Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science &Commerce, Baramati.

(Empowered Autonomous)

Three/Four Year Honours / Honours with Research B.Sc. Degree Program in

Environmental Science

(Faculty of Science)

CBCS Syllabus

T.Y.B.Sc. (Environmental Science) Semester-VI

For Department of Environmental Science

NEP 2.0

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2025-2026

Title of the Programme: B.Sc. (Environmental Science)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, and ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Environmental Science and related subjects, the Board of Studies in Environmental Science at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the first semester of F.Y.B.Sc. Environmental Science which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

In today's rapidly changing world, a Bachelor's degree in Environmental Science offers ample opportunities for individuals passionate about making a positive impact on the environment and understanding the interrelated systems governing the planet. As the global population surges and natural resources dwindle, the need for professionals skilled in environmental management, conservation, and sustainable development has never been more critical. With a strong foundation in critical thinking, problem-solving, and interdisciplinary understanding, Environmental Science graduates can pursue a wide range of rewarding careers in various sectors.

One of the most prominent careers in this field is that of an Environmental Scientist. This role entails conducting research and analysis to identify, monitor, and mitigate environmental hazards, develop sustainable land, water, and waste management practices, and inform public policy on environmental conservation. Industries such as mining, oil and gas, chemical production, and urban development actively seek Environmental Scientists to ensure compliance with environmental regulations and reduce their ecological footprint.

Environmental Consulting is another avenue that combines scientific knowledge and problem-solving abilities to help businesses, nonprofits, and governments develop eco-conscious strategies and innovative solutions to mitigate environmental risks. These consultants play a crucial role in developing and implementing sustainable practices that meet legislative and social expectations. Environmental education and awareness are now more significant than ever. Environmental Science graduates can contribute as educators in schools, colleges, and community organizations, creating environmentally literate citizens that can make informed decisions about the planet's future.

Overall, revising the Environmental Science syllabus in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

Programme Specific Outcomes (PSOs)

PSO1. Critical Thinking- Students will demonstrate an understand major concepts of Environment in association with multidisciplinary subjects such as physics, chemistry and mathematics etc. Understood the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevance in the day-to-day life.

PSO2. Effective Communication- Development of various communication skills such as reading, listening, speaking, etc., which we will help in expressing ideas and views clearly and effectively.

PSO3. Social Interaction- Development of scientific outlook not only with respect to science subjects but also in all aspects related to life.

PSO4. Effective Citizenship- Imbibe moral and social values in personal and social life leading to highly cultured and civilized personality.

PSO5. Ethics- Follow the ethical principles and responsibilities to serve the society.

PSO6. Environment and Sustainability- Understand the issues of environmental contexts and sustainable development.

PSO7. Self-directed and Lifelong learning- Students will be capable of self- paced and self-directed learning aimed at personal development and for improving knowledge/skill development.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Empowered Autonomous)

Board of Studies (BOS) in Environmental Science

From 2025-26 to 2027-28

Sr.No.	Name	Designation
1.	Ms. Surashri Sonawane	Chairman
2.	Ms. Aruna Kadam	Member
3.	Prof. Dr. Ajit Telave	Member
4.	Dr. Deepali Nimbalkar	Expert from SPPU
5.	Dr. Asawari Jadhav	Expert from other University
6.	Dr. Rachana Ingavale	Expert from other University
7.	Dr. Ganesh Kadam	Industry Expert
8.	Dr.Neeta Dhane	Academic Invitee
9.	Ms. Bhavana Upadhyay	Alumni
10.	Ms. Vaishnavi Lonkar	Student Representative

Course Structure for F.Y.B.Sc. Environmental Science (2024 Pattern)

Sem	Course Type	Course Code	Course Title	Theory / Practical	Credits
I	DSC-I (General)	-101-GEN	-------	Theory	04
	DSC-II (General)	-101-GEN	-------	Theory	04
	DSC-III(General)	ENV-101-GEN	Basics of Environmental Science	Theory	02
		ENV-102-GEN	Environment Science Practical-I	Practical	02
	Open Elective (OE)	ENV-103-OE	Disasters and their Management	Theory	02
	Skill Enhancement Course (SEC)	ENV-104-SEC	Introduction to lab instruments	Practical	02
	Ability Enhancement Course (AEC)	ENG-104-AEC	-----	Theory	02
	Value Education Course (VEC)	ENV-105-VEC	Environmental Education	Theory	02
	Generic Indian Knowledge System (GIKS)	GEN-106-IKS	------	Theory	02
				Total Credits	**22**
II	DSC-I (General)	ENV-151-GEN	-----	Theory	04
	DSC-II (General)	ENV-151-GEN	-----	Theory	04
	DSC-III (General)	ENV-151-GEN	Fundamentals of Environmental Biology	Theory	02
		ENV-152-GEN	Environment Science Practical-II	Practical	02
	Open Elective (OE)	ENV-153-OE	Environmental Management and Safety	Practical	02
	Skill Enhancement Course (SEC)	ENV-154-SEC	Sustainable Agricultural Practices	Practical	02
	Ability Enhancement Course (AEC)	ENG-154-AEC	----	Theory	02
	Value Education Course (VEC)	COS-155-VEC	Digital and technological solutions	Theory	02
	CC	YOG/PES/CUL/NSS/NCC-156-CC	To be selected from the CC Basket	Theory	02
				Total Credits	**22**
				Grand Total Sem I + Sem II	**44**

Course Structure for S. Y. B. Sc. Environmental Science (2024 Pattern) as per NEP 2020

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
III (5.0)	Major Mandatory	ENV-201-MRM	Natural Resources and Management	Theory	02
	Major Mandatory	ENV-202-MRM	Environmental Pollution-I	Theory	02
	Major Mandatory	ENV-203-MRM	Practicals based on ENV-201-MJM and ENV-202-MJM	Practical	02
	Vocational Skill Course (VSC)	ENV-204-VSC	Practical based on Organic farming	Practical	02
	Field Project(FP)	ENV-205-FP	Field Project	Practical	02
	Minor	ENV-206-MN	Man and Environment	Theory	02
	Minor	ENV-207-MN	Basic Practicals in Environmental science	Practical	02
	Open Elective (OE)	ENV-208-OE	Initiatives for Environmental Management	Theory	02
	Subject Specific Indian Knowledge System (IKS)	ENV-209-IKS	Environment, cultural values and Society	Theory	02
	Ability Enhancement Course (AEC)	MAR-210-AEC/ HIN-210-AEC/ SAN-210-AEC		Theory (Any One)	02
	Co-curricular Course (CC)	YOG/PES/CUL/NSS /NCC-211-CC	To be continued from the Semester - II		02
				Total Credits Semester - III	**22**
	Major Mandatory	ENV-251-MRM	Solid and Hazardous Waste Management	Theory	02
	Major Mandatory	ENV-252-MRM	Environmental Pollution-II	Theory	02
	Major Mandatory	ENV-253-MRM	Practicals based on ENV-251-MJM and ENV-252-MJM	Practical	02
	Vocational Skill Course (VSC)	ENV-254-VSC	Organic farming	Theory	02
	Community Engagement Project(CEP)	ENV-255-CEP	Community Engagement Project (CEP)	Practical	02
	Minor	ENV-256-MN	Basics of Environmental Geoscience and Biology	Theory	02
	Minor	ENV-257-MN	Practical course on Environmental Geoscience and Biology	Practical	02
	Open Elective (OE)	ENV-258-OE	Eco-Friendly Practices	Practical	02
	Skill Enhancement Course (SEC)	ENV-259-SEC	Practicals on Waste Management	Practical	02
	Ability Enhancement Course (AEC)	MAR-260-AEC/ HIN-260-AEC SAN-260-AEC		Theory (Any One)	02

IV (5.0)					
	Co-curricular Course (CC)	YOG/PES/CUL/NSS /NCC-261-CC	To be continued from the Semester - III		02
				Total Credits Semester - IV	22
				Total Credits Semester – III + IV	44

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T.Y. B.Sc. Environmental Science 2025-26

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
V	Major Mandatory	ENV-301-MJM	Ecosystem Management	Theory	02
	Major Mandatory	ENV-302-MJM	Wildlife Biology	Theory	02
	Major Mandatory	ENV-303-MJM	Geoscience	Theory	02
	Major Mandatory	ENV-304-MJM	Nature Conservation	Theory	02
	Major Mandatory	ENV-305-MJM	Practical based on ENV-301MJM to ENV-304-MJM	Practical	02
	Major Elective (MJE)	ENV-306-MJE(A)	Environmental Governance, Laws and Ethics	Theory (Any two)	04
	Major Elective (MJE)	ENV-306-MJE(B)	Environmental Biotechnology		
	Major Elective (MJE)	ENV-306-MJE(C)	Remote sensing ,GIS and modeling		
	Minor	ENV-311-MN	Water and Soil quality	Theory	02
	Minor	ENV-312-MN	Practical based on Water and Soil quality	Practical	02
	Vocational Skill Course (VSC)	ENV-321-VSC	Practical based on Environmental Microbiology	Practical	02
	Field Project(FP)	ENV-335-FP	Field project	Practical	02
				Total Credits Semester-V	**22**
VI	Major Mandatory	ENV-351-MJM	Climate Change	Theory	02
	Major Mandatory	ENV-352-MJM	Analytical Methods	Theory	02
	Major Mandatory	ENV-353-MJM	Sustainable Development	Theory	02
	Major Mandatory	ENV-354-MJM	Environmental Statistics	Theory	02
	Major Mandatory	ENV-355-MJM	Practical based on ENV-351MJM to ENV-354-MJM	Practical	02
	Major Elective(MJE)	ENV-356-MJE(A)	Environmental Safety and Risk Management	Theory (Any two)	04
	Major Elective(MJE)	ENV-356-MJE(B)	Environmental Economics and Audit		
	Major Elective(MJE)	ENV-356-MJE(C)	Soil Health Management		
	Minor	ENV-361-MN	Air and Noise quality	Theory	02
	Minor	ENV-362-MN	Practicals based on Air and Noise quality	Practical	02
	On Job Training(OJT)	ENV-385-OJT	On Job Training	Practical	04
				Total Credits Semester-VI	**22**
			Total Credits Semester-V+ VI		**44**

CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code	: USENV
Class	: T.Y.B.Sc.
Semester	: VI
Course Type	: Major Mandatory (Theory)
Course Code	: ENV-351-MJM
Course Name	: **Climate Change**
No. of Credits	: 2
No. of Teaching Hours	: 30

Course Objectives:

1) Understand the anthropogenic and natural drivers of climate change and future developments aspects for the sustainability
2) Identify and evaluate the environmental, social, and economic impacts of anthropogenic activities and required sustainability framework for mitigation of the same.
3) Realize scope, importance, and opportunities for climate change studies.
4) Develop skills to critically analyze climate change data and reports.
5) Explore strategies for raising awareness and advocating for climate action at local, national, and global levels.
6) Examine global disparities in climate change impacts and contributions, and discuss concepts of climate justice and equity.
7) Understand the role of international cooperation and the responsibilities of different stakeholders in addressing climate change.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Sensitize about Impacts of climate change and future goals and of sustainability.
CO2. Aware of various policies and agreements regarding these two aspects.
CO3. Understand Methodologies for impact assessments and current practices of the societies.
CO4. Help us understand why global temperatures continue to rise, how the climate affects us, and how we can tackle this challenge before things get much worse.
CO5. Students will be able to define climate change.
CO6. Students will be able to analyze the global impact of climate change.
CO7. Students will be able to outline the process of climate change.

Topics and Learning Points

Teaching Hours

Unit-1- Climatic Systems and Variations (10L.)

- Global Climate System, Causes for Climate Change.
- Internal Variability: Ocean Currents, Ocean-Atmosphere Variability, Volcanism, Plate Tectonics, Greenhouse Gases
- External Climate Forces: Orbital Variations, Solar Fluctuations
- Evidence of Climate change, Extreme Events and Disasters

Unit-2-Consequences and Challenges (8L)

- Impacts on Life, Flora and Fauna
- Glaciers and Ice Sheets Melting, Climate Change and Water Scarcity, Coastal Ecosystem and Vulnerability,
- Economics of Climate Change,
- Climate Change in agriculture and health

Unit-3- International and National Organization for Climate Change (12L)

- International Efforts,
- UNFCCC and Conference of the Parties,
- IPCC,
- Kyoto Protocol and Agreements (G-7, G-17)
- Copenhagen Conference,
- Glasgow Conference
  Confronting Climate Change: Policies and Efforts by India-
- National Action Plan on Climate Change (NAPCC),
- State Action Plan on Climate Change (SAPCC),
- National Adaptation Fund on Climate Change (NAFCC),
- Long Term Ecological Observatories (LTEO) Programme.
- Role of NGOs

References:

1. The Climate Fix: What Scientists and Politicians Won't Tell You About Global Warming by Roger Pielke, Basic Books (2010)
2. The Climate Solution: India's Climate Change Crisis and What We Can Do About It by Mridula Ramesh, Hachette India (2018).
3. This Changes Everything: Capitalism vs. the Climate by Naomi Klein, Penguin (2015).
4. What Is Climate Change? (What Was?) by Gail Herman (Author), Illustrated by John Hinder liter, Penguin Workshop (2018).
5. Climate Change Biodiversity and Green Economy by H.S. Sharma S. Padmaja and Ganesh Sharma, Concept Publishing Company Pvt. Ltd. (2013). 6) Climate Change by Joseph Romm, OUP US (2018).

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	1	1	1	1	1	1	1	1	2	3	1	3
CO2	3	3	1	1	1	1	1	1	1	1	3	2	1
CO3	1	3	1	1	3	1	3	1	3	1	1	1	1
CO4	3	1	1	1	3	1	1	1	1	1	3	1	3
CO5	3	1	1	1	1	1	1	1	1	1	3	1	1
CO6	3	1	1	1	3	1	3	1	1	1	3	1	1
CO7	3	3	1	1	1	1	1	1	1	1	3	1	1

Justification for the mapping

PO1: Disciplinary Knowledge:
CO1. Fundamental probability theory strengthens disciplinary knowledge.
CO2. Deeper understanding of statistical methods builds core disciplinary knowledge.
CO4. Students apply core knowledge to interpret environmental issues and processes.
CO5. Understanding inter-variable relationships supports core knowledge in environmental science.
CO6. Mathematical modeling for environmental problems reinforces subject-based learning. CO7: Environmental studies foster disciplinary grounding in ecological principles.

PO2: Critical Thinking and Problem solving:
CO2. Interpreting and presenting statistical data enhances academic and scientific communication skills.
CO3. Learners develop critical reasoning through analysis of environmental data and research outcomes.
CO7. Conveying environmental issues and solutions improves both written and verbal communication skill

PO5: Trans-disciplinary knowledge:
CO3. Students will integrate concepts from physics, chemistry, and biology to analyze environmental processes.
CO4. Students will relate environmental studies with social, economic, and policy dimensions, reflecting transdisciplinary awareness.
CO6. Learners will apply multidisciplinary approaches for environmental monitoring and assessment.

PO7: Effective Citizenship and Ethics:
CO3. Students will recognize ethical dimensions in environmental research and sustainable resource use. CO6. Learners will demonstrate environmental ethics through responsible laboratory and field practices

PO9: Communication Skills
CO3. Learners will communicate research findings and environmental information effectively to communities and stakeholders, strengthening public understanding of sustainability.

PO10: Project Management and Teamwork

CO1. Students will gain teamwork experience through collaborative environmental projects.

PO11: Digital Competence

CO1. Students will utilize digital tools for data analysis and environmental reporting.
CO2. Students will apply ICT skills for environmental data representation.
CO4. Students will adopt digital mapping and analysis tools to interpret spatial data.
CO5. Learners will use modern computational tools to process and visualize environmental data.
CO6. Students will apply digital and analytical instruments for accurate measurement, data interpretation reporting in environmental studies.
CO7. Students will present digital reports and environmental data using ICT-based methods.

PO12: Life-long Learning

CO2. Students will develop curiosity and adaptability for continuous learning in the environmental field.

PO13: Environment and Sustainability

CO1. Students will understand the importance of sustainable development and conservation strategies. CO4: Learners will apply eco-friendly practices to address local and global environmental issues.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code	: USENV
Class	: T.Y.B.Sc.
Semester	: VI
Course Type	: Major Mandatory (Theory)
Course Code	: ENV-352-MJM
Course Name	: **Analytical Methods**
No. of Credits	: 2
No. of Teaching Hours	: 30

Course Objectives:

1) To Learn about different categories of analytical methods, such as qualitative vs. quantitative, statistical vs. non-statistical, and their appropriate contexts.
2) Develop skills in gathering data using various analytical techniques, ensuring accuracy and reliability.
3) Learn to process and clean data to prepare it for analysis, including handling missing values and outliers.
4) Interpret the results of analyses in a meaningful way, making connections between data and real-world implications.
5) Develop the ability to write clear and concise reports summarizing analytical findings, including visualizations and recommendations.
6) Understand and apply ethical principles in data handling and analysis, including data privacy, consent, and the responsible use of results.
7) Stay updated on advancements in analytical methods and tools, and be open to adopting new techniques as they emerge.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Explain the theoretical aspects of key analytical techniques and instruments used in geochemistry, including but not limited to electron microscopy, X-ray diffraction, mass spectrometry and spectroscopy (including synchrotron techniques).
CO2. Strategically plan analytical campaigns to apply to different types of samples and research objectives, including selection of the most appropriate technique/instrumentation for the students' research project.
CO3. Undertake the correct sample preparation and characterization prior to analysis by the chosen techniques or instruments.
CO4. Design an analytical work-flow to acquire data and achieve the research objectives of their project.
CO5. Process data from the chosen instruments and demonstrate understanding of the limitations and quality of the data. Justify the approach taken to data processing.
CO6. Write a clear and concise justification and description of the analytical techniques employed, suitable for publication in a scientific journal.

CO7. Students will understand the physiological functions that regulate the proper growth and development of living things.

Topics and Learning Points

Teaching Hours

Unit-1 Analytical Instrumentation (10L.)

- Instrumentation technique and its principles, merits and demerits of the techniques
- Spectrophotometry,
- Colorimetry,
- Flame photometry and polarography
- Gas chromatography
- Ion exchange chromatography,
- Atomic absorption spectroscopy.

Unit-2 Introduction to Soil and Water Chemistry. (10L)

- Definition of soil, composition of soil,
- Process of soil formation,
- Types of soils, nutrient functions.
- factors affecting on soil

Chemistry of Water:

- Unusual properties of Water
- Hydrogen bonding in biological systems,
- Changes in water properties by addition of solute.
- Cationic, anionic and nonionic detergents, modified detergents

Unit-3 Chemistry of Biologically Important Molecules (10L)

- Protein structure and biological functions, enzymes, biosynthesis of DNA and RNA.
- Chemistry of hydrocarbon decay, environmental effects, effects on macro and microorganisms Surfactants.
- Lead and its compounds: Physical and chemical properties, behavior, human exposure

References:

1) Environmental Chemistry- A.K.Dey New Age International publishers
2) Destruction of hazardous chemical- G.Lunn, E.B.Sandome
3) Hazardous substances in chemical lab-G.D.MuMivir
4) Essentials of Nuclear Chemistry, H. J Arnikar, Wiley Eastern Limited, 4th Edition.(1995) Course no. Title Credits Semester I
5) Instrumental methods of analysis-Chatwal and Anand

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	P13
CO1	3	2	1	2	2	1	1	3	1	1	2	1	1
CO2	2	3	1	3	3	1	1	2	1	1	1	1	1
CO3	2	3	1	3	3	1	1	1	1	1	1	1	1
CO4	2	3	1	3	3	1	3	2	2	1	1	1	1
CO5	2	2	1	3	3	1	3	2	1	1	1	1	1
CO6	2	2	1	2	2	3	3	2	1	1	1	1	1
CO7	3	2	1	2	2	1	1	1	1	2	1	1	1

Justification for Mapping

PO1: Comprehensive Knowledge and Understanding

CO1: Students gain foundational understanding of key analytical techniques and instruments in geochemistry, representing comprehensive disciplinary knowledge.
CO7: Understanding physiological functions regulating growth and development contributes to comprehensive biological knowledge.
CO8: Expressing the role of analytical chemistry in science strengthens theoretical and conceptual understanding.

PO2: Practical, Professional, and Procedural Knowledge

CO1: Explaining analytical techniques demonstrates theoretical procedural knowledge.
CO2: Planning analytical campaigns and selecting appropriate instruments shows applied procedural and professional competency.
CO3: Correct sample preparation and characterization require hands-on procedural skills.
CO4: Designing an analytical workflow involves practical implementation of scientific procedures.
CO5: Processing data and understanding limitations reflects professional analytical practices.
CO6: Writing justifications for analytical techniques demonstrates procedural and documentation skills. CO8: Applying analytical chemistry in research and projects develops professional competency.

PO4: Specialized Skills and Competencies

CO1: Explaining advanced instruments and techniques develops specialized knowledge.
CO2: Planning research campaigns shows specialized methodological skills.
CO3: Sample preparation and characterization reflect technical competency.
CO4: Designing workflows demonstrates specialized analytical and project skills.
CO5: Data processing with understanding of limitations cultivates specialized analytical skills.
CO6: Writing publication-ready justifications enhances specialized communication competencies.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

CO2: Selecting appropriate instruments requires problem-solving and analytical reasoning.
CO4: Designing workflows to achieve research objectives demonstrates application and analytical skills.
CO5: Processing and interpreting data involves applied reasoning and critical analysis.
CO6: Justifying analytical techniques cultivates problem-solving in research contexts.
CO7: Understanding physiological functions requires application and analytical thinking.
CO8: Expressing the role of analytical chemistry in science involves application of knowledge to research contexts.

PO6: Communication Skills and Collaboration

CO6: Writing clear, publication-ready descriptions develops scientific communication and collaboration skills.

PO7: Research-related Skills

CO2: Planning research campaigns builds research-related planning skills.
CO4: Workflow design contributes to research skill development.
CO5: Data analysis and interpretation reinforce research methodology skills.
CO6: Writing justifications and documenting methods enhances core research-related competencies. CO8: Expressing the role of analytical chemistry fosters research awareness and reporting skills.

PO8: Learning How to Learn Skills

CO2: Planning and executing analytical campaigns cultivates independent learning skills.
CO4: Workflow design nurtures adaptive and reflective learning. CO6:
Writing justifications encourages self-directed learning.
CO8: Understanding analytical chemistry's role enhances lifelong learning and conceptual growth.

PO9: Digital and Technological Skills

CO5: Data processing using software and analytical tools develops digital proficiency.
CO8: Application of analytical chemistry may involve technological and computational methods.

PO11: Value Inculcation and Environmental Awareness

CO1: Understanding analytical techniques emphasizes ethical and responsible research practices.
CO2: Lab safety awareness fosters respect for human and environmental welfare.
CO3: Sample handling and eco-friendly practices build environmental consciousness.
CO4: Risk management and workflow planning demonstrate ethical responsibility.
CO6: Documenting analytical methods ethically encourages scientific integrity.
CO8: Expressing the significance of analytical chemistry promotes scientific and societal responsibility.

PO12: Autonomy, Responsibility, and Accountability

CO2: Independent planning of analytical campaigns cultivates autonomy and responsibility.
CO5: Data analysis and evaluation require accountable decision-making.
CO6: Preparing publication-ready justifications demonstrates responsibility and accountability in research.

PO13: Community Engagement and Service

CO8: Understanding and communicating the role of analytical chemistry in science promotes broader scientific engagement and service to the community.

CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code	: USENV
Class	: T.Y.B.Sc.
Semester	: VI
Course Type	: Major Mandatory (Theory)
Course Code	: ENV-353-MJM
Course Name	: **Sustainable development**
No. of Credits	: 2
No. of Teaching Hours	: 30

Course Objectives:

1) To understand the fundamental concepts and principles of sustainable development, including the three pillars: environmental, economic, and social sustainability.
2) Explore strategies and practices for conserving natural resources, reducing waste, and promoting renewable energy.
3) Develop skills to evaluate the economic impact of sustainable development initiatives, including cost benefit analysis and long-term economic planning.
4) Learn methods for engaging communities in sustainable development processes, including participatory planning and stakeholder analysis.
5) Familiarize yourself with international agreements and frameworks related to sustainable development, such as the Paris Agreement and the SDGs.
6) Develop skills to identify and implement innovative solutions to sustainability challenges, including technological advancements and creative problem-solving.
7) Learn how to advocate for sustainable practices and policies at local, national, and international levels.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Students will be able to define sustainability and identify major sustainability challenges.
CO2. Students will have an understanding of the carrying capacity of ecosystems as related to providing for human needs.
CO3. Students will be able to apply concepts of sustainable development to address sustainability challenges in a global context.
CO4.Students will identify, act on, and evaluate their professional and personal actions with the knowledge and appreciation of interconnections among economic, environmental, and social perspectives.
CO5.Students will have an understanding of their social responsibility as future professionals and citizens.
CO6. Students will be able to analyze power, structures of inequality, and social systems that govern individual and communal life.
CO7. Students will be able to recognize the global implications of their actions.

Topics and Learning Points

Teaching Hours

Unit- 1 Introduction, Goals and Issues (10L)

- Sustainable Development: Definition, Evolution and Principles
- Strategies for Sustainable Development,
- Sustainability and Human Development.
- Tools for Sustainable Development,
- Sustainable Development Goals,
- Criticisms in Sustainability,
- Women and Gender Equality,
- Roll of women and youth in environmental protection.

Unit -2 Environmental Conservation, Management and Strategies for Sustainability (10L)

- Technical Skills in Environment and Sustainability,
- Preservation of Biological Diversity,
- Sustainable Forest Management,
- Challenges in Energy, Food and Agriculture.
- Cultural Elements in Sustainable Development Frameworks,
- Human Centered Designs in Sustainability, The 2030 Agenda.
- Environmental management and innovation strategies.

Unit-3 Recent Trends in Sustainability and Green Building (10L)

- Appropriate Technology and Sustainability Science,
- Consumption and Production Patterns,
- Sustainable Transport,
- Ecological and Carbon Footprint for Sustainability Measurement,
- Sustainability in Policy Design.
- Introduction of green building, Features, Goals, design, material and energy efficiency,
- Examples, Impacts, Role of Green building in environmental protection,
- The Indian Green Building Council (IGBC).

References:

1. Chaturvedi .P.(2003), Energy, Environment and Sustainable Development, Concept Publishing Company, New Delhi
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3. Sustainable Development in Digital Era by Dr. Aparna Mishra, Dr. Vikas Dahiya, Dr. Kamini Tandon, JSR Publishing House LLP; (2019).
4. The Age of Sustainable Development by Jeffrey D. Sachs and Ban Ki –moon, Columbia University Press (2015).
5. Target 3 Billion: Innovative Solutions Towards Sustainable Development by APJ Abdul Kalam, Srijan Pal Singh, Penguin India (2011)

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	1	3	1	1	1	1	1	1	3	1	
CO2	2	3	1	3	3	1	3	3	1	1	3	3	1
CO3	2	3	1	3	1	1	1	1	1	1	3	1	1
CO4	2	3	1	3	3	1	3	3	1	1	3	1	1
CO5	2	3	1	3	3	1	3	1	3	1	1	3	1
CO6	2	3	1	3	3	3	3	3	1	1	3	3	1
CO7	3	1	1	1	3	1	1	1	1	1	1	1	1

Justification for Mapping

PO1: Comprehensive Knowledge and Understanding:
CO1, CO7, CO8: Students acquire in-depth knowledge of analytical techniques, physiological functions, and the theoretical role of analytical chemistry, building strong disciplinary foundations.

PO2: Practical, Professional, and Procedural Knowledge:
CO1–CO6, CO8: Hands-on skills such as explaining techniques, planning campaigns, sample preparation, workflow design, data processing, and applying analytical chemistry in projects foster procedural competence and professional practice.

PO4: Specialized Skills and Competencies:
CO1–CO6, CO8: Specialized technical skills are developed through workflow design, sample preparation, advanced instruments, and communication of analytical chemistry principles.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning:
CO2, CO4–CO8: Selecting instruments, workflow design, data processing, and applying analytical knowledge strengthen analytical reasoning and problem-solving abilities.

PO6: Communication Skills and Collaboration:
CO6: Writing justifications and documenting methods fosters clear scientific communication and collaboration skills.

PO7: Research-related Skills:
CO2, CO4–CO6, CO8: Planning research campaigns, designing workflows, data analysis, and documenting methods cultivate strong research competencies.

PO8: Learning How to Learn Skills:
CO2, CO4, CO6, CO8: Planning and executing campaigns, workflow design, writing justifications, and understanding the role of analytical chemistry promote self-directed and lifelong learning.

PO9: Digital and Technological Skills:
CO5, CO8: Data processing using software and analytical tools develops digital and technological proficiency.

PO11: Value Inculcation and Environmental Awareness:
CO1–CO4, CO6, CO8: Ethical research practices, lab safety, eco-friendly procedures, workflow planning, and communicating scientific significance foster ethical responsibility and environmental awareness.

PO12: Autonomy, Responsibility, and Accountability:
CO2, CO5, CO6: Independent planning, accountable data evaluation, and preparing publication-ready justifications develop autonomy and professional responsibility.

PO13: Community Engagement and Service:
CO8: Communicating the societal and scientific significance of analytical chemistry promotes community engagement and service.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code	: USENV
Class	: T.Y.B.Sc.
Semester	: VI
Course Type	: Major Mandatory (Theory)
Course Code	: ENV-354-MJM
Course Name	: **Environmental Statistics**
No. of Credits	: 2
No. of Teaching Hours	: 30

Learning Objectives :

1) Understand fundamental statistical concepts such as descriptive statistics, probability distributions, and inferential statistics.
2) Understand how to ensure data quality, manage data effectively, and address issues related to missing or erroneous data.
3) Learn techniques for visualizing environmental data, including histograms, scatter plots, box plots, and time series graphs.
4) Assess the strength and direction of relationships between environmental variables using correlation coefficients.
5) Apply cluster analysis techniques to group similar environmental data points and identify distinct patterns or categories.
6) Use time series models to make predictions about future environmental conditions based on historical data.
7) Apply statistical methods to real-world environmental problems and case studies, integrating theory with practical experience.

Learning Outcomes :

By the end of the course, students will be able to:

CO1.To finds the probabilities of various events.
CO2.Compute various measures of central tendency, dispersion, moments, skewness and kurtosis.
CO3. Compute correlation coefficient, regression coefficients and to interpret the results.
CO4. Compute the correlation coefficient for bivariate data and interpret it.
CO5. To fit linear, parabolic and exponential curves to the bivariate data to investigate relation between two variables.
CO6. It helps to students to environmental problems in terms of mathematical modeling to understand the impact of the chosen variables under study and show the direction of change in positive or negative manner.
CO7. Allowing researchers to gain an understanding of environmental issues through researching and developing potential solutions to the issues they study.

Topics and Learning Points

Teaching Hours

Unit 1 :Population and Sample (8L)

- Definition of Statistics, Scope of Statistics in environmental Science.
- Population and sample: Definition of population ans with illustration.
- Methods of sampling –SRSWR, SRSWOR, Stratified, Systematic, cluster sampling and two-stage sampling.

Unit 2 :Data condensation and representation (6L)

- Data: Types of data, quantitative and qualitative, attributes, variables, scales of measurement: nominal, ordinal, interval and ratio.
- Presentation of data: Classification of data, frequency distribution, cumulative frequency distribution,
- Graphical representations: Histogram, frequency polygon, frequency curve, ogive curves, Numerical problems.

Unit 3 : Univariate data analysis (8L)

- Measures of Central Tendency: Mean median and mode for ungrouped and grouped data. Geometric mean, Harmonic mean. Numeric problems.
- Measures of Dispersion: Range, Variance, standard deviation, coefficient of variation
- Moments, Skewness and Kurtosis.

Unit 4: Correlation and Regression: (8L)

- Bivariate data
- Correlation: Concept of correlation, types of correlation Scatter diagram, interpretation of the type of correlation from scatter diagram, Karl Pearson's coefficient of correlation (r), Spearman's rank correlation coefficient.
- Regression: Linear and nonlinear regression models. Fitting of regression line ($Y=a+bX$), and fitting of second-degree curve ($Y=a+bX+cX^2$), Fitting of exponential curves of the type $Y = ab^X$ and $Y = aX^b$.

References:

1. Gupta and Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
2. Sarma K.V.S.(2001)Statistics made it simple: Do it yourself on PC. Prentce Hall of India, New Delhi.
3. B.L.Agarwal: Programmed Statistics, New Age International Publishers ,New Delhi.

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	1	1	2	2	1	1	2	1
CO2	3	3	1	2	3	2	2	2	3	1	1	2	1
CO3	3	2	1	3	3	1	2	2	3	1	1	2	1
CO4	3	2	1	3	3	1	2	2	3	1	1	2	1
CO5	3	3	1	3	3	2	2	2	3	1	1	3	1
CO6	3	2	1	3	3	1	2	2	3	1	1	2	1
CO7	3	3	2	3	3	3	3	3	3	2	2	3	2

Justification for Mapping

PO1: Comprehensive Knowledge and Understanding

All COs contribute strongly (CO1–CO7) as they involve conceptual understanding of statistical fundamentals—population, sample, measures, probability, and correlation representing a solid theoretical foundation.

PO2: Practical, Professional, and Procedural Knowledge

CO2, CO5, CO7 are strongly related (3) because students apply data handling, correlation, and probability tools in real or simulated professional contexts.

CO1, CO3, CO4, CO6 are moderately related (2) due to conceptual and procedural focus.

PO3: Entrepreneurial Mindset and Knowledge

Statistics nurtures decision-making and data-driven entrepreneurship.

CO7 has moderate linkage (2) as it connects data analysis with real-life problem solving and risk assessment.

Other COs have partial relation (1) as they indirectly support analytical thinking useful for entrepreneurship.

PO4: Specialized Skills and Competencies

CO3–CO7 have strong relation (3) since computation, analysis, and interpretation demand technical and analytical skills.

CO1–CO2 are moderately related (2) through data organization and presentation skills.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning

All COs strongly align (3) — statistics inherently develops logical, analytical, and quantitative reasoning used to interpret data and solve problems.

PO6: Communication Skills and Collaboration

CO2 and CO7 are strongly related (3) because data presentation and interdisciplinary application involve communicating statistical findings effectively.

CO1, CO5 have moderate relation (2) through interpretation and reporting results.

PO7: Research-related Skills

CO2, CO3, CO4, CO5, CO7 are **moderately to strongly related (2–3)** — they involve data analysis, correlation, regression, and inference, all core research tools.

CO1–CO6 support research planning (sampling, data representation).

PO8: Learning How to Learn Skills

CO7 has strong linkage (3)since it integrates multiple tools requiring self-learning.

Other COs are moderately related (2) as statistical learning encourages continuous skill upgrading.

PO9: Digital and Technological Skills

CO2–CO7 are strongly related (3) because data analysis and visualization often involve ICT tools (Excel, R, SPSS).

CO1 is moderately related (2) since sampling can be simulated digitally.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO7 is moderately related (2) — applying statistics in social sciences fosters understanding of human and cultural diversity through data. Others have partial relation (1).

PO11: Value Inculcation and Environmental Awareness

CO7 has moderate linkage (2) since applying statistics in community/environmental data analysis promotes social responsibility.

Others have partial relation (1) indirectly through ethical data handling.

PO12: Autonomy, Responsibility, and Accountability

CO5, CO7 are strongly related (3) — statistical analysis requires independent thinking and responsible reporting.

CO1–CO4, CO6 are moderately related (2)for independent data handling and interpretation.

PO13: Community Engagement and Service

CO7 has moderate linkage (2) as statistics can address societal issues (education, health, and environment). Others are partially related (1), as data understanding supports informed community participation.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code : USENV
Class : T.Y.B.Sc.
Semester : VI
Course Type : Major Mandatory (Practical)
Course Code : ENV-355-MJM
Course Name : **Practical based on ENV-351-MJM to ENV-354- MJM**
No. of Credits : 2
No. of Teaching Hours : 30

Course Objectives:

1) To learn controlling pollution in environment.
2) Identify and apply practices and principles of a green economy to promote environmental sustainability and economic efficiency.
3) To learn different analytical methods.
4) Plan and execute environmental audits, including defining audit scope, collecting data, and evaluating environmental performance.
5) To learn and controlling global warming.
6) Prepare comprehensive and clear audit reports with findings, conclusions, and actionable recommendations for improving environmental performance.
7) Use theoretical knowledge and practical skills to address real-world environmental and economic challenges effectively.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Students understood handling of instruments.
CO2. Students understanding the basics for industrial purpose.
CO3. Student understanding the sustainable farming practices.
CO4. Students will reduce their reliance on non-renewable energy, reduce chemical use and save resources.
CO5. Students will aware to reduce pollution and waste reduction measures like reuse and recycling.
CO6. Know the impacts that climate change is having on the natural environment;
CO7. Understand how soil erosion may be made worse by climate change and could in turn lead to further climate change.

Practical based on ENV-351-MJM to ENV-354- MJM

1) Measurements for the impact of environmental stress conditions on plants.
2) Estimation of carbon sequestration.
3) Studies on plants facing pollutants from selected areas.
4) Impacts of extreme events in selected areas: A case study.
5) Estimation of COD.
6) Demonstration of alkali metals in various samples by Flame-photometry .
7) Estimation of oil and grease from given sample.
8) Studies on measurements of sustainable farming practices.
9) Measurement of sustainability by using innovative approaches and designs.
10) Designing of Green Building.
11) Measurement of carbon footprint of electricity.
12) Grouping of data and preparation of frequency distribution, histogram and frequency polygon.
13) Calculating mean, median and mode for grouped and ungrouped data
14) Calculating variance, standard deviation and coefficient of variation, correlation coefficient for grouped and ungrouped data
15) Fitting simple linear regression. Plotting scatter diagram and regression line

Visit: Visit to any Agricultural Research Institute and submission of report.

References:

1. APHA, AWWA, WEF. (2017). *Standard Methods for the Examination of Water and Wastewater* (23rd Edition). American Public Health Association, Washington, D.C.
2. Trivedy, R. K., & Goel, P. K. (1986). *Chemical and Biological Methods for Water Pollution Studies.* Environmental Publications, Karad.
3. Allen, S. E., Grimshaw, H. M., & Rowland, A. P. (1989). *Chemical Analysis of Ecological Materials* (2nd Edition). Blackwell Scientific Publications.
4. Kudesia, V. P. (2014). *Air Pollution* (Revised Edition). Pragati Prakashan, Meerut.
5. Gupta, S. P., & Kapoor, V. K. (2022). *Fundamentals of Applied Statistics* (4th Edition). Sultan Chand & Sons, New Delhi.

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	1	1	3	1	1	2	2	1
CO2	2	3	1	3	3	1	1	2	1	1	1	1	1
CO3	2	3	1	3	3	1	1	1	1	1	1	1	1
CO4	2	3	1	3	3	1	3	2	2	1	1	3	1
CO5	2	2	1	3	3	1	3	2	1	1	1	1	3
CO6	2	2	1	2	2	3	3	2	1	1	1	2	3
CO7	3	2	1	2	2	1	1	1	1	1	2	1	1
CO8	3	2	1	2	2	1	3	3	1	1	3	3	1

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding (Disciplinary Knowledge)
CO1: Handling instruments develops core disciplinary knowledge in environmental science and sustainability practices.
CO2, CO3, CO4, CO7, CO8: Understanding industrial basics, sustainable farming, climate-related issues enhance students' foundational knowledge.

PO2: Practical, Professional, and Procedural Knowledge
CO1: Using instruments practically strengthens procedural skills.
CO2, CO3, CO4, CO6, CO8: Applying knowledge in industrial and environmental contexts builds professional competence.

PO3: Entrepreneurial Mindset and Knowledge (Social Competence/Innovation)
CO6: Understanding climate impacts encourages students to innovate solutions and recognize social systems.

PO4: Specialized Skills and Competencies
CO1, CO2, CO3, CO4, CO5, CO6, CO8: Skills in instrument handling, sustainable practices, and climate mitigation enhance specialized competency.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning (Trans-disciplinary Knowledge) CO1, CO2, CO3, CO4, CO5, CO6, CO8: Applying concepts of sustainability and climate adaptation improves problem-solving and analytical skills.

PO6: Communication Skills and Collaboration (Personal/Professional Competence)
CO4, CO6: Evaluating actions in a holistic manner fosters teamwork and personal responsibility.

PO7: Research-related Skills (Effective Citizenship and Ethics)

CO4, CO5, CO6, CO8: Researching environmental impacts encourages ethical awareness and responsibility.

PO8: Learning How to Learn Skills (Environment and Sustainability)
CO1, CO4, CO8: Reflecting on sustainability issues enhances independent learning and lifelong Adaptability.

PO9: Digital and Technological Skills
CO4, CO5: Using technological tools for monitoring resources and pollution control strengthens digital competencies

PO11: Value Inculcation and Environmental Awareness
CO1, CO7, CO8: Understanding climate change and environmental consequences fosters values of sustainability.

PO12: Autonomy, Responsibility, and Accountability
CO1, CO4, CO6, CO8 → Handling instruments safely, reducing resource use, and understanding climate impact require autonomous and responsible action.

PO13: Community Engagement and Service
CO5, CO6 → Awareness of pollution reduction and climate impacts encourages active community engagement and environmental service.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code	: USENV
Class	: T.Y.B.Sc.
Semester	: VI
Course Type	: Major Elective (Theory)
Course Code	: **ENV-356-MJE(A)**
Course Name	: **Environmental Safety and Risk Management**
No. of Credits	: 2
No. of Teaching Hours	: 30

Learning Objectives:

1) Understand the basic principles and concepts of environmental safety, including hazard identification, risk assessment, and mitigation strategies.
2) Develop skills in identifying and assessing environmental risks using various methods, including qualitative and quantitative risk assessment techniques.
3) Identify different types of environmental hazards, including chemical, biological, physical, and radiological hazards.
4) Understand key environmental laws, standards, and guidelines that impact environmental safety and risk management.
5) Learn to develop and implement mitigation measures to address and reduce negative environmental impacts identified during impact assessments.
6) Apply techniques for monitoring environmental safety and risk management practices, including inspections, audits, and performance metrics.
7) Apply theoretical knowledge to real-world scenarios and case studies to develop practical problem-solving skills.

Learning Objectives:

By the end of the course, students will be able to:

CO1. Demonstrate a thorough understanding of fundamental environmental safety principles, including hazard identification, risk assessment, and safety protocols.

CO2. Identify potential environmental hazards and assess their risks using appropriate qualitative and quantitative methods.

CO3. Apply appropriate risk control measures, including engineering controls, administrative controls, and personal protective equipment.

CO4. Develop comprehensive emergency response plans for various environmental incidents, including spills, accidents, and natural disasters.

CO5. Conduct environmental impact assessments (EIAs) to evaluate the potential effects of projects or activities on the environment.

CO6. Demonstrate a commitment to environmental stewardship by promoting responsible practices and fostering a culture of environmental responsibility.

CO7. Apply theoretical knowledge to real-world scenarios, demonstrating practical problem-solving skills and effective risk management solutions.

Topics and Learning Points

Unit-1 Introduction to Environmental Risk — Teaching Hours (10L)

- Environmental safety: Definition, Goals, Introduction, objectives.
- Categorization of Industries (Red, Orange, Green, White) (MPCB)
- Concept of Risk and risk identification,
- Risk assessment and risk communication,
- Allocation and mitigation strategies,
- Potential of health risks in industrial and development processes.

Risk Management-

- National policies,
- Industrial environmental conditions,
- Emissions and noise abatement,
- Ecological risk assessment.

Unit-2 Fire Risk (10L)

- Introduction –Definition, Classification of fire, Causes, Detection and management.
- The regulatory Reform (Fire safety) order 2005,
- Fire control technologies.
- Fire Audit.

Fire Risk and Management-

- Fire Risk Assessment structure and Layout,
- Fire signage,
- Fire alarms and fire detection

Unit-3 Chemical Risk Assessment (10L)

- Importance of Chemical Safety, Basic laboratory rules and Safety.
- Personal Protective Equipment (PPE),
- Toxic Substances: Definition, Classes of toxicity, Effects of Toxic substances.
- Chemical process safety –Decomposition and Runway Reactions
- Chemical safety technologies. Case study in India.

Hazard Identification and Risk Management-

- The Process of Risk Management,
- Hazard Identification,
- Evaluation (Risk Assessment, Risk Matrix),
- Risk Control implementation,

References:

1) Computerized environmental modelling – J. Hardstay, DM Tailor & SEMetcalf
2) Computerized aided environmental management – SA Abbassi and FIKhan.
3) Environmental Governance: The Global Challege; By Lamont C. Hempel; Island Press (1996)
4) Environmental Issues in India – A Reader; By Mahesh Rangrajan; Pearson-Longman Publ.(2007)

5) Handbook of Environmental Law, Acts, Guidelines, Compliances, and Standards: Vol. I and II, by R.K. Trivedy; BS publ(2004).
6) International Environmental Law, Fairness, Effectiveness and World Order; by Elli Louka, Cambridge, (2006)
7) Global Environmental Governance: A Reform Agenda; by Adil Najam, Mihaela Papa, and Nadaa Taiyab (2006), International Institute for Sustainable Development (IISD),Canada
8) Environmental Governance and Regulation in India: by *Atiyah Curmally*; (Environment and Rehabilitation) India Infrastructure Report2002

Mapping of Program Outcomes with Course Outcomes

	Programme Outcomes (POs)												
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	1	2	3	1	2	3	1	1	3	1	1
CO2	2	3	1	3	3	1	3	2	1	1	3	3	1
CO3	2	3	1	3	3	2	1	2	2	1	3	1	1
CO4	2	3	1	3	3	3	1	2	2	1	3	3	2
CO5	2	3	1	3	3	2	3	2	2	1	3	2	2
CO6	3	2	1	2	2	3	1	2	1	3	3	3	3
CO7	3	2	1	2	2	3	1	2	1	3	3	3	3

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding:
CO1, CO6, CO7: Students gain foundational knowledge of environmental safety principles, stewardship, and practical risk management.

PO2: Practical, Professional, and Procedural Knowledge:
CO1–CO5, CO7: Hands-on application of risk assessment, control measures, EIAs, and emergency planning develops procedural and professional skills.

PO3: Entrepreneurial Mindset and Knowledge:
No direct mapping; COs focus on safety and environmental management rather than entrepreneurship.

PO4: Specialized Skills and Competencies:
CO1–CO5, CO7: Developing emergency plans, applying control measures, and conducting EIAs cultivate specialized technical and analytical skills.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning:
CO1–CO5, CO7: Risk assessment, problem-solving in real-world scenarios, and decision-making during environmental emergencies enhance analytical reasoning and problem-solving.

PO6: Communication Skills and Collaboration:
CO3–CO5: Applying control measures and developing EIAs requires effective collaboration and communication with teams and stakeholders.

PO7: Research-related Skills:
CO2, CO5: Hazard identification, risk assessment, and EIAs reinforce research planning and methods skills.

PO8: Learning How to Learn Skills:
CO1, CO2, CO4, CO7: Students develop reflective skills through understanding safety principles, assessing hazards, emergency planning, and applying knowledge to practice.

PO9: Digital and Technological Skills:
CO3–CO5, CO7: Use of risk assessment software, simulation tools, and EIA platforms develops digital competence.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy:
CO6: Environmental stewardship emphasizes respect for diverse communities and inclusive practices in environmental management.

PO11: Value Inculcation and Environmental Awareness:
CO1–CO6, CO7: Ethical risk management, sustainability awareness, and responsible practices foster environmental and societal values.

PO12: Autonomy, Responsibility, and Accountability:
CO2, CO4–CO7: Independent risk assessment, emergency planning, and professional responsibility cultivate autonomy and accountability.

PO13: Community Engagement and Service:
CO4–CO7: Emergency planning, stewardship, and practical application encourage engagement with communities and service-oriented environmental practices.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code	: USENV
Class	: T.Y.B.Sc.
Semester	: VI
Course Type	: Major Elective (Theory)
Course Code	: **ENV-356-MJE(B)**
Course Name	: **Environmental Economics and Audit**
No. of Credits	: 2
No. of Teaching Hours	: 30

Course Objectives:

1. To understand the meaning, scope, and need of the economic environment in the context of development.
2. To study the concepts of economic efficiency, cost, and cost-benefit analysis in environmental decision-making.
3. To learn about consumerism, poverty, and globalization and their impact on environmental quality.
4. To identify and analyze factors influencing the economic environment and challenges faced by the Indian economy.
5. To explore the application of economics in improving environmental quality through rural planning and sustainable development.
6. To understand the methods of environmental valuation such as hedonic pricing, contingent valuation, and travel cost method.
7. To study the importance, services, and national value of natural resources and issues related to SEZs and EEZs in India.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Explain the relationship between economics and environmental sustainability and apply cost-benefit principles in real-world contexts.
CO2. Assess the influence of globalization, poverty, and consumerism on India's economic and environmental landscape.
CO3. Apply environmental valuation techniques (hedonic pricing, contingent valuation, travel cost method) to assess natural resource worth.
CO4. Evaluate issues and challenges in the management of natural resources and the functioning of SEZs and EEZs.
CO5. Conduct and interpret Environmental Audits and Appraisals, integrating environmental accounting concepts.
CO6. Demonstrate understanding of Environmental Management Systems (EMS) and apply ISO standards in environmental monitoring and compliance.
CO7. Integrate economic principles, resource valuation, and management systems to formulate sustainable environmental policies and decisions.

Topics and Learning Points

Unit-1 Meaning and need of Economic Environment Teaching (10L)

- Economic and Development; Economic efficiency and Concept of Cost.
- Cost benefit analysis; concept of Consumerism;
- Poverty and globalization.
- Factors influence economic environment
- Challenges in Indian Economy
  Application of economics to improve environmental quality-
- Rural planning and development.
- Environmental valuation (Hedonic pricing. Contingent valuation and Travel cost Method) and decision making
- Agricultural environment, Factors Affecting agricultural Environment.

Unit-2 Environmental Audit (10L)

- Basics of Environmental Audit and its need.
- Types of Environmental Audits
- Environmental Audit Procedure,
- Environmental Appraisal and Environmental Accounting
- Case studies.

Unit-3 Environmental Management System (EMS)

- EMS definition, Environment Policy and components of EMS,
- Identification of environmental aspects and impacts,
- Legal and other requirements,
- Training and awareness requirements,
- Application of Environmental Standards, ISO standards.

References:

1. Plant Diversity Hotspots in India (1997): PK Hajra and V. Mudgal; Botanical Survey of India
2. Environmental Management (2005): Bala Krishnamoorthy; Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Ecology and environment; PD Sharma, Rastogi publications, Meerut. 7th ed –2004.
4. Environmental Science; by-Santra SC; Central Publ. New Delhi
5. Raymond F Dasmann, Environmental Conservation, John Wiley (1984).
6. Kato, M. The Biology of Biodiversity, (1999), Springer Verlag, Tokyo.
7. Kotwal, P.C. and S. Banerjee. Biodiversity Conservation – In Managed Forest and Protected areas, (2002). Agrobios, India.
8. Krishnamurthy, K.V. An Advanced Textbook on Biodiversity – Principles and Practice, 9. (2003). Oxford and IBH Publishing, New Delhi.

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	1	1	3	1	1	3	2	2
CO2	2	3	1	3	3	1	2	1	1	1	2	1	1
CO3	2	3	1	3	3	1	1	1	1	1	3	2	3
CO4	2	3	1	3	3	1	3	2	2	1	3	2	1
CO5	2	2	1	3	3	1	3	2	1	1	2	1	1
CO6	2	2	1	2	2	3	3	2	1	1	3	2	1
CO7	3	2	1	2	2	1	1	2	1	1	3	2	1

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
CO1: Students demonstrate comprehensive understanding of natural resources.
CO4, CO6: Provide detailed theoretical grounding in environmental economics.
CO8: Knowledge depth aids in specialized environmental research.

PO2: Practical, Professional, and Procedural Knowledge
CO2: Learning environmental audit involves professional and procedural application.
CO3, CO4: Apply developmental and economic concepts in real-world sustainability contexts.

PO4: Specialized Skills and Competencies
CO2, CO3, CO4: Students gain competence in specialized environmental assessment and management tools.

PO5: Capacity for Application, Problem-Solving, Analytical Reasoning
CO1–CO5: Students develop analytical reasoning through economic and environmental case applications.

PO6: Communication Skills and Collaboration
CO6: Students interpret and communicate environmental economics data effectively.

PO7: Research-related Skills
CO4, CO5, CO8: Apply research methods and analytical tools to environmental policy and economics.

PO8: Learning How to Learn Skills
CO1, CO4, CO6, CO8: Students develop autonomous and continuous learning habits through interdisciplinary study.

PO9: Digital and Technological Skills
CO4: Analytical economic modeling involves digital and data-based approaches.

PO11: Value Inculcation and Environmental Awareness
CO1, CO3, CO4, CO5, CO6, CO8: All outcomes reinforce awareness of environmental ethics and sustainable value systems.

PO12: Autonomy, Responsibility, and Accountability
CO1, CO3, CO6, CO7, CO8: Encourage responsible environmental and economic decision-making.

PO13: Community Engagement and Service
CO3: Emphasizes rural development and local community participation for sustainability.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code	: USENV
Class	: T.Y. B.Sc.
Semester	: VI
Course Type	: Major Elective (Theory)
Course Code	: ENV-356-MJE(C)
Course Name	: **Soil Health Management**
No. of Credits	: 2
No. of Teaching Hours	: 30

Course Objectives:

1. Understand the composition, fertility, and nutrient dynamics of soil.
2. Learn methods for evaluating soil fertility and identifying nutrient deficiencies in plants.
3. Study the concept and significance of Integrated Plant Nutrient Management (IPNM).
4. Understand biological and mechanical soil and water conservation measures.
5. Learn techniques for rainwater harvesting, irrigation scheduling, and drainage management.
6. Explore the classification and causes of plant diseases and pests.
7. Understand different pest management methods—biological, cultural, legislative, physical, and chemical.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Identify major soil components and evaluate soil fertility through nutrient analysis.
CO2. Diagnose nutrient deficiencies in plants and recommend corrective measures.
CO3. Apply principles of Integrated Plant Nutrient Management for sustainable agriculture.
CO4. Demonstrate understanding of soil and water conservation practices suited for different terrains.
CO5. Design small-scale systems for rainwater harvesting and effective irrigation scheduling.
CO6. Classify plant diseases and pests, and explain their interaction in the disease triangle.
CO7. Implement eco-friendly pest control techniques and evaluate pesticide impacts on the environment.

Topics and Learning Points

Teaching Hours (4L)

Unit 1-

- Composition of Soil – physical, chemical, and biological components.
- Soil Fertility – concept, evaluation, and factors affecting fertility.
- Essential Plant Nutrients – macro & micronutrients, their functions, and deficiency symptoms.
- Integrated Plant Nutrient Management (IPNM) – concept, need, and approaches.

Unit 2-

- Introduction to Soil & Water Conservation – need and importance.
- Biological Measures – contour cultivation, strip cropping, vegetative barriers, shelterbelts, shifting cultivation.
- Cropping Systems – multiple, inter, and mixed cropping and their role in conservation
- Hill Slope Measures – contour trench, bench terrace, and contour stone walls.
- Rainwater Harvesting & In-situ Moisture Conservation – principles and techniques. Farm Ponds, Percolation Ponds & Irrigation Management – scheduling, storage, groundwater recharge, and drainage.

Unit 3- **(8L)**

- Concept & Classification of Plant Diseases and Pests; Disease Triangle.
- Major Chemical Groups – chlorinated hydrocarbons, organophosphates, carbamates.
- Pesticide Use & Environment – risks, safety, and mitigation.
- Integrated Pest Management (IPM) – principles, methods, and advantages.
- Agroforestry & Ecological Pest Management – energy crops and sustainable balance.

Unit 4- **(6L)**

- Types of Industrial Waste – hazardous vs. non-hazardous;
- Impact of Industrial Waste – effects on air, water, and soil.
- Stack Emission Control – techniques and emission monitoring systems.
- Effluent Treatment Plants (ETP) – components, process flow, and functions.
- Sewage Treatment Plants (STP) – working principles and reuse of treated water.

Unit 5- **(4L)**

- Fertilizers – types, classification (organic/inorganic/complex).
- Effects of Excess Fertilizer Use – soil degradation, water pollution & management techniques.
- Biofertilizers – concept, types, uses, and importance in sustainable farming.
- Government Schemes – water conservation programs, fertilizer & seed purchase schemes, Soil Health Card.

References:

1. Brady, N., and R. Weil. The Nature and Properties of Soils. 14th ed. Upper Saddle River, NJ: Prentice Hall, 2008.
2. Clark, A., ed. Managing Cover Crops Profitably. 3rd ed. Handbook Series No. 9. Beltsville, MD: Sustainable Agriculture Network, 2007.
3. Coleman, D. C., D. A. Crossley Jr., and P. F. Hendrix. Fundamentals of Soil Ecology. 2nd ed. Burlington, MA: Elsevier Academic Press, 2004.
4. Gugino, B. K., O. J. Idowu, R. R. Schindelbeck, H. M. van Es, B. N. Moebius-Clune, D. W. Wolfe, J. E. Thies, and G. S. Abawi. Cornell Soil Health Assessment Training Manual. Edition 2.0. Ithaca: Cornell University, 2009.
5. Hall, M., and G. Roth, eds. The Penn State Agronomy Guide .

(8L)

6. Hooper, D., et al. —Interactions between aboveground and belowground biodiversity in terrestrial ecosystems: Patterns, mechanisms, and feedbacks." BioScience 50 (20): 1049–61.
7. Magdoff, F., and H. van Es. Building Soils for Better Crops: Sustainable Soil Management. 3rd ed. Handbook Series No. 10. Beltsville, MD: Sustainable Agriculture Network, 2009.
8. Tisdall, J. M., and J. M. Oades. —Organic matter and water-stable aggregates in soils." Journal of Soil Science 33 (1982): 141–63.
9. Tugel, A., A. Lewandowski, D. HappevonArb, eds. Soil Biology Primer. Rev. ed. Ankeny, Iowa: Soil and Water Conservation Society, 2000.
10. Zehnder, G. Farmscaping: Making Use of Nature's Pest Management Services

Mapping of Program Outcomes with Course Outcomes

	Programme Outcomes (POs)												
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**
CO1	3	2	1	2	3	1	3	2	1	1	3	2	2
CO2	2	3	1	3	3	1	2	2	1	1	3	1	2
CO3	2	3	1	3	3	1	1	2	1	1	3	2	3
CO4	2	3	1	3	3	1	3	2	2	1	3	2	3
CO5	2	2	1	3	3	1	3	2	3	1	3	2	3
CO6	2	2	1	2	3	3	3	2	1	1	3	2	2
CO7	3	2	1	2	2	1	3	3	1	1	3	3	3

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
CO1–CO7: Students gain strong disciplinary knowledge in soil fertility, nutrient management, conservation practices, and eco-friendly pest control.

PO2: Practical, Professional, and Procedural Knowledge
CO2–CO5, CO6: Lab and field techniques like nutrient analysis, irrigation design, and pest identification enhance procedural skills.

PO4: Specialized Skills and Competencies
CO2–CO5: Students develop technical expertise in IPNM, water conservation, and irrigation scheduling.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1–CO7: Apply integrated approaches to diagnose nutrient deficiencies, design solutions, and assess pesticide impacts.

PO6: Communication Skills and Collaboration
CO6: Teamwork and reporting during disease/pest diagnosis enhance collaboration.

PO7: Research-related Skills
CO1, CO4, CO7: Field experiments and analysis of soil and pest management Support research skill develop

PO8: Learning How to Learn Skills
CO1, CO3, CO4, CO7: Students adapt to evolving farming techniques and conservation practices.

PO9: Digital and Technological Skills
CO5: Use of irrigation and water management technologies strengthens tech competency.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy
CO3, CO7: Sustainable and eco-friendly practices encourage sensitivity to farmers' needs and local ecosystems.

PO11: Value Inculcation and Environmental Awareness
CO1–CO7: Awareness of soil health, nutrient cycles, and environmental safety fosters responsible and ethical practices.

PO12: Autonomy, Responsibility, and Accountability
CO1, CO3, CO5, CO7: Students independently plan, implement, and evaluate nutrient and pest management interventions.

PO13: Community Engagement and Service
CO3, CO4, CO7: Students can contribute to rural development, community awareness, and sustainable agricultural practices.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code	:USENV
Class	: T.Y.B.Sc.
Semester	: VI
Course Type	: Minor (Theory)
Course Code	: ENV-361-MN
Course Name	: **Air and Noise quality**
No. of Credits	: 02
No. of Teaching Hours	: 30

Course Objectives:

1. Understand the composition, structure, and dynamics of the Earth's atmosphere.
2. Study chemical and photochemical reactions occurring in the atmosphere.
3. Learn about human impacts on atmospheric processes, including global warming and ozone depletion.
4. Understand sources, types, and classification of air pollutants and their effects.
5. Explore various forms of air pollution—industrial, vehicular, and indoor—and their control measures.
6. Learn methods for sampling and monitoring major air pollutants such as SO_2, CO, and particulate matter.
7. Understand working principles of air pollution control equipment for particulates and gaseous pollutants.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Describe the structure and chemical composition of the atmosphere and related meteorological phenomena.
CO2. Explain the effects of human activities on atmospheric chemistry, including global warming, ozone depletion, and El Niño–La Niña.
CO3. Identify major air pollutants, their sources, and their impacts on the environment and human health.
CO4. Assess air pollution status using Air Quality Index (AQI) and Air Pollution Tolerance Index (APTI).
CO5. Apply analytical methods for sampling and monitoring of gaseous and particulate pollutants.
CO6. Operate and evaluate pollution control equipment such as scrubbers, cyclones, and electrostatic precipitators.
CO7. Analyze causes and propagation mechanisms of indoor and outdoor noise pollution.

Topics and Learning Points

Teaching

Unit 1 Air pollution (10L)

- Meaning, definition, and importance of studying air pollution
- Sources of air pollution – natural vs. man-made
- Major air pollutants (SO_2, NOx, CO, PM, hydrocarbons, etc.)
- Effects of air pollution on humans, animals, and plants
- Smog and acid rain
- Basic control measures for air pollution
- Air Quality Index (AQI)
- Air Pollution Tolerance Index (APTI)
- Introduction to analytical methods

Unit 2 Noise pollution (10L)

- Meaning and types of sound
- Difference between sound and noise
- Sources of noise pollution
- Units and measurement of sound
- Effects of noise pollution on health
- Noise standards and permissible limits
- Instruments used in noise measurement

Unit 3 Air and Noise Pollution control (10L)

- Concept of Air Pollution Control and Control at Source
- Control of Particulate Pollutants and Settling Chambers
- Cyclone Separators, Fabric Filters, and Scrubbers
- Electrostatic Precipitators and Gaseous Pollutant Control
- Real-Life Applications and Pollution Control Devices
- Concept, Sources, and Effects of Noise Pollution
- Measurement of Noise and Permissible Standards
- Noise Control at the Source
- Control along Transmission Path and at Receiver End
- Urban Noise Management and Legal Framework

References:

- Rao and Rao: Air Pollution Control Engineering.
- Environmental Pollution Control Engineering-CS Rao, Wiley Eastern Ltd., New Delhi, 1996.
- C.S. Rao, Air pollution and control
- Environmental Noise Pollution-PE Cunniff, McGraw Hill, New York, 1987

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	2	1	2	2	1	3	3	1	1	3	2	2
CO2	3	3	1	3	3	1	2	2	1	1	3	2	3
CO3	2	3	1	3	3	1	1	2	1	1	3	2	3
CO4	2	3	1	3	3	1	3	2	2	1	3	2	2
CO5	2	3	1	3	3	1	3	2	3	1	3	2	2
CO6	2	3	1	3	3	2	3	2	3	1	3	2	3
CO7	3	2	1	2	2	1	2	2	1	1	3	2	3

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
CO1–CO7: Students acquire in-depth disciplinary knowledge of atmospheric structure, chemistry, and pollution phenomena.

PO2: Practical, Professional, and Procedural Knowledge
CO4–CO6: Students apply sampling, monitoring, and equipment-handling techniques in real-world air quality studies.

PO4: Specialized Skills and Competencies
CO3–CO6: Skill development in AQI/APTI analysis, pollution abatement equipment operation, and interpretation of air data.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO2–CO6: Students evaluate anthropogenic impacts and develop solutions for mitigation of air and noise pollution.

PO6: Communication Skills and Collaboration
CO6: Presenting results and collaborating during lab and fieldwork enhances communication and teamwork.

PO7: Research-related Skills
CO4–CO6: Engaging in air quality measurement and pollution control studies nurtures scientific investigation and analytical thinking.

PO8: Learning How to Learn Skills
CO1–CO3, CO7: Students adapt to evolving climate and pollution data, developing lifelong learning habits.

PO9: Digital and Technological Skills
CO5–CO6: Exposure to modern instruments, sensors, and monitoring software fosters technological competency.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy
CO2, CO3, CO7: Understanding how pollution impacts diverse communities promotes empathy and inclusiv

PO11: Value Inculcation and Environmental Awareness
CO1–CO7: Awareness of air and noise pollution's effects cultivates environmental ethics and sustainable values

PO12: Autonomy, Responsibility, and Accountability
CO4–CO7: Independent handling of instruments and data interpretation builds professional accountability.

PO13: Community Engagement and Service
CO2, CO3, CO7: Involvement in air-quality awareness and mitigation activities contributes to societal well-being.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code	:USENV
Class	: T.Y. B.Sc.
Semester	: VI
Course Type	: Minor (Practical)
Course Code	: ENV-362-MN
Course Name	: **Practical based on Air and Noise Quality**
No. of Credits	: 2
No. of Teaching Hours	: 60

Course Objectives:

1. To understand the principle, design, and operation of a high-volume air sampler used for monitoring air quality.
2. To learn proper sampling techniques for collecting wastewater from different polluted sites.
3. To study the methods of estimation of Suspended Particulate Matter (SPM) in the atmosphere.
4. To understand analytical techniques for determination of Sulphur Oxides (SO_x) in air samples.
5. To learn the procedure for determining Nitrogen Oxides (NO_x) in the atmosphere and assess air quality.
6. To gain practical exposure to pollution monitoring instruments and laboratory procedures through field and laboratory visits.
7. To analyze and interpret air and water quality data to evaluate pollution levels and recommend suitable control measures.

Course Outcomes:

By the end of the course, students will be able to:

CO1. Demonstrate the ability to operate and explain the working of a high-volume air sampler.

CO2. Collect and preserve wastewater samples accurately from various polluted sites.

CO3. Analyze ambient air samples to determine concentrations of Suspended Particulate Matter (SPM).

CO4. Estimate Sulphur Oxides (SO_x) in air samples and interpret their environmental significance.

CO5. Determine Nitrogen Oxides (NO_x) concentrations and evaluate their impact on air quality.

CO6. Identify and use air and water pollution monitoring instruments during visits to pollution control laboratories.

CO7. Integrate practical knowledge from sampling and analysis to assess overall environmental pollution levels and suggest mitigation measures.

Topics and Learning Points

Practical based on ENV-362-MN:

1.Principle and functioning of high-volume air sampler.
2.Determination of noise pollution by Db meter.
3.To study noise pollution control devices.
4. Study of Suspended Particulate Matter (Dust Fall Jar)
5. Measurement of Air Temperature, Humidity, and Wind Direction
6. Comparison of Air Quality in Different Areas
7. Calculation of Air Quality Index (AQI)
8 Study of Indoor Air Pollution Sources
9. Study of Air Pollution Tolerance Index (APTI) – Simple
10. Demonstration of Simple Air Filter
11. Measurement of Noise Levels in Different Areas
12. Effect of Distance on Noise Level
13. Identification of Major Noise Sources in Campus
14. Preparation of Noise Map of Campus

References:

1. Trivedy, R. K., & Goel, P. K. (1986). *Chemical and Biological Methods for Water Pollution Studies.* Environmental Publications, Karad, India.
2. APHA, AWWA, & WEF. (2017). *Standard Methods for the Examination of Water and Wastewater* (23rd ed.). American Public Health Association, Washington, D.C.
3. CPCB (Central Pollution Control Board). (2010). *Laboratory Manual for the Analysis of Air Pollutants.* Ministry of Environment, Forest and Climate Change, Government of India, New Delhi.
4. Mani, S., & Patil, D. (2016). *Environmental Engineering: Theory and Practice.* Pearson Education, New Delhi.
5. NEERI (National Environmental Engineering Research Institute). (2015). *Methods for Measurement of Air Pollutants and Noise Levels.* NEERI Technical Publication, Nagpur, India.

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	1	3	3	1	2	2	3	1	3	2	2
CO2	3	3	1	3	3	1	2	2	2	1	3	3	2
CO3	2	3	1	3	3	1	3	2	3	1	3	2	2
CO4	2	3	1	3	3	1	3	2	3	1	3	2	2
CO5	2	3	1	3	3	1	3	2	3	1	3	2	2
CO6	3	3	1	3	3	2	3	2	3	1	3	3	3
CO7	3	3	1	3	3	3	3	2	3	1	3	3	3

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
CO1–CO7: Students acquire fundamental understanding of air and water pollution parameters, instruments, and monitoring concepts.

PO2: Practical, Professional, and Procedural Knowledge
CO1–CO6: Hands-on experience in operating samplers, collecting samples, and laboratory analysis develops professional procedural skills.

PO4: Specialized Skills and Competencies
CO1–CO7: Students gain competence in pollution control equipment handling, sample analysis, and data interpretation.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO3–CO7: Students evaluate pollutant concentrations, assess air and water quality, and propose mitigation strategies.

PO6: Communication Skills and Collaboration
CO6–CO7: Students effectively communicate laboratory findings and collaborate during field and group studies.

PO7: Research-related Skills
CO3–CO7: Exposure to sampling, data collection, and result interpretation builds foundational research aptitude.

PO8: Learning How to Learn Skills
CO1–CO7: Adapting to varied field and lab conditions fosters continuous, independent learning.

PO9: Digital and Technological Skills
CO1, CO3–CO7: Operation of analytical instruments and data analysis software enhances digital proficiency.

PO11: Value Inculcation and Environmental Awareness
CO1–CO7: Awareness of environmental pollution's effects nurtures responsibility toward sustainability and ethics.

PO12: Autonomy, Responsibility, and Accountability
CO2–CO7: Independent handling of instruments and precise sample collection cultivates accountability.

PO13: Community Engagement and Service
CO6–CO7: Students engage with pollution control agencies and local communities, applying knowledge for pu benefit.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2023 Pattern)

Name of the Programme: B.Sc. Environmental Science

Program Code :USENV
Class : T.Y. B.Sc.
Semester : VI
Course Type : **On Job Training (Practical)**
Course Code : ENV-385-OJT
Course Name : **On Job Training**
No. of Credits : 2
No. of Teaching Hours : 60

A) Learning Objectives:

1. To familiarize students with the working environment of environmental industries, research institutes, or pollution control agencies.
2. To develop the ability to identify, assess, and analyze environmental issues at the workplace.
3. To understand standard procedures for environmental monitoring — air, water, soil, and noise.
4. To learn about environmental management systems and regulatory compliance (e.g., ISO 14001, EIA, and EMS).
5. To observe waste treatment processes — such as ETP, STP, and solid waste management.
6. To gain knowledge of documentation, report preparation, and data interpretation for environmental audits.
7. To acquire hands-on experience with laboratory instruments and field sampling techniques.

B) Learning Outcomes:

By the end of the course, students will be able to:

CO1. Apply environmental science principles to real-life industrial, agricultural, or research-based scenarios.
CO2. Perform environmental sampling, laboratory analysis, and data interpretation using standard scientific protocols.
CO3. Evaluate the efficiency of pollution control systems and sustainable resource management techniques.
CO4. Identify environmental problems and propose feasible, eco-friendly, and sustainable solutions.
CO5. Demonstrate familiarity with environmental legislation, regulations, and environmental auditing processes.
CO6. Communicate effectively through technical reports, data presentation, and collaborative teamwork.
CO7. Exhibit professionalism, ethical responsibility, and commitment to sustainable development in workplace practices.

Topics and Learning Points

Unit1 **(30L)**

Industry selection, Topic selection, Study design, Survey preparation, Field work, Analysis.

Unit2 **(30L)**

Report writing and Oral presentation based on Job Training(OJT) Project work.

Standard Operating Protocols for On Job Training
UG
(Year-III Semester-VI)

1. Objective of On-Job Training(OJT)
   To provide hands-on exposure to real-world working environments, improve employability, and bridge the gap between academic learning and industry expectations.
2. Industry/Organization Engagement
   - Students must be placed in an industry, NGO, government organization, private enterprise, MSME, or other approved workplaces relevant to their field of study.
   - The organization should be identified by the department/placement cell/student (with departmental approval).
   - A formal letter(from department to organization)and consent letter(from organization to department) should be exchanged before OJT begins.
3. Faculty Guide and Departmental OJT Coordinator
   - One faculty member will be assigned as a Guide for 2-3 students or per student(based on department policy).
   - A departmental OJT Coordinator will oversee the implementation and record maintenance of all students.
4. Learning Hours Requirement
   - A minimum of 30hours per credit(i.e.,60 hours total)must be completed for the award of 2 credits.
5. Project Topic/Area Selection
   Students should identify at raining domain/topical signed with their academic course and job aspirations.
   The Training Plan must include:
   - Objective of training
   - Expected outcomes
   - Activities to be undertaken
   - Organization details
6. Training Diary/Logbook Maintenance
   - Students must maintain a Daily Training Diary **or** Logbook detailing:
   - Date-wise tasks performed
   - Skills learned
   - Observations
   - Reflections on practical exposure

- The diary should be signed weekly by the industry supervisor and submitted to the guide for review.

7. Evaluation Parameters &Hours Allocation
- Attendance and behavior at the workplace will be monitored by both the industry and academic supervisors.
- Insurance coverage (if required) to be clarified in advance.

Step of Project	Individual student work in hours	Marks
Topic Selection/Study Design	05	05
Hands-on Training	30	20
Weekly Logbook/Daily Diary	05	05
Final Report Writing	10	10
Oral Presentation		10
Total	**60**	**50**

8. OJT Report Format
- Typed and spiral bound report with the following structure(minimum25pages):
- Title Page
- Certificate(by Organization & College)
- Acknowledgment
- Index
- Chapter1:Introduction Of Organization
- Chapter2: Nature of Work Assigned
- Chapter3: Skills and Knowledge Acquired
- Chapter4:ObservationsandLearning
- Chapter5:Challengesand Solutions
- Chapter6:Conclusionand Recommendations
- References
- Appendices(if any– photos, documents, certificates)

9. Submission Guidelines
- Submit the final OJT Report(2copies)with signatures of the Guide and Industry Mentor to the Departmental OJT Coordinator.

10. Oral Presentation/Viva Voce
- All students must make a presentation of their training experience.
- Evaluation to be conducted by two examiners(internal/external)a pointed by the HoD.

11. Passing Criteria
- This is a compulsory subject under the NEP curriculum.
- Students must successfully complete the OJT and pass all components to be eligible for their degree.

12. Important Notes
- Students are responsible for their own safety, conduct, and punctuality during the training

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes (POs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	3	3	2	3	3	1	2	2	2	1	3	2	3
CO2	3	3	1	3	3	1	3	2	3	1	3	2	2
CO3	2	3	3	3	3	1	3	2	2	1	3	2	2
CO4	2	3	3	3	3	1	3	3	2	1	3	2	3
CO5	3	3	2	3	2	1	2	2	2	2	3	3	3
CO6	2	2	1	2	3	3	2	2	3	1	3	2	3
CO7	3	2	2	2	2	3	2	2	1	2	3	3	3

Justification for them mapping

PO1: Comprehensive Knowledge and Understanding
CO1–CO5: Students demonstrate a deep understanding of environmental concepts applied to industries, research, and auditing.

PO2: Practical, Professional, and Procedural Knowledge
CO1–CO6: Students gain professional laboratory and field skills through sampling, testing, and report generation.

PO3: Entrepreneurial Mindset and Knowledge
CO3–CO5: Students explore sustainability-driven innovation and resource management, fostering eco-entrepreneurial ideas.

PO4: Specialized Skills and Competencies
CO1–CO5: Students acquire specialized technical competence in environmental monitoring and auditing.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO3–CO4: Students apply analytical reasoning to evaluate pollution control efficiency and devise sustainable solutions.

PO6: Communication Skills and Collaboration
CO6–CO7: Students prepare technical reports and collaborate effectively during interdisciplinary projects.

PO7: Research-related Skills
CO2–CO4: Students integrate field and lab research skills to assess environmental performance and policy outcomes.

PO8: Learning How to Learn Skills
CO1–CO7: Students develop adaptability and continuous learning through real-world engagement.

PO9: Digital and Technological Skills
CO2–CO6: Students employ instruments, software tools, and digital data systems for analysis and reporting.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy
CO5–CO7: Students learn to respect diverse communities affected by environmental decisions and policies.

PO11: Value Inculcation and Environmental Awareness
CO1–CO7: Students uphold environmental ethics and adopt sustainable professional conduct.

PO12: Autonomy, Responsibility, and Accountability
CO5–CO7: Students show responsible professional behaviour, independently completing environmental audits and reports.

PO13: Community Engagement and Service
CO1–CO7: Students engage in sustainability initiatives and environmental improvement programs benefitting communities.

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