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-V

For Department of Environmental Science

NEP 2.0

Choice Based Credit System Syllabus (2024 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2026-2027

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 2026-27 to 2028-29

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

Credit Distribution Structure for Three/ Four Year Honours/ Honours with Research Degree Programme with Multiple Entry and Exit options as per National Education Policy (2024 Pattern)

Level/ Difficulty	Sem	Subject - 1	Subject-2	Subject-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5/100	I	2(T)+2 (P)	2(T)+2(P)	2(T)+2 (P)	2 (T)	2(T/P)	2(T) (Generic)	2(T)	2	--	22
	II	2(T)+2 (P)	2(T)+2(P)	2(T)+2 (P)	2 (P)	2(T/P)	--	2(T)	2	2	22
Exitoption:Award of UG Certificate in Major with 44 credits and an additional 4credits core NSQF course/Internship OR Continue with Major and Minor **Continue option**: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and another as minor and third subject will be dropped.											
Level / Difficulty	**Sem**	**Credits Related to Major**				**Minor**		**GE/OE**	**SEC**	**IKS**	**AEC**	**VEC**	**CC**	**Total**
		Major Core	**Major Elective**	**VSC**	**FP/OJT/CEP**									
5.0/200	III	4(T)+2 (P)	--	2(T/P)	2 (FP)	2(T)+2(P)	--	2 (T)	--	2 (T) (Subject Specific)	2(T)	--	2	22
	IV	4(T)+2 (P)	--	2(T/P)	2 (CEP)	2(T)+2(P)	--	2 (P)	2(T/P)	--	2(T)	--	2	22
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course /Internship OR Continue with Major and Minor														
5.5/300	V	8(T)+4(P)	2(T)+2 (P)	2(T/P)	2 (FP/CEP)	2(T)	--	--	--	--	--	--	--	22
	VI	8(T)+4(P)	2(T)+2 (P)	2(T/P)	4 (OJT)	--	--	--	--	--	--	--	--	22
Total3Years		44	8	8	10	18	8	8	6	4	8	4	6	132
Exitoption: Award of **UG Degree in Major** with 132 credits OR Continue with Major and Minor														
6.0/400	VII	6(T)+4 (P)	2(T)+2 (T/P)	--	--	4 (RP)	4(RM)(T)	--	--	--	--	--	--	22
	VIII	6(T)+4 (P)	2(T)+2 (T/P)	--	0	8 (RP)	0		0	0	0	0	0	22
Total4Years		68	16	8	2	22	22		12	6	8	4	8	176
Four Year **UG Research Degree** in Major and Minor with 176 credits **OR**														
6.0/400	VII	10(T)+4(P)	2(T)+2 (T/P)	0	0	0	4 (RM)		0	0	0	0	0	22
	VIII	10(T)+4(P)	2(T)+2 (T/P)	0	0	4 (OJT)	0		0	0	0	0	0	22
Total4Years		76	16	8	2	14	22		12	6	8	4	8	176
Four Year **UG Honours Degree** in Major and Minor with 176 credits														

*** Note : The above credit structure is applicable for the students who enrolled for the academic year 2024-25**

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**

Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati.
(Empowered Autonomous)
T.Y. B.Sc. Environmental Science 2026-27

Sem	Course Type	Course Code	Course Title	Theory/ Practical	Credits
V	Major Mandatory	ENV-301-MRM	Ecosystem Management	Theory	02
		ENV-302-MRM	Wildlife Biology	Theory	02
		ENV-303-MRM	Geoscience	Theory	02
		ENV-304-MRM	Nature Conservation	Theory	02
	Major Mandatory	ENV-305-MJM	Practical's based on ENV-301-MRM and ENV-302-MRM	Practical	02
		ENV-306-MJM	Practical's based on ENV-303-MRM and ENV-304-MRM	Practical	02
	Major Elective (MJE)	ENV-307-MJE(A)	Environmental Governance, Laws and Ethics	Theory (Any one)	02
	Major Elective (MJE)	ENV-307-MJE(B)	Remote sensing ,GIS and modeling		
	Major Elective (MJE)	ENV-308-MJE(A)	Applied Practical's on Environmental Policy and Regulatory Mechanism	Practical (Any one)	02
		ENV-308-MJE(B)	Practical's Based on Basic in Remote Sensing and GIS		
	On Job Training (OJT)	ENV-309-OJT	On-Job Training	Practical	04
	Minor	ENV-310-MN	Water and Soil quality	Theory	02
			Total Credits Semester-V		**22**
VI	Major Mandatory	ENV-351-MRM	Climate Change	Theory	02
		ENV-352-MRM	Analytical Methods	Theory	02
		ENV-353-MRM	Sustainable Development	Theory	02
		ENV-354-MRM	Environmental Economics and Audit	Theory	02
	Major Mandatory	ENV-355-MJM	Practical's based on ENV-351-MRM and ENV-352-MRM	Practical	02
		ENV-356-MJM	Practical's based on ENV-353-MRM and ENV-354-MRM	Practical	.02
	Major Elective(MJE)	ENV-357-MJE(A)	Environmental Safety and Risk Management	Theory (Any one)	02
	Major Elective(MJE)	ENV-357-MJE(B)	Environmental Statistics		
	Major Elective(MJE)	ENV-358-MJE(A)	Practical's based on Environmental Safety and Risk Management	Practical (Any one)	02
		ENV-358-MJE(B)	Practical's based on Environmental Statistics		
	Vocational Skill Course (VSC)	ENV-359-VSC	Environmental Microbiology	Theory	02
	Vocational Skill Course (VSC)	ENV-360-VSC	Practical's based on Environmental Microbiology	Practical	02

Field Project	ENV-361-FP	Field Project	Practical	02
			Total Credits Semester-VI	**22**
			Total Credits Semester-V+ VI	**44**

CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code : USENV
Class : T.Y.B.Sc.
Semester : V
Course Type : Major Mandatory (Theory)
Course Code : ENV-301-MRM
Course Name : **Ecosystem Management**
No. of Credits : 2
No. of Teaching Hours : 30

Course Objectives:

1) To learn terrestrial ecosystem and its detailed classification.
2) To learn aquatic ecosystem and its distribution.
3) To make student aware about importance of aquatic and terrestrial ecosystem.
4) Sustainability of resources and species population viability.
5) To maintain an ecosystem in a healthy, productive and resilient condition through the implementation of policies and management measures.
6) The local and geographical distribution and abundance of organisms.
7) Temporal changes in the occurrence, abundance and activities of organisms.

Course Outcomes:

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

CO1**:** Students understood terrestrial ecosystem and its resources.
CO2**:** Students understood aquatic ecosystem and their importance.
CO3: Students will demonstrate an understanding of fundamental ecological principles, such as nutrient cycling, energy flow, and biodiversity.
CO4: Students will develop strategies for the conservation and restoration of ecosystems, considering both natural and human-induced disturbances.
CO5: Students will evaluate the challenges and opportunities associated with the conservation and management of grassland and forest ecosystems.
CO6:Students will explore principles and practices of sustainable forest management, including timber harvesting, reforestation, and the conservation of old-growth forests.
CO7: Students will understand the ecological importance of wetlands, and develop strategies for the conservation and restoration of these critical habitats.

Topics and Learning Points

Teaching Hours

Unit-1-Terrestrial Ecosystem and community (10L)

- Introduction, The Terrestrial Environment, The terrestrial biota and biogeographic regions, general structure of terrestrial communities. The soil subsystem, the vegetation subsystem, parameters of the terrestrial environment, hotspots in India.
- Distribution of major terrestrial communities, patterns, classification, ecotone and edge effect, keystone species and control of community structure, types of interactions: predation, parasitism, antibiosis, commensalism, cooperation, and mutualism.

Unit-2-Aquatic Ecosystem and community (10L)

- Introduction, Limnology, Aquatic environment, aquatic biota ,energy flow in aquatic ecosystem, The parameters of the aquatic environment. Major environmental factors and ecosystem processes, Ramsar convension and Ramsar site in India.
- Distribution of major aquatic ecosystems classification, structure and patterns, impact of climate change on aquatic ecosystem ecotone and edge effect, types of interactions.

Unit-3- Terrestrial and aquatic Ecosystem Management (10L)

- Methods of terrestrial ecosystem management: remote sensing, geographical information system, community-based forest management ,traditional methods, Forest fire: reasons, effects, control measures and management Methods of vegetation sampling and data analysis: sampling approaches, quadrate methods, line and belt transect, the point frame method.
- Methods of aquatic ecosystem management: remote sensing, geographical information system, Eco development program, traditional methods, Methods of aquatic sampling and data analysis: sampling approaches, species association.
- Role of NGOs in ecosystem management, EIA

References:

1. Principles of Environmental science - Cunningham and Cunningham
2. Ecology, Environment and Resource Conservation (2006): Singh JS, Singh SP and Gupta SR; Anamaya Publ, New Delhi.
3. Fundamental of Ecology (1971): EP Odum; WB Saunders Company.
4. Ecology and environment; PD Sharma, Rastogi publications, Meerut. 7th ed – 2004.
5. Environmental Science; by-Santra SC; Central Publ. New Delhi
6. Lillisand, T. M. and Keifer, R. W. (1990): Remote Sensing and Image interpretation, John Willey and Sons, New York
7. Joseph G. (2003): Fundamentals of Remote Sensing, Universities Press, Hyderabad.

8. Haywood, Ian (2000): Geographical Information Systems, Longman
9. Chang, Kang-taung (2002): Introduction to Geographic Information Systems, Tata McGraw-Hill.
10. Burroughs, P. A (1986): Principles of Geographical Information Systems for land Resource Assessment, Oxford University Press.
11. Gupta, R. P. 2003. Remote sensing geology, Springer, New York
12. Barrett, E. C. and Curtis, L. F. 1999. Introduction to environmental remote sensing. Chapman and Hall

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	1	3	1	1	1	1	1	1	1	1	2	1	1
CO2	1	3	1	1	1	1	1	1	1	2	1	1	1
CO3	1	1	1	1	1	1	1	3	1	1	2	1	1
CO4	1	1	3	1	2	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	3	1	1	1	1	1	1	2
CO6	1	1	1	3	1	1	1	1	2	1	1	1	1
CO7	3	1	1	1	1	1	2	1	1	1	1	1	1

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding

CO1: Understanding terrestrial ecosystems and their resources provides a broad overview of ecological systems. This aligns with developing comprehensive knowledge in environmental science.

PO2: Practical, Professional, and Procedural Knowledge

CO4: Developing strategies for conservation and restoration directly correlates with applying practical knowledge in real-world environmental scenarios. This outcome also highlights procedural knowledge, especially considering human-induced disturbances.

CO6: Sustainable forest management, including timber harvesting and reforestation, involves practical application of environmental management skills.

PO3:Entrepreneurial Mindset and Knowledge

CO5: Evaluating the challenges and opportunities in grassland and forest ecosystems encourages students to consider innovative, entrepreneurial approaches to managing these ecosystems**.**

PO4: Specialized Skills and Competencies

CO3: Understanding fundamental ecological principles (nutrient cycling, energy flow, and biodiversity) builds specialized knowledge in ecology, developing the students' competencies in this domain.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO2: Understanding aquatic ecosystems and their importance requires students to apply ecological principles in analyzing and solving environmental issues related to aquatic environments.
CO5 & CO7: Evaluating and developing strategies for the conservation and restoration of ecosystems requires problem-solving and analytical thinking, particularly with grasslands, forests, and wetlands.

PO6: Communication Skills and Collaboration
CO6 & CO7: The development of strategies for forest and wetland conservation will require students to effectively communicate their ideas and collaborate on sustainable management practices.

PO7: Research-related Skills
CO4: The development of strategies for ecosystem restoration necessitates research on both natural and human-induced disturbances, allowing students to strengthen their research skills**.**

PO8: Learning How to Learn Skills
CO3 & CO5: Understanding ecological principles and evaluating conservation challenges encourages students to adopt independent learning approaches to stay updated with new developments in ecology and environmental conservation.

PO9: Digital and Technological Skills
CO6: The principles and practices of sustainable forest management, especially with reforestation and timber harvesting, may involve the use of digital tools or technologies for forest inventory, mapping, and ecosystem management.

PO10:Multicultural Competence, Inclusive Spirit, and Empathy
CO7: Understanding the ecological importance of wetlands and developing conservation strategies could incorporate considerations of local communities, cultures, and inclusive practices in environmental conservation.

PO11: Value Inculcation and Environmental Awareness
CO2 & CO4: Understanding aquatic ecosystems, as well as developing strategies for ecosystem conservation and restoration, directly contributes to building an awareness of environmental issues, emphasizing sustainability and ethical responsibility towards nature.

PO12: Autonomy, Responsibility, and Accountability
CO4 & CO6: The course outcomes that involve developing conservation strategies for ecosystems require students to take responsibility and demonstrate accountability in addressing environmental challenges.

PO13: Community Engagement and Service
CO7: Conservation and restoration of wetlands and other ecosystems often involve community engagement, which reflects the students' role in contributing to societal needs through service-oriented actions**.**

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code : USENV
Class : T.Y.B.Sc.
Semester : V
Course Type : Major Mandatory (Theory)
Course Code : ENV-302-MRM
Course Name : **Wildlife Biology**
No. of Credits : 2
No. of Teaching Hours : 30

Course Objectives:

1) To learn wildlife resource or wildlife biology.
2) To learn major group of plant and animal species and their natural habitat.
3) To learn wildlife management techniques and biodiversity hotspot.
4) Provide information and advice on specific wildlife management problems.
5) To maintain balance in ecosystem.
6) To maintain life supporting system and essential ecological processes.
7) To preserve and use natural resources in sustainable manner.

Course Outcomes:

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

CO1. Students get information about wildlife and their various species.
CO2. Students understanding diversity of wildlife and their scope.
CO3. Students will learn to assess different types of habitats and understand the principles of habitat management to support wildlife populations.
CO4. Students will comprehend the principles of conservation biology, including the importance of genetic diversity, habitat preservation, and the role of protected areas..
CO5.Students will be familiar with wildlife policies, laws, and regulations. They will understand the principles of wildlife management, conservation planning, and the role of stakeholders.
CO6. Students will understand and apply ethical principles in wildlife research and management, ensuring humane treatment of animals and responsible conduct in the field.
CO7. Students will demonstrate a deep understanding of wildlife ecology, including population dynamics, community interactions, and ecosystem relationships..

Topics and Learning Points

Teaching Hours

Unit-1 Introduction (10L)

- Introduction, Concept of Wildlife Biology, Definition of Wildlife, examples of protected wildlife species (Refer to Wildlife Protection Act).
- Diversity of major groups of plants and animals.

  Plants: Algae, Bryophytes, Pteridophytes,

  Gymnosperms, Angiosperms (Monocots and Dicots)

  Animals: Mollusca, Vertebrates- (Mammals, Birds, Fish, Reptiles, Amphibians), habitats of faunal species.

Unit-2 Wildlife diversity (10L)

- Wildlife Habitats - Aquatic (Marine, Freshwater, Brackish), Terrestrial habitats (Vegetation types:- forest, grassland, arid zones, hot and cold deserts, agriculture, landscape patterns). Examples of food chain in each type of habitat.
- Threats to Wildlife- Habitat destruction, developmental projects, urbanization, agricultural expansions, excessive harvesting and poaching, human- wildlife conflict. Examples of excessive exploitation of plants and animals.

Unit-3 Wildlife Management Techniques (10L)

- Population assessment techniques(wildlife census)
- Direct count- block count, transects method , point count method ,visual encounter survey, water hole survey.
- Indirect count: Transects, Point Counts, census from pug marks, camera trapping, DNA fingerprinting, track and sign, pellet count.
- Marking wildlife: ringing, tagging, clipping, colouring.
- Modern wildlife management techniques.

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.
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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

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

Justification for Mapping

PO1: Comprehensive Knowledge and Understanding

CO1: Gaining information about wildlife and their various species provides foundational knowledge in wildlife science and biodiversity, aligning with PO1.

CO7: Understanding wildlife ecology, including population dynamics, community interactions, and ecosystem relationships, strengthens the comprehensive understanding of ecological processes and the complexity of ecosystems.

PO2: Practical, Professional, and Procedural Knowledge

CO3: Learning to assess different types of habitats and understanding habitat management principles directly connects with practical knowledge in wildlife management and environmental conservation.

CO5: Becoming familiar with wildlife policies, laws, and regulations helps students gain professional knowledge and understand procedural aspects of wildlife management, ensuring they are equipped for professional work in the field.

PO3: Entrepreneurial Mindset and Knowledge

CO2: Understanding the diversity of wildlife and its scope can stimulate entrepreneurial ideas for conservation efforts, wildlife tourism, and sustainable wildlife management, fostering an entrepreneurial approach to addressing ecological challenges.

PO4: Specialized Skills and Competencies

CO4: The principles of conservation biology, such as genetic diversity and habitat preservation, require specialized knowledge in biological conservation. This outcome builds the competencies necessary for students to engage in advanced wildlife conservation efforts.

CO6: Applying ethical principles in wildlife research and management contributes to specialized ethical competency in the field of wildlife science.

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

CO3: Assessing habitats and managing wildlife populations requires practical problem-solving and analytical thinking in the context of conservation.

CO7: Understanding wildlife ecology, including population dynamics, requires analytical reasoning to interpret ecological patterns and relationships, as well as problem-solving to address wildlife management issues.

PO6: Communication Skills and Collaboration

CO5: Understanding wildlife policies, laws, and the role of stakeholders requires students to communicate effectively with various groups, such as government agencies, NGOs, and local communities, fostering collaborative efforts in conservation.

CO6: Applying ethical principles in wildlife research also involves clear communication about ethical practices, enabling collaboration with other researchers and stakeholders in wildlife conservation.

PO7: Research-related Skills

CO6: Students learn to apply ethical principles in wildlife research, which requires research skills related to humane treatment and responsible conduct in the field.

CO7: The deep understanding of wildlife ecology fosters students' research abilities, enabling them to engage in ecological studies and fieldwork focused on wildlife populations and ecosystems.

PO8: Learning How to Learn Skills

CO1 & CO2: Learning about wildlife species and their diversity enhances the student's ability to explore new areas of wildlife science, encouraging them to continue learning and stay updated with advancements in the field.

CO5 & CO6: Learning about policies, laws, and ethical principles in wildlife management promotes continuous self-learning in how to approach changing regulations, conservation strategies, and ethical standards.

PO9: Digital and Technological Skills

CO3 & CO7: Assessing habitats and understanding wildlife ecology increasingly requires the use of digital tools, GIS mapping, and other technologies. These technological skills are vital for modern wildlife conservation and habitat management.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO6: Ethical principles in wildlife research emphasize humane treatment and respect for all species, which aligns with fostering empathy and an inclusive spirit in wildlife management.

CO5: Understanding wildlife policies, laws, and stakeholder involvement includes recognizing the importance of diverse cultural perspectives and approaches to conservation.

PO11: Value Inculcation and Environmental Awareness

CO4: Understanding conservation biology principles, such as the importance of genetic diversity and habitat preservation, directly contributes to cultivating environmental awareness and instilling values of sustainability and responsibility towards wildlife.

CO7: A deep understanding of wildlife ecology helps students develop values related to ecosystem conservation and biodiversity protection.

PO12: Autonomy, Responsibility, and Accountability

CO6: Applying ethical principles in wildlife management and ensuring humane treatment of animals instills a sense of responsibility and accountability in students' actions, both in research and conservation efforts.

CO3: Assessing and managing habitats requires students to take ownership and responsibility for their impact on wildlife populations and ecosystems.

PO13: Community Engagement and Service

CO5: Understanding wildlife policies and the role of stakeholders includes engaging with local communities, government bodies, and NGOs to foster a collaborative approach to wildlife conservation and management, promoting active community involvement in wildlife protection efforts.

CO6: Ethical principles in wildlife research often involve community engagement, especially in field studies and conservation programs that impact local populations.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code : USENV
Class : T.Y.B.Sc.
Semester : V
Course Type : Major Mandatory (Theory)
Course Code : ENV-303-MRM
Course Name : **Geoscience**
No. of Credits : 2
No. of Teaching Hours : 30

Course Objectives:

1) To learn or study the geological study of earth.
2) To make student aware about conservation natural resources.
3) To learn origin of earth, soil weathering.
4) It also helps us to study about crystal systems and how the minerals crystallized in different systems.
5) To understand the fundamental processes of the atmosphere.
6) To learn effects of the atmosphere on other aspects of the earth's environments and on humans.
7) To learn the resulting weather and climate. .

Course Outcomes:

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

CO1. Students understood origin of earth and soil weathering process..
CO2. Students understood natural hazards and disaster.
CO3. Students will demonstrate a comprehensive understanding of the Earth's internal structure, including the composition and properties of the Earth's crust, mantle, and core.
CO4. Students will analyze and interpret the principles of plate tectonics, including the movement of Earth's lithospheric plates, volcanic activity, and seismic events.
CO5. Students will identify minerals and rocks, understand their formation processes, and analyze their significance in geological contexts..
CO6. Students will understand atmospheric processes, climate patterns, and weather systems, including factors influencing climate change
CO7. Students will study the chemical composition of Earth materials, including rocks, minerals, and fluids, and their role in geological processes

Topics and Learning Points

Teaching Hours

Unit 1- Origin and evolution of earth (10L)

- Introduction, Primary geochemical differentiation and formation of core, mantle, crust, atmosphere and hydrosphere, Lithosphere. Concept of minerals and rocks.
- Climates of India, western disturbances, Indian monsoon, droughts, El Nino, La Nina. Concept of residence time and rates of natural cycles. Geophysical fields.

Unit 2- Soil Weathering (10L)

- Definition, Classification, Weathering, erosion, transportation and deposition of sediments.
- Soil forming minerals and process of soil formation, Identification and characterization of clay minerals.
- Soil physical and chemical properties, soil types and climate control on soil formation, mineralogical controls.

Unit 3- Natural Hazards and Disasters (10L)

- Concept, Catastrophic geological hazards - floods, landslides, earthquakes, volcanism, avalanche, tsunami and cloud bursts. Prediction of hazards and mitigation of their impacts.
- Atmospheric disturbances: Thunderstorms, cyclones, lightning, and drought.
- Impact of anthropogenic activities on nature.

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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	1	3	1	1	1	1	1	1	1	1	2	1	1
CO2	1	3	1	1	1	1	1	1	1	2	1	1	1
CO3	1	1	1	1	1	1	1	3	1	1	2	1	1
CO4	1	1	3	1	2	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	3	1	1	1	1	1	1	2
CO6	1	1	1	3	1	1	1	1	2	1	1	1	1
CO7	3	1	1	1	1	1	2	1	1	1	1	1	1

Justification for Mapping

PO1: Comprehensive Knowledge and Understanding

CO1: Understanding the origin of Earth and soil weathering processes provides foundational knowledge about the planet's formation and ongoing geological processes, contributing to a comprehensive understanding of Earth sciences.

CO3: A comprehensive understanding of the Earth's internal structure (crust, mantle, and core) directly enhances the student's foundational geological knowledge.

PO2: Practical, Professional, and Procedural Knowledge

CO5: Identifying minerals and rocks and understanding their formation processes equip students with the practical skills to analyze geological samples and interpret their significance in real-world contexts.

CO7: Understanding the chemical composition of Earth materials, including rocks, minerals, and fluids, prepares students to apply professional knowledge and procedures in geological analysis.

PO3: Entrepreneurial Mindset and Knowledge

CO2: Understanding natural hazards and disasters, such as earthquakes, volcanic eruptions, and floods, encourages entrepreneurial thinking related to disaster preparedness, mitigation, and response strategies, which can have real-world business and social applications.

CO6: Climate patterns and factors influencing climate change can lead students to think about entrepreneurial ventures focused on sustainability, climate change solutions, or weather prediction technologies.

PO4: Specialized Skills and Competencies

CO4: Analyzing and interpreting plate tectonics, volcanic activity, and seismic events develop specialized knowledge in Earth processes, enhancing competencies in geological analysis and understanding of Earth's dynamic systems.

CO5: Identifying and analyzing minerals and rocks provide specialized skills in mineralogy and petrology, crucial for geologists and Earth scientists.

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

CO4 & CO7: The analysis of plate tectonics and the study of Earth materials require problem-solving and analytical reasoning, particularly in interpreting geological data, understanding Earth's structure, and predicting geological events or processes.

CO6: Understanding atmospheric processes and climate patterns involves problem-solving related to weather systems and climate change, encouraging analytical reasoning in forecasting and climaterelated studies.

PO6: Communication Skills and Collaboration

CO3: Communicating the understanding of Earth’s internal structure, including its composition and properties, requires clear explanations of complex geological concepts, fostering communication skills.

CO5: Identifying and explaining the formation of minerals and rocks also necessitates communication skills, particularly in the context of academic and professional geological reporting.

PO7: Research-related Skills

CO1 & CO4: Understanding the origin of Earth, soil weathering processes, and the principles of plate tectonics promotes research-oriented thinking, encouraging students to explore and investigate Earth's geological processes through hands-on research.

CO6 & CO7: Studying atmospheric processes and the chemical composition of Earth materials requires research skills to analyze data, interpret findings, and contribute to the body of knowledge in Earth sciences.

PO8: Learning How to Learn Skills

CO1 & CO3: The study of Earth's origin, soil weathering processes, and Earth's internal structure encourages independent learning and critical thinking, allowing students to stay curious and explore further into Earth sciences.

CO5 & CO6: Learning about minerals, rocks, and atmospheric processes motivates students to pursue self-directed learning about new geological discoveries and environmental changes.

PO9: Digital and Technological Skills

CO4: The study of plate tectonics, volcanic activity, and seismic events often involves the use of digital tools, simulation software, and geospatial technologies, thus promoting digital and technological skills in geological research and analysis.

CO7: Understanding the chemical composition of Earth materials often requires the use of laboratory technology, analytical tools, and digital data collection methods to analyze and interpret samples.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO2 & CO6: Understanding natural hazards and climate change fosters a sense of empathy toward communities impacted by these events, promoting an inclusive spirit when developing solutions for disaster preparedness or climate resilience.

CO6: The study of weather systems and climate patterns encourages awareness of how diverse global communities are affected by climate change and the importance of inclusive, culturally sensitive solutions.

PO11: Value Inculcation and Environmental Awareness

CO2 & CO6: Understanding natural hazards and climate change instills a sense of environmental responsibility and awareness of the human impact on Earth's systems, reinforcing the importance of sustainable practices and climate resilience.

CO5: Studying the formation of minerals and rocks and their geological significance helps students appreciate the Earth's natural resources, fostering environmental stewardship.

PO12: Autonomy, Responsibility, and Accountability

CO4 & CO7: Analyzing and interpreting geological processes such as plate tectonics, volcanic activity, and the chemical composition of Earth materials requires students to take responsibility for their analyses and conclusions, fostering autonomy in their academic and professional work.

PO13: Community Engagement and Service

CO2 & CO6: Understanding natural hazards and climate processes involves engaging with communities impacted by disasters and climate change. Students may collaborate with local organizations and policymakers in the application of geological knowledge to address real-world environmental challenges.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc.
(2024 Pattern)

Name of the Programme: B.Sc. Environmental Science
Program Code : USENV
Class : T.Y.B.Sc.
Semester : V
Course Type : Major Mandatory (Theory)
Course Code : ENV-304-MRM
Course Name : **Nature Conservation**
No. of Credits : 2
No. of Teaching Hours : 30

Learning Objectives :

1) To learn basic natural resources.
2) To learn methods for conservation of a nature.
3) To learn information about international efforts for conservation of nature.
4) The program also builds skills in conducting research and communicating for wildlife conservation.
5) To preserve and conserve natural forests which meet the basic needs of people living in or near by the forest.
6) Skill required foe assessment and monitoring of biodiversity as well as wildlife management.
7) To apply knowledge to solve problems related to wildlife conservation and management

Learning Outcomes :

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

CO1. Students aware about nature conservation methods and their international efforts.
CO2. Students understood objectives and challenges of nature conservation.
CO3. Students will understand the ecological principles that govern ecosystems and develop skills in habitat management for the conservation of biodiversity.
CO4. Students will gain knowledge about the conservation of wildlife species, including endangered and threatened species, and understand the principles of captive breeding and reintroduction. .
CO5. Students will understand the legal and policy frameworks related to nature conservation at local, national, and international levels..
CO6. Students will learn principles and practices related to the establishment, design, and management of protected areas for conservation purposes
CO7. Students will explore ethical considerations in conservation decision-making, addressing issues such as the trade-off between conservation goals and human development.

Topics and Learning Points

Teaching Hours

Unit 1- Introduction to nature conservation (10L)

- Concept of Nature Conservation; Convention on Biological Diversity (CBD), Protected Area Network (PAN) in India, Details of PAN in Maharashtra state.

Unit 2-Methods of Nature conservation (10L)

- Methods: In situ-Concept, Principles, Protected area types (global and national level, Heritage sites), Examples, challenges, merits and limitations.
- Ex situ-Concept, Principles, Types (captive breeding and reintroductions, seed banks, gene banks), examples, challenges, merits and limitations.
- Traditional/community conservation-Concept, examples, challenges, merits and limitations, Roll of (NBA) National Biodiversity Authority (Roll and structure), State biodiversity board.

Unit-3 International and National Efforts for Conservation (10L)

- International efforts for Conservation: Role of IUCN, WWF for nature conservation introduction to protocol and convension for nature conservation,
- National efforts –BNHS ,tiger, crocodile ,
- Administrative set up-MoEFCC, SPCB, CPCB etc.
- Role of NGO species conservation efforts.
- Awareness about nature conservation.

References:

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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	1	3	1	1	1	1	1	1	1	1	2	1	1
CO2	1	3	1	1	1	1	1	1	1	2	1	1	1
CO3	1	1	1	1	1	1	1	3	1	1	2	1	1
CO4	1	1	3	1	2	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	3	1	1	1	1	1	1	2
CO6	1	1	1	3	1	1	1	1	2	1	1	1	1
CO7	3	1	1	1	1	1	2	1	1	1	1	1	1

Justification for Mapping

PO1: Comprehensive Knowledge and Understanding

CO1: Being aware of nature conservation methods and international efforts provides students with a comprehensive understanding of global conservation strategies and initiatives.

CO3: Understanding ecological principles and habitat management for biodiversity conservation enhances the students' grasp of ecosystems' functioning and their significance in nature conservation.

PO2: Practical, Professional, and Procedural Knowledge

CO4: Gaining knowledge about wildlife species conservation, including captive breeding and reintroduction, equips students with practical knowledge on wildlife management techniques.

CO6: Learning about the establishment, design, and management of protected areas for conservation purposes provides procedural knowledge, preparing students for real-world applications in conservation planning and management.

PO3: Entrepreneurial Mindset and Knowledge

CO2: Understanding the objectives and challenges of nature conservation encourages entrepreneurial thinking, especially in the development of sustainable solutions for conservation that balance environmental and economic interests.

CO7: Ethical considerations in conservation decision-making, including trade-offs between conservation and development, foster entrepreneurial thinking related to sustainable development and conservation projects.

PO4: Specialized Skills and Competencies

CO3: Developing skills in habitat management and understanding ecological principles directly contributes to specialized competencies in ecological conservation and biodiversity management.

CO5: Understanding legal and policy frameworks related to conservation enhances specialized skills in navigating regulatory and legislative landscapes in conservation practice.

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

CO4: Knowledge of wildlife conservation techniques, such as captive breeding and reintroduction, requires problem-solving abilities to address challenges related to species preservation.

CO6: Understanding the design and management of protected areas encourages students to apply their knowledge to solve real-world conservation problems, such as habitat fragmentation and species protection.

PO6: Communication Skills and Collaboration

CO1 & CO5: Understanding the international conservation efforts and the legal and policy frameworks necessitates communication skills to articulate these complex systems to various stakeholders, including local communities, governments, and international organizations.

CO7: Exploring ethical considerations in conservation requires students to communicate effectively about the trade-offs between conservation goals and human development, promoting collaboration among stakeholders with diverse perspectives.

PO7: Research-related Skills

CO3 & CO4: Gaining an understanding of ecological principles and conservation methods promotes research skills in ecological studies, wildlife management, and biodiversity conservation.

CO6: Learning about protected area management fosters research-related skills, particularly in evaluating conservation effectiveness and monitoring biodiversity within protected areas.

PO8: Learning How to Learn Skills

CO2: Understanding the challenges of nature conservation encourages students to engage in selfdirected learning to keep up with new research, policies, and practices in the conservation field.

CO7: Ethical decision-making in conservation requires continuous learning and reflection, as conservation practices often evolve to incorporate new ethical perspectives and data.

PO9: Digital and Technological Skills

CO6: Learning about the establishment, design, and management of protected areas often involves the use of GIS, mapping technologies, and other digital tools for land-use planning and biodiversity monitoring.

CO3: Implementing habitat management plans for biodiversity conservation may also involve using digital tools for ecosystem monitoring, habitat mapping, and data collection on species.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO1 & CO7: Understanding international conservation efforts and ethical considerations in conservation decision-making fosters a multicultural approach to conservation, emphasizing inclusive practices that take into

account different cultural values, traditions, and local needs. requiring students to adopt an inclusive approach when analyzing conservation laws and regulations.

PO11: Value Inculcation and Environmental Awareness

CO1 & CO3: Gaining awareness of nature conservation methods and ecological principles encourages students to develop a strong environmental ethos, fostering a deeper understanding of biodiversity's importance and sustainability.

CO4: Knowledge of wildlife conservation, especially regarding endangered species, promotes the development of values such as responsibility, ethical consideration, and commitment to preserving natural resources.

PO12: Autonomy, Responsibility, and Accountability

CO6: Learning about the design and management of protected areas requires students to take responsibility for their actions in conservation management, fostering autonomy in conservation decision-making.

CO7: Ethical considerations in conservation decision-making encourage students to act responsibly, considering the impacts of their decisions on wildlife and human communities.

PO13: Community Engagement and Service

CO2 & CO4: Understanding the challenges of nature conservation and the need for wildlife conservation efforts highlights the importance of community engagement. Students may contribute to local conservation projects, working with communities to implement solutions for species protection and habitat restoration.

CO6: The establishment and management of protected areas often involve direct community engagement to ensure successful conservation efforts, such as through sustainable livelihood programs or eco-tourism initiatives.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code : USENV
Class : T.Y.B.Sc.
Semester : V
Course Type : Major Mandatory (Practical)
Course Code : ENV-305-MJM
Course Name : **Practical's based on ENV-301-MRM and ENV-302- MRM**
No. of Credits : 2
No. of Teaching Hours : 60

Course Objectives:

1. To develop understanding of ecological concepts such as productivity, nutrient cycling and species interactions through field-based experiments.
2. To train students in vegetation analysis techniques including quadrat, belt transect and line transect methods.
3. To introduce quantitative methods for biodiversity assessment using ecological indices such as Shannon, Simpson and Sorenson's coefficient.
4. To provide practical exposure to estimation of primary productivity and decomposition rate in terrestrial ecosystems.
5. To develop skills in identification and classification of flora and fauna, including major wildlife groups and phytoplankton analysis.
6. To enable students to assess biodiversity status, including endangered, endemic and native species, and evaluate threats to local ecosystems.
7. To enhance field research skills such as bird diversity estimation, urban fauna survey and trophic level analysis in natural habitats.

Course Outcomes:

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

CO1. Estimate primary productivity and analyze nutrient cycling processes in grassland ecosystems.
CO2. Apply transect and quadrat methods to study vegetation structure, density, frequency and abundance.
CO3. Perform quantitative biodiversity analysis using Shannon, Simpson and Sorenson's indices.
CO4**:** Conduct phytoplankton analysis and calculate percent composition using Lackey's drop count method.
CO5. Identify species interactions, food chains and trophic levels in forest and wildlife ecosystems.
CO6. Assess conservation status of endangered, endemic and native species and evaluate biodiversity threats.
CO7. Conduct independent field surveys including bird diversity estimation and urban ecosystem fauna assessment with proper scientific methodology.

Topics to be learned

Practical based on ENV-301-MRM to ENV-302- MRM

1. Determination of primary productivity in a grassland community.
2. Identification of species interactions in a forest ecosystem.
3. Study of vegetation using belt transect and line transect method.
4. Study of vegetation by quadrate method
5. To study rate of litter Decomposition rate to check nutrient cycling efficiency.
6. Quantitative analysis of phytoplankton and determination of percent composition using Lackey's drop count method.
7. To calculate Shannon, Simpson, Sorenson's coefficient index.
8. Survey of endangered, endemic and native species.
9. Assessment of threats to local Biodiversity.
10. Study of fauna of an urban terrestrial ecosystem.
11. Identification and classification of major wildlife groups.
12. Estimation of Bird Diversity using point count method.
13. Study of food chains and trophic levels in different wildlife habitats.

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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	1	3	1	1	1	1	1	3	1	1
CO2	3	3	1	3	2	1	1	1	2	1	1	1	1
CO3	3	1	1	1	3	1	3	1	1	1	1	1	1
CO4	1	3	1	3	2	1	3	1	1	1	1	1	1
CO5	3	1	1	1	3	2	1	1	1	1	3	1	1
CO6	3	1	3	1	3	1	1	1	1	2	3	3	3
CO7	1	3	1	1	2	3	3	3	1	1	1	3	3

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding
CO1, CO2, CO3, CO5, CO6:
Understanding primary productivity, vegetation analysis methods, biodiversity indices, species interactions, food chains, and conservation status develops strong foundational and integrative knowledge of ecosystem structure and functioning.

PO2: Practical, Professional, and Procedural Knowledge
CO1, CO2, CO4, CO7:
Application of quadrat and transect methods, phytoplankton analysis, productivity estimation, and biodiversity surveys provides essential field and laboratory-based procedural skills in ecological studies.

PO3: Entrepreneurial Mindset and Knowledge
CO6:
Assessment of biodiversity threats and conservation strategies develops sustainability awareness and environmental decision-making abilities, though direct entrepreneurial skills are not the primary focus.

PO4: Specialized Skills and Competencies
CO2, CO4:
Vegetation sampling techniques, taxonomic identification, and quantitative ecological analysis build specialized disciplinary competencies in environmental science.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO1, CO3, CO5, CO6, CO7:
Calculation of diversity indices, interpretation of trophic structures, evaluation of biodiversity threats, and ecosystem productivity analysis enhance logical reasoning and applied ecological problem-solving skills.

PO6: Communication Skills and Collaboration
CO5, CO7:
Field surveys, bird diversity estimation, and ecological reporting require effective teamwork, scientific communication, and collaborative data interpretation.

PO7: Research-related Skills
CO3, CO4, CO7:
Quantitative biodiversity assessment, phytoplankton composition analysis, and independent ecological surveys foster research aptitude, data analysis skills, and scientific methodology.

PO8: Learning How to Learn Skills
CO7:
Independent field-based biodiversity assessment encourages self-directed learning, adaptability, and continuous scientific inquiry.

PO9: Digital and Technological Skills
CO2:
Use of ecological sampling tools, biodiversity data recording techniques, and analytical methods introduces students to technological applications in environmental studies.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy
CO6:
Understanding conservation of endangered and endemic species promotes empathy toward ecosystems and recognition of globally shared environmental responsibilities.

PO11: Value Inculcation and Environmental Awareness
CO1, CO5, CO6:
Studying ecosystem productivity, food chains, and biodiversity conservation instils environmental ethics and awareness regarding sustainable resource use.

PO12: Autonomy, Responsibility, and Accountability
CO6, CO7:
Biodiversity assessment and conservation studies develop responsible environmental decision-making and accountability in ecosystem management.

PO13: Community Engagement and Service
CO6, CO7:
Survey of local biodiversity, assessment of environmental threats, and wildlife monitoring encourage community participation and service-oriented environmental stewardship.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code : USENV
Class : T.Y.B.Sc.
Semester : V
Course Type : Major Mandatory (Practical)
Course Code : ENV-306-MJM
Course Name : **Practical's based on ENV-303-MRM and ENV-304- MRM**
No. of Credits : 2
No. of Teaching Hours : 60

Course Objectives:

1. To develop understanding of soil properties including temperature, texture, particle size, moisture content, and water holding capacity.
2. To provide knowledge and practical skills in identification and classification of minerals and rocks.
3. To train students in soil sampling techniques and environmental data collection methods.
4. To introduce GIS-based mapping for assessment of natural resources.
5. To develop awareness regarding biodiversity conservation including endangered, endemic, and native species.
6. To understand conservation practices including tree census, carbon stock estimation, wildlife protection, and medicinal plant conservation.
7. To provide field exposure through water conservation studies and visits to wildlife sanctuaries for experiential learning.·

Course Outcomes:

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

CO1. Analyze physical properties of soil including temperature, texture, particle size, moisture content, and water holding capacity.
CO2. Identify and classify major minerals and rocks based on physical characteristics.
CO3. Apply soil sampling techniques and conduct environmental field surveys.
CO4. Utilize GIS tools for mapping and assessment of natural resources.
CO5. Assess biodiversity status including endangered, endemic, and native species and evaluate threats to local ecosystems.
CO6. Evaluate conservation practices such as tree census, carbon stock estimation, wildlife protection, and medicinal plant conservation.
CO7. Demonstrate environmental awareness and practical understanding through water conservation studies and wildlife sanctuary visits.

Topics to be learned

Practical based on ENV-303-MRM to ENV-304- MRM

1. To study types of Soil Sample.
2. Study of Soil sampling techniques.
3. Study of soil properties – Temperature, texture and particle size
4. Estimation of the Moisture Content ,Water Holding Capacity & Field Capacity of soil
5. Identification and classification of minerals.
6. Identification and classification of rocks.
7. GIS- Based Mapping of Natural Resources in Selected Area
8. Study of tree census and Carbon Stock estimation.
9. Study of wildlife conservation practices and protected species.
10. Conservation of Medicinal Plants-Identification and ethno botanical uses of medicinal plants.
11. Study of Water Conservation Techniques- Study Rainwater harvesting structures survey.
12. Case study of Community Forest Management.
13. Study of sacred groves in Maharashtra.
14. Case Study of UNESCO National Heritage Site.

References:

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10. APHA (2017). *Standard Methods for the Examination of Water and Wastewater*, American Public Health Association.
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12. Jain, S.K. (1991). *Dictionary of Indian Folk Medicine and Ethnobotany*, Deep Publications

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	1	3	1	1	1	1	1	3	1	1
CO2	3	3	1	3	2	1	1	1	1	1	1	1	1
CO3	3	3	1	1	3	1	3	1	1	1	1	1	1
CO4	3	3	1	3	2	1	3	1	3	1	1	1	1
CO5	3	1	1	1	3	2	3	1	1	2	3	1	3
CO6	3	1	3	3	3	1	1	1	1	1	3	3	1
CO7	1	1	1	1	2	3	1	3	1	2	3	3	3

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding

CO1–CO6: provide integrated knowledge of soil science, mineral and rock classification, GIS-based resource mapping, biodiversity assessment, and conservation principles, building strong foundational understanding of environmental systems.

PO2: Practical, Professional, and Procedural Knowledge

CO1–CO4: emphasize hands-on laboratory and field-based skills including soil analysis, mineral identification, sampling techniques, and GIS applications essential for environmental studies.

PO3: Entrepreneurial Mindset and Knowledge

CO6: develops sustainability-oriented thinking through carbon stock estimation, conservation practices, and resource management awareness, though direct entrepreneurial training is limited.

PO4: Specialized Skills and Competencies

CO2, CO4, and CO6: develop specialized competencies in geological classification, GIS mapping, and conservation-based technical expertise.

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

CO1, CO3, CO5, and CO6: enhance analytical interpretation of soil properties, biodiversity threats, conservation challenges, and environmental decision-making.

PO6: Communication Skills and Collaboration

CO5 and CO7: involve biodiversity surveys, sanctuary visits, and conservation studies that require teamwork, reporting, and effective scientific communication.

PO7: Research-related Skills

CO3, CO4, and CO5: strengthen data collection, GIS-based analysis, biodiversity surveys, and research methodology development.

PO8: Learning How to Learn Skills

CO7: promotes experiential and self-directed learning through field exposure, conservation studies, and wildlife sanctuary visits.

PO9: Digital and Technological Skills

CO4: enhances technological competence through GIS-based mapping and spatial data analysis.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO5 and CO7: foster empathy toward ecosystems, indigenous knowledge systems, and community-based conservation practices.

PO11: Value Inculcation and Environmental Awareness

CO1, CO5, CO6, and CO7: strongly instil environmental ethics, conservation values, and sustainable resource management awareness.

PO12: Autonomy, Responsibility, and Accountability

CO6 and CO7: encourage responsible environmental decision-making, conservation accountability, and sustainable practices.

PO13: Community Engagement and Service

CO5 and CO7: promote participation in biodiversity surveys, conservation activities, water management studies, and community-oriented environmental service.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code : USENV
Class : T.Y.B.Sc.
Semester : V
Course Type : Major Elective (Theory)
Course Code : **ENV-307-MJE (A)**
Course Name : **Environmental Governance, Laws and Ethics**
No. of Credits : 2
No. of Teaching Hours : 30

Learning Objectives:

1) To learn environmental governance, Laws and ethics.
2) To learn international conferences and summit for the protection and conservation of environment.
3) To learn Environmental ethics.
4) To understand concepts that are central to environmental governance, including participation, common property resources and decentralization.
5) To develop a single economic market through a standardized system of laws that applies in all member state.
6) Promoting sustainable development and safeguarding ecosystem for present and future generations.
7) Studies the moral relationship between humans and the natural environment

Learning Objectives:

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

CO1. Students understood the Acts and laws related to Environment protection..
CO2. Students aware about the fundamental duties and rights and also environmental ethics.
CO3. Students will comprehend the principles and structures of environmental governance at local, national, and international levels.
CO4. Students will demonstrate knowledge of key environmental laws, regulations, and policies, including their historical development and current status.
CO5. Students will develop research and writing skills specific to environmental law, including the ability to interpret and analyze legal documents.
CO6. Students will understand mechanisms for compliance monitoring and enforcement of environmental laws, exploring the role of regulatory agencies and legal instruments.
CO7. Students will analyze ethical considerations and dilemmas in environmental decision making, exploring the ethical implications of various policy choices.

Topics and Learning Points

Teaching Hours

Unit-1 Environmental Governance and International Conference (10L)

- Introduction, Need and necessity, Elements of environmental governance.
  Environmental governance in India since 1972.Environmental protection and Fundamental Rights. +
- Environmental International Conference: Stockholm conference, The Earth Summit 1992 –
  The Rio declaration on environment and development, The Earth Summit agreements.
  India's International Obligations, Public interest litigation.

Unit-2 Environmental Acts and Compliance System (14L)

- The Water (Prevention and Control of Pollution) Act 1974.
- The Air (Prevention and Control of Pollution) Act 1981.
- The Environment (Protection) Act, 1986.
- Extended Producer Responsibility (EPR), Environmental Clearance (EC) and EIA Process.
- ESG Framework and Corporate Environmental Governance.
- Recent Amendments in Waste Management Rules.
- Scheme of labelling of environmentally friendly products (Ecomark) .

Unit-3 Environmental Ethics and Ethical Challenges (06L)

- Concept and development of environmental ethics, major approaches (anthropocentric, biocentric, ecocentric);human- environment relationship and sustainability.
- Ethical dilemmas related to population and technology, Value choices and global environmental challenges.

References:

1) Computerized environmental modelling – J. Hardstay, DM Tailor & SE Metcalf
2) Computerized aided environmental management – SA Abbassi and FI Khan.
3) Environmental Governance: The Global Challege; By Lamont C. Hempel; Island Press (1996)
4) Environmental Issues in India – A Reader; By Mahesh Rangarajan;
5) Handbook of Environmental Law, Acts, Guidelines, Compliances, and Standards: Vol. I and II; by R.K. Trivedy; BS pub (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 Report 2002.

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 & CO4: Understanding environmental laws and regulations gives students comprehensive knowledge of how environmental protection is structured legally, both historically and in the present. This aligns with PO1, as students gain a broad understanding of environmental legal frameworks and their evolution.

CO3: Comprehending the principles and structures of environmental governance at local, national, and international levels expands students' understanding of governance systems, offering a well-rounded perspective on environmental law.

PO2: Practical, Professional, and Procedural Knowledge

CO6: Understanding mechanisms for compliance monitoring and enforcement of environmental laws provide students with professional knowledge of the procedures and roles of regulatory agencies. This outcome equips students with the practical skills to apply the legal frameworks in real-world contexts.

CO5: Developing research and writing skills specific to environmental law enhances students' profession competencies, preparing them to interpret, analyze, and apply legal documents and regulations in professional settings.

PO3: Entrepreneurial Mindset and Knowledge

CO3 & CO4: Comprehending the principles of environmental governance and key environmental laws can foster an entrepreneurial mindset. Students may recognize opportunities to innovate within the legal and regulatory frameworks for environmental protection, whether through advocacy, consultancy, or new policy development.

CO6: Understanding compliance mechanisms can also inspire entrepreneurial approaches to creating services or technologies that aid in monitoring and enforcing environmental laws.

PO4: Specialized Skills and Competencies

CO1 & CO4: The knowledge of environmental laws and regulations gives students specialized competencies that are essential for navigating the legal complexities of environmental protection, helping them become skilled professionals in the field.

CO5: Developing research and writing skills related to environmental law adds to students' specialized capabilities in legal analysis, interpretation, and documentation, which are crucial for work in legal practice or policy development.

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

CO7: Analyzing ethical considerations in environmental decision-making encourages students to apply critical thinking and problem-solving abilities to ethical dilemmas within environmental law and policy, fostering analytical reasoning.

CO5: The ability to interpret and analyze legal documents in environmental law builds the capacity for applying knowledge in complex situations and solving legal problems related to environmental issues.

PO6: Communication Skills and Collaboration

CO5: The development of research and writing skills specific to environmental law enhances students' ability to communicate complex legal ideas clearly and effectively, whether through written documents or presentations.

CO7: Analyzing ethical considerations and dilemmas in environmental decision-making encourages students to collaborate with others, including stakeholders, policymakers, and communities, to address environmental issues effectively.

PO7: Research-related Skills

CO5: Developing research and writing skills specific to environmental law directly enhances students' research capabilities, teaching them to analyze legal texts, apply appropriate methodologies, and produce high-quality legal research.

CO6: Understanding compliance monitoring and enforcement mechanisms requires students to engage in research to track the effectiveness of legal instruments, identify gaps, and propose improvements in enforcement strategies.

PO8: Learning How to Learn Skills

CO3: Comprehending the principles and structures of environmental governance at local, national, and international levels encourages students to learn independently about evolving governance structures and the impact of international treaties and national laws.

CO7: Analyzing ethical dilemmas requires continuous learning, as ethical considerations in environmental law evolve with new policies, case law, and social expectations.

PO9: Digital and Technological Skills

CO6: Understanding mechanisms for compliance monitoring often involves the use of technology (e.g., digital databases, environmental monitoring tools, and legal compliance software), equipping students with technological skills to track, manage, and enforce environmental laws.

CO5: Developing research and writing skills related to environmental law may involve using digital tools for legal research, data collection, and document management, thus enhancing students' digital competencies.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO1: Awareness of environmental laws and protection efforts encourages students to recognize the importance of preserving the environment for future generations, promoting an inclusive and empathetic approach to global environmental concerns.

CO7: Analyzing ethical considerations in environmental decision-making helps students understand diverse cultural perspectives and the need for inclusive solutions to environmental issues that respect both human rights and ecological well-being.

PO11: Value Inculcation and Environmental Awareness

CO2: Understanding fundamental duties and rights, along with environmental ethics, directly cultivates students' values related to environmental protection, sustainability, and social responsibility.

CO7: Analyzing ethical dilemmas in environmental law and policy promotes value inculcation by encouraging students to consider the broader environmental and societal impacts of legal decisions, fostering awareness of ecological and ethical responsibility.

PO12: Autonomy, Responsibility, and Accountability

CO6: Understanding compliance monitoring and enforcement mechanisms in environmental law fosters autonomy and responsibility, as students are prepared to make independent decisions in their professional lives, ensuring accountability in environmental governance.

CO7: Analyzing ethical considerations in environmental decision-making requires students to take responsibility for their ethical stance and decisions, aligning with the need for accountability in addressing complex environmental challenges.

PO13: Community Engagement and Service

CO3 & CO4: Comprehending environmental governance at various levels and understanding key environmental laws encourage students to engage with communities and participate in policy advocacy, thus contributing to public awareness and service.

CO5: Researching and writing about environmental law can encourage students to communicate complex legal topics to diverse audiences, fostering community engagement on environmental issues and policies.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code : USENV
Class : T.Y.B.Sc.
Semester : V
Course Type : Major Elective (Theory)
Course Code : **ENV-307-MJE (B)**
Course Name : **Remote sensing, GIS and modelling**
No. of Credits : 2
No. of Teaching Hours : 30

Course Objectives:

1. Provide foundational knowledge of remote sensing principles, electromagnetic spectrum, and sensor technologies.
2. Explain the interaction between electromagnetic radiation and the Earth's surface and atmosphere.
3. Develop skills in aerial photography and interpretation for analysing terrain and surface features.
4. Introduce Geographic Information Systems (GIS), including data types, database management, and GIS software.
5. Demonstrate the use of GPS technology for data acquisition and spatial mapping.
6. Highlight real-world applications of remote sensing and GIS in geosciences, environmental management, and planning.
7. Equip students with basic statistical tools and techniques for analysing and modeling geospatial data

Course Outcomes:

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

CO1. Define and explain the fundamental concepts of remote sensing and satellite-based observation platforms.
CO2**.** Analyze how electromagnetic energy interacts with Earth materials and atmospheric constituents.
CO3. Apply techniques of aerial photo interpretation to assess landforms and structures.
CO4. Utilize GIS tools to manage, analyze, and visualize spatial and non-spatial data.
CO5. Conduct basic GPS surveys and integrate GPS data into GIS platforms for mapping and analysis.
CO6. Evaluate the use of remote sensing and GIS in solving real-world problems in land use, agriculture, forestry, and water resource management.
CO7. Apply statistical methods such as hypothesis testing, correlation, regression, and analysis of variance to interpret geospatial data.

Topics and Learning Points

Teaching Hours

Unit I: Fundamentals of Remote Sensing (10 L)

- Definitions and principles of Remote Sensing
- Electromagnetic (EM) spectrum
- Interaction of EMR with Earth's surface
- Spectral signature and sensors
- Types of platforms: Geostationary and Sun-synchronous Polar Orbits
- Multi-spectral scanning
- Interaction of EMR with atmosphere
- Energy response mechanisms: Reflection, Absorption, Transmission, Scattering, Refraction, Emission
- Atmospheric windows

Unit II: Aerial Photography & Geographic Information Systems (GIS) (12 L)

- Aerial Photography and Air Photo Interpretation
  - o Geometric characteristics
  - o Scale, resolution, overlaps, and flight planning
  - o Measurement of height, tone, and mapping units
  - o Photo interpretation techniques
- Geographic Information Systems
  - o Definitions and components
  - o Raster vs. vector data
  - o Spatial and non-spatial data
  - o GIS software overview
  - o GPS: Surveying, data import, processing

Unit III: Applications & Statistical Analysis (8 L)

- Applications and Case Studies in:
  - o Geosciences o Water Resource Management
  - o Land Use Planning
  - o Forestry, Agriculture, Marine & Atmospheric Studies
- Basic Statistical Elements:
  - o Sampling & distributions (normal, binomial, Poisson).
  - o Measures of central tendency, dispersion, skewness, kurtosis.
  - o Hypothesis testing (parametric & non-parametric).
  - o Correlation, regression, curve fitting, ANOVA, ordination.

References:

1. Lillis and, T.M. and Keifer, R.W. (1990): Remote Sensing and Image interpretation, John Willey and Sons, New York.
2. JosephG.(2003):FundamentalsofRemoteSensing,UniversitiesPress,Hyderabad.
3. Haywood, Ian (2000): Geographical Information Systems, Longman .
4. Chang, Kang tang (2002): Introduction to Geographic Information Systems, Tata McGraw Hill.
5. Burroughs, P.A (1986): Principles of Geographical Information Systems for land Resource Assessment, Oxford University Press.
6. Edmondson,A.&Druce,D.1996.AdvancedBiologyStatistics.Oxford University Press.
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8. Richards,J.A.&Jia,X.1999.RemoteSensingandDigitalImageProcessing. Springer.
9. Sabins,F.F.1996.RemoteSensing:PrinciplesanInterpretation.W.H. Freeman.

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	1	3	1	1	1	1	1	1	1	1	2	1	1
CO2	1	3	1	1	1	1	1	1	1	2	1	1	1
CO3	1	1	1	1	1	1	1	3	1	1	2	1	1
CO4	1	1	3	1	2	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	3	1	1	1	1	1	1	2
CO6	1	1	1	3	1	1	1	1	2	1	1	1	1
CO7	3	1	1	1	1	1	2	1	1	1	1	1	1

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding

CO1 & CO2: Defining and explaining fundamental concepts of remote sensing and understanding the interaction of electromagnetic energy with Earth materials provides students with foundational knowledge essential to understanding geospatial data and its role in analysing Earth's processes. These outcomes build a comprehensive knowledge of remote sensing technology, which is fundamental to geospatial sciences and environmental analysis.

CO6: Evaluating the use of remote sensing and GIS in solving real-world problems deepens students' understanding of how these technologies are applied across various fields such as agriculture, forestry, and water resource management, contributing to their broader comprehension of Earth sciences.

PO2: Practical, Professional, and Procedural Knowledge

CO3 & CO4: Applying aerial photo interpretation techniques to assess landforms and structures, and utilizing GIS tools to manage, analyze, and visualize spatial and non-spatial data, helps students develop practical skills in remote sensing and GIS, which are highly relevant in professional environmental management, land use planning, and spatial analysis.

CO5: Conducting basic GPS surveys and integrating the data into GIS platforms provide students with practical, hands-on skills in geospatial data collection and analysis, directly applicable in real-world scenarios like land surveying, environmental monitoring, and resource management.

PO3: Entrepreneurial Mindset and Knowledge

CO6: Evaluating the application of remote sensing and GIS in solving real-world problems encourages students to think about how these technologies can be used to create business solutions in areas like land use planning, agriculture, or forestry. This develops an entrepreneurial mindset by encouraging students to identify marketable opportunities in these fields.

CO4 & CO7: The use of GIS tools and statistical methods for geospatial data analysis encourages innovative thinking, where students can create entrepreneurial solutions to spatial and environmental problems, especially in industries requiring land management or resource optimization.

PO4: Specialized Skills and Competencies

CO1, CO3, & CO4: Defining fundamental concepts of remote sensing, applying aerial photo interpretation, and utilizing GIS tools to manage and analyze data directly contributes to specialized skills and competencies in spatial analysis, remote sensing, and geospatial technologies.

CO5 & CO7: Conducting GPS surveys and applying statistical methods to interpret geospatial data equip students with specialized technical competencies that are critical in fields such as geospatial technology, environmental science, and land use planning.

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

CO6: Applying remote sensing and GIS to solve real-world problems, such as land use, agriculture, or forestry, requires students to apply analytical reasoning and problem-solving skills to address practical challenges in resource management and environmental conservation.

CO7: The application of statistical methods such as hypothesis testing, correlation, regression, and analysis of variance to interpret geospatial data demonstrates students' capacity to engage in problem-solving and data-driven analysis, a vital skill for making informed decisions in environmental and resource management.

PO6: Communication Skills and Collaboration

CO4 & CO6: Utilizing GIS tools to manage and visualize spatial data and evaluating remote sensing technologies to solve practical problems require effective communication skills. Students must interpret and present their findings clearly and work collaboratively with peers or professionals in interdisciplinary settings.

CO5 & CO7: When applying GPS data to GIS platforms or analysing geospatial data using statistical methods, students will need to collaborate, present, and communicate technical information effectively, especially when working with diverse teams in the field or during project presentations.

PO7: Research-related Skills

CO6 & CO7: The ability to evaluate the use of remote sensing and GIS in solving real-world problems, as well as applying statistical methods to interpret geospatial data, enhances students' research-related skills. They will be engaged in the research process of data collection, analysis, and interpretation, which are foundational to academic and applied research in environmental and geospatial sciences.

PO8: Learning How to Learn Skills

CO1 & CO4: By understanding fundamental concepts of remote sensing and learning how to use GIS tools for spatial data analysis, students are encouraged to develop the ability to learn independently. The practical skills involved in using these technologies require a continuous learning approach, keeping students updated with technological advancements.

CO5 & CO7: Applying statistical methods and conducting GPS surveys requires students to refine their learning strategies for data interpretation and geospatial technologies, developing adaptability and lifelong learning skills.

PO9: Digital and Technological Skills

CO1, CO4 & CO5: The use of remote sensing technologies, GIS tools, and GPS systems builds students' digital and technological skills, as they must become proficient in specialized software and hardware to analyze spatial data and conduct field surveys.

CO7: The application of statistical methods to analyze geospatial data further reinforces students' technical abilities in handling complex data sets and using digital tools for scientific inquiry.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy

CO6: Evaluating how remote sensing and GIS can solve real-world problems related to land use, agriculture, and resource management encourages students to consider diverse global and local contexts. This aligns with promoting multicultural competence by understanding the varying environmental and developmental needs across different regions and cultures.

CO7: Statistical analysis of geospatial data helps students appreciate the diverse socioeconomic and environmental factors that may affect resource management and land use in different cultures, fostering empathy and a more inclusive understanding of environmental issues**.**

PO11: Value Inculcation and Environmental Awareness

CO6: By evaluating the use of remote sensing and GIS to address environmental problems, students gain greater environmental awareness, learning how technology can support sustainable land use, agriculture, and water resource management. This promotes values such as sustainability and ecological responsibility.

CO5 & CO7: Conducting GPS surveys and analysing geospatial data can help students gain insights into the environmental implications of human activities. This fosters an awareness of the need for responsible and ethical decision-making in land management and resource conservation.

PO12: Autonomy, Responsibility, and Accountability

CO5 & CO7: Conducting GPS surveys and applying statistical methods to interpret data require students to take responsibility for their work, ensuring the accuracy and reliability of the data they collect. They must be accountable for the proper use of technology and adherence to scientific methodologies.

CO6: Evaluating and applying remote sensing and GIS solutions in real-world contexts requires students to take initiative in solving environmental problems and managing geospatial data responsibly.

PO13: Community Engagement and Service

CO6: Evaluating the use of remote sensing and GIS for land use, agriculture, and water resource management encourages students to consider the benefits of these technologies for community development. They are empowered to engage in projects that improve resource management practices, contributing positively to local and global communities.

CO4 & CO7: The ability to interpret and analyze geospatial data and to apply statistical techniques can be used in community-based environmental monitoring projects, where students can engage with stakeholders to inform decision-making and advocate for better resource management strategies.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code : USENV
Class : T.Y. B.Sc.
Semester : V
Course Type : Major Elective (Practical)
Course Code : **ENV-308-MJE (A)**
Course Name : **Applied Practical's on Environmental Policy and Regulatory Mechanism**
No. of Credits : 2
No. of Teaching Hours : 60

Course Objectives:

1. To study the salient features of the Environmental Protection Act, 1986 (EPA-1986).
2. To examine the roles, functions and penalties under the Air (Prevention and Control of Pollution) Act, 1981.
3. To understand the role and administrative structure of the Ministry of Environment, Forest and Climate Change (MoEFCC).
4. To understand the jurisdiction, importance and functioning of the National Green Tribunal (NGT).
5. To perform a comparative analysis of the merits and demerits of the EIA Notification 2006 and EIA Notification 2020.
6. To analyze the role of UNFCCC in international climate change mitigation efforts.
7. To study the legal framework and practical application of Environmental Impact Assessment (EIA) in India.

Course Outcomes:

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

CO1. Explain the salient provisions and significance of the Environmental Protection Act, 1986.
CO2. Describe the roles, responsibilities, and penalty mechanisms under the Air Act, 1981.
CO3. Illustrate the structure and functions of MoEFCC and the National Green Tribunal in environmental governance.
CO4. Critically compare EIA Notification 2006 and EIA Notification 2020 and evaluate their implications.
CO5. Analyze the role of UNFCCC in global climate governance and India's commitments.
CO6. Conduct baseline data collection and apply tools such as the checklist method and Leopold Matrix in EIA studies.
CO7. Prepare draft and comprehensive EIA reports for projects such as mining, highways, dams, sugar factories, and solid waste management sites.

Topics and Learning Points

1. Study the salient features of EPA-1986.
2. To examine the roles, functions and penalties in Air pollution act, 1981.
3. Study the role and administrative structure of Ministry of Environment, Forest and Climate change (MoEFCC).
4. To understand jurisdiction, importance and functioning of National Green Tribunal.
5. Comparative Analysis of Eco-friendly vs Conventional Products.
6. Identification of Ecomark- labelled products in Market.
7. To study the legal framework governing Environmental Impact Assessment (EIA) in India.
8. To conduct baseline data collection for a sugar factory using the checklist method.
9. To execute the baseline data collection procedure for a proposed Dam project.
10. To prepare waste audit format.
11. Preparation of EPR Compliance Flow-Chart.
12. Case Study on plastic waste management in urban area.
13. Study of emission standards for industries.

References:

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2. Introduction to Environmental Law – Singh, Avtar, LexisNexis, 2018.
3. Environmental Law and Policy in India – Divan, S., & Rosencrantz, A., Oxford University Press, 2020.
4. Ministry of Environment, Forest and Climate Change – Government of India, Official Acts, Rules & Notifications Portal.
5. National Green Tribunal – Jurisdiction, Orders & Case Documentation, Government of India.
6. United Nations Framework Convention on Climate Change – Climate Agreements, COP Decisions & Mitigation Frameworks.
7. Central Pollution Control Board – EIA Guidelines, Baseline Monitoring & Industrial Checklists.
8. Environmental Impact Assessment: A Guide to Best Professional Practices – Eccleston, C. H., CRC Press, 2011.
9. Introduction to Environmental Impact Assessment – Glasson, J., Therivel, R., & Chadwick, A., Routledge, 2013.
10. World Bank – Environmental & Social Impact Assessment Sourcebook.

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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	1	1	1	2	1	1	1	1	1	3	1	1
CO2	3	2	1	1	2	1	1	1	1	1	3	2	1
CO3	3	2	1	1	2	2	1	1	1	1	3	2	1
CO4	3	1	1	2	3	2	1	2	1	1	3	2	1
CO5	3	1	1	2	3	2	2	2	1	2	3	2	2
CO6	2	3	1	3	3	2	2	2	3	1	3	2	2
CO7	2	3	2	3	3	3	3	2	3	1	3	3	2

Justification for the Mapping

PO1: Comprehensive Knowledge and Understanding
CO1, CO2 & CO3: Understanding the provisions of the Environmental Protection Act (1986), Air Act (1981), and the structure of MoEFCC and NGT provides students with a broad and integrated understanding of environmental governance and regulatory systems in India. This strengthens their comprehensive knowledge of environmental legislation and policy frameworks.

PO2: Practical, Professional, and Procedural Knowledge
CO6 & CO7: Conducting baseline data collection, applying EIA tools such as checklist and Leopold Matrix methods, and preparing EIA reports require professional competence and procedural understanding. These outcomes develop practical skills necessary for environmental consultancy and regulatory compliance.

PO3: Entrepreneurial Mindset and Knowledge
CO7: Preparation of EIA reports for projects such as mining, highways, dams, and solid waste management encourages students to understand environmental consultancy practices, fostering entrepreneurial thinking in environmental services and sustainable project planning.

PO4: Specialized Skills and Competencies
CO4 & CO6: Comparative analysis of EIA Notifications (2006 and 2020) and application of technical EIA tools develop specialized competencies in environmental impact assessment and environmental law interpretation.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO4, CO5 & CO6: Critical comparison of EIA notifications, analysis of the role of UNFCCC in climate mitigation, and application of impact assessment tools require analytical reasoning and problem-solving abilities in addressing environmental challenges at national and international levels.

PO6: Communication Skills and Collaboration
CO3 & CO7: Understanding environmental governance structures and preparing detailed EIA reports require effective written communication, presentation skills, and collaboration while addressing stakeholders and regulatory authorities.

PO7: Research-related Skills
CO5 & CO6: Analysis of international climate frameworks such as UNFCCC and conducting baseline environmental data collection promote research orientation, data interpretation, and evidence-based environmental decision-making.

PO8: Learning How to Learn Skills
CO4 & CO5: Comparative evaluation of policy frameworks and understanding global climate agreements encourage continuous learning and adaptation to evolving environmental regulations and international developments.

PO9: Digital and Technological Skills
CO6 & CO7: Application of EIA methodologies, data analysis, environmental monitoring, and preparation of reports involve the use of digital tools, software, and technological platforms for impact prediction and documentation.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy
CO5 & CO7: Understanding global climate governance and assessing environmental impacts on local communities in EIA studies promote inclusive thinking, cultural sensitivity, and empathy towards affected populations.

PO11: Value Inculcation and Environmental Awareness
CO1, CO2 & CO4: Study of environmental laws and impact assessment frameworks builds strong environmental ethics, sustainability values, and awareness of ecological protection responsibilities.

PO12: Autonomy, Responsibility, and Accountability
CO2 & CO7: Understanding legal penalties under environmental laws and preparing EIA reports cultivate responsibility, accountability, and ethical decision-making in environmental management.

PO13: Community Engagement and Service
CO7: Preparation of EIA reports for infrastructure and development projects involves assessing impacts on communities and recommending mitigation measures, reflecting students' engagement with societal and environmental needs.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code : USENV
Class : T.Y. B.Sc.
Semester : V
Course Type : Major Elective (Practical)
Course Code : **ENV-308-MJE (B)**
Course Name : **Practical Based on Basic in Remote Sensing and GIS**
No. of Credits : 2
No. of Teaching Hours : 60

Course Objectives:

1. To understand the components of remote sensing systems and different satellite platforms.
2. To perform visual image interpretation using elements such as tone, texture, size, shape, and pattern.
3. To analyze spectral reflectance characteristics of vegetation, soil, and water across the electromagnetic spectrum.
4. To identify and map features using true colour and false colour composite band combinations.
5. To perform georeferencing of toposheets and satellite images for assigning real-world coordinates.
6. To apply raster processing, image enhancement, and classification techniques (supervised and unsupervised).
7. To develop practical skills in QGIS software for vector mapping, satellite data analysis, and aerial photo interpretation.

Course Outcomes:

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

CO1. Explain the components and platforms of remote sensing systems.
CO2. Interpret satellite imagery using visual interpretation techniques.
CO3. Analyze spectral signatures of natural features across different wavelengths.
CO4. Identify and map land features using appropriate band combinations.
CO5. Perform georeferencing of toposheets and satellite images accurately.
CO6. Apply image enhancement, raster processing, and classification methods for land use analysis.
CO7. Create vector maps and perform spatial analysis using QGIS software.

Topics and Learning Points

Practicals in ENV-308(B)-

1. To study the components of remote sensing system and different types of platforms
2. To perform visual image interpretation of satellite imagery using element like tone texture size shape and pattern
3. To analyze the spectral reflectance characteristics of vegetation, water and soil across different wavelengths of EMS
4. To identify and map specific feature using different band combination true color or false color combination (Spectral Signature)
5. To identify and map specific feature using different band combination true color or false color combination (Spectral Signature)
6. To perform Georeferencing of Topo sheet to assign real world coordinates.
7. To familiarize students with various satellite data portals like LANDSAT,BHUVAN
8. Installation and familiarization with QGIS free and open-source software
9. To perform Georeferencing of Satellite image to assign real world coordinates
10. Satellite image enhancement and correction using raster processing tools
11. Satellite Image classification using Supervised and unsupervised Classification method
12. To calculate the scale, height and relief displacement of Aerial photographs
13. To identify different land features from a satellite image and create a basic vector map using QGIS software

References:

1. Remote Sensing and Image Interpretation – Lilles and, T. M. , Kiefer, R. W., & Chipman, J. W., Wiley, 2015.
2. Introductory Digital Image Processing: A Remote Sensing Perspective – Jensen, J. R., Pearson Education, 2016.
3. Introduction to Remote Sensing – Campbell, J. B., & Wynne, R. H., Guilford Press, 2011.
4. Remote Sensing: Principles and Interpretation – Sabins, F. F., Waveland Press, 2007.
5. Principles of Geographical Information Systems – Burrough, P. A., & McDonnell, R. A., Oxford University Press, 1998.
6. Concepts and Techniques of Geographic Information Systems – Lo, C. P., & Yeung, A. K. W., Prentice Hall, 2007.
7. QGIS Documentation – QGIS Development Team, User Manual & Training Material.
8. USGS Earth Explorer – United States Geological Survey, Satellite Data Download Portal.
9. Bhuvan – National Remote Sensing Centre, Indian Space Research Organisation.
10. Copernicus Open Access Hub – European Space Agency Satellite Data Portal.

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	1	1	1	1	1	1	1	1	1	2	1	1
CO2	2	2	1	2	3	1	1	1	1	1	2	1	1
CO3	3	1	1	2	3	1	1	2	1	1	2	1	1
CO4	2	3	1	3	3	1	1	1	2	1	2	1	1
CO5	2	3	1	3	3	1	2	1	3	1	2	2	1
CO6	2	3	1	3	3	2	2	1	3	1	2	2	1
CO7	2	3	2	3	3	3	3	2	3	1	2	3	2

Justification for the Mapping

PO1: Comprehensive Knowledge and Understanding
CO1 & CO3: Understanding remote sensing components and spectral reflectance builds strong foundational and theoretical knowledge in geospatial science.

PO2: Practical, Professional, and Procedural Knowledge
CO4, CO5, CO6 & CO7: Mapping features, georeferencing, classification, and spatial analysis in QGIS develop strong procedural and professional competencies in GIS applications.

PO3: Entrepreneurial Mindset and Knowledge
CO4 & CO7: Feature mapping and spatial analysis skills can be applied in consultancy, land planning, and environmental monitoring, encouraging entrepreneurial thinking in geospatial services.

PO4: Specialized Skills and Competencies
CO4, CO5 & CO6: Application of band combinations, raster processing, georeferencing, and classification techniques enhances specialized technical skills in remote sensing and GIS.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO2, CO3, CO4 & CO6: Interpretation of imagery, analysis of spectral signatures, and classification techniques require analytical reasoning and problem-solving in spatial data interpretation.

PO6: Communication Skills and Collaboration
CO7: Preparation of vector maps and spatial outputs requires presentation skills and collaborative interpretation of spatial information.

PO7: Research-related Skills
CO3, CO5 & CO6: Spectral analysis, georeferencing, and classification techniques involve data collection, interpretation, and research-based spatial analysis.

PO8: Learning How to Learn Skills
CO3 & CO7: Continuous updates in satellite technology and GIS tools encourage self-learning and adaptation to emerging geospatial technologies.

PO9: Digital and Technological Skills
CO5, CO6 & CO7: Use of QGIS software, raster tools, georeferencing, and classification techniques directly enhance digital and technological competencies.

PO10: Multicultural Competence, Inclusive Spirit, and Empathy
CO7: Spatial mapping of land features supports inclusive planning and sustainable land-use decisions considering societal and regional diversity.

PO11: Value Inculcation and Environmental Awareness
CO2 & CO4: Interpretation and mapping of land features promote awareness of environmental resources and sustainable management.

PO12: Autonomy, Responsibility, and Accountability
CO5 & CO7: Accurate georeferencing and spatial data handling develop responsibility and accountability in geospatial decision-making.

PO13: Community Engagement and Service
CO7: Spatial mapping supports community-level planning, disaster management, and resource assessment contributing to societal welfare.

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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code :USENV
Class : T.Y. B.Sc.
Semester : V
Course Type : **On Job Training (Practical)**
Course Code : ENV-309-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-V)

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

Programme Outcomes (POs)													
Course Outcomes	**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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CBCS Syllabus as per NEP 2020 for T.Y. B.Sc. (2024 Pattern)

Name of the Programme : B.Sc. Environmental Science
Program Code : USENV
Class : T.Y. B.Sc.
Semester : V
Course Type : **Minor (Theory)**
Course Code : ENV-310-MN
Course Name : **Water and Soil Quality**
No. of Credits : 2
No. of Teaching Hours : 30

Course Objectives:

1. To introduce students to techniques for sampling polluted soil and water.
2. To impart practical knowledge of physicochemical parameters such as pH, DO, BOD, and COD in environmental samples.
3. To train students in microbiological analysis for pollution monitoring, including MPN testing.
4. To provide hands-on experience in air pollution monitoring, including SPM, SOx, and NOx.
5. To educate students about pollution control equipment and their functioning.
6. To explore the principles and applications of phytoremediation and bioremediation using microorganisms and macrophytes.
7. To familiarize students with environmental standards, pollution control labs, and safety procedures in environmental monitoring

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Course Outcomes:

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

CO1. Collect and analyze soil and water samples from polluted environments
CO2:Measure and interpret key water quality parameters such as pH, DO, COD, BOD, nitrates, and phosphates.
CO3. Operate and understand the use of high-volume air samplers and other pollution monitoring instruments.
CO4. Assess bacteriological quality of drinking water through MPN and pathogen detection techniques.
CO5. Operate and handle microscopes and perform simple staining techniques.
CO6. Understand preparation of culture media, sterilization and aseptic techniques.
CO7. Demonstrate the use of biological indicators like macrophytes and microbes for pollution monitoring.

Topics and Learning Points

Teaching Hours

Unit 1 Introduction to water pollution (10L)

- Uses, Water resources sources, distribution of Water resources on Earth, Water cycle.
- Characteristics of Water–Physical, Chemical and Biological.
- Water Inventory.
- Sewage water –its characteristic and effects.
- Water Pollution definition, types of water pollution based on Point and Non- point sources.
- Types of Water Pollution-Lake water pollution, River water pollution, Groundwater pollution, Sea water pollution with Case studies. Water Borne diseases.

Unit 2 Introduction to soil pollution (10L)

- Introduction to soil and its importance in ecosystem and Agriculture Composition of soil
- Soil types and their formation
- Soil Horizons, Texture, Soil structure, fertility
- Factors influencing soil–Soil aeration, Soil temperature etc
- Soil Analysis –pH, Lime ,Silica ,phosphorous , Total nitrogen, Total Sulphur, Manganese, Soluble salts, Pesticides and Environmentally friendly technologies

Unit 3 Water and Soil Pollution Management (10L)

- Water Quality Standards for drinking water, different uses and by different agencies
- Water treatment Process for Drinking Water-Primary, Secondary &Tertiary treatment, nutrient removal
- Role of National and International agencies in Water health and Sanitation
- Soil sickness & Soil Toxicology
- Remediation of Contaminated site
- Soil Conservation techniques.

References:

1. Principles of Environmental Science-Cunningham &Cunningham
2. Ecology,EnvironmentandResourceConservation(2006):SinghJS,SinghSP, GuptaSR,AnamayaPubl,New Delhi
3. Fundamentals of Ecology(1971):EPOdum,WB Saunders Company
4. RSRamalho,1983IntroductiontoWastewaterTreatmentProcess,Academicpress,NewYork
5. Quanag,EAR,PrinciplesofWastewasterTreatmentVolI,Biologicalprocess,NationalScienceDevelopment Board ,Manila, Philippines
6. Water pollution by Dr. Anuradha Salpekar
7. Environmental pollution Analysis by S. M. Khopkar
8. Textbook of Practical Chemistry by Vogel, A. I Tatchell and Furnis
9. Dean,J.R.,Jones,A.M.,Holmes,D.,Reed,R.,Weyers,J.,&Jones,A.,(2011),Practical skills in Chemistry, 2nd Ed., Prentice Hall, Harlow 10.Hydrology–Principles,analysisandDesign– H.M Ragunath, New age International Publications. (1996)
11. Standard Methods for the examination of water and waste water – APHA(American Public Health Association),AWWA(American Water Works Association),WEF(Water Environmental Federation)
12. LowcostwastewatertreatmenttechnologiesR.K.TrivedyandSiddharthKaul

13. Pollution and Bioremediation-P.C.Trivedi
14. An Introduction to Environmental Pollution-B.K. Sharmaand.

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	1	3	1	1	1	1	1	1	1	1	2	1	1
CO2	1	3	1	1	1	1	1	1	1	2	1	1	1
CO3	1	1	1	1	1	1	1	3	1	1	2	1	1
CO4	1	1	3	1	2	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	3	1	1	1	1	1	1	2
CO6	1	1	1	3	1	1	1	1	2	1	1	1	1
CO7	3	1	1	1	1	1	2	1	1	1	1	1	1

Justification for the mapping

PO1: Comprehensive Knowledge and Understanding

CO1: Identify various sources and types of water and soil pollution and explain their environmental consequences.
CO2: Analyze the physical, chemical, and biological characteristics of water and their relevance to water quality.
CO5: Describe the properties, types, and horizons of soil and their role in agricultural productivity and ecosystem balance.

PO2: Practical, Professional, and Procedural Knowledge
CO3: Recognize water-borne diseases and explain the significance of case studies in pollution monitoring.
CO4: Interpret water quality standards and describe different water treatment processes for pollution control.
CO6: Assess soil analysis methods for determining pollution levels and suggest suitable remediation techniques.

PO3: Entrepreneurial Mindset and Knowledge
CO7: Apply knowledge of soil and water conservation strategies and recommend sustainable environmental management practices.

PO4: Specialized Skills and Competencies
CO7: Apply knowledge of soil and water conservation strategies and recommend sustainable environmental management practices.

PO5: Capacity for Application, Problem-Solving, and Analytical Reasoning
CO2: Analyze the physical, chemical, and biological characteristics of water and their relevance to water quality.

CO6: Assess soil analysis methods for determining pollution levels and suggest suitable remediation techniques.

PO6: Communication Skills and Collaboration
CO3: Recognize water-borne diseases and explain the significance of case studies in pollution monitoring.
CO7: Apply knowledge of soil and water conservation strategies and recommend sustainable environmental management practices.

PO7: Research-related Skills
CO6: Assess soil analysis methods for determining pollution levels and suggest suitable remediation techniques.
CO7: Apply knowledge of soil and water conservation strategies and recommend sustainable environmental management practices.

PO8: Learning How to Learn Skills
CO6: Assess soil analysis methods for determining pollution levels and suggest suitable remediation techniques.
CO7: Apply knowledge of soil and water conservation strategies and recommend sustainable environmental management practices.

PO9: Digital and Technological Skills
CO4: Interpret water quality standards and describe different water treatment processes for pollution control. (Can include technologies involved in water treatment processes and pollution control.)

PO11: Value Inculcation and Environmental Awareness
CO1: Identify various sources and types of water and soil pollution and explain their environmental consequences.
CO7: Apply knowledge of soil and water conservation strategies and recommend sustainable environmental management practices.

PO12: Autonomy, Responsibility, and Accountability
CO7: Apply knowledge of soil and water conservation strategies and recommend sustainable environmental management practices.

PO13: Community Engagement and Service
CO3: Recognize water-borne diseases and explain the significance of case studies in pollution monitoring.
CO7: Apply knowledge of soil and water conservation strategies and recommend sustainable environmental management practices.

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