

**ABILITY ENHANCEMENT COURSE**  
**Offered by**  
**DEPARTMENT OF ENVIRONMENTAL SCIENCE**

**AEC 1: Environmental Science: Theory into Practice – I**

**Credit distribution, Eligibility and Pre-requisites of the Course**

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department Offering the Course
		Lecture	Tutorial	Practical/ Practice			
AEC 1: Environmental Science: Theory into Practice – I	02	01	–	01	All UG Courses	All UG Courses	Department of Environmental Studies/Sciences

**Learning Objectives**

The Ability Enhancement Course on Environmental Science: Theory into Practice (I & II) at Undergraduate level (AEC- I) aims to train students to cater to the need for ecological citizenship through development of a strong foundation on the critical linkages between ecology-society-economy.

**The Learning Objectives of this course are as follows:**

- **Disciplinary knowledge**  
 Enable students to develop a comprehensive understanding of various facets of life forms, ecological processes, and the impacts on them by humans during the Anthropocene era.
- **Critical thinking**  
 Build capabilities to identify relevant environmental issues, analyse the various underlying causes, evaluate the practices and policies, and develop framework to make informed decisions.
- **Moral and ethical awareness/reasoning**  
 Develop empathy for all life forms, appreciation for the various ecological linkages within the web of life, awareness and responsibility towards environmental protection and nature preservation.

**[State the purpose for creating and teaching the course. Describe what the course aims to do from the teacher’s perspective.]**

## Learning outcomes

**The Learning Outcomes of this course are as follows.**

After the course the students will be empowered and able to:

- Analyse natural processes and resources that sustain life and govern economy.
- Predict the consequences of human actions on the web of life, global economy, and quality of human life.
- Think critically and develop appropriate strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.
- Demonstrate values and show compassionate attitudes towards complex environmental-economic-social challenges, and participate at national and international levels in solving current environmental problems and preventing the future ones.
- Adopt sustainability as a practice in life, society, and industry.

## Teaching Learning process

**The teaching–learning methodologies are designed to provide the undergraduate students a comprehensive understanding of the subject in a simplistic manner as well as evoke critical reasoning and analytical thinking among them. Some of the theoretical concepts related to practicals/outreach activities, etc. should be covered during practical sessions. The various approaches to teaching–learning process include classroom lectures, video presentations, and ICT enabled teaching tools. Forenhancing practical understanding, field visits are encouraged to relevant places in Delhi like Biodiversity parks, Protected areas, Wetlands, Sewage treatment plants, etc.**

## SYLLABUS OF AEC-1: Environmental Science: Theory into Practice – I

### UNIT – I

(1-2 Weeks)

**Introduction to Environmental Studies** (1 lectures and 1 practical/ outreach activities)

- Multidisciplinary nature of environmental studies; components of environment: atmosphere, hydrosphere, lithosphere, and biosphere
- Scope and importance; Concept of sustainability and sustainable development; Brief history of environmentalism

### UNIT – II

(3-7 Weeks)

**Ecosystems** (5 lectures and 7 practical/ outreach activities)

- Definition and concept of Ecosystem
- Structure of ecosystem (biotic and abiotic components); Functions of Ecosystem: Physical (energy flow), Biological (food chains, food web, ecological succession), and Biogeochemical (nutrient cycling) processes. Concepts of productivity, ecological pyramids and homeostasis

- Types of Ecosystems: Tundra, Forest, Grassland, Desert, Aquatic (ponds, streams, lakes, rivers, oceans, estuaries); importance and threats with relevant examples from India
- Ecosystem services (Provisioning, Regulating, Cultural, and Supporting); Ecosystem preservation and conservation strategies; Basics of Ecosystem restoration

### **UNIT – III**

**(8-11 Weeks)**

#### **Natural Resources** (5 lectures and 6 practical/ outreach activities)

- Land resources: Minerals, soil, agricultural crops, natural forest products, medicinal plants, and forest-based industries and livelihoods; Land cover, land use change, land degradation, soil erosion, and desertification; Causes of deforestation; Impacts of mining and dam building on environment, forests, biodiversity, and tribal communities
- Water resources: Natural and man-made sources; Uses of water; Over exploitation of surface and ground water resources; Floods, droughts, and international & inter- state conflicts over water
- Energy resources: Renewable and non-renewable energy sources; Use of alternate energy sources; Growing energy needs; Energy contents of coal, petroleum, natural gas and bio gas; Agro-residues as a biomass energy source
- Case studies: Contemporary Indian issues related to mining, dams, forests, energy, etc (e.g., National Solar Mission, Cauvery River water conflict, Sardar Sarovar dam, Chipko movement, Appiko movement, Tarun Bharat Sangh, etc)

### **UNIT – IV**

**(12-15 Weeks)**

#### **Environmental Pollution and Control** (4 lectures and 6 practical/ outreach activities)

- Environmental pollution (Air, water, soil, thermal, and noise): causes, effects, and controls; Primary and secondary air pollutants; Air and water quality standards
- Nuclear hazards and human health risks
- Solid waste management: Control measures for various types of urban, industrial waste, Hazardous waste, E-waste, etc; Waste segregation and disposal
- Pollution control measures: Introduction to legal, biological, and physico-chemical methods; Role in sustainability
- Pollution case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues, Plastic waste management rules, Bhopal gas tragedy, etc

**(The total number of weeks should add up to 15 only)**

**Practical component (if any) –**

**(15 Weeks)**

#### *Unit I*

#### **Introduction to Environmental Studies** (1 practical/ outreach activity)

### **Practical/Exercises/Experiential activities/Outreach activities**

*(College may choose as per requirement)*

- Analysis of achievement of Sustainable Development Goals of any country.
- Gain insights of sustainability framework for an industrial activity using activity worksheets
- Use of environmental activity worksheets to understand interdependence and interactions between different environmental components.

### *Unit 2*

**Ecosystems** (7 practical/ outreach activities)

### **Practical/Exercises/Experiential activities/Outreach activities**

*(College may choose as per requirement)*

- Schematic collection of data for depicting ecological pyramids in the College campus
- Differentiation of natural and managed ecosystems using Google Earth/Google Map
- Field visit to terrestrial and aquatic ecosystems (a) forests, (b) grasslands, (c) wetlands, (d) biodiversity parks, etc.
- Develop a working model of any ecosystem
- Use of worksheets to identify structure and function of different ecosystems.

### *Unit 3*

**Natural Resources** (6 practical/ outreach activities)

### **Practical/Exercises/Experiential activities/Outreach activities (College may choose as per requirement)**

- Visit to a paper recycling unit/rainwater harvesting plant/solar plant/biogas plant in the College campus
- Develop and understand working model of renewable/non-renewable sources of energy
- Mapping of natural resources of a given study area using Google Earth
- Time-series analysis of natural resource consumption of a given country using publicly available data
- Comparison of energy demand and consumption of a particular state over the years using graphical tools
- Assessing the consumption pattern of a natural resource in the dominant industry at local scale and status of natural resource in areas supplying it

### *Unit 4*

**Environmental Pollution** (6 practical/ outreach activities)

### **Practical/Exercises/Experiential activities/Outreach activities**

*(College may choose as per requirement)*

- Determine water quality of a given location using rapid pollution monitoring kits
- Assess air quality index (AQI) of any location using real-time air quality parameters
- Determine magnitude of solid waste generated in a home/college on a monthly basis
- Develop and maintain compost/vermicompost using biodegradable waste in the College
- Identify suitability of given water samples for various purposes using given kits
- Prepare water audit report of the college/house/locality/colony.
- Map solid and liquid discharge of the college/colony and develop a management plan

(show it using schematic diagram, and photographs.

- Repurpose waste for economic and environmental benefits in your college/near by area/colony (submit a small video).
- Analyze river-society-economy nexus based on primary or secondary data (use quantitative data, and show it using photographs on a poster).

## Essential/recommended readings

### Unit 1

#### Introduction to Environmental Studies

1. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*, 8thEdition. Wiley Publishing, USA. **Chapter 1** (Pages: **1-17**); **Chapter 2** (Pages: **22-23**); **Chapter3** (Pages: **40, 41**); **Chapter 4** (Pages: **64, 66**).
2. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 1** (Page: **3-28**).

### Unit 2

#### Ecosystems

1. Odum, E.P., Odum, H.T., and Andrews, J. (1971). *Fundamentals of Ecology*. Saunders, Philadelphia, USA. **Chapter 1** (Pages: **1-16**); **Chapter 2** (Pages: **18-76**); **Chapter 10** (Pages: **414-458**).
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*, 9thEdition. Wiley Publishing, USA. **Chapter 3** (Pages: **38-52**); **Chapter 4** (Pages: **53-62**); **Chapter5** (Pages: **100-103**); **Chapter 6** (Pages: **106-128**).
3. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 13** (Pages: **307-323**); **Chapter 18** (Pages: **420-442**); **Chapter 28** (Pages: **747-769**).

### Unit 3

#### Natural Resources

1. Gadgil, M. and Guha, R. (1993). *This Fissured Land: An Ecological History of India*. University of California Press, Berkeley, USA. (pp. 1-245).
2. McCully, P. (1996). *Rivers no more: the environmental effects of dams*, In: *Silenced Rivers: The Ecology and Politics of Large Dams*, Zed Books, New York, USA. **Page. 29-64**.
3. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9thEdition. Wiley Publishing, USA. **Chapters 10, 11, 12, 13** (Pages: **180-263**); **Chapter 14** (Pages:**272-275**); **Chapter 15** (Pages: **286-289**).
4. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 25** (Pages: **623-663**).

## Unit 4

### Environmental Pollution

1. Brusseau, M.L., Pepper, I.L. and Gerba, C.P. (2019). *Environmental and Pollution Science*, 3rd Edition. Academic Press, USA. **Chapter 16** (Pages: 243-255); **Chapter 18** (Pages: 280-305); **Chapter 21** (Pages: 352-358); **Chapter 22** (Pages: 365-374); **Chapter 23** (Pages: 378-388); **Chapter 25** (Pages: 416-426).
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapter 19** (Pages: 359-381); **Chapter 21** (Pages: 401-421); **Chapter 23** (Pages: 440-453).
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapters 19, 20, 12** (Pages: 445-535).

### Suggested readings

1. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA.
2. Carson, R. (2002). *Silent Spring*. Houghton Mifflin Harcourt, USA.
3. Brusseau, M.L., Pepper, I.L. and Gerba, C.P. (2019). *Environmental and Pollution Science*, 3rd Edition. Academic Press, USA.

**Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time**

### Assessment methods

1. Written examinations (Semester exams) [(**Year 1**: 01 credit (1 hour); **Year 2**: 01 credit (1 hour))]
2. Project work and reports related to field visits, outreach activities, case study, project formulation, assignments, presentations and practical learning (Internal practical assessment) [(**Year 1**: 01 credit (2 hour); **Year 2**: 01 credit (2 hour))]  
**Year 1 (Sem-I/Sem-II):** 01 Credit Theory+ 01 Credit practical exercises, etc.  
= **Total 02 Credits (03 hours)**  
**Year 2 (Sem-I/Sem-II):** 01 Credit Theory+ 01 Credit practical exercises, etc.  
= **Total 02 Credits (03 hours)**

## AEC 1: Environmental Science: Theory into Practice –II

### Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department Offering the Course
		Lecture	Tutorial	Practical/ Practice			
AEC 1: Environmental Science: Theory into Practice – II	02	01	–	01	All UG Courses	All UG Courses	Department of Environmental Studies/Sciences

### Learning Objectives

The Ability Enhancement Course on Environmental Science: Theory into Practice (I & II) at Undergraduate level (AEC- I) aims to train students to cater to the need for ecological citizenship through development of a strong foundation on the critical linkages between ecology-society-economy.

The Learning Objectives of this course are as follows:

- **Disciplinary knowledge**  
Enable students to develop a comprehensive understanding of various facets of life forms, ecological processes, and the impacts on them by humans during the Anthropocene era.
- **Critical thinking**  
Build capabilities to identify relevant environmental issues, analyse the various underlying causes, evaluate the practices and policies, and develop framework to make informed decisions.
- **Moral and ethical awareness/reasoning**  
Develop empathy for all life forms, appreciation for the various ecological linkages within the web of life, awareness and responsibility towards environmental protection and nature preservation.

**[State the purpose for creating and teaching the course. Describe what the course aims to do from the teacher’s perspective.]**

## Learning outcomes

The Learning Outcomes of this course are as follows.

After the course the students will be empowered and able to:

- Analyse natural processes and resources that sustain life and govern economy.
- Predict the consequences of human actions on the web of life, global economy, and quality of human life.
- Think critically and develop appropriate strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.
- Demonstrate values and show compassionate attitudes towards complex environmental-economic-social challenges, and participate at national and international levels in solving current environmental problems and preventing the future ones.
- Adopt sustainability as a practice in life, society, and industry.

## Teaching Learning process

The teaching-learning methodologies are designed to provide the undergraduate students a comprehensive understanding of the subject in a simplistic manner as well as evoke critical reasoning and analytical thinking among them. Some of the theoretical concepts related to practicals/outreach activities, etc. should be covered during practical sessions. The various approaches to teaching-learning process include classroom lectures, video presentations, and ICT enabled teaching tools. For enhancing practical understanding, field visits are encouraged to relevant places in Delhi like Biodiversity Parks, Protected areas, Wetlands, Sewage treatment plants, etc.

## SYLLABUS OF AEC-1: Environmental Science: Theory into Practice – II (Year 2)

### Unit V

**Global Environmental Issues and Policies** (5 lectures 8 practical/ outreach activities)

- Causes of Climate change, Global warming, Ozone layer depletion, and Acid rain; Impacts on human communities, biodiversity, global economy, and agriculture
- International agreements and programmes: Earth Summit, UNFCCC, Montreal and Kyoto protocols, Convention on Biological Diversity (CBD), Ramsar convention, The Chemical Weapons Convention (CWC), UNEP, CITES, etc.
- Sustainable Development Goals: India's National Action Plan on Climate Change and its major missions
- Environment legislation in India: Wildlife Protection Act, 1972; Water (Prevention and Control of Pollution) Act, 1974; Forest (Conservation) Act 1980; Air (Prevention & Control of Pollution) Act, 1981; Environment Protection Act, 1986; Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006



## Unit VI

### **Biodiversity and Conservation** (6 lectures and 7 practical/ outreach activities)

- Definition of Biodiversity; Levels of biological diversity: genetic, species and ecosystem diversity
- India as a mega-biodiversity nation; Biogeographic zones of India; Biodiversity hotspots; Endemic and endangered species of India; IUCN Red list criteria and categories
- Value of biodiversity: Ecological, economic, social, ethical, aesthetic, and informational values of biodiversity with examples; sacred groves and their importance with examples
- Threats to biodiversity: Habitat loss, degradation, and fragmentation; Poaching of wildlife; Man-wildlife conflicts; Biological invasion with emphasis on Indian biodiversity; Current mass extinction crisis
- Biodiversity conservation strategies: in-situ and ex-situ methods of conservation; National Parks, Wildlife Sanctuaries, and Biosphere reserves; Keystone, Flagship, Umbrella, and Indicator species; Species reintroduction and translocation
- *Case studies*: Contemporary Indian wildlife and biodiversity issues, movements, and projects (e.g., Project Tiger, Project Elephant, Vulture breeding program, Project Great Indian Bustard, Crocodile conservation project, Silent Valley movement, Save Western Ghats movement, etc)

## Unit VII

### **Human Communities and the Environment** (4 lectures and 5 practical/ outreach activities)

- Human population growth: Impacts on environment, human health, and welfare; Carbon foot-print
- Resettlement and rehabilitation of developmental project affected persons and communities; relevant case studies
- Environmental movements: Chipko movement, Appiko movement, Silent valley movement, Bishnois of Rajasthan, Narmada Bachao Andolan, etc
- Environmental justice: National Green Tribunal and its importance
- Environmental philosophy: Environmental ethics; Role of various religions and cultural practices in environmental conservation
- Environmental communication and public awareness: case studies (e.g., CNG vehicles in Delhi, Swachh Bharat Abhiyan, National Environment Awareness Campaign (NEAC), National Green Corps (NGC) "Eco-club" programme, etc)

**(The total number of weeks should add up to 15 only)**

## Practical component–

(15 Weeks)

### Unit V

**Global Environmental Issues and Policies** (8 practical/ outreach activities)

#### **Practical/Exercises/Experiential activities/Outreach activities**

*(College may choose as per requirement)*

- Depict temperature/precipitation trend of a given study area using online data
- Formulate questionnaire/online surveys for assessment of the impact of climate change on people
- Assess Nationally Determined Contributions (NDCs) of developed and developing countries
- Development and simulation of Model UNFCCC for inoculating negotiation skills at climate change summits
- Development and simulation of Moot Court for Mock Trials in Negotiation Green Tribunal
- Identify carbon footprint of your college/home/locality (refer [wwf@envis.nic.in](mailto:wwf@envis.nic.in)).
- Analyze the status of at least 3 sustainable development goals in your neighbourhood and write a proposal to help achieve them at global standard (identify environmental problems and its social and economic impact, define objectives, explain methodology, budgetary requirements, and suggest the expected outcomes). A PowerPoint presentation to be made based on the project proposal.

### Unit VI

**Biodiversity and Conservation** (7 practical/ outreach activities)

#### **Practical/Exercises/Experiential activities/Outreach activities**

*(College may choose as per requirement)*

- Acquaintance with open-source databases of biodiversity
- Determine species location in a given study area
- Depict distribution of biodiversity across latitude and altitude
- Show species distribution across space and time
- Quantify species loss across different time periods
- Sampling of plant and animal biodiversity of the College campus
- Identification of the floral diversity of Delhi and other states.
  - Documentation of the plants by clicking pictures, finding out the scientific names/ local names through literature or mobile applications, identification of their conservation status (IUCN red book list), medicinal properties, water consumption status, and socio-economic-environmental importance. A short report to be submitted)
- Exercise to understand the socio-economic-environmental impact of wildlife conservation.

(Students can choose any global animal species and identify the relevance of the species for the ecosystem/ society/ culture/ local economy, historic or present range of the species, emerging threats due to human activities, identification of documented events of natural disasters/ conflicts/ poaching of the species in the present range, conservation status (IUCN red book list), identification of protected areas/ programs of the government/ international organisation, and their opinion to further improve the conservations of the species. A short report to be submitted.

## Unit 7

### Human Communities and the Environment (5 practical/ outreach activities)

#### Practical/Exercises/Experiential activities/Outreach activities

(College may choose as per requirement)

- Assessment of carbon foot-print of different countries using online databases and mathematical tools
- Visit to marginalized localities and students for environmental education and environmental awareness
- Formulation of questionnaire/online surveys for assessment of the impact of environmental education
- Visit to any developmental project affected locality for assessing the impacts of economic development on human lives
- Correlation analysis of human population growth and impacts on the environment and human health

## Essential/recommended readings

### Unit V

#### Global Environmental Issues and Policies (5 lectures 8 practical/ outreach activities)

1. Divan, S. and Rosencranz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statutes*, 2nd Edition. Oxford University Press, India. **Chapter 2** (Pages: 23-39); **Chapter 3** (Pages: 41-86).
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapter 19** (Pages: 370-376); **Chapter 20** (Pages: 385-399).
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 23** (Pages: 555-598); **Chapter 30** (Pages: 801-807).

### Unit VI

#### Biodiversity and Conservation (6 lectures and 7 practical/ outreach activities)

1. Primack, R.B. (2014). *Essentials of Conservation Biology*, Oxford University Press, USA. Page.1-536.
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapter 5** (Pages: 97-99); **Chapter 16** (Pages: 299-318).
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapters 24** (Pages: 599-690); **Chapter 26** (Pages: 664-714).

### Unit VII

#### Human Communities and the Environment (4 lectures and 5 practical/ outreach activities)

#### Suggested Readings

1. Divan, S. and Rosencranz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statutes*, 2nd Edition. Oxford University Press, India. **Chapter 10** (Pages: 416-473).
2. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. **Chapter 2** (Pages: 33-36); **Chapter 8** (Pages: 148-162).
3. Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. **Chapter 1** (Pages: 23-26); **Chapter 31** (Pages: 826-842).

## Suggested readings

1. Brusseau, M.L., Pepper, I.L. and Gerba, C.P. (2019). *Environmental and Pollution Science*, 3rd Edition. Academic Press, USA.
2. Carson, R. (2002). *Silent Spring*. Houghton Mifflin Harcourt, USA.
3. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y. and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA.
4. van Wormer, K. and Besthorn, F. (2017). *Human Behavior and the Social Environment, Macro Level Groups, Communities, and Organizations*, Third Edition, Oxford University Press.

**Examination scheme and mode: Subject to directions from the Examination Branch/University of Delhi from time to time**

## Assessment methods

1. Written examinations (Semester exams) [(**Year 1**: 01 credit (1 hour); **Year 2**: 01 credit (1 hour))]
2. Project work and reports related to field visits, outreach activities, case study, project formulation, assignments, presentations and practical learning (Internal practical assessment) [(**Year 1**: 01 credit (2 hour); **Year 2**: 01 credit (2 hour))]

**Year 1 (Sem-I/Sem-II):** 01 Credit Theory+ 01 Credit practical exercises, etc.  
= **Total 02 Credits (03 hours)**

**Year 2 (Sem-I/Sem-II):** 01 Credit Theory+ 01 Credit practical exercises, etc.  
= **Total 02 Credits (03 hours)**