Department of Environmental Science, University of Kashmir, Hazratbal Srinagar-190006, J&K, India

Environmental Science (Code EVS)

Implementation Year 2022

PROGRAMME LEARNING OUTCOMES OF NEP 2020 FOUR YEARS UNDERGRADUATE PROGRAMME (FYUP) WITH ENVIRONMENTAL SCIENCE AS A MAJOR

Programme learning outcome: Environmental science programme is designed for students to complete their undergraduate and postgraduate degree in environmental science. It typically focuses on advanced studies in environmental science and research. A student is expected to have comprehensive understanding of environmental issues and gain a deep understanding of various environmental challenges, including, pollution, biodiversity loss, resource depletion, climate change and their interconnectedness. Students should be familiar with national and international environmental laws, regulations, and policies governing environmental protection and conservation. Students should be also capable of conducting Environmental impact assessment and develop environment management plans for different sectors. The students will learn effective communication skills essential for conveying complex environmental issues to various audiences, including policymakers and the general public. Students are expected to develop strong analytical and research skills to study environmental problems, gather data, and propose potential solutions and learn about innovative and sustainable technologies for promoting sustainable practices and strategies. Being a multidisciplinary subject, the program may encourage collaborative efforts and team work to address environmental issues and challenges effectively.

COURSE TITLES WITH CREDIT WEIGHTAGE FOR ALL THE SEMESTERS OF FYUP FOR ENVIRONMENTAL SCIENCE AS A MAJOR/MINOR AS PER NEP 2020

SEMESTER	COURSE CODE	COURSE TYPE	COURSE TITLE	CREDITS	
				THEORY	PRACTICAL
I	EVS124J	CT-1 (MAJOR)	Environment and Ecology	4	2
II	EVS224J	CT-1 (MAJOR)	Natural Resources and Biodiversity	4	2
III	EVS324J	CT-1 (MAJOR)	Environmental Chemistry	4	2
IV	EVS422J1	CT-1 (MAJOR)	Human and Environment	3	1
	EVS422J2	CT-2 (MAJOR)	Environmental Pollution	4	2
	EVS422J3	CT-3 (MAJOR)	Environmental Geoscience and Disaster Management	4	2
V	EVS522J1	CT-1 (MAJOR)	Environmental Laws and Policies	3	1
	EVS522J2	CT-2 (MAJOR)	Environmental Pollution Control and Management	4	2
	EVS522J3	CT-3 (MAJOR)	Aquatic Ecology	4	2
VI	EVS622J1	CT-1 (MAJOR)	Environmental Economics and Sustainable Development	3	1
	EVS622J2	CT-2 (MAJOR)	Atmospheric Science	4	2
	EVS622J3	CT-3 (MAJOR)	Terrestrial Ecology	4	2
For students having CGPA Score of < 7.5 are eligible for Honours mode PG (Eligible for PG only)					
VII	EVS722J1	CT-1 (MAJOR)	Environmental Impact Assessment and Auditing	3	1
	EVS722J2	CT-2 (MAJOR)	Environmental Engineering	4	2
	EVS722J3	CT-3 (MAJOR)	Environmental Planning, Remote Sensing and GIS	4	2
VIII	EVS822J1	CT-1 (MAJOR)	Climate Change	3	1
	EVS822J2	CT-2 (MAJOR)	Environmental Toxicology	4	2
	EVS822J3	CT-3 (MAJOR)	Environmental Microbiology and Biotechnology	4	2
Or For students having CGPA Score of >7.5 are eligible for Research mode PG (Eligible for PhD if they get CGPA score of >7.5 overall)					
VIII	EVS822J1R	CT-1 (MAJOR)	Research Methodology and Ethics	3	1
	EVS822J2R	Internship/ Research	Research project	12	

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR
ENVIRONMENTAL SCIENCE
I SEMESTER

COURSE CODE: EVS124J **COURSE TYPE: CT-1 (MAJOR)**

COURSE TITLE: Environment and Ecology **CREDITS: (Theory-4, Practical -2)**

Course learning outcome: *This paper is designed to introduce the basic concepts of Environment and Ecology leading to better understanding of inter-connections of Environmental Science as a discipline. The course will introduce the students to different components of the environment, biotic and abiotic interactions, ecosystem structure and functions and role of humans in shaping the present day ecology and environment.*

THEORY (4 Credits, 60 hours)

UNIT I. Basics of environment

Environmental science: Scope and importance, Components of environment: atmosphere, lithosphere, hydrosphere, biosphere (structure and function), Brief account of cryosphere and anthroposphere (built environment).

UNIT II. Population and community

Concept of population, Population growth (Density dependent and density independent factors), Survivorship curves and age structure, Biotic potential and carrying capacity (r and k strategists), Population interactions: Mutualism, Protocooperation, Commensalism, Competition, Herbivory, Predation, Parasitism, Community: Concept and characteristics, Ecological succession.

UNIT III. Ecosystems

Ecosystem: Concept, Organization and significance, Types of ecosystems, Food chains, Food webs and trophic levels, Ecological pyramids, Energy flow in ecosystems, Ecosystem productivity, Decomposition, Biogeochemical cycles: carbon, nitrogen, phosphorus and sulphur.

UNIT IV. Human ecology

Global and regional human population growth, Theories of human population growth (Malthusian and neo-malthusian), Drivers of human population change, Growth curves and population projections, Earth's carrying capacity and ecological footprint, Brief account of anthropocene.

PRACTICAL (2 CREDITS) 60 hours

1. Determination of latitude/ longitude/ altitude using GPS
2. Identification of major rock types
3. Estimation of moisture and field capacity in soils of different ecosystems
4. Estimation of pH and conductivity in soils of different ecosystems
5. Estimation of pH and conductivity in water samples of different ecosystems
6. Analysis of population age structure using demographic data
7. Schematic collection of data for depicting ecological pyramid in the college campus
8. Field /Environmental visit to understand various environmental components

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR
ENVIRONMENTAL SCIENCE
II SEMESTER

COURSE CODE: EVS224J **COURSE TYPE: CT-1 (MAJOR)**

COURSE TITLE: Natural Resources and Biodiversity **CREDITS: (Theory-4, Practical -2)**

Course leaning outcome: *This paper is expected to have a broad understanding of various natural resources including biodiversity in terms of availability, utilization and management. The course is expected to give basic understanding regarding different types of natural resources, their importance and global distribution. The students will also have basic knowledge about the diverse life forms present in the world, their status, distribution and need for their conservation and preservation.*

THEORY (4 credits: 60 hours)

UNIT I: Natural resources

Natural resources: concept and classification; forest resources; water resources; mineral resources; Energy resources

UNIT II: Biodiversity

Biodiversity: Status and importance; Levels of biodiversity; Values of biodiversity; Endemism, Hot spots and cold spots; India as a mega-diversity nation; Threats to biodiversity, IUCN's Red list (Scheme and Status)

Unit III: Biogeography

Geographical classification and zones; Major biomes of the world; Zoogeographic realms of the world: Dispersal: Means, modes and barriers; Migrations

UNIT IV: Management of natural resources

Monitoring and management of bio-diversity; Biodiversity conservation; Management of natural resources (forest, minerals, water); Conservation of energy resources

PRACTICAL (02 CREDITS) **(60 hours)**

1. Study of vegetation in a particular ecosystem (lake, forest, agricultural, grassland etc)
2. Study of fauna in a particular ecosystem (lake, forest, agricultural, grassland etc)
3. To determine the minimum size of the quadrat by Species Area Curve Method.
4. To study communities by quadrat method and to determine % Frequency, Density and Abundance.
5. To determine similarity and dissimilarity index of ground vegetation.
6. Calculation of species biodiversity (alpha, beta and gamma)
7. Time-series analysis of natural resource consumption of a given country using publicly available data
8. Visit to a natural ecosystem (Forest, National park, Sanctuary, Lake)

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR
III SEMESTER

COURSE CODE: EVS324J **COURSE TYPE: CT-1 (MAJOR)**

COURSE TITLE: Environmental Chemistry **CREDITS: (Theory-4, Practical -2)**

Course learning outcome: *This course introduces the students to basic analytical chemistry relevant to the course and is designed to and is designed to equip the students to handle the analytical instruments. Emphasis is laid to have an understanding of the chemistry of atmosphere, water and soil. The students will also learn basic principles of various chemical processes occurring in the different components of the environment.*

THEORY (4 Credits: 60 hours)

Unit I: Analytical chemistry (15 hours)

Stoichiometry, titrimetry and gravimetry, Spectrophotometry: UV-Visible, Flame photometry and AAS Chromatography: Paper and TLC

Unit II: Atmospheric chemistry (15 hours)

Evolution of Earth's atmosphere, Ions and radicals in the atmosphere, 1.3. Inorganic and organic particulate matter, Photochemical reactions in the atmosphere, Thermochemical reactions in the atmosphere

Unit III: Water chemistry (15 hours)

Physico-chemical properties of water, Solubility of gases in water, Biochemical oxygen demand and chemical oxygen demand, Carbonate-bicarbonate system, Nutrients in water: Phosphorus and nitrogen

Unit IV: Soil chemistry (15 hours)

Pedogenesis, Soil profile, Inorganic and organic components of soil, Physical, chemical and biological properties of soils, Soil classification and types

PRACTICALS: (2 credits) (60 hours)

1. Standardization of reagents – titrants (acids, bases)
2. Experimental verification of Beer-Lambert's law
3. Measurement of ozone gas concentration by ozone sensor
4. Estimation of dry deposition from the atmosphere
5. Determine suspended solids and TDS in different water samples
6. Determination of chloride and alkalinity in water samples
7. Determination of soil texture of different ecosystems
8. Determination of chloride and alkalinity in soil samples

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR

ENVIRONMENTAL SCIENCE
IV SEMESTER

COURSE CODE: EVS422J1 **COURSE TYPE: CT-1 (MAJOR)**
COURSE TITLE: Human and Environment **CREDITS: (Theory-3, Practical -1)**

Course outcome: *This course is designed to introduce students with a comprehensive conceptual, theoretical and empirical background between social systems and environment. The course explores important perspectives like environmental education, human cognition and behaviour, psychology, urban stress, Eco-philosophies, ethics and politics and policy. The students will be able to understand the social roots of ecological problems, and to unveil the social responses to the environmental crisis. The course also discusses the environmental history and the rise of environmentalism and environmental organizations.*

THEORY (3 Credits: 45 hours)

Unit I: Environmental education

Environmental education: aims, objectives and principles, Environmental protection and religious teachings, Environmental literacy and activism, Environmental ethics, Environmental policy and public attitude

Unit II: Environmental psychology and sociology

Environment psychology: concept and theory, Influence of environment on human cognition and behaviour, Urban environmental stress, Eco-philosophies: deep, social and feminist, Science, policy and society interface

Unit III: Environmentalism

Environmentalism: concept and history, Environmental organizations (WWF, UNEP, IUCN, WHO), Environmental justice, The monetization frontier, Environmental politics

PRACTICALS: (1 credits) **(30 hours)**

1. Formulation of questionnaire for the assessment of environmental education among the people.
2. Assessing the impacts of economic development on human lives.
3. Visit to marginalized localities for environmental education and environmental awareness.
4. Preparing a list of projects taken by WWF in India

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR

ENVIRONMENTAL SCIENCE
IV SEMESTER

COURSE CODE: EVS422J1 **COURSE TYPE: CT-1 (MAJOR)**
COURSE TITLE: Environmental Pollution **CREDITS: (Theory-4, Practical -2)**

***Course outcome**: The students in this course will be provided a comprehensive picture of pollution scenario especially air and radiation pollution and its likely impact of pollutants on the environment. Students will be able to achieve competence in the area of prevention and control measures of various types of pollution like air, noise, and electromagnetic.*

THEORY (4 credits: 60 hours)

Unit I: Air and noise pollution

Air pollution: Sources and classification, Indoor air pollution, Air quality standards and monitoring: SO_2, NO_2, CO, PM and ozone, Noise pollution: sources and measurement, Noise standards; Impact of air and noise pollution on human health and environment

Unit II: Water pollution

Water Pollution: sources and types, Inland water and marine pollution, Biocides and heavy metals, Water quality standards and monitoring, Impacts of water pollution on human health and environment

Unit III: Soil pollution

Soil pollution: causes and types, Land degradation and desertification, Soil erosion: causes and impacts, Fate of pesticides and fertilizers in soil; Soil quality standards and monitoring

Unit IV: Waste and radiation pollution

Solid waste pollution, Electronic waste pollution, Plastic waste pollution, Radiation exposure and human health, Light pollution

PRACTICALS: (02 credit) **(60 hours)**

1. Study of ambient noise levels in different zones
2. Determination of particulate matter (PM) in ambient air
3. Determination of dissolved oxygen content in water samples
4. Determination of nitrate in a water sample.
5. Determination of phosphorus in a water sample.
6. Estimation of organic carbon in different soils samples
7. Estimation of nitrogen in different soils samples
8. Qualitative and quantitative assessment of municipal solid waste

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR
ENVIRONMENTAL SCIENCE
IV SEMESTER

COURSE CODE: EVS422J3 **COURSE TYPE: CT-3 (MAJOR)**
COURSE TITLE: Environmental Geoscience and Disaster Management
CREDITS: Theory-4, Practical -2

Course learning outcome: *This course provides an in-depth understanding of environmental geoscience and disaster management, exploring the relationship between natural processes, environmental factors, and their impact on human societies. Students will learn about the causes and consequences of various natural disasters, mitigation strategies, and disaster preparedness.*

THEORY (4 credits: 60 hours)

Unit I: Introduction to environmental geoscience

Origin and evolution of earth, Geological time scale, Earth's structure and plate tectonics, Geomagnetism: Magnetic and gravitational fields of the earth, Continental drift: Plate tectonics and Neo-tectonics

Unit II: Geochemistry

Geochemical classification and distribution of elements in earth, Mobility of trace elements, Concept of rare earth elements, Radioactive tracers, Geochemical cycles - C, N, P, S

Unit III: Natural hazards and disasters

Concept and classification of natural hazards and disasters, Concept of hazard risk and vulnerability, Types of natural hazards and disasters (earthquakes, volcanic eruptions, tsunamis, hurricanes, floods, landslides, avalanches, global climate extremes), Causes and triggers of natural disasters, Case studies of significant historical events

Unit IV: Disaster, mitigation and management

Basic principles of disaster management, Disaster management cycle, Disaster management policy (National and State Bodies for Disaster Management), Early warming systems, Disaster management: success and failure studies

PRACTICALS: (02 credit) **(60 hours)**

1. Estimation of calcium and magnesium in soil samples
2. Estimation of sodium and potassium in soil samples
3. Estimation of total hardness in water samples
4. Estimation of calcium and magnesium in water samples
5. Estimation of sodium and potassium in water samples
6. Estimation of sulfur in soil and water samples
7. Preparation of maps showing distribution of important metallic and non-metallic deposits
8. Identifying potential natural hazards, such as flood-prone zones, earthquake risk areas, and landslide susceptibility, and create hazard maps

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR
V SEMESTER

COURSE CODE: EVS522J1 **COURSE TYPE: CT-1 (MAJOR)**

COURSE TITLE: Environmental Laws and Policy **CREDITS: (Theory-3, Practical -1)**

Course learning outcome: *This course is framed in such a way that students of environmental science should be aware of the legal perspective on various issues and dimensions of environment. They will get a better understanding about the situation whether there is matching response from the legal and policy front of the nation towards the ever increasing environmental degradation.*

THEORY (3 credits: 45 hours)

Unit I: Environmental Protection

An overview of evolution of environmental laws and policy in India, Environment protection: Provisions of Indian constitution (48A, 51A, and 253); Wildlife protection Act (amended) (1972), Water prevention and control of pollution Act, Air prevention and control of pollution Act

Unit II: National Laws

Forest Conservation Act (1980), Environmental Protect Act, 1986, National green tribunal Act (2010), Solid wastes (management and handling) rules (2016), Hazardous and other waste rules, 2016

Unit III: National Policies and Missions

National Environmental Policy, 2006; National Water Policy, 2012; National Energy Policy, 2017; National Forest Policy, 2018; National Missions

PRACTICALS: (1 credits) **(30 hours)**

1. Case studies under article 14, 19, and 21
2. Study of any success story regarding the with implementation of Environmental Laws and Policies
3. Identification of biomedical and hazardous waste in households
4. Case study under Forest Conservation Act, 1980, EPA, 1986, NGT 2010

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR

ENVIRONMENTAL SCIENCE

V SEMESTER

COURSE CODE: EVS522J2 **COURSE TYPE: CT-2 (MAJOR)**

COURSE TITLE: Environmental Pollution Control and Management

CREDITS: (Theory-4, Practical -2)

Course learning outcome: *The students in this course will be able to achieve the competence in the area of prevention and control measures of various types of pollution like air, water, soil, noise and electromagnetic. Students are expected to achieve the technical competence in monitoring the various types of pollutants.*

THEORY (4 credits: 60 hours)

Unit I: Air pollution control and management

Control of particulate air and gaseous air pollution; Bio-filters for control of air pollution; Indoor air pollution control; Noise control and abatement measures

Unit II: Water pollution control and management

Sanitation and sewage treatment (Municipal. Industrial and Agriculture); Control of eutrophication; Restoration of lakes and wetlands; Control of stream and river pollution; Groundwater pollution management; Control of marine pollution

Unit III: Soil pollution control and management

Control of soil pollution; Soil conservation and control of soil erosion; Waste lands and their reclamation; Reclamation of soils (acidic. alkaline, sodic); Sustainable agricultural practices; integrated pest management.

Unit IV: Waste and radiation management

Plastic and E-waste management; Radioactive waste management: Reduction in health impacts of cell phones and towers; Solutions for reducing light pollution; Measures to control thermal pollution;

PRACTICALS: (2 credits) **60 hours**

1. Determination of gaseous pollutants in ambient air
2. Case studies on air quality index of various cities
3. Estimation of BOD in different waters
4. Estimation of COD in different waters
5. Measurement of soil erosion
6. Survey of a local area for identification of common soil pollutants such as pesticides, organic pollutants and fertilizers
7. Preparation of report about solid waste management practices adopted in the campus of the institute.
8. Visit to any landfill site /SWM facility

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR
ENVIRONMENTAL SCIENCE
V SEMESTER

COURSE CODE: EVS522J3 **COURSE TYPE: CT-3 (MAJOR)**
COURSE TITLE: Aquatic Ecology **CREDITS: (Theory-4, Practical -2)**

***Course learning outcome:**: It offers students a snapshot of the physical, chemical, and biological processes that characterize inland waters such as lakes, streams, rivers, and wetlands and focusses on understanding the relationships between humans and freshwater, and discusses these challenges in Management. Field and laboratory study of the ecology of freshwater systems lead to provide experience by sampling and identifying freshwater organisms, designing and analysing ecological experiments.*

THEORY (4 credits: 60 hours)

Unit I: Freshwater biodiversity

Major taxonomic groups of freshwater biodiversity: Algae, Zooplankton, Macrophytes, Macroinvertebrates and Fish, Measures of diversity; Endemism and Biological invasion in freshwater ecosystems

Unit II: Stream and river ecology

Fluvial ecosystem diversity, Stream classification, Stream flow and Hydrograph, Environmental Flow, Influence of thermal regime and substrate on aquatic biota, streams and rivers as products of Landscapes

Unit III: Lakes and wetland ecology

Lakes: Origin, diversity, distribution and Classification, Wetlands: Origin, diversity, distribution and Classification, Lake stratification, Paleolimnology, Ontogeny of freshwater systems

Unit IV: Threats to freshwater systems

Threats to freshwater systems: Habitat and hydrology modification, Channelization, mining, invasion, pollution, overexploitation, acidification, dams, Climate change, Harmful algal blooms

PRACTICALS: (2 credits) **(60 hours)**

1. Collection/Identification of some freshwater phytoplankton specimen
2. Collection/Identification of some freshwater Periphyton specimen
3. Collection/Identification of some freshwater Zooplankton specimen
4. Collection/Identification of some Macroinverebrates Specimen
5. Calculation of species diversity indices from a given data
6. Calculation of Nygaards Indices and water pollution index
7. Chlorophyll estimation of any freshwater system
8. Case studies on control of water pollution in any lake/river in Jammu and Kashmir

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR

ENVIRONMENTAL SCIENCE

VI SEMESTER

COURSE CODE: EVS622J1 **COURSE TYPE: CT-1 (MAJOR)**

COURSE TITLE: Environmental Economics and Sustainable Development

CREDITS: (Theory-3, Practical -1)

Course learning outcome: *This course focuses on the ecosystem services and provides students an understanding of various types of services provided freely by the nature. In particular, the course aims to make students learn about how good environment is key to a strong economy, and how the two are interrelated. The students will examine issues in the contemporary environmental discourse from an economists' point of view as well as discuss the argument that how environment sets the limits to economic growth thereby setting the context for the emergence of the idea of sustainable development.*

THEORY (3 credits: 45 hours)

Unit 1: Economy and the natural environment

Environmental economics: definition and scope; Natural capital and flow; Concept of intangibles and externalities; Carbon credits and carbon market

Unit II: Ecosystem services and their valuation

Typologies of ecosystem services; Valuation and accounting of ecosystem services; Methods of environmental valuation, (empirical approaches, revealed preference methods and direct methods); Incentives for ecosystem services (IES) in the Himalayas

Unit III: Sustainable development

Concept of sustainable development; Sustainable development goals; Circular economy; Green infrastructure; Sustainable cities and globalization

PRACTICALS: (1 credits) **30 hours**

1. Economic valuation of ecosystem services: a case study of natural forests
2. A cost benefit analysis of urban/rural solid waste management project.
3. Calculation of carbon footprint
4. Assessing the level of knowledge, attitude and practices of different sections of society towards sustainability.

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR
ENVIRONMENTAL SCIENCE
VI SEMESTER

COURSE CODE: EVS622J2 **COURSE TYPE: CT-2 (MAJOR)**
COURSE TITLE: Atmospheric Science **CREDITS: (Theory-4, Practical -2)**

Course learning outcomes: *Atmospheric Science is the study of the Earth's atmosphere, its composition, structure, and dynamics. This course provides an introduction to the fundamental concepts and principles in atmospheric science, including meteorology and climatology.*

THEORY (4 credits: 60 hours)

Unit I: Meteorology

Meteorological parameters: Atmospheric pressure, temperature, precipitation, humidity; Wind, atmospheric stability; Radiation and heat budget:

Unit II: Climatology

Fundamentals of climatology; Classification of climate: Koppen's; Monsoon and climatic zones of India Western disturbances and climate of J&K; Paleo-climatology and climate change

Unit III: Atmosphere composition and circulation

Composition and structure of atmosphere; Atmospheric aerosols: Types, sources and atmospheric effects; Atmospheric-sea interactions; Atmospheric general circulation; Climate variability and forcing: Madden Julian oscillations (MJO), El-nino and southern oscillations (ENSO), Indian Ocean dipole (IOD)

Unit IV: Atmospheric data analysis

Weather analysis and forecasting techniques; Dry and wet atmospheric deposition; LIDARS, SODARS, weather RADARS; Remote-sensing techniques (WP-RASS); Self-recording instruments, radiosondes, radiometersondes, ozone sonde; Satellite meteorology: visible and infrared radiometer and multi scanner radiometer

PRACTICALS: (2 credits) **(60 hours)**

1. Visit local weather stations for demonstration of meteorological parameters
2. Measure temperature, humidity, and pressure at different altitudes.
3. Understand cloud formation and classification by using cloud charts
4. Set up rain gauges to measure precipitation.
5. Survey of local area for collection of activity data for air pollution studies
6. Survey of local area for emission inventory for air pollution studies
7. Study of weather maps/satellite imagery for identification of different atmospheric features
8. Measurements of wet and dry depositions

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR
ENVIRONMENTAL SCIENCE
VI SEMESTER

COURSE CODE: EVS622J3 **COURSE TYPE: CT-3 (MAJOR)**
COURSE TITLE: Terrestrial Ecology **CREDITS: (Theory-4, Practical -2)**

Course learning outcome: *To give a broad outline and deep understanding of different terrestrial systems, components and interactions. This course shall help students in understanding that the structure and function of terrestrial ecosystems is fundamental to their conservation. This course provides a conceptual framework for understanding the range of the world's terrestrial ecosystems and provides practical field experience with major terrestrial ecosystems.*

THEORY (4 credits: 60 hours)

Unit I: Terrestrial ecosystems

Distribution of terrestrial ecosystems; Community structure and functioning; Patterns of terrestrial primary production; Terrestrial decomposition; Carbon sequestration storage and utilization

Unit II: Forest ecology

Major forest types of the world; Major forest types in India; Forest community structure and function; Forest biota; Deforestation and global climate change

Unit III: Desert ecology

Introduction to world deserts; Classification of desert; Ecological complexity of desert ecosystems; Ecological adaptation of desert flora and fauna

Unit IV: Grasslands and agroecosystems

Major grassland types of world; Grassland types in India; Management of grassland ecosystems
Concept of agroecosystems; Role of biodiversity in agroecosystems

PRACTICALS: (2 credits) **60 hours**

1. Estimation of primary productivity in terrestrial ecosystems
2. Estimation of light intensity in different ecosystems
3. Determination of DBH of tree species in a forest and calculation of the basal area
4. Determine carbon sequestration potential of any terrestrial ecosystem in your area
5. Explore insect biodiversity and population dynamics by using sweep nets, pitfall traps, or insect traps in different habitats.
6. Study bird populations and their distribution in different terrestrial ecosystems
7. Study the impact of grazing on plant community
8. Field visit to the local agricultural area for evaluation of IPM strategies

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR

ENVIRONMENTAL SCIENCE

VII SEMESTER

COURSE CODE: EVS722J1 **COURSE TYPE: CT-1 (MAJOR)**

COURSE TITLE: Environmental Impact Assessment and Auditing

CREDITS: (Theory-3, Practical -1)

Course learning outcome: *The students completing the course will have ability to carry out scoping and screening of developmental projects for environmental and social assessments, explain different methodologies for environmental impact prediction and assessment, plan environmental impact assessments and environmental management plans and evaluate environmental impact assessment reports.*

THEORY (3 credits: 45 hours)

Unit I: Fundamentals of EIA

Environment impact assessment: concept, history and objectives; EIA process; EIA guidelines 2006; Strategic environment assessment: concept and process

Unit II: EIA methodologies

EIA methods; Air and water quality assessment; Ecological and social impact assessment; Basic concept of environment modelling; Model validation and forecasting EIA studies

Unit III: Environmental auditing and risk management

Principles and guidelines of environmental auditing; Preparation of environmental audit report; ISO 14000 series; Risk analysis; Risk management

PRACTICALS: (1 credits) (30 hours)

1. EIA – Leopold Matrix method and case studies
2. Socio-economic studies – preparing of questionnaire and case studies
3. Waste auditing of any institution/ organization
4. Case study based on EIA of any developmental project

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR
ENVIRONMENTAL SCIENCE
VII SEMESTER

COURSE CODE: EVS722J2 **COURSE TYPE: CT-2 (MAJOR)**

COURSE TITLE: Environmental Engineering **CREDITS: (Theory-4, Practical -2)**

Course learning outcome: *The syllabus for an environmental engineering course typically covers a range of topics related to the application of engineering principles to address environmental issues. This course introduces students to the principles and practices of environmental engineering, focusing on the identification, assessment, and design of solutions for environmental challenges. This course shall help students to find solutions for quality issues in air, water and land, which may pose a threat to life. Further the practical's will strengthen the theoretical concepts and help students to develop practical skills for environmental engineering*.

THEORY (4 credits: 60 hours)

Unit 1. Fundamentals of environmental engineering

Scope of environmental engineering; Sewerage and storm water drainage; Ecological sanitation; Green buildings; Green engineering and sustainable practices

Unit II. Water supply engineering

Overview of public water supply systems; Water distribution systems; Water purification methods for public supply: Screening; Coagulation; Flocculation; Sedimentation; Filtration; Disinfection methods; Advanced treatment processes

Unit III. Wastewater engineering

Nature and types of wastewater; Wastewater characteristics: physical, chemical and biological; Wastewater treatment methods: primary, secondary, tertiary and advanced; Sludge management; Design of treatment facilities

Unit IV: Air and soil engineering

Concept of ventilation; Air conditioning; Green technologies for air pollution control; Noise control engineering; Soil remediation techniques; Design and operation of sanitary landfills; Recycling and waste-to-energy technologies;

PRACTICALS: (2 credits) (60 hours)

1. Evaluate the condition of sanitary facilities.
2. Ecological foot print of an individual/house/building or institute
3. Calculate water footprint of individuals/households
4. Demonstrate the treatment of water for drinking purposes either by coagulation/disinfection/filtration/ activated charcoal process.
5. Working and design of sewage treatment plants
6. Visit to a waste water treatment plant
7. Analysis of indoor air quality
8. Showcase sustainable agriculture practices using treated wastewater or composted materials

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR
ENVIRONMENTAL SCIENCE
VII SEMESTER

COURSE CODE: EVS722J3 **COURSE TYPE: CT-3 (MAJOR)**
COURSE TITLE: Environmental planning, Remote Sensing and GIS
CREDITS: (Theory-4, Practical -2)

Course learning outcome: *This course focuses on the principles and practices of environmental planning. Students will learn how to assess, design, and implement sustainable solutions to environmental challenges, considering ecological, social, and economic factors. The students will also explore the use of remote sensing and GIS in environmental planning and management. Students will learn how to collect, analyse, and visualize spatial data to make informed decisions for sustainable environmental practices.*

THEORY (4 credits: 60 hours)

Unit I: Introduction to environmental planning

Environmental planning – importance and objectives; Land use planning and zoning; Urban and rural development and environmental planning; Smart city concept; carbon neutral

Unit II: Introduction to remote sensing

Remote sensing: Concept and history; Electromagnetic spectrum: EMR sources-active & passive, radiation laws; Resolution: spatial, spectral, radiometric and temporal; Remote Sensing satellites: LANDSAT & IRS satellite series; Image processing and interpretation; Aerial photographs

Unit III: Introduction to geographic information system (GIS)

GIS: history and development; Functional requirements: Hardware configuration, software modules; Geographic data: Spatial and non-spatial data types; Geospatial data models: raster and vector; Global positioning system (GPS)

Unit IV: Applications of remote sensing and GIS

Environmental impact assessment; Biodiversity conservation; Watershed management; Land-use planning; Disaster management

PRACTICALS: (2 credits) **(60 hours)**

1. Data collection techniques (GPS, field surveys, etc.)
2. Demonstration of basic image interpretation skills using satellite imagery or aerial photography
3. Delineation of point, line and polygon
4. Delineation of drainage of a given area from satellite data
5. Generation of land use/ land cover map
6. Calculate vegetation indices like NDVI (Normalized Difference Vegetation Index) using satellite imagery.
7. Identify changes in land cover using change detection techniques
8. GPS-based survey and mapping

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ENVIRONMENTAL SCIENCE
VIII SEMESTER

COURSE CODE: EVS822J1 **COURSE TYPE: CT-1 (MAJOR)**
COURSE TITLE: Climate Change **CREDITS: (Theory-3, Practical -1)**

Course learning outcome: *This course provides an in-depth examination of climate change, including its causes, consequences, and potential solutions. Students will explore the science behind climate change, its environmental, societal impacts, policy and mitigation strategies.*

THEORY (3 credits: 45 hours)

Unit I: Introduction to climate science

Earth's climate system; Greenhouse gases and radiative forcing; Climate change indicators; Extreme weather events; Impacts of climate change on environment, Climate modelling

Unit II: Climate policy and international agreements

United Nations Framework Convention on Climate Change (UNFCCC); IPCC and emission scenarios; International initiatives: Kyoto protocol and Paris Agreement; Clean development mechanism (CDM); Grassroots activism and climate movements

Unit III: Adaptation and mitigation strategies

Concept of climate vulnerability and risk; Mitigation strategies for different sectors; Adaptation strategies for different sectors; National action plan on climate change (NAPCC); Nationally determined contributions (NDCs); Climate justice and equity

PRACTICALS: (1 credits) **(30 hours)**

1. Emission inventory of GHG in your locality
2. Quantify individual or community carbon footprints.
3. Calculation of climate vulnerability and risk based on indicators
4. Analyse and interpret temperature trends, and precipitation patterns from meteorological data

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VIII SEMESTER

COURSE CODE: EVS822J2 **COURSE TYPE: CT-2 (MAJOR)**
COURSE TITLE: Environmental Toxicology **CREDITS: (Theory-4, Practical -2)**

Course learning outcome: *The students are expected to learn about various types of toxins, their absorption, excretion and the mechanism involved in the bioaccumulation, bio concentration and bio magnification of xenobiotic besides their impact on human health and environment.*

THEORY (4 credits: 60 hours)

Unit I: Fundamentals of toxicology

Toxicology: Concept, scope and goals; Divisions of toxicology; Toxicological interactions; Factors influencing toxicity; Dose - response relationship

Unit II: Ecotoxicology

Ecotoxicology: objectives, principles and scope; Fate of toxic substances; Toxicity testing methods; Ethical issues in toxicology

Unit II: Toxicokinetics

Xenobiotics and recalcitrants: concept and classification; Absorption of xenobiotics, membrane barriers, binding and storage; Excretion of xenobiotics; Biotransformation: Mechanism; Bioaccumulation, bioconcentration and biomagnification;

Unit IV: Toxicants as public health hazard

Food additives; Impact of pesticides on human health; Impact of heavy metals on human health; Automobile emissions; Occupational diseases: Evaluation and control of occupational health hazards

PRACTICALS: (2 credits) **(60 hours)**

1. Pharmacological importance of various toxic medicinal plants of Kashmir Himalaya
2. Evaluating LD_{50} of various toxicants
3. To study the effect of toxic chemicals on seed germination or plant growth
4. Estimation of carbohydrates in biological samples
5. Estimation of proteins in biological samples
6. Investigate the toxicity of common household chemicals.
7. Assess the impact of pesticides on non-target organisms.
8. Investigate the impact of microplastics on aquatic organisms.

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VIII SEMESTER

COURSE CODE: EVS822J3 **COURSE TYPE: CT-3 (MAJOR)**
COURSE TITLE: Environmental Microbiology and Biotechnology
CREDITS: (Theory-4, Practical -2)

Course learning outcome: *This course is designed with the aim to study the importance of microorganisms in the establishment of life on earth, distribution of microorganisms in different habitats like soil, water air, extra-terrestrial environments and methods to study them. It also deals with the ways these microorganisms can be motivated and manipulated for remodifying the environmental issues, extraction of valuable substances, and conversion of waste to wealth.*

THEORY (4 credits: 60 hours)

Unit I: Microbes and environment
Microorganisms in environment; Factors effecting microbial growth; Microbial interactions; Role of microbes in carbon, nitrogen, phosphorus and sulphur cycles

Unit II: Microorganisms and human health
Human health and environment: Air borne microbial diseases: (SARS, COVID, Influenza, Tuberculosis); Water borne microbial diseases: Hepatitis, Cholera, Typhoid, Giardiasis); Soil borne Disease: (Tetanus, Gangrene); Food borne disease

Unit III: Environmental biotechnology
Bioremediation: concept and applications; Biocomposting and biogas production; Biofuels; Ecofriendly approach of Biofertilizers; Application of microbes in the control of oil pollution, pesticides and metals

Unit IV: Biotechnology applications
Biotechnology in pollution Control; Environmental genomics: concept and applications; Genetic engineering: concept and applications; Genetically modified organisms: Benefit and environmental risks; Metagenomics: environmental applications

PRACTICALS: (2 credits) **(60 hours)**

1. Demonstration of different sterilization techniques
2. Estimation of bacterial population in different water samples
3. Estimation of bacterial population in different soil samples
4. Preparation of bacterial smears and gram staining
5. Determination of coliforms in water samples
6. Estimation of fungal population in soil samples through culture techniques
7. Demonstration of molecular techniques for microbial identification.
8. A brief survey of any major disease in an area

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ENVIRONMENTAL SCIENCE
VIII SEMESTER

COURSE CODE: EVS822J1R **COURSE TYPE: CT-1 (MAJOR)**
COURSE TITLE: Research Methodology and Ethics
CREDITS: (Theory-3, Practical -1)

Course learning outcome: *The primary objective of the research methodology and ethics is to provide students with the fundamental knowledge of research methods and design used in. It also aims to facilitate students understanding for how using valid scientific methods of measurement and scaling can improve and create knowledge. The students will also be tasked to analyse and interpret the methods of quantitative and qualitative data and write and present a valid and ethical research report.*

THEORY (3 credits: 45 hours)

Unit I: Basics of research

Research foundations; Meaning and nature of research; Types of research- exploratory, experimental, descriptive, & causal research; Formulation of research problem and hypotheses; Identification of variables; Review of existing literature; Research design; research report writing

Unit II: Research methodology

Data collection; Development of scales/questionnaire/schedules/tests; Sampling- types, methods and errors; Measure of central tendency; Measurement of variance (range; standard deviation, standard error), Analysis of variance; Correlation and regression;

Unit III: Research ethics

Research ethics: introduction and importance; Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP); Predatory publishers and journals; Journal metrics; Intellectual property rights;

PRACTICALS: (1 credits) **(30 hours)**

1. Demonstration of different references styles
2. Demonstration of using statistical software (Excel/ SPSS/PAST)
3. Estimation of sampling size
4. Drafting of questionnaire

NEP 2020 FYUG PROGRAMME WITH ENVIRONMENTAL SCIENCE AS MAJOR/MINOR

ENVIRONMENTAL SCIENCE

VIII SEMESTER

COURSE CODE: EVS822J2R **COURSE TYPE: Internship/Research (MAJOR)**

COURSE TITLE: Research Project **CREDITS: (12)**

Course learning outcome: *The course outcome includes inspiring research aptitude among the students to carry out the research on various environmental issues, particularly the contemporary problems, albeit on a minor scale. The research project is also intended to provide students with a necessary platform to analyse the localized environmental problems at a greater depth and look for the solutions at a local level. Moreover it will also aid in helping students for writing the research proposals, seeking grants, and publishing their results to a wider audience through research publications.*

(Project work 12 credits)

Research Project:

This entails the submission of a project work dissertation by each student for evaluation. Students are mandated to submit their project work dissertations, which can be either laboratory-based or survey-based, for assessment. Prior to evaluation by an external examiner, the student is required to conduct an internal seminar and viva voce. The assessment breakdown includes 20% for internal evaluation, 60% for the dissertation, and 20% for the Viva Voce.

- **Submission of Dissertation/Thesis:**

(I). The student shall submit, after obtaining clearance, 3 hard bound copies of the Dissertation/ Thesis with the prescribed certificate on the first page duly signed by the candidate, the supervisor concerned, in the Department/Centre/Institute.

(II). Plagiarism: The students have to also attach plagiarism certificate with the dissertation

(III). The project dissertation should include following components:

1. Abstract
2. Introduction
3. Review of literature
4. Study area
5. Material and methods
6. Results
7. Discussion
8. Summary and conclusions