Course Structure along with credit distribution for P.G Programmes (From batch 2026-28 onwards)

(For practical based subjects)

P.G. First Year (for Two-year P.G. program)

First Semester

	M. Sc. First Semester					
Entry requirement	3-year Bachelor's degree (minimum 120 credits) or 4-Year Bachelor's Degree (In case of B. Tech and B.E programme-Minimum-160 credits) and candidates who have met the entrance requirements, including specified levels of attainment, in the programme admission regulations.					
Course Code	Course Category		Course Title	Credits		Total Credit
				T	P	
SOLS/EVS-C-001	DSC-1		Fundamentals of Environmental Sciences	**3**	**2**	**5**
SOLS/EVS- C-002	DSC-2		Natural Resource Management	**3**	**2**	**5**
SOLS/EVS-C-003	DSC-3		Environmental Chemistry	**3**	**2**	**5**
SOLS/EVS-SEC-001	SEC-1 **SEC**	Opt any one out of two	Community Based Conservation and Management	**3**	**2**	**5**
SOLS/EVS-SEC-002	SEC-1 **Vocational**		Field Visit	**5**	**0**	**5**
SOLS/EVS-DSE-001	DSE-1	Opt any one out of two	Man and Environment	**3**	**1**	**4**
SOLS/EVS-DSE-002			Traditional Ecological Knowledge	**3**	**1**	**4**
OR						
SOLS/EVS-MDE-001	MDE-1	Opt any one out of two	Forest ecology and management	**3**	**1**	**4**
SOLS/EVS-MDE-002			Himalayan Wildlife Management	**3**	**1**	**4**
OR						
SWAYAM 1	Opt any one out of two		Climate and Environmental Protection	**4**	**0**	**4**
SWAYAM 2			Rural Water Resource Management	**4**	**0**	**4**
AEC	**AEC (Non-CGPA Course)**		Indian Knowledge System	**1**	**0**	**1**
Total Credit				**15**	**09**	**24**

Note: *1. In lieu of SEC the departments may offer any one course i.e. skill-based courses/Vocational Course work of 5 credits.*

2. In lieu of DSE the departments may offer any one course i.e. Field work based/Swayam Course work of 4 credits.

3. The University shall provide a common syllabus for the course titled **"Indian Knowledge System."**

Second Semester

M. Sc. Second Semester						
Course Code	Course Category		Course Title	Credits		Total Credit
				T	P	
SOLS/EVS-C-004	DSC-4		Environmental Microbiology and Biotechnology	**3**	**2**	**5**
SOLS/EVS-C-006	DSC-5		Disaster Risk Reduction	**3**	**2**	**5**
SOLS/EVS-C-006	DSC-6		Environmental Pollution	**3**	**2**	**5**
SOLS/EVS-SEC-003	SEC-2		Ecosystem Restoration and Management	**3**	**2**	**5**
SOLS/EVS-SEC-004	SEC-2		**Vocational** (Field Visit)	**5**	**0**	**5**
SOLS/EVS-DSE-003	DSE-2	Opt any one out of two	Environment *Vs* Development	**3**	**1**	**4**
SOLS/EVS-DSE-004			Mountain Ecology	**3**	**1**	**4**
OR						
SOLS/EVS-MDE-003	MDE-2	Opt any one out of two	Waste Management	**3**	**1**	**4**
SOLS/EVS-MDE-004			Human–Wildlife Conflict	**3**	**1**	**4**
VAC	**VAC (Non-CGPA Course)**		Constitutional, ethical, and moral values	**1**	**0**	**1**
Total Credit				**15**	**09**	**24**
NHEQF Level-6	Student on exit after successfully completing first year of two-year PG programme (i.e., securing minimum required 48 credits will be awarded "Postgraduate Diploma" of one year, in related field/discipline/subject.					

Note: *1. In lieu of SEC the departments may offer any one course i.e. skill-based courses/Vocational Course work of 5 credits.*

2. In lieu of DSE the departments may offer any one course i.e. Field work based/Swayam Course work of 4 credits.

3. The University shall provide a common syllabus for the course titled "Constitution, Ethical and Moral Values."

Third Semester

M. Sc. Third Semester						
Course Code	Course Category		Course Title	Credits		Total Credit
				T	P	
SOLS/EVS-C-007	DSC-7		Environmental Economics and Sustainable Development	**3**	**2**	**5**
SOLS/EVS-C-08	DSC-8		Environmental Geosciences and Polar Affairs	**3**	**2**	**5**
SOLS/EVS-C-09	DSC-9		Biodiversity Conservation and Management	**3**	**2**	**5**
SOLS/EVS-C-010	DSC-10		Research Methodology and Environmental Statistics	**3**	**2**	**5**
SOLS/EVS-DSE-005	DSE-3	Opt any one out of two	Ecosystem services and their valuation	**3**	**1**	**4**
SOLS/EVS-DSE-006			Protected Area Network in India	**3**	**1**	**4**
OR						
SOLS/EVS-MDE-005	MDE-3	Opt any one out of two	Himalayan Bioresources and Management	**3**	**1**	**4**
SOLS/EVS-MDE-006			Green Development	**3**	**1**	**4**
SEC	**SEC (Non-CGPA Course)**		Academic Library Systems and Services	**1**	**0**	**1**
OR						
SEC	**SEC (Non-CGPA Course)**		Entrepreneurship &Startup Awareness	**1**	**0**	**1**
Total Credit				**15**	**09**	**24**

Note: 1. ***In lieu of DSE/MDE the departments may offer any one course i.e. dissertation/project/Field work of 4 credits.***

2. The University shall provide a common syllabus for the course titled **"Academic Library Systems and Services/Entrepreneurship & Startup Awareness"**

Fourth Semester

M. Sc. Fourth Semester						
Course Code	Course Category		Course Title	Credits		Total Credit
				T	P	
SOLS/EVS-C-011	DSC-11		Environmental Management: EIA and Environmental Auditing	**3**	**2**	**5**
SOLS/EVS- C-012	DSC-12		Environmental Laws, Ethics and Policies	**3**	**2**	**5**
SOLS/EVS-C-013	DSC-13		Climate Change Adaptation and Mitigation	**3**	**2**	**5**
SOLS/EVS-C-014	DSC-14		Remote sensing, GIS and Environmental Modeling	**3**	**2**	**5**
OR						
Optional Component (Research / Skill Oriented) in lieu of DSC			**Option–I: Minor Dissertation / Project Work***(in lieu of any **one** DSC)*	**5**		**5**
			Option–II: Major Dissertation / Project Work*(in lieu of any **two** DSCs)*	**10**		**10**
SOLS/EVS-DSE-007	DSE-4	Opt any one out of two	Spring-shed Conservation and Management	**3**	**1**	**4**
SOLS/EVS-DSE-008			Wetland ecosystem and management	**3**	**1**	**4**
OR						
SOLS/EVS-MDE-007	MDE-4	Opt any one out of two	Toxicology	**3**	**1**	**4**
SOLS/EVS-MDE-008			Green Business, IPR and International Agreements	**3**	**1**	**4**
SEC	**SEC (Non-CGPA Course)**		Community outreach activities	**1**	**0**	**1**
Total Credit				**15**	**09**	**24**
NHEQF Level-6.5	***Student on successfully completing one-year PG programme (i.e., securing minimum required 48 credits will be awarded "Postgraduate Degree", in related field/discipline/subject.***					

Note: 1. ***In lieu of* DSC *the departments may offer any one course i.e. core paper course/Minor Dissertation / Project Work of 5 credits. Or Major Dissertation / Project Work****(in lieu of any **two** DSCs)* ***of 10 credit***

2 . In lieu of* SEC Non-CGPA Course) *the departments may offer Community outreach activities of 1 credit.

First Semester for 2-year M.Sc. program

Course Code: SOLS/EVS-C-001
Course Title: DSC-1 Fundamentals of Environmental Sciences (03 Credits)

Unit I. Introduction to Environmental Science

1.1 Definition, scope and importance of Environmental Sciences
1.2 Components of environment: atmosphere, hydrosphere, lithosphere and biosphere
1.3 Human Influence on the Environment: Biosphere-2, Noosphere and Technosphere
1.4 Various activities under national environment awareness Campaigns (NEAC)

Unit II. Ecosystem

2.1 Structure and Function of an ecosystem
2.2 Major ecosystems: Himalaya, Marine ecosystems, Deserts, Freshwater ecosystems, Forests and Antarctica ecosystem
2.3 Food chain, food web and ecological pyramids
2.4 Energy pathways and ecological processes
2.5 Ecosystem productivity (primary and secondary)
2.6 Biogeochemical cycles: Nitrogen, Carbon, Phosphorus, Sulphur, Water and Oxygen

Unit III. Population, Community, Ecological Succession

3.1 Characteristics of population
3.2 Population growth
3.3 Concept and characteristics of communities (concept of habitat, niche, keystone species, dominant species, flagship species and ecotones)
3.4 Ecological succession: primary and secondary succession, climax communities and trends in succession
3.5 Ecological adaptations (Air, Hill, Stream water, Desert and Deep Sea)

Unit IV.Self-Sustenance of Ecosystem

4.1 Homeostasis and Self-Regulation in Ecosystems
4.2 Ecosystem Stability, Resilience and Adaptation
4.3 Biodiversity as a Key to Ecosystem Stability
4.4 Factors Influencing Ecosystem Sustainability

Course Code: SOLS/EVS-C-P-001

Course Title: DSC -1 Practical **(02 Credits)**

Exercise01. Analysis of various components of ecosystems.

Exercise02. Determination of soil texture in different terrestrial habitats.

Exercise03. Calculation of frequency, density and abundance of different ecosystem.

Exercise04. Calculation of Importance Value Index (IVI) for grassland ecosystems/forest patches.

Exercise05. Monitoring of biological diversity and calculation of Shannon Wiener diversity index in aquatic/ terrestrial habitats.

Course Code: SOLS/EVS- C-002
Course Title: DSC-2 Natural Resource Management (03Credits)

Unit I. Fundamentals of Natural Resource Management

- **1.1** Natural resources- concepts, types, distribution and consumption pattern.
- **1.2** Factors influencing resource availability
- **1.3** Ecosystem services by various natural resources
- **1.4** Resource management paradigms

Unit II. Forest and Wildlife Resources and their Management

- **2.1** Forest resources: Major Forest types, their characteristics and distribution status of forest cover of India
- **2.2** Forest use and over exploitation: Timber extraction, infrastructure development, dams and their effects on forests and tribal communities
- **2.3** Forest conservation and management practices
- **2.4** Wildlife resources: current status, services and threats
- **2.5** Human-wildlife conflict and its resolution
- **2.6** Principles and practices of wildlife management

Unit III. Water Resources and their Management

- **3.1** Water resources: Historical background, world scenario and current challenges, status of surface and groundwater
- **3.2** Water resources in Uttarakhand (glaciers, lakes and rivers of Uttarakhand), utilization pattern; Drainage systems of Ganga, Yamuna and Ramganga.
- **3.3** Use and over exploitation of surface and ground waters
- **3.4** Integrated Water Resource Management (IWRM): Key challenges and issues
- **3.5** Legal aspects of water resources and management

Unit IV. Energy Resources and their Management

- **4.1** Definition, concept and classification of energy resources
- **4.2** Non-renewable energy resources (fossil fuels, nuclear energy, hydrogen fuel cell)
- **4.3** Renewable energy resources (solar energy, wind energy, hydropower energy, tidal energy, geo-thermal energy)
- **4.4** Energy Management: energy crisis, energy audit, sustainable use of energy resources, alternate energy sources, future energy options and challenges

Course Code -SOLS/EVS- C-P-002

Course Title: DSC -2 Practical **(02 Credits)**

Exercise01. To inventory of natural resources of any forest ecosystem located in nearby area.

Exercise02. To study socio-economic status of any given locality.

Exercise03. Calculate analytical and synthetic characters of different forest stands.

Exercise04. Inventorization of local NTPFs.

Exercise05. Economic evaluation of a forest/lake/river area

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Course Code- SOLS/EVS-C-003

Course Title- DSC-3 Environmental Chemistry **(03 Credits)**

Unit I. Fundamentals of Environmental Chemistry

1.1 Stoichiometry
1.2 LawsofThermodynamics andGibbsenergy
1.3 Chemicalpotential
1.4 ChemicalkineticsandChemicalequilibrium
1.5 Solubilityof gases in water
1.6 ConcentrationUnits(Normality,MolarityandMolality)
1.7 Saturatedandunsaturated hydrocarbons
1.8 Radioisotopes

Unit II. Atmospheric Chemistry

2.1 Troposphericchemistry
2.2 Atmosphericaerosols and particulate matter
2.3 Gaseouspollutants
2.4 Stratospheric ozone chemistry
2.5 Photochemical smog

Unit III. Water Chemistry

3.1 Physico-chemicalpropertiesofwater
3.2 HydrologicalCycle
3.3 Sedimentation,Coagulation,flocculation,filtration
3.4 Carbonatesystem

UnitIV.Soil Chemistry

4.1 Physicochemical and biological properties of soil
4.2 Mechanismofrockweathering
4.3 Physiochemical properties of soil
4.4 Biogeochemical cycles- Nitrogen, carbon, phosphorus and sulphur

Course Code- SOLS/EVS-C-P-003

Course Title –DSC3 Practical (02 credits)

Exercise01. Determination of temperature, pH and electrical conductivity of a given sample of water and soil samples

Exercise02. Determination of dissolved oxygen (Modified Winkler's method),BOD and COD in a given sample of water

Exercise03. Determination of Total solid, Total dissolved solids (TDS) and total suspended solids (TSS) in a water sample

Exercise04. Determination of Total hardness and alkalinity of a given water sample

Exercise05. Determination of chloride in a given water sample

Course Code - SOLS/EVS-SEC-001
Course Title -SEC-1 - Community Based Conservation and Management (03 Credit)

Unit I. Introduction of community based approaches

1.1 Fundamental concepts and structure of indigenous and local communities
1.2 Evolution of conservational attitude in communities and TEK
1.3 Concept of protection, conservation, preservation and management
1.4 Principles of participatory management
1.5 Difference between government based and community based conservation

Unit II. Natural resource management and biodiversity conservation

2.1Community based practices in forest, water, land, grassland, pasture, agriculture, healthcare, wildlife management and sustainable use and conservation of biodiversity
2.2 Participatory rural appraisal and urban community conservation
2.3 Gender and social inclusion in resource management
2.4. Community reserves and sacred groves
2.5 Human-wildlife conflict management

Unit III. Sustainable livelihoods and conservational approaches

3.1 Eco-development and community participation
3.2 Eco-tourism and livelihood security
3.3 Sustainable agriculture and agro-forestry
3.4 Utilization of non-timber forest products
3.5 Climate resilience and community adaptation strategies

Unit IV. Policy framework and governance

4.1 Community institutions and self-help groups
4.2 Panchayti raj institutions, van panchayat system and community conserved areas
4.3 Role of governmental institutions and NGOs and co-management approaches
4.4 Legal initiatives (Biological Diversity Act 2002, Forest Right Act 2006, Forest Conservation Act, Joint Forest Management, Protected Area Network and Mission LiFE)
4.5 Case study (Chipko movement, Bishnoi movement, Appiko movement, Narmada Bachao Andolan, Chilka Bachao Andolan etc.)

Course Code - SOLS/EVS-SEC-P-001
Course Title -SEC-1 – Practical **(02 Credit)**

Exercise01. To study socioeconomic structure of communities in your locality.

Exercise02. To study resource conservation and management attitude in various societies.

Exercise03. To study causes and impacts of human-wildlife conflicts on society.

Exercise04. To study livelihood security through resource conservation and management in various communities.

Exercise05. To study implementation of legal and policy framework for conservation and management.

Course Code - SOLS/EVS-SEC-002
Course Title -SEC-1 – Field Visit (Vocational) (05 Credit)

Field Visit: Optany one of following:

1. **Ecosystem Study Tour**

   1.1 Field visit to any National Parks, wetlands, forests, rivers, disaster prone areas

   1.2 Preparation and submission of a detailed field study report including observations, data collection, analysis, findings, and recommendations.

2. **Industrial Environmental Management**

   2.1 Visit to industries or industrial areas to study pollution control systems, effluent treatment plants (ETP), and environmental management practices.

   2.2 Preparation and submission of a detailed field study report including observations, data collection, analysis, findings, and recommendations.

3. **Sustainable Agriculture and Rural Ecology**

   3.1 Visit to organic farms, agroforestry systems, and rural communities to understand sustainable farming and natural resource management.

   3.2 Preparation and submission of a detailed field study reportincluding observations, data collection, analysis, findings, and recommendations.

4. **Waste and Water Management Study**

   4.1 Visit to solid waste management facilities, sewage treatment plants (STP), rainwater harvesting sites, and water treatment plants for practical understanding of resource management.

   4.2 Preparation and submission of a detailed field study report including observations, data collection, analysis, findings, and recommendations.

Course Code: SOLS/EVS-DSE- 001
Course Title: DSE-1 Man and Environment **(03 Credits)**

Unit I. Man and Environment Relationship

- **1.1** Pre-historic man and Environment
- **1.2** Hunting and Gathering society and Environment
- **1.3** Pastoralism and Environment
- **1.4** Agro-society and Environment
- **1.5** Industrial society and Environment
- **1.6** Future Society (Sustainable Society)

Unit II. Fundamentals of Environmental Sociology

- **2.1** Definition, concepts, issues and scope of Environmental Sociology
- **2.2** Concept of caste, tribe, clan, society and social structure
- **2.3** Cultural Resources
- **2.4** Indigenous/traditional wisdom for Environmental protection

Unit III. Religion, Culture and Environment

- **3.1** Role of religion, culture, belief and traditions in conserving environment
- **3.2** Hinduism and The Environment
- **3.3** Buddhism and The Environment
- **3.4** Islam and The Environment
- **3.5** Christianity and The Environment
- **3.6** Jainism and The Environment
- **3.7** Sikhism and The Environment

Unit IV. Environmental Ethics and Moral

- **4.1** Definition and concept of Environmental Ethics
- **4.2** Resource consumption patterns and need for equitable utilization
- **4.3** Anthropocentrism, stewardship, biocentrism, ecocentrism, Cosmo centrism
- **4.4** Conservation ethics, traditional value system in India
- **4.5** Sacred Landscapes, Sacred grooves and Sacred species

Course Code: SOLS/EVS-DSE- P-001

Course Title: DSE-1 Practical

(01 Credit)

Exercise01: To study the various stages of human evolution.

Exercise02: To study the artifacts of ancient human.

Exercise03: To study the social structure of communities in nearby area.

Exercise04: To study the environmental concerns in various religions.

Exercise05: To study traditional conservational ethics in various Indian communities.

Course Code: SOLS/EVS-DSE- 002
Course Title: DSE-1 Traditional Ecological Knowledge (03 Credits)

Unit I. Introduction

- **1.1.** Definition, concept, and scope of TEK
- **1.2.** Traditional ecological knowledge as a science
- **1.3.** TEK in different forms (stories, legends, folklore, rituals, folk songs, and dictums)
- **1.4.** Traditional technology of subsistence (artifacts, crafts *etc.*)
- **1.5.** Language and traditional knowledge

Unit II. Cultural, Sacred, Myth, Rituals and Beliefs

- **2.1.** Basic concept of society, culture and religion
- **2.2.** Nature, aims and objectives of comparative religion (caste, community and their culture).
- **2.3.** Basic feature of religion and principal sets of religion
- **2.4.** Myths, rituals and beliefs associated with TEK in Hinduism, Buddhism, Islam and Christainity
- **2.5.** TEK in Indian Himalayan states

Unit III. TEK and Natural Resources Management

- **3.1.** TEK for forest conservation,
- **3.2.** TEK for water harvesting,
- **3.3.** TEK for wildlife case study
- **3.4.** TEK for conservation of biodiversity
- **3.5.** TEK related with medicinal plants
- **3.6.** TEK related with agriculture, horticulture and cattle rearing

Unit IV. Knowledge Transfer: Old Concepts and Barriers

- **4.1.** Old concepts and barriers in transferring indigenous traditional knowledge
- **4.2.** Old myths in transferring traditional knowledge
- **4.3.** God and man
- **4.4.** Ways of prayers, rituals in different communities

Unit V. Documentation and Preservation of TEK

- **5.1.** Need for Documentation and Preservation
- **5.2.** International laws and policy of TEK
- **5.3.** Laws and policy in India for TEK

Course Code: SOLS/EVS-DSE- P-002

Course Title: DSE-1 Practical

(01 Credit)

Exercise01: To study origin and evolution of various environmental movements.

Exercise02: Preparation of an inventory of TEK for water conservation.

Exercise03: Preparation of an inventory of TEK for biodiversity conservation.

Exercise04: Preparation of an inventory of TEK related to medicinal plants.

Exercise05: Documentation of traditional technology of subsistence (Artifacts, Crafts, Handlooms etc.)

Course Code: SOLS/EVS-MDE- 01
Course Title: MDE-1 Forest ecology and management (03 Credits)

Unit I: Fundamentals of Forest Ecology

1.1 Introduction to Forest Ecology: Definition, scope, autecology and synecology, Levels of ecological organizationand applications of forest ecology
1.2 Forest Ecosystem: Structure and functions, Ecosystem productivity, Forest biomes of the world, Forest types of India
1.3 Energy Flow and Ecological Processes, Nutrient dynamics in forest ecosystems and Ecological factors affecting forests
1.4 Ecological Succession: Types of succession, Hydrosere and xerosere, Climax theories Ecotone and edge effect

Unit II: Forest Soil, Climate and Hydrology

2.1 Forest Soiland Nutrient Cycling: Soil formation processes, Soil profile and horizons, Physico-Chemical properties of soil, Soil organic matter and microorganisms, Litter decomposition
2.2 Climate and Forests: Climate–vegetation interactions, Microclimate in forests,
2.3 Forest Hydrology: Watershed concept, Runoff and infiltration, soil erosion and conservation
2.4 Climate Change and Carbon Dynamics: Greenhouse gases, Carbon sequestration, Carbon stock estimation, Climate change impacts on forests, REDD+ mechanisms

Unit III: Forest Mensuration,Forest Protection and Disturbances

3.1 Tree Measurement: Diameter and Height measurement, Basal area calculation, Tree form and volume
3.2 Forest Inventory: Sampling methods, Fixed and variable plots, Inventory design, Stock mapping
3.3 Biomass and Carbon Estimation: Above-ground biomass, Below-ground biomass, Carbon stock estimation methods, Allometric equations
3.4 Statistical Applications: Descriptive statistics, Correlation and regression, Analysis of variance
3.5 Forest Insects and Diseases, Integrated pest management, Invasive Species
3.6 Anthropogenic Disturbances: Deforestation and Fragmentation, grazing and lopping, Fuelwood extraction, Shifting cultivation,Forest Fire, Mining and developmental activities

Unit IV: Forest Management, Silviculture and Forest Policy

4.1 Forest Management: Objectives, Multiple-use forestry, Forest management systems
4.2 Social Forestry and Agroforestry: Social forestry concepts, Farm forestry, Community forestry, Agroforestry systems and benefits
4.3 Plantation Forestry: Afforestation and reforestation, Plantation management, Urban forestry, forest restoration
4.4 Participatory Forest Management: Sustainable forest management, Joint Forest Management (JFM), Community participation
4.5 Principles of Silviculture: Scope and importance,Tree growth and development, Silvicultural practices
4.6 Forest Policy and Legislation: National Forest Policy, Indian Forest Act, Forest Conservation Act, Wildlife Protection Act, Biodiversity Act

Course Code: SOLS/EVS-MDE-P- 01
Course Title: MDE-1 Practical **(01 Credit)**

Exercise 1.Study of forest structure and composition using quadrat method; calculation of frequency, density, abundance and Importance Value Index (IVI).

Exercise 2.Determination of soil texture, pH, moisture content, organic carbon and soil organic matter from forest soil samples.

Exercise 3.Estimation of tree volume using standard forestry instruments and formulae.

Exercise 4.Estimation of above-ground biomass and carbon stock using allometric equations.

Exercise 5.Field assessment of anthropogenic disturbances (grazing, lopping, fire, fragmentation)in forest areas.

Course Code: SOLS/EVS-MDE- 002

Course Title: MDE-1 Himalayan Wildlife Management **(03 Credits)**

Unit I. An Introduction to the Himalaya

- **1.1** Physiography- location, expansion and importance
- **1.2** Origin and evolution of the Himalaya
- **1.3** Himalayan Environment
- **1.4** Natural resources of the Himalaya
- **1.5** Fragility of the mountain ecosystem

Unit II. Wildlife of the Himalaya

- **2.1** Unique characteristics and importance of the wildlife
- **2.2** Himalayan biodiversity
- **2.3** Endemism
- **2.4** Depletion of Himalayan wildlife

Unit III. Manifestation of Himalayan Wildlife

- **3.1** Himalayan wild Mammals
- **3.2** Himalayan wild Birds
- **3.3** Himalayan Reptiles and Amphibians
- **3.4** Himalayan Fish
- **3.5** Himalayan Butterflies
- **3.6** Rare and Endangered Himalayan wild flora

Unit IV. Conservation and Management

- **4.1** Administrative and legislative measures for protection of wildlife
- **4.2** Protected areas (National parks, sanctuaries, biosphere reserves) in the Himalaya
- **4.3** Tiger Project, Project Elephant, Project Rhino, Project Snow Leopard
- **4.4** Man-Wildlife Conflict: agriculture-wildlife conflict
- **4.5** Wildlife Protection Act 1972 and successive amendments
- **4.6** Problems in implementation of the Wildlife Protection Act

Course Code: SOLS/EVS-MDE- P-002
Course Title: MDE-1 Practical **(01 Credit)**

Exercise 1: Documentation of Wild life conflict hotspots using field mapping & interviews.

Exercise 2: Mitigation measure evaluation for Himalayan Wild life

Exercise 3: Preparation of a micro-management plan for a Himalayan wildlife habitat.

Exercise 4: Assessment of anthropogenic pressures to Himalayan Wild life

Exercise 5: Preparation of corridor maps for species movement (least-cost path analysis).

SWAYAM 1: Climate and Environmental Protection (04 Credits)

By Prof. B S Balaji, Chairperson, Special Centre for E-Learning and Professor in School of Biotechnology| Jawaharlal Nehru University, New Delhi

https://onlinecourses.swayam2.ac.in/ugc25_ge08/preview

Course layout

Week wise schedule (including the assignment to be kept in the week):

Week 1

- Introduction to Arctic
- Arctic-definition
- Arctic overview-part-1

Week 2

- Arctic overview-part-2
- Arctic expedition-Part 1
- Arctic expedition-Part 2

Week 3

- Solar irradiance and Albedo
- Albedo, Evapotranspiration
- Arctic-amplification

Week 4

- Arctic-amplification-contributors
- Arctic Aerosols and Mechanisms-Part 1
- Arctic Aerosols and Mechanisms-Part 2: Short-lived climate forcers (SLCFs)

Week 5

- Arctic Cryosphere and Glacier Change Mechanism
- Plant-biodiversity-Part-1
- Plant-biodiversity-Part-2

Week 6

- Animal-biodiversity-Part-1
- Animal-biodiversity-Part-2

Week 7

- Marine biodiversity
- Biogeochemical cycle and arctic-Part-1

Week 8

- Biogeochemical cycle and arctic-Part-2
- Carbon cycle and Arctic
- Anti-freeze proteins Part 1

Week 9

- Anti-freeze proteins Part 2
- Persistent Pollutants in the Arctic

- Methanogenesis, Mechanisms, Pathways, and its Relevance to the Arctic

Week 10

- Ocean Acidification
- Ocean Acidification and trace metal biogeochemistry
- Organic Carbon Recycling and its Influence on the Arctic

Week 11

- Marine Contamination in the Arctic
- Permafrost and Biogeochemistry Relationship

Week 12

- Arctic Chemical and Climate Stressors
- Chemolithotrophy and Arctic Ecosystems

Week 13

- Greenhouse Gases and Climate Change Mechanism in the Arctic
- Halogens and Atmospheric Chemistry in the Arctic

Week 14

1. Influence of Ozone and UV Radiation in the Arctic
2. Arctic Water and Carbon Cycle and Climate Change Mechanisms
3. Northern Sea route and climate change

Week 15

- Asian countries working in the Arctic region
- NCPOR and arctic studies a brief overview
- Interaction with researchers, opportunities for student

SWAYAM 2: Rural Water Resource Management **(04 Credits)**

By Prof. PennanChinnasamy | IIT Bombay

https://onlinecourses.nptel.ac.in/noc22_ce45/preview

Course layout

Week wise schedule (including the assignment to be kept in the week):

Week 1

- Importance of water resource management in India and Introduction to Hydrological Cycle and representations

Week 2

- Key Hydrological Parameters 1

Week 3

- Key Hydrological Parameters 2

Week 4

- Introduction to Groundwater hydrology

Week 5

- Groundwater components

Week 6

- Surface water hydrology

Week 7

- Water Mass Balance Equation

Week 8

- Rural water management issues, data challenges and observation records.

Week 9

- Rural water resource management infrastructure (engineered)

Week 10

- Rural water resource management infrastructure (nature based)

Week 11

- Rural hydrological databases for India

Week 12

- Remote Sensing data bases for Rural water resources

Second Semester for 2-year M.Sc. program

Course Code: SOLS/EVS-C- 004
Course Title: DSC-4 Environmental Microbiology and Biotechnology (03 Credits)

Unit I. Basic and Environmental Microbiology

- **1.1** Introduction, history and scope of Environmental Microbiology
- **1.2** Characteristics of major groups of microbes
- **1.3** Level of microbial diversity, distribution of microorganism and microbes of extreme environment
- **1.4** Microbial pathogen and their control

Unit II. Microbial Ecology

- **2.1** Mode of microbial nutrition
- **2.2** Ecological interactions of microbes and indicator microorganism
- **2.3** Effects of environmental factors (light, temperature, moisture, pH) on microorganisms
- **2.4** Biodegradation of organic pollutants by microorganisms
- **2.5** Determination of microbial growth (bacteria and fungi)

Unit III. Basic and Environmental Biotechnology

- **3.1** Concept, history and scope of Biotechnology
- **3.2** Plant tissue culture: General introduction, scope, cellular differentiation, totipotency
- **3.3** Recombinant DNA technology: Gene cloning, cDNA libraries, choice of vectors, PCR, DNA finger printing.
- **3.4** Genetic improvement of industrial microbes and nitrogen fixers, fermentation technology, vermiculture technology

Unit IV.Environmental Applications and Sustainable Technologies

- **4.1** Wastewater and solid waste management; Bioremediation and phytoremediation; Biodegradation of pollutants
- **4.2** Environmental genomics; Biofertilizers and biopesticides
- **4.3** Bio-indicators, bio-fuels and biosensors and renewable energy
- **4.4** Environmental monitoring and pollution control
- **4.5** Biosafety, bioethics and Intellectual Property Rights (IPR)
- **4.6** Applications of environmental biotechnology and climate change mitigation.

Course Code: SOLS/EVS-C- P-004

Course Title: DSC-04 Practical **(02 Credits)**

Exercise01: Isolation and Culturing of Microorganismsfrom soil and water samples using standard culture techniques.

Exercise02: Determination of Microbial Growth.

Exercise03: Effect of Environmental Factors on Microbial Growth.

Exercise04: Demonstration of microbial degradation of organic pollutants.

Exercise04: Preparation of culture media, sterilization and demonstration of callus culture/tissue culture methods.

Course Code: SOLS/EVS-C- 05
Course Title: DSC-5 Disaster Risk Reduction (03 Credits)

Unit I. An overview of Disaster

1.1 Introduction and definition of vulnerability, risk, hazard, disaster and catastrophe
1.2 Impact of disaster on economy and society
1.3 Disaster management and sustainability
1.4 Disaster management cycle
1.5 The Disaster Management Act 2005 and subsequent amendments

Unit II. Natural Disasters

2.1 Natural disasters: introduction, meaning and nature
2.2 Natural Disasters in Himalaya: Earthquake, cloudburst, Glacier lake outburst (GLOF), Landslides, Snow Avalanches, flesh-flood
2.3 Natural hazards Cyclone, volcanic eruptions, drought, floods, heat and cold waves and Tsunami

Unit III.Anthropogenic Disasters

3.1 Anthropogenic disasters: introduction, meaning and nature
3.2 Nuclear disaster, fires (Forest fire, Building, coal, and chemical fires), Desertification causes, effects, management
3.1 Transportation Accidents, war, stamped and riots: causes, effects, management

Unit IV. Disaster Mitigation and Risk Reduction

4.1 Risk and vulnerability assessment
4.2 Disaster preparedness; information, education, awareness and communication
4.3 Disaster mitigation; approaches and strategies
4.4 Disaster response and planning; Search, Rescue and evacuation, damage, community health and casualty management
4.5 Disaster recovery: social and economic aspects of rehabilitation and resettlement
4.6 Prediction and perception of the hazards
4.7 Community based disaster risk reduction strategies

Course Code: SOLS/EVS-C- P-05
Course Title: DSC-5 practical **(02 Credits)**

Exercise 1: Understanding the occurrence of various hazards in Himalayas

Exercise 2: Role of various agencies in disaster management

Exercise 3: Rehabilitation of People from disaster affected areas

Exercise 4: Preparation of master plan for any Environmental Hazard mitigation

Exercise 5: To assess the disaster awareness preparedness in nearby communities

Course Code: SOLS/EVS-C-006

Course Title: DSC-6: Environmental Pollution (03 Credits)

UnitI.AirandWaterPollution

1.1 Majorsources and typesofairandwaterpollution
1.2 Effectsofpollutantsonhumanbeings,plantsandanimals
1.3 Controlmeasuresandmanagementtechniquesforair
1.4 Waste watertreatment
1.5 Indoorairpollution

UnitII. Noise Pollution

2.1 Sourcesofnoise pollution
2.2 Measurementofnoise,exposurelevelsandstandards
2.3 Impactofnoiseonhumanhealth
2.4 Noisecontrolandabatementmeasures

UnitIII. Soil pollution

3.1 Soil composition and classification
3.2 Causes of soil degradation
3.3 Industrial effluents and their interactions with soil components
3.4 Soil micro-organisms and their functions- degradation of pesticides and synthetic fertilizers

Unit IV.Radioactive, Thermal pollution, and Marine pollution

4.1 Radioactivepollution:Causes, consequences and control measures
4.2 Thermalpollution:Causes, consequences and control measures
4.3 Marine pollution: Causes, consequences and control measures

Course Code: SOLS/EVS-C-P-006

Course Title: DSC-6: Practical **(02Credits)**

Exercise01: Sampling and monitoring of PM_{10} and $PM_{2.5}$ in ambient air

Exercise02: Sampling and monitoring of noise level in different environments

Exercise03: Determinationof moisture content, organic carbon , organic matter of a given soil samples)

Exercise 04: Principle of analytical methods: chromatography (Paper Chromatography, TLC, GC, HPLC)

Exercise 05: Principle of analytical methods: Spectrophotometry (UV-VIS, AAS, ICP-MS)

Course Code: SOLS/EVS-SEC-003
Course Title: SEC-2: Ecosystem Restoration and Management (03Credits)

Unit–I-Fundamentals of Ecosystems and Ecological Restoration

- **1.1** Concept, structure, and functions of ecosystems
- **1.2** Types of ecosystems: Forest, grassland, wetland, freshwater, marine, agro-ecosystems, and mountain ecosystems
- **1.3** Causes and processes of ecosystem degradation
- **1.4** Relationship between conservation, restoration, and sustainable development

Unit–II-Ecosystem Degradation, Assessment, and Restoration Techniques

- **2.1** Land degradation and desertification
- **2.2** Deforestation, habitat fragmentation, and biodiversity loss
- **2.3** Afforestation, reforestation, and revegetation methods
- **2.4** Restoration of degraded forests, grasslands, wetlands, rivers, and mined areas

Unit–III- Ecosystem Restoration and Community Participation

- **3.1** Principles and objectives of ecosystem management
- **3.2** Role of local communities, NGOs, and other stakeholders in restoration programs
- **3.3** Joint Forest Management (JFM) and participatory approaches
- **3.4** Ecosystem restoration for livelihood enhancement and sustainable development

Unit–IV- Policies, Planning and Case Studies in Ecosystem Restoration

- **4.1** Convention on Biological Diversity (CBD), UN Decade on Ecosystem Restoration, Sustainable Development Goals (SDGs)
- **4.2** Indian environmental policies, Forest Policy, Biodiversity Act, CAMPA, and restoration initiatives
- **4.3** Case studies of successful restoration programs in India and the Himalaya
- **4.4** Restoration of degraded Himalayan ecosystems and mountain landscapes

Course Code: SOLS/EVS-SEC-P-003

Course Title: SEC-2: Practical **(02Credits)**

Exercise01: Field assessment of degraded ecosystems

Exercise02: Vegetation analysis and biodiversity assessment

Exercise03: Analyse causes and impacts of ecosystem degradation.

Exercise04: Preparation of restoration plans for degraded landscapes

Exercise05: Visits to restoration sites, wetlands, forests, and watershed projects

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Course Code - SOLS/EVS-SEC-004
Course Title -SEC-1 – Field Visit (Vocational) (05 Credit)

Field Visit: Opt any one of following:

1. **Ecosystem Study Tour**

   1.1 Field visit to any National Parks, wetlands, forests, rivers, disaster prone areas

   1.2 Preparation and submission of a detailed field study report including observations, data collection, analysis, findings, and recommendations.

2. **Industrial Environmental Management**

   2.1 Visit to industries or industrial areas to study pollution control systems, effluent treatment plants (ETP), and environmental management practices.

   2.2 Preparation and submission of a detailed field study report including observations, data collection, analysis, findings, and recommendations.

3. **Sustainable Agriculture and Rural Ecology**

   3.1 Visit to organic farms, agroforestry systems, and rural communities to understand sustainable farming and natural resource management.

   3.2 Preparation and submission of a detailed field study reportincluding observations, data collection, analysis, findings, and recommendations.

4. **Waste and Water Management Study**

   4.1 Visit to solid waste management facilities, sewage treatment plants (STP), rainwater harvesting sites, and water treatment plants for practical understanding of resource management.

   4.2 Preparation and submission of a detailed field study report including observations, data collection, analysis, findings, and recommendations.

Course Code: SOLS/EVS-DSE- 003
Course Title: DSE-2 Environment *Vs* Development (03 Credits)

Unit I. Growth and Development

1.1 Definition, concept and scope of economic growth and development
1.2 Classical theories of development
1.3 Contemporary models of development and underdevelopment
1.4 Poverty, inequality and development
1.5 Evolution of worldwide awareness about environment and activity of Nations, environment and awareness programs

Unit II. Resource and Development

2.1 Environment and human resources
2.2 Urbanization and informal sector
2.3 Agriculture transformation and rural development
2.4 International aspect of development

Unit III. Environment *Versus* Development

3.1 Development dominant phases at global and National levels
3.2 Conflict between environment development
3.3 Environmental Activism
3.4 Resolution of conflict between environment and development
3.5 Sustainable Development: Various dimensions

Unit IV. Controversies Related with Environment and Development

4.1 Industrial revolution and environment
4.2 Hydropower development and environment in the Himalayas
4.3 Impact of road construction and widening on environment and wildlife
4.4 Ganga *Bachao / NadiBachoaAndolan*
4.5 Sand mining and environment

Course Code: SOLS/EVS-DSE-P-003
Course Title: DSE-2 Practical **(01 Credit)**

Exercise01: To study the origin and genesis of environmental awareness at Global, National and Local level.

Exercise02: To know about the famous environmental activists of your region.

Exercise03: To study the origin and genesis of environmental movements in your locality.

Exercise04: To study the impacts of industrialization on environment.

Exercise05: To study the impacts of road construction and widening, Mining and Hydropower development in Himalayan region

Course Code: SOLS/EVS-DSE- 004
Course Title: DSE-2 Mountain Ecology **(03 Credits)**

Unit I. Introduction to Mountain Ecology

- **1.1** Definition, importance and scope of Mountain Ecology
- **1.2** Characteristics and specificity of mountain ecosystems
- **1.3** Environmental importance of mountains
- **1.4** Indigenous communities of mountains and their livelihood security

Unit II. Mountain Ecosystem

- **2.1** Structure and components of Mountain Ecosystem
- **2.2** Geological formations of mountains
- **2.3** Vulnerability of mountain ecosystems
- **2.4** Environmental degradation in mountains

Unit III. Environmental Hazards in the Mountains

- **3.1** Landslides, soil erosion and sedimentation
- **3.2** Cloud bursts
- **3.3** Flash floods and river blockades
- **3.4** Avalanches and Glaciers Lake Outburst Floods (GLOF)
- **3.5** Earthquakes
- **3.6** Forest fires

Unit IV. Conservation and Management of Natural Resources of Mountains

- **4.1** Natural resources of mountains (Forest, Water, Wildlife and Minerals)
- **4.2** Sustainable exploitation of natural resources
- **4.3** Traditional knowledge for management of natural resources
- **4.4** Social and Economic dimension of mountain's natural resources
- **4.5** National and international efforts for management natural resources of mountains

Course Code: SOLS/EVS-DSE-P-004
Course Title: DSE-2 Practical **(01Credit)**

Exercise01: Analysis of various components of mountain ecosystem.

Exercise02: To study the environmental degradation in mountain ecosystem.

Exercise03: Assessment of threats to biodiversity in mountain region.

Exercise04: To study the geological formations of mountains.

Exercise05: To study the socio-economic status of mountain's natural resources.

Course Code: SOLS/EVS-MDE-003
Course Title: MDE-2- Waste Management (03 Credits)

Unit I: Introduction to Waste and Its Classification

- **1.1** Concepts, Scope, historical development, and need for sustainable waste management
- **1.2** Types of Waste Solid, liquid, hazardous, biomedical, and e-waste
- **1.3** Sources and Characteristics of municipal, industrial, agricultural, commercial, and domestic Waste
- **1.4** Waste Generation trends

Unit II: Solid Waste Management

- **2.1** Collection and transportation and storage of Municipal Solid Waste (MSW)
- **2.2** Segregation and Recycling: Source segregation, material recovery, and recycling processes.
- **2.3** Aerobic and anaerobic composting, vermin-composting, organic waste management, biogas
- **2.4** Types of landfills, sanitary landfills, incineration technologies, and environmental concerns

Unit III: Hazardous and Biomedical Waste Management

- **3.1** Industrial, chemical, hazardous and toxic waste categories and sources
- **3.2** Waste treatment and disposal methods (physical, chemical, and biological method)
- **3.3** Biomedical Waste Management Rules and Practices
- **3.4** Occupational hazards and safety measures, risk to waste workers, PPE, training, and emergency protocols.

Unit IV: Liquid Waste, E-Waste, and Plastic Waste

- **4.1** Wastewater and Sewage Management: Urban and rural systems, decentralized treatment (DEWATS), reuse options
- **4.2** E-Waste: Generation and Impacts: Composition, toxic components, and informal recycling issues.
- **4.3** Plastic Waste Management: Single-use plastics, Extended Producer Responsibility (EPR), recycling technologies.
- **4.4** Policy Framework and Rules: Plastic Waste Management Rules, E-Waste Rules, and CPCB guidelines

Course Code: SOLS/EVS-MDE-P-003
Course Title: MDE-2- Practical **(01 Credit)**

Exercise01: Segregation and composition analysis of municipal solid waste

Exercise02: Vermi-composting – preparation, maintenance and product analysis

Exercise03: Assessment of construction & demolition (C&D) waste composition

Exercise04: Identification and classification of hazardous waste types

Exercise05: Visit to a Sewage Treatment Plant (STP)/Effluent Treatment Plant (ETP)

Course Code: SOLS/EVS-MDE-004
Course Title: MDE-2- Human–Wildlife Conflict **(03 Credits)**

Unit–I: Introduction and Conceptual Framework

1.1 Concept, definition and scope of Human–Wildlife Conflict (HWC)
1.2 Causes and drivers of Human–Wildlife Conflict
1.3 Historical trends and global perspectives of HWC
1.4 Ecological, social and economic dimensions of HWC

Unit–II: Types and Impacts of Human–Wildlife Conflict

2.1 Crop raiding and livestock depredation
2.2 Human injury and loss of life due to wildlife attacks
2.3 Habitat fragmentation, land-use change and resource competition
2.4 Environmental, economic and psychological impacts of conflict

Unit–III: Management and Mitigation Strategies

3.1 Traditional and modern conflict mitigation techniques
3.2 Wildlife corridors, fencing and habitat restoration
3.3 Community participation and conflict resolution mechanisms
3.4 Compensation policies, insurance and government interventions

Unit–IV: Conservation Policies and Case Studies

4.1 Wildlife protection laws and policies in India
4.2 Role of International Union for Conservation of Nature (IUCN), NGOs and forest departments
4.3 Case studies of Human–Elephant, Human–Tiger and Human–Leopard conflicts
4.4 Future challenges and sustainable coexistence strategies

Course Code: SOLS/EVS-MDE-P-004

Course Title: MDE-2- Practical **(01 Credit)**

Exercise01: Field survey and identification of wildlife conflict-prone areas (mapping conflict hotspots).

Exercise02: Study of crop damage and livestock depredation patterns in nearby villages through questionnaire survey.

Exercise03: Analysis of human–wildlife conflict case studies (Elephant, Tiger, Leopard, Monkey) and mitigation measures.

Exercise04: Assessment of wildlife movement corridors and habitat fragmentation through field observation.

Exercise05: Documentation and evaluation of traditional and modern mitigation techniques (fencing, trenches, early warning systems, compensation schemes).

Third Semester for 2-year M.Sc. program

Course Code: SOLS/EVS-C- 007
Course Title: DSC-7 Environmental Economics and Sustainable Development (03 Credits)

Unit I. Fundamentals of Environmental Economics

- **1.1** Definition, concepts, issues and scope of Environmental Economics
- **1.2** Concept of the commons, tragedy of commons, externalities (indirect costs), economic goods/ services, supply, demand, intangibles, public goods and bads
- **1.3** Limitations of Environmental Economics

Unit II. Economic Tools

- **2.1** Valuing the environment and natural resources
- **2.2** Ecology and equity
- **2.3** Natural resource accounting, cost-benefit analysis
- **2.4** Life cycle assessment (LCA)
- **2.5** Intellectual property rights (IPR) and environment

Unit III. Sustainable Development

- **3.1** Principles of Sustainable Development: History and emergence of the concept and definition of Sustainable Development
- **3.2** Goals of Sustainable Development
- **3.3** Stake holders of Sustainable development: People, Government, investor, Industry, Judiciary & international organization working for Sustainable development
- **3.4** From unsustainable to sustainable development

Unit IV.Urbanization and Environmental Economics

- **4.1** Urban Growth and Environmental Stress
- **4.2** Economics of Urban Pollution (air, water, waste)
- **4.3** Sustainable Urban Planning and Transport
- **4.4** Green Infrastructure and Urban Resilience
- **4.5** Major environmental movements (Chipko, Appiko, Narmada Bachao Andolan, Tehri dam conflicts and Silent valley movement, Nadi Bachao Andolan, Beej Bachao Andolan)

Course Code: SOLS/EVS-C- P-007
Course Title: DSC-7 Practical **(02 Credits)**

Exercise01: To study socio-economic status- Preparing of questionnaire and case studies.

Exercise02: Inventorization of local NTPFs.

Exercise03: Economic evaluation of a forest area/lake/river.

Exercise04: Cost-benefit analysis of a river valley project.

Exercise05: Market survey for forest products.

Course Code: SOLS/EVS-C- 008
Course Title: DSC-8 Environmental Geosciences and Polar Affairs (03 Credits)

Unit I. Fundamentals of Environmental Geosciences and Earth System

- **1.1** Definition, concept and scope of Environmental Geosciences
- **1.2** Origin and evolution of the Earth; plate tectonics, rocks and their classification
- **1.3** Relationship among various geospheres
- **1.4** Energy budget and thermal environment of the Earth

Unit II. Environmental Geochemistry and Land use Planning

- **2.1** Concept, importance and use of the Earth elements
- **2.2** Weathering, soil formation, soil profile, soil classification and distribution
- **2.3** Land use planning: Soil survey, methods of site selection and evaluation

Unit III. Earth's Processes and Geological Hazards

- **3.2** Catastrophic geological hazards, hazards in Himalayan and coastal areas
- **3.3** Terrestrial hazards; floods, landslides, cloud burst, earthquakes, volcanism, avalanche and glacier lake outburst
- **3.4** Coastal hazards; Tsunami, storms in oceans, ice sheets and fluctuation s of sea levels, marine pollution by toxic wastes

Unit IV. Arctic and Polar Affairs

- **4.1** Introduction, history and importance of polar regions and zones on earth
- **4.2** Structure and Specificity of polar ecosystems
- **4.3** Periglacial and terrestrial habitats in arctic and polar regions
- **4.4** Arctic and polar species diversity
- **4.5** Vulnerability of arctic ecosystems
- **4.6** Stress, adaptation and survival in polar regions
- **4.7** Climate change and environmental degradation in arctic and polar zones

Course Code: SOLS/EVS-C- P-008
Course Title: DSC-8 Practical **(02 Credits)**

Exercise01: To understand the interior of the Earth

Exercise02: To understand the process of soil formation

Exercise03: To study the soil profile

Exercise04: To study the various soil types of India

Exercise05: To study the impacts of climate change on polar and snow covered areas

Course Code: SOLS/EVS-C- 009
Course Title: DSC-9 Biodiversity Conservation and Management (03 Credits)

Unit I. Introduction to Biodiversity

1.1 Concept and values of biodiversity
1.2 Biodiversity and ecosystem services
1.3 Biodiversity at different levels (genetic, species and ecosystem)
1.4 Magnitude and distribution of biodiversity
1.5 Biodiversity hotspots and keystone species
1.6 Threats to biodiversity: Habitat loss and fragmentation, Genetic drift, Inbreeding, Disturbance, Pollution, Climate Change, Overexploitation, Invasive Species, Disease, etc.

Unit II. Biodiversity: Conservation and Management

2.1 Need for biodiversity conservation and management
2.2 Biodiversity and livelihood security
2.3 Extinction to species: IUCN threatened species categories, causes of species extinction, endangered species, Red and Green Data Books.
2.4 *In -situ* and *Ex-situ* conservation
2.5 Current Trends in Biodiversity Conservation

Unit III.Biodiversity Policyand Climate Change

3.1 Biodiversity Policies, Act, Rules and Regulations
3.2 International efforts for conserving biodiversity *viz.*, CITES, CBD, IUCN, MAB, UNEP, UPOV and WTO
3.3 International treaty on Plant Genetic Resources
3.4 International Agreement for conserving biodiversity, wetland conservation, rangeland management.
3.5 Environmental and Climate change impacts on biodiversity and adaptation strategies

Unit IV.Environmental Monitoring and Biodiversity Assessment

4.1 Environmental Monitoring: Concept, objectives and types of environmental monitoring
4.2 Biodiversity Assessment: Biodiversity inventory and sampling methods for flora and fauna
4.3 Ecological Indices: Species richness, abundance and diversity indices
4.4 Bioindicators and Biomonitoring: Indicator organisms and biological monitoring techniques
4.5 Applications of Remote Sensing and GPS in environmental monitoring and biodiversity mapping
4.6 Role of biodiversity assessment in EIA and environmental management

Course Code: SOLS/EVS-C- P-009

Course Title: DSC-9 Practical **(02 Credits)**

Exercise01: To calculate the Alpha (∝) diversity, Beta (β) diversity and total diversity of given community.

Exercise02: Survey of biological resources in your locality.

Exercise03: Assessment of threats to biodiversity of a given region.

Exercise04: Preparation of inventory of endangered and extinct species of plants/animals of Garhwal Himalaya.

Exercise05: To study the role of key stone species in ecosystem.

Course Code: SOLS/EVS-C-010

Course Title: DSC-10 Research Methodology and Environmental Statistics (03 Credits)

Unit I. Introduction of Research Aptitude

- **1.1** Research: Meaning, Types and Characteristics
- **1.2** Positivism and post positivistic approach to research
- **1.3** Methods of research
- **1.4** Qualitative and Quantitative methods

Unit II. Various steps in the Research

- **2.1** Identification of research problems
- **2.2** Search of literature
- **2.3** Experimental design/construction of hypothesis
- **2.4** Materials and methods
- **2.5** Field study and collection of samples/questionnaire
- **2.6** Collection and analysis of data
- **2.7** Presentation of data in graphic and tabular form
- **2.8** Use of statistical tools
- **2.9** Discussion of results/ testing of hypothesis, Citation of references and bibliography

Unit III.Application of computer in Environmental Research

- **3.1** Use of different software for analysis of data- SPSS, Excel
- **3.2** Use of internet and search for literature
- **3.3** Format and styles of referencing
- **3.4** Writing of thesis and dissertation
- **3.5** Plagiarism and research ethics

Unit IV. Environmental Statistics

- **4.1** Measurement of central tendency- Mean, Mode and Median
- **4.2** Dispersion- Standard deviation, Standard error, Mean deviation and Coefficient of variation
- **4.3** Moments – measure of Skewness and Kurtosis
- **4.4** Distributions - Normal, log-normal, Binomial, Poisson
- **4.5** Simple and multiple correlation and regression coefficient
- **4.6** Basic laws and concept of probability
- **4.7** Test of hypothesis and significance.
- **4.8** t, F, chi square tests
- **4.9** ANOVA

Course Code: SOLS/EVS-C- P-10

Course Title: DSC-10 Practical **(02 Credits)**

Exercise01: Experimental design/construction of hypothesis

Exercise02: Methods of collection, presentation and analysis of data

Exercise03: Measurement of Standard deviation, Standard error, Mean deviation correlation and regression

Exercise04: Chi square tests

Exercise05: ANOVA

Course Code: SOLS/EVS-E- 005
Course Title: DSE-3 Ecosystem Services and their Valuation (03 credits)

Unit I. Aquatic Ecosystem

1.1 Definition, concept and scope of aquatic ecosystem
1.2 Goods and services of aquatic ecosystem
1.3 Distribution of aquatic ecosystem
1.4 Basic concept of Hyporheic biodiversity and crenobiodiversity
1.5 Drivers of degradation of aquatic ecosystems and their conservation and management

Unit II. Terrestrial Ecosystem

2.1 Structure and function of terrestrial ecosystem
2.2 Biomes and Biogeographic realms of the worlds
2.3 Forest Ecosystem
2.4 Grassland Ecosystem
2.5 Desert Ecosystem
2.6 Goods and services provided by terrestrial ecosystems
2.7 Drivers of degradation of terrestrial ecosystems and their conservation and management

Unit III. Agro-ecosystem and their Management

3.1 Agriculture in India and the World
3.2 Key concepts of Agro-ecosystems
3.3 Functional basis for the sustainable management of Agro-ecosystems
3.4 Management of Agro-ecosystems

Unit IV. Valuation of Ecosystem Services

4.1 Rationale and Objectives of Valuation
4.2 Types of Values: Use, Non-use, Option, and Existence
4.3 Overview of Valuation Methods
4.4 International Initiative regarding Ecosystem Services: MA,TEEB, IPBES, CICES

Course Code: SOLS/EVS-DSE-P-005

Course Title: DSC-3 Practical **(01 Credit)**

Exercise01: Distribution of freshwater sources in your local area.

Exercise02: Collection and identification of aquatic diversity in nearby river or streams.

Exercise03: To study forest stratification, dominant vegetation, and ecological services in a nearby forest area.

Exercise04: A case study of ecosystem services provided by any ecosystem(forest/lake/river).

Exercise05: To study the different economic value and valuation methods for ecosystem services.

Course Code: SOLS/EVS-DSE- 006

Course Title: DSE-3 Protected Area Network in India (03 Credits)

Unit 1: History and Evolution of Protected Areas

1.1. History of scientific forestry in India: pre-colonial forest management, colonial annexation of forests, Indian Forest Acts, and post-independence forest governance.

1.2. History of protected areas in India: origin, establishment of National Parks and Sanctuaries, growth of protected area networks, and conservation movements.

1.3. Forest and wildlife policies: National Forest Policies (1894, 1952, 1988), National Wildlife Action Plan, biodiversity conservation strategies, and community participation.

1.4. International conservation history: global conservation ethics, Stockholm Conference (1972), Convention on Biological Diversity (CBD), and sustainable development approaches.

Unit 2: Types and Classification of Protected Areas

2.1. National Parks and Wildlife Sanctuaries: objectives, legal framework, ecological significance, and major protected areas of India.

2.2. Biosphere Reserves and Conservation Reserves: UNESCO-MAB programme, zonation (core, buffer, transition), and Community Reserves.

2.3. Ex-situ conservation facilities: zoological parks, botanical gardens, gene banks, seed banks, cryopreservation, and tissue culture.

2.4. Wetlands and marine protected areas: Ramsar sites, mangroves, coral reefs, and coastal biodiversity conservation.

Unit 3: Biodiversity Conservation and Legal Framework

3.1. Conservation approaches: in-situ and ex-situ conservation, species recovery programmes, conservation breeding, and reintroduction.

3.2. Wildlife Protection Act, 1972: objectives, schedules, protected area provisions, amendments, and legal significance.

3.3. Biodiversity assessment: IUCN Red List, Red Data Book, endangered and endemic species, and biodiversity hotspots of India.

3.4. Human dimensions: Human-Wildlife conflict, Eco-Development, Indigenous Knowledge, and Participatory Conservation Approaches.

Unit 4: Conservation Initiatives and Emerging Challenges

4.1. International conservation programmes: IUCN, WWF, UNEP, UNESCO, CITES, and Ramsar Convention.

4.2. Wildlife conservation initiatives in India: Project Tiger (1973), Crocodile Conservation Project (1975), Project Elephant (1992), Rhino Conservation Programme (2005), and Snow Leopard Programme (2009).

4.3. Climate change and protected areas: impacts on biodiversity, habitat fragmentation, ecosystem resilience, adaptation, and carbon conservation.

4.4. Emerging trends in protected area management: Landscape Ecology, GIS and Remote Sensing, Ecotourism, Conservation Education, and Future challenges.

Course Code: SOLS/EVS-DSE-P-006

Course Title: DSC-3 Practical **(01 Credit)**

Exercise 1: Visit to National Parks/Wildlife Sanctuaries

Exercise 2: Identification of endangered species using IUCN categories

Exercise 3: Case studies on protected area management

Exercise 4: GIS mapping of protected areas

Exercise 5: Preparation of biodiversity conservation reports

Course Code: SOLS/EVS-MDE- 005
Course Title: MDE-3 Himalayan Bioresources and Management (03 Credits)

Unit I: Introduction to Himalayan Bioresources

- **1.1** Concept, classification and Socio-economic importance of bioresources for mountain communities
- **1.2** Himalayan ecosystem: geography, climate and
- **1.3** Forest, agricultural, medicinal, aromatic and wild edible bioresources of the Himalaya
- **1.4** Indigenous and traditional knowledge systems related to bioresource utilization

Unit II: Diversity and Utilization of Himalayan Bioresources

- **2.1** Medicinal and aromatic plants, Wild edibles, and non-timber forest products (NTFPs)
- **2.2** Agro-biodiversity and traditional farming systems in the Himalaya
- **2.3** Ethnobotanical and ethnomedicinal importance of Himalayan flora

Unit III: Conservation and Sustainable Management

- **3.1** Threats to Himalayan bioresources: climate change, habitat degradation, overexploitation and invasive species
- **3.2** In-situ and ex-situ conservation approaches
- **3.3** Community-based natural resource management and participatory conservation

Unit IV: Emerging Approaches and Policy Perspectives

- **4.1** Bioprospecting, bioeconomy and sustainable entrepreneurship
- **4.2** Intellectual Property Rights (IPR), traditional knowledge and biopiracy issues
- **4.3** Case studies on successful bioresource management initiatives and sustainable development practices

Course Code: SOLS/EVS-MDE-P- 005
Course Title: MDE-3 Practical **(01 Credit)**

Exercise01: Identification and Documentation of Bioresources

Exercise02: Resource Assessment and Sustainable Utilization

Exercise03: Conservation and Management Techniques

Exercise04: Field-Based Skill Development and Case Studies

Course Code: SOLS/EVS-MDE-006

Course Title: MDE-3 Green Development **(03 Credits)**

Unit–I: Introduction to Green Development

1.1 Concept, principles and scope of Green Development
1.2 Green economy and sustainable development
1.3 Environmental challenges and green growth strategies
1.4 Role of natural resources in green development

Unit–II: Green Technologies and Resource Management

2.1 Renewable energy technologies (solar, wind, biomass, hydro)
2.2 Green building concepts and sustainable infrastructure
2.3 Water conservation and sustainable water management
2.4 Waste management and circular economy approaches

Unit–III: Green Policies and Community Development

3.1 Environmental policies and green governance
3.2 Climate change adaptation and mitigation strategies
3.3 Community participation in green development
3.4 Green entrepreneurship and eco-friendly innovations

Unit–IV: Green Development Planning and Future Perspectives

4.1 Urban green planning and smart city concepts
4.2 Sustainable agriculture and organic farming
4.3 Green indicators and environmental impact assessment
4.4 Future challenges and opportunities in green development

Course Code: SOLS/EVS-MDE- P-006

Course Title: MDE-4 Practical **(01 Credit)**

Exercise 1: Assessment of household or institutional carbon footprint.

Exercise 2: Field survey of renewable energy use in local communities.

Exercise 3: Preparation of waste management plan for a campus/locality.

Exercise 4: Study of rainwater harvesting systems and water conservation practices.

Exercise 5: Green audit of campus/building (energy, water and waste assessment).

Fourth Semester for 2-year M. Sc. program

Course Code: SOLS/EVS-C- 011
Course Title: DSC-11 Environmental Management: EIA and Environmental Auditing (03 Credits)

Unit I. Environmental Impact Assessment (EIA)

- **1.1** Concept, scope and objectives of EIA
- **1.2** Evolution of EIA and developmental projects under EIA
- **1.3** Protocol for Environmental Impact Statement (EIS)
- **1.4** EIA guidelines 1994: Notifications of Government of India
- **1.5** EIA Notification 2006 and subsequent modifications

Unit II. Methods of Impact Analysis

- **2.1** Procedure of EIA
- **2.2** Impact assessment methodologies (Ad-hoc, Simple Checklist, Overlays, Matrices, Network, Combination Computer aided)
- **2.3** Concept of Cumulative Environmental Impact Assessment (CEIA)

Unit III. Statuary Clearance Procedure and Public Consultation

- **3.1** Expert Appraisal Committee(EAC)
- **3.2** Environmental Clearance, Wildlife Clearance and Forest Clearance
- **3.3** State Expert Appraisal Committee (SEAC) and State EIA Authority (SEIAA)
- **3.4** Concept, objectives and procedures of Public Consultation

Unit IV. Post-Project Monitoring and Environmental Auditing

- **4.1** Principles and guidelines of environmental auditing
- **4.2** General Audit: Methodology and basic structure of environmental auditing
- **4.3** ISO 14000 series and ISO 9000 series

Unit V. Environmental Management and Management Plan

- **5.1** Concept, objectives and scope of environmental management.
- **5.2** Guidelines for EMP
- **5.3** Development of EMP
- **5.4** Rehabilitation and resettlement
- **5.5** Compensatory Afforestation
- **5.6** Green belt development

Course Code: SOLS/EVS-C- P-011

Course Title: DSC-11 Practical **(02 Credits)**

Exercise01: Presentation of procedure of Environmental Impact Assessment (EIA) through flowchart

Exercise02: Presentation of procedure of Environmental Clearance through flowchart

Exercise03: Presentation of procedure of Forest Clearance through flowchart

Exercise04: Presentation of procedure of Environmental Auditing through flow chart

Exercise05: Presentation of procedure of Environmental Management Plan (EMP) through flow chart

Course Code: SOLS/EVS-C- 012
Course Title: DSC-12 Environmental Laws, Ethics and Policies (03 Credits)

Unit I. National and International Efforts for Environmental Protection

- **1.1** Brief introduction about the structure of Indian Constitution
- **1.2** Environmental protection in the Indian Constitution
- **1.3** International and national efforts related to environmental Pollution, Climate change, Green house Gas emission, Ozone layer depletion and biodiversity conservation)
- **1.4** REDD+ in India

Unit II. National Environmental Laws

- **2.1** Indian Forest Act 1927; The Forest Conservation Act 1980, and Forest conservation Rules 2003
- **2.2** Wildlife Protection Act 1972 and its successive amendments
- **2.3** Biological Diversity Act 2002 and Biological Diversity Rules 2004
- **2.4** Water (Prevention and Control of Pollution) Act 1974 and Rules 1975 and subsequent amendments
- **2.5** Air (Prevention and Control of Pollution) Act 1981 and Rules 1982 and successive amendments
- **2.6** The Environmental (Protection) Act 1986 and its amendment in 1991, The environment (Protection) Rules 1986
- **2.7** The scheduled tribes and other traditional forest dwellers (recognition of forest rights) act, 2006
- **2.8** The National Green Tribunal Act 2010
- **2.9** Disaster Management Act, 2005

Unit III. National Laws related to waste management

- **3.1** Biomedical Waste Management rules, 2016, as Amended 2019
- **3.2** Hazardous and other waste (Management &Transboundary movement) Rules,
- **3.3** Plastic waste management rules 2016, as amended 2021
- **3.4** Solid waste management rules 2016
- **3.5** E-waste rules 2016 and E-waste (Management) Amendment Rules, 2018

Unit IV. National Policies

- **4.1** National Environment Policy, 2006 (Approved by the Union Cabinet on 18 May, 2006
- **4.2** National Forest Policy, 1988, and New National Forest Policy Draft,2018
- **4.3** National Policy on Disaster Management (NPDM) and Disaster Management Act, 2005
- **4.4** National water policy (2012) and new national water policy-2021

Course Code: SOLS/EVS-C- P-012
Course Title: DSC-12 Practical **(02 Credits)**

Exercise01: Presentation of salient features of Wildlife Protection Act 1972

Exercise02: Presentation of salient features of Water (Prevention and Control of Pollution) Act 1974

Exercise03: Presentation of salient features of the Air (Prevention and Control of Pollution) Act 1981

Exercise04: Presentation of salient features of The Environmental (Protection) Act and Rules 1986

Exercise05: Presentation of salient features of The Indian Forest Conservation Act 1980

Exercise06: Disaster Management Act, 2005

Course Code: SOLS/EVS-C- 013
Course Title: DSC-13 Climate Change Adaptation and Mitigation (03 Credits)

Unit I. Introduction to Climatology

- **1.1** Definition, brief history and scope of Climatology
- **1.2** Meteorological parameters: temperature, pressure, precipitation, humidity, radiation, wind and clouds
- **1.3** Composition, structure and importance of atmosphere
- **1.4** Concept of weather , season and Climate

Unit II. Different Climatological process

- **2.1** Atmospheric heating and cooling, Heat budget and Heat balance, Global temperature circulation
- **2.2** Planetary wind pattern and General atmospheric circulation
- **2.3** Atmospheric moisture: Condensation and different types of precipitation
- **2.4** Atmospheric humidity: Measurement and distribution
- **2.5** Oceans and international variations in climate (El Nino, ENSO, La Nina)
- **2.6** Natural and atmospheric extreme events: Tropical cyclone, thunder storms, tornadoes, flood, cloud burst, drought

Unit III. Regional Climatology

- **3.1** Definition, microclimate and meso-climate scale
- **3.2** Climate and distribution of vegetation
- **3.3** Mid-latitude climate
- **3.4** Polar and high land climate

Unit IV. Applied Climatology or Responses to Climate Change: Adaptation and Mitigation

- **4.1** Natural and Anthropogenic (man- made) causes of climate change
- **4.2** Consequences of climate change
- **4.3** Climate Change: Biodiversity, agriculture and industry
- **4.4** Climate change and Food security
- **4.5** Human response to climate
- **4.6** Adaptation concepts and strategies
- **4.7** Limiting climate change: Adaptation and Mitigation
- **5.1** Climate change and environmental degradation in arctic and polar zones

Course Code: SOLS/EVS-C- P-013
Course Title: DSC-13 Practical **(02 Credits)**

Exercise01: Measurement of dry and wet bulb temperature.

Exercise02: Recording of wind speed and direction.

Exercise03: Preparation of wind roses with the given data.

Exercise04: Recording of diurnal variations in temperature

Exercise05: To study the impact of global warming on glaciers.

Course Code: SOLS/EVS-C- 014
Course Title: DSC-14 Remote Sensing, GIS and Environmental Modeling (03 Credits)

Unit I.Introduction to Remote Sensing

1.1 Definition, concepts, history and scope of remote sensing

1.2 Electromagnetic radiations (EMR) and electromagnetic spectrum

1.3 Platforms, sensors and types of scanning systems

1.4 Basic characteristics of sensors; salient features of sensors used in LANDSAT, SPOT and Indian remote sensing satellites

1.5 Earth's and atmospheric interaction with EMR and atmosphere window

1.6 Spectral reflectance of vegetation, soil and water

Unit II. Application of Remote Sensing

2.1 Application of remote sensing in EIA

2.2 Application of remote sensing in forest management

2.3 Application of remote sensing in characterization and monitoring of biodiversity

2.4 Application of remote sensing in mapping of wetlands

Unit III. Geographic Information System (GIS)

3.1 Introduction and basic principle and scope of GIS

3.2 Application of GIS in environmental management

3.3 Brief outline of Digital Image Processing

Unit IV.Environmental Modeling

4.1 Definition, concept and role of modeling in Environmental Sciences

4.2 Components of a model

4.3 Models of population (growth and interaction) and pollution dispersal: LotkaVoltera model, Leslie Matrix model and Gaussian Plume model

Course Code: SOLS/EVS-C-P- 014
Course Title: DSC-14 Practical **(02 Credits)**

Exercise01: Interpretation of Satellite Imagery

Exercise02: Analysis of spectral signatures of vegetation, soil and water bodies.

Exercise03: Preparation of thematic maps using GIS software and spatial data.

Exercise04: Demonstration of image enhancement, classification and image interpretation methods.

Exercise05: Environmental Modelling Exercises.

Course Code: SOLS/EVS-DSE- 007

Course Title: DSE-4 Spring-shed Conservation and Management (03 Credits)

Unit I: Introduction to Springs and Spring-Sheds

- **1.1** Definition, scope and importance of spring-sheds
- **1.2** Types and Classification of Springs: Gravity, artesian, contact, fracture, and solution springs.
- **1.3** Hydro-geological Framework of Spring Systems: Structure of aquifers; groundwater flow in mountainous terrains.
- **1.4** Ecological and Socioeconomic Importance of Springs: Role in drinking water, irrigation, biodiversity, and community livelihoods.

Unit II: Hydrological and Climatic Influences

- **2.1** Watershed and Spring Hydrology: Rainfall-runoff processes, infiltration, percolation, and aquifer recharge.
- **2.2** Impacts of Land Use and Land Cover Change (LULC): Effects of deforestation, agriculture, road construction, and urbanization.
- **2.3** Climate Change and Seasonal Variability: Impacts on spring discharge, recharge cycles, and long-term water availability.
- **2.4** Monitoring Tools and Techniques: Use of rain gauges, piezometers, flow meters, and soil moisture sensors.

Unit III: Spring-Shed Management Approaches

- **3.1** Spring Rejuvenation Techniques: Implementation of recharge structures like trenches, percolation pits, check dams, and ponds.
- **3.2** Delineation and Mapping using GIS & Remote Sensing: Application of geospatial tools for spring-shed mapping and intervention planning.
- **3.3** Community-Based Water Resource Management: Participatory rural appraisal (PRA), stakeholder engagement, and local knowledge integration.
- **3.5** Demand and Supply Side Water Management: Strategies for efficient water use, rainwater harvesting, and equitable distribution.

Unit IV: Conservation and Policy Perspectives

- **4.1** National Water Policies and Programs: Overview of Jal Shakti Abhiyan, AtalBhujalYojana, MGNREGA in spring conservation.
- **4.2** Institutional and Governance Framework: Roles of Panchayati Raj institutions, Van Panchayats, NGOs, and water user groups.
- **4.3** Environmental and Social Safeguards: Inclusion of gender, marginalized groups, and mechanisms for conflict resolution.
- **4.4** Ecosystem Services and Valuation of Springs: Assessing provisioning, regulatory, cultural, and supporting services of spring ecosystems.

Course Code: SOLS/EVS-DSE- P-007

Course Title: DSE-4 Practical **(01 Credit)**

Exercise 1: To identify, document, and map springs in a designated area.

Exercise 2: To measure the quantity of water discharged by a spring.

Exercise 3: To assess the land use and land cover (LULC) of the spring catchment area.

Exercise 4: To evaluate the basic quality of spring water for human use.

Exercise 5: To plan and construct basic recharge or conservation structures in a spring-shed.

Course Code: SOLS/EVS-DSE- 008
Course Title: DSE-4 Wetland Ecosystem and Management (03 Credits)

Unit 1: Wetland Fundamentals

1.1. Definitions of wetlands, including hydroperiod, hydric soils, and hydrophytic vegetation.
1.2. Types of wetlands: marshes, swamps, bogs, fens, lotic/lentic, estuarine, and mangroves.
1.3. Wetland formation: geological, climatic, and hydrological controls; global distribution and biomes.
1.4. Water balance, groundwater-surface water interactions, and Ghyben-Herzberg relation.

Unit 2: Ecological Processes

2.1. Biotic components: wetland flora (adaptations), fauna (birds, amphibians, invertebrates), and food webs.
2.2. Abiotic factors: nutrient cycling (biogeochemistry of C, N, P, S), redox processes, and stratification.
2.3. Ecosystem functions: primary productivity, decomposition, energy flow, and succession.
2.4. Biodiversity: species diversity, keystone species, edge effects, and ecotones in wetlands.

Unit 3: Threats and Impacts

3.1. Anthropogenic threats: drainage, filling, pollution (nutrients, toxics), invasive species, and climate change.
3.2. Impacts on services: provisioning (fish, plants), regulating (flood control, water purification), cultural, and supporting roles.
3.3. Valuation methods: economic (market/non-market), ecological integrity indices, and hotspot identification.

Unit 4: Management Strategies

4.1. Conservation policies: Ramsar Convention, National Parks, Sanctuaries, and Protected Areas in India.
4.2. Restoration techniques: Rehydration, Revegetation, Artificial Wetlands, and Ecological Engineering.
4.3. Management tools: Treatment Wetlands, Bio-remediation (plants/microbes), and adaptive strategies.
4.4. Case studies: Indian wetlands (e.g., Chilika, Keoladeo), Global examples, and Community-based approaches.

Course Code: SOLS/EVS-DSE-P- 008

Course Title: DSE-4 Practical **(01 Credit)**

Exercise 1: Wetland Morphology and Classification Study

Exercise 2: Economic Valuation of Wetland Resources

Exercise 3: Wetland Biodiversity Assessment

Exercise 4: Assessment of Wetland Ecosystem Services and Threats

Exercise 5: Wetland Conservation and Restoration Planning

Course Code: SOLS/EVS-MDE- -007

Course Title: MDE-4 Toxicology **(03 Credits)**

Unit–I: Fundamentals of Toxicology

1.1 Concept, definition, scope and history of toxicology
1.2 Classification of toxic substances (natural and synthetic toxicants)
1.3 Dose–response relationship and toxicity evaluation
1.4 Toxicokinetics: absorption, distribution, metabolism and excretion (ADME)

Unit–II: Environmental and Chemical Toxicology

2.1 Air pollutants and their toxic effects
2.2 Water pollutants, pesticides and heavy metal toxicity
2.3 Industrial chemicals and occupational toxicology
2.4 Food toxicology and toxic contaminants in food chain

Unit–III: Biological and Health Toxicology

3.1 Mechanism of toxicity at cellular and molecular level
3.2 Organ toxicity: liver, kidney, nervous and reproductive systems
3.3 Mutagenicity, carcinogenicity and teratogenicity
3.4 Biomarkers and bioindicators in toxicological studies

Unit–IV: Risk Assessment and Management

4.1 Toxicity testing and bioassay methods
4.2 Risk assessment and hazard identification
4.3 Toxic waste management and remediation techniques
4.4 Regulatory framework and environmental safety standards (e.g., World Health Organization, United States Environmental Protection Agency guidelines)

Course Code: SOLS/EVS-MDE-P-007

Course Title: MDE-4 Practical **(01 credit)**

Exercise 1: Determination of acute toxicity (LC50/LD50 concept study through case data).

Exercise 2: Analysis of water samples for toxic contaminants (heavy metals/pesticides).

Exercise 3: Study of toxic effects of pesticides on non-target organisms.

Exercise 4: Identification and estimation of common food toxicants/adulterants.

Exercise 5: Preparation of toxicological risk assessment report of an environmental pollutant.

Course Code: SOLS/EVS-MDE- -008

Course Title: MDE-4 Green Business, IPR and International Agreements (03 Credits)

Unit I: Introduction to Green Business

- **1.1** Concept, definition and scope of Green Business
- **1.2** Evolution of green economy and sustainable development
- **1.3** Principles of sustainability and the Triple Bottom Line approach (People, Plant, Profit)
- **1.4** Role of green business in achieving Sustainable Development Goals (SDGs)
- **1.5** Scope, challenges and future prospects of green business in India

Unit II: Tools and Practices of Green Business

- **2.1** Green production, clean technology and eco-efficient processes
- **2.2** Green marketing, eco-labeling and green consumer behavior
- **2.3** Green supply chain management and green logistics
- **2.4** Carbon footprint, Life Cycle Assessment (LCA) and energy audits
- **2.5** Corporate environmental responsibility

Unit III: Intellectual Property Rights (IPRs): Concepts and Types

- **3.1** Meaning, nature and objectives of Intellectual Property Rights (IPRs)
- **3.2** Patents: concept, procedure, rights and duration
- **3.3** Copyrights, trademarks and industrial design
- **3.4** Geographical Indications (GI) and protection of traditional knowledge
- **3.5** Importance of IPRs in innovation, startups and green technologies

Unit IV: IPRs in the International Framework

- **4.1** Role and functions of World Intellectual Property Organization (WIPO)
- **4.2** TRIPS Agreement: objectives and provisions
- **4.3** IPRs under the World Trade Organization (WTO)
- **4.4** Technology transfer and access to environmentally sound technologies
- **4.5** Issues of biopiracy, biodiversity and IPR challenges for developing countries

Unit V: International Environmental Agreements and Green Governance

- **5.1** Need and importance of international environmental agreements
- **5.2** Paris Agreement and global climate action
- **5.3** Kyoto Protocol and carbon trading mechanisms
- **5.4** Role of United Nations Environment Programme (UNEP), India's participation and global environmental governance

Course Code: SOLS/EVS-MDE-P -008

Course Title: MDE-4 Practical **(01Credit)**

Exercise 1: Green marketing case study

Exercise 2: Preparation of a green business plan

Exercise 3: Patent search and drafting patent (Google Patents, WIPO, InPASS)

Exercise 4: Copyright and trademark study

Exercise 5: Comparative analysis of major agreements (CBD, UNFCCC, Kyoto, Paris, Ramsar, CITES)

Course Code: SOLS/EVS-SEC-005

Course Title: SEC- Community Outreach Activities **(01 Credit)**

1. Environmental Awareness Campaigns

- Awareness rallies on pollution control, Solid Waste Management Programme, biodiversity conservation, Water Conservation Activities, and climate change
- Public lectures and village awareness programmes

2. Tree Plantation and Green Belt Development

- Plantation drives in University, local area
- Monitoring survival and growth of planted saplings

3. Biodiversity Conservation Programmes

- Nature walks and biodiversity documentation with local communities
- Awareness on wildlife conservation and human–wildlife conflict

4. Report Writing

- Preparation of field reports on community outreach activities