

University of Mumbai



No. AAMS_UGS/ICC/2024-25/ 122

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the Recognized Institutions and the Head, University Departments is invited to this office Circular No. AAMS_UGS/ICC/2023-24/23 dated 08th September, 2023 relating to the NEP UG & PG Syllabus.

They are hereby informed that the recommendations made by the **Board of Studies in Environment Science** at its meeting held on 5th April, 2024 and subsequently passed by the Board of Deans at its meeting held on 10th July, 2024 vide item No. 8.9 (N) have been accepted by the Academic Council at its meeting held on 12th July, 2024 vide item No. 8.9 (N) and that in accordance therewith the **Correction in the syllabus of M.Sc. (Environmental Science) Sem - I & II** as per appendix (NEP 2020) with effect from the academic year 2024-25.

(The Circular is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
2nd September, 2024

(Dr. Prasad Karande)
REGISTRAR

To

The Principals of the Affiliated Colleges, Directors of the Recognized Institutions and the Head, University Departments.

A.C/8.9(N)12/07/2024

Copy forwarded with Compliments for information to:-

- 1) The Chairman, Board of Deans,
- 2) The Dean, Faculty of Interdisciplinary Studies,
- 3) The Chairman, **Board of Studies in Home Science**
- 4) The Director, Board of Examinations and Evaluation,
- 5) The Director, Department of Students Development,
- 6) The Director, Department of Information & Communication Technology,
- 7) The Director, Centre for Distance and Online Education (CDOE) Vidyayagari,
- 8) The Deputy Registrar, Admission, Enrolment, Eligibility & Migration Department (AEM),

Copy forwarded for information and necessary action to :-	
1	The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Dept)(AEM), dr@eligi.mu.ac.in
2	The Deputy Registrar, Result unit, Vidyanagari drresults@exam.mu.ac.in
3	The Deputy Registrar, Marks and Certificate Unit,. Vidyanagari dr.verification@mu.ac.in
4	The Deputy Registrar, Appointment Unit, Vidyanagari dr.appointment@exam.mu.ac.in
5	The Deputy Registrar, CAP Unit, Vidyanagari cap.exam@mu.ac.in
6	The Deputy Registrar, College Affiliations & Development Department (CAD), deputyregistrar.uni@gmail.com
7	The Deputy Registrar, PRO, Fort, (Publication Section), Pro@mu.ac.in
8	The Deputy Registrar, Executive Authorities Section (EA) eau120@fort.mu.ac.in He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
9	The Deputy Registrar, Research Administration & Promotion Cell (RAPC), rapc@mu.ac.in
10	The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA) dy.registrar.tau.fort.mu.ac.in ar.tau@fort.mu.ac.in
11	The Deputy Registrar, College Teachers Approval Unit (CTA), concolsection@gmail.com
12	The Deputy Registrars, Finance & Accounts Section, fort draccounts@fort.mu.ac.in
13	The Deputy Registrar, Election Section, Fort drelection@election.mu.ac.in
14	The Assistant Registrar, Administrative Sub-Campus Thane, thanesubcampus@mu.ac.in
15	The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan, ar.seask@mu.ac.in
16	The Assistant Registrar, Ratnagiri Sub-centre, Ratnagiri, ratnagirisubcentre@gmail.com
17	The Director, Centre for Distance and Online Education (CDOE), Vidyanagari, director@idol.mu.ac.in
18	Director, Innovation, Incubation and Linkages, Dr. Sachin Laddha pinkumanno@gmail.com
19	Director, Department of Lifelong Learning and Extension (DLLE),

Copy for information :-	
1	P.A to Hon'ble Vice-Chancellor, vice-chancellor@mu.ac.in
2	P.A to Pro-Vice-Chancellor pvc@fort.mu.ac.in
3	P.A to Registrar, registrar@fort.mu.ac.in
4	P.A to all Deans of all Faculties
5	P.A to Finance & Account Officers, (F & A.O), camu@accounts.mu.ac.in

To,

1	The Chairman, Board of Deans pvc@fort.mu.ac.in
2	Faculty of Humanities, Dean 1. Prof.Anil Singh Dranilsingh129@gmail.com Associate Dean 2. Dr.Suchitra Naik Naiksuchitra27@gmail.com 3.Prof.Manisha Karne mkarne@economics.mu.ac.in Faculty of Commerce & Management, Dean 1. Dr.Kavita Laghate kavitalaghate@jbims.mu.ac.in Associate Dean 2. Dr.Ravikant Balkrishna Sangurde Ravikant.s.@somaiya.edu 3. Prin.Kishori Bhagat kishoribhagat@rediffmail.com

	Faculty of Science & Technology Dean 1. Prof. Shivram Garje ssgarje@chem.mu.ac.in Associate Dean 2. Dr. Madhav R. Rajwade Madhavr64@gmail.com 3. Prin. Deven Shah sir.deven@gmail.com
	Faculty of Inter-Disciplinary Studies, Dean 1. Dr. Anil K. Singh aksingh@trcl.org.in Associate Dean 2. Prin. Chadrashekhkar Ashok Chakradeo cachakradeo@gmail.com
3	Chairman, Board of Studies,
4	The Director, Board of Examinations and Evaluation, dboee@exam.mu.ac.in
5	The Director, Board of Students Development, dsd@mu.ac.in@gmail.com DSW directr@dsw.mu.ac.in
6	The Director, Department of Information & Communication Technology, director.dict@mu.ac.in

As Per NEP 2020

University of Mumbai



Title of the program

- A-** P.G. Diploma in Environmental Science 2023-24
- B-** M.Sc. (Environmental Science) (Two Year) 2023-24
- C-** M.Sc. (Environmental Science) (One Year) - 2027-28

Syllabus for Semester – Sem I & II

Ref: GR dated 16th May, 2023 for Credit Structure of PG

University of Mumbai

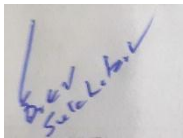


(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	Title of program O. IMP-11A	A	P. G. Diploma in Environmental Science
	O. IMP-11B	B	M.Sc. (Environmental Science) (Two Years)
	O. IMP-11C	C	M.Sc. (Environmental Science) (One Year)
2	Eligibility O. IMP-12A	A	Graduate with three year degree recognised by UGC in the discipline of Environmental Science OR Mention any other eligibility criteria (if any), As per National Credit Framework (N.Cr.F.) 2023 with Academic Level 5.5 OR The candidate should have passed the Bachelors degree in any Science subject such as Botany, Zoology, Chemistry, Physics, Statistics, Geography, Geology, Life Sciences, Environment Sciences, Microbiology, Biotechnology, Fisheries, Marine Biology, Horticulture, Agriculture, Computer Science, Data Science, Veterinary Science, Health Sciences or any branch of Engineering/Pharmacy. The candidate should have secured at least 45% or 40 % aggregate marks for open and SC/ST/OBC category respectively at the graduate level. OR Passed equivalent Academic Level 5.5
	O. IMP-12B	B	P.G. Diploma in Environmental Science OR Mention any other eligibility criteria (if any), As per National Credit Framework (N.Cr.F.) 2023 with Academic Level 6.0 OR The candidate should have passed the Bachelors degree in any Science subject such

			as Botany, Zoology, Chemistry, Physics, Statistics, Geography, Geology, Life Sciences, Environment Sciences, Microbiology, Biotechnology, Fisheries, Marine Biology, Horticulture, Agriculture, Computer Science, Data Science, Veterinary Science, Health Sciences or any branch of Engineering/Pharmacy. The candidate should have secured at least 45% or 40 % aggregate marks for open and SC/ST/OBC category respectively at the graduate level. OR Passed equivalent Academic Level 6.00
	O. IMP-12C	C	Graduate with 4 year U. G. Degree (Honours/ Honours with Research) with specialization in Environmental Science or Passed equivalent Academic Level 6.0 OR Graduate with four years UG Degree program (Honours/ Honours with Research) with 18 credits in Environmental Science as Minor Subjects.
3	Duration of program R: _____	A	1 Year
		B	2 Year
		C	1 Year
4	R: _____ Intake Capacity		
5	R: _____ Scheme of Examination		NEP 50% Internal 50% External, Semester End Examination Individual Passing in Internal and External Examination
6	Standards of Passing R: _____		40%
7	Credit Structure R: _____		Attached herewith
8	Semesters	A	Sem. I & II
		B	Sem. I, II, III& IV
		C	Sem. I & II
9	Program Academic Level	A	6.0
		B	6.5
		C	6.5
10	Pattern		Semester

11	Status	New	
12	To be implemented from Academic Year Progressively	A	2023-24
		B	
		C	2027-28



Sign of HOD

Name of the Head of the Department

Name of the Department

Sign of Dean,

Name of the Dean

Name of the Faculty

Preamble

1) Introduction

The University of Mumbai offers a unique opportunity to pursue a job-oriented M.Sc. Environmental Science program. This program provides a focused learning environment for those passionate about creating a sustainable future.

The program emphasizes a proactive approach to environmental challenges. Students will gain the knowledge and skills to solve problems at their source, fostering preventative solutions rather than relying solely on reactive measures. This approach equips graduates for success in various sectors, including research, academia, industry, NGOs, and the service sector.

Furthermore, the program directly addresses the growing demand for skilled environmental professionals in both public and private sectors.

2) Aims and Objectives

The M.Sc. Environmental Science program has the following key aims and objectives:

Aim: To cultivate a generation of environmental professionals equipped with the knowledge and skills to address sustainability challenges across various sectors.

Objectives:

- Equip students with the ability to identify and address environmental issues at their root cause, promoting preventative solutions over reactive measures.
- Provide a comprehensive understanding of sustainable practices applicable to research, academia, industry, NGOs, and the service sector.
- Prepare graduates to meet the growing demand for skilled environmental managers and sustainability professionals in both public and private sectors.
- Integrate knowledge from diverse disciplines to cultivate well-rounded environmental professionals capable of tackling complex challenges.

3) Learning Outcomes

- a. Acquire in-depth knowledge and integrate with existing knowledge to sensitize the people about global and local environmental issues.
- b. Develop an ability to identify, critically analyze, formulate and solve environmental problems using basic principles of nature conservation. Get acquainted with environmental and social impacts of any developmental activity.
- c. An ability to design a system and process to meet desired needs of society within realistic limitations such as health, safety, security and environmental considerations.
- d. An ability to design and conduct experiments, interpret data, and provide well informed conclusions.

- e. Communicate effectively socio-economic problems related to environment by appropriate documentations and presentations.
- f. Environments and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

a) Programme Outcomes (POs):

On successful completion of the program, students will be able to:

- Demonstrate a comprehensive understanding of fundamental ecological principles and their application to environmental issues.
- Analyze environmental problems using scientific methods and tools.
- Design and implement solutions for environmental pollution control and resource management.
- Apply research methodologies to investigate environmental challenges.
- Communicate environmental issues effectively to diverse audiences.
- Advocate for sustainable practices and policies.
- Foster critical thinking, problem-solving, and decision-making skills in the context of environmental management.
- Uphold ethical principles and social responsibility in their professional endeavors.

b) Programme Specific Outcomes (PSOs):

- Students will gain in-depth knowledge of various ecosystems, their functions, and the impact of anthropogenic activities on them.
- Students will acquire a comprehensive understanding of different types of environmental pollution, their sources, and control technologies.
- Students will develop practical skills in environmental monitoring, analysis, and pollution control techniques.
- Students will gain knowledge about various natural resources, their importance, and sustainable management practices.
- Students will develop skills in scientific research methods, data analysis, and scientific writing.
- Students will explore economic principles applied to environmental issues like resource valuation, cost-benefit analysis, and environmental policy design.
- Students will gain knowledge about wildlife conservation strategies, habitat management, and human-wildlife conflict resolution.
- Students will gain advanced knowledge and skills in environmental legislation, disaster management, instrumentation, biostatistics, environmental auditing, sustainable tourism, and on-job training.

4) Any other point (if any) –Nil

5) Baskets of Electives- 08 Electives given (Each Semester two)

Sem I	Sem II	Sem III	Sem IV
Environmental Economics	Environmental Audit	Environmental Biotechnology & Nanotechnology	Intellectual Property Rights
Wildlife Conservation and Management	Sustainable Tourism	Environmental Toxicology	Sustainable Management

Credit Structure of the Program (Table as per परिशिष्ट १ with sign of HOD and Dean)

Credit Structure M.Sc. Part I (Sem I & II) Environmental Science Ratnagiri Sub-Campus University of Mumbai

Year (2Yr PG)	Level	Sem. (2 Yr)	Major		RM	OJT /FP	RP	Cum. Cr.	Degree
			Mandatory*	Electives Any one					
I	6.0	Sem I	PSEVS 101 - Credits 4	(Credits 4)	(Credits 4) PSEVSRM 105	—	—	22	PG Diploma (after 3 Year Degree)
			PSEVS 102 - Credits 4	PSEVSEL 106A					
			PSEVSP 103 - Credits 4	OR					
			PSEVS 104 - Credits 2	PSEVSEL 106B					
		Sem II	PSEVS 201 - Credits 4	(Credits 4)	—	(Credits 4) PSEVSOJT 205	—	22	
			PSEVS 202 - Credits 4	PSEVSEL 206A					
			PSEVSP 203 - Credits 4	Or					
			PSEVS 204 - Credits 2	PSEVSEL 206B					
Cum. Cr. For PG Diploma			28	8	4	4	-	44	
Exit option: PG Diploma (44 Credits) after Three Year UG Degree									

Year (2Yr PG)	Level	Sem. (2 Yr)	Major		RM	OJT /FP	RP	Cum. Cr.	Degree
			Mandatory*	Electives Any one					
II	6.5	Sem III	PSEVS 301 - Credits 4	(Credits 4)	—	—	(Credits 4) PSEVSPR 305	22	PG Degree (after 3 Year UG)
			PSEVS 302 - Credits 4	PSEVSEL 306A					
			PSEVS P 303 - Credits 4	Or					
			PSEVS 304 - Credits 2	PSEVSEL 306B					
		Sem IV	SEVS 401 - Credits 4	(Credits 4)	—	—	(Credits 6) PSEVSPR 404	22	
			PSEVS 402 - Credits 4	PSEVSEL 405A					
PSEVSP 403 - Credits 4	Or PSEVSEL 405B								
Cum. Cr. for 1 Yr PG Degree			26	8			10	44	
Cum. Cr. for 2 Yr PG Degree			54	16	4	4	10	88	

Sign of HOD

Name of the Head of the Department

Name of the Department

Sign of Dean,

Name of the Dean

Name of the Faculty

M. Sc. - I Environmental Sciences Syllabus

(As per NEP 2020)

From the Academic Year 2024-25

Semester - I papers		
Mandatory	Paper Code	Credits
1. Environmental Biology	PSEVS 101	4
2. Environmental Pollution & Pollution Control Technology	PSEVS 102	4
3. Practicals of PSEVS 101 & 102	PSEVSP 103	4
4. Environment & Natural Resources	PSEVS 104	2
5. Research Methodology	PSEVSRM 105	4
Elective (Any one)		
1. Environmental Economics Or 2. Wildlife Conservation and Management	PSEVSEL 106A Or PSEVSEL 106B	4
Semester - II papers		
Mandatory		Credits
1. Environmental legislation, monitoring and Disaster Management	PSEVS 201	4
2. Instrumentation & Biostatistics	PSEVS 202	4
3. Practicals of PSEVS 201 & 202	PSEVSP 203	4
4. Environmental Policies & Regulations	PSEVS 204	2
5. On Job Training	PSEVSOJT 205	4
Elective (Any one)		
1. Environmental Audit Or 2. Sustainable Tourism	PSEVSEL 206A Or PSEVSEL 206B	4

SEMESTER – I

Mandatory:-

PSEVS 101 Environmental Biology (Credits: 4)

Course Objectives:

1. Gain foundational understanding of ecology, its core principles, and various sub-disciplines like freshwater ecology, marine ecology, etc.
2. Explore the concept of the biosphere and different ecosystems, including their characteristics, structures, and functions.
3. Analyze the interactions between populations within an ecosystem, including competition, predation, and symbiotic relationships.
4. Understand the concept of carrying capacity and its role in population dynamics.
5. Examine the organization of ecological systems, focusing on energy flow, food webs, and ecological pyramids.
6. Investigate biogeochemical cycles, including their importance and impact on the environment.
7. Analyze the process of ecological succession, both primary and secondary, and its implications for ecosystem development.

Course Outcomes:

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

1. Explain the fundamental ecological concepts and differentiate between various ecological sub-disciplines.
2. Describe the structure and function of different ecosystems, including their biotic and abiotic components.
3. Analyze the interactions between populations within an ecosystem and their ecological significance.
4. Assess the carrying capacity of an ecosystem and its influence on population growth.
5. Explain the flow of energy and transfer of matter through an ecosystem using food chains, food webs, and ecological pyramids.
6. Evaluate the importance of biogeochemical cycles and their contribution to a healthy environment

7. Analyze the process of ecological succession and its role in shaping ecosystems over time.

Unit I (10L)

Ecology: Definition, principle and scope of ecology, aquatic and terrestrial ecology, freshwater ecology, marine ecology, estuarine ecology, Community concept, types of community, succession process, competition and Coexistence, types of interactions: predation, parasitism, antibiosis, commensalism, cooperation and mutualism, population growth.

Unit II (20L)

Concept of Biosphere and Ecosystem: Biomes, Population parameters, structure, Growth Regulation, Interaction between populations, life, history, strategies. Types of ecosystem, eco system of India, Characteristics of eco system, structure of ecosystem and function of an ecosystem, population Dynamics, Carrying capacity. Abiotic and Biotic environment, limiting factors, adaptation, Habitat and niche, nature of environment. Littoral Zones: Fauna of intertidal zones, their distribution and adaptations, ecological importance of mangrove vegetation, distribution of mangrove areas in India, salinity ingress in coastal areas. Marine Environment: Biota in different types of zones, its diversity-plankton, nekton, benthos, their adaptations and productivity, Indian marine territory, Exclusive Economic Zones (EEZ) Dynamic biogeography: routes of migration of plants and animals, their impact on local ecosystems, trade routes, shipping, accidental import, weeds, ballast water.

Unit III (15L)

Organization of Ecological systems: Ecosystem components, Producers, consumers and decomposer, Food chains, food web and ecological pyramids, Biotic and abiotic components, Ecological pyramids, Bioaccumulation and biomagnification, mass and energy transfer in successive trophic level.

Unit IV (15L)

Energy and Ecological succession: Flow and energy fixation, construction of ecological pyramids. Biogeochemical cycles: Hydrological cycles, carbon cycle, oxygen cycle, nitrogen cycle, sulfur cycle, phosphorus cycle-its importance and applications. Primary succession, secondary succession and ecological climax, impacts of development of ecosystem, population, community ecology, predator and prey relationship.

References:

1. E. P. Odum (1996) Fundamentals of Ecology, Nataraj Publisher, Dehra Dun.
2. K. M. M. Dakshini (1999) Principle and Practices in Plant Ecology, CRC, Boston.
3. M. C. Dash (1994) Fundamentals of Ecology, Tata McGraw Hill, New Delhi.
4. M. C. Molles Jr. (1999) Ecology- Concepts and Application, McGraw Hill, New Delhi.
5. V. Ingegnoli (2002) Landscape Ecology: a widening foundation, Springer, Bonn.
6. E. J. Kormondi (1999) Concepts of Ecology, Prentice Hall of India, New Delhi.
7. Chapman, J.L. and Reiss M.J. (2005) Ecology Principles and Applications, Cambridge University Press, London.
8. E. P. Odum and G. W. Barrett (2005) Fundamentals of Ecology, Thomson Asia Pvt. Ltd., Singapore.
9. S.V.S. Rana (2005) Essentials of Ecology and Environmental Sciences, Prentice Hall of India, New Delhi.
10. Environment And Ecology-EAS105/EAS 205-R.Rajagopalan
11. Environmental Studies from Crisis to Cure-2nd Edition-R. Rajagopalan
12. Environmental Biotechnology-Alan Scragg, Oxford University Press.

PSEVS 102**Environmental Pollution & Pollution Control Technology (Credits: 4)****Course Objectives:**

1. Understand the fundamental concepts of environmental pollution, its various types, sources, and global impact.
2. Gain knowledge about the causes and effects of air and water pollution, including the reactions and interactions of pollutants in their respective environments.
3. Explore the detrimental effects of pollution on soil, noise levels, and thermal balance, along with the associated health hazards.
4. Identify the sources, management, and disposal methods for solid waste, radioactive waste, and electronic waste.

5. Analyze existing pollution control technologies and their applications in addressing different environmental issues.

Course Outcomes:

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

1. Critically evaluate the sources and consequences of environmental pollution on various ecosystems.
2. Apply their knowledge to analyze and discuss the chemical and biological impacts of pollutants.
3. Propose potential solutions and mitigation strategies for controlling air, water, and soil pollution.
4. Assess the environmental implications of waste generation and propose sustainable waste management practices.
5. Evaluate the effectiveness of existing pollution control technologies and explore future advancements in this field.

Unit I

(20L)

Introduction to Environmental pollution, Air and Water Pollution: Definition and sources of pollution; Different types of pollution and their global, regional and local aspects. Types and sources of air pollutants; Reaction of pollutants in air forming smog, PAN, Acid rain; Atmospheric diffusion and stackperformance; Transport of pollutants; Effects of air pollutants on flora and fauna; Sinks of atmospheric gases. Sources of water and their contamination; Types of pollutants, various industrial effluents such as pulp and paper mills, oil exploration and refinery, petrochemicals, iron and steel industries, domestic wastes ,organic debris, agricultural wastes, pesticides; Eutrophication - causes and effects and control measures.

Unit II

(10L)

Soil pollution and solid waste pollution: Causes of soil pollution; Effects of Fungicides and weedicides on soil components, residual toxicity and pollution. Different kinds of synthetic fertilizer (N, P, K), and their interactions with different components of soil, their toxicity and pollution. Industrial effluents and their interactions with soil components, Contamination by radio nuclides. Solid waste pollution: sources, nature, classification and environmental effects.

Unit III

(15L)

Radiation and Noise pollution: Radioactive decay; Interaction of radiation with matter; Biological impact and health hazards associated with radiation, Units of radioactivity and radiation dose; Protection against ionizing isotopes and their applications in waste water and air pollution analysis and treatment; Radioactive waste disposal. Basic properties of sound waves – plane and spherical waves, sound pressure, loudness and intensity levels, decibel; Sources of Noise Pollution–Measurement and analysis of sound, Measures to control noise pollution.

Unit IV

(15L)

Thermal pollution, Oil Pollution and Electronic waste (E-waste): Definition and sources, Chemical and biological effects of thermal pollution, Effect on marine life, bacteria and water quality and other aquatic biota; Thermal pollution from power plants and their control. Oil pollution and marine ecology, sources of oil pollution, factors effecting fate of oil after spillage movement, spreading, evaporation, emulsification, dispersion, remote sensing in water quality monitoring. Sources and types and constituents of E-wastes and its environmental consequences.

References:

1. J. N. B. Bell (2002) Air Pollution and Plant Life, 2nd Edition, John Wiley and Sons, New Delhi.
2. Christon J. Hurst, Ronald L. Crawford, Guy R. Knudsen, Michael J. McInerney, Manual of Environmental Microbiology, 2nd edition, ASM Press. 2001.
3. Bruce Rittman, Perry L. McCarty. Environmental Biotechnology: Principles and Applications, 2nd Edition, McGraw-Hill, 2000.
4. Air Pollution – Stern
5. Environmental Pollution Control Engineering: C. S. Rao
6. Environmental Chemistry : B.K. Sharma, and H. Kaur
7. Air pollution – threat and response: D. A. Lynn
8. Air pollution and Environmental Protection – Legislative policies, Judicial trend and Social perceptions: N. Kumar; Mittal Publication

PSEVSP 103
Practical of PSEVS 101 & PSEVS 102 (Credits: 4)

Practical of PSEVS 101

A. Minor Experiments

1. Determination of diversity indices in plant communities.
2. To construct ecological pyramids of population sizes in ecosystem.
3. Determination of Chlorophyll content from plant species.
4. Determination of Harvest method from plant species.

B. Major Experiments

1. Determination of Importance value index of species in a plant community.
2. To compare two plant communities
3. Quantitative measurement of plankton in fresh and marine water samples.
4. Determination of primary productivity by light and dark bottle method.

Practical of PSEVS 102

A. Minor Experiments

1. Determination of Total Dissolved Solids from the lake water.
2. Determination of Total Hardness of well water.
3. Study the effect of heavy metals on the growth of bacteria.
4. Determination of MPN value of the drinking water and mineral water.

B. Major Experiments

1. Determination of physical parameters of (I) Well water (ii) Industrial of given type effluent (iii) River water (iv) Sea water.
2. Determination of Dissolved Oxygen from Sea water by Winkler's method.
3. Determination of SO₂ by spectrophotometry using high volume sampler.
4. Determination of NO₂ from the atmosphere by Colorimetric method using high volume sampler.

PSEVS 104
Environment and Natural Resources (Credits: 2)

Course Objectives:

1. Categorize natural resources based on their renewability and origin (renewable vs. non-renewable, sunlight vs. minerals).
2. Analyze the threats to natural resources, including overexploitation, pollution, climate change, and land degradation.
3. Evaluate resource conservation methods, such as reduce, reuse, recycle, sustainable extraction, energy conservation, and integrated management approaches.
4. Explore the concept of ecosystem services and natural capital in relation to sustainability. This includes understanding how resources provide benefits like food production, climate regulation, biodiversity support, and recreation, and how these services contribute to economic growth, environmental protection, and social well-being

Course Outcomes:

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

1. Students will be able to distinguish between different natural resources, identifying their characteristics and significance.
2. Students will understand and examine the concept of natural capital and its importance for sustainable development.

Unit I **(15L)**

Introduction to Natural Resources: Natural resources, Renewable Resources: sunlight, wind, water, forests, food and wildlife, Non-renewable Resources- coal, oil, and natural gas, and minerals. Causes of Degradation: Overexploitation, Pollution, Climate Change, Land Degradation. Methods of Resource Conservation; Reduce, Reuse, and Recycle, Sustainable Extraction and Harvesting, Energy Conservation, Integrated Management of Land, Water, forest, Nuclear Energy

Unit II **(15L)**

Ecosystem Services and Natural Capital for Sustainability: Resources for production, regulating climate and water cycles, supporting biodiversity, and offering recreational and cultural benefits. Economic growth with environmental protection and social well-being. Ecosystem Services- Provisioning services, Regulating Services, Supporting Services, Cultural

Services, Agricultural Resources and Sustainable Economy, Natural Resources and tourism development.

References:

1. Environmental studies by R. Rajagopalan, Member, Governing Board, International Ocean Institute, Malta, Oxford University Press
2. Renewable Energy - Environment and Development by Mhaeshwar Dayal, Konark Publication Private Limited
3. Non-Conventional Energy sources by S. N Kaul, A. R Bhalerao, R. K Trivedy, Current Publication
4. Fundamentals of Ecology by Madhab Chandra Dash, Satya Prakash Jha, Tata Mcgraw Education Private Limited
5. Environmental Policy - Neil Kheti, Oxford book company
6. Environment and Development -B N Pandey and G K Kulkarni, A. P. H. Publishing Corporation
7. Green Energy Technologies - Utkarsh Sharma, Jnanada Prakashan

PSEVSRM 105
Research Methodology (Credits: 4)

Course Objectives:

1. Grasp the fundamental concepts of research methodology.
2. Develop skills in research design.
3. Master methods of data collection.
4. Enhance skills in data interpretation and report writing.

Course Outcomes:

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

1. Critically approach research questions and effectively frame a research problem.
2. Design a research study using appropriate methodologies and sampling techniques.

3. Collect and analyze primary data through various methods.
4. Interpret research findings and communicate them clearly through written reports and presentations.

Unit I (15L)

Research Methodology: An Introduction, meaning of research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, and Importance of Knowing how Research is done. Defining the Research Problem: What is Research Problem? Selecting the Problem? Necessity of Defining the Problem.

Unit II (15L)

Research Design: Need for Research Design, Features of a Good Design, Important Concept Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs. Sampling Design; Census and Sample Survey, Implications of a sample Design, Steps in Sampling Design, Criteria for Selecting a Sampling Procedure, Characteristics of a Good Sample Design.

Unit III (15L)

Methods of Data Collection: Collection of Primary Data: Collection of Data through Questionnaires, Collection of Data through Schedules, Different between Questionnaires and Schedules. Selection of Appropriate Method for Data Collection; Case Study Method, Appendices (i): Guidelines for Constructing Questionnaires/ Schedule, (ii): Guidelines for Successful Interviewing, (iii): Difference between Survey and Experiment.

Unit IV (15L)

Interpretation and Report Writing: Interpretation and Report Writing: Meaning of Interpretation, Why Interpretation? Technique of Interpretation: Precaution in Interpretation, Significance of Report Writing. Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precaution for Writing Research Reports.

References:

1. Ahuja, Ram (2014). Research methods. Jaipur: Rawat Publications.
2. Babu, G. Ramesh (2008). Research methodology in social sciences. New Delhi: Concept Publishing.

3. Burns, Robert B. (2000). Introduction to research methods. London: Sage Publications.
4. Rajendar Kumar : Research Methodology, APH Publishing
5. Kumar R. Research Methodology: A Step by Step Guide for Beginners. 3rd Ed. London: Sage Publications; 2011.
6. Kothari CR. Research Methodology: Methods and Techniques. 2nd Ed. New Delhi: New Age International (P) Ltd; 2004. Tests of sound measurement.
7. Rastogi VB, editor. Biostatistics. 3rd Ed. New Delhi: Medtech Publications; 2015. Statistical data;
8. Ali Z, Bhaskar SB. Basic statistical tools in research and data analysis.
9. Kothari, C. R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
10. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nd.ed), Singapore, Pearson Education
11. Shajahan S. : Research Methods for Management, 2004
12. The SAGE Handbook of Qualitative Research (Sage Handbooks) 4th Edition, by Norman K. Denzin (Editor), Yvonna S. Lincoln (Editor)

Elective (Any One):-

PSEVSEL 106A Environmental Economics (Credits: 4)

Course Objectives:

1. Analyse the interconnections between economic activities and the environment.
2. Evaluate the relationship between economic growth, resource exploitation, and sustainability.
3. Examine the concept of sustainable development and its economic implications.
4. Analyse the economic theory behind environmental regulations and their implementation.

Course Outcomes:

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

1. Explain the interconnectedness of the economy and the environment and identify potential market failures related to environmental issues.
2. Critically assess the impact of economic growth and resource exploitation on environmental sustainability.
3. Articulate the concept of sustainable development and propose strategies for achieving it through economic policies and reforms.
4. Evaluate the effectiveness of various environmental regulations based on economic principles and their implementation methods.

Unit I (15L)

The Economy and the Environment: Two Parts of a Whole – Interlinkages between the economy and the environment. Micro Foundations of Environmental Economics - Theory of Public goods, Externalities and Market failure – The Problem of Social Cost - Design of Environmental Policy.

Unit II (15L)

Economic growth, exploitation and sustainability: Economic Growth and the Environment: Environmental Kuznets' curve, Foreign Direct Investment Inflow and the Environmental quality. Economics of Natural Resource Exploitation – Renewable and Non-Renewable Resources – Methods of valuation of Environmental Costs and Benefits. Sustainable Development: Concept of and issues in Sustainable Development, Strategic Planning for Sustainable Development,

Economic reforms and sustainable development.

Unit III (15L)

The economics of environmental regulations: Regulating the environment through judicial procedures, regulating the environment, through pollution tax, regulating the environment, through markets for pollution permits

Unit IV (15L)

The economic theory and measurement of environmental damage (benefit): The economics of atmospheric pollution, valuing the environment, framework for assessing the worthiness of environmental project; cost benefit analysis, population, development and environmental degradation in the developing

References:

1. Vijay Kulkarni and T. V. Ramachandra, 2006. Environment Management, Commonwealth of Learning, Canada, Centre for Ecological Sciences, Indian Institute of Science, Karnataka Environment Research Foundation. TERI press.
2. Environmental Economics for Non-Economist, John Asafu Adjaye, World scientific publishing Co Pvt. Ltd., 1999
3. Arrow, K.J. and Scitovsky, T., Readings in Welfare Economics Part III, 1969.
4. James, D.E., Economic Approaches to Environmental Problems: Techniques and Results of Empirical Analysis, Elsevier Scientific Publishing Co., 1978.

PSEVSEL 106B

Wildlife Conservation & Management (Credits: 4)

Course Objectives:

1. Grasp the fundamental concepts of wildlife and its management.
2. Explore various conservation methods and species management strategies.
3. Develop critical thinking skills for analyzing conservation challenges.
4. Gain knowledge about human-wildlife interactions and sustainable practices.

Course Outcomes:

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

1. Students will learn about the fundamental concepts of wildlife and management.
2. They can understand the conservation methods and about issues related to habitat fragmentation and management of threatened species and populations.
3. They will develop critical thinking to recognize factors that complicate solutions to current conservation difficulties.
4. They will get to know constitutional foundations of wildlife laws.
5. They will be able to analyse and assess wildlife threats
6. They will be able to pursue a career in wildlife conservation or related research.

Unit I

(15L)

Basic concepts of Wildlife: Definition and basic concepts of wildlife, Scope of wildlife, importance of wildlife, Values of wildlife: Positive values (recreational, aesthetic, educational, scientific, ecological, utilitarian, commercial, cultural etc.) and negative values (accidents, life stock and crop damage, disease reservoirs); measurement and attitude survey of wildlife values. Conservation, preservation, protection, Concept of species extinction, Causes of extinction/depletion (Hunting, destruction of habitat, cleanliness, migratory routes, exotic species, low fecundity, Industrial/environmental pollution, Economic considerations), Rare, Threatened and Endangered species, causes for endangering the species (Habitat disturbances, predator and pest control, pollution). Species Conservation Techniques: In situ conservation (Biosphere Reserves, National Parks, Wildlife Sanctuaries, Conservation Reserves, Community reserves, Sacred Habitats), Ex-situ conservation (Botanical & Zoological Gardens, Gene Banks, Seed and Seedling Banks, Pollen Culture, Tissue Culture and DNA banks, Butterfly Gardening);

Unit II

(15L)

Wildlife Resources in India and Its Management: Need and ecological basis of wildlife management, concept of carrying capacity, Species conservation projects in India- Initiation, Finance, Objective, Management, Status, Threats (Tiger, Rhino, Lion, Turtles, Crocodiles, Birds, Coral reefs etc.), Estimation of wildlife and its habitat, Planning of Wildlife Management (Wildlife Census, Measurement of Productivity, Diagnosis of control measures, treatment); Problems in Wildlife Conservation and management, Management of National Parks and

Sanctuaries, Management measures (Wildlife habitats, Protection, Biotic interference, Forestry operation, use of fire, effects of Silvicultural practices on the status of Wildlife), National Park- Future plan and strategy. Observation and survey techniques: Ethics in Field Studies, Data handling: Methods of recording field observations; Essential Field kit and its usage; Data analysis

Unit III (15L)

Legal aspects in wildlife management: International and National Organizations in Wildlife Conservation: Government Organizations- CITES, Global Tiger Forum (GTF); Non-Government Organizations – Worldwide Fund for Nature (WWF), Bombay Natural History Society (BNHS), Wildlife Preservation Society of India (WPSI), Indian Board for Wildlife (IBWL), International Union for Conservation of Nature and Natural Resources (IUCN), Conservation Breeding Specialist Group (CBSG), Species Survival Commission (SSC), Population and Habitat Viability Assessment (PHVA), Conservation Assessment and Management Plan (CAMP). Indian Wildlife (Protection) Act, 1972, Concept of Schedule in Wildlife Protection; Indian Biodiversity Act 2002; IUCN Red list of Threatened Species; The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

Unit IV (15L)

Human-wildlife interaction: Man-animal conflict in India; Human-wildlife Coexistence; Eco-tourism; Wildlife Crimes, Mortality and Decimating factors (Wildlife diseases, adverse climate, accidents, poisoning, human interference, Illegal hunting, stress, starvation, movement). Wildlife Tourism and its impact on wildlife. Sustainable Utilization of Biodiversity Resources, Wildlife Photography, Field techniques for identification of plants, mammals, birds, herpetofauna, indigenous fishes, butterflies in field

SEMESTER-II

PSEVS 201

Environmental legislation, monitoring and Disaster Management (Credits: 4)

Course Objectives:

1. Understand the concept of environmental monitoring and its importance.
2. Gain knowledge about Environmental Impact Assessment (EIA) and its application.
3. Develop a comprehensive understanding of environmental legislation in India.
4. Gain knowledge about disaster management principles and practices.

Course Outcomes:

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

1. Design and implement environmental monitoring programs to assess environmental quality.
2. Conduct Environmental Impact Assessments for proposed projects, considering potential environmental impacts and proposing mitigation strategies.
3. Analyze and interpret environmental legislation in India, applying relevant laws to specific situations.
4. Develop and implement disaster management plans, incorporating prevention, mitigation, preparedness, response, and recovery phases.

Unit I (15L)

Environmental Monitoring: What is environmental quality? Quality of environment for life on earth and man; Advantages of Environmental Monitoring, Deterioration of environmental quality concerning anthropogenic impact; Methods of assessment of environmental quality; Short-term study/surveys; Rapid assessment; Continuous short and long term monitoring, Sampling – Types, methods for Air, Noise, Soil, Water sampling and equipment.

Unit II (15L)

Environmental Impact Assessment (EIA): Need of EIA; Scope and objectives; Types of environmental impacts; Steps involved in conducting the EIA Studies; Environmental Impact Assessment techniques method, checklist method, overlay mapping method, network method, simulation and modeling technique, matrix method, and system diagram technique; Merits and Demerits of EIA studies. Understanding the process of Environmental Clearance (Parivesh 2.0)

Unit III

(15L)

Environmental Laws in India: Indian Forest Act, 1927; Factories Act, 1948; the Mines and Minerals Act, 1957; The Wildlife Protection Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest Conservation Act, 1980; The Air Act (Prevention and Control of Pollution), 1981; The Environment Protection Act, 1986; Motor Vehicles Act, 1988; The National Environment Appellate Authority Act, 1997; The Biodiversity Act, 2002; Coastal Regulation Zone Notification, 2011; Biomedical Waste Management Rules, 2016; Solid Waste Management Rules, 2016. The National Green Tribunal Act, 2010. The Hazardous Wastes (Management and Handling) Rules, 1989, the E-Waste (Management) Rules, 2016. The Plastic Waste Management Rules, 2016. Environmental standards- EPA, CPCB, BIS, WHO, NAAQS

Unit IV

(15L)

Disaster Management: Concept of disaster, Types of disaster, and its characteristics. Impact of disaster- physical, psychological, economic, social. Overview of disaster management, Disaster Management Plan (DMP)- Phases of DMP- Prevention, Mitigation, Disaster Preparedness, Response, Recovery, Implementing DMAP, Training and evacuation drills Human Rights issues in addressing disaster, Role of National Disaster Management Authority (NDMA), Disaster Management Act, 2005, National Policy on Disaster Management(NPDM). Case Study of Natural and Industrial Disaster

References:

1. D. P. Lawrence (2003) Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley and Sons, New Delhi.
2. Environmental Impact Analysis Handbook: J. G. Rau and D. C. Wooten; McGraw-Hill Book Co.
3. Environmental Impact Assessment, L. W. Canter, Mc Graw Hill Publication.
4. P. Morris and R. Therivel (2001), Methods of Environmental Impact Assessment, Spoon Press.
5. J. Weston (1997) Planning and EIA in Practice, Longman.
6. Jos Arts and Angus Morrison-Saunders (2004) Assessing Impact - Handbook of EIA and SEA follow-up, Earthscan, London.
7. website of MoEF, GOI, New Delhi
8. Srivastava, D. C. (2005) Readings in Environmental Ethics: Multidisciplinary

perspectives, Rawat Publications, Jaipur.

PSEVS 202
Instrumentation and Biostatistics (Credits: 4)

Course Objectives:

1. Grasp the fundamentals of environmental monitoring and sampling.
2. Develop skills in instrumental methods for environmental analysis.
3. Explore advanced instrumental methods for environmental analysis.

Course Outcomes:

1. To understand about the Environmental Monitoring
2. To obtain basic capability in skills and functional knowledge to carry out Environmental Impact Assessment based project

Unit I **(15L)**

Environmental Monitoring and Sampling: Define environmental monitoring, its types and its significance, Methods of physical characterization of samples, Sampling of air, water and soil:- Protocol and methods of sampling, sampling devices, factors affecting sampling, Preservation, storage and processing of air, water and soil samples

Unit II **(15L)**

Instrumental methods of environmental analysis: Conductometry, Potentiometry, Voltammetry: principal, working, applications, Colorimetry and spectrophotometry: Electromagnetic radiation spectrum. Interaction of radiation with matter. Beer- Lambert's law, Flame photometry, spectrophotometry, Conventional microscopy and scanning electron microscopy, hyphenated techniques for analysis – AAS, GC-MS, HPL, GC-AES. Electrophoresis: Theory, classification, instrumentation and applications.

Unit III **(15L)**

Instrumental methods of environmental analysis: Principle, instrumentation, and environmental applications of Neutron Activation Analysis, X-ray fluorescence, X-ray diffraction, and Thermogravimetry, Continuous monitoring analysis – fluorescent analyzer for SO₂, chemiluminescent analyzer for NO_x, NDIR for CO, Flow injection analyzer.

Unit IV

(15L)

Statistical Aspects: Data Collection and Preparation: Collection, Classification, and Tabulation of Data, Diagrammatic and Graphical Representation of Data (Histograms, box plots, bar charts, pie charts, scatter plots, picots, frequency polygons, frequency curves, and cumulative curves) Sampling Methods (Simple random sampling, stratified sampling, cluster sampling, systematic sampling), Survey Design, Handling Missing Data, Data Transformation: Normalization and standardization of data, Descriptive Statistics:- Measures of central tendency and dispersion(Mean, Median, Mode), Measures of Dispersion:- Range, Variance, standard and relative deviation, Coefficient of Variation, Skewness, Kurtosis Confidence Limits and Confidence Intervals and Standard Distribution Curve, Analysis of Variance One Way and Two-Way Classification, Probit Analysis, Testing of Hypothesis: - Accuracy, precision, and errors (Type I and Type II Error), Classification and Minimisation of errors (Random and Systematic), and Data Rejection. Z, t, F, and chi-square tests, Data cleaning and processing, Correlation and Regression: Pearson's coefficient, Spearman's coefficient, regression lines and their use. Curve fitting, Probability: Exclusive and independent events, addition and multiplication theorems, dependent events and conditional probability

References:

1. Fulekar, M. H. and BhawanaPathak "Bioinstrumentation" I K International Publication, New Delhi, 2013.
2. Willard. H., Merritt, L., Dean, D.A. and Settle F.A., 'Instrumental Methods of Analysis', 7th edition, Wordsworth, New York, 1998.
3. Galen. W. Ewing, 'Instrumental Methods of Chemical Analysis 5th edition, McGraw Hill, New York., 1995.
4. Roger Reeve, Introduction to Environmental Analysis, John Wiley & Sons Ltd, 2002
5. Fundamentals of Analytical chemistry, D.A. Skoog, D.M. West and F.J. Holler, Harcourt Asia PTE. Ltd., 7th edition, New Delhi, 2001.
6. APHA standard methods for Water and Wastewater Examination, 20th Edition, Washington, 1998.

PSEVSP 203
Practical of PSEVS 201 & PSEVS 202 (Credits: 4)

Practical of PSEVS 201

A. Minor Experiments

1. Interpretation of Aerial photographs and preparing weather report based on it.
2. Determination of relative humidity from the atmosphere.
3. Determination of particulate matter from the industrial area by High Volume Sampler/
Settling method.
4. Determination of Salinity of water by volhard's method.

B. Major Experiments

1. Determination of Cation-exchange capacity, moisture content, alkalinity/acidity of soil sample.
2. To prepare the station based wind rose for an area.
3. Determination of Residual Chlorine from drinking water using colorimetric method.
4. Determination of hydrocarbon from fuel gas using Orsat's apparatus.

Practical of PSEVS 202

A. Minor Experiments

1. Estimation of Chloride in water sample by conductometric titration.
2. Estimation of Fe +2 by potentiometric titration.
3. Determination of mean, median, mode, geometric mean, range, quartile using a given data
4. Determination of standard deviation, variance, coefficient of variation, skewness, kurtosis using a given data

B. Major Experiments

1. Separation of proteins using Polyacrylamide Gel Electrophoresis.
2. Determination Pesticides in soil/plants by GC-MS.
3. Analysis of a given data by t- test/ f test,
4. Analysis of a given data by z test /Anova

PSEVS 204
Environmental Policies and Regulations (Credits: 2)

Course Objectives:

1. Gain a comprehensive understanding of environmental legislation and regulations in India
2. Develop knowledge about international environmental treaties and conventions.

Course Outcomes:

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

1. Explain the fundamental principles and legal framework for environmental protection in India, including national and international regulations.
2. Analyze the role of various stakeholders, including government agencies, international organizations, and individuals, in environmental protection efforts.
3. Evaluate the effectiveness of specific environmental laws, regulations, and policies in addressing environmental challenges.

Unit I (15L)

Introduction to Acts and Rules Legislations and its Amendments: Fundamental principles of environmental protection - sustainable development- Brundtland report 1987, Intergenerational and intra-generational Equity, Polluter pays principle, precautionary principle, Public Trust Doctrine, Constitutional Perspective: Fundamental right to wholesome environment. Directive principles of state policy. Fundamental duty, National Environmental Policy, Environmental Regulatory Framework in India, Role of International Environmental Agencies -UNEP, GEF, UNFCCC and IPCC, EPA and its Regulations, E-waste Management and Handling Rules 2011, Plastics Manufacture, Sale and Usage Rules, 2011, Recycled Plastics Manufacture and Usage Rules, 1999, VEANA convention,, Earth Summit and Kyoto protocol-related agreements for climate action, Heat action plan, Smart city policy, Environmental NGT, Single-use plastic ban notification

Unit II (15L)

International Treaties and Conventions: Stockholm Conference on Human Environment, 1972, Ramsar Convention on Wetlands, 1971, Montreal Protocol, 1987, Basel Convention (1989, 1992), Earth Summit at Rio de Janeiro, 1992, Kyoto Protocol, 1997, Earth Summit at

Johannesburg, 2002, Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Convention on Desertification 1996, Convention on Biodiversity & Cartagena Protocol on Bio safety, Climate Change and Agreements, Paris Agreement, CERP

References:

1. Shyam Divan and Armin Rosencranz, 2005, Environmental Law and Policy in India, Oxford University Press, New Delhi, 2005
2. Leelakrishnan. P, 2008, Environmental Law Case Book ,Lexis Nexis, Butterworths
3. Mohanty. S. K., 2011, Environment and Pollution Law, Universal Law Publishing Co.Pvt. Ltd.
4. Shastri S C, 2008, Environmental Law, (2nd Edn.), Eastern Book Company, Lucknow
5. Singh Gurdip, 2004, Environmental Law in India, Mcmillan & Co.
6. Shantakumar S,2005 Introduction to Environmental Law, (2nd Edn.), Wadhwa& Company, Nagpur
7. Sahasranaman P B, 2008 Handbook of Environmental Law in India, Oxford University Press (India)

PSEVSOJT 205

OJT/FP (On Job Training, Internship/Apprenticeship/Field Project) (Credits: 4)

Course Objectives:

1. Develop practical skills in research methodologies and techniques
2. Enhance professional communication and presentation abilities
3. Deepen understanding of research ethics and professional conduct
4. Broaden knowledge and career exploration in a chosen field.

Course Outcomes:

By successfully completing the OJT/RP/FP (On-the-Job Training/Research Project), students will be able to:

1. Apply research methodologies and techniques learned in coursework to real-world settings.
2. Effectively communicate research findings in written and oral formats.

3. Demonstrate professional conduct and adhere to ethical research practices.
4. Gain valuable insights into potential career paths within their chosen field.

(OJT/RP) Students are expected to spend a minimum of 30 days (120 hours) during their semester break under the guidance of a competent professional/ scientist at a research institute or research centre with the aim of learning techniques and their applications Or internship in industry/ consultancy/ NGO. The assessments should be based on supervisor's feedback, submission of a training report and an open presentation and Viva voce. The evaluation of this training will be conducted in accordance with University of Mumbai guidelines for the "On-job-training for Post Graduate students as per NEP 2020 with effect from 2023-2024." (<https://mu.ac.in/wp-content/uploads/2024/06/MU-OJT-Guidelines-Draft.pdf>)

Elective (Any One):-

PSEVSEL 206A Environmental Audit (Credits: 4)

Course Objectives:

1. Grasp the concept and significance of environmental auditing.
2. Explore various environmental audit types, methodologies, and processes
3. Gain expertise in specific types of environmental audits
4. Develop a comprehensive understanding of Environmental Management Systems (EMS) and Life Cycle Assessment (LCA)

Course Outcomes:

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

1. Conduct comprehensive environmental audits for various purposes, considering relevant regulations and best practices.
2. Analyze and interpret environmental audit data to identify areas for improvement and ensure compliance.
3. Develop and implement effective strategies for waste minimization and pollution prevention.
4. Integrate environmental management systems and life cycle assessment principles into sustainable business practices

Unit I (15L)

Environmental Audit- scope and requisites: Environmental Audit: Definition; Objectives; Scope, Coverage - GOI Notification on Environmental Audit - Benefits to Industry. Reporting Environmental Audit Findings - Importance of Environmental Audit Reports to industry, the public, and the governments.

Unit II (15L)

Audit Types, Methodology and Process: Types of Environmental Audits: Objectives-Based Audits, Client-Driven Audits, Internal vs. External Audits, General Audit Methodology: Introduction to Audit Methodology, Basic Steps of an Environmental Audit Program, Audit Process: Elements of Audit Process, Developing an Audit Plan, Data Collection Techniques, Data Analysis and Interpretation, Reporting and Documentation. Audit Protocols: planning and scoping, data collection and review, evaluation and analysis, reporting, ISO 14001:2015:

overview, Key Requirements and Clauses, Implementation and Certification Process, Integration with Environmental Audits

Unit III (15L)

Specific Types of Audits: Waste Audits and Pollution Prevention Assessments: Definition and Objectives, Methodologies, Case Studies and Examples Waste Minimization Audits: Techniques and Strategies, Examples and Case Studies, Site Assessment and Liability Audits: Purpose and Scope, Methodologies, Legal and Regulatory Considerations.

Unit IV (15L)

EMS and LCA: Environmental Management Systems Definition and scope, Goals and purposes of EMS, Planning, Implementation, Review and Improvement (Plan, do, check, act model), Benefits of EMS Environmental benefits, economic benefits, Costs associated with EMS. Life Cycle Analysis Definition, Goals and purpose, Stages in product LCA, Procedure for LCA- defining the goal and scope, analyzing the inventory, assessing the environmental impact and evaluating the environmental profiles, LCA uses and tools, Variants of LCA

**PSEVSEL 206B
Sustainable Tourism (Credits: 4)**

Course Objectives:

1. Recognize the importance of sustainable tourism practices
2. Analyze sustainable tourism principles

Course Outcomes:

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

1. Students will demonstrate the ability to critically analyze and articulate the concept of sustainable tourism, evaluating its relevance to sustainable development.
2. Students will be able to comprehend the fundamental concept of tourism and recognize the imperative for adopting sustainable practices within the tourism industry.

Unit I (15L)

Tourism and Sustainability: Basic concept of tourism, Types of Tourism, and challenges faced for tourism development in India. Impacts of Tourism- Positive and negative- Social, Environmental, Cultural, and Economic, The Incredible India campaign, Need for sustainability in the tourism sector. Triple bottom line approach for tourism development, National Strategy for

Sustainable Tourism (GOI)

Unit II (15L)

Sustainable approach to tourism: Concept of sustainable tourism, Example of Sustainable tourism, Ecotourism – A case study. Role of UNWTO for the promotion of sustainable tourism in the world, One Planet Sustainable Tourism Programme, Tourism for SDGs, Role of the Responsible Society of India for promoting sustainable tourism, Role and responsibilities of Government, NGO, Service industry, and tourists. Case study, Kerala, Sikkim, Role of Ministry of Tourism – National Tourism Policy, Sustainable Tourism Criteria for India (STCI)

Unit III (15L)

Challenges and Opportunities of Ecotourism: Definition and Principles of Ecotourism, History, and Evolution of Ecotourism, Differences Between Ecotourism and Other Forms of Tourism, Role of Ecotourism in Biodiversity Conservation, Case Studies of Ecotourism contributed to habitat restoration, species protection, and sustainable community development. Business models, marketing strategies, policies, regulations, and impact assessments, Challenges and technological innovations in ecotourism, Future of Ecotourism, Strategies for promoting ecotourism

Unit IV (15L)

Geo Tourism and Heritage Tourism: Definition, principles and importance of heritage tourism, Overview of India's cultural heritage Major cultural heritage sites Case studies: Taj Mahal, Jaipur City, Varanasi, Rajasthan's palaces, Kerala's temples. Overview of India's natural heritage Major natural heritage sites, Case studies: Western Ghats, Sundarbans, Nilgiri Biosphere Reserve, Government policies on heritage and geo-tourism, International guidelines and standards, Role of UNESCO and other organizations. Concept of Geo-tourism, Case studies, Lonar Lake, Valley of Flowers, Uttarakhand, Great Rann of Kutch, and Gujarat.

References:

1. "Tourism in India: An Overview" by Manoj Kumar Goyal
2. "Geotourism" by Ross Dowling and David Newsome
3. Introduction to Travel and Tourism by Lalitha Sharma, Centrum Press
4. Tourism Development Problems and Prospects by Meenakshi Thakur, Omega Publications
5. Tourism and Hospitality in the 21st Century, A. Lockwood and S. Medlik,

Butterworth Heinemann

6. Travel and Tourism Management by D. Sunita Maral, late Dr. Sachin Pendse, Dr. Chandani Bhattacharjee, Sheth Publishers Pvt. Lmt.
7. Ecotourism and Third World by Dr. Aradhana Salpekar, Jnanada Prakashan

Websites:

1. [UNWTO | World Tourism Organization a UN Specialized Agency](#)
2. [Home | Ministry of Tourism | Government of India](#)
3. <https://rtsoi.org/>
4. [MTDC | Maharashtra Tourism Development Corporation](#)

NOTE:-

Students should undertake field work and survey. The Students should visit different places to collect data to make survey and analyze. At least four places may be visited. The Places of visit could be: Lakes, rivers, estuary and marine, nature parks, water/ sewage/ Industrial effluent treatment plant, Solid waste dump, meteorological centre, mangrove vegetation, industries – food, pharmaceutical, petrochemical, fertilizer, paper, sugar, distillery etc. The students should also be encouraged to participate in the public lectures/ seminars/ workshops etc. on environmentrelated issues.

Reports on each of visit/ activity undertaken must be included in the journal.

Examination Scheme: M.Sc. Part I – Environmental Science (Sem I & II)

A) Theory Examination Pattern:

a) Internal Assessment (CA) – 50%- (for 4 credit theory paper of 50 Marks)

Particulars	Continuous Internal Assessment CA		Average Marks of Internal – I & Internal – II (Out of 50)
	Internal Test – I (Based on Unit-I, Unit-II)	Internal Test – II (Based on Unit-III, Unit-IV)	
Descriptive Type Exam	50	50	

Two internal examinations are conducted, the first at the middle of the semester, the second at the end of the semester. The average of both the marks is taken.

b) Internal Assessment (CA) – 50% (for 2 credit theory paper of 25 marks)

Particulars	Continuous Internal Assessment CA		Average Marks of Internal – I & Internal – II (Out of 25)
	Internal Test – I (Based on Unit-I)	Internal Test – II (Based on Unit-II)	
Descriptive Type Exam	25	25	

c) External Examination – 50% - 50 Marks paper pattern (for 4 credit theory paper)

Semester end theory examinations are conducted.

Duration - The duration of these examination is 2 hours.

Theory Question Paper Pattern: (for 4 credit paper of 50 marks)

All questions shall be compulsory with internal choice within the question.

Question	Options	Marks
Q. 1	Any 2 out of 4 (Unit I)	10
Q. 2	Any 2 out of 4 (Unit II)	10
Q. 3	Any 2 out of 4 (Unit III)	10
Q. 4	Any 2 out of 4 (Unit IV)	10
Q. 5	Any 4 out of 8 (Short notes based on Unit I, II, III, IV)	10
	Total	50

d) Theory question paper pattern: (for 2 credit paper of 25 marks)

Duration – Duration of these exam is one hour

Question	Options	Marks
Q. 1	Any 2 out of 4 (Unit I & II)	9
Q. 2	Any 2 out of 3 (Unit I)	8
Q. 3	Any 2 out of 3 (Unit II)	8
	Total	25

B) Practical Examination Pattern:

a) Internal Assessment (CA) – (Practical 50%) for 50 marks

Particulars	Continuous Internal Assessment CA		Average Marks of Internal – I & Internal – II (Out of 50)
	Internal Test – I	Internal Test – II	
Practical (1 Major of 25 marks, 1 Minor of 15 marks)	40	40	
Journal (05) + Viva (05)	10	10	
	50	50	

Two internal examinations are conducted, the first at the middle of the semester, the second at the end of the semester. The average of both the marks is taken.

b) External Assessment (Practical 50%) for 50 marks

Sr. No.	Evaluation Type	Total Marks
1	Practical (1 Major of 25 marks, 1 Minor of 15 marks)	40
2	Journal (05) + Viva (05)	10
	Total	50

The semester end practical examination will be based on the practical activities conducted throughout the course, as determined by the Chairperson concerned. It will encompass all practical exercises outlined in the syllabus while maintaining the courses academic integrity.

C) Evaluation of OJT/FP (On Job Training, Internship/Apprenticeship/Field Project): Total Marks 100

Evaluation during the OJT program involves two key components: External Evaluation (50%) 50 marks and Internal Evaluation (50%) 50 marks. The following is a suggested two-fold pattern of evaluation.

1. Host Organization Evaluation: The host organization will assess students based on criteria such as punctuality, completion of hours, and proficiency in required skill sets. They will also provide feedback on the student's overall performance.

2. Department Mentor Evaluation: Additionally, students will be evaluated by their department mentor based on their weekly reporting, written report, and viva voce/presentations.

Students are required to complete on-the-job training between the end of the first semester-end examination and the commencement of the second semester-end examination for four credits (120 hours), fulfilling a component of the National Education Policy 2020. The evaluation of this training will be conducted in accordance with University of Mumbai guidelines for the “on-the-job training for Post Graduate students as per NEP 2020 with effect from 2023-2024.” (<https://mu.ac.in/wp-content/uploads/2024/06/MU-OJT-Guidelines-Draft.pdf>)

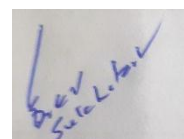
Sr. No.	Internal (Department Mentor)		External (OJT, supervisor, for instance)	
	Particulars	Marks	Particulars	Marks
1	Weekly Reporting	15	Completion of Hours	20
2	Written Report	20	Quality/ Performance	20
3	Viva-Voce/ Presentation	15	Punctuality/ Regularity	10
		50		50
Total				100

Scheme of Examination M.Sc. Part I (Semester I & II)

Semester	Course Code No.	Credits	Semester End University Examination			Internal Assessment		
			Out of Marks	Passing Marks	Duration in Hrs.	Out of Marks	Passing Marks	Duration in Hrs.
Semester I	PSEVS 101	4	50	20	2	50	20	2
	PSEVS102	4	50	20	2	50	20	2
	PSEVSP 103	4	50	20	4	50	20	4
	PSEVS 104	2	25	10	1	25	10	1
	PSEVSRM 105	4	50	20	2	50	20	2
	PSEVSEL 106A Or PSEVSEL 106B	4	50	20	2	50	20	2
Semester II	PSEVS 201	4	50	20	2	50	20	2
	PSEVS 202	4	50	20	2	50	20	2
	PSEVSP 203	4	50	20	4	50	20	4
	PSEVS 204	2	25	10	1	25	10	1
	PSEVSOJT 205	4	50	20	--	50	20	--
	PSEVSEL 206A	4	50	20	2	50	20	2
	PSEVSEL 206B							

Letter Grade and Grade Points

Semester GPA/ Program CGPA/ Program	% of Marks	Alpha-Sign/ Letter Grade Result
9.00-10.00	90.0-100	O (Outstanding)
8.00<9.00	80.0<90.0	A+ (Excellent)
7.00<8.00	70.0<80.0	A (Very Good)
6.00<7.00	60.0<70	B+ (Good)
5.50<6.00	55.0<60.0	B (Above Average)
5.00<5.50	50.0<50.0	C (Average)
4.00<5.00	40.0<50.0	P (Pass)
Below 4.00	Below 40	F (Fail)
Ab (Absent)		Absent



Director (I/C)

Sign of HOD

Name of the Head of the Department
Name of the Department

Sign of Dean,

Name of the Dean
Name of the Faculty