

## **Course Outcome**

*Curricula developed /adopted have relevance to the local/ national/ regional/ global developmental needs with learning objectives including program outcomes, program specific outcomes and course outcomes of all the programmes offered by the University*

This curriculum is designed to give a basic understanding of the Earth's life-supporting, ecological systems and the threats to those systems. Environmental Science is aimed to give students a broader understanding of how science and the scientific method work to address environmental problems. The student will become familiar with the Earth's major systems (ecosystems and biogeochemical cycles), how they function and how they are affected by human activity (population growth, air, water and soil pollution, ozone depletion, global warming, and solid waste disposal). Students will learn and gain understanding about the interaction of human society (urban sprawl, energy use/generation, resource consumption and economics) with the Earth's systems. There is a vast scope in private or in the government sector for the environments science degree holders. Under this course, aspirants can apply for a research degree in government organizations. Candidates those holding M.Sc. degree in Environmental Science can find many lucrative career opportunities in India as well as in abroad. Candidates who have completed masters degree in Environmental Science can find many jobs in government sector and private sector. They can get jobs in several government organizations like Pollution Control Board, Water Authority and Urban Planning. They can also work as Environmental Consultant for Central or State government. They can also get job in Indian Forestry Services. They can find opportunities in Research and Development area. Several government research organizations are offering jobs like Research Assistant and Research Fellow. MSc. Environmental Science graduates can apply for these jobs. Another job option available for these graduates is to take up teaching assignments in government Institutions.

DEPARTMENT OF  
ENVIRONMENTAL SCIENCE  
UNIVERSITY OF KASHMIR  
SRINAGAR-190006



**M.Sc. in Environmental Science**

**CHOICE BASED CREDIT BASED COURSE STRUCTURE TO BE  
IMPLEMENTED FROM ACADEMIC SESSION 2017**

**General course outline for two years program for four semesters**

**1<sup>ST</sup> SEMESTER**

Course	Course Code	Course Name	Paper category	Hours/Week			Credits
				L	T	P	
Core	<b>ENS17101CR</b>	Fundamentals of Environmental Science	Core	4			4
	<b>ENS17102CR</b>	Environmental Chemistry	Core	4			4
	<b>ENS17103CR</b>	Laboratory Course	Core			8	4
Discipline Centric Elective	<b>ENS17104DCE</b>	Environmental Geosciences	DCE	3	1		4
	<b>ENS17105DCE</b>	Environmental Toxicology	DCE	3	1		4
	<b>ENS17106DCE</b>	Mountain Ecology	DCE	1	1		2
	<b>ENS17107DCE</b>	Human and Environment	DCE	1	1		2

**2<sup>nd</sup> SEMESTER**

Course	Course Code	Course Name	Paper category	Hours/Week			Credits
				L	T	P	
Core	<b>ENS17201CR</b>	Environmental Pollution and its Control -I	Core	4			4
	<b>ENS17202CR</b>	Environmental Pollution	Core	4			4

		and its Control -II					
	<b>ENS17203CR</b>	Laboratory Course	Core			8	4
Discipline Centric Elective	<b>ENS17204DCE</b>	Atmospheric Sciences	DCE	3	1		4
	<b>ENS17205DCE</b>	Environmental Microbiology	DCE	3	1		4
	<b>ENS17206DCE</b>	Green Environment	DCE	1	1		2
	<b>ENS17207DCE</b>	Ecological Tour	DCE			2	2

### 3<sup>rd</sup> SEMESTER

Course	Course Code	Course Name	Paper category	Hours/Week			Credits
				L	T	P	
Core	<b>ENS17301CR</b>	Natural Resources	Core	4			4
	<b>ENS17302CR</b>	Environmental Impact Assessment	Core	4			4
	<b>ENS17303CR</b>	Laboratory Course	Core			8	4
Discipline Centric Elective	<b>ENS17304DCE</b>	Environmental Laws	DCE	3	1		4
	<b>ENS17305DCE</b>	Environmental Biotechnology	DCE	3	1		4
	<b>ENS17306DCE</b>	Remote Sensing and GIS	DCE	1	1		2
	<b>ENS17307DCE</b>	Ecological Tour (Ladakh)	DCE			2	2

### 4<sup>th</sup> SEMESTER

Course	Course Code	Course Name	Paper category	Hours/Week			Credits
				L	T	P	
Core	<b>ENS17401CR</b>	Environmental Engineering	Core	4			4
	<b>ENS17402CR</b>	Biodiversity and Resource Management	Core	4			4
	<b>ENS17403CR</b>	Project Work	Core			8	4
Disciplin e Centric Elective	<b>ENS17404DCE</b>	Aquatic Ecology	DCE	3	1		4
	<b>ENS17405DCE</b>	Terrestrial Ecology	DCE	3	1		4
	<b>ENS17406DCE</b>	Environmental Planning and Auditing	DCE	1	1		2
	<b>ENS17407DCE</b>	Restoration Ecology	DCE	1	1		2

## Course Descriptions 1<sup>st</sup> Semester

### CORE COURSES

#### **ENS17101CR: Fundamentals of Environmental Science (04 credits)**

##### **Unit I: Components of environment**

- 1.1. Definition, principle and scope of environmental science
- 1.2. Atmosphere: Structure and composition
- 1.3. Hydrosphere and cryosphere: Hydrological cycle
- 1.4. Lithosphere: Structure and composition
- 1.5. Biosphere: Components

##### **Unit II: Ecosystem dynamics**

- 1.1. Structure and function of ecosystems
- 1.2. Ecosystem resilience
- 1.3. Primary productivity
- 1.4. Secondary productivity
- 1.5. Energy flow, energy models and energy relations in ecosystems

##### **Unit III: Population and community ecology**

- 1.1. Characteristics of population
- 1.2. Population growth and population interactions
- 1.3. Population regulation: Density dependent and density independent
- 1.4. Concept and characteristics of communities
- 1.5. Ecological succession, primary and secondary processes in successions, climax community and types of climax

##### **Unit IV: Meteorology**

- 1.1. Meteorological parameters: Atmospheric pressure, temperature, precipitation, humidity and wind
- 1.2. Radiation and heat budget
- 1.3. Atmospheric stability
- 1.4. Temperature inversions
- 1.5. Wind roses

#### **ENS17102CR: Environmental Chemistry (04 credits)**

##### **Unit I: Analytical chemistry**

- 1.1. Stoichiometry
- 1.2. Titrimetry and gravimetry
- 1.3. Potentiometry (pH and conductivity)
- 1.4. UV-visible and flame photometry
- 1.5. Atomic absorption spectrophotometry

##### **Unit II: Atmosphere chemistry**

- 1.1. Formation and evolution of earth's atmosphere
- 1.2. Ions, radicals and particulates in the atmosphere

- 1.3. Formation of inorganic and organic particulate matter
- 1.4. Thermo-chemical and photochemical reactions in the atmosphere
- 1.5. Chemistry of green house gasses

### **Unit III: Water chemistry**

- 1.1. Physico-chemical characteristics of water
- 1.2. Solubility of gases in water; dissolved gases in water - CO<sub>2</sub>, O<sub>2</sub>, H<sub>2</sub>S, CH<sub>4</sub> and NH<sub>3</sub>
- 1.3. Biochemical oxygen demand and chemical oxygen demand
- 1.4. Carbonate-bicarbonate system
- 1.5. Redox potential

### **Unit IV: Soil chemistry**

- 1.1. Soil profile and pedogenesis
- 1.2. Inorganic and organic components of soil
- 1.3. Physico- chemical properties of soils
- 1.4. Biochemical properties of soil
- 1.5. Soil classification and types

## **ENS17103CR: Laboratory Course**

**(04 credits)**

### **Course Contents**

1. Estimation of volume of a water body: Pond, pool, lake
2. Determination of the soil texture in different terrestrial habitats
3. Estimation of meteorological parameters (temperature, precipitation, humidity, wind)
4. Determination of latitude, longitude and altitude of a place
5. Demonstration of major rock types
6. Determination of light intensity in different habitats
7. Standardization of reagents – titrants (acids, bases)
8. Determination of pH, conductivity, alkalinity and acidity of water samples
9. Estimation of pH, conductivity and alkalinity of soil samples
10. Estimation of free carbon dioxide content in water samples
11. Estimation of chloride content in different water and soil samples
12. Estimation of cations (calcium, magnesium, sodium, potassium) in water samples
13. Estimation of cations (calcium, magnesium, sodium, potassium) in soil samples
14. Experimental verification of Beer-Lambert's law
15. Determination of primary productivity aquatic habitats
16. Determination of primary productivity in terrestrial habitats
17. Study of dose – effect relationships in important toxicants/pollutants
18. Study of leaf pigment by paper chromatography and TLC methods
19. Estimation of protein and carbohydrate content in biological samples
20. Collection and identification of the fish fauna of different aquatic habitats

**DISCIPLINE CENTRIC ELECTIVE**

**ENS17104DCE: Environmental Geoscience**

**(04 credits)**

**Unit I: Earth science**

- 1.1. Origin and evolution of earth
- 1.2. Geological time scale
- 1.3. Earth surface processes
- 1.4. Geomagnetism: Magnetic and gravitational fields of the earth
- 1.5. Continental drift: Plate tectonics and Neo-tectonics

**Unit II: Natural hazards and disaster management**

- 1.1. Concept and classification of natural hazards
- 1.2. Causes and environmental consequences of
  - a. Earth quakes and Tsunami
  - b. Floods and droughts.
  - c. Landslides
- 1.3. Risk assessment and vulnerability analysis
- 1.4. Disaster management: preparedness, response, rehabilitation and failures (case studies)
- 1.5. National disaster management policy

**Unit III: Marine systems**

- 1.1. Marine zones
- 1.2. Composition of seawater
- 1.3. Marine resources and their recycling
- 1.4. Ice sheets and fluctuations of seawater
- 1.5. Ocean conveyor belt

**Unit IV: Geochemistry**

- 1.1. Geochemical classification and distribution of elements in earth
- 1.2. Mobility of trace elements
- 1.3. Concept of rare earth elements
- 1.4. Geochemical cycles - C, N, P, S
- 1.5. Concept of residence time and rate of natural cycles

**ENS17105DCE: Environmental Toxicology**

**(04 credits)**

**Unit I: Principles of toxicology**

- 1.1. Definition, scope, goals and divisions of toxicology
- 1.2. Factors influencing toxicity, toxicity of chemical mixtures
- 1.3. Factors affecting environmental concentration of toxicants,
- 1.4. Dose - response relationship
- 1.5. Toxicity testing methods (single & multi species, acute, sub-acute and chronic toxicity)

**Unit II: Biotransformation of xenobiotics**

- 1.1. Membranous barriers, binding, storage and absorption of xenobiotics
- 1.2. Excretion of xenobiotics
- 1.3. Biotransformation: General principles and types of biotransformation
- 1.4. Cytochrome P 450, its variants and their role
- 1.5. Glutathione – S- transferase, its variants and their role

**Unit III: Bio-magnification of xenobiotics**

- 1.1. Bioaccumulation, bioconcentration and biomagnification - study methods (microcosm)
- 1.2. Compartment models
- 1.3. Bioassay and its applications in toxicology
- 1.4. Antidotal procedures in toxicology
- 1.5. Chemical safety evaluation

**Unit IV: Toxicants as public health hazard**

- 1.1. Pesticides and heavy metals.
- 1.2. Radioactive substances and food additives
- 1.3. Automobile emissions.
- 1.4. Occupational diseases: Principles and methods of occupational health.
- 1.5. Evaluation and control of occupational health hazards.

**ENS17106DCE: Mountain Ecology**

**(02 credits)**

**Unit I: Mountains ecology**

- 1.1. Mountain ecosystem: Goods and services
- 1.2. Major mountains systems of the world: Himalayas, Alps, Andes
- 1.3. Ecological specializations in high altitude ecosystems
- 1.4. Impacts of climate change on mountain ecosystems
- 1.5. Mountain policy support: Land use dynamics, poverty and food security

**Unit II: Himalayan resources**

- 1.1. Glacier resources
- 1.2. Forests and forestry
- 1.3. Medicinal plants
- 1.4. Flora and fauna of Jammu & Kashmir
- 1.5. Energy resources of Jammu & Kashmir (Hydel and Solar)

**ENS17107DCE: Human and Environment**

**(02 credits)**

**Unit I: Environmentalism**

- 1.1. Environmentalism: Concept and history
- 1.2. Environmental organizations (WWF, UNEP, IUCN, WHO)
- 1.3. Environmental movements in India: Narmada dam, Tehri dam, Almatti dam and Chipko
- 1.4. The monetization frontier
- 1.5. Environmental politics

**Unit II: Environmental education and psychology**

- 1.1. Environmental education
- 1.2. Environmental protection and religious teachings
- 1.3. Public awareness and role of NGOs
- 1.4. Environmental psychology and current problems
- 1.5. Environmental ethics

## Course Descriptions 2<sup>nd</sup> Semester

### CORE COURSES

#### **ENS17201CR: Environmental Pollution and its Control – I (04 credits)**

##### **Unit I: Air pollution**

- 1.1. Sources, classification and properties of primary and secondary air pollutants
- 1.2. Pollutant's behaviour in atmosphere
- 1.3. Smog and acid rain
- 1.4. Ozone layer depletion
- 1.5. Global warming and climate change

##### **Unit II: Control of air pollution**

- 1.1. Indoor air pollution and its control: smoke, HCs, particulate matter, radon
- 1.2. Air quality standards and monitoring of air pollution: SO<sub>x</sub>, NO<sub>x</sub>, CO, SPM and hydrocarbon
- 1.3. Control of particulate and gaseous air pollution - SO<sub>x</sub>, NO<sub>x</sub>, CO
- 1.4. Control of green house gases
- 1.5. Bio-filters for control of air pollution

##### **Unit III: Noise pollution and its control**

- 1.1. Noise pollution: definition and sources
- 1.2. Measurement of noise
- 1.3. Equivalent sound pressure level (Leq), noise pollution level (NPL), sound exposure level (SEL), traffic noise index (TNI), day-night level (DNL), noise criteria curves
- 1.4. Impact of noise on human health and environment
- 1.5. Noise control and abatement measures

##### **Unit IV: Thermal and radioactive pollution and their control**

- 1.1. Thermal pollution: causes and consequences
- 1.2. Control of thermal pollution
- 1.3. Radioactive pollution: causes and consequences
- 1.4. Types of radioactive pollutants and their sources
- 1.5. Radioactive waste management and control

#### **ENS17202CR: Environmental Pollution and its Control – II (04 Credits)**

##### **Unit I: Land degradation and soil pollution**

- 1.1. Land degradation and soil pollution: causes and types
- 1.2. Desertification: causes, consequences
- 1.3. Soil erosion: causes, assessment and environmental impacts
- 1.4. Impact of pesticides in soil
- 1.5. Industrial waste effluents and heavy metals and their interaction with soil components

##### **Unit II: Control of land degradation and soil pollution**

- 1.1. Control of soil pollution
- 1.2. Soil conservation and control of soil erosion
- 1.3. Waste lands and their reclamation



- 1.4. Sustainable agricultural practices
- 1.5. Integrated pest management

### **Unit III: Water pollution**

- 1.1. Sources and types of water pollution
- 1.2. Lake eutrophication and stream pollution
- 1.3. Petroleum hydrocarbons and marine pollution
- 1.4. Ground water pollution
- 1.5. Biocides, heavy metals and their impact on aquatic life

### **Unit IV: Control of water pollution**

- 1.1. Water and waste water standards
- 1.2. Control of eutrophication and restoration of lakes and wetlands
- 1.3. Role of microbes in pollution abatement
- 1.4. Role of aquatic plants in pollution abatement
- 1.5. Control of Stream and groundwater pollution

## **ENS17203CR: Laboratory Course**

**(04 credits)**

### **Course Contents**

1. Estimation of rate of flow of water and determination of silt load of a stream / river
2. Estimation of total dissolved and suspended solids in water
3. Determination of rate of soil erosion in different ecosystems
4. Estimation of dissolved oxygen, BOD and COD in different waters
5. Estimation of organic carbon and organic matter in different soils samples
6. Estimation of nitrogen ( $\text{NH}_3$ ,  $\text{NO}_2$  and  $\text{NO}_3$ ) in different water samples
7. Estimation of phosphorus (inorganic, organic and total) in different waters
8. Estimation of phosphorus and nitrogen content in different soil samples
9. Estimation of dissolved silica and sulfate in different water bodies
10. Determination of  $\text{SO}_x$ ,  $\text{NO}_x$  and particulate matter (PM) in ambient air
11. Estimation of dust accumulated on plant parts and its effect on morphology and anatomy
12. Study of ambient noise levels in different zones
13. Qualitative and quantitative estimation of phytoplankton community in different aquatic habitats
14. Qualitative and quantitative estimation of periphyton community in different aquatic habitats
15. Qualitative and quantitative analysis of zooplankton in relation to eutrophication
16. Application of diversity indices in aquatic and terrestrial ecosystems
17. Biochemical tests for different enzymes
18. Preparation of bacterial smears and gram staining
19. Estimation of bacterial population in different water samples by culture technique
20. Estimation of fungal population in different habitats through culture techniques

**DISCIPLINE CENTRIC ELECTIVE**

**ENS17204DCE: Atmospheric Science**

**(04 credits)**

**Unit I: The atmosphere**

- 1.1. Introduction to atmospheric science
- 1.2. Atmospheric dynamics
- 1.3. Basic structure and mechanism of atmospheric general circulation,
- 1.4. Monsoon systems, cyclones, anticyclones, jet streams, ENSO
- 1.5. Air-sea interactions

**Unit II: Climatology**

- 1.1. Fundamentals of climatology
- 1.2. Classification of climate: Koppen's and Trewartha
- 1.3. Climatic zones of India
- 1.4. Climate of J&K
- 1.5. Paleo-climatology and climate change

**Unit III: Atmospheric aerosols**

- 1.1. Introduction and types of aerosols
- 1.2. Sources, transformation, geographical distribution and atmospheric effects
- 1.3. Chemical composition of aerosols
- 1.4. Carbonaceous aerosols: Black carbon
- 1.5. Global cooling versus global warming

**Unit IV: Atmospheric data analysis**

- 1.1. Dry and wet atmospheric deposition
- 1.2. LIDARS, SODARS, weather RADARS
- 1.3. Remote-sensing techniques (WP-RASS)
- 1.4. Self recording instruments, radiosondes, radiometersondes, ozone sonde
- 1.5. Climate modeling

**ENS17205DCE: Environmental Microbiology**

**(04 credits)**

**Unit I: Microbial ecology**

- 1.1. History and scope of microbiology
- 1.2. General account of micro-organisms
  - a. Bacteria
  - b. Fungi, algae and viruses
  - c. Protozoa
- 1.3. Interactions between microbes and other organisms
- 1.4. Factors affecting growth of microorganisms
- 1.5. Brief introduction to thermophiles, barophiles, acidophiles, alkalophiles and psychrophiles

**Unit II: Microbes and environment**

- 1.1. Nature and function of micro-organisms in soil, water and air
- 1.2. Microbial spoilage of food and its preservation
- 1.3. Microbial activity in sewage disposal
- 1.4. Application of micro-organisms in the control of

- a. Oil pollution
  - b. Chemical pollution - pesticides, synthetic polymers, and metals
  - c. Bio-deterioration of materials
- 1.5. Role of microbes in fixation and solubilization / mineralization of nutrients: carbon, nitrogen, phosphorus, sulphur

### **Unit III: Microorganisms and human health**

- 1.1. Human health and environment: MMR, IMR, Life expectancy, morbidity
- 1.2. Status of communicable diseases in India
- 1.3. Epidemiology (reservoir of infection, communicability and control)
  - a. Air borne diseases: tuberculosis, influenza viruses
  - b. Soil borne diseases: tetanus and gas-gangarine
  - c. Water and food borne diseases: cholera, typhoid, giardiasis, hepatitis
- 1.4. Allergic diseases
- 1.5. Insect vectors of human diseases like malaria, dengue, encephalitis, and their control

### **Unit IV: Industrial microbiology**

- 1.1 Major products of industrial microbiology - Antibiotics, amino acids and biopolymers.
- 1.2 Fermentation technology and bioprocessing
- 1.3 Role of microbiology in metallurgy.
- 1.4 Basic techniques in molecular biology - PCR and electrophoresis
- 1.5 Biosafety levels in microbiology labs.

## **ENS17206DCE: Green Environment**

**(02 Credits)**

### **Unit II: Ecotourism**

- 1.1. Ecotourism: concept and significance
- 1.2. Tourism in National Parks, sanctuaries, wetlands and other landscapes
- 1.3. Concept of tourism carrying capacity
- 1.4. Tourism policy
- 1.5. Ecotourism potential in J&K

### **Unit IV: Green cities**

- 1.1. Concept of green buildings and cities
- 1.2. Green belt
- 1.3. Consumer behavior
- 1.4. Sustainable urban traffic management
- 1.5. Green city: a case study

## **ENS17207DCE: Ecological Tour**

**(02 credits)**

During 2<sup>nd</sup> semester, students are required to go for institutional visit to various academic and research institutions outside Jammu & Kashmir carrying 02 credits and will form a component of Elective Allied. One credit will be given for participation and one credit for Tour report and viva voce.

## Course Descriptions 3<sup>rd</sup> SEMESTER

### CORE COURSES

#### **ENS17301CR: Natural Resources**

**(4 credits)**

##### **Unit I: Mineral resources**

- 1.1. Classification of mineral resources
- 1.2. Metals and minerals from land and their global distribution
- 1.3. Metals and minerals from oceans and their global distribution
- 1.4. Metals and mineral deposits in India with special reference in J&K
- 1.5. Environmental consequences of mineral exploitation

##### **Unit II: Water resources**

- 1.1. Inventory of earth's water resources: Surface and groundwater
- 1.2. Water resources of India with special reference to Kashmir
- 1.3. Global water budget
- 1.4. Surface and ground water resources: Global consumption pattern
- 1.5. Water resource management

##### **Unit III: Bio-resources**

- 1.1. Animal resources: current status with special reference to India
- 1.2. Fishery resources of India with special reference to J&K
- 1.3. Plant resources
- 1.4. Forest resources of India: Timber and non timber
- 1.5. Rangelands

##### **Unit IV: Energy resources**

- 1.1. Renewable energy resources
- 1.2. Non-renewable energy Resources
- 1.3. Nuclear energy
- 1.4. Concept of green fuels
- 1.5. Hydrogen as a source of energy

#### **ENS17302CR: Environmental Impact Assessment**

**(04 credits)**

##### **Unit I: Fundamentals of EIA**

- 1.1. Environment impact assessment: Concept, objectives and approaches
- 1.2. Strategic environmental assessment
- 1.3. EIA guidelines 2006 and amendments
- 1.4. Protocol for environment impact statements
- 1.5. Public participation in environmental decision making

##### **Unit II: EIA methodologies**

- 1.1. EIA methods
- 1.2. Baseline data generation
- 1.3. Air and water quality assessment
- 1.4. Ecological assessment
- 1.5. Social impact assessment

**Unit III: EIA Case studies**

- 1.1. Hydro power, irrigation and drainage
- 1.2. Industrial estates and Parks
- 1.3. Highways and Railways
- 1.4. Thermal power projects
- 1.5. Cement and Chemical industries

**Unit IV: Ecological modeling**

- 1.1. Role of models in ecology
- 1.2. Components of a model
- 1.3. Classes of mathematical models
- 1.4. Models of population (growth and interaction) and pollutant dispersal
  - a. Lotka – Volterra model
  - b. Leslie’s matrix model
  - c. Gaussian plume model
- 1.5. Modeling of air quality, water quality and noise characteristics

**ENS17303CR: Laboratory Course**

**(04 credits)**

**Course Contents**

1. Case studies based on environmental laws
2. Survey of different residential areas for determining the prevalence of different air, water, soil and food borne diseases
3. EIA – Leopold Matrix method and case studies
4. Socio-economic studies – preparing of questionnaire and case studies
5. Computation of standard deviation, standard error and coefficient of variation
6. Computation of correlation and regression
7. One way and two way classification of ANOVA
8. Land use / land cover classification from satellite data
9. Delineation of drainage of a given area from satellite data
10. Delineation of point, line and polygon themes
11. Waste auditing of any institution/ organization
12. Working and design of treatment plants
13. Spring and stream order classification
14. Study of colonization potential of periphyton on artificial substrates
15. Study of morphogenetic response of explants on media
16. Collection and demonstration of the pharmacognostic characters of important medicinal plants
17. Comparative anatomical study of mesophytes, hydrophytes and xerophytes
18. Collection and identification of common aquatic macrophytes
19. Field trip to National park/wildlife sanctuary/industrial area
20. Study of insect fauna in different environments

**DISCIPLINE CENTRIC ELECTIVE**

**ENS17304DCE: Environmental Laws**

**(04 credits)**

**Unit I: Environmental Protection**

- 1.1. Environment protection: Provisions of constitution (article 21,48A, 51A, and 253)
- 1.2. National efforts on environmental protection, laws and policy in India
- 1.3. International efforts for environment protection (Stockholm, Kyoto protocol)
- 1.4. CITES (1973)
- 1.5. Earth Summit

**Unit II: National Laws-I**

- 1.1. Indian forest act (1927), forest conservation Act (1980) and rules (1981)
- 1.2. Wildlife protection Act (1972) and amended (2002) and J & K wildlife (protection) Act (1978) as amended in (2002)
- 1.3. The Water (Prevention and Control of Pollution) Act (1974) as amended up to (1988) and rules (1975)
- 1.4. The Air (Prevention and Control of Pollution) Act as amended by amendment Act (1987) and rules (1982)
- 1.5. The Environmental (Protection) Act (1986)

**Unit III: National Laws-II**

- 1.1. Hazardous waste management and handling rules (1989)
- 1.2. Biomedical waste (management and handling) rules (1998)
- 1.3. Noise pollution (regulations and control) rules (2000)
- 1.4. Municipal solid wastes (management and handling) rules (2000)
- 1.5. The EPA rules (1986)

**Unit IV: National Laws-III**

- 1.1. Biological diversity Act (2002)
- 1.2. Public liability insurance act (1991)
- 1.3. Intellectual property rights and patent act (2005)
- 1.4. National environment tribunal act (1995)
- 1.5. National green tribunal act (2010)

**ENS17305DCE: Environmental Biotechnology**

**(04 credits)**

**Unit I: Introduction to environmental biotechnology**

- 1.1. Biotechnology
  - a. Concept and environmental relevance
  - b. Environmental risks
- 1.2. Elementary information of gene transfer, brief account of cloning vehicles
- 1.3. Recombinant DNA technology and its applications.
- 1.4. Environmental Genomics: A key to understanding biology, pathophysiology and disease
- 1.5. Molecular taxonomy: documenting biodiversity by DNA barcoding

**Unit II: Eco-friendly role of animals**

- 1.1. Vermiculture technology
  - a. Earth worms and soil productivity
  - b. Earthworm culture and vermi-composting

- 1.2. Aquaculture improvement through biotechnology
- 1.3. Fish farming through biological wastes
- 1.4. Stem cell and animal cloning
- 1.5. Biological control of insects -definition, principles and control mechanisms

### **Unit III: In-vitro storage of plants**

- 1.1 Tissue culture: Concept and importance
- 1.2 Micropropagation: Techniques and application
- 1.3 Conservation: Short term, medium term and long term
- 1.4 Recent developments in cryopreservation
- 1.5 Biotechnology in biodiversity conservation: Germplasm conservation , Gene banks and DNA banks

### **Unit IV: Biotechnology in environmental management**

- 1.1. Biosensors and bioindicators
- 1.2. Biotechnology in pollution control
- 1.3. Biodegradation and bioremediation
- 1.4. Emerging environmental biotechnological trends
- 1.5. Genetically modified organisms and bio-safety: a general account

## **ENS17306DCE: Remote Sensing and GIS**

**(02 credits)**

### **Unit I: Remote-sensing**

- 1.1. Concept and overview of remote sensing: Concept of resolution-spatial, spectral, radiometric and temporal
- 1.2. Remote Sensing satellites: LANDSAT & IRS satellite series
- 1.3. Electromagnetic spectrum: EMR sources-active & passive, radiation laws
- 1.4. Fundamentals of image interpretation and processing
- 1.5. Aerial photographs and their types on the basis of look angle

### **Unit II: Geographic information system**

- 1.1. Global positioning system : Basic principles and functioning
- 1.2. Development of GIS, functional requirements of GIS: hardware configuration and software modules
- 1.3. Geographic data: Spatial and non-spatial, data models: raster and vector
- 1.4. Remote sensing and GIS integration
- 1.5. Application of remote sensing and GIS in:
  - a. Monitoring and management of biodiversity
  - b. Integrated watershed development and
  - c. Environmental impact assessment

## **ENS17307DCE: Ecological Tour to Ladakh**

**(02 credits)**

During 3<sup>rd</sup> semester, students will be required to go for the field study tour within Jammu & Kashmir carrying 02 credits which will form a component of the elective allied. One credit will be given for participation and one credit for field collection, tour report and viva-voce.

## Course Descriptions 4<sup>th</sup> SEMESTER

### CORE COURSES

#### **ENS17401CR: Environmental Engineering (04 credits)**

##### **Unit I: Fundamentals of environmental engineering**

- 1.1. Environmental engineering: Introduction and scope
- 1.2. Sewage and storm water drainage
- 1.3. Planning of housing drainage
- 1.4. Environmental sanitation
- 1.5. Ventilation and air conditioning

##### **Unit II: Drinking water treatment**

- 1.1. Methods of water purification: flocculation, sedimentation, sedimentation with coagulation
- 1.2. Filtration: sand filters, pressure filters, horizontal filters
- 1.3. Disinfection and desalination of water
- 1.4. Chemical treatment: adsorption, gas stripping, ion exchange
- 1.5. Reverse osmosis and distillation

##### **Unit III: Sewage treatment**

- 1.1. Wastewater treatment plants: Concept, methods and design
  - a. Primary
  - b. Secondary
  - c. Tertiary
- 1.2. Sludge and its disposal techniques
- 1.3. Natural methods of sewage disposal
- 1.4. Biology of sewage treatment
- 1.5. Reclamation and reuse of industrial and domestic wastewater

##### **Unit IV: Solid and hazardous waste management**

- 1.1. Solid wastes: sources, generation and their characteristics
- 1.1. Hazardous waste: sources and generation and their characteristics
- 1.2. Disposal and management of solid, industrial and hazardous wastes,
- 1.3. Hospital waste management
- 1.4. Site remediation

#### **ENS17402CR: Biodiversity and Resource Management (04 credits)**

##### **Unit I: Biogeography**

- 1.1. Geographical classification and zones
- 1.2. Major biomes of the world: Distribution and characteristic features
- 1.3. Zoogeographic realms of the world: Palaearctic, nearctic, neotropical, oriental, australian and african
- 1.4. Dispersal: Means, modes and barriers, island life
- 1.5. Migrations



**Unit II: Biodiversity**

- 1.1. Biodiversity: Status and importance, India as a mega-diversity nation
- 1.2. Endemism: Factors controlling distribution of flora and fauna
- 1.3. Hot Spots and cold spots, concept of native and exotic species
- 1.4. Biodiversity decline: Drivers of change and pressures
- 1.5. Threatened species categories of IUCN; concept of extinction threshold and extinction debt

**Unit III: Biodiversity Management**

- 1.1. Forest conservation: social forestry and joint forest management
- 1.2. Management of rangelands
- 1.3. Fishery resource management
- 1.4. Monitoring and management of bio-diversity
- 1.5. Biodiversity Conservation
  - a. In-situ conservation: National parks, sanctuaries, biosphere reserves, Ramsar Sites
  - b. Ex-situ conservation: botanical gardens, zoological parks, zoos, seed banks, in-vitro conservation

**Unit IV: Management of natural resources**

- 1.1. Concept and strategies of sustainable development
- 1.2. Management of mineral resources
- 1.3. Management of fresh water resources
- 1.4. Energy crisis and conservation of energy resources
- 1.5. Concept of ecological footprint and carbon sequestration

**ENS17403CR: Project Work**

**(04 credits)**

The project work shall be of practical nature and the candidate has to carry out the project work related to environment under the supervision of concerned teacher.

The distribution should be as follows:

- **Part I:** Identification of problem area and general description
- **Part II:** Study of specific literature in detail pertaining to the statement of the problem
- **Part III:** Developing a solution, methodology or proposing a hypothesis to solve the problem
- **Part IV:** Experimental analysis, results, discussion, conclusion and recommendations

Each student has to submit the dissertation of the project work for evaluation. The student has to give seminar (internal) and vivo voce (external) of the project work.

**DISCIPLINE CENTRIC ELECTIVE**

**ENS17404DCE: Aquatic Ecology**

**(04 credits)**

**Unit I: Freshwater ecology**

- 1.1. Aquatic ecosystem services
- 1.2. Aesthetic values of lakes and rivers
- 1.3. Paleolimnology
- 1.4. Trophic dynamics in aquatic ecosystems
- 1.5. Role of phytoplankton and zooplankton

**Unit II: Stream and river ecology**

- 1.1. Concepts in stream ecology and stream classification
- 1.2. Streams and rivers as ecosystems
- 1.3. Chemical fluxes and dynamics in river and stream ecosystems
- 1.4. Aquatic insects ecology and feeding in streams and rivers
- 1.5. Concept and importance of riparian zones

**Unit III: Lakes and wetland ecology**

- 1.1. Ecology of lakes and wetlands: Global distribution and classification systems
- 1.2. Macrophytes: classification and zonation
- 1.3. Mixing dynamics in lakes across climatic zones
- 1.4. Effect of climate change on lakes and wetlands
- 1.5. Important lakes and wetlands of J&K

**Unit IV: Groundwater ecology**

- 1.1. Groundwater ecology and hydrology
- 1.2. Vertical distribution of groundwater, Darcy's law and its validity
- 1.3. Types of aquifers and their classification
- 1.4. Subterranean ecosystems and biodiversity
- 1.5. Groundwater quality and management

**ENS17405DCE: Terrestrial Ecology**

**(04 credits)**

**Unit I: Terrestrial ecosystems**

- 1.1. Ecosystem structure and processes
- 1.2. Terrestrial water and energy balance
- 1.3. Terrestrial production
- 1.4. Terrestrial decomposition
- 1.5. Carbon sequestration potential of terrestrial ecosystems

**Unit II: Soil and landscape ecology**

- 1.1. Soil process and ecosystem functioning
- 1.2. Soil biology
- 1.3. Concept of landscape ecology
- 1.4. Tools and approaches in landscape ecology
- 1.5. Application of landscape ecology

**Unit III: Forest and agro-ecology**

- 1.1. Forest community structure and function

- 1.2.Theory and practice of managing the establishment, composition, and development of the forest
- 1.3.Urban forest ecology
- 1.4. Agro-ecosystems: Concept, structural and functional components
- 1.5. Role of biodiversity in agro-ecosystems, Food security and agriculture

**Unit IV: Desert and grassland ecology**

- 1.1. Ecological complexity of the desert commies
- 1.2. fauna and flora of the deserts
- 1.3. Ladakh cold desert
- 1.4. Grasslands ecology: evolution and types
- 1.5. Biodiversity and conservation in grasslands

**ENS17406DCE: Environmental Planning and Auditing (02 credits)**

**Unit I**

- 1.1.Environmental planning – importance and objectives
- 1.2.Land use planning
- 1.3.Urban development and environmental planning
- 1.4.Rural development and environmental planning
- 1.5. Role of ethics, aesthetics and science in environmental planning

**Unit II**

- 1.1.Principles and guidelines of environmental auditing
- 1.2.Preparation of environmental audit report
- 1.3.Waste audit procedures – sources, types and management of wastes
- 1.4.ISO 9001 and 9002
- 1.5.ISO 14000

**ENS17407DCE: Restoration Ecology (02 credits)**

**Unit I: Concepts in restoration ecology**

- 1.1. The basic principles and concepts of restoration ecology
- 1.2. Characteristics of degraded and restored ecosystems
- 1.3. Ecological indicators in restoration
- 1.4. Theory and practice of restoring animal and plant diversity
- 1.5. Ecological principles of the restoration of native ecosystems

**Unit II: Restoration planning**

- 1.1. Goals and objectives
- 1.2. Adaptive management and monitoring
- 1.3. Ethics of restoration
- 1.4. Role of public-private partnership in restoration
- 1.5. Measuring progress and success of restoration programs