# **Ability Enhancement Course (AEC)**

# **Environmental Science: Theory into Practice (I) at UG level (AEC I)**

## **Course Learning Outcomes**

- **6.0** The course will empower the undergraduate students by helping them to:
  - i. Gain in-depth knowledge on natural processes and resources that sustain life and govern economy.
  - ii. Understand the consequences of human actions on the web of life, global economy, and quality of human life.
- iii. Develop critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.
- iv. Acquire values and attitudes towards understanding complex environmental- economicsocial challenges, and active participation in solving current environmental problems and preventing the future ones.
- v. Adopt sustainability as a practice in life, society, and industry.

## 6.1 Year – 1

# Ability Enhancement Course on Environmental Science: Theory into Practice (I) – at UG level (AEC-I)

#### Unit 1

Introduction to Environmental Studies (2 lectures and 3 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

## **Suggested Readings**

- Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). Environment, 8th Edition. Wiley Publishing, USA. Chapter 1 (Pages: 1-17); Chapter 2 (Pages: 22-23); Chapter 3 (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).

# Practical/Exercises/Experiential activities/Outreach activities

(College may choose as per requirement)

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

#### Unit 2

Ecosystems (6 lectures and 6 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

#### Suggested Readings

- 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).
- Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*, 9th Edition. Wiley Publishing, USA. Chapter 3 (Pages: 38-52); Chapter 4 (Pages: 53-62); Chapter 5 (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).

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

(College may choose as per requirement)

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

### Unit 3

Natural Resources (8 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 &interstate 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)

### **Suggested Readings**

- 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, 9th Edition. 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).

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

- 1. Visit to a paper recycling unit/rainwater harvesting plant/solar plant/biogas plant in the College campus
- 2. Develop and understand working model of renewable/non-renewable sources of energy
- 3. Mapping of natural resources of a given study area using Google Earth
- 4. Time-series analysis of natural resource consumption of a given country using publicly available data
- 5. Comparison of energy demand and consumption of a particular state over the years using graphical tools
- 6. 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 (8 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 case studies: Ganga Action plan (GAP), Delhi air pollution and public health issues, Plastic waste management rules, Bhopal gas tragedy, etc

## **Suggested Readings**

- 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. Carson, R. (2002). Silent Spring. Houghton Mifflin Harcourt, USA. Pp. 1-264.
- 3. 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).
- 4. 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).

# Practical/Exercises/Experiential activities/Outreach activities

(College may choose as per requirement)

- 1. Determine water quality of a given location using rapid pollution monitoring kits
- 2. Assess air quality index (AQI) of any location using real-time air quality parameters
- 3. Determine magnitude of solid waste generated in a home/college on a monthly basis
- 4. Develop and maintain compost/vermicompost using biodegradable waste in the College
- 5. Identify suitability of given water samples for various purposes using given kits
- 6. Prepare water audit report of the college/house/locality/colony.
- 7. Map solid and liquid discharge of the college/colony and develop a management plan (show it using schematic diagram, and photographs.
- 8. Repurpose waste for economic and environmental benefits in your college/near by area/colony (submit a small video).
- 9. Analyze river-society-economy nexus based on primary or secondary data (use quantitative data, and show it using photographs on a poster).