Alberola. (2009). *Sustainable Agriculture*. Springer Science & Business Media.
- Kazim B. Rahim Debash Sarkar Bidhan Chand. (2012). *Sustainable Agriculture and Environment*. New Delhi Publishers.
- Satyanarayana, T., Johri, B. N., & Prakash, A. (Eds.). (2012). *Microorganisms in sustainable agriculture and biotechnology*. Springer Science & Business Media.
- Songstad, D. D., Hatfield, J. L., & Tomes, D. T. (Eds.). (2014). *Convergence of food security, energy security and sustainable agriculture (Vol. 67)*. New York: Springer.

Formative Assessment – Continuous Internal Assessment = 40% (40 Marks)	
Assessment Occasion/ type	Weightage in Marks
End Semester Examination	60% (60 Marks)
Total	100% (100 Marks)

ES 40E4: INITIATIVES FOR ENVIRONMENTAL MANAGEMENT

Number of Theory Credits

Number of lecture hours/ semester

3

42

Content of OPEN ELECTIVE Theory Course 4	42Hours
Unit – 1	14
<p>Environment: Definition and components of the environment – Atmosphere, hydrosphere, lithosphere and biosphere – Definitions and influences on human beings. Environmental issues: Natural resource overuse and depletion, pollution, loss of biodiversity, Degradation of air, water and land. Water and wastewater management: Household water demand and uses. Availability of water for household uses. Centralised supply system – Rivers. Water treatment for portable purposes. Decentralised sources – Bore wells. Sustainable use of water – Reuse and recycling, rooftop rainwater harvesting. Grey water management – Septic tanks.</p> <p>Energy conservation: Sources of energy – Electricity, LPG, Other petroleum fuels and feasible alternative sources (Solar heating and photovoltaic). Measures to conserve energy – LED, energy efficient electrical appliances. Bureau of Energy Efficiency standards and labeling. Domestic solid waste management: Biodegradable – Kitchen waste - Issues and management. Compositing – Composters – Bin composter, three tier composters, pipe composting and mechanical composters. Human excreta - Issues and management. Bio-toilets, Dry/waterless toilets. Non- Biodegradable – Issues and management. Segregation – Dry, recyclables and sanitary wastes – Incinerators, pyrolysis and sanitary landfills.</p>	
Unit - 2	14
<p>Agriculture: Implications on soil water management – Fertilizer pollution – Soil salinity, Eutrophication and Bio-magnification. Pesticide pollution - DDT and Endosulphan - Integrated Pest Management (IPM), Bio-pesticides, Genetic Modified Crops (GMCs). Natural farming methods. Irrigation and drainage systems (Israel Model), Hydroponics and Aeroponics. Alternative cultivation methods: Negative impacts of food grown by conventional agriculture methods. Minimizing fertiliser use and preventing chemical pesticide usage. Role of rooftop gardens and kitchen gardens in regulating microclimate. Biofertilisers–<i>Rhizobium</i>, <i>Azotobactor</i>, <i>Azospirillum</i>, Blue green algae, <i>Azolla</i>, Mycorrhizae. Livestock management: Dung and urine management – Biogas plants, Farm Yard Manure (FYM) and Vermi-composting. Human dwellings as micro climatic regimes: Variations in temperature and relative humidity in indoor and outdoor environment. Impacts of increased temperatures. Role of vegetation in micro climate regulation and Carbon capture. Green buildings and micro climate regulations.</p>	
Unit - 3	14
<p>Environmental Management: Definition, need, significance and applications. Environmental Technology vs. Technology for Environment. Technological</p>	

<p>solutions for environmental degradation: Concept, advantages and limitations. Remedial actions - Waste recycling; Preventive actions - pollution prevention and Management actions - Environmental Management System (ISO-14000 series). Factors influencing transfer of Environmental technology - developer to technology user: Information, Research and Marketing. Factors influencing technology development: Localization, Customization and Contextualization. External factors influencing technology transfer: Laws and legislation; Administrative/Management systems; Information management; and Codes and Standards (<i>Eco-labeling and Green ratings</i>). Role of individuals in Environmental management: Resource measurements and monitoring, Ecological footprint analysis, Carbon footprint analysis, Water footprint analysis, Micro-climate monitoring and Participation in eco-friendly and sustainable endeavours.</p>	
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References

Baskar, S., & Baskar, R. (2007). *Environmental Studies For Undergraduate Courses*. Unicorn Books.

Behera, B. K., & Prasad, R. (2020). *Environmental technology and sustainability: Physical, chemical and biological technologies for clean environmental management*. Elsevier.

Broniewicz, E. (Ed.). (2011). *Environmental management in practice*. BoD-Books on Demand.

Kreith, F., & Tchobanoglous, G. (2002). *Handbook of solid waste management*. McGraw-hill.

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Wong, J. W., Surampalli, R. Y., Zhang, T. C., Tyagi, R. D., & Selvam, A. (Eds.). (2016, January). *Sustainable solid waste management*. Reston, VA: American Society of Civil Engineers.

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Assessment Occasion/ type	Weightage in Marks
End Semester Examination	60% (60 Marks)
Total	100% (100 Marks)


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Scheme of Examination

I/II/III/IV/V/VI/VII/VIII Semester B. Sc. Examination,MONTHYEAR
(NEP-2020)

Environmental Science

Paper title

Duration: 3 Hrs

Max

Marks: 60

Instruction: Answer all Sections. Section- A is compulsory

SECTION – A

Q. 1. Answer any FIVE of the following.

5 ×

2 = 10

- a.
- b.
- c.
- d.
- e.
- f.
- g.

SECTION – B

Answer any FOUR of the Following

04×05=20

Q.2

Q.3

Q.4

Q.5

Q.6

Q.7

SECTION – C

Answer any THREE of the Following

03×10=30

Q.8

Q.9

Q.10

Q.11

Q.12

Note: While drawing questions, all the units in the syllabus must be given equal weightage.

I/II/III/IV/V/VI/VII/VII Semester B. Sc. Examination..... MONTH YEAR
Practicals

Environmental Science
Paper title
Scheme of Examination

Duration: 3 Hrs

Max. Marks: 25

- Q.1. Conduct the given Experiment;
Write Aim, Principle, Procedure and Tabulation, calculations and results. **1×12=12**
- Q.2. Identify and give critical comments on given Specimens: **4×2 = 08**
- A.
- B.
- C.
- D.
- Q.3. Viva-Voce **05**