

दिल्लीविश्वविद्यालय
UNIVERSITY OF DELHI

Six-Month **Ability Enhancement Compulsory Course (AECC-I)**
Environmental Studies
at Undergraduate Level

Learning Outcome-based Curriculum Framework
(Effective from Academic Year 2019–20)



Revised Syllabus as approved by

Academic Council

Date: 15 July

No:

Executive Council

Date:

No:

Applicable for students registered with Regular Colleges,
Non Collegiate Women's Education Board and School of Open Learning

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Introduction

Content: The Compulsory course on Environmental Studies at Undergraduate level (AECC-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.

Learning Outcome based approach to Curriculum Planning

1. Graduate Attributes in Subject

- a. **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.
- b. **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.
- c. **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.

2. Programme Learning Outcome in course

The course will empower the undergraduate students through:

- i. Gaining of in-depth knowledge on natural processes and resources that sustain life and govern economy.
- ii. Understanding and predicting the consequences of human actions on the web of life, global economy, and quality of human life.
- iii. Development of critical thinking for shaping strategies (scientific, social, economic, administrative, and legal) for environmental protection, conservation of biodiversity, environmental equity, and sustainable development.
- iv. Acquisition of values and attitudes towards understanding complex environmental-economic-social challenges, and active participation in solving current environmental problems and preventing the future ones.
- v. Encouraging adoption of sustainability as a practice in life, society, and industry.

3. Qualification Description

Graduates will evolve into ecologically, environmentally, and socially informed and responsible citizens who are empowered to protect the natural resources while ensuring sustainable lifestyle and developmental model.

Environmental Studies

Compulsory course on Environmental Studies at UG level (AECC I)

Course Learning Outcomes

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.

Unit 1

Introduction to Environmental Studies (2 lectures)

- 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).

Unit 2

Ecosystems (6 lectures)

- 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).

Unit 3

Natural Resources (8 lectures)

- 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).

Unit 4

Biodiversity and Conservation (8 lectures)

- 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)

Suggested Readings

1. Primack, R.B. (2014). *Essentials of Conservation Biology*, Oxford University Press, USA. Page. 1-536.
2. Raven, P.H, Hassenzuhl, 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 5

Environmental Pollution (8 lectures)

- 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, Hassenzuhl, 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**).

Unit 6

Global Environmental Issues and Policies (7 lectures)

- 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

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 2** (Pages: 23-39); **Chapter 3** (Pages: 41-86).
2. Raven, P.H, Hassenzuhl, 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 7

Human Communities and the Environment (6 lectures)

- 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)

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, Hassenzuhl, 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).

Field work/ Practicals

(Equal to 5 lectures, including two mandatory field visits)

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc., or any nearby lake or pond, explaining the theoretical aspects taught in the class room
- Visit to any biodiversity park/ reserve forest/ protected area/ zoo/ nursery/ natural

history museum in and around Delhi, such as Okhla bird sanctuary/ Asola Bhatti Wildlife Sanctuary/ Yamuna Biodiversity Park/ Sultanpur National Park, explaining the theoretical aspects taught in the classroom

- Visit to a local polluted site (urban/rural/industrial/agricultural), wastewater treatment plants, or landfill sites, etc
- Study of common plants and animals; basic principles of identification
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building, and critical reasoning among students

Essential Readings

1. Brusseau, M.L., Pepper, I.L., and Gerba, C.P. (2019). *Environmental and Pollution Science*, 3rd Edition. Academic Press, USA. (pp. 1-520).
2. Divan, S. and Rosencranz, A. (2002). *Environmental Law and Policy in India: Cases, Material & Statutes*, 2nd Edition. Oxford University Press, India. (pp. 1-837).
3. Gadgil, M., and Guha, R. (1993). *This Fissured Land: An Ecological History of India*. University of California Press, Berkeley, USA. (pp. 1-245).
4. Raven, P.H, Hassenzahl, D.M., Hager, M.C, Gift, N.Y., and Berg, L.R. (2015). *Environment*, 8th Edition. Wiley Publishing, USA. (pp. 1-472).
5. Singh, J.S., Singh, S.P., and Gupta, S.R. (2017). *Ecology, Environmental Science and Conservation*. S. Chand Publishing, New Delhi. (pp.1-842).

Weekly Lesson Plan

Week 1

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

Week 2

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

Week 3

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

Week 4

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
Natural and man-made sources of water; Uses of water; Over exploitation of surface and ground water resources; Floods, droughts, and international & inter-state conflicts over water

Week 5

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).

Week 6

Definition of Biodiversity; Levels of biological 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

Week 7-8

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)

Week 9

Environmental pollution (Air, water, soil, thermal, and noise): causes, effects, and controls; Primary and secondary air pollutants; Air and water quality standards

Related case studies

Week 10

Nuclear hazards and human health risks; Control measures for various types of urban, industrial waste, Hazardous waste, E-waste, etc; Waste segregation and disposal

Related case studies

Week 11

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

Week 12

Sustainable Development Goals: India's National Action Plan on Climate Change and its major missions

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

Week 13

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

Week 14

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)

Week 15-16

Practical/project

- Field visit to any of the ecosystems found in Delhi like Delhi Ridge/ Sanjay lake/ Yamuna river and its floodplains etc., or any nearby lake or pond, explaining the theoretical aspects taught in the class room
- Visit to any biodiversity park/ reserve forest/ protected area/ zoo/ nursery/ natural history museum in and around Delhi, such as Okhla bird sanctuary/ Asola Bhatti Wildlife Sanctuary/ Yamuna Biodiversity Park/ Sultanpur National Park, explaining the theoretical aspects taught in the classroom
- Visit to a local polluted site (urban/rural/industrial/agricultural), wastewater treatment plants, or landfill sites, etc
- Organize a seminar/ conference/ workshop/ panel discussion on relevant topics for enhancing awareness, capacity building, and critical reasoning among students
- Basic exercise to Calculate and Assess carbon footprint/ Solid waste generation/ water consumption for a specific duration at individual/ family/ college/ locality level.

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. 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.

Assessment methods

1. Written examinations (Semester exams, Internal assessment)
2. Project work and reports related to field visits and practical learning
3. Assignment/presentations on any contemporary environmental issue

Keywords

Environment, Ecosystem, Biodiversity, Conservation, Pollution, Natural Resources, Environmental Degradation, Protection, Sustainable Development, Climate Change, Environmental Justice, Environmental Ethics, Environmental Communication