



Maharashtra Education Society's

Abasaheb Garware College

(Autonomous)

(Affiliated To Savitribai Phule Pune University)

B.Sc In Environmental science

(Faculty of Science & technology)

Syllabi Under NEP

T.Y.B.Sc. Environmental Science

To be implemented from Academic Year 2025-2026

**Maharashtra Education Society's
Abasaheb Garware College, Pune**

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Sem V

	Course Type	Course Code	Course Name	Credits
Sem V	Major Core	EVS-301-MJ	Remote Sensing and GIS	2T
		EVS-302-MJ	Climate change & sustainability	2T
		EVS-303-MJ	Environmental Governance and Ethics	2T
		EVS-304-MJ	Ecological Restoration	2T
		EVS-305-MJP	Environmental Practical V	2P
		EVS-306-MJP	Environmental Practical VI	2P
	Major Elective (Choose Any One group EVS-310-MJE & EVS-311-MJEP OR EVS-312-MJE & EVS-313-MJEP)	EVS-310-MJE	Design and Development of Eco-friendly Products	2T
		EVS-311-MJEP	Practicals in Design and Development of Eco-friendly Products	2P
		EVS-312-MJE	Basics in Industrial Safety	2T
		EVS-313-MJEP	Industrial Safety Practicals	2P
	VSC	EVS-321-VSC	Disaster Management	2T
	Minor	EVS-391-MN	Environmental Biotechnology	2T
	FP/CEP/INTERNSHIP	EVS-331-CEP	Community-Based Environmental Education and Awareness	2
				Total credit-22

Sem VI

	Course Type	Course Code	Course Name	Credits
Sem VI	Major Core	EVS-351-MJ	Environment Impact Assessment & Environmental Management System	2T
		EVS-352-MJ	Environmental Laws & Policies	2T
		EVS-353-MJ	Basics of Environmental Statistics	2T
		EVS-354-MJ	Green Buildings & Certifications	2T
		EVS-355-MJP	Environmental Practical VII	2P
		EVS-356-MJP	Environmental Practical VIII	2P
	Major Elective (Choose Any One group EVS-360-MJE & EVS-361-MJEP OR EVS-362-MJE & EVS-363-MJEP)	EVS-360-MJE	Concepts of Urban Green Spaces and Sustainability	2T
		EVS-361-MJEP	Urban Green Space Mapping and Sustainability Audit	2P
		EVS-362-MJE	Organic Farming & Gardening	2T
		EVS-363-MJEP	Practical in Organic Farming & Gardening	2P
	VSC 2P	EVS-371-VSC	Environmental Monitoring & Assessment	2P
	FP/CEP/INTERNSHIP	EVS-381-OJT	ON-JOB TRAINING	4
				Total credit-22

Program Outcomes

PO1: Environmental Knowledge

Apply fundamental and advanced knowledge of environmental science, including ecology, biotechnology, climate science, and sustainability.

PO2: Problem Analysis

Identify, analyze, and evaluate environmental problems using scientific, statistical, and interdisciplinary approaches.

PO3: Design & Development of Solutions

Develop sustainable solutions for environmental issues such as pollution control, resource management, and ecosystem restoration.

PO4: Investigation & Data Analysis

Conduct field and laboratory investigations, collect environmental data, and apply statistical and analytical tools for interpretation.

PO5: Modern Tool Usage

Use modern tools and technologies such as GIS, remote sensing, environmental monitoring instruments, and data analysis software.

PO6: Environment & Sustainability

Understand and promote sustainable development, climate change mitigation, conservation strategies, and green technologies.

PO7: Ethics & Environmental Responsibility

Apply environmental ethics, legal frameworks, and professional responsibility in decision-making.

PO8: Individual & Team Work

Function effectively as an individual and as a member or leader in multidisciplinary teams.

PO9: Communication Skills

Communicate environmental concepts, research findings, and solutions effectively through reports, presentations, and discussions.

PO10: Project Management & Entrepreneurship

Apply project management principles and explore green entrepreneurship opportunities such as eco-products, sustainable farming, and green technologies.

PO11: Lifelong Learning

Recognize the need for continuous learning and adapt to emerging environmental challenges and technologies.

EVS-301-MJ: Remote Sensing & GIS

Course Outcomes (COs):

CO1: Explain the fundamental principles of remote sensing, including electromagnetic radiation, sensor types, and platforms.

CO2: Interpret and analyze satellite imagery (optical, thermal, microwave) using concepts of resolution and image processing techniques.

CO3: Describe the components and functioning of GIS, including spatial data types, coordinate systems, and data handling methods.

CO4: Perform basic spatial analysis using GIS tools such as overlay, buffer, interpolation, and DEM analysis.

CO5: Apply remote sensing and GIS techniques in environmental applications such as land use mapping, disaster management, agriculture, and urban planning.

CO6: Evaluate advanced geospatial technologies including GPS, drones (UAVs), and the role of AI and big data in geospatial analysis.

Unit. No.	Title of Unit and Contents	No. of hours
1	Fundamentals of Remote Sensing ● Definition, history, and scope of remote sensing. ● Principles of remote sensing: electromagnetic radiation, interaction with the atmosphere and Earth's surface. ● Types of remote sensing: passive and active. ● Platforms and sensors: aerial photography, satellites, and drones.	5
2	Satellite Remote Sensing ● Overview of satellite systems: Landsat, Sentinel, MODIS, and others. ● Types of satellite imagery: optical, thermal, and microwave. ● Resolution: spatial, spectral, temporal, and radiometric. ● Image processing: pre-processing, enhancement, classification, and interpretation.	5

3	Basics of Geographic Information Systems (GIS) ● Definition and components of GIS: hardware, software, data, people, and methods. ● Spatial data: types, formats, and sources. ● Coordinate systems and map projections. ● Data input, editing, and geo-referencing.	5
4	Spatial Analysis in GIS ● Vector and raster data models: concepts and applications. ● Overlay analysis, buffer analysis, and network analysis. ● Spatial interpolation and digital elevation models (DEM). ● Geospatial statistics and data visualization.	5
5	Applications of Remote Sensing and GIS ● Environmental management: land use/land cover mapping, deforestation, and wetland monitoring. ● Disaster management: flood, drought, and forest fire monitoring. ● Agriculture: crop monitoring, soil analysis, and irrigation planning. ● Urban planning: mapping infrastructure, population density, and urban sprawl.	5
6	Advanced Topics and Emerging Trends ● Integration of remote sensing and GIS. ● Role of GPS in spatial data collection. ● Use of drones and UAVs in geospatial studies. ● Big data and artificial intelligence in remote sensing and GIS applications.	5

References:

- Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2015). *Remote sensing and image interpretation* (7th ed.). Wiley.
- Jensen, J. R. (2007). *Remote sensing of the environment: An earth resource perspective* (2nd ed.). Pearson.
- Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). *Geographic information systems and science* (4th ed.). Wiley.
- Burrough, P. A., McDonnell, R. A., & Lloyd, C. D. (2015). *Principles of geographical information systems* (3rd ed.). Oxford University Press.
- Kumar, S. (2005). *Remote sensing and GIS*. Laxmi Publications.
- M Anji Reddy, M. A. (2008). *Remote sensing and geographical information systems* (3rd ed.). BS Publications.
- Indian Space Research Organisation. (n.d.). *Bhuvan Geoportal*. <https://bhuvan.nrsc.gov.in/>
- United States Geological Survey. (n.d.). *EarthExplorer*. <https://earthexplorer.usgs.gov/>

EVS-302-MJ: Climate Change & Sustainability
Course Outcomes (COs):

CO1: Explain the global climate system, drivers of climate change, and its impacts on ecosystems, biodiversity, and socio-economic sectors.

CO2: Analyze climate change policies and international agreements, including national initiatives and global frameworks for mitigation and adaptation.

CO3: Evaluate various mitigation strategies such as carbon reduction technologies, carbon sequestration, and climate-resilient infrastructure.

CO4: Assess the role of sustainable development goals, public participation, and resource management in addressing climate change challenges.

CO5: Apply concepts of environmental sustainability in areas such as agriculture, urbanization, and risk management.

CO6: Analyze sustainability assessment tools including carbon footprint, ecological footprint, and life cycle assessment (LCA) for environmental decision-making.

Unit. No.	Title of Unit and Contents	No. of hours
1	Global Climate System and Challenges • Understanding the global climate system: Internal variability and external climate forces. • Evidence and measurement of climate change: Historical and contemporary trends. • Impacts of climate change on life, vegetation, fauna, and biodiversity. • Economics of climate change: Water scarcity, food security, and socio-economic challenges. • Case study: Climate change effects on agriculture in India.	5
2	Confronting Climate Change: Policies and Efforts • National Action Plan on Climate Change (NAPCC) and its missions. • National Adaptation Fund on Climate Change (NAFCC) and mitigation programs. • UNFCCC, IPCC reports, and international agreements like the Paris Agreement. • Role of organizations like ISRO and NASA in climate change research. • Flagship Initiatives by United Nations • Digitalisation and Decarbonisation • Case study: India's adaptation strategies for rising temperatures.	5

3	Mitigation Approaches in Climate Change • Carbon emission reduction technologies and carbon sequestration. • Governance and policy frameworks for climate change mitigation. • Integrated Assessment Models (IAMs) for economic evaluation of mitigation strategies. • Climate-resilient infrastructure • Case study: Successful carbon capture initiatives in developed nations.	5
4	Sustainable Development Goals and Strategies • The 2030 Agenda for Sustainable Development, 2070- Agenda for Net Zero Emission, Criticisms and challenges in achieving sustainability goals, with a focus on gender equality and education. • Role of public engagement in sustainable development. • Water conservation and sustainable urbanization: Challenges and frameworks. • Sustainable Livelihoods and Adaptation to Climate Change (SLACC) • Case study: Implementation of sustainable cities initiatives in India.	5
5	Environmental Conservation and Sustainability • Technical skills for environmental sustainability: GIS and remote sensing applications. • Challenges in energy, food, forest, and agricultural sustainability. • Risk Management and Agricultural Insurance • Urbanization and its impact on sustainable cities. • Case study: Role of CSR in environmental conservation in industries.	5
6	New Developments in Sustainability • Sustainability metrics and indices: Ecological and carbon footprints. • Life cycle assessment (LCA) as a tool for sustainability measurement. • Sustainability assessment of food and agriculture (SAFA). • Digital Climate Advisory Services (DCAS) • Case study: Corporate sustainability practices in global organizations.	5

References:

- Intergovernmental Panel on Climate Change. (2023). *Climate change 2023: Synthesis report*. IPCC.
- United Nations Framework Convention on Climate Change. (2015). *Paris Agreement*. United Nations.
- Government of India. (2008). *National action plan on climate change*. Ministry of Environment, Forest and Climate Change.
- NITI Aayog. (2018). *Strategy for new India @75*. Government of India.
- Food and Agriculture Organization. (2013). *SAFA: Sustainability assessment of food and agriculture systems guidelines*. FAO.
- United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations.
- Madhav Gadgil, M., & Ramachandra Guha, R. (1995). *Ecology and equity: The use and abuse of nature in contemporary India*. Routledge.
- Stern, N. (2007). *The economics of climate change: The Stern review*. Cambridge University Press.
- National Aeronautics and Space Administration. (n.d.). *Global climate change: Vital signs of the planet*. <https://climate.nasa.gov/>
- Indian Space Research Organisation. (n.d.). *Climate change research and Earth observation*. <https://www.isro.gov.in/>

EVS-303-MJ Environmental Governance and Ethics

Course Outcomes (COs):

CO1: Explain the concepts, principles, and evolution of environmental governance at local, national, and global levels.

CO2: Analyze the roles of institutions, regulatory bodies, industries, and stakeholders in environmental governance and decision-making.

CO3: Evaluate environmental governance practices including policy implementation, corporate responsibility (ESG), and public participation.

CO4: Explain key concepts of environmental ethics, including anthropocentric and ecocentric approaches, environmental justice, and intergenerational equity.

CO5: Assess the role of Indian culture, policies, and legal frameworks in shaping environmental ethics and governance.

CO6: Evaluate global perspectives on environmental ethics, including philosophical approaches, religious views, and ethical challenges in sustainability.

Unit No.	Title of Unit and Contents	No. of hours
1	Introduction to Environmental Governance • Concept and scope of environmental governance • Difference between government and governance • Evolution of environmental governance (global and India) • Principles of good governance (transparency, accountability, participation) • Multi-level governance (local, national, global) • Role of institutions and stakeholders	6
2	Governance In Practice, Institutions and Stakeholder Roles • Role of Pollution Control Boards (CPCB/SPCB) • Environmental clearance and compliance procedures • Role of private sector and industries • Corporate environmental responsibility and ESG • Urban governance and environmental management • Role of NGOs, Public participation and environmental decision-making • Community participation and local governance • Decentralization and Panchayati Raj	8

3	Environmental Ethics • Concept and importance of environmental ethics • Anthropocentric vs ecocentric approaches • Deep ecology and biocentrism • Intergenerational equity • Environmental justice • Rights of nature	6
4	Environmental Ethics in India • Origin of environmental ethics and value education. • Ethical theories applied to environmental protection. • Role of Indian culture in the development of environmental ethics. • Policies in India addressing environmental ethics. • Legal Foundations of Environmental Ethics in India • Case study: Development and ethical issues in India's urbanization	5
5	Global Perspectives on Environmental Ethics • Earth ethics and business ethics for environmental sustainability. • Role of Western philosophers in environmental ethics. • Religions and their contributions to environmental ethics. • Ethics and sustainability: Challenges in the contemporary world. • Ethical Consumerism and Corporate Accountability • Case study: International efforts to address global environmental ethics	5

References:

- United Nations Environment Programme. (2019). *Environmental rule of law: First global report*. United Nations.
- World Bank. (2017). *World development report 2017: Governance and the law*. World Bank.
- United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations.
- Ministry of Environment Forest and Climate Change. (2020). *India: Third biennial update report to the UNFCCC*. Government of India.
- Central Pollution Control Board. (2021). *Annual report 2020–21*. Government of India.
- DesJardins, J. R. (2013). *Environmental ethics: An introduction to environmental philosophy* (5th ed.). Cengage Learning.
- Ramachandra Guha. (2014). *Environmentalism: A global history*.
- Sunita Narain. (2018). *Conflicts of interest: My journey through India's green movement*. Penguin Random House India.

EVS-304-MJ Ecological Restoration

Course Outcomes (COs):

CO1: Explain the concepts, principles, and significance of ecological restoration and its applications in environmental management.

CO2: Analyze the theoretical basis of ecological restoration, including ecosystem resilience, dynamics, and socio-economic factors.

CO3: Evaluate restoration strategies for urban ecosystems such as lakes, rivers, soil, and biodiversity conservation.

CO4: Assess restoration approaches in industrial environments, including mine restoration and waste site rehabilitation.

CO5: Analyze restoration techniques for natural ecosystems such as forests, wetlands, grasslands, and coastal regions.

CO6: Apply restoration tools and techniques for terrestrial and aquatic ecosystems, including hydrological and geomorphological interventions.

Unit No.	Title of Unit and Contents	No. of hours
1	Introduction • Restoration Ecology • Eco Restoration • Definition • Principles, Significances, Guidelines, Principles of Restoration • Applications of Restoration Ecology.	5
2	Theory of Restoration • Theoretical basis for understanding restoration potential • Concepts of resilience and ecosystem change as they relate to aquatic and terrestrial systems, • Social, economic and political realities of restoration	5
3	Urban Restoration • Restoration of Urban Ecosystem Ponds, lakes, river banks, avenue tree • Biodiversity restoration through gardens, park, restoration of dumping ground, • Restoration of ecosystem on hills, Restoration of soil in urban areas • Ground water resource – replenishment, Sewage or wastewater - recycling for supporting ecosystems Case studies	5

4	Industrial Restoration - Eco-restoration and Industrial Environment - Eco-restoration of mines (Open-cast), restoration of solid waste dumping sites, Improving aesthetics by partial restoration at industrial sites, Case studies	5
5	Restoration of Natural Habitats - Restoration of other Natural Habitats / Ecosystems - Mangroves, Grasslands, Wetlands, Restoration of streams - Degraded forest patches, Coastal ecosystems, Case Studies	5
6	Restoration Toolbox - Terrestrial techniques, Fire, Mechanical, Chemical And rest Aquatic techniques - Geomorphic structures - Hydrologic regimes - Riparian structures and processes	5

References:

- James Aronson, J., Milton, S. J., & Blignaut, J. N. (2007). *Restoring natural capital: Science, business, and practice*. Island Press.
- Karen Holl. (2020). *Primer of ecological restoration* (2nd ed.). Island Press.
- David A Falk, Falk, D. A., Palmer, M. A., & Zedler, J. B. (2016). *Foundations of restoration ecology* (2nd ed.). Island Press.
- Society for Ecological Restoration. (2019). *International principles and standards for the practice of ecological restoration*. SER.
- International Union for Conservation of Nature. (2021). *Global standard for nature-based solutions*. IUCN.
- Ministry of Environment Forest and Climate Change. (2018). *National afforestation programme guidelines*. Government of India.
- Indian Council of Forestry Research and Education. (2019). *Forest and landscape restoration in India*. Government of India.
- Food and Agriculture Organization. (2020). *Forest landscape restoration: Key concepts and practices*. FAO.
- United Nations Environment Programme. (2021). *Ecosystem restoration for people, nature and climate*. United Nations.
- Vijay Kumar. (2017). *Ecological restoration*. Scientific Publishers.

EVS-305-MJP Environmental Practical V

Course Outcomes (COs):

CO1: Demonstrate basic operations of GIS software for spatial data handling and mapping.

CO2: Interpret and analyze satellite imagery for land use and land cover classification.

CO3: Perform georeferencing of spatial data and prepare accurate base maps.

CO4: Apply digitization techniques and manage attribute data for spatial feature creation.

CO5: Conduct spatial analysis using GIS tools such as buffer, overlay, and proximity analysis.

CO6: Demonstrate basic molecular biology techniques including DNA isolation, restriction digestion, ligation, and transformation in prokaryotic systems.

Sr. No	Content	No of practicals
1	Introduction to GIS Software: Hands-on GIS software (e.g., QGIS or ArcGIS).	01
2	Image Interpretation and Analysis: Interpretation of satellite imagery for land use and land cover mapping.	01
3	Data Georeferencing: Georeferencing scanned maps and satellite images.	02
4	Digitization and Attribute Data Handling: Digitization of features such as roads, rivers, and administrative boundaries.	02
5	Spatial Analysis: Performing buffer, overlay, and proximity analysis in GIS.	02
6	Isolation of Genomic (bacterial/animal/ plant) and plasmid DNA, - Restriction digestion, ligation and Transformation in Prokaryotic systems	04

References:

- QGIS Development Team. (2023). *QGIS training manual*. <https://qgis.org/>
- Esri. (2022). *ArcGIS desktop tutorials and spatial analysis guide*. Esri Press.
- Paul Bolstad. (2016). *GIS fundamentals: A first text on geographic information systems* (5th ed.). Eider Press.
- Joseph Sambrook, J., & Russell, D. W. (2001). *Molecular cloning: A laboratory manual* (3rd ed.). Cold Spring Harbor Laboratory Press.

- Bruce Rittmann, B. E., & McCarty, P. L. (2012). *Environmental biotechnology: Principles and applications*. McGraw-Hill.
- Food and Agriculture Organization. (2013). *Composting and organic waste management guidelines*. FAO.

EVS-306-MJP Environmental Practical VI

Course Outcome (COs):

CO1: Apply geospatial and analytical tools for environmental data interpretation and mapping.

CO2: Analyze environmental changes and trends using scientific and quantitative methods.

CO3: Apply sustainability assessment tools for evaluating environmental impacts and resource use.

CO4: Collect, organize, and interpret environmental and socio-economic data through field-based studies.

CO5: Assess environmental risks, hazards, and vulnerability using appropriate methodologies.

CO6: Evaluate environmental governance, ethical issues, and public awareness related to environmental problems.

CO7: Develop practical solutions including awareness programs and management plans for environmental issues.

Sr. No	Content	No of practicals
1	Digital Elevation Models (DEM) Creation and Analysis: Generation of DEM and slope/contour mapping.	01
2	Change Detection Using Remote Sensing: Analysing temporal changes in land use using multi-temporal satellite data	01
3	Climate change modelling and prediction tools.	01
4	Life cycle assessment (LCA)- DEMO	01
5	Estimation of carbon footprint	01
6	Calculation of ecological footprint	01
7	Preparation of climate data records	01
8	Survey on public awareness of environmental issues	01
9	Ethical analysis of environmental case	01
10	Hazard mapping of selected area	01

11	Preparation of disaster risk assessment report	01
12	Vulnerability assessment of community	01
13	Study of local environmental governance	01
14	Design and execution of environmental awareness campaign	01
15	Preparation of emergency evacuation plan with layout	01

References:

- United Nations Office for Disaster Risk Reduction. (2015). *Sendai framework for disaster risk reduction 2015–2030*. United Nations.
- Intergovernmental Panel on Climate Change. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge University Press.
- National Disaster Management Authority. (2019). *National disaster management plan*. Government of India.
- International Organization for Standardization. (2018). *ISO 14040: Environmental management—Life cycle assessment—Principles and framework*. ISO.
- National Aeronautics and Space Administration. (n.d.). *Earth data and remote sensing applications*. <https://earthdata.nasa.gov/>
- QGIS Development Team. (2023). *QGIS training manual*. <https://qgis.org/>
- United Nations Environment Programme. (2020). *Emissions gap report and carbon footprint methodologies*. United Nations.

EVS-310-MJE: Design & Development of Eco-Friendly Products

Course Outcomes (COs):

CO1: Explain the concepts, principles, and importance of eco-friendly products and sustainable product design.

CO2: Analyze the environmental impacts of materials and evaluate criteria for selecting sustainable materials.

CO3: Apply eco-design principles for developing sustainable products with efficient use of resources and energy.

CO4: Evaluate environmental performance of products using tools such as life cycle thinking, carbon footprint, and eco-labeling.

CO5: Assess the role of policies, circular economy, and green entrepreneurship in promoting eco-friendly products.

CO6: Analyze emerging trends and technological innovations in sustainable product development.

Unit	Content	Hrs of Lectures 30
1	• Introduction to Eco-Friendly Products • Concept, scope, and importance of eco-friendly products • Environmental impacts of conventional products • Principles of sustainability in product design • Life cycle thinking (cradle-to-grave concept) • Green consumerism and market trends • Examples of eco-friendly products	6
2	• Materials for Eco-Friendly Products • Properties and environmental implications of natural materials (bamboo, jute, biopolymers) • Recycled and upcycled materials: concepts and applications • Principles of green chemistry in product design • Toxicity, persistence, and environmental fate of materials • Criteria for sustainable material selection	6

3	• Eco-Design and Product Development • Principles of eco-design and sustainable product development • Design for environment (DfE) and design for sustainability • Energy efficiency and resource optimization in product design • Sustainable packaging: materials and design strategies • Prototype development and performance considerations	6
4	• Environmental Evaluation and Certification • Environmental impact assessment of products (qualitative approach) • Carbon footprint and water footprint (concept and significance) • Eco-labeling and certification systems (basic frameworks) • Quality, safety, and regulatory considerations • Cost-benefit and life cycle cost analysis • Consumer perception and behavioral aspects	6
5	• Policies, Entrepreneurship and Emerging Trends • Environmental policies and initiatives supporting green products in India • Circular economy: principles and applications in product design • Green entrepreneurship and sustainable business models • Innovations in sustainable materials (bioplastics, biodegradable polymers) • Role of technology (AI, digital tools) in sustainable product development • Case studies of successful eco-friendly product innovations	6

References:

- Ministry of Environment Forest and Climate Change. (2019). *India's resource efficiency policy*. Government of India.
- Central Pollution Control Board. (2021). *Guidelines for environmentally sound management of waste*. Government of India.
- Bureau of Indian Standards. (2019). *Eco-mark scheme: Criteria and labeling requirements*. Government of India.
- NITI Aayog. (2021). *Circular economy in India: A multi-sectoral approach*. Government of India.
- Ministry of Micro Small and Medium Enterprises. (2020). *Sustainable and green MSME initiatives*. Government of India.
- Food Safety and Standards Authority of India. (2021). *Sustainable packaging guidelines*. Government of India.
- Ashby, M. F. (2013). *Materials and the environment: Eco-informed material choice* (2nd ed.). Butterworth-Heinemann.
- Ellen MacArthur Foundation. (2017). *Towards the circular economy: Economic and business rationale for an accelerated transition*. Ellen MacArthur Foundation.

EVS-311-MJEP: Practicals in Design & Development of Eco-friendly Products

Course Outcomes (COs):

CO1: Apply principles of sustainability in the design and development of eco-friendly products.

CO2: Select and utilize natural, recycled, and biodegradable materials for product preparation.

CO3: Demonstrate skills in developing eco-friendly formulations and value-added products.

CO4: Conduct basic market surveys and evaluate consumer awareness and preferences for green products.

CO5: Analyze the environmental benefits of eco-friendly products and waste utilization techniques.

CO6: Develop innovative and sustainable product prototypes using eco-design principles.

CO7: Communicate and present eco-friendly product concepts effectively.

No.	Practical Content	No of practicals
1	Design and development of eco-friendly packaging materials	01
2	Market survey on eco-friendly products	01
3	Preparation of bio-enzyme (natural cleaning agent) using organic waste	01
4	Preparation of herbal floor cleaner using natural ingredients	01
5	Preparation of eco-friendly candles using soy wax or beeswax	01
6	Development of cloth or jute-based reusable carry bags	01
7	Extraction and application of natural dyes from plant sources	01
8	Preparation of natural air freshener using plant-based materials	01
9	Preparation of recycled paper sheets	01
10	Preparation of compost from biodegradable waste	01

11	Preparation of lip balm using natural wax and oils	01
12	Preparation of seed balls for afforestation purposes	01
13	Development of useful products through upcycling of waste materials	01
14	Preparation of natural body scrubbers (basic eco-friendly formulation)	02
15	Development and presentation of a simple eco-friendly product prototype	01

References:

- National Innovation Foundation India. (2019). *Grassroots innovations for sustainable development*. Government of India.
- Khadi and Village Industries Commission. (2020). *Training manual for village industries and eco-friendly products*. Government of India.
- Central Pollution Control Board. (2020). *Solid waste management guidelines*. Government of India.
- Ministry of Environment Forest and Climate Change. (2018). *Manual on municipal solid waste management*. Government of India.
- Food and Agriculture Organization. (2013). *Composting and organic waste management guidelines*. FAO.
- Michael F Ashby. (2013). *Materials and the environment: Eco-informed material choice* (2nd ed.). Butterworth-Heinemann.

EVS-312-MJE: Basics in Industrial Safety

Course Outcomes (COs):

CO1: Explain the concepts, principles, and importance of industrial safety and safety culture.

CO2: Identify and analyze different types of industrial hazards and risk factors in workplace environments.

CO3: Apply risk assessment methods and hazard identification techniques for ensuring workplace safety.

CO4: Evaluate safety management practices including control measures, PPE, and occupational health standards.

CO5: Assess emergency preparedness, disaster management strategies, and safe handling of hazardous materials.

CO6: Analyze legal frameworks, regulatory bodies, and current trends in industrial safety and sustainability.

Unit	Content	Hrs of Lectures 30
1	Introduction to Industrial Safety • Definition, scope, and importance of industrial safety • Evolution of industrial safety practices • Types of industries and associated risks • Concepts: hazard, risk, accident, incident, near-miss • Causes of industrial accidents (human, mechanical, environmental) • Safety culture and its significance	6
2	• Industrial Hazards and Risk Identification • Classification of hazards: physical, chemical, biological, ergonomic • Chemical hazards: toxic, flammable, corrosive substances • Physical hazards: noise, heat, radiation, vibration • Biological and ergonomic hazards • Risk assessment methods (basic concepts: HAZID, HAZOP) • Hazard identification techniques and safety audits	6

3	Safety Management and Control Measures • Hierarchy of controls (elimination, substitution, engineering, administrative, PPE) • Personal Protective Equipment (PPE): types and selection • Machine safety and guarding • Electrical safety basics • Fire hazards and fire prevention methods • Occupational health and hygiene	6
4	Industrial Safety Practices and Emergency Preparedness • Safety procedures and standard operating procedures (SOPs) • Emergency planning and disaster management in industries • Fire safety systems and evacuation procedures • First aid and basic life-saving techniques • Handling hazardous materials (MSDS/SDS understanding) • Case studies of industrial accidents	6
5	• Legal Framework and Current Trends • Overview of Indian safety laws 1. Factories Act 1948 2. Public Liability Insurance Act, 1991 • Role of regulatory bodies: 1. Directorate General Factory Advice Service and Labour Institutes 2. Occupational Safety and Health Administration • Occupational health and safety standards (ISO 45001 – basic idea) • Safety training and awareness programs • Sustainability and ESG in industrial safety	6

References:

- Ministry of Labour and Employment. (2020). *Occupational safety, health and working conditions code*. Government of India.
- Directorate General Factory Advice Service and Labour Institutes. (2018). *Industrial safety and health guidelines*. Government of India.
- Factories Act. (1948). *The Factories Act*. Government of India.
- Occupational Safety and Health Administration. (2021). *Occupational safety and health standards*. U.S. Department of Labor.
- International Labour Organization. (2019). *Safety and health at the heart of the future of work*. ILO.
- International Organization for Standardization. (2018). *ISO 45001: Occupational health and safety management systems—Requirements with guidance for use*. ISO.
- Goel, P. K. (2015). *Industrial safety and environment* (2nd ed.). New Age International.
- K Venkataraman. (2017). *Safety management in industries*. Tata McGraw-Hill.

EVS-313-MJEP: Industrial Safety Practicals

Course Outcomes (COs):

CO1: Identify and classify workplace hazards and associated risks in different industrial settings.

CO2: Apply risk assessment techniques and develop tools such as risk matrices and safety checklists.

CO3: Demonstrate the selection and use of appropriate personal protective equipment (PPE) and safety measures.

CO4: Conduct safety audits and evaluate workplace safety practices using standard methods.

CO5: Analyze emergency preparedness procedures including fire safety, evacuation planning, and first response.

CO6: Interpret safety documentation such as Safety Data Sheets (SDS/MSDS) and prepare standard operating procedures (SOPs).

CO7: Assess workplace conditions including ergonomics and environmental parameters for occupational safety.

No.	Practical Content	No of practicals
1.	Identification and classification of workplace hazards	01
2.	Study of industrial safety signs and symbols	01
3.	Basic risk assessment of a selected activity	01
4.	Preparation of risk matrix (likelihood vs severity)	01
5.	Safety audit using checklist method	01
6.	Study and demonstration of Personal Protective Equipment (PPE)	01
7.	Evaluation of PPE selection for different hazards	01
8.	Study of fire types and fire extinguisher use	01
9.	Mock emergency evacuation drill and planning	02
10.	Study and interpretation of Safety Data Sheet (SDS/MSDS)	01
11.	Preparation of Standard Operating Procedure (SOP)	01

12.	Ergonomic assessment of workplace	01
13.	Basic noise level assessment	01
14.	Industrial visit / virtual visit safety report	01

References:

- Directorate General Factory Advice Service and Labour Institutes. (2018). *Safety audit manual and industrial safety guidelines*. Government of India.
- Central Pollution Control Board. (2019). *Guidelines for handling hazardous chemicals and safety management*. Government of India.
- Occupational Safety and Health Administration. (2021). *Hazard identification and risk assessment guidelines*. U.S. Department of Labor.
- International Labour Organization. (2019). *Guidelines on occupational safety and health management systems*. ILO.
- Goel, P. K. (2015). *Industrial safety and environment* (2nd ed.). New Age International.
- National Disaster Management Authority. (2020). *Mock drill guidelines for industrial emergency preparedness*. Government of India.

EVS-321-VSC: Disaster Management & Planning

Course Outcomes (COs)

CO1: Explain the concepts, types, causes, and impacts of natural and man-made disasters.

CO2: Analyze the disaster management cycle including mitigation, preparedness, response, and recovery strategies.

CO3: Apply risk assessment and vulnerability analysis techniques for disaster risk reduction.

CO4: Evaluate the role of environmental planning, land-use strategies, and nature-based solutions in disaster management.

CO5: Assess institutional frameworks, policies, and governance mechanisms for disaster management at national and global levels.

CO6: Analyze case studies of major disasters to understand challenges, response strategies, and resilience planning.

Unit	Content	Hrs of Lectures 30
1	Introduction to Disasters • Concept, definition, and classification of disasters • Natural disasters: earthquakes, floods, cyclones, droughts • Man-made disasters: industrial, chemical, nuclear • Causes and impacts of disasters (environmental, social, economic) • Vulnerability and risk concepts • Disaster trends and global scenario	6
2	Disaster Management Cycle • Phases: mitigation, preparedness, response, recovery • Risk assessment and vulnerability analysis • Early warning systems • Disaster preparedness planning • Emergency response mechanisms • Post-disaster recovery and rehabilitation	6

3	Environmental Planning and Risk Reduction • Concept of environmental planning • Land-use planning and zoning • Role of environmental impact assessment in disaster prevention • Sustainable resource management • Climate change and disaster risk • Nature-based solutions for disaster mitigation	6
4	Institutional Framework and Policies • Disaster management framework in India • Role of government agencies and institutions • National disaster management policies and guidelines • Role of local bodies and community participation • International frameworks (Sendai Framework – overview) • Integration of disaster management with development planning	6
5	Case Studies and Contemporary Issues • Odisha Cyclone Fani 2019 • Indian Ocean Tsunami • Fukushima Daiichi nuclear disaster 2011 • Urban disasters and risk management • Industrial and chemical disaster management • Community-based disaster management • Challenges in disaster management • Future strategies for resilience and sustainability	6

References:

- National Disaster Management Authority. (2019). *National disaster management plan*. Government of India.
- Ministry of Home Affairs. (2020). *Disaster management in India: Annual report*. Government of India.
- United Nations Office for Disaster Risk Reduction. (2015). *Sendai framework for disaster risk reduction 2015–2030*. United Nations.
- Intergovernmental Panel on Climate Change. (2022). *Climate change 2022: Impacts, adaptation and vulnerability*. Cambridge University Press.
- Central Water Commission. (2021). *Flood management and risk assessment guidelines*. Government of India.
- Singh, R. B. (Ed.). (2018). *Disaster risk reduction: Approaches and practices*. Springer.
- R K Bhandari. (2014). *Disaster education and management: A joyride for students, teachers and disaster managers*. Springer.
- World Bank. (2020). *Cities, flooding and risk management: Lessons from India*. World Bank.

EVS-391-MN: Environmental Biotechnology

Course Outcome (COs):

CO1: Explain the structure, properties, and functions of biomolecules and the central dogma of molecular biology.

CO2: Describe recombinant DNA technology, genetic engineering tools, and applications including GMOs and biosafety aspects.

CO3: Apply biotechnological approaches in sustainable agriculture, including biofertilizers, biopesticides, and composting techniques.

CO4: Analyze the principles and applications of bioremediation and phytoremediation for environmental pollution control.

CO5: Explain the concepts and applications of biopolymers, biosensors, and bioindicators in environmental monitoring.

CO6: Evaluate the role of environmental biotechnology in sustainable development and environmental management.

Unit No.	Title of Unit and Contents	No. of hours
1	Environmental Biotechnology Introduction • DNA: structural forms and their characteristics; physical properties: UV absorption spectra, denaturation and renaturation kinetics. • RNA: structural forms and their characteristics. • Protein: hierarchical structure, types of amino acids; posttranslational modifications and their significance. • Synthesis; types and their role: structural, functional (enzymes). Central dogma of biology; • Prokaryotes, viruses, eukaryotes and organelles; mobile DNA; chromosomal organization (euchromatin, heterochromatin - constitutive and facultative heterochromatin).	8
2	Recombinant Biotechnology • Recombinant DNA: origin and current status; steps of preparation; enzymes for manipulation of DNA: restriction enzymes, polymerases (DNA/RNA polymerases, transferase, reverse transcriptase). • Other DNA modifying enzymes (nucleases, ligase, phosphatases, polynucleotide kinase); genomic and cDNA libraries: construction, screening and uses; cloning and expression vectors Genetically Modified Organisms (GMOs)	8

	Problems associated with GMO's Biosafety regulations, Cartagena protocol	
3	Ecological Safe Products and process - Composting Biotechnology for Sustainable Agriculture - Biopesticides, Biofertilizers - Composting technology and methods of production, Design aspects and factors influencing the process - Vermicomposting, Operating process, Characteristics of vermicomposting	4
4	Bioremediation, Phytoremediation - Microbial Remediation Process - Types & Principles of bioremediation - Concept of bio augmentation and bio stimulation, - Factors affecting the bioremediation process: microbial metabolism, environmental conditions and nature of pollutants	4
5	Biopolymers, Biosensors and Bioindicators Biopolymers and bioplastics- Concept of biopolymers, Types of biopolymers and its applications Biosensor Concept of Biosensors, Design and components, Applications of biosensors in environmental monitoring	6

References:

- Bruce Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2022). *Molecular biology of the cell* (7th ed.). Garland Science.
- James D Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. (2014). *Molecular biology of the gene* (7th ed.). Pearson.
- Alexander N Glazer, A. N., & Nikaido, H. (2007). *Microbial biotechnology: Fundamentals of applied microbiology*. Cambridge University Press.
- Bruce Rittmann, B. E., & McCarty, P. L. (2012). *Environmental biotechnology: Principles and applications*. McGraw-Hill.
- S N Jogdand. (2010). *Environmental biotechnology*. Himalaya Publishing House.
- A K Chatterji. (2011). *Introduction to environmental biotechnology*. Prentice Hall India.
- United Nations Environment Programme. (2018). *Biotechnology and environment: Applications and implications*. United Nations.
- Food and Agriculture Organization. (2017). *The future of food and agriculture: Trends and challenges*. FAO.
- Convention on Biological Diversity. (2000). *Cartagena protocol on biosafety*. United Nations.
- Karl-Erik Eriksson. (2007). *Biotechnology for the environment: Wastewater treatment and bioremediation*. Springer.

EVS-351-MJ: Environment Impact Assessment and EMS

Course Outcomes (COs):

CO1: Explain the concepts, objectives, and legal frameworks of Environmental Impact Assessment (EIA) and its role in sustainable development.

CO2: Analyze various EIA methodologies including qualitative, quantitative, and GIS-based approaches for environmental assessment.

CO3: Identify environmental impacts and develop Environmental Management Plans (EMP) including mitigation and risk assessment strategies.

CO4: Explain the principles and components of Environmental Management Systems (EMS) and their role in organizational sustainability.

CO5: Apply ISO 14001 standards and PDCA cycle for environmental management and performance evaluation.

CO6: Evaluate environmental auditing processes and their significance in regulatory compliance and environmental protection.

Unit No.	Title of Unit and Contents	No. of hours
1	EIA • EIA: Scope and Objectives • Relationship between EIA and sustainable development • Key provisions of EIA Notification 1994 & 2006 (with amendments) • Role of statutory bodies • International guidelines on EIA (World Bank, UNEP, EU Directives) • Components and Process- Screening, scoping, impact analysis, mitigation, reporting, public participation • Baseline Data - Physical, biological, and socio-economic components, Methods of data collection • Challenges in EIA implementation	5
2	Methods • Qualitative & Quantitative Approaches • Ad Hoc Method – Expert judgment and rapid assessment • Checklists – Simple, descriptive, and weighted checklists • Matrices – Leopold and other impact matrices • Networks – Cause-effect relationships • Simulation Modelling – Predictive models for environmental changes	5

	Overlays and GIS Applications – Spatial analysis and mapping for impact assessment	
3	EMP - Identification of significant environmental impacts - Mitigation Plans, Relief & Rehabilitation - Risk Assessment and Disaster Management Plan - Hazard identification, exposure assessment, risk characterization - Review of Environmental Management Plan - Draft of EIA report-Structure and content of an EIA report	5
4	EMS - Introduction to Environment management systems - Organization's approach to the Environment - Environmental and economic sustainability - Concept of EMAS and EMS standards and tools - Projecting EMS: planning, implementation, general requirements, control tasks - Evaluation of Environmental performance	5
5	ISO 14001:2015 - ISO governance, structure and functions - Plan Do Check Act- PDCA cycle - ISO 14000 family of standards - Introduction to ISO 14001:2015: Guidelines for implementation of standard	5
6	Environmental Audit - Requirement of Rule 14, Environment (Protection) Act,1986 - Environmental Audit: Need & Importance - Process of Environmental Audit - Types of Audit	5

References:

- Ministry of Environment Forest and Climate Change. (2006). *Environmental impact assessment notification (as amended)*. Government of India.
- Central Pollution Control Board. (2020). *Guidelines for environmental management plan*. Government of India.
- International Organization for Standardization. (2015). *ISO 14001: Environmental management systems—Requirements with guidance for use*. ISO.
- World Bank. (2017). *Environmental and social framework*. World Bank.
- United Nations Environment Programme. (2018). *Environmental impact assessment training resource manual*. United Nations.
- Glasson, J., Therivel, R., & Chadwick, A. (2013). *Introduction to environmental impact assessment* (4th ed.). Routledge.
- R R Barthwal. (2012). *Environmental impact assessment*. New Age International.
- R K Trivedi. (2009). *Environmental audit and management*. APH Publishing.

EVS-352-MJ: Environmental Laws & Policies

Course Outcomes (COs):

CO1: Explain constitutional provisions, environmental principles, and national policies related to environmental protection in India.

CO2: Analyze major environmental legislations and their amendments related to air, water, and environmental protection.

CO3: Evaluate environmental rules and regulatory frameworks for pollution control and waste management.

CO4: Assess the role of conservation laws and legal mechanisms in biodiversity and wildlife protection.

CO5: Analyze landmark case studies, judicial decisions, and public interest litigations in environmental governance.

CO6: Evaluate contemporary issues, policy challenges, and enforcement mechanisms in environmental law and governance.

Unit No.	Title of Unit and Contents	No. of hours
1	Constitutional Provisions and National Policies • Constitutional provisions (Articles 48A, 51A(g)) • Principles: precautionary principle, polluter pays, sustainable development • National Environmental Policy and National Forest Policy, National Water Policy • Eco-mark Scheme and National Conservation Strategy. • Case study: Judicial interventions in India for environmental governance/policy. • Noteworthy Court Orders in Relation to Constitutional and Statutory Laws	7
2	Anti-pollution Acts and Important Amendments • The Air (Prevention and Control of Pollution) Act, 1981. • The Water (Prevention and Control of Pollution) Act, 1974. • Environment (Protection) Act, 1986. • The Motor Vehicles Act, 1988, and its environmental implications. • Case study: Implementation of the Public Liability Insurance Act, 1991. • Important Judgements & Orders on above laws	6

3	Anti-pollution Rules and Management • The Noise Pollution (Regulation and Control) Rules, 2000. • E-waste (Management) Rules, 2016. • Plastic Waste Management Rules, 2016. • Hazardous Waste Management Rules • Bio-Medical Waste Management Rules, 2016. • Case study: Solid Waste Management Rules 2016 – Impact and challenges. • Key Court Decisions Shaping Legal Framework on Rules	7
4	Environmental Conservation Acts with Amendments • The Wild Life (Protection) Act, 1972. • Forest Conservation Act 1980 • Biological Diversity Act, 2002, and Forest (Conservation) Act, 1980. • Prevention of Cruelty to Animals Act, 1960. • Protection of Plant Varieties and Farmers' Rights Act, 2001. • Case study: Regulatory framework for genetically engineered plants in India. • Pivotal Judgments Influencing Legislative Interpretation	5
5	Case Studies and Contemporary Issues • Landmark case studies • Environmental litigation and Public Interest Litigation (PIL) • Climate change laws and policies • Challenges in implementation of laws • Policy gaps and governance issues • Legal basis of Environmental Impact Assessment • Public participation and legal provisions • Environmental tribunals and courts • Penalties and enforcement mechanisms	5

References:

- Shyam Divan, S., & Armin Rosencranz, A. (2020). *Environmental law and policy in India* (3rd ed.). Oxford University Press.
- P Leelakrishnan. (2019). *Environmental law in India* (5th ed.). LexisNexis.
- Gurdip Singh. (2021). *Environmental law in India*. Macmillan.
- Ministry of Environment Forest and Climate Change. (2006). *Environmental impact assessment notification (as amended)*. Government of India.
- Central Pollution Control Board. (2021). *Annual report*. Government of India.
- Government of India. (1986). *The Environment (Protection) Act*. Government of India.
- Government of India. (1981). *The Air (Prevention and Control of Pollution) Act*. Government of India.

- Government of India. (1974). *The Water (Prevention and Control of Pollution) Act*. Government of India.
- National Green Tribunal. (2010). *National Green Tribunal Act*. Government of India.
- United Nations Environment Programme. (2019). *Environmental rule of law: First global report*. United Nations.

EVS-353-MJ: Basics of Environmental Statistics

Course Outcomes (COs):

CO1: Explain fundamental statistical concepts including data types, sampling methods, and their role in environmental research.

CO2: Organize, present, and interpret environmental data using appropriate graphical and tabular methods.

CO3: Apply principles of experimental design, statistical inference, and hypothesis testing in environmental studies.

CO4: Calculate and interpret measures of central tendency and dispersion for environmental datasets.

CO5: Apply parametric and non-parametric statistical tests for analysis of environmental data.

CO6: Analyze environmental datasets using statistical tools and indices for real-world applications.

Unit. No.	Title of Unit and Contents	No. of hours
1	Introduction • Role of statistics in Environmental research • Introduction to concept of Statistics, Population, Sample, Data • Concept of univariate, bivariate data • Sampling • Types of sampling - Random and non-random	5
2	Data Presentation • Types of data: Discrete and continuous data, • Frequency and non-frequency data • Frequency distributions • Sample collection and data presentation methods • Graphical methods	5
3	Experiment design • Experimental Design and sample collection • Statistical Inference • Hypothesis Testing, p-value • Types of Hypothesis	5
4	Measures of Central Tendency, Parametric Tests • Arithmetic mean, Median, Mode, Geometric mean, Harmonic mean Measures of Dispersion – Range, Mean deviation, Variance • Standard deviation, Skewness and Kurtosis	5

5	• Parametric tests: T-test, Z-test, ANOVA • Non-Parametric Test- Chi-square, Mann-Whitney U-test, Wilcoxon signed test	5
6	Applications • Introduction to indices used for various Environmental studies • Examples based on ecology and ecosystem, weather and air quality monitoring, soil quality data, water and effluent data, etc.	5

References:

- Jerrold H Zar. (2010). *Biostatistical analysis* (5th ed.). Pearson.
- Wayne W Daniel, W. W., & Cross, C. L. (2013). *Biostatistics: A foundation for analysis in the health sciences* (10th ed.). Wiley.
- Douglas C Montgomery. (2017). *Design and analysis of experiments* (9th ed.). Wiley.
- George W Snedecor, G. W., & Cochran, W. G. (2016). *Statistical methods* (8th ed.). Wiley.
- S C Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of mathematical statistics* (12th ed.). Sultan Chand & Sons.
- P N Arora, P. N., & Malhan, P. K. (2019). *Biostatistics*. Himalaya Publishing House.
- R S N Pillai, R. S. N., & Bagavathi, V. (2016). *Statistics: Theory and practice*. S. Chand.
- Andy Field. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). Sage Publications.
- World Health Organization. (2016). *Statistical methods for environmental health studies*. WHO.
- United States Environmental Protection Agency. (2017). *Statistical analysis of environmental data*. EPA.
- Central Pollution Control Board. (2020). *Guidelines for environmental monitoring and data analysis*. Government of India.
- Indian Council of Agricultural Research. (2018). *Statistical techniques for agricultural and environmental research*. ICAR.
- United Nations Environment Programme. (2019). *Environmental data and indicators: Framework and methodologies*. United Nations.
- Food and Agriculture Organization. (2017). *Statistical methods for environmental and agricultural data analysis*. FAO.
- Ministry of Statistics and Programme Implementation. (2021). *Statistical year book India*. Government of India.

EVS-354-MJ Green Buildings & Certifications

Course Outcomes (COs):

CO1: Explain the concepts, principles, and benefits of green buildings and sustainable construction practices.

CO2: Analyze the selection and use of sustainable building materials with respect to environmental impact and resource efficiency.

CO3: Apply energy and water conservation strategies, including passive design and renewable energy integration in buildings.

CO4: Evaluate green building design parameters including site planning, indoor environmental quality, and building performance.

CO5: Assess green building certification systems and rating frameworks such as Leadership in Energy and Environmental Design, Green Rating for Integrated Habitat Assessment, and Indian Green Building Council.

CO6: Analyze cost-benefit aspects and case studies of green buildings for sustainable development.

Unit	Content	Hrs of Lectures
		30
1	Introduction to Green building • Concept and need of green buildings • Environmental impacts of conventional buildings (energy, water, materials, waste) • Principles of sustainable building design • Benefits of green buildings (environmental, economic, social) • Life cycle approach in buildings • Overview of green building movement (global and India)	6
2	Sustainable Building Materials and Resources • Selection of eco-friendly building materials • Renewable and recycled construction materials • Low embodied energy materials • Use of local and natural materials (bamboo, fly ash, etc.) • Waste reduction and material efficiency in construction • Indoor environmental quality (IEQ) and material safety	6

3	Energy and Water Efficiency in Buildings • Energy consumption in buildings and conservation strategies • Passive design techniques (orientation, ventilation, insulation) • Renewable energy use (solar energy basics) • Water conservation methods (rainwater harvesting, low-flow fixtures) • Wastewater treatment and reuse • Solid waste management in buildings	6
4	Green Building Design and Performance • Site selection and sustainable site planning • Building envelope and thermal performance • Indoor air quality and occupant health • Lighting and ventilation strategies • Building operation and maintenance • Performance assessment parameters (energy, water, comfort)	6
5	Green Building Certifications and Rating • Systems, Concept and importance of green building certification • Overview of major rating systems: Leadership in Energy and Environmental Design, Green Rating for Integrated Habitat Assessment, Indian Green Building Council • Criteria and scoring systems (basic structure) • Certification process and documentation • Cost-benefit analysis of green buildings • Case studies of certified green buildings	6

References:

- Indian Green Building Council. (2020). *IGBC green building rating systems*. Confederation of Indian Industry.
- The Energy and Resources Institute. (2019). *GRIHA manual: Green rating for integrated habitat assessment*. TERI.
- Leadership in Energy and Environmental Design. (2021). *LEED v4.1 for building design and construction*. U.S. Green Building Council.
- Bureau of Energy Efficiency. (2017). *Energy conservation building code (ECBC)*. Government of India.
- Ministry of Housing and Urban Affairs. (2021). *Model building bye-laws*. Government of India.
- Kibert, C. J. (2016). *Sustainable construction: Green building design and delivery* (4th ed.). Wiley.
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- Michael Bauer, Bauer, M., Möhle, P., & Schwarz, M. (2010). *Green building: Guidebook for sustainable architecture*. Springer.
- United Nations Environment Programme. (2020). *2020 global status report for buildings and construction*. United Nations.
- World Green Building Council. (2019). *Bringing embodied carbon upfront*. World Green Building Council.

EVS-355-MJP: Environmental Practical VII

Course Outcome (COs):

CO1: Apply advanced Environmental Impact Assessment (EIA) techniques for comprehensive project evaluation.

CO2: Analyze environmental impacts and develop detailed assessment reports using standard methodologies.

CO3: Design and evaluate Environmental Management Plans (EMP) for effective mitigation and compliance.

CO4: Assess Environmental Management Systems (EMS) and environmental auditing processes in real-world contexts.

CO5: Evaluate environmental policies, legal frameworks, and clearance procedures for regulatory compliance.

CO6: Interpret case studies and legal scenarios for environmental decision-making and governance.

CO7: Integrate environmental assessment tools for sustainable planning and management.

Sr. No	Content	No of practicals
1	Screening of a project for EIA requirement	01
2	Scoping exercise for a selected development project	01
3	Identification of environmental impacts using checklist method	01
4	Baseline data collection design	01
5	Preparation of environmental impact statement (EIS) Outline	01
6	Development of environmental Management Plan	01
7	Study of Environmental Management system framework (ISO 14001 overview)	01
8	Preparation of environmental audit report for a selected activity	01
9	Analysis of environmental clearance process	01
10	Review of a national environmental policy	01

11	Preparation of report on environmental legal framework	01
12	Study of Public Interest Litigation (PIL) in environmental issues	01
13	Preparation of report on environmental legal framework	01
14	Case study analysis of environmental law violation	01
15	Impact assessment using simple matrix method	01

References:

- Ministry of Environment Forest and Climate Change. (2006). *Environmental impact assessment notification (as amended)*. Government of India.
- Central Pollution Control Board. (2020). *Guidelines for environmental management plan and audit*. Government of India.
- International Organization for Standardization. (2015). *ISO 14001: Environmental management systems—Requirements with guidance for use*. ISO.
- United Nations Environment Programme. (2018). *Environmental impact assessment training resource manual*. United Nations.
- Shyam Divan, S., & Armin Rosencranz, A. (2020). *Environmental law and policy in India* (3rd ed.). Oxford University Press.
- National Green Tribunal. (2010). *National Green Tribunal Act*. Government of India.

EVS-356-MJP: Environmental Practical VIII

Course Outcomes (COs):

CO1: Identify and evaluate green building features and sustainability aspects in built environments.

CO2: Apply techniques for energy, water, and waste audits in buildings.

CO3: Assess indoor environmental quality and sustainable building materials.

CO4: Analyze green building certification frameworks such as Green Rating for Integrated Habitat Assessment and Leadership in Energy and Environmental Design using standard methods.

CO5: Collect, organize, and interpret environmental data for analysis.

CO6: Apply statistical tools including measures of central tendency, dispersion, correlation, and regression.

CO7: Perform basic probability analysis and hypothesis testing for environmental datasets.

CO8: Interpret and present analytical results for environmental decision-making.

Sr. No	Content	No of practicals
1	Identification of green building features in a campus	01
2	Energy audit of building	01
3	Water audit of building	01
4	Solid waste management assessment in building	01
5	Study of indoor environmental quality	01
6	Analysis of building materials for sustainability	01
7	Assessment of rainwater harvesting system	01
8	Study of GRIHA & LEED- Checklist method & Preparation of report	01
9	Collection & tabulation of environmental data	01
10	Calculation of mean, median & Mode	01

11	Calculation of standard deviation and variance	01
12	Regression analysis & Correlation between two environmental variables	01
13	Time series analysis of environmental data	01
14	Probability analysis	01
15	Hypothesis testing	01

References:

- Bureau of Energy Efficiency. (2017). *Energy conservation building code (ECBC) user guide*. Government of India.
- The Energy and Resources Institute. (2019). *GRIHA rating system manual*. TERI.
- Leadership in Energy and Environmental Design. (2021). *LEED v4.1 reference guide for building design and construction*. U.S. Green Building Council.
- Central Pollution Control Board. (2020). *Guidelines for solid waste management and environmental monitoring*. Government of India.
- Jerrold H Zar. (2010). *Biostatistical analysis* (5th ed.). Pearson.
- Andy Field. (2018). *Discovering statistics using IBM SPSS statistics* (5th ed.). Sage Publications.

EVS-360-MJE: Concepts of Urban Green Spaces and Sustainability

Course Outcomes (COs):

CO1: Explain the concepts, types, and ecological importance of urban green spaces in urban environments.

CO2: Analyze urban ecological processes including biodiversity, urban heat island effect, and ecosystem services.

CO3: Apply principles of planning and design for sustainable development of urban green spaces.

CO4: Evaluate the role of green infrastructure and nature-based solutions in urban sustainability and climate resilience.

CO5: Assess policies, governance frameworks, and institutional roles in urban environmental management.

CO6: Analyze emerging trends such as smart cities and the application of geospatial tools in urban planning.

Unit	Content	Hrs of Lectures
		30
1	Introduction to Urban Green Spaces • Concept and types of urban green spaces (parks, gardens, green belts, urban forests) • Importance of green spaces in urban ecosystems • Urbanization and its environmental impacts • Ecosystem services provided by urban green spaces • Role of green spaces in climate regulation • Case studies of urban green spaces (Indian cities)	6
2	Urban Ecology and Environmental Functions • Urban ecosystems and ecological processes • Biodiversity in urban areas (flora and fauna) • Urban heat island effect and mitigation • Air pollution control through vegetation • Stormwater management and green infrastructure • Soil and water interactions in urban green spaces	6

3	Planning and Design of Green Spaces • Principles of urban green space planning • Landscape design basics • Green belts, corridors, and connectivity • Urban forestry and afforestation • Sustainable park and garden design • Role of community participation in planning	6
4	Sustainability and Urban Development • Concept of sustainable cities • Green infrastructure and nature-based solutions • Urban resilience and climate adaptation • Waste management and water conservation in green spaces • Social and health benefits of urban greenery • Urban sustainability indicators	6
5	Policies, Governance and Emerging Trends • Urban environmental policies and planning in India • Role of municipal bodies and governance • Smart cities and green city concepts • Use of GIS and remote sensing in urban planning (introductory) • Urban green space management challenges • Case studies of sustainable urban development	6

References:

- Ministry of Housing and Urban Affairs. (2021). *Smart cities mission guidelines*. Government of India.
- National Institute of Urban Affairs. (2020). *Urban green space planning and management in India*. NIUA.
- United Nations Environment Programme. (2020). *Nature-based solutions for sustainable urban development*. United Nations.
- World Health Organization. (2016). *Urban green spaces and health: A review of evidence*. WHO.
- Food and Agriculture Organization. (2018). *Urban and peri-urban forestry*. FAO.
- Indian Council of Forestry Research and Education. (2019). *Urban forestry in India: Status and opportunities*. Government of India.
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- Beatley, T. (2016). *Handbook of biophilic city planning and design*. Island Press.
- Timothy Beatley. (2011). *Biophilic cities: Integrating nature into urban design and planning*. Island Press.
- NITI Aayog. (2021). *Sustainable urban development in India*. Government of India.
- World Bank. (2020). *Resilient cities: Urban green infrastructure and climate adaptation*. World Bank.
- Central Public Works Department. (2014). *Guidelines for sustainable habitat*. Government of India

EVS-361-MJEP Urban Green Space Mapping and Sustainability Audit

Course Outcomes (COs):

CO1: Identify and classify different types of urban green spaces and their ecological characteristics.

CO2: Conduct field surveys and collect environmental data related to urban green spaces.

CO3: Apply basic mapping techniques, including manual and GIS-based methods, for spatial analysis.

CO4: Assess biodiversity, vegetation characteristics, and ecological parameters of green spaces.

CO5: Evaluate environmental conditions such as temperature, air quality, soil, and water use in urban green spaces.

CO6: Perform sustainability audits and analyze ecosystem services provided by green spaces.

CO7: Develop and present improvement plans for enhancing sustainability of urban green spaces.

Sr. No	Content	No of practicals
1	Identification and classification of different types of urban green spaces	01
2	Field survey of a local park/garden (basic observation study)	01
3	Mapping of green spaces in a selected area (manual/sketch-based)	01
4	Basic introduction to GIS-based mapping (demonstration/record)	01
5	Measurement of tree density in a selected area	01
6	Estimation of green cover percentage (visual/approximate method)	01
7	Biodiversity assessment (plants/trees identification)	01
8	Preparation of inventory of plant species in a green space	01
9	Assessment of urban heat conditions (temperature comparison shaded vs open area)	01
10	Observation of air quality indicators (dust deposition on leaves – basic study)	01
11	Study of soil condition in green space (texture/organic matter – basic)	01
12	Water usage assessment in parks/gardens	01
13	Sustainability audit of a selected green space (checklist method)	01
14	Evaluation of ecosystem services provided by green space	01
15	Preparation and presentation of a green space improvement plan	01

References:

- National Institute of Urban Affairs. (2020). *Urban green space planning and management: Field guidelines*. NIUA.
- Food and Agriculture Organization. (2018). *Urban and peri-urban forestry: Field guide for practitioners*. FAO.
- Indian Council of Forestry Research and Education. (2019). *Manual for urban biodiversity assessment and tree inventory*. Government of India.
- United States Environmental Protection Agency. (2017). *Guidelines for environmental field sampling and analysis*. EPA.
- QGIS Development Team. (2023). *QGIS training manual*. <https://qgis.org/>
- Central Public Works Department. (2014). *Guidelines for sustainable habitat and site assessment*. Government of India.

EVS-362-MJE Organic Farming & Gardening

Course Outcomes (COs):

CO1: Explain the concepts, principles, and importance of organic farming and its role in sustainable agriculture.

CO2: Analyze soil health, nutrient management, and the role of organic inputs in maintaining soil fertility.

CO3: Apply organic farming practices for crop production, including pest, weed, and water management.

CO4: Demonstrate techniques of organic gardening and urban agriculture for sustainable food production.

CO5: Evaluate certification systems, marketing aspects, and government policies related to organic farming.

CO6: Analyze current trends and innovations in organic agriculture and their role in sustainability.

Unit	Content	Hrs of Lectures 30
1	Introduction to Organic Farming • Concept, definition, and scope of organic farming • History and development of organic agriculture • Principles of organic farming (health, ecology, fairness, care) • Differences between organic and conventional farming • Benefits and limitations of organic farming • Current status of organic farming in India	6
2	Soil Health and Nutrient Management • Soil as a living system • Soil fertility and productivity in organic farming • Organic manures (FYM, compost, green manure) • Vermicomposting and biofertilizers • Nutrient cycling and soil microorganisms • Soil conservation practices	6
3	Organic Crop Production and Management • Crop rotation and mixed cropping • Seed selection and organic seed treatment • Water management in organic farming • Weed management (mechanical and biological methods) • Organic pest and disease management • Role of indigenous knowledge in farming	6

4	Organic Gardening and Urban Agriculture • Concept of kitchen gardening • Terrace gardening and container gardening • Selection of crops for home gardens • Composting at household level • Use of organic inputs in gardening • Benefits of urban gardening for sustainability	6
5	Certification, Marketing and Current Trends • Organic certification process in India • Standards and labeling of organic products • Marketing and economics of organic produce • Government schemes and policies • Emerging trends (urban farming, hydroponics) • Case studies of successful organic farms	6

References

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- International Federation of Organic Agriculture Movements. (2020). *The principles of organic agriculture*. IFOAM.
- Ministry of Agriculture and Farmers Welfare. (2021). *Paramparagat Krishi Vikas Yojana (PKVY) guidelines*. Government of India.
- Agricultural and Processed Food Products Export Development Authority. (2020). *National programme for organic production (NPOP)*. Government of India.
- Indian Council of Agricultural Research. (2019). *Handbook of organic farming*. ICAR.
- S S Purohit. (2018). *Organic farming: Principles and practices*. Agrobios.
- T V Reddy. (2017). *Principles of organic farming*. Kalyani Publishers.
- Lampkin, N. (2019). *Organic farming*. Old Pond Publishing.
- National Centre of Organic Farming. (2020). *Organic farming practices and input production*. Government of India.
- United Nations Environment Programme. (2019). *Sustainable agriculture and food systems*. United Nations.
- NITI Aayog. (2021). *Doubling farmers' income through sustainable agriculture*. Government of India.
- Research Institute of Organic Agriculture. (2022). *The world of organic agriculture: Statistics and emerging trends*. FiBL & IFOAM.

EVS-363-MJEP: Practicals in Organic Farming & Gardening

Course Outcomes (COs):

CO1: Apply principles of organic farming in the preparation and use of organic inputs for sustainable agriculture.

CO2: Demonstrate techniques for composting, vermicomposting, and preparation of organic manures and biofertilizers.

CO3: Perform basic crop production practices including seed treatment, nursery preparation, and transplantation.

CO4: Apply organic methods for pest, weed, and water management in farming and gardening.

CO5: Develop and manage small-scale organic gardens using sustainable practices.

CO6: Identify common plant pests and diseases and apply eco-friendly control measures.

CO7: Record, analyze, and present observations related to plant growth and farming practices.

Sr. No	Content	No. of Practicals
1	Preparation of compost from organic waste	01
2	Preparation of vermicompost	01
3	Preparation of organic liquid manure (e.g., jeevamrut/panchagavya)	01
4	Preparation of biofertilizers (demonstration/basic)	01
5	Seed treatment using organic methods	01
6	Preparation of nursery beds and seed sowing	01
7	Transplantation of seedlings	01
8	Preparation of kitchen garden / container garden	01
9	Preparation of potting mixture for plants	01
10	Preparation of organic pesticides (neem extract, garlic-chilli extract)	01
11	Weed management practices (manual/mulching)	01
12	Irrigation methods in small-scale gardening	01
13	Identification of common pests and diseases in plants	01

14	Harvesting and post-harvest handling of crops	01
15	Maintenance and record of garden growth (logbook/project)	01

References:

- National Centre of Organic Farming. (2020). *Organic farming practices and input production*. Government of India.
- Indian Council of Agricultural Research. (2019). *Handbook of organic farming*. ICAR.
- Food and Agriculture Organization. (2013). *Composting and organic waste management guidelines*. FAO.
- Ministry of Agriculture and Farmers Welfare. (2021). *Organic farming training manual (PKVY)*. Government of India.
- S S Purohit. (2018). *Organic farming: Principles and practices*. Agrobios.
- National Horticulture Board. (2020). *Guidelines for nursery management and kitchen gardening*. Government of India.

EVS-371-VSC: Environmental Monitoring & Assessment

Course Outcomes (COs):

CO1: Apply standard methods and tools for monitoring environmental parameters such as air, water, soil, and noise.

CO2: Collect, record, and analyze environmental data using field-based and basic analytical techniques.

CO3: Evaluate environmental quality using indices and indicator-based assessment methods.

CO4: Perform environmental audits including waste and resource consumption assessment.

CO5: Interpret environmental data using graphical and statistical methods for meaningful analysis.

CO6: Prepare and present environmental monitoring reports based on field observations and data interpretation.

Sr. No	Content	No. of Practical
1	Measurement of ambient temperature variation (shade vs open area) and data analysis	01
2	Measurement of relative humidity using hygrometer/mobile app	01
3	Measurement of noise levels at different locations and time intervals	01
4	Estimation of light intensity in different environments (lux meter/app-based)	01
5	Quantitative assessment of dust deposition on leaves (weight/visual scale method)	01
6	Leaf area dust index (comparative scoring method)	01
7	Estimation of green cover percentage using quadrat or grid method	01
8	Calculation of tree density and frequency in a selected area	01
9	Soil moisture estimation using gravimetric/simple field method	01
10	Soil quality scoring using indicator-based index (color, texture, vegetation)	01

11	Water quality assessment using field test kits	01
12	Development of environmental quality index (EQI) using selected parameters	01
13	Solid waste quantification and characterization audit (kg/day, composition %)	01
14	Water consumption audit (estimation and per capita calculation)	01
15	Preparation of environmental monitoring report with data interpretation and graphical representation	01

References:

- National Institute of Urban Affairs. (2020). *Urban green space planning and management: Field guidelines*. NIUA.
- Food and Agriculture Organization. (2018). *Urban and peri-urban forestry: Field guide for practitioners*. FAO.
- Indian Council of Forestry Research and Education. (2019). *Manual for urban biodiversity assessment and tree inventory*. Government of India.
- United States Environmental Protection Agency. (2017). *Guidelines for environmental field sampling and analysis*. EPA.
- QGIS Development Team. (2023). *QGIS training manual*. <https://qgis.org/>
- Central Public Works Department. (2014). *Guidelines for sustainable habitat and site assessment*. Government of India.
