

DEPARTMENT OF ENVIRONMENTAL SCIENCE

Category-I

SEMESTER - VI

BSC (H) ENVIRONMENTAL SCIENCE

DISCIPLINE SPECIFIC CORE COURSE – 16 (DSC-EVS-16): ENVIRONMENTAL POLLUTION AND HUMAN HEALTH

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 (if any) |
|--|---------|-----------------------------------|----------|---------------------|----------------------|--------------------------------------|
| | | Lecture | Tutorial | Practical/ Practice | | |
| DSC-EVS-16: ENVIRONMENTAL POLLUTION AND HUMAN HEALTH | 4 | 2 | 0 | 2 | Class XII pass | NA |

Learning objectives

The Learning Objectives of this course are as follows:

- Provide in-depth knowledge about pollution sources, and its effects on human health
- Equip with skills to assess and manage pollution related health risks
- Enable to analyze the roles government agencies, industry, and the public, in protecting environment and human health
- Familiarize with the advancements in research and technology to control environmental pollution and protect human health
- Encourage to apply skills and knowledge to real-world problems of environmental pollution and human health

Learning outcomes

After this course, students will be able to:

- Identify different types and sources of environmental pollutants and associated impacts on human health
- Use analytical techniques to monitor environmental pollutants in air, water, and soil
- Assess the health risks associated with exposure to different pollutants and recommend appropriate strategies to manage associated risks
- Recommend appropriate scientific analysis related to environmental health, risks and solutions to decision-makers

SYLLABUS OF DSC-EVS-16

Theory (02 Credits: 30 lectures)

UNIT – I Introduction

(1 Week) (2 lectures)

Environmental pollutants and their classification, Link between pollution and human health, Ecological principles and pollution, Environmental health risk assessment, Global perspectives on pollution and health, Ethics and social responsibility in pollution management

UNIT – II Air pollution

(2½ Week) (5 lectures)

Ambient air quality: monitoring and standards (National Ambient Air Quality Standards of India); air quality index; sources and types of pollutants (primary and secondary); smog (case study); effects of different pollutants on human health (NO_x, SO_x, PM, CO, CO₂, hydrocarbons and VOCs) and control measures; indoor air pollution: sources and effects on human health.

UNIT – III Water pollution

(3 Week) (6 lectures)

Sources of surface and ground water pollution; water quality parameters and standards; organic waste and water pollution; eutrophication; COD, BOD, DO; effect of water contaminants on human health (nitrate, fluoride, arsenic, chlorine, cadmium, mercury, pesticides); water borne diseases; concept and working of effluent treatment plants (ETPs).

Marine resources and their importance; sources of marine pollution; oil spill and its effects; coral reefs and their demise; coastal area management; existing challenges and management techniques (planning, construction, environmental monitoring of coastal zones).

UNIT – IV Soil pollution

(1 Week) (2 lectures)

Causes of soil pollution and degradation; effect of soil pollution on environment, vegetation and other life forms; control strategies.

UNIT – V Noise, radioactive and thermal pollution

(2½ Week) (5 lectures)

Noise pollution – sources; frequency, intensity and permissible ambient noise levels; effect on communication, impacts on life forms and humans - working efficiency, physical and mental health; control measures.

Radioactive material and sources of radioactive pollution; effect of radiation on human health (somatic and genetic effects); thermal pollution and its effects.

UNIT – VI Chemistry of environmental pollutants

(2½Week) (5 lectures)

Solubility of pollutants (hydrophilic and lipophilic pollutants), transfer of pollutants within different mediums, role of chelating agents in transferring pollutants, concept of biotransformation and bioaccumulation, concept of radioactivity, radioactive decay and half-life of pollutants, organometallic compounds, acid mine drainage.

UNIT – VII Pollution control

(2½Week) (5 lectures)

Activated Sludge Process (ASP) – Trickling Filters – oxidation ponds, fluidized bed reactors,

membrane bioreactor neutralization, ETP sludge management; digesters, up flow anaerobic sludge blanket reactor, fixed film reactors, sequencing batch reactors, hybrid reactors, bioscrubbers, biotrickling filters; regulatory framework for pollution monitoring and control; case study: Ganga Action Plan; Yamuna Action Plan; implementation of CNG in NCT of Delhi.

Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)

- 1-3. Determine the levels of selected gaseous pollutants (oxides of nitrogen and sulfur, carbon monoxide) and particulate matter
4. Analyze National Ambient Air Quality Standards (NAAQS) of your City and compare it with any other city of similar size and demography from the country or other parts of the world
- 5-7. Analyze quality of water sampled from different sources based on pH, dissolved oxygen, turbidity, and nutrient contents
8. Analyze the most probable soil pollutants of area near your college and predict its impact on human health
9. Identify health hazard by any target air/water pollutant of your city and develop the possible exposure pathway and predict the associated environmental health risk
10. Assess potential of water pollution control techniques like coagulation-flocculation, sedimentation, filtration, and disinfection
11. Measure the noise levels in different environments using sound level meters and analyze the impacts of noise pollution on human health
12. Determine the probable indoor air pollutants in the buildings of your college and identify their sources
13. Analyze the cases of waterborne Disease during past 30-years in any country of your choice and determine the pattern, if any
14. Practice different communication strategies for educating the pollution-related health hazards and assess their impacts

Teaching and learning interface for theoretical concepts

To achieve the course objectives and match with the contents, a wide range of teaching and learning tools will be employed, including (a) Formal lectures; (b) Interactive sessions using visual aid; (c) Case study analyses; (d) Hypothetical scenario building; (e) Group discussion on key topics; and (f) documentary screening and critical analyses.

Essential/recommended readings

- Brauer, M., & Brook, J. (Eds.). (2019). Air pollution and health (2nd ed.). Academic Press.
- Gee, D. (2019). Toxic legacy: Synthetic toxins in the food, water and air of American cities. MIT Press.
- Gee, D. (2019). Toxic legacy: Synthetic toxins in the food, water and air of American cities. MIT Press.
- Harrison, R. M. (2019). Pollution: Causes, effects and control (5th ed.). Royal Society of Chemistry.
- Lippmann, M. (2019). Environmental toxicants: Human exposures and their health

effects (4th ed.). John Wiley & Sons.

- Merchant, R. M. (2019). An introduction to environmental epidemiology. CRC Press.
- World Health Organization. (2019). Chemicals of public health concern: Fact sheets. World Health Organization.
- Yang, Y., & Khudyakov, J. I. (Eds.). (2020). Environmental surveillance and population monitoring for chemical, biological, and radiological agents. Academic Press.

Suggestive readings

- Clements, A. L. (2019). Green building: Guidebook for sustainable architecture. Routledge.
- Cohen, A. J. (2017). The human cost of air pollution: Health implications for billions of people. The MIT Press.
- Guha, M., & Sircar, N. (Eds.). (2019). Environmental hazards in South Asia: Domestic and transboundary perspectives. Routledge.
- Peterson, R. E. (2019). The fundamentals of environmental chemistry. CRC Press.
- Ritz, B. (2019). Critical windows of exposure to environmental pollutants. Springer.
- White, L. W., & Gibson, J. E. (2019). Principles of toxicology: Environmental and industrial applications (3rd ed.). John Wiley & Sons.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 17 (DSC-EVS-17): ENVIRONMENTAL LEGISLATION & POLICY

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 (if any) |
|--|---------|-----------------------------------|----------|---------------------|----------------------|--------------------------------------|
| | | Lecture | Tutorial | Practical/ Practice | | |
| DSC-EVS-17: ENVIRONMENTAL LEGISLATION & POLICY | 4 | 2 | 0 | 2 | Class XII pass | NA |

Learning objectives

The Learning Objectives of this course are as follows:

- Provide an overview of the key environmental laws, regulations, and policies of India and world
- Examine the role of government agencies, stakeholders, and the public in the environmental policy-making process.
- Explore the historical development and contemporary challenges of environmental policy and its implementation.
- Analyze the impact of environmental policies on environmental quality, public health, and social justice.

Learning outcomes

After this course, students will be able to

- Describe the key environmental laws, regulations, and policies of India and world, including their history and objectives
- Analyze the roles of government agencies, stakeholders, and the public in the environmental policy-making process, and understand the challenges and opportunities in policy implementation
- Evaluate the effectiveness of environmental policies in achieving their intended outcomes, including their impacts on environmental quality, public health, and social justice
- Communicate their understanding of environmental policy issues and solutions to a variety of audiences, including policymakers, stakeholders, and the public.

SYLLABUS OF DSC-EVS-17

Theory (02 Credits: 30 lectures)

UNIT – I Introduction (3½ Week) (7 lectures)

Constitution of India; fundamental rights; fundamental duties; Union of India; union list, state list, concurrent list; legislature; state assemblies; judiciary; panchayats and

municipal bodies; National Green Tribunal.

UNIT – II History of environmental legislation and policy (2½ Week) (5 lectures)

Ancient period: worship of water, air, trees; Mauryan period: Kautilya's Arthashastra, Yajnavalkyasmriti and Charaksamhita; Medieval period: forests as woodland and hunting resources during Mughal reign; British India: Indian Penal Code 1860, Forest Act 1865, Fisheries Act 1897; Independent India: Van Mahotsava 1950, National Forest Policy 1952, Orissa River pollution and prevention Act 1953.

UNIT – III Environmental legislation (2½ Week) (5 lectures)

Legal definitions (environmental pollution, natural resource, biodiversity, forest, sustainable development); Article 48A (The protection and improvement of environment and safeguarding of forests and wildlife); Article 51 A (Fundamental duties).

UNIT – IV Legislative Instruments (1½ Week) (3 lectures)

The Indian Forest Act 1927; The Wildlife (Protection) Act 1972; The Water (Prevention and Control of Pollution) Act 1974; The Forests (Conservation) Act 1980; The Air (Prevention and Control of Pollution) Act 1981; The Environment (Protection) Act 1986; Motor Vehicle Act 1988; The Public Liability Insurance Act 1991; Noise Pollution (Regulation and Control) Rules 2000; The Biological Diversity Act 2002; The Schedule Tribes and other Traditional Dwellers (Recognition of Forests Rights) Act 2006; The National Green Tribunal Act 2010; Scheme and labeling of environment friendly products, Ecomarks.

UNIT – V India's recent efforts (1½ Week) (3 lectures)

Namami Gange Programme 2014, National Mission on Sustainable Agriculture 2014, Smart Cities Mission 2015, Plastic Waste Management Rules of 2016, National Policy on Marine Fisheries of 2017, National Clean Air Programme 2019, Jal Shakti Abhiyan 2019, Swachh Bharat Abhiyan 2.0, EIA Notification 2020, National Biodiversity Act of 2022.

UNIT – VI Government institutions and case studies (2 Week) (4 lectures)

Role of Ministry of Environment, Forests & Climate Change in environmental law and policy making; role of central and state pollution control boards in environmental law and policy making.

National Green Tribunal: Aditya N Prasad vs. Union of India & Others; Ganga Tanneries Case: M.C. Mehta vs. Union of India 1988; Environmental education case: M.C. Mehta vs. Union of India, WP 860/1991.

UNIT – VII International laws and policy (3 Week) (6 lectures)

Stockholm Conference 1972; Ramsar Convention, Montreal Protocol 1987; United Nations Conference on Environment and Development 1992; Rio de Janeiro (Rio Declaration, Agenda 21); Kyoto Protocol 1997; Copenhagen and Paris Summits; The Sustainable Development Goals 2015, and The Basel Convention Plastic Waste Amendments 2019,

Teaching and learning interface for theoretical concepts

To achieve the course objectives and match with the contents, a wide range of teaching and learning tools will be employed, including (a) Formal lectures; (b) Interactive sessions using visual aid; (c) Case study analyses; (d) Hypothetical scenario building; (e) Group discussion on key topics; and (f) documentary screening and critical analyses.

Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)

1. Conduct a stakeholder analysis of an environmental policy issue in your community to understand the range of interests and perspectives of stakeholders in environmental policy-making
2. Analyze a recent environmental impact statement (EIS) for a proposed development project
3. Develop a compliance checklist for a specific environmental regulation to understand the key requirements of an environmental regulation and ensure compliance
4. Conduct a cost-benefit analysis of a proposed environmental policy
5. Develop a communications plan for an environmental advocacy campaign
6. Analyze a landmark environmental court case and its implications for policy-making
7. Develop a policy brief on an emerging environmental issue. Aim to effectively communicate the key facts and policy options related to an emerging environmental issue
8. Analyze the policy-making process for a recent environmental regulation to understand the key stages and actors involved in environmental policy-making
9. Conduct a comparative analysis of environmental policies in two different countries
10. Analyze the role of civil society in environmental policy-making, especially of non-governmental organizations, and other stakeholders
11. Conduct a stakeholder analysis of issues of climate change or biodiversity loss, or marine conservation

Teaching and learning interface for practical skills

To impart training on technical and analytical skills related to the course objectives, a wide range of learning methods will be used, including (a) laboratory practicals; (b) field-work exercises; (c) customized exercises based on available data; (d) survey analyses; and (e) developing case studies; (f) demonstration and critical analyses; and (h) experiential learning individually and collectively.

Essential/recommended readings

- Alexander, L. (2018). Environmental law: Cases and materials. West Academic

Publishing.

- Christoff, P. (2018). Fourteen environmental reformers: Speaking up for nature. Routledge.
- Donnelly, K. (2019). Environmental law, policy, and economics: Reclaiming the environmental agenda. Routledge.
- Fisher, E. (2019). Environmental law: A very short introduction. Oxford University Press.
- Hird, J. A. (2019). Pollution, politics, and international law: Tankers at sea. Routledge.
- Lavanya, R. (2021). Environmental law in India: An introduction to legal principles, policy and practice. Bloomsbury Publishing.
- Menon, M. K. (2020). Environmental law and policy in India. Springer.

Suggestive readings

- Bhaskar, V. (2019). Environmental law and policy in India: Trends, issues and challenges. Springer.
- Fisher, E. (2018). Regulating chemicals: Law, science, and the unbearable burdens of regulation. Routledge.
- Gunningham, N. (2015). Smart regulation: Designing environmental policy. Oxford University Press.
- Kramer, R., & Leape, J. (Eds.). (2018). Legal and policy tools for the transition to sustainable societies: Regional pathways to green economy. Routledge.
- Sutherland, E. H. (Ed.). (2020). Handbook of international environmental law (2nd ed.). Edward Elgar Publishing.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 18 (DSC-EVS-18) URBAN ECOSYSTEMS

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 (if any) |
|---------------------------------|---------|-----------------------------------|----------|---------------------|----------------------|--------------------------------------|
| | | Lecture | Tutorial | Practical/ Practice | | |
| DSC-EVS-18: URBAN ECOSYSTEMS | 4 | 2 | 0 | 2 | Class XII pass | NA |

Learning objectives

The Learning Objectives of this course are as follows:

- Gain insights into the concepts and principles of sustainability of urban ecosystems and development
- In-depth understanding of the interactions in socio-ecological systems in urban settings
- Equip with skills to analyze urban environmental problems and provide effective solutions
- Encourage to critically evaluate policies and practices related to urban ecosystems and suggest ecologically sound alternative strategies
- Foster appreciation for urban biodiversity and ecosystems and its linkages with human well-being and social equity

Learning outcomes

After this course, students will be able to

- Explain key concepts of urban ecosystems and its linkages with sustainable urban development.
- Analyze interactions between socio-ecological systems in urban settings and its impacts on ecosystem services
- Apply socio-ecological methods to assess urban environmental problems, including pollution, water scarcity and habitat fragmentation
- Recommend green urban development strategies, such as green infrastructure, and ecosystem-based adaptation
- Communicate the relevance of urban biodiversity with reference to human well-being and social equity

SYLLABUS OF DSC-EVS-18

Theory (02 Credits: 30 lectures)

UNIT – I Introduction to Urban Ecosystems (3½ Weeks) (7 lectures)

Definition and scope of urban ecosystems, Historical and cultural contexts of urbanization, Ecological approach to urban systems, Urbanization process and its impacts on ecosystems, Concept of sustainability and its application to urban ecosystems, Urban environmental issues and challenges, Methods and tools for studying urban ecosystems, Urban ecosystem services and benefits

UNIT – II Urban Ecology and Biodiversity (3½ Weeks) (7 lectures)

Principles of urban ecology, Biodiversity in urban ecosystems, Urban habitats and their characteristics, Ecological interactions in urban ecosystems, Species adaptation and evolution in urban environments, Urban wildlife and conservation, Urban agriculture and gardening, Urban forestry and green infrastructure

UNIT – III Urban Hydrology and Water Management (3½ Weeks) (7 lectures)

Urban water cycle, Water demand and supply in urban areas, Stormwater management and green infrastructure, Water quality and pollution control, Groundwater management in urban areas, Urban wetlands and their functions, Water conservation and efficiency in urban areas, Water governance and policy in urban areas

UNIT – IV Urban Air Quality and Pollution (3½ Weeks) (7 lectures)

Sources and types of urban air pollution, Health effects of urban air pollution, Atmospheric chemistry and pollution transport, Air quality monitoring and modelling, Urban heat island effects and mitigation, Energy and transportation systems and air pollution, Indoor air quality in urban areas, Policy and regulation for air quality in urban areas

UNIT – V Urban Waste Management and Recycling (3½ Weeks) (7 lectures)

Urban waste generation and composition, Waste reduction and recycling strategies, Municipal solid waste management and disposal, Hazardous waste management in urban areas, Electronic waste and recycling, Construction and demolition waste management, Composting and organic waste management, Waste-to-energy and alternative waste management technologies

UNIT – VI Urban Land Use and Planning (3½ Weeks) (7 lectures)

Urban land use patterns and dynamics, Urban sprawl and its impacts, Smart growth and compact cities, Sustainable urban development and planning, Land use regulations and zoning, Brownfields and urban redevelopment, Transit-oriented development and walkability, Public participation and community-based planning

UNIT – VII Urban Social and Economic Systems (3½ Weeks) (7 lectures)

Urbanization and Urban Demography linked with: social diversity, homelessness, inequality and poverty, education and workforce, health, entrepreneurship, innovation and well-being

Teaching and learning interface for theoretical concepts

To achieve the course objectives and match with the contents, a wide range of teaching and learning tools will be employed, including (a) Formal lectures; (b) Interactive sessions using visual aid; (c) Case study analyses; (d) Hypothetical scenario building; (e) Group discussion on key topics; and (f) documentary screening and critical analyses.

Practicals/Hands-on Exercises – based on theory (02 Credits: 60 hours)

1. Assess magnitude of urban heat island effects and the role of urban forests in mitigating them
2. Quantify the ecological and economic benefits of urban trees and understand the importance of urban forestry
3. Assess the impact of urbanization on soil quality and understand the principles of soil health in urban landscapes
4. Analyze the impact of urbanization on water quality and understand the principles of stream health in urban environments
5. Determine the effects of urbanization on bird populations and understand the importance of bird conservation in urban areas
6. Identify opportunities for green infrastructure improvements in a neighborhood and understand the principles of green infrastructure planning and implementation
7. Quantify the economic benefits of urban agriculture and understand the principles of sustainable food systems.
8. Determine the effects of air pollution on plant health and understand the impact of air pollution on urban ecosystems
9. Examine the impact of urbanization on insect populations and understand the importance of insect biodiversity in urban areas
10. Analyze the impact of urbanization on carbon cycling and understand the role of urban ecosystems in climate change mitigation.
11. Assess the impact of urbanization on amphibian populations and understand the importance of amphibian conservation in urban environments
12. Determine the effects of urbanization on soil microbial communities and understand the role of soil microbiota in urban ecosystems
13. Design and implement a green infrastructure project for a specific urban site or neighborhood and understand the principles of green infrastructure planning and implementation.

Teaching and learning interface for practical skills

To impart training on technical and analytical skills related to the course objectives, a wide range of learning methods will be used, including (a) laboratory practicals; (b) field-work exercises; (c) customized exercises based on available data; (d) survey analyses; and (e) developing case studies; (f) demonstration and critical analyses; and (h) experiential learning individually and collectively.

Essential/recommended readings

- Colding, J. (2018). *Ecological Landscapes in the Anthropocene*. Cambridge University Press.
- Colding, J., & Barthel, S. (2021). *Urban Greening for Health and Well-Being*. Cambridge University Press.
- McDonnell, M. J., & Hahs, A. K. (2020). *Ecology of Cities and Towns: A Comparative Approach*. Cambridge University Press.
- Miller, J. R. (2019). *The Nature of Cities: The Ecological Imperative in Urban Design and Planning*. Routledge.
- Wu, J., & Zhang, Y. (2020). *Urban Ecology: An Introduction*. Springer.
- Zhang, Y. (2019). *Urban Ecosystems: Ecological Principles for the Built Environment*. Routledge.

Suggestive readings

- Andersson, E., Barthel, S., & Borgström, S. (Eds.). (2020). *Urban Ecosystems: Ecological Principles for the Built Environment*. Cambridge University Press.
- Escobedo, F. J., Clerici, N., & Staudhammer, C. L. (Eds.). (2019). *The Urban Forest: Cultivating Green Infrastructure for People and the Environment*. Springer.
- Heynen, N. (2019). *The Political Ecology of Green Spaces*. Routledge.
- Kowarik, I., & Körner, S. (Eds.). (2019). *Wild Urban Woodlands: New Perspectives for Urban Forestry*. Springer.
- Li, Y. (2018). *Sustainable Cities and Communities Design Handbook: Green Engineering, Architecture, and Technology*. Butterworth-Heinemann.
- Schellnhuber, H. J., & Grimm, N. B. (Eds.). (2018). *Urban Planet: Knowledge Towards Sustainable Cities*. Cambridge University Press.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.