Anekant Education Society's

Tuljaram Chaturchand College, Baramati.

(Autonomous)

(Faculty of Science & Technology)

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

For Department of Environmental Science
Tuljaram Chaturchand College, Baramati.

Programme Specific Outcomes (PSOs)

PO1: Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.

PO2: Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.

PO3: Social competence: Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibit thoughts and ideas effectively in writing and orally

PO4: Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.

PO5: Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem

PO6: Personal and professional competence: Performing dependently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self- motivation and adaptability skills and commit to professional ethics.

PO7: Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.

PO8: Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

PO9: Self-directed and Life-long learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

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

Class	Semester	Paper Code	Paper Title	Credit
T.Y.B.Sc.	V	EVS 3501	Ecosystem Management	3
		EVS 3502	Wildlife Biology	3
		EVS 3503	Geoscience	3
		EVS 3504	Nature Conservation	3
		EVS 3505	Environmental Governance, Laws and Ethics	3
		EVS 3506	Environmental Biotechnology	3
		EVS 3507	Practical based on EVS3501 and EVS3502	2
		EVS 3508	Practical based on EVS3503 and EVS3504	2
		EVS 3509	Practical based on EVS3505 and EVS3506	2
	VI	EVS 3601	Climate Change	3
		EVS 3602	Analytical Methods	3
		EVS 3603	Sustainable Development	3
		EVS 3604	Environmental Statistics	3
		EVS 3605	Environmental Safety and Risk Management	3
		EVS 3606	Environmental Economics And Audit	3
		EVS 3607	Practical based on EVS 3601 to EVS 3603	2
		EVS 3608	Practical based on EVS 3604 to EVS 3606	2
		EVS 3609	Project	2

Class : **T. Y. B. Sc. (Semester - V)**
Paper Code : **EVS 3501**
Paper: **I** Title of Paper: **Ecosystem Management**
Credit: **3** No. of lectures: 48

Learning Objectives:

1) To learn terrestrial ecosystem and its detailed classification.
2) To learn aquatic ecosystem and its distribution.
3) To make student aware about impotance of aquatic and terrestrial ecosystem.

Course Outcome:

1) Students understood terrestrial ecosystem and its resources.
2) Students understood aquatic ecosystem and their importance.
3) Students will demonstrate an understanding of fundamental ecological principles, such as nutrient cycling, energy flow, and biodiversity.
4) Students will develop strategies for the conservation and restoration of ecosystems, considering both natural and human-induced disturbances.
5) Students will evaluate the challenges and opportunities associated with the conservation and management of grassland and forest ecosystems.
6) Students will explore principles and practices of sustainable forest management, including timber harvesting, reforestation, and the conservation of old-growth forests.
7) Students will understand the ecological importance of wetlands, and develop strategies for the conservation and restoration of these critical habitats.

Credit-I (16L)

Unit-1-Terrestrial Ecosystem

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. (8L)

Unit-2- Terrestrial Community

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. (8L)

Credit –II (16L)

Unit-1- Terrestrial Ecosystem Management

Methods of terrestrial ecosystem management: remote sensing, geographical information system, And ethanobotany, non wood forest (From Wood and non-wood forest) 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, vegetation classification, species association. (8L)

Unit-2-Aquatic Ecosystem

Introduction, Limnology, Aquatic environment, aquatic biota and water resources. water and plant functioning, structure of aquatic communities. The parameters of the aquatic environment. (8L)

Credit-III (16L)

Unit-1 Types of Aquatic Ecosystem

Distribution of major aquatic ecosystems, patterns, ecotone and edge effect, types of interactions: predation, parasitism, antibiosis, commensalism, cooperation, and mutualism. (6L)

Unit-2 Management of Aquatic Ecosystem

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. (10L)

Reference:-

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**
CO1	3								
CO2	3								
CO3		3							
CO4		3		2	1				
CO5			3						
CO6			3				2		1
CO7				3					

Justification for the mapping

PO1: Disciplinary Knowledge:
CO1: Students will demonstrate an understanding of terrestrial ecosystem structure and function.
CO2: Students will demonstrate an understanding of aquatic ecosystem dynamics.

PO2: Critical Thinking and Problem solving:
CO3: Students will apply critical thinking skills to analyze the challenges associated with ecosystem conservation and restoration.
CO4: Students will develop problem-solving strategies for addressing natural and human-induced disturbances in ecosystems.

PO3: Social competence:
CO5: Students will collaborate in group projects focused on ecosystem conservation and management.
CO6: Students will communicate effectively about ecological principles and conservation strategies to diverse audiences.

PO4: Research-related skills and Scientific temper:
CO7: Students will conduct research on ecological topics, applying scientific methods to gather and analyze data.
CO4: Students will demonstrate a scientific temper by critically evaluating ecological research literature.

PO5: Trans-disciplinary knowledge:
CO4: Students will integrate knowledge from various disciplines to address complex challenges in ecosystem conservation.

PO7: Effective Citizenship and Ethics:
CO6.Students will explore the role of effective citizenship in promoting sustainable ecosystem practices.

PO9: Self directed and life- long Learning:
CO6: Students will recognize the importance of life-long learning in the dynamic field of ecology and ecosystem management.

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Class : **T. Y. B. Sc. (Semester - V)**
Paper Code : **EVS 3502**
Paper : **II** Title of Paper : **Wildlife Biology**
Credit : **3** No. of lectures : 48

Learning 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.

Course Outcome:

1) Students get information about wildlife and their various species.
2) Students understanding diversity of wildlife and their scope.
3) Students will learn to assess different types of habitats and understand the principles of habitat management to support wildlife populations.
4) Students will comprehend the principles of conservation biology, including the importance of genetic diversity, habitat preservation, and the role of protected areas.
5) 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.
6) Students will understand and apply ethical principles in wildlife research and management, ensuring humane treatment of animals and responsible conduct in the field.
7) Students will demonstrate a deep understanding of wildlife ecology, including population dynamics, community interactions, and ecosystem relationships.

Credit-I (16L)
Unit-1 Introduction
Introduction, Concept of Wildlife Biology, Definition of Wildlife, examples of protected wildlife species (Refer to Wildlife Protection Act). (8L)

Unit-2 Outline of Diversity of major groups
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. (8L)

Credit-II (16L)
Unit-1 Habitats of wildlife diversity
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. (8L)

Unit-2 Threats of wildlife diversity

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. (8L)

Credit-III (16L)

Unit-1 Wildlife Management Techniques

Wildlife Management Techniques: Population assessment techniques for flying insects, Birds and Mammals: Transects, Point Counts, net swipes, census from pug marks, camera trapping Diversity assessment for plants: Determination of sampling area, quadrates, transects, point centre method, Diversity Indices and its applications. UAV (Unmanned aerial vehicles), remotely piloted aircraft. (8L)

Unit-2 Biodiversity

Reasons for biodiversity formation, contribution to adaptive evolution, land races of crop plants, conservation of genetic resources, highly productive and unique habitats, examples of wetlands and mangrove ecosystem. (8L)

Reference:-

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

Mapping of Program Outcomes with Course Outcomes

Programme Outcomes (POs)									
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**

CO1				3					
CO2	3								
CO3	3	2		1	1			1	
CO4	3	2		1				1	
CO5			3						2
CO6		3	2			1	2		
CO7	3		2		1	1			1

Justification for the mapping

PO1: Disciplinary Knowledge:
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.
CO7: Students will demonstrate a deep understanding of wildlife ecology, including population dynamics, community interactions, and ecosystem relationships.

PO2: Critical Thinking and Problem solving:
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.
CO6: Students will understand and apply ethical principles in wildlife research and management, ensuring humane treatment of animals and responsible conduct in the field.

PO3: Social competence:
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.

PO4: Research-related skills and Scientific temper:
CO1: Students get information about wildlife and their various species.
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.

PO5: Trans-disciplinary knowledge:
CO3: Students will learn to assess different types of habitats and understand the principles of habitat management to support wildlife populations.
CO7: Students will demonstrate a deep understanding of wildlife ecology, including population dynamics, community interactions, and ecosystem relationships.

PO6: Personal and professional competence:

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.

PO7: Effective Citizenship and Ethics:
CO6: Students will understand and apply ethical principles in wildlife research and management, ensuring humane treatment of animals and responsible conduct in the field.

PO8: Environment and sustainability:
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.

PO9: Self directed and life- long Learning:
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.
CO7: Students will demonstrate a deep understanding of wildlife ecology, including population dynamics, community interactions, and ecosystem relationships.

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Class : **T. Y. B. Sc. (Semester - V)**
Paper Code : **EVS 3503**
Paper : **III** Title of Paper : **Geosciences'**
Credit : **3** No. of lectures : 48

Learning 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.

Course Outcome:

1) Students understood origin of earth and soil weathering process.
2) Students understood natural hazards and disaster.
3) 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.
4) Students will analyze and interpret the principles of plate tectonics, including the movement of Earth's lithospheric plates, volcanic activity, and seismic events.
5) Students will identify minerals and rocks, understand their formation processes, and analyze their significance in geological contexts.
6) Students will understand atmospheric processes, climate patterns, and weather systems, including factors influencing climate change.
7) Students will study the chemical composition of Earth materials, including rocks, minerals, and fluids, and their role in geological processes.

Credit-I (16L)

Unit 1- Origin and evolution of earth.

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

(10L)

Unit 2- Soil Weathering

Definition, Classification, Weathering including weathering reactions, erosion, transportation and deposition of sediments. Soil forming minerals and process of soil formation, Identification and characterization of clay minerals, Soil physical and 5 chemical properties, soil types and climate control on soil formation, Cation exchange capacity and mineralogical controls. Factors affecting on soil erosion. (10L)

Credit-II (16L)

Unit 1- Oceanography

Distribution of water in earth, hydrology and hydrogeology, major basins and groundwater provinces of India, Darcy's law, groundwater fluctuations, , groundwater tracers, land subsidence, effects of excessive use of groundwater, groundwater quality. Pollution of groundwater resources. Ocean basins and physical structure of the ocean floor. Properties of sea water, waves and tides, ocean Currents. (10L)

Unit 2 - Conservation of Natural Resources

Introduction, Natural resource exploration and exploitation and related environmental concerns. Historical perspective and conservation of non-renewable resources. Methods of soil Conservation. (9L)

Credit-III (16L)

Unit 1 - Natural Hazards and Disasters

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, lightening, and drought. Impact of anthropogenic activities such as urbanization, mining, river-valley projects, excess withdrawal of ground water, etc. (9L)

Reference:-

1) Ecology and environment; PD Sharma, Rastogi publications, Meerut. 7th ed – 2004.
2) Environmental Geology: Edward A. Keller Khanke, H. 1968.
3) Soil Physics. McGraw Hill Publishing Co., New Delhi.
4) Ghildyal, B P, KP Tripathi. 1987. Soil Physics. Wiley Eastern Limited, New Delhi
5) Environmental chemistry by B. K. Sharma, Goel publication house, Meerut, Sixth revised edition – 2001.
6) Environmental Science; by-Santra SC; Central Publ. New Delhi
7) Lutgens F. K., Tarbuck, E. J. and Tasa, D. 2008. Essentials of Geology, Prentice Hall Publishers.
8) Bell F. G., 1998. Environmental geology: principles and practice. Blackwell Sc.. Oxford.
9) Thurman, H.V. and Trujillo, A.P., 2004, Introductory Oceanography, Prentice Hall.
10) Randolph, J. 2004 Environmental land use planning and management, Island Press, Washington.
11) Strahler, A.H and Strahler A.N (2002): Modern Physical Geography, John Wiley and Sons.
12) Kale, V. S. and Gupta, A. 2001. Introduction to Geomorphology, Orient Longman, Calcutta.
13) Chamley, H. and Chamley, H. 2003. Geosciences, Environment and Man Elsevier Science & Technology.
14) Savindra Singh (2002): Geomorphology, PrayagPustakBhawan, Allahabad.
15) Sharma &Vatal (1962): Oceanography for Geographers. Chaitanya Publishing House, Allahabad.
16) Basu S.K. (2003) (ed): Handbook of Oceanography, Global Vision, Delhi.
17) Kusky, T. M. 2003. Geological Hazards, Greenwood Press, Westport, Conn. London.
18) Physical geography by Mazid Husen.

Mapping of Program Outcomes with Course Outcomes

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

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1: Students have acquired knowledge of the origin of Earth and the soil weathering process.

CO3: Students have demonstrated a comprehensive understanding of the Earth's internal structure, including the composition and properties of the Earth's crust, mantle, and core.

CO5: Students can identify minerals and rocks, understand their formation processes, and analyze their significance in geological contexts.

PO2: Critical Thinking and Problem solving:

CO4: Students have analyzed and interpreted the principles of plate tectonics, including the movement of Earth's lithospheric plates, volcanic activity, and seismic events.

CO6: Students understand atmospheric processes, climate patterns, and weather systems, including factors influencing climate change.

PO4: Research-related skills and Scientific temper:

CO3: Students have demonstrated a comprehensive understanding of the Earth's internal structure, showcasing research-related skills.

CO4: Students have analyzed and interpreted geological principles, displaying scientific temper.

PO5: Trans-disciplinary knowledge:

CO2: Students have understood natural hazards and disasters, bridging geological knowledge with broader considerations.

PO8: Environment and Sustainability:

CO6: Students understand atmospheric processes, climate patterns, and weather systems, contributing to awareness of environmental factors.

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Class : **T. Y. B. Sc. (Semester - V)**
Paper Code : **EVS 3504**
Paper : **IV** Title of Paper : Nature Conservation
Credit : **3** No. of lectures : 48

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.

Course Outcome:

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

Credit-I (16L)

Unit 1- Introduction

Concept of Nature Conservation; Convention on Biological Diversity (CBD), Protected Area Network (PAN) in India, Details of PAN in Maharashtra state. (8L)

Unit 2-Methods of Nature conservation

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. (8L)

Credit-II (16L)

Unit 1 Awareness about Conservation

Awareness about Conservation: Need, Importance, Methods, Examples National Initiatives for Nature Conservation Ecotourism: Objectives, Principles, Merits, Disadvantages, Limitations, Challenges, Examples. (8L)

Unit-2 International efforts for Conservation

International efforts for Conservation: Role of IUCN, WWF and other Prominant organizations, Role of Governments, International Conventions and Protocols .Role of NGOs, Green Peace, International Whaling Mission, BNHS, Reindeers, Tigers, Crocodile farms, Examples of extreme activism, and practical sustainable efforts. (8L)

Credit-III

Unit 1- Wildlife Law and Administration

Wildlife Law and Administration: Wildlife Protection Act, its merits and limitations .State Symbols (Animals and Plants), Administrative Setup: MoEF, Climate Change Central and State Pollution Control Boards, Interface between administration and NGO's. Personalities, Institutions, Groups & NGO working for environmental conservation. (8L)

Unit 2- Nature Conservation Challenges

Objectives of Nature Conservation, Challenges (Social, Political, Economical) (8L)

Reference:-

1) Ecology and environment; PD Sharma, Rastogi publications, Meerut. 7th ed – 2004.
2) Environmental Science; by-Santra SC; Central Publ. New Delhi
3) Fundamentals of Ecology: E. P. Odum
4) Modern concepts in Ecology: H. D. Kumar
5) Gary K Meffe and Ronald Carroll C (1994) Principles of Conservation Biology.
6) Sinauer Associates Inc., Massachusetts.
7) Groombridge B (Ed.) (1992) Global Biodiversity Status of the Earths Living
8) Resources. Chapman & Hall, London. • IUCN (1992) Global Biodiversity and Strategy.
9) Sharma PD (2000) Ecology and Environment. Rastogi Publications, Meerut, • India.
10) Singh MP, Singh BS and Soma S. Dey (2004) Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
11) Virchow D (1998) Conservation and Genetic Resources, Springer-Verlag, Berlin.
12) Singh B, Social Forestry for Rural Development, Anmol Publishers, New Delhi (1992).
13) Murthy J.V.S., Watershed Management in India, (1994).
14) Raymond F Dasmann, Environmental Conservation, John Wiley (1984).
15) Kato, M. The Biology of Biodiversity, (1999), Springer Verlag, Tokyo.
16) Kotwal, P.C. and S. Banerjee. Biodiversity Conservation – In Managed forest and Protected areas, (2002). Agrobios, India.
17) Krishnamurthy, K.V. An Advanced Textbook on Biodiversity – Principles and Practice,
18) (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**
CO1	3		3		2	2		3	
CO2	3	2							2
CO3	2	2		3					3
CO4	3	3		3					
CO5					2				
CO6						2			
CO7			3				3		

Justification for the mapping

PO1: Disciplinary Knowledge:
CO1: Students are knowledgeable about methods for nature conservation and their international initiatives.
CO2: Students have a comprehensive understanding of the objectives and challenges associated with nature conservation.
CO3: Students comprehend the ecological principles governing ecosystems and possess skills in habitat management for biodiversity conservation.
CO4: Students acquire knowledge about wildlife conservation, including endangered species, and understand the principles of captive breeding and reintroduction.

PO2: Critical Thinking and Problem solving:
CO2: Students critically analyze the objectives and challenges associated with nature conservation.
CO3: Students engage in critical thinking about ecological principles governing ecosystems and apply problem-solving skills in habitat management for biodiversity conservation.
CO4: Students critically assess principles of captive breeding and reintroduction for wildlife conservation.

PO3: Social competence:
CO1: Students are socially aware of nature conservation methods and international efforts.
CO7: Students explore the social and ethical dimensions of conservation decision-making, considering trade-offs between conservation goals and human development.

PO4: Research-related skills and Scientific temper
CO3: Students develop research-related skills in understanding ecological principles governing ecosystems and habitat management for biodiversity conservation.
CO4: Students cultivate a scientific temper in acquiring knowledge about wildlife conservation, captive breeding, and reintroduction principles.

PO5: Trans-disciplinary knowledge:
CO1: Students integrate trans-disciplinary knowledge by being aware of international nature conservation efforts.

CO5: Students understand the legal and policy frameworks related to nature conservation, fostering trans-disciplinary awareness.

PO6: Personal and professional competence:
CO1: Students enhance personal and professional competence by being aware of nature conservation methods and international efforts.
CO6: Students develop competence in principles and practices related to the establishment, design, and management of protected areas for conservation purposes.

PO7: Effective Citizenship and Ethics:
CO7: Students explore ethical considerations in conservation decision-making, addressing issues such as the trade-off between conservation goals and human development.

PO8: Environment and Sustainability:
CO1: Students advocate for nature conservation methods and international efforts as part of environmental sustainability.

PO9: Self-directed and Life-long learning
CO2: Students engage in self-directed learning by understanding the objectives and challenges of nature conservation.
CO3: Students continue lifelong learning by understanding ecological principles and habitat management for biodiversity conservation.

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Class : **T. Y. B. Sc. (Semester - V)**
Paper Code : **EVS 3505**
Paper: **V** Title of Paper: **Environmental Governance, Laws and Ethics**
Credit: **3** No. of lectures: 48

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.

Course Outcomes:

After studying this course,

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

Credit-I (16L)

Unit-1 Environmental Governance

Introduction, Need and necessity, Elements of environmental governance Environmental governance in India since 1972. Environmental protection and Fundamental Rights. (8L)

Unit-2 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. (8L)

Credit-II (16L)

Unit-1 Environmental Act

The Water (Prevention and Control of Pollution) Act – 1974
The Air (Prevention and Control of Pollution) Act – 1981
The public liability Insurance Act, 1991
The National Environmental Tribunal Act,

1995 Environmental Policy Resolution. Legislation, public Policy Strategies in Pollution Control. Motor Vehicle Act, 1988. Public Liability Insurance Act, 1991 and Rules 1991. (8L)

Unit-2 Environmental Conservation Act

The Biological Diversity Act, 2002 Forest Conservation Act, 1980.
Indian Forests Act (Revised) 1982. National Forest Policy.
The Environment (Protection) Act, 1986
Scheme of labelling of environmentally friendly products (Ecomark) . (8L)

Credit-III (16L)

Unit-1 Environmental Ethics

Environmental Ethics: Introduction, concept. Development of environmental ethics, ethical theories applied to the environment. Environmental ethics in spirituality, fundamental concerns, relationship between people and environment. (8L)

Unit-2 Ethical Challenges

The ethical dilemma, environmental ethics and population, pollution. Value options, environment and technology.Human life and its environment – The art of ethics and an ethical dilemma,Challenges of world environmental ethics. (8L)

Reference:-

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 Rangrajan; Pearson-Longman Publ. (2007)
5) Handbook of Environmental Law, Acts, Guidelines, Compliances, and Standards: Vol. I and II; by R.K. Trivedy; BS publ (2004).
6) International Environmental Law, Fairness, Effectiveness and World Order; by Elli Louka, Cambridge, (2006)
7) Global Environmental Governance: A Reform Agenda; by Adil Najam, Mihaela Papa, and Nadaa Taiyab (2006), International Institute for Sustainable Development (IISD), Canada
8) Environmental Governance and Regulation in India: by *Atiyah Curmally*; (Environment and Rehabilitation) India Infrastructure Report 2002

Mapping of Program Outcomes with Course Outcomes

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

Justification for the mapping

PO1: Disciplinary Knowledge:
CO1: Demonstrate a comprehensive understanding of Acts and laws related to environmental protection.

PO2: Critical Thinking and Problem solving:
CO2: Develop critical thinking by being informed about fundamental duties and rights, along with environmental ethics.
CO7: Analyze ethical considerations and dilemmas in environmental decision-making, exploring the ethical implications of various policy choices.

PO3: Social competence:
CO3: Comprehend the principles and structures of environmental governance at local, national, and international levels.

PO4: Research-related skills and Scientific temper
CO4: Demonstrate knowledge of key environmental laws, regulations, and policies, including their historical development and current status.
CO5: Develop research and writing skills specific to environmental law, including the ability to interpret and analyze legal documents.

PO5: Trans-disciplinary knowledge:
CO4: Demonstrate knowledge of key environmental laws, regulations, and policies, which requires an understanding of various disciplines.

PO6: Personal and professional competence:
CO6: Understand mechanisms for compliance monitoring and enforcement of environmental laws, exploring the role of regulatory agencies and legal instruments.

PO7: Effective Citizenship and Ethics:
CO2: Foster awareness about the fundamental duties and rights, including environmental ethics.
CO7: Analyze ethical considerations and dilemmas in environmental decision-making, exploring the ethical implications of various policy choices.

PO8: Environment and Sustainability:
CO1: Ensure students understand Acts and laws related to environmental protection, fostering environmental awareness.
CO3: Comprehend the principles and structures of environmental governance for sustainable practices.

PO9: Self-directed and Life-long learning
CO2: Foster awareness about the fundamental duties and rights, including environmental ethics, promoting a sense of life-long learning.
CO4: Demonstrate knowledge of key environmental laws, regulations, and policies, encouraging self-directed learning in the legal aspects of environmental protection.

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Class : **T. Y. B. Sc. (Semester - V)**
Paper Code : **EVS 3506**
Paper : **VI** Title of Paper : **Environmental Biotechnology**
Credit : **3** No. of lectures : 48

A) Learning Objectives:

1) To learn composting , Vermicomposting and biofuels.
2) To learn genetically modified organisms and their release criteria.
3) To learn bioremediation and energy production process.

Course Outcomes:

1) Students understood composting, Vermicomposting and biofuel.
2) Students understanding biotechnology and it's used to control the environmental pollution.
3) Students will gain a foundational understanding of biotechnological principles and applications in the context of environmental science.
4) Students will learn and apply various bioremediation techniques to address environmental pollution, including the use of microorganisms to degrade pollutants.
5) Students will understand and apply biotechnological methods for the treatment of various types of wastes, with an emphasis on recovering valuable resources.
6) Students will learn about the microbial processes involved in biogas production, anaerobic digestion, and other bioenergy production methods using organic waste.
7) Students will understand the regulatory frameworks governing environmental biotechnology and consider ethical aspects in the application of biotechnological solutions.

Credit-I (16L)
Unit-1 Introduction

Environmental Biotechnology: Meaning, necessity and scope, history of environmental biotechnology, objectives of environmental biotechnology. (8L)

Unit-2 Vermicomposting and Biofuels

Composting, Vermicomposting and Biofuels—Composting technology, Design aspect, composting process, Temp. Trend I and influencing factors, Vermicomposting—Earthworm life cycle, chemical characteristic of vermicompost, Operating vermicompost, Biofuels—Alternative to non fossil energy resources, Biological energy resources, Combustion of biomass, Biogas, Biodiesel, Ethanol and hydrogen. (8L)

Credit-II (16L)
Unit-1 GMO's in the environment

GMO's in the environment—Risk of GMO's, Risk assessment management (Need and Importance), Directive principles for GMO's. Measures, Deliberate release, and release criteria. Biosafety—Cartagena Protocol, Biosafety regulation. (8L)

Unit-2 Bioremediation

Bioremediation—Principles, factors responsible, microbial population for bioremediation, Environmental variation in field, Enzymatic – biodegrative pathway, Genetic Engineering Approach, Bioremediation strategies; Phytoremediation—Metal and Organic Phytoremediation, need for Research and development. (8L)

Credit-III (16L)

Unit-1 Biomethanation

Biomethanation—Anaerobic treatment for gas generation,microbiology and biochemistry, factors affecting, Problems in Biomethanation, Design of digester, Biomethannation in industries, Potential of Biomethanation from MSW, Merits of Biomethannation from MSW and Biomass gasification, Medical and hospital Waste.

(8L)

Unit-2 Energy Production

Energy production from biomass - biogas, ethanol, hydrogen Biotechnology application of bioleaching. (8L)

Reference:-

1) Environmental Biotechnology --------- Dr. M. Jay
2) Environmental Biotechnology -- M.H. Fulekar; Oxford & IBH Publ., (2005)
3) Environmental Biotechnology --- Alan Sagg
4) Environmental Biotechnology --- Rajendran Gunasekaran
5) Environmental Biotechnology --- Indu Shekar Thakur
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7) Agrawal, KC 1996. Environmental Biology. Agro-botanical Publishers – New Delhi.
8) Trivedi, PR and R. Gundeep, 1992. Environmental Ecology. AkashdeepPublishing House, New Delhi.
9) Jogdand, SN 1995. Environmental Biotechnology. Himalaya Publishing House, Mumbai.
10) Crawford, RL and DLCrawford. 1996. Bioremediation - Principles and Applications. Cambridge University Press, London.
11) Unsworth, MH and DP Ormrod, 1992. Effects of Gaseous Air Pollution in Agriculture and Horticulture. Butterworth Scientific. p.532.
12) Lepp, NW, Effects of Heavy Metal Pollution on Plants. p.257.
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14) RS Ramalho.1983. Introduction to Waste Water Treatment Process. Academic press. Newyork.
15) Qunag, EAR, Principles of Waste Water Treatment Vol.I Biological Process. National Science Development Board, Manila, Phillipines.
16) Anonymous, 1991. The Biocycle Guide to the Art and Science of Composting. The JG Press Inc., Pennsylvania. p.270
17) Epstein .E, 1997. The Science of Composting. Technomic publishing co inc.,

Pennsylvania. p.487
18) Dirk van Elsas, J., T.Trevors and MH Wellington, 1998. Modern Soil Microbiology.
19) Gasser, J.K.R. 1985. Composting of Agricultural and other Wastes. Elsevier Applied Science Publishers, New York
20) Gaur, AC; 1992. Organic Recycling. Indian Council of Agricultural Research Publication
21) Crawford.,R.L.and D.L.Crawford. 1996. Bioremediation: Principles and Applications. Cambridge University Press, Cambride.p.399.
22) Cook R.J. and K.F.Baker. 1983. The Nature and Practice of Biological Control of Plant Pathogens. American Phytopathological Society.p.539.
23) Glick,BR and Jack J Pasternak. 1994. Molecular Biotechnology: Principles and Applications of Recombinant DNA- Chapter-10 Bioremediation and Biomass Utilization.
24) Hinchee, R. 1994. Air Sparging for Site Remediation. Baco Ratan, Lewis Publishers.
25) National Research Council, Water Science and Technology Board 1993. In situ Bioremediation: When does it work? National Academy Press, Washington

Mapping of Program Outcomes with Course Outcomes

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

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1: Students have demonstrated proficiency in composting, Vermicomposting, and biofuel processes.

CO2: Students possess a comprehensive understanding of biotechnology and its applications in controlling environmental pollution.

CO3: Students have acquired a foundational understanding of biotechnological principles applied in environmental science.

PO2: Critical Thinking and Problem solving:

CO4: Students have developed critical thinking skills through learning and applying various bioremediation techniques for environmental pollution.

CO5: Students can analyze and apply biotechnological methods for waste treatment, emphasizing resource recovery.

PO3: Social competence:
CO7: Students understand the regulatory frameworks governing environmental biotechnology and consider ethical aspects in its application.

PO4: Research-related skills and Scientific temper
CO3: Students have gained a foundational understanding of biotechnological principles, fostering research-related skills and scientific temper.
CO4: Students have learned and applied various bioremediation techniques, demonstrating research-related skills and a scientific temper.

PO5: Trans-disciplinary knowledge:
CO2: Students comprehend biotechnology and its diverse applications in addressing environmental pollution, fostering trans-disciplinary knowledge.
CO6: Students learn about microbial processes in biogas production, anaerobic digestion, and bioenergy production from organic waste, promoting trans-disciplinary insights.

PO6: Personal and professional competence:
CO1: Students' understanding of composting, vermicomposting, and biofuel contributes to their personal and professional competence.
CO7: Consideration of regulatory frameworks and ethical aspects in environmental biotechnology enhances personal and professional competence.

PO7: Effective Citizenship and Ethics:
CO7: Understanding regulatory frameworks and ethical considerations in applying biotechnological solutions fosters effective citizenship and ethical awareness.

PO8: Environment and Sustainability:
CO5: Students understanding and applying biotechnological methods for waste treatment aligns with environmental sustainability goals.

PO9: Self-directed and Life-long learning
CO2: Students' exploration of biotechnology and its applications supports self-directed learning.
CO6: Learning about microbial processes in bioenergy production encourages a life-long learning approach.

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Class: **T. Y. B. Sc. Practical-I (Based on Semester – V Theory Papers)**
Paper Code: **EVS 3507**

Title of Paper: **Practical based on Sem-V EVS 3501 And EVS 3502**

Credit: 2 No. of Practicals: 12

A) Learning Objectives:

1 To aware the students about ecosystem management.
2 To enhance the knowledge of students about the environmental science.
3 To aware the students about environmental laws and ethics.

B) Course Outcome:

1) It will help to conserve the wildlife biology.
2) Students will get job in GIS mapping and remote sensing.
3) Data analyzer will be expert to conclude the significance of biological experiments.
4) Students will demonstrate the ability to identify key components of ecosystems, including flora, fauna, and abiotic factors, through field observations and assessments.
5) Students will develop and implement strategies for the identification, control, and management of invasive species within an ecosystem.
6) Students will be able to analyze different statistical models.
7) Students will develop and implement strategies for the identification, control, and management of invasive species within an ecosystem.

Practical based on EVS 3501-Ecosystem Management

1. Study of Flora of an urban terrestrial ecosystem/herbarium (Field practical)...2P
2. Study of primary productivity from grassland community....1P
3. Study of species interaction from forest area....1P
4. Study of vegetation by Belt/Line method....1P
5. Web series study of invasive species in agricultural ecosystem...1P

Practical based on EVS 3502-Wildlife biology

6. Study of Fauna of an urban terrestrial ecosystem(Field practical)...1P
7. Quantitative analysis of phytoplanktons and determination of percent composition lockey's drop count method....1P
8. To calculate Shannon, Simpson, Sorenson's coefficient index....2P

Mapping of Program Outcomes with Course Outcomes

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

Justification for the mapping

PO1: Disciplinary Knowledge:
CO1: Contribute to the conservation of wildlife biology.
CO3: Analyze data to conclude the significance of biological experiments.
CO4: Demonstrate the ability to identify key components of ecosystems through field observations.

PO2: Critical Thinking and Problem solving:
CO6: Apply critical thinking skills to analyze different statistical models.
CO7: Develop and implement strategies for the identification, control, and management of invasive species within an ecosystem.

PO3: Social competence:
CO4: Collaborate with peers in field observations and assessments of ecosystems.

PO4: Research-related skills and Scientific temper
CO3: Enhance skills in data analysis to conclude the significance of biological experiments.
CO4: Apply scientific temper to identify key components of ecosystems through field observations.

PO5: Trans-disciplinary knowledge:
CO1: Apply knowledge to contribute to the conservation of wildlife biology.
CO2: Gain skills for jobs in GIS mapping and remote sensing.

PO6: Personal and professional competence:
CO2: Develop skills for jobs in GIS mapping and remote sensing.
CO6: Apply critical thinking in analyzing different statistical models.

PO7: Effective Citizenship and Ethics:
CO1: Contribute to the ethical conservation of wildlife biology.
CO5: Develop and implement ethical strategies for the identification, control, and management of invasive species within an ecosystem.

PO8: Environment and Sustainability:

CO1: Contribute to the conservation of wildlife biology in the context of environmental sustainability.

CO5: Develop and implement strategies for the sustainable identification, control, and management of invasive species within an ecosystem.

PO9: Self-directed and Life-long learning

CO2: Acquire skills for jobs in GIS mapping and remote sensing to promote self-directed learning.

CO6: Apply critical thinking skills to engage in life-long learning through analyzing different statistical models.

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Class: T. Y. B. Sc. Practical-II (Based on Semester – V Theory Papers)
Paper Code: EVS 3508
Title of Paper: Practical based on Sem-V EVS 3503 to EVS 3504
Credit: 2 No. of Practicals: 10

A) Learning Objectives:

1) To aware the students about ecosystem management.
2) To enhance the knowledge of students about the environmental science.
3) To aware the students about environmental laws and ethics.

B) Course Outcome:

1) It will help to conserve the wildlife biology.
2) Students will get job in GIS mapping and remote sensing.
3) Data analyzer will be expert to conclude the significance of biological experiments.
4) Students will develop proficiency in conducting geological fieldwork, including mapping, data collection, and observation of geological features in diverse terrains.
5) Students will gain a thorough understanding of the principles of composting, including the biological processes involved in decomposition and nutrient cycling.
6) Students will be able to set up and design composting systems, considering factors such as bin selection, size, aeration, and temperature control.
7) Students will understand the role of microorganisms in the composting process and learn techniques to manage and optimize microbial activity.

Practical based on EVS 3503-Geoscience

1. Exercise based on the lapse rate ..1P
2. Draw the simple wind roses with the help of given data....1P
3. Draw the Compound wind roses with the help of given data....P
4. Draw the climatic maps and diagram of climograph /circular graph....2P

Practical based on EVS 3504-Nature Conservation

5. To study methods of preparation of compost by using Indore and Bangalore method...1P
6. To study vermicomposting of farm/other solid waste...2P
7. To Study factors influencing on composting...1P
8. Continuation of use of social media for e-networking and dissemination of ideas of nature conservation...1P

Mapping of Program Outcomes with Course Outcomes

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

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1: Proficiency in wildlife biology conservation, ensuring a comprehensive understanding of ecological principles.

CO3: Expertise in data analysis to conclude the significance of biological experiments.

PO2: Critical Thinking and Problem solving:

CO3: Development of critical thinking skills through expert data analysis in biological experiments.

CO4: Proficiency in conducting geological fieldwork, including mapping, data collection, and observation, requiring problem-solving skills.

PO3: Social competence:

CO5: Understanding of composting principles, fostering social competence in sustainable waste management practices.

PO4: Research-related skills and Scientific temper

CO3: Expert data analysis in biological experiments, enhancing research-related skills.

CO4: Proficiency in conducting geological fieldwork, contributing to scientific temper.

PO5: Trans-disciplinary knowledge:

CO2: Job opportunities in GIS mapping and remote sensing, showcasing trans-disciplinary knowledge in geospatial technologies.

PO6: Personal and professional competence:

CO6: Ability to set up and design composting systems, reflecting personal and professional competence in waste management practices.

CO7: Understanding the role of microorganisms in composting, showcasing competence in microbial activity management.

PO7: Effective Citizenship and Ethics:
CO1: Contribution to wildlife biology conservation, demonstrating effective citizenship in environmental stewardship.
CO7: Ethical management of microorganisms in the composting process.

PO8: Environment and Sustainability:
CO5: Thorough understanding of composting principles, contributing to environmental sustainability.
CO6: Designing composting systems with consideration for factors such as size, aeration, and temperature control, reflecting sustainability awareness.

PO9: Self-directed and Life-long learning
CO2: Job opportunities in GIS mapping and remote sensing, promoting self-directed learning in geospatial technologies.

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Class: T. Y. B. Sc. Practical-III (Based on Semester – V Theory Papers)
Paper Code: EVS 3509
Title of Paper: Practical based on Sem-V EVS 3505 to EVS 3506

Credit: 2 No. of Practicals: 10

A) Learning Objectives:

1) To aware the students about ecosystem management.
2) To enhance the knowledge of students about the environmental science.
3) To aware the students about environmental laws and ethics.

B) Course Outcome:

1) Students will be able to identify and analyze various legal instruments related to Environmental governance, including international conventions, national laws, and local regulations.
2) Students will engage with stakeholders, such as local communities and industry representatives, to understand practical challenges and considerations in environmental governance.
3) Students will conduct legal research on environmental cases, analyze court decisions, and develop case studies to understand the practical implications of environmental laws.
4) Students will participate in ethical decision-making exercises, addressing dilemmas related to environmental governance and laws.
5) Students will learn and apply aseptic techniques for handling microbial cultures, ensuring Contamination-free experiments.
6) Students will develop proficiency in fundamental laboratory techniques such as pipetting, dilution, solution preparation, and accurate measurement.
7) Students will analyze experimental data, interpret results, and present findings, developing skills in scientific data analysis and reporting.

Practical based on EVS 3505-Environmental Governance, Laws and Ethics.

1. Introduction of Environmental Governance, Laws and Ethics...1P
2. Understanding process of public interest litigation through court...1P
3. Legal survey based on questionnaire to understand environmental governance...2P
4. Introduction about Central Pollution Control Board (CPCB) ..1P

Practical based on EVS 3506-Environmental Biotechnology

5. To isolate microorganisms from decaying matter/soil...2P
6. Identification and classification of bacteria...1P
7. Determination of H_2S from sewage sample...1P
8. Identification and classification of bacteria by gram staining technique...1P

- Visit to Biodiversity rich area / Sewage treatment plant and submit the report.

Mapping of Program Outcomes with Course Outcomes

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

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1: Identify and analyze various legal instruments related to environmental governance, encompassing international conventions, national laws, and local regulations.

CO5: Learn and apply aseptic techniques for handling microbial cultures, ensuring contamination-free experiments.

CO6: Develop proficiency in fundamental laboratory techniques such as pipetting, dilution, solution preparation, and accurate measurement.

PO2: Critical Thinking and Problem solving:

CO2: Engage with stakeholders, including local communities and industry representatives, to understand practical challenges and considerations in environmental governance.

CO3: Conduct legal research on environmental cases, analyze court decisions, and develop case studies to understand the practical implications of environmental laws.

CO4: Participate in ethical decision-making exercises, addressing dilemmas related to environmental governance and laws.

PO3: Social competence:

CO2: Engage with stakeholders, fostering an understanding of the practical challenges and considerations in environmental governance.

PO4: Research-related skills and Scientific temper

CO1: Conduct legal research on environmental cases, analyzing court decisions and developing case studies to understand the practical implications of environmental laws.

CO7: Analyze experimental data, interpret results, and present findings, fostering skills in scientific data analysis and reporting.

PO5: Trans-disciplinary knowledge:
CO1: Identify and analyze various legal instruments related to environmental governance, fostering trans-disciplinary knowledge.

PO6: Personal and professional competence:
CO4: Participate in ethical decision-making exercises, addressing dilemmas related to environmental governance and laws.
CO6: Develop proficiency in fundamental laboratory techniques, enhancing personal and professional competence.

PO7: Effective Citizenship and Ethics:
CO4: Participate in ethical decision-making exercises related to environmental governance and laws.

PO8: Environment and Sustainability:
CO1: Identify and analyze various legal instruments related to environmental governance, emphasizing environment and sustainability.
CO2: Engage with stakeholders, including local communities and industry representatives, to understand practical challenges and considerations in environmental governance.

PO9: Self-directed and Life-long learning
CO1: Conduct legal research on environmental cases, fostering self-directed learning and a commitment to lifelong learning.

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