ST JOSEPH'S UNIVERSITY
BENGALURU . INDIA

Curricular Structure for the Undergraduate Programme

in

ENVIRONMENTAL SCIENCE

(Three major subjects up to IV Semester and specialisation in one subject in V and VI semesters)

As per (1)b. of

STATE EDUCATION POLICY – 2024

(SEP-2024)

(As per Case 2: Deep Specialisation in 5th & 6th Semester)

DEPARTMENT OF ENVIRONMENTAL SCIENCE

ST JOSEPH'S UNIVERSITY

 # 36, LALBAGH ROAD, BENGALURU – 560 027

DEPARTMENT OF ENVIRONMENTAL SCIENCE

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BENGALURU – 560 027

Curricular Structure for the Undergraduate Programme in ENVIRONMENTAL SCIENCE (Three major subjects up to IV Semester and specialisation in One subject in V and VI semesters) as per (1)b. of STATE EDUCATION POLICY – 2024 (SEP-2024) ***(As per Case 2: Deep Specialisation in 5th & 6th Semester)***

Semester	No. of Theory papers (3 credits)	No. of teaching hours / week / batch	No. of practical papers (2 credits)	Total credits (Theory + Practical)	No. of batches expected	Teaching workload (hours)	
						Theory	Practicals (2 teachers each)
I	1	3	1	3 + 2 = 05	2	3	12
II	1	3	1	3 + 2 = 05	2	3	12
III	1	3	1	3 + 2 = 05	2	3	12
IV	1	3	1	3 + 2 = 05	2	3	12
V	3	9	3	(3 + 2 = 5) X 3 papers =15	1	6	06
VI	3	9	3	(3 + 2 = 5) X 3 papers =15	1	6	06
Total	**10**	**30**	**10**	**50**	**10**	**30**	**60**

Undergraduate teaching workload of the Department of Environmental Science = 30 (theory) + 60 (Practical) **= 90 hours (Total)**

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Sem-ester	Paper code	Tentative Paper Title
I	ES 124	Components of the Environment
	ES 1P1	Water quality analysis
II	ES 224	Ecosystem Dynamics, Biodiversity and Wildlife
	ES 2P1	Ecological analysis and Biodiversity Assessment
III	ES 324	Natural Resource Management and Environmental Pollution
	ES 3P1	Natural Resource Management and Environmental Pollution
IV	ES 424	Climate Sciences and Disaster Management
	ES 4P1	Meteorology and Climate Change Assessment
V	ES 5124	Air Pollution, Noise and Radiation Pollution Management
	ES 5P1	Air Quality and Noise Monitoring
	ES 5224	Water Pollution and Land Pollution Management
	ES 5P2	Wastewater and Soil/Refuse analysis
	ES 5324	Waste Management and Environmental Health and Safety
	ES 5P3	Dissertation
VI	ES 6124	Environmental Biotechnology and Environmental Forensics
	ES 6P1	Environmental Biotechnology and Environmental Forensics
	ES 6224	Environmental Impact Assessment, Environmental Audit and Geospatial Applications
	ES 6P2	Environmental Impact Assessment, Environmental Audit and Geospatial Applications
	ES 6324	Environmental Economics, Sustainability and Entrepreneurship
	ES 6P3	Dissertation

B.Sc. Semester – I

ES 124: COMPONENTS OF THE ENVIRONMENT

Number of Lecture hours per semester	Number of credits
45	**3**

Course Specific Objectives	
CSO 1	To develop competency in understanding the interrelatedness of the divisions of the Environment.
CSO 2	To instill an introductory knowledge of the divisions of Environment and develop necessary analytical skills to characterise their variations.
CSO 3	To motivate and inspire to acquire contemporary understanding and skills leading to issue identification.
CSO 4	To inculcate creativity and innovative spirit in the domain of human-environment interface.

Course Outcomes	
CO 1	Demonstrate an entry-level competence in understanding the environmental divisions and associated processes.
CO 2	Demonstrate the ability to carry out water quality analysis in the laboratory and interpret the results.
CO 3	Ability to understand and appreciate the role of environmental parameters in specific day-to-day activities.
CO 4	Be able to understand the demands and function in work environment dealing with environmental systems

ES 124 – COMPONENTS OF THE ENVIRONMENT	45 Hours
Unit – 1	**8**
Environmental Education: Definition, Aim, Objectives and Scope. Environmental Science: Definition, Aim of Study and Scope. Differences between Ecology and Environmental Science; Various approaches to study Environmental Science. **Solar system:** Formation and evolution. **Evolution of Earth:** Theories of origin. Earth: Position in the solar system, distance from the Sun, rotation, revolution, tilt, axis and their influences.	

Geological time scale: Geochronologic units - Eon, Era, Period, Epoch, Sub-epoch and Age. Period and Etymology of eras – Cenozoic, Mesozoic, Paleozoic, Neoproterozoic, Mesoproterozoic, Paleoproterozoic, Neoarchean, Mesoarchean, Paleoarchean and Eoarchean. **Anthropocene:** Definition and significance. **Earth as a system** - Spheres of Earth - Atmosphere, Hydrosphere, Lithosphere and Biosphere - their complex interactions and significance.	
Unit – 2	**10**
Atmosphere: Definition, Evolution of the atmosphere – Principal components – permanent and variable gases. Chemical composition - Homosphere and Heterosphere. Thermal structure of the atmosphere. **Insolation:** Definition, Factors affecting the distribution. Solar (short-wave) and terrestrial (long-wave) radiations. Thermodynamics and Atmospheric circulation. Earth's Albedo and Heat Budget of the Earth. **Weather:** Definition, parameters - Temperature, Pressure, Humidity, Precipitation, Wind Speed & Direction. Differences between weather and climate. **Greenhouse effect:** Factors and significance. **Ozone chemistry:** Significance of stratospheric ozone layer, causes, mechanism and effects of ozone layer depletion. Control measures - Vienna Convention and Montreal Protocol. Recovery of stratospheric ozone. Ozone layer monitoring.	
Unit – 3	**12**
Hydrosphere: Hydrologic cycle - process of heat energy transfer - Radiation, Conduction and Convection. Types of lifting and precipitation - Bergeron process – The Collision and Coalescence process. Cloud formation and classification. Forms of condensation; Forms of precipitation; Cloud burst and flash floods. Artificial rainfall - Cloud seeding. **Limnology:** Definition – Lotic and Lentic environment. Differences	

between Lotic and Lentic systems. Lotic environment: Springs, Stream profile: Potomon and Rhithron. Lentic environment: Ponds, Lakes and Estuaries – their types. Photic and thermal stratification of Lentic systems. Marine environment: Zonation, Salinity status of marine environment, biotic communities of oceanic zones, acidification of sea water; Coral bleaching; ocean currents and tides, coastal upwelling and Red tide – significance. **Groundwater:** Definition. Zonation; Types of wells. Salinization of groundwater in coastal regions.	
Unit – 4	**15**
Lithosphere: Definition. Internal structure of the Earth. Endogenic processes: Plate Tectonics – Earthquake and Volcanism – Causes, Effects, and Management. Exogenic processes: River, Sand dunes, Glaciation, Avalanches and Landslides. **Mineralogy:** Definition. Outline classification of minerals. **Petrology:** Definition. Classification - Igneous, Sedimentary and Metamorphic rocks – their formation – types – uses. **Pedology:** Soil – definition – formation – soil profile. Soil types – Alluvial; Black; Red and Laterite; Arid and Desert; Saline and Alkaline; Peaty and Marshy; Grassland, Forest and Mountain Soils. **Soil biota:** Definition, characteristics, flora & fauna and their significance. **Weathering:** Definitions, factors and types. **Soil erosion:** Definitions, types, effects and management.	

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ES 1P24: WATER QUALITY ANALYSIS

Number of practical hours per semester	Number of credits
45	**2**

1. Sampling techniques of water
2. 2a. Determination of Colour - *Visual/Colorimetric method*

   2b. Determination of Temperature - Thermometer method
3. Determination of Turbidity - Nephelometric method
4. Determination of pH – Electrochemical method
5. Determination of Electrical Conductance - Conductivity meter method
6. 6a. Estimation of Total Solids - Evaporation and Gravimetric method

   6b. Estimation of Total Settleable Solids - Volumetric method
7. 7a. Estimation of Total Dissolved Solids - Filtration and Gravimetric method

   7b. Estimation of Total Suspended Solids - Filtration and Gravimetric method
8. Determination of Alkalinity - Acidimetric method
9. Determination of Total Hardness - EDTA complexometric method
10. Estimation of Dissolved Oxygen – Modified Winkler's method
11. Estimation of Dissolved Carbon dioxide - Titrimetric method
12. Determination of Chlorides - Argentometric method

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B.Sc. Semester – II

ES 224: ECOSYSTEM DYNAMICS, BIODIVERSITY AND WILDLIFE

Number of Lecture hours per semester	Number of credits
45	3

Course Specific Objectives	
CSO 1	To develop competency in understanding the ecological principles governing the biosphere, biodiversity and wildlife.
CSO 2	To develop necessary analytical skills to assess and understand the ecological systems, local biodiversity and regional wildlife.
CSO 3	To motivate and inspire to acquire contemporary understanding and skills leading to issue identification and conservation.
CSO 4	To inculcate creativity and innovative spirit in identifying appropriate conservation tools and their timely implementation.

Course Outcomes	
CO 1	Demonstrate an entry-level competence in understanding the ecological dynamics and the influence of biodiversity/wildlife on social and legal dimensions.
CO 2	Demonstrate the ability to carry-out data collection procedures and analysis in field conditions/laboratories leading to appropriate interpretations.
CO 3	Ability to understand and appreciate the role of ecosystem dynamics in conservation of specific habitats/ agroecosystems.
CO 4	Be able to develop competence and academic skills in contributing towards biodiversity and wildlife conservation.

ES 224 – ECOSYSTEM DYNAMICS, BIODIVERSITY AND WILDLIFE	45 Hours
Unit – 1	**13**
Ecology: Levels of organization, Ecology: Divisions of Ecology - approaches in studying Ecology. **Ecosystems**: Definitions. Classification of ecosystem – Terrestrial and Aquatic with their divisions. Structure of the ecosystem - Function of ecosystem - food chain – food web – bio-magnification. Ecological pyramids – Types. **Ecological Niche:** Concept and Types of niches: Spatial, Trophic and Multidimensional – Niche parameters: Form, Position and Width –	

Niche Partitioning - Realized and Fundamental Niche. **Biotic and Abiotic factors:** Influence of Temperature, Wind and Water, Edaphic, Topographic on flora and fauna. **Concept of Limiting Factors:** Liebig's Law of Minimum; Shelford's Law of Tolerance and the combined concept. **Biogeochemical cycles:** Classification. Carbon and Phosphorus cycles – anthropogenic influences on these cycles. **Energy flow in an ecosystem**: Productivity - trophic levels; Study of pond and crop land ecosystems; homeostasis and feedback mechanisms.	
Unit – 2	**12**
Population Ecology: Definition, Characteristics of Population: Density – Natality – Mortality – Age distribution – Growth form – Population Equilibrium – Biotic potential – Carrying capacity – Dispersal – Dispersion – Population fluctuations – Population regulation. **Community Ecology:** Definition, Characteristics of a Community – Species diversity, growth form and structure, dominance, relative abundance, trophic structure. **Ecological succession**: Primary and Secondary succession – Natural and man-influenced succession, – Hydrarch and Xerarch - Climax vegetation and their theories; Ecotone and Edge effect; Ecological equivalents; Ecotypes and Ecophenes; Ecological indicators. **Biomes:** Definition and concept. Classification of biomes. **Evolution:** Definition – Darwin's postulates - Natural selection – Types – Industrial Melanism – Pesticide resistance. Co-evolution; Mimicry – Batesian and Mullerian mimicry, warning colouration.	
Unit – 3	**10**
Biodiversity: Definition: Levels of Biodiversity - genetic diversity, species diversity and ecosystem diversity. Values of Biodiversity: *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 centres. Biogeography of India. Concept of Eco-Sensitive Areas (ESA). Biodiversity profile of India: Forests and Grasslands; Wetlands and Riverine ecosystems; Marine and coastal diversity; Agrobiodiversity; Urban Biodiversity; Invasive Alien species. **Wildlife:** Definition. Wildlife of India. Values of wildlife. Importance of wildlife: Ecological, economic, socio-cultural, investigatory, medicinal, conservation of biological diversities, importance in agriculture. Endangered species: Definition, characteristics and reasons for endangering. Endangered species of India. Endemic species – Concept, types, characteristics, theories of endemism. Endemic Wildlife Species of India. Wildlife (Protection) Act, 1972, Concept of Eco-Sensitive Zones (ESZ). Threats to biodiversity and wildlife: *Over exploitation, Habitat destruction, fragmentation, urbanisation, agriculture extension, Illegal trapping and poaching, diseases, deforestation, invasive species, pollution, acidification of soil and water, desertification, tourism and climate change.*	
Unit – 4	**10**
Conservation (Biodiversity and Wildlife): Definition, need and significance. Conservation goals - *Habitat conservation, Prevention of deforestation, Preventing species from extinction, Sustainable harvest of biological resources and climate change mitigation.* Terminologies of conservation significance: *Keystone species, Foundation species, Umbrella Species and Flagship species, Edge species, Critical link species, Indicator species, Priority species and Rare species.* **IUCN Red Listed species:** *Data Deficient, Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild and Extinct.* **In-situ conservation:** Protected areas – Sanctuaries - National Parks	

– Biosphere Reserves – Sacred groves. Case studies Project Tiger and Project Elephant, Project Crocodile; Vulture (Ramadevarabetta Vulture Sanctuary), Black Buck, Snow Leopard, Amur falcon, Sarus Crane, Great Indian Bustard, King Cobra and Mahseer Fish; Translocation of Cheetah in Kuno National Park, M.P. ***(One Case study to be taught in the class; Others are to be given as assignments)*.** **Ex-situ conservation:** Captive breeding (Botanical gardens, zoological parks, seed banks). Case study of *Ailuropoda melanoleuca* (Giant panda), *Ramosmania heterophylla* and *Madhuca insignis*. Cryopreservation, pollen storage, tissue culture, genetic engineering, field gene banks. Case study of Indian rhinoceros and black rhinoceros. ***(One Case study to be taught in the class; Others are to be given as assignments)***. Traditional Knowledge and ethics in conservation of biodiversity. A locally relevant case study on biodiversity related aspects. People's Biodiversity Register. Bio-piracy. **Communication on Wildlife:** Journalism and Wildlife Photography. **Overview of International and National conservation efforts -** *Convention on Biological Diversity and Agenda 21. 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+. National Biodiversity Action Plan (NBAP).*	

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ES 2P24: ECOLOGICAL ANALYSIS AND BIODIVERSITY ASSESSMENT

Number of practical hours/semester	Number of credits
45	2

1. Sampling technique of plankton
2. Quantitative estimation of phytoplankton – Sedgwick-Rafter method
3. Quantitative estimation of zooplankton – Sedgwick-Rafter method
4. Determination of organic pollution – Palmer's Algal Pollution index
5. Estimation of primary productivity of a pond – Light and Dark bottle method
6. Estimation of primary productivity of terrestrial vegetation – Chlorophyll method
7. Identification of ecological indicators and Identification of endangered flora and fauna of India
8. Documentation and assessment of vegetation diversity – Census method/quadrat method
9. Documentation and assessment of faunal diversity – Line transect method
10. Documentation and assessment of winged insect fauna (Entomology) – Light trap/Sticky trap method / Visual encounter /Photographic survey
11. Documentation and assessment of soil fauna – Pitfall trap method
12. Determination of species diversity indices – Simpson's Index and Shannon-Weiner Index

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