Ability Enhancement Course on Environmental Science: Theory into Practice (I & II) 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- economic-social 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

1. 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**).
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 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 &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)

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

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. 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).