UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A ++' GRADE' UNIVERSITY)
Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

Academic Section
Email: academicsectionju14@gmail.com

NOTIFICATION
(25/Sep/Adp./64)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the syllabi and courses of studies for **Post Graduate Programme** in **Environmental Science** under **NEP-2020** as per details given below:-

Two Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Environmental Science	Semester-I	December 2025, 2026 and 2027
	Semester-II	May 2026, 2027 and 2028
	Semester-III	December 2026, 2027 and 2028
	Semester-IV	May 2027, 2028 and 2029

One Year Post Graduate Programme under NEP-2020

Subject	Semester	For the examinations to be held in the year
Environmental Science	Semester-I	December 2026, 2027 and 2028
	Semester-II	May 2027, 2028 and 2029

The Syllabi of the courses are also available on the University website: www.jammuuniversity.ac.in

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/25/ 9085-9112
Dated: 9/9/25

Copy for information and necessary action to:

1. Dean, Faculty of **Life-Science**
2. Director/Convener, Board of Studies in **Environmental Science**
3. Director, Centre for IT Enabled services and Management, University of Jammu for information and for uploading on University Website.
4. All members of the Board of Studies
5. Joint Registrar (Evaluation/P.G. Exam.)
6. Programmer, Computer Section, Examination Wing

9/9/25
Joint Registrar (Academic)

8/9 8/9/25

UNIVERSITY OF JAMMU
SYLLABUS FOR
TWO-YEAR P.G. IN ENVIRONMENTAL SCIENCES (NEP-2020)

COURSE STRUCTURE
(Programme Code PGFLE005),
Examinations to be held in 2025, 2026 & 2027

DISTRIBUTION OF COURSES AND CREDITS

[SEMESTER-I]

Course Code	Course Name	Credits	Contact Hours / Week L-T-P
P2ESTC101	Ecology and Environment	4	4-1-0
P2ESTC102	Aquatic Environment	4	4-1-0
P2ESTC103	Remote Sensing and GIS Applications	4	4-1-0
*P2ESTE104	Solid Waste Management: Circular Economy and Valorization	4	4-1-0
*P2ESTE105	Traditional Knowledge System	4	4-1-0
P2ESPC111	Lab Course-1 (P2ESTC101)	2	0-0-2
P2ESPC112	Lab Course-2 (P2ESTC102)	2	0-0-2
P2ESPC113	Lab Course-3 (P2ESTC103)	2	0-0-2
*P2ESPE114	Lab Course-4 (P2ESTE104)	2	0-0-2
*P2ESPE115	Lab Course-5 (P2ESTE105)	2	0-0-2

Note: Total Credits to be earned in Semester-I= 24 Credits
[Major Core 12 (Theory) + 6 (Practicals) = **18**; Major Elective (Any one*) 4 (Theory) + 2 (Practical) = **6**]

[SEMESTER-II]

Course Code	Course Name	Credits	Contact Hours / Week L-T-P
P2ESTC201	Environmental Pollution: Chemistry and Control	4	4-1-0
P2ESTC202	Biodiversity and Wildlife Ecology	4	4-1-0
P2ESTC203	Physical Environment	4	4-1-0
*P2ESTE204	Environmental Geochemistry	4	4-1-0
*P2ESTE205	Environmental Economics and Auditing	4	4-1-0
P2ESPC211	Lab Course-1 (P2ESTC201)	2	0-0-2
P2ESPC212	Lab Course-2 (P2ESTC202)	2	0-0-2
P2ESPC213	Lab Course-3 (P2ESTC203)	2	0-0-2
*P2ESPE214	Lab Course-4 (P2ESTE204)	2	0-0-2
*P2ESPE215	Lab Course-5 (P2ESTE205)	2	0-0-2

Note: Total Credits to be earned in Semester-II= 24 Credits
[Major Core 12 (Theory) + 6 (Practicals) = **18**; Major Elective (Any one*) 4 (Theory)+2 (Practical) = **6**]

L- Lectures, T- Tutorials, P- Practical

UNIVERSITY OF JAMMU
SYLLABUS FOR
TWO-YEAR P.G. IN ENVIRONMENTAL SCIENCES (NEP-2020)

[SEMESTER-III]

Course Code	Course Name	Credits	Contact Hours / Week L-T-P
P2ESTC301	Disaster Risk Reduction and Management	4	4-1-0
P2ESTC302	Ecotechnologies for Contaminant Remediation	4	4-1-0
P2ESTC303	Research Methodology and Statistics	4	4-1-0
P2ESTE304	Atmospheric Chemistry and Climate Change	4	4-1-0
*P2ESTE305	Environmental Toxicology and Health Hazarads	4	4-1-0
*P2ESTE306	Environmental Microbiology and Biotechnology	4	4-1-0
P2ESPC315	Lab Course-1 (P2ESTC301 and P2ESTC302)	2	0-0-2
P2ESPC316	Lab Course-2 (P2ESTC303 and P2ESTC304)	2	0-0-2
**P2ESMO350	MOOC/SWAYAM Course	4	4-0-0

Note: Total credits to be earned in Semester-III= 24 Credits
[Major Core 16 (Theory) +4 (Practicals) = **20**; Major Elective (Any one*) 2 (Theory) = **4**

**MOOC Course is compulsory and over and above the 24 Credits.

[SEMESTER-IV]

Course Code	Course Name	Credits	Contact Hours / Week L-T-P
P2ESTC401	Environmental Law and Policy	4	4-1-0
*P2ESTC402	Environmental Impact Assessment	2	2-1-0
*P2ESTC403	Environmental Monitoring and Instrumentation	2	2-1-0
*P2ESTE404	Artificial Intelligence for Sustainable Development	2	2-1-0
*P2ESTE405	Energy and Environment	2	2-1-0
P2ESRC430	Research Project/ Dissertation	16	0-0-16

Note: Total credits to be earned in Semester-IV= 24 Credits
[Major Core 4 (Theory) + Major Elective (Any Two*) 2 + 2 (Theory) = **8**;
Research Project/ Dissertation = **16** (including field visits / industrial training / practicals)]

L- Lectures, T- Tutorials, P- Practical

UNIVERSITY OF JAMMU
SYLLABUS FOR
TWO-YEAR P.G. IN ENVIRONMENTAL SCIENCES (NEP-2020)

EXIT OPTION (AFTER ONE YEAR)
VOCATIONAL COURSES 4-Credit (Any one)

Course Code	Course Name	Credits	Contact Hours / Week L-T-P
P2ESVC251	Environmental Quality Monitoring and Analysis	4	-
P2ZOVC252	Parataxonomy with special focus on Plants, Birds, and Butterflies	4	-
P2ZOVC253	Vermitechnology and Solid Waste Management	4	-
P2ZOVC254	Tools and Techniques in Wildlife Monitoring	4	-

UNIVERSITY OF JAMMU
SYLLABUS FOR
TWO-YEAR P.G. IN ENVIRONMENTAL SCIENCES (NEP-2020)

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.:P2ESTC101 | **Title: Ecology and Environment**
Credits: 4 | **Maximum Marks : 100**
Duration of Examination: 3 hrs | **a) Minor Test-I : 20 Marks**
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

Objectives:

To equip students with theoretical knowledge and practical skills in ecology and environmental sciences, fostering interdisciplinary thinking, critical analysis, and problem-solving abilities to address complex environmental challenges. The module will help students in comprehensive understanding of fundamental ecological principles, the structure and function of ecosystems, and the intricate relationships between living organisms and their environment, laying the groundwork for advanced environmental studies.

UNIT 1: ECOLOGICAL PRINCIPLES AND ENVIRONMENTAL INTERACTIONS

1.1. Definitions and scope of ecology, levels of organization in ecology, habitat, niche, and ecological amplitude
1.2. Components of ecosystem, biotic and abiotic
1.3. Food chains, food webs, ecological pyramids, energy flow
1.4. Nutrient cycles, ecosystem dynamics and feedback mechanisms

UNIT 2: POPULATION AND COMMUNITY ECOLOGY IN A CHANGING ENVIRONMENT

2.1. Population growth models, carrying capacity, environmental resistance and limiting factors, r/K selection theory
2.2. Competition, predation, parasitism, mutualism, niche differentiation and resource partitioning
2.3. Ecological succession, climax community, stability, and resilience, role of disturbance and anthropogenic succession
2.4. Community patterns and environmental gradients, ecotone, and edge effect, diversity indices

UNIT 3: LANDSCAPE, ECOSYSTEM AND GLOBAL ECOLOGY

3.1. Landscape metrics, edge effects and connectivity, land use change and ecological implications with reference to the Himalaya
3.2. Major ecosystem types, forest, grassland, desert, wetland, alpine and aquatic ecosystems
3.3. Functional traits and ecosystem processes, primary productivity and carbon sequestration
3.4. Ecosystem services, classification and valuation, ecosystem-based adaptation

UNIT 4: HUMAN ECOLOGY AND ANTHROPOGENIC IMPACTS

4.1. Human-environment relationships, socio-ecological systems, carrying capacity
4.2. Ecological footprint analysis,
4.3. Urban sprawl; ecological implications urban biodiversity and green infrastructure
4.4. Ecosystem disruption due to mining, dams, roads, ecological dimensions of air, water, and soil pollution

UNIT 5: APPLIED ECOLOGY

5.1. Field sampling; quadrats, transects, tagging, biodiversity monitoring and bioindicators
5.2. Ecosystem management, participatory forest and community-based conservation
5.3. Climate-vegetation feedback, phenology and ecosystem shifts, ecosystem vulnerability
5.4. International priorities on ecology and environment, ecology-informed policy making

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESTC101 | **Title: Ecology and Environment**
Credits: 4 | **Maximum Marks : 100**
Duration of Examination: 3 hrs | **a) Minor Test-I : 20 Marks**
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

LITERATURE RECOMMENDED

1. Benton, A. H. and Werner, W. E. (1976). *Field Biology and Ecology*. Tata McGraw Hill Publishing Company Ltd. New Delhi
2. Chapman, J. L. and Reiss, M. J. (1999). *Ecology-Principles and applications*. Cambridge University Press
3. Dash, M. C. (1993). *Fundamentals of Ecology*. Tata McGraw Hill Publishing Company Ltd. New Delhi.
4. De, A. K. and De, A. K. (2009). *Environment and Ecology*, New Age International (P) Ltd. Publisher, New Delhi
5. Fauric, C.; Ferra, C.; Medori, P. and Devaux, J. (2001). *Ecology. Sciences & Practice*. Oxford & IBH Pub. Co. Pvt. Ltd. (New Delhi).
6. Kormondy, E. J. (1986). *Concept of Ecology*. Prentice Hall of India, New Delhi.
7. Odum, E. P. and Barrett, G. W (2017) (5thEd.). *Fundamentals of Ecology*. Cengage Learning (RS); 30.16 Edition Publishers, Dehradun.
8. Southwick, H. C. (1976). *Ecology & Quality of our Environment* Van No. Strand Reinhold Company, New York.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.:P2ESTC102 | **Title: Aquatic Environment**
Credits: 4 | **Maximum Marks : 100**
Duration of Examination: 3 hrs | **a) Minor Test-I : 20 Marks**
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

Objectives:

The course has been designed to provide information on various aspects of aquatic environment, its chemistry, changing physico-chemical profile, biotic characteristics, and applicability of the information for the exploitation of different water resources and also for their better management and conservation. Students will learn about the physical and chemical aspects of aquatic systems and the life cycles, and adaptations of aquatic organisms.

UNIT 1: AQUATIC ENVIRONMENT: PRINCIPLES AND CHEMICAL PROCESSES

1.1 Hydrology: Definition, terms, and concepts to describe physical hydrological processes including evaporation, transpiration, precipitation, infiltration
1.2 Hydrological cycle and water budget, global water balance
1.3 Chemical speciation in aquatic systems: Cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}),
1.4 Chemical speciation in aquatic systems: Anions (CO_3^{2-}, HCO_3^{-}, SO_4^{2-}, Cl^{-}, etc.)

UNIT 2: LENTIC ENVIRONMENT- LAKES AND WETLANDS

2.1 Lakes: Origin and classification
2.2 Lake stratification and mixing; eutrophication and restoration of eutrophic waterbodies
2.3 Characteristics of lakes (physical, chemical and biological)
2.4 Wetlands: Definition, types, classification and management

UNIT 3: LOTIC ENVIRONMENT-STREAMS AND RIVERS

3.1 Types of rivers; types of flow and flow characteristics
3.3 Stream structure and classification: stream order, channel features, zonation
3.3 Characteristics of lotic waters (physical, chemical and biological)
3.4 Conservation of rivers with focus on national river conservation plan; Case studies: Ganga
- Action Plan, Yamuna Action Plan and Namami Gange

UNIT 4: GROUNDWATER HYDROLOGY

4.1 Groundwater occurrence and types of groundwater
4.2 Principles of groundwater flow: Darcy's Law and hydraulic potential
4.3 Groundwater and its chemical constituents: organic, inorganic and dissolved gases
4.4 Springs: origin, classification, characteristics and importance

UNIT 5: ESTUARINE AND MARINE ENVIRONMENT

5.1 Estuary: Definition, types and classification
5.2 Environmental factors within estuaries
5.3 Introduction to marine environment and its zonation
5.4. Classification of marine biota and factors affecting marine environment

LITERATURE RECOMMENDED

1. Abbasi, S. A. (1997). *Wetlands of India*. Discovery Publishing House. New Delhi.
2. Aggarwal, S. C. (1999). *Limnology*. APH Publication Corporation, New Delhi.
3. Allan, J. D. (1995). *Stream Ecology-Structure and function of running waters*. Chapman and Hall Publication, UK.
4. Cole, G.A. and Weihe, P. E. (2016). *Limnology*. 5th Ed., Waveland Press. Inc., Long Grove, IL, 60047-9580(e-book).
5. Dodds, W. and Whiles, M. (2010). *Freshwater Ecology*. 2nd Ed. Academic Press.
6. Goldman, C. R. and Horne, A. J. (1994). *Limnology*. McGraw Hill Int. Book Co., New Delhi.

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.:P2ESTC102 | **Title: Aquatic Environment**
Credits: 4 | **Maximum Marks : 100**
Duration of Examination: 3 hrs | **a) Minor Test-I : 20 Marks**
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

7. Hutchinson, G. E. (2004). *Treatise on Limnology*. Vol. I, part-2, Vol. II. John Willey and Sons, New York.
8. Jhingran, V. G. (1992). *Fish and Fishes of India*. Hindustan Publishing Corporation, India.
9. Keddy, P.A. (2010). *Wetland Ecology- Principles and Conservation*. 2nd Ed. Cambridge University Press, Cambridge, UK. ISBN 978-521-51940-3(e-book)
10. Mortimer, C.H. (2003). *Lake Michigan in Motion: Responses of an Inland Sea to Weather, Earth-Spin and Human Activities*. University of Wisconsin Press.
11. Rushton, K.R. (2003). *Groundwater Hydrology- Conceptual and computational Models*. John Wiley and Sons, West Sussex, England. ISBN 0-470-85004-3.
12. Schowoerbel, J. (1991). *Handbook of limnology*. Scientific Publication. Jodhpur.
13. Speight, M. and Henderon, P. (2010). Marine Ecology- Concepts and applications. Wiley Blackwell. A John Wiley & Sons, Ltd. Publication, UK.
14. Wetzel, R. G. (2001). Limnology: Lakes and River Ecosystem. Academic Press, London.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESTC103 | **Title: Remote Sensing and GIS Applications**

Credits: 4

Duration of Examination: 3 hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

Objectives:

Remote Sensing and Geographical Information System (GIS) have developed remarkably as an important tool for scientific management of resources and environment. The technology is instrumental in facilitating the mapping and monitoring of changes in the environment. Remote Sensing application for natural/ physical resources assessment is helpful to improve student's ability to achieve the goal of optimum land use planning for sustainable resource management. This course has been designed with the objectives to acquaint the students with basic principles of Remote Sensing and GIS and their applications in various fields especially environment.

UNIT 1: FUNDAMENTALS OF REMOTE SENSING

1.1. Remote sensing - Concept, and principles, electromagnetic radiations, remote sensing regions and bands
1.2. Data characteristics: Spectral signatures, response patterns, and image resolution (spatial, spectral, temporal, and radiometric)
1.3. Aerial photography: History, characteristics and attributes. Drone / UAV mapping and surveying
1.4. Indian remote sensing satellites: History, characteristics, and applications

UNIT 2: DATA ACQUISITION AND IMAGE INTERPRETATION

2.1. Platforms and sensors: Classification and characteristics
2.2. Remote sensing data acquisition, image rectification, and restoration
2.3. Image processing and classification: Supervised and unsupervised classification
2.4. Remote sensing data interpretation: Nature and elements of interpretation (Land use, landforms, drainage, erosion, fire details)

UNIT 3: ADVANCES IN REMOTE SENSING AND ITS APPLICATIONS

3.1. Microwave remote sensing: Introduction, fundamentals, and functions
3.2. RADAR and LiDAR: components, operating principles, and imaging systems
3.3. Multispectral and hyperspectral remote sensing
3.4. Thermal remote sensing

UNIT 4: GEOGRAPHICAL INFORMATION SYSTEM (GIS) AND GLOBAL POSITIONING SYSTEM (GPS)

4.1. Geographical Information System: Concept, components, geographical data (spatial and non-spatial); spatial data models (raster and vector)
4.2. Fundamentals of mapping in GIS: Map projections, datum, coordinate systems, georeferencing; types of maps (reference maps, topographic sheets, and thematic maps); data input and output in GIS, map generation
4.3. Introduction to GIS software: Overview of QGIS; installation and interface; basic tools and functions, map outputs
4.4. Global Positioning System (GPS): Concept, functioning, integration with GIS

UNIT 5: APPLICATIONS OF REMOTE SENSING AND GIS

5.1. Remote Sensing and GIS in meteorology: Weather monitoring and climate change
5.2. Biodiversity monitoring and mapping: Terrestrial carbon estimation, forest stock and density mapping, change detection, biodiversity characterization, forest fire risk zonation
5.3. Remote Sensing and GIS in urban planning: Urban sprawl monitoring, analysis, and planning
5.4. Role of GIS in disaster prediction and management: Vulnerability analysis of infrastructure and settlements, planning relief operations and disaster management

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESTC103 | **Title: Remote Sensing and GIS Applications**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

LITERATURE RECOMMENDED

1. Campbell, J. B. (2002). *Introduction to Remote Sensing*. 5th ed. Taylor & Francis, London.
2. Chang, K.T. (2003). *Introduction to Geographic Information Systems*. Tata McGraw Hill Publications Co., New Delhi.
3. Cracknell, A. et al. (1990). *Remote Sensing Yearbook*, Taylor and Francis, London.
4. Curran, P.J. (1985). *Principles of Remote Sensing*, Longman, London.
5. Deekshatulu, B.L. Rajan, Y.S. (ed.) (1984). *Remote Sensing*. Indian Acd. of Science, Bangalore.
6. Demers, M. N. (2000). *Fundamentals of Geographic Information Systems*. John Wiley & Sons, Singapore.
7. Floyd, F., Sabins, Jr. (1986). *Remote Sensing: Principles and Interpretation*, W.H. Freeman, New York.
8. Fraser Taylor, D.R. (1991). *Geographic Information Systems*. Pergamon Press, Oxford.
9. Guham, P. K. (2003). *Remote Sensing for Beginners*. Affiliated East-West Press Pvt. Ltd., New Delhi.
10. Hallert, B. (1960). *Photogrammetry*, McGraw Hill Book Co. Inc.
11. Harry, C.A. (ed.) (1978). *Digital Image Processing*, IEEE Computer Society.
12. Hord, R.M. (1982). *Digital Image Processing of Remotely Sensed Data*, Academic Press, New York.
13. Leuder, D.R. (1959). *Aerial Photographic Interpretation: Principles and Application*. McGraw Hill, New York.
14. Lillesand, T.M. and Kiefer, R.W. (2000). *Remote Sensing and Image Interpretation*. 4th ed. John Wiley and Sons, New York.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESTE104 | **Title: Solid Waste Management: Circular Economy and Valorization**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

Objectives:

The course will equip the students with the knowledge and skills to understand the fundamentals of solid waste management and the principles of circular economy. It will acquaint them with various processes of waste valorization, to convert waste into valuable resources, thereby promoting sustainability, resource efficiency and integrating waste management with Sustainable Development Goals (SDGs). The students through analysis of real-world case studies shall identify tools and policy instruments for effective waste planning and governance.

UNIT 1: SOLID WASTE MANAGEMENT AND CIRCULAR ECONOMY

1.1. Solid Waste: sources, characteristics, and classification, waste segregation, collection, storage, and transfer
1.2. Waste processing: Size and volume reduction, waste minimization; waste management hierarchy
1.3. Concept of circular economy, 7R's and zero waste
1.4. Legal and policy framework for waste management: Indian Waste Management Rules (2016) and subsequent amendments for Municipal Solid Waste, Plastic Waste, Extended Producer Responsibility (EPR)

UNIT 2: TECHNOLOGIES FOR WASTE PROCESSING AND VALORIZATION

2.1. Material Recovery and Recycling: metals, plastic, paper, and glass
2.2. Waste conversion technologies: Thermal, chemical, and biological
2.3. Waste to energy conversion (WTE) and its environmental consideration; Refuse Derived Fuel (RDF) and co-processing
2.4. Green Technologies in Waste Management (WM) and valorization

UNIT 3: HAZARDOUS WASTE: MANAGEMENT AND VALORIZATION

3.1. Hazardous waste: definition, classification, sources and types, Basel convention and Hazardous waste and electronic waste management rules (2016) and subsequent amendments
3.2. Waste minimization and resource recovery; treatment technologies, storage, transportation, disposal, and monitoring
3.3. E-waste and battery recycling technologies; Critical Raw Material (CRM) recovery
3.4. Emerging trends and techniques: Circular economy and hazardous waste, nanotechnology in waste treatment; digital tools and Artificial Intelligence in waste tracking

UNIT 4: LANDFILLS: DESIGN, OPERATION AND MONITORING

4.1. Landfills: Definition and classification, site selection, design, and operation
4.2. Liner system (Clay, geomembrane, and composite); cover system (daily, intermediate, and final)
4.3. Monitoring of landfill leachate, gas and ground water; Leachate collection and treatment system
4.4. Landfill closure and environmental monitoring, Rehabilitation of open dump sites, case studies, Smart landfill technologies and circular economy integration

UNIT 5: GOVERNANCE, INNOVATIONS AND FUTURE TRENDS

5.1. Tools and indicators for Circular Economy Assessment
5.2. Innovations in WM: Circular design and eco-innovation
5.3. Policy, institutional framework and financial tools for waste management
5.4. Extending lifecycle of products, best practices in WM and case studies, entrepreneurship, and opportunities in waste Management

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESTЄ104 | **Title: Solid Waste Management: Circular Economy and Valorization**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

LITERATURE RECOMMENDED

1. Asnani, P. U. (2006). Solid waste management. India Infrastructure Report 570.
2. Bagchi, A. (2004). Design of Landfills and Integrated Solid Waste Management. John Wiley & Sons.
3. Elena Cristina Rada, E. C. (2017).Waste Management and Valorization: Alternative Technologies, CRC Press.
4. Ghosh, S. K. (2020). Waste Management as Economic Industry Towards Circular Economy Editor: Publisher: Springer.
5. Hasan, S. E. (2022). Introduction to Waste Management: A Textbook. John Wiley & Sons.
6. Manual on Municipal Solid waste Management (2000). CPHEEO, Ministry of Urban Development, Govt. of. India, New Delhi.
7. McDougall, F. R., White, P. R., Franke, M., & Hindle, P. (2008). Integrated Solid Waste Management: A Life Cycle Inventory. John Wiley & Sons.
8. Tchobanoglous, G. et al. (2023). Integrated Solid Waste Management: Engineering Principles and Management, McGraw - Hill. US EPA. (1999). Guide for Industrial Waste Management. Washington D.C.
9. Van Ewijk, S., & Stegemann, J. (2023). An introduction to waste management and circular economy. UCL Press.
10. White, P.R., Franke, M. & Hindle P. (2001). Integrated Solid waste Management: A Lifecycle Inventory. Blackie Academic & Professionals.
11. Zhu, D., Asnani, P.U., Zurbrugg, C., Anapolsky, S. & Mani, S. (2008). Improving Municipal Solid Waste Management in India. The World Bank, Washington D.C.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESTE105 | **Title: Traditional Knowledge System**

Credits: 4 | **Maximum Marks : 100**

Duration of Examination: 3 hrs | **a) Minor Test-I : 20 Marks**

b) Minor Test-II : 20 Marks

c) Major Test : 60 Marks

Objectives:

This course is designed to introduce students to the Indian Knowledge systems, help them in understanding the concept and assess the relevance of traditional knowledge in modern science, technology, and sustainable development. The course aims to foster appreciation for ancient Indian scientific achievements, including medicine, metallurgy, agriculture, and environmental management and learn about indigenous technologies that would help in conserving traditional knowledge and integrating it with modern practices.

UNIT 1: INTRODUCTION TO TRADITIONAL KNOWLEDGE

1.1. Traditional knowledge: concept, nature, characteristics, scope and importance
1.2. Importance and need for protecting traditional knowledge
1.3. Indigenous vs. traditional knowledge: historical evolution and social impact
1.4. Role of government and legal framework in protection, global economic value of traditional knowledge

UNIT 2: SACRED ECOLOGY AND ENVIRONMENT

2.1. Sacred ecology: Introduction and scope
2.2. Sacred forests, sacred groves, sacred hills and mountains
2.3. Traditional Ecological Knowledge (TEK), Resilience to climate change
2.4. Sacred ecology and SDGs (especially SDG 13 and 15); Integration of sacred ecology in environmental education and policy

UNIT 3: TRADITIONAL WATER WISDOM

3.1. Indigenous knowledge systems and hydrological understanding; Regional adaptations and cultural significance
3.2. Historical evolution of water management in ancient civilizations: Harappan and traditional water management system of Gujarat
3.3. Traditional rainwater harvesting system typology based on region and structure type; Communities involved in water management
3.4. Decline of traditional systems and urbanization pressures, revival initiatives and importance, challenges, and modern integration

UNIT 4: FOUNDATION OF SUSTAINABILITY IN INDIAN TRADITIONAL KNOWLEDGE

4.1. Sustainability, resilience, Ethics of intergenerational equity and harmony with nature; Indian philosophical perspectives on nature and sustainability (e.g., Vasudhaiva Kutumbakam, Pancha Mahabhutas)
4.2. Oral traditions, community memory, and transmission; Community-led resource management and food security
4.3. Traditional Medicine for health and well-being: Ayurveda, Unani, Siddha and Sowa Rigpa, Sushruta Samhita—ancient surgical techniques, Diet and Lifestyle: Dinacharya & Ritucharya); Yoga & Ayurveda: integration of physical and mental wellness.
4.4. Ancient wisdom for achieving sustainable development goals (SDGs)

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESTE105 | **Title: Traditional Knowledge System**
Credits: 4 | **Maximum Marks : 100**
Duration of Examination: 3 hrs | **a) Minor Test-I : 20 Marks**
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

UNIT 5: TRADITIONAL KNOWLEDGE IN CONTEMPORARY WORLD AND PROTECTION

5.1. Integration of traditional knowledge in modern education and innovation
5.2. Exploring the potential of Traditional knowledge in addressing contemporary challenges (Climate Change, water scarcity, biodiversity conservation, food security, organic farming etc.)
5.3. Intellectual Property Rights and protection of indigenous knowledge
5.4. The protection of Traditional Knowledge Bill, (2016), Geographical Indications Act (2003)

LITERATURE RECOMMENDED

1. Agrawal, A. (1995). Dismantling the divide between indigenous and scientific knowledge. Development and Change, 26(3), 413-439.
2. Fredrick W. B. (2013). *The Iconography of Water: Well and Tank Forms of the Indian Subcontinent*, DK Printworld, New Delhi, 2013
3. Mosse, D. (1999). Colonial and Contemporary Ideologies of 'Community Management': The Case of Tank Irrigation Development in South India. Modern Asian Studies, 33(02), 303-338
4. Pahl-Wostl, C. (2007). Transitions towards adaptive management of water facing climate and global change. Water Resources Management, 21(1), 49-62.
5. Raymond, C. M., Fazey, I., Reed, M. S., Stringer, L. C., Robinson, G. M., & Evely, A. C. (2010). Integrating local and scientific knowledge for environmental management. Journal of Environmental Management, 91(8), 1766-1777.
6. Roux, D. J., Rogers, K. H., Biggs, H., Ashton, P. J., & Sergeant, A. (2006). Bridging the science management divide: Moving from unidirectional knowledge transfer to knowledge interfacing and sharing. Ecology and society, 11(1), 4 (online).

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESPC111 | **Title: Lab Course-1 (Based on P2ESTC101)**

Credits : 2
Duration of Examination: 4 hrs

Maximum Marks : 50
a) Internal : 25 Marks
b) External : 25 Marks

Objectives:

To make students familiar with experimental work based on Course No. P2ESTC101

1. Documenting species, mapping trophic levels and constructing food chains/webs.
2. Construction of biomass and number pyramids from field data.
3. Estimation of primary productivity using the light and dark bottle method (aquatic) or Harvest method (terrestrial).
4. Quadrat and transect sampling for plant density, frequency, and abundance.
5. Calculation of Shannon-Wiener, Simpson, alpha, beta, and gamma diversity.
6. Use of GIS/Google Earth to assess land use changes and habitat fragmentation.
7. Estimation of tree biomass and carbon stock in a forest plot.
8. Comparative analysis of conventional vs organic/agroecological farms.
9. Interview and TEK documentation from local farmers.
10. Phenological observations of key indicator species.

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESPC112 | **Title: Lab Course-2 (Based on P2ESTC102)**

Credits: 2
Duration of Examination: 4 hrs

Maximum Marks : 50
a) Internal : 25 Marks
b) External : 25 Marks

Objectives:
To make students familiar with the experimental work based on Course No. PSESTC102

1. Sampling techniques for collecting surface and ground water samples for physico-chemical analysis.
2. To find out the amount of DO from water samples by Winkler method and plot the DO variations in lake water at different depths
3. To find out the amount of Cl^- in water samples by volumetric method.
4. To find out the amount of CO_3^{2-} and HCO_3^- from given water samples by volumetric method.
5. To find out the amount of Ca^{2+} and Mg^{2+} from given water samples by volumetric method.
6. To measure the flow of river/stream using the float method.
7. To study the temperature variations in lotic and lentic water bodies at different depths.
8. To find out the transparency of water by the Secchi Disc method.
9. To identify the given specimen of macrophytes and write their morphological characteristics.
10. Environmental monitoring and assessment of any of the fresh water sources (river / stream / lake / pond / spring).
11. To map visited aquatic ecosystems (pond/lake/springs/) on google earth.

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESPC113 | **Title: Lab Course-3 (Based on P2ESTC103)**

Credits : 2 | **Maximum Marks : 50**

Duration of Examination: 4 hrs | **a) Internal : 25 Marks**

b) External : 25 Marks

Objectives:

To make students familiar with the experimental work based on Course No. P2ESTC103

1. Virtual tour on Google Earth to understand the local landforms and landuse.
2. Interpretation of satellite images (true and false colour composites).
3. Interpretation of topographical sheets.
4. Introduction to GPS, ground truthing and collection of GPS readings.
5. Introduction to QGIS interface, adding raster/vector layers, and viewing attribute tables.
6. Digitization of point, line, and polygon features from a georeferenced map and editing attribute data in QGIS.
7. Performing spatial analysis operations like buffer creation and overlay analysis in QGIS.
8. Preparation of a thematic map with proper map layout design, legend, scale, and export (as JPG/PNG/TIFF/PDF).
9. Exposure to Google earth Engine and the understanding case studies referring to Global Forest Cover Change, Global Surface Water and Tiger Habitat Monitoring
10. To find the height of a tree using Hypsometer.

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESPC114 | **Title: Lab Course-4 (Based on P2ESTE104)**

Credits: 2 | **Maximum Marks : 50**

Duration of Examination: 4 hrs | **a) Internal : 25 Marks**

b) External : 25 Marks

Objectives:

To make students familiar with experimental work based on Course No. P2ESTE104

1. To determine sources and composition of municipal solid waste (MSW) by collection and segregation of solid waste samples (organic, plastic, paper, glass, metal)
2. Measurement of moisture content of solid waste.
3. Measurement of calorific value of solid waste.
4. Classification of solid waste into biodegradable, recyclable, and inert categories.
5. To observe real-world operations of waste handling and disposal by visiting a municipal composting facility or hazardous waste incinerator and preparation of a detailed field report and process flow diagram.
6. Field visit to plastic recycling unit and preparation of a detailed field report and process.
7. Landfill Model Construction: To understand the design, operation, and environmental impacts and controls of sanitary landfills.
8. To simulate the identification, segregation, labelling, storage, and emergency response procedures for hazardous waste in compliance with safety regulations.
9. To design municipal waste management plan of campus/residential area/ housing colony.
10. Analyze and document case studies of successful waste management projects from India/world to learn best practices.

SCHEME OF EXAMINATION

Practical Test	**Time allotted for the examination**	**% Weightage (Marks)**		**Remarks**
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

[SEMESTER-I]

Examinations to be held in December 2025, 2026 & 2027

Course No.: P2ESPE115 | **Title: Lab Course-5 (Based on P2ESTE105)**

Credits: 2
Duration of Examination: 4 hrs

Maximum Marks : 50
a) Internal : 25 Marks
b) External : 25 Marks

Objectives:
To make students familiar with experimental work based on Course No. P2ESTE105

1. Explore vernacular building techniques (e.g., mud houses, stepwells) and Hands-on: Build a small model using local materials.
2. Visit to sacred groves to explore their ecological and cultural significance.
3. Field visit to a traditional water harvesting system to observe, document, and understand the design, function, and cultural relevance of traditional water harvesting systems, and evaluate their role in modern water conservation.
4. To observe, document, and evaluate the ecological, hydrological, and cultural significance of natural springs in traditional water management—especially in hilly or tribal regions.
5. To visit traditional farms to identify, document, and analyze traditional farming techniques in a local context and assess their ecological, economic, and cultural relevance today.
6. Exploring Traditional Architecture and its relevance in modern day sustainable architecture.
7. Mapping and documentation of sacred ecological practices
8. Field visit to an Ayurvedic center or medicinal plant garden. Identify and document any ten local medicinal plants.
9. Documentation of case studies from India where traditional knowledge has been successfully integrated into green solutions.

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESTC201 | **Title: Environmental Pollution: Chemistry and Control**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

Objectives:

The objective of this course is to make the students understand environmental pollution and its types: air, water, soil, and noise, Identify primary and secondary pollutants and their sources. This course is designed to equip the students with the knowledge and skills to understand the chemical reactions in the atmosphere, hydrosphere, and lithosphere and develop analytical and monitoring skills for environmental pollution.

UNIT 1: AIR POLLUTION

1.1. Overview of air pollution: types and classification, criteria pollutants
1.2. Transport and fate of air pollutants; Gaussian plume model
1.3. Air quality standards (WHO, NAAQS); Air Quality Index (AQI)
1.4. Air pollution control technologies; gaseous and particulate pollutants

UNIT 2: WATER POLLUTION

2.1. Overview of water pollution: Types and classification
2.2. Transport and fate of water pollutants
2.3. Groundwater contamination and modeling
2.4. Water pollution control technologies; sewage treatment plants, effluent treatment plants

UNIT 3: SOIL / LAND POLLUTION

3.1. Overview of soil pollution: Types and classification
3.2. Fate and transport of soil pollutants
3.3. Pollutant Interaction with soil minerals and organic matter
3.4. Control, remediation and management strategies for soil/land pollution

UNIT 4: MISCELLANEOUS POLLUTION TYPES

4.1. Sources, impact and control of thermal and light pollution
4.2. Oil pollution: sources of oil spillage and impact, factors affecting fate of oil spillage
4.3. Noise pollution: types, sources, consequences; measurement of noise pollution. threshold hearing level and abatement measures
4.4. Radioactive Pollution: types, sources, consequences; disposal and management of radioactive waste

UNIT 5: POLLUTION MONITORING AND CONTROL: FUTURE TRENDS

5.1. Isotope tracing for source identification of pollutants
5.2. IoT and AI in Pollution monitoring studies; GIS applications
5.3. Use of drones and machine learning for pollution pattern detection
5.4. Climate-smart pollution control strategies

LITERATURE RECOMMENDED

1. De A.K. (2001). *Environmental Chemistry*, New Age International Publishers, New Delhi.
2. Andrew D. Eaton, Lenore S. Glesceri, Eugene W. Rice and Arnold E. Greenberg (Eds) (2005). *Standards Methods for the Examination of Water and Wastewater Analysis. 21st Edition*, APHA, Washington DC.
3. Dara S. S (1998). *A Textbook of Environmental Chemistry and Pollution Control*, S. Chand & Company Ltd, New Delhi.
4. Fifield F. W. (2000). *Environmental Analytical Chemistry*. 2nd edition, Blackwell Publishers.

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESTC201 | **Title: Environmental Pollution: Chemistry and Control**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

5. Howard S Peavy (2003). *Environmental Engineering*, Tata Mc Graw Hill Publishing Company Ltd., New Delhi.
6. Julian E Andrews et al (2004). *An Introduction to Environmental Chemistry*, Blackwell Publishing.
7. Sawyer C.N., Mc Carty P. L., and Parkin, G. F (2003). *Chemistry for Environmental Engineering and Science*, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
8. S. E. Manahan (2009). *Fundamentals of Environmental Chemistry*, CRC Press, USA.
9. Stanley E. Manahan (2010). *Environmental Chemistry*, 9th Edition, CRC Press, London.
10. Lawrence K. Wang, Yung-Tse Hung, Nazih K. Shammas (2009) *Handbook of Advanced Industrial and Hazardous Wastes Treatment*. CRC Press.
11. Lawrence K. Wang, Norman C. Pereira, Yung-Tse Hung (2005) *Advanced Air and Noise Pollution Control*. Springer.
12. Martin B. Hocking (2005) *Handbook of Chemical Technology and Pollution Control*. Elsevier.
13. Spellman, F. R, 2021. *The Science of Environmental Pollution*, 4th Edition, CRC Press
14. Masters, G. M. (2014). *Introduction to Environmental Engineering and Science*, 3rd Edn. Englewood Cliffs, NJ: Prentice Hall.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESTC202 | **Title: Biodiversity and Wildlife Ecology**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

Objectives:

Biodiversity and its components help in maintaining the ecological balance of nature and provides immense resources to various stakeholders. There is a growing concern of biodiversity loss across the globe. The course is intended to teach students regarding the status of biodiversity, its distribution, threats it encounters and the mitigative measures for its conservation and management at regional, national, and international levels.

UNIT 1: FUNDAMENTALS OF BIODIVERSITY

1.1. Biodiversity: Definition, concept, and types of biodiversity
1.2. Patterns and distribution of biodiversity at spatial and temporal scales
1.3. Evolution of biodiversity: Factors promoting biodiversity, global biodiversity, hotspots / coldspots and endemism
1.4. Ecosystem services and values of biodiversity: Intrinsic, consumptive, productive use, social, ethical, aesthetic and option values

UNIT 2: BIODIVERSITY: THREATS AND CONSERVATION

2.1. Causes, patterns, and consequences of biodiversity loss
2.2. Biodiversity conservation: Methods, practices, and strategies
2.3. Biodiversity management: Ecosystem restoration and management practices
2.4. National and international efforts for biodiversity conservation

UNIT 3: INTRODUCTION TO WILDLIFE

3.1. Wildlife: Definition, concept, and importance of wildlife
3.2. Plant systematics: Characteristics and broad classification of plants (algae to angiosperms)
3.3. Animal systematics: characteristics and broad classification of animals (invertebrates and vertebrates)
3.4. Wildlife forensics: Protocols for species identification

UNIT 4: WILDLIFE ECOLOGY AND MANAGEMENT

4.1. Concept of population ecology, habitat ecology, landscape ecology, nutritional ecology *vis- a- vis* terrestrial wildlife
4.2. Monitoring wildlife: Sampling design for population estimation
4.3. Human wildlife interactions: Implications and mitigative strategies
4.4. Wildlife conservation and management: Techniques and strategies

UNIT 5: STATUS AND DISTRIBUTION OF WILDLIFE IN INDIA

5.1. Zoo-geographic regions *vis-a-vis* mammalian distribution in India
5.2. Protected Area Network in India with special reference to Jammu and Kashmir
5.3. Species of global concern (RET species) in India and Jammu and Kashmir
5.4. Citizen science and its role in wildlife conservation in India: Introduction to eBird and iNaturalist

LITERATURE RECOMMENDED

1. Cain, James W., Paul R. Krausman (2022). *Wildlife Management and Conservation: Contemporary Principles and Practices*, John Hopkins University Press.
2. Decker, D. J.; Riley, S. J. and Siemer, W. F. (Eds.) (2012). *Human Dimensions of Wildlife Management*. JHU Press.

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESTC202 | **Title: Biodiversity and Wildlife Ecology**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

3. Fryxell John M., Anthony R.E., and Grame Coughley (2014) *Wildlife Ecology, Conservation, and Management,* Wiley Blackwell
4. George A. Feldhamer , Joseph F. Merritt, Carey Krajewski , Janet L. Rachlow (2020). *Mammalogy – Adaptation, Diversity, Ecology (Fifth Edition),* John Hopkins University Press.
5. Gopal, R. (2021). *Fundamentals of Wildlife Management.* Natraj Publishers
6. Hosetti, B. B. (2014). *Concepts in Wildlife Management. 3rd Ed.*, Daya Publishing House.
7. Kant, S. and Alavalapati, J. (Eds.) (2014). *Handbook of Forest Resource Economics*. Routledge.
8. Koprowski, J. L. and Krausman, P. R. (Eds.) (2019). *International Wildlife Management: Conservation Challenges in a Changing World*. JHU Press.
9. Krausman, P. R.; Cain III, J. W. and Cain, J. W. (Eds.) (2013). *Wildlife Management and Conservation: Contemporary Principles and Practices*. JHU Press.
10. McComb, B. C. (2015). *Wildlife Habitat Management: Concepts and Applications in Forestry*. CRC Press.
11. Nova J. Silvy (2020). *The Wildlife Techniques Manual – Volume 1: Research. Volume 2: Management.: Volumes 1 and 2 (Eighth Edition),* Johns Hopkins University Press

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESTC203 | **Title: Physical Environment**
Credits: 4 | **Maximum Marks : 100**
Duration of Examination: 3 hrs | **a) Minor Test-I : 20 Marks**
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

Objectives:

This course is designed to provide students with a foundational understanding of the Earth's internal structure and the geomorphological processes that drive the formation, transformation, and modification of landforms. It explores the dynamic systems—both endogenic and exogenic—that shape the physical landscape. The course also introduces the fundamental principles of climatology, focusing on the distribution of atmospheric temperature and pressure and global and local wind systems. By integrating earth system science with climatological perspectives, this course enables students to critically analyze the interactions between natural processes and human environments, laying the groundwork for informed environmental decision-making and sustainable management practices.

UNIT 1: BASICS OF GEOSCIENCE

1.1. Concept of seismology, types of seismic waves and their role in the study of Earth's interior
1.2. Different zones in the Earth's interior and their composition based on diverse criteria
1.3. Characteristics and classification and of sedimentary and igneous rocks
1.4. Characteristics and classification of metamorphic rocks; Rock cycle

UNIT 2: EARTH SYSTEM PROCESSES

2.1. Folds: Structure, components and types
2.2. Faults: Structure, components and types
2.3. The Earth's magnetic field - Magnetic reversal and magnetic anomaly
2.4. Volcanism - Components and types of volcanoes, volcanic materials, process and effects of volcanism

UNIT 3: GEOMORPHOLOGICAL SYSTEMS

3.1. Fluvial system - Factors affecting stream erosion and deposition, erosional and depositional landforms
3.2. Underground water system - Water table, landforms formed by groundwater action
3.3. Aeolian system - Mechanism of wind erosion, erosional and depositional landforms
3.4. Glacial system - Mechanism of glacial erosion, erosional and depositional landforms

UNIT 4: CLIMATOLOGY: BASICS AND TEMPERATURE DISTRIBUTION

4.1. Composition and layered structure of the atmosphere
4.2. Insolation: Definition, factors governing insolation
4.3. Heat budget of the Earth
4.4. Factors determining the horizontal distribution of temperature

UNIT 5: ATMOSPHERIC PRESSURE AND WIND SYSTEMS

5.1. Factors controlling pressure, horizontal distribution of pressure
5.2. Factors controlling wind
5.3. Wind system: classification, types of planetary winds
5.4. Local winds and types

LITERATURE RECOMMENDED

1. Bierman, P. R. and Montgomery, D. (2014). *Key Concepts in Geomorphology*, Macmillan Higher Education Company, New York.
2. Huggett, R. J. (2016). *Fundamentals of Geomorphology*. Routledge, London.
3. Keller, E. A. (1999). *Introduction to Environmental Geology*. Prentice-Hall, New Jersey.

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESTC203 | **Title: Physical Environment**
Credits: 4 | **Maximum Marks : 100**
Duration of Examination: 3 hrs | **a) Minor Test-I : 20 Marks**
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

4. Press, F., Siever. R., Grotzinger, J. and Jordan, T. H. (2003). *Understanding Earth*. 4th Ed. W. H. Freeman & Co. U.S.A.
5. Singh, S. (2020). *Physical Geography*. Pravalika Publications, Prayagraj.
6. Smithson, P.; Addison, K. and Atkinson, K. (2008). *Fundamentals of the Physical Environment*. 4th Ed., Routledge Publishers, London.
7. Strahler, A. H. (2013). *Introducing Physical Geography*. 6th Ed., John Wiley & Sons, New York.
8. Thornbury, W.D. (2018). *Principles of Geomorphology*. New Age International Publishers, New Delhi.
9. Barry, R. G. and Carleton, A. M. (2001). *Synoptic and Dynamic Climatology*, Routledge, London.
10. Critchfield, J. H. (1993). *General Climatology*. Prentice-Hall, New Delhi, India.
11. Gilbert, L. (2019). *Climatology and Weather forecasting- An Integrated Approach*. Syrawood Publishing House, U.S.A.
12. Lutgens, F. K.; Tarbuck, E. J. and Tasa, D. (2009). *The Atmosphere: An Introduction to Meteorology*, Prentice-Hall, Englewood Cliffs, New Jersey.
13. McKnight, T. L. (1993). *Physical Geography - A Landscape Appreciation*. Prentice-Hall, New Jersey.
14. Smithson, P.; Addison, K. and Atkinson, K. (2002). *Fundamentals of the Physical Environment*. Routledge Publishers, London.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2EST€204 **Title: Environmental Geochemistry**

Credits: 4

Duration of Examination: 3 hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

Objectives:

This course is designed to introduce students to the principles of environmental geochemistry and elemental cycles in Earth's reservoirs and basics of soil science. It aims to provide a comprehensive understanding of geochemical processes in soil formation, mineral weathering, and water systems and develop an understanding on soil genesis and evolution, the key physical and chemical properties of soils, evaluate relationship between soil properties and nutrient cycling. Students will also be able to analyze the sources, pathways, and effects of contaminants.

UNIT 1: FUNDAMENTALS OF ENVIRONMENTAL GEOCHEMISTRY

1.1. Principles and scope of Environmental Geochemistry; Earth's geochemical reservoirs and elemental cycles (carbon, nitrogen, sulfur, phosphorus)

1.2. Geochemical distribution of elements in rocks: major, minor, trace elements; Weathering processes and elemental redistribution: chemical, physical, and biological weathering

1.3. Mineralogical controls: primary and secondary minerals, mineral structure, stability, and solubility

1.4. Types of geochemical reactions (acid-base, complexation, precipitation-dissolution), Redox processes in natural systems

UNIT 2: SOIL GENESIS, CLASSIFICATION, AND PHYSICAL PROPERTIES

2.1. Soil concepts: pedological and edaphological concepts

2.2. Factors influencing soil genesis; Soil profile development and horizon differentiation

2.3. Soil architecture and physical properties (textural classes, pore space, particle density etc.)

2.4. International soil classification systems: World Reference Base (WRB), USDA Soil Taxonomy, and ICAR classification. Major soil types of India

UNIT 3: SOIL CHEMISTRY AND GEOCHEMICAL INTERACTIONS

3.1. Soil organic matter: Origin, structure, properties and decomposition.

3.2. Soil mineralogy: role of clay minerals, silicate groups, and their geochemical reactivity; Soil–organic matter interactions: complexation, adsorption-desorption mechanisms

3.3. Soil pH and buffering capacity; role in nutrient solubility and availability. Soil temperature: thermal properties, seasonal variation, influence on chemical processes

3.4. Soil colloids: types (inorganic and organic), surface charge, cation and anion exchange capacity (CEC & AEC)

UNIT 4: SOIL CHEMISTRY OF AERATION, ACIDITY, AND NUTRIENT DYNAMICS

4.1. Soil aeration and gas exchange: mechanisms, factors, and influence on microbial and root activities

4.2. Soil acidity: sources (active, exchangeable, residual), acidification processes, and liming materials

4.3. Chemistry of salt-affected soils: saline, sodic, saline-sodic soils; formation, diagnostics, and management

4.4. Soil macro and micronutrients; Nitrogen and Sulfur economy of soils, soil fertility evaluation and integrated nutrient management

UNIT-V: CONTAMINANT GEOCHEMISTRY AND POLLUTION

5.1. Sources, behaviour, and fate of major environmental pollutants (heavy metals, PAHs, pesticides)

5.2. Sources of trace elements in soils, trace element problems in crops and livestock. Assessment of metal pollution in soils, sources and types of metal pollution.

5.3. Geochemical pathways of contaminants; Acid mine drainage, saline intrusion, radionuclide geochemistry

5.4. Risk assessment and geochemical criteria for remediation

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESTC204 | **Title: Environmental Geochemistry**
Credits: 4 | **Maximum Marks : 100**
Duration of Examination: 3 hrs | **a) Minor Test-I : 20 Marks**
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

LITERATURE RECOMMENDED

1. Carter, M. R. (Ed.). (1993). *Soil sampling and methods of analysis*. CRC Press.
2. Conklin, A. R. (2013). *Introduction to soil chemistry: Analysis and instrumentation*. John Wiley & Sons.
3. Essington, M. E. (2015). *Soil and water chemistry: an integrative approach*. CRC press.
4. Foth, H. D. (1978). Fundamentals of Soil Science. *Soil Science*, *125*(4), 272.
5. Horton, R. E. (1941). An approach toward a physical interpretation of infiltration-capacity. *Soil Science Society of America Journal*, *5*(C), 399-417.
6. Mason, B., & Moore, C. B. (1985). Principles of geochemistry.
7. McSween, H. Y., Richardson, S. M., & Uhle, M. E. (2003). *Geochemistry: pathways and processes*. Columbia University Press.
8. Millar, C. E., & Turk, L. M. (2002). *Fundamentals of soil science*. Daya Books.
9. Sparks, D. L. (2003). *Environmental soil chemistry*. Academic press.
10. White, R. E. (2013). *Principles and practice of soil science: the soil as a natural resource*. John Wiley & Sons.
11. White, W. M. (2020). *Geochemistry*. John Wiley & Sons.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESTE205 | **Title: Environmental Economics and Auditing**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

Objectives:

The course aims to develop understanding of the interrelationship between economics and the environment. It will help students to examine tools and methods of environmental valuation and economic instruments for environmental management. It aims at imparting skills in conducting environmental audits and understanding sustainability reporting. It will promote critical thinking in policy evaluation and decision-making related to sustainable development.

UNIT 1: FUNDAMENTALS OF ENVIRONMENTAL ECONOMICS

1.1. Introduction to Environmental Economics: Basic concepts, scope, and relevance to environmental sciences
1.2. Economy–Environment Interactions: Natural resources, ecological systems, and economic growth
1.3. Market Failures and Externalities: Public goods, external costs/benefits, tragedy of the commons
1.4. Sustainable Development: Definitions, indicators, and approaches (weak vs. strong sustainability)

UNIT 2: ENVIRONMENTAL VALUATION AND COST–BENEFIT ANALYSIS

2.1. Valuation of Environmental Goods and Services: Use and non-use values, Total Economic Value (TEV)
2.2. Valuation Techniques: Contingent valuation, travel cost, hedonic pricing, and choice modelling
2.3. Cost–Benefit Analysis (CBA): Discounting, risk, and uncertainty, case studies
2.4. Natural capital accounting and green GDP: Concepts and applications at national and international level

UNIT 3: ENVIRONMENTAL POLICY INSTRUMENTS AND GOVERNANCE

3.1. Economic Instruments: Taxes, subsidies, tradable permits, pollution charges
3.2. Command-and-Control Approaches: Regulations, standards, and enforcement challenges
3.3. Environmental Policies in India: Legal framework, EIA policy, fiscal instruments
3.4. Global Environmental Governance: Role of UNEP, IPCC, World Bank, WTO, and MEAs

UNIT 4: ENVIRONMENTAL AUDITING AND MANAGEMENT SYSTEMS

4.1. Concept and types of environmental audits: Compliance, performance, and risk-based audits
4.2. Audit Protocols and Methodologies: ISO 14001, Environmental Management System, Life Cycle Assessment (LCA)
4.3. Audit process: Planning, execution, reporting, follow-up
4.4. Case studies: Industrial, institutional, and municipal environmental audits

UNIT 5: CONTEMPORARY ISSUES AND PRACTICAL APPLICATIONS

5.1. Climate change economics: Carbon markets, green credits, social cost of carbon
5.2. Circular economy and resource efficiency: Concepts, metrics, and business models
5.3. Sustainability reporting and environmental and Social Governance
5.4. Skill Module: Preparation of environmental audit report; group project or fieldwork

LITERATURE RECOMMENDED

1. Gupta, N. (2008). *Environmental Accounting, Auditing and Reporting*. Sultan Chand & Sons.
2. Hanley, N., Shogren, J. F., & White, B. (2013). *Environmental Economics: In Theory and Practice*. Palgrave Macmillan.
3. Pearce, D. W., & Turner, R. K. (1990). *Economics of Natural Resources and the Environment*. Johns Hopkins University Press.

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESTE205 **Title: Environmental Economics and Auditing**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

4. Tietenberg, T. H., & Lewis, L. (2018). *Environmental & Natural Resource Economics*. Routledge.
5. UNEP, ISO, and GRI publications on environmental auditing and sustainability reporting.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESPC211 | **Title: Lab Course-1 (Based on P2ESTC201)**

Credits: 2
Duration of Examination: 4 hrs

Maximum Marks : 50
a) Internal : 25 Marks
b) External : 25 Marks

Objectives:
To make students familiar with experimental work based on Course No. P2ESTC201

1. To determine the Biological Oxygen Demand (BOD) in given water sample.
2. To determine the Chemical Oxygen Demand (COD) in given water sample.
3. To determine the nitrate concentration in different water samples (tap/sewage/lake).
4. To estimate Suspended Particulate Matter (SPM) in ambient air.
5. To measure the noise level in different environments by sound level meter (SLM).
6. To compare the results of Environmental parameters (air or water) with permissible limits set by WHO, CPCB, and BIS.
7. To visit the Sewage Treatment Plant (STP) and write about the treatment methods.
8. To visit a drinking water treatment plant and write about the treatment methods.
9. To visit a dumping site and write a note on the environmental pollution problems resulting from the disposal of solid waste.
10. Geotag and map air/water contamination hotspots using QGIS.
11. Finding air quality index based on given data.
12. Exercises based on modeling dispersion of pollutants using Gaussian plume model.

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESPC212 | **Title: Lab Course-2 (Based on P2ESTC202)**

Credits: 2 | **Maximum Marks : 50**

Duration of Examination: 4 hrs | **a) Internal : 25 Marks**

b) External : 25 Marks

Objectives:

To make students familiar with experimental work based on Course No. P2ESTC202

1. Make a rapid assessment of terrestrial faunal species (reptiles, birds and mammals) within and nearby areas of the University Campus.
2. Make a rapid assessment of lepidoptera (butterflies and moths) within and nearby areas of the University Campus.
3. Make a (respective ward wise) inventory of urban biodiversity of Jammu
4. Mark the Protected Area Network of Jammu and Kashmir on the map
5. Sampling techniques: Forests and vegetation structure, phytosociology, and ecological classification
6. Wildlife monitoring: Field protocols (transect sampling) for population estimation of mammals, birds, and butterflies
7. Wildlife monitoring: Camera trapping for population estimation of mammals
8. Data collation and analysis using statistical software (occupancy and diversity attributes)
9. Citizen Science in bird monitoring
10. Preparation of People Biodiversity Registers (PBR)
11. Understanding management perspective of a nearby Ex-situ conservation site (Jambu Zoo)
12. Visit to nearby Nature Interpretation Center (Eco-Vista, Raika, Jambu Zoo)

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESPC213 | **Title: Lab Course-3 (Based on P2ESTC203)**

Credits: 2 | **Maximum Marks : 50**

Duration of Examination: 4 hrs | **a) Internal : 25 Marks**

b) External : 25 Marks

Objectives:

To make students familiar with the experimental work based on Course No. P2ESTC203

1. To study types and coding of meteorological laboratories.
2. Selection of site and layout for instruments in an agro meteorological laboratory.
3. To understand the concept of air masses and air front and their representation on weather map.
4. To draw wind roses with given data.
5. Visit to a meteorological observatory at SKUAST-Jammu. To study the components and working of Automatic Weather Station (AWS).
6. Visit to a Doppler Weather Radar (DWR) system at IMD, Jammu.
7. To draw a climograph based on given data.
8. To draw a hythergraph based on given data.
9. To study various landforms shaped by the fluvial erosion and deposition.
10. To compute the sinuosity index of a river segment and analyze the degree of meandering.
11. To calculate intensity of rainfall during successive time periods and categorize the type of rainfall according to intensity.
12. Identification of various symbols used in the weather map.
13. Decoding of synoptic elements plotted on a weather map.

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESPC214 | **Title: Lab Course-4 (Based on P2ESTE204)**

Credits: 2 | **Maximum Marks : 50**

Duration of Examination: 4 hrs | **a) Internal : 25 Marks**

b) External : 25 Marks

Objectives:

To make students familiar with the experimental work based on Course No. P2ESTE204

1. Sampling techniques for collection of soil samples
2. Collection of surface sediments for determination of heavy metal toxicity.
3. Preparation of soil samples for analysis.
4. Particle size analysis of soil sediments
5. To determine water soluble major ions in soil using Ion chromatograph.
6. Acid digestion of soil samples using microwave digestion.
7. Determination of loss on ignition in given soil sample.
8. Estimation of organic carbon in a given soil sample
9. Determination of available nitrogen in soils.
10. Determination of the cation exchange capacity (CEC) of soil.
11. Determination of available phosphorus in soil.
12. Determination of available potassium in soil.
13. Determination of alkali and alkaline earth metals in soil using flame photometry.

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

[SEMESTER-II]

Examinations to be held in May 2026, 2027 & 2028

Course No.: P2ESPE215 | **Title: Lab Course-5 (Based on P2ESTE205)**

Credits: 2
Duration of Examination: 4 hrs

Maximum Marks : 50
a) Internal : 25 Marks
b) External : 25 Marks

Objectives:
To make students familiar with the experimental work based on Course No. PSESTE205

1. Identify and classify local natural resources (renewable/non-renewable).
2. Collect and analyze SDG indicators for a region.
3. Study and interpret India's Green GDP or State of Environment reports
4. Review and present summaries of Indian Environmental Policies (e.g., Environment Protection Act, EIA Notification)
5. Develop audit checklists for different sectors (industrial, institutional).
6. Conduct mini audits of selected campus facilities (e.g., energy use, waste management).
7. Calculate carbon footprint using online tools (e.g., carbonfootprint.com).
8. Analyze case studies of Indian companies implementing circular economy practices.
9. Develop business model canvas for a hypothetical circular product.

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

UNIVERSITY OF JAMMU
SYLLABUS FOR
TWO-YEAR P.G. IN ENVIRONMENTAL SCIENCES (NEP-2020)

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTC301 | **Title: Disaster Risk Reduction and Management**

Credits: 4

Duration of Examination: 3 hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

Objectives:

A course on disaster risk reduction and mitigation is vital for equipping students with the knowledge and skills needed to understand hazards, assess risks, and design effective strategies to reduce the impacts of disasters. It fosters scientific and interdisciplinary thinking by integrating environmental science, engineering, policy, and community-based management approaches. The course aims to enhance the capacity of the students to innovate, engage with vulnerable communities, and address the growing challenges of rising natural and human induced disasters. By linking theory with practical applications, the course empowers future professionals to build resilience and safeguard lives, livelihoods, and ecosystems.

UNIT 1: DISASTERS – CHARACTERISTICS AND ATTRIBUTES (NATURAL DISASTERS)

1.1. Hazards, risks, disasters and vulnerability: concept and their relationship. Classification of disasters
1.2. Natural disasters: causes, consequences and mitigation of geological disasters
1.3. Natural disasters: causes, consequences and mitigation of hydrometeorological disasters
1.4. Climate change and extreme weather events

UNIT 2: DISASTERS – CHARACTERISTICS AND ATTRIBUTES (HUMAN INDUCED DISASTERS)

2.1. Technological and industrial disasters (industrial accidents, mining accidents, structural failures, fires and explosions)
2.2. Transportation disasters (rail, road, aviation, and maritime accidents caused by technical faults or human error)
2.3. Armed conflicts and warfare. Urban heat-island effect
2.4. Socio-economic and public health disasters

UNIT 3: DISASTER RISK IDENTIFICATION AND VULNERABILITY ASSESSMENT

3.1. Disaster risk identification and impact analysis
3.2. Vulnerability: concept and key dimensions
3.3. Vulnerability assessment: steps and indicators
3.4. Hazard mapping and risk analysis

UNIT 4: DISASTER MITIGATION AND PREPAREDNESS

4.1. Disaster management cycle : an overview
4.2. Disaster preparedness: concept and significance
4.3. Disaster response and recovery: early warning systems, response plans, rescue, and relief operations
4.4. Disaster management: concept, principles, mitigation approaches and strategies

UNIT 5: TECHNOLOGY AND LEGAL FRAMEWORK IN DISASTER MANAGEMENT

5.1. Applications of science and technology in disaster management
5.2. Disaster management (amendment) Act, 2025
5.3. National building codes (2016) and dam safety bill (2019)
5.4. Jammu and Kashmir disaster management plan (2023)

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTC301 | **Title: Disaster Risk Reduction and Management**

Credits: 4

Duration of Examination: 3 hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

LITERATURE RECOMMENDED

1. Alexander, D. (2002). *Principles of Emergency Planning and Management-Comprehensive principles and practical approaches to disaster risk reduction.* Oxford University Press,.
2. Coppola, D. P (2015). Introduction to International Disaster Management. Elsevier, 3rd ed., Global case studies, mitigation frameworks, and policy implications.
3. Sharma, V. K. (1999). *Disaster Management.* National Centre for Disaster Management, IIPA, 1999.– Indian perspective with focus on policy and community-based approaches.
4. Carter, Nick W. (2008). *Disaster Management: A Disaster Manager's Handbook.* Asian Development Bank– Hands-on guide with disaster preparedness and mitigation strategies.
5. Gupta, A. K. and Gupta, N. (2016). *Disaster Management and Risk Reduction: Role of Environmental Knowledge.* PHI Learning, 2016.– Links environmental understanding with disaster mitigation.
6. Gupta, H. (2003). *Disaster Management.* University Press, Hyderabad.
7. Prakash, I. (1995). *Disaster Management.* Rashtra Prahari Prakashan, Ghaziabad.
8. National Disaster Management Authority (NDMA), Government of India – Guidelines on Cyclones, Earthquakes, Floods, Landslides, Urban Flooding, and Heatwaves. – https://ndma.gov.in
9. UNDRR (United Nations Office for Disaster Risk Reduction) – *Sendai Framework for Disaster Risk Reduction (2015–2030).*– https://www.undrr.org
10. Ministry of Home Affairs, GoI – *National Policy on Disaster Management (NPDM), 2009.*

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.,* Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

UNIVERSITY OF JAMMU
SYLLABUS FOR
TWO-YEAR P.G. IN ENVIRONMENTAL SCIENCES (NEP-2020)

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTC302 | **Title: Ecotechnologies for Contaminant Remediation**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

Objectives:

Biological treatment technologies are increasingly recognized within environmental science as effective and ecologically sound approaches for the remediation of contaminated sites. Based on the ecological principles, ecotechnological interventions capitalize on the inherent self-regulating and self-repairing capacities of natural systems to mitigate pollution while contributing to broader environmental restoration. This course offers an in-depth exploration of bioremediation and ecotechnologies, with a focus on their applications in the remediation of contaminated environments. Through the integration of ecological theory and eco-engineering, students will develop a critical understanding of ecosystem structure and function, the biogeochemical and microbial processes underpinning contaminant transformation, and the environmental and design factors influencing remediation efficacy. Particular attention is given to the development of green infrastructure and nature-based solutions that align with site-specific ecological conditions.

UNIT 1: INTRODUCTION TO ECOTECHNOLOGY

1.1. Definition, scope, historical evolution, and conceptual framework
1.2. Fundamentals of Phytotechnology: Types and mechanisms, advantages, and limitations of plant-based remediation
1.3. Concept of Green Infrastructures (GIs) and Nature-based solutions (NbS)
1.4. Ecological principles behind Ecotechnology- Self-regulation, Ecosystem services, Nutrient cycling, Biomimicry, etc.

UNIT 2: BIOREMEDIATION- OVERVIEW AND PROCESSES INVOLVED

2.1. Concept, types, advantages, and disadvantages of bioremediation
2.2. Applied bioremediation- An overview, Biotreatability studies
2.3. Factors affecting bioremediation
2.4. Microbial processes for the remediation of environmental pollutants

UNIT 3: BIOREMEDIATION TECHNOLOGIES

3.1. *In-situ* bioremediation- Concept, design, applications, and limitations
3.2. Bioventing- Concept, design, applications, and limitations
3.3. Air sparging- Concept, design, applications, and limitations
3.4. Bioaugmentation- Concept, process, applications, and limitations

UNIT 4: ECOTECHNOLOGY IN PRACTICE-I

4.1. Introduction to Constructed Wetland technology for wastewater treatment, Classification and types of Constructed Wetlands
4.2. Design and applications of Constructed Wetlands: Horizontal Flow CWs, Vertical Flow CWs
4.3. Design and applications of Hybrid Constructed Wetlands
4.4. Operation, maintenance, and monitoring of Constructed Wetlands, Global and National Case studies on CW-based wastewater treatment

UNIT 5: ECOTECHNOLOGY IN PRACTICE-II

5.1. Land farming- Concept, site requirements, application, and limitations
5.2. White-rot Fungal technology for waste treatment
5.3. Introduction to Green Roofs and Green Walls
5.4. Rain Gardens: Concept and applications

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

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Credits: 4
Duration of Examination: 3 hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

LITERATURE RECOMMENDED:

1. Gadd, G. M. (2001). Fungi in Bioremediation. Cambridge University Press, ISBN: 0-521-78119-1.https://clu-in.org/techfocus/default.focus/sec/Bioremediation/cat/Overview/ (accessed on 26th May 2025)
2. Malaviya, P. and Singh, A. (2012). Constructed wetlands for management of urban stormwater runoff. Critical Reviews in Environmental Science and Technology. 42(20): 2153-2214.
3. Malaviya, P. and Singh, A. (2012). Phytoremediation strategies for remediation of uranium-contaminated environments: A Review. Critical Reviews in Environmental Science and Technology. 42(24): 2575-2647.
4. Mitsch, W. J. and Jorgensen, S. E. (1989). Ecological Engineering: An Introduction to Ecotechnology. John Wiley & Sons, ISBN: 0-471-62559-0.
5. Rai, J. P. N. and Saraswat, S. (2023). Green Technologies for Waste Management: A Wealth from Waste Approach (1st ed.). CRC Press, ISBN: 9781003279136.
6. Sharma, R. and Malaviya, P. (2021). Management of stormwater pollution using green infrastructure: The role of rain gardens. Wiley Interdisciplinary Reviews, Water. 8(2): e1507.
7. Singh, A. and Ward, O. P. (2004). Applied Bioremediation and Phytoremediation. Springer-Verlag, ISBN: 3-540-21020-2.
8. Singh, S. N. and Tripathi, R. D. (2007). Environmental Bioremediation Technologies. Springer-Verlag, ISBN: 3-540-34790-9.
9. Vinasco, J. P. S. (2021). Greenhouse Gas Emissions from Ecotechnologies for Wastewater Treatment (1st ed.). CRC Press, ISBN: 9781003131137.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTC303 | **Title: Research Methodology and Statistics**

Credits: 4

Duration of Examination: 3 hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

Objectives:

The primary objective of this course is to equip students with the basic understanding of research methodology and statistical techniques applicable to environmental sciences. The course aims to develop students' skills in scientific research design, data collection and analysis, and the use of statistical methods for interpreting complex environmental systems.

UNIT 1: FUNDAMENTALS OF RESEARCH METHODOLOGY

1.1. Definition, types of research, significance of research in environmental sciences
1.2. Components of research design, hypothesis testing
1.3. Scientific literature, digital libraries and databases, review of literature
1.4. Scientific writing, structure of a research paper, thesis, and reports, referencing styles

UNIT 2: ENVIRONMENTAL DATA COLLECTION AND SAMPLING TECHNIQUES

2.1. Types of environmental data; Qualitative vs quantitative; discrete vs continuous
2.2. Scales of measurement: Nominal, ordinal, interval, ratio
2.3. Sampling methods; Random, stratified, systematic, and cluster sampling, sample size determination and bias
2.4. Data validation and cleaning, use of spreadsheets and data management tools

UNIT 3: DESCRIPTIVE STATISTICS

3.1. Measures of central tendency: Mean, median, mode
3.2. Measures of dispersion: Range, variance, standard deviation, coefficient of variation
3.3. Measures of shape: Skewness and kurtosis
3.4. Data summarization techniques (tabulation and visualization)

UNIT 4: INFERENTIAL STATISTICS

4.1. Null and alternative hypothesis
4.2. Type I and Type II Errors
4.3. t-test (one-sample, independent, paired), p-value
4.4. Chi-square test, ANOVA (One-way)

UNIT 5: CORRELATION AND REGRESSION

5.1. Pearson's and Spearman's correlation
5.2. Simple linear regression: Fitting, interpretation, assumptions
5.3. Coefficient of determination (R^2)
5.4. Introduction to multiple regression models

LITERATURE RECOMMENDED

1. Kothari, C.R. (2004). *Research Methodology: Methods and Techniques*. New Age International.
2. Zar, J.H. (2010). *Biostatistical Analysis*. Pearson Education.
3. S.C. Gupta (2016). *Fundamentals of Statistics*. Himalaya Publishing House.
4. Prem. S. Maan. (2017). *Introductory Statistics*. Wiley; 9th edition.

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTC303 | **Title: Research Methodology and Statistics**

Credits: 4

Duration of Examination: 3 hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

UNIVERSITY OF JAMMU
SYLLABUS FOR
TWO-YEAR P.G. IN ENVIRONMENTAL SCIENCES (NEP-2020)

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTC304

Title: Atmospheric Chemistry and Climate Change

Credits: 4

Maximum Marks: 100

Duration of Examination: 3 hrs

a) Minor Test-I: 20 Marks

b) Minor Test-I : 20 Marks

c) Major Test : 60 Marks

Objectives:

This course aims to develop an understanding about the chemical composition and processes occurring in the troposphere. To explore the role of reactive gases, radicals, and aerosols in air quality and climate. To analyze pollution formation and transformation at urban, regional, and global scales. To introduce observational techniques and chemical transport modeling for tropospheric chemistry. It aims to provide students with a comprehensive understanding of the chemical and physical processes occurring in the atmosphere, and how these processes interact with climate change, the science behind climate change, and the policy responses needed to address this global challenge.

UNIT 1: EARTH'S ATMOSPHERE

1.1. Evolution of the Earth's atmosphere: Prebiotic atmosphere and origins of life; rise of oxygen and ozone; oxygen and carbon budgets

1.2. Vertical profiles of temperature and pressure in Earth's atmosphere

1.3. Half-life, residence time, and renewal time of chemicals in the atmosphere; units for chemical abundance

1.4. Interaction of solar and terrestrial radiation with atmospheric components

UNIT 2: ATMOSPHERIC CHEMISTRY-I

2.1. Key atmospheric radicals (OH, HO_2, NO, NO_2, Cl) and their role in atmospheric self-cleansing

2.2. Criteria air pollutants and atmospheric pollution chemistry: primary and secondary pollutants, chemical transformation of SO_2, NO_x, CO, and NH_3 in polluted atmospheres

2.3. Photochemical smog mechanisms (Los Angeles-type vs VOC-limited/NOx-limited regimes); secondary pollutants: peroxyacyl nitrates (PAN), secondary organic aerosols (SOA)

2.4. Cloud and precipitation chemistry: cloud condensation nuclei and nucleation; scavenging; dissolution of gases in cloud droplets; aqueous-phase chemical reactions

UNIT 3: ATMOSPHERIC CHEMISTRY-II

3.1. Atmospheric aerosols: classification (primary vs secondary), sources, size distributions; processes of nucleation, growth, coagulation, and removal

3.2. Chemical composition and hygroscopicity of aerosols; role in Cloud Condensation Nuclei and impacts on radiative forcing and climate

3.3. Stratospheric ozone chemistry, catalytic ozone destruction cycles involving Cl, NO, and Br radicals

3.4. Polar stratospheric clouds (PSCs), ozone depletion events, ozone hole formation; chlorofluorocarbons (CFCs); Montreal Protocol; observed recovery trends

UNIT 4: GREENHOUSE GASES AND CLIMATE INTERACTIONS

4.1. Greenhouse effect and Earth's radiative balance; GHGs and aerosols; radiative forcing and climate sensitivity.

4.2. Evidence for climate change: paleoclimatic data, instrumental records, changes in cryosphere.

4.3. Global carbon cycle and climate feedback; estimation of global warming potential (GWP); national and global emission inventories. Large-scale atmospheric and ocean circulation

4.4. Observed trends and projected climate change: historical temperature and CO_2 trends, IPCC AR6 findings, climate models, emission scenarios.

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTC304 | **Title: Atmospheric Chemistry and Climate Change**

Credits: 4 | **Maximum Marks: 100**

Duration of Examination: 3 hrs | **a) Minor Test-I: 20 Marks**
b) Minor Test-I : 20 Marks
c) Major Test : 60 Marks

UNIT 5 : CLIMATE CHANGE IMPACTS, MITIGATION, AND POLICY

5.1. Climate change impacts: Ecological, socio-economic and health
5.2. GHG mitigation strategies, energy transition and sustainable practices
5.3. Climate adaptation strategies and early warning system for weather forecasting
5.4. Climate policies and governance at National and International level

LITERATURE RECOMMENDED

1. Baird, C., and Cann, M. (2005). *Environmental chemistry*. Macmillan.
2. Barry, R. G. and Carleton, A. M. (2001). *Synoptic and Dynamic Climatology*, Routledge, London.
3. Finlayson-Pitts, B. J. and Pitts Jr, J. N. (1986). Atmospheric chemistry. Fundamentals and experimental techniques.
4. Girard, J. (2013). *Principles of environmental chemistry*. Jones & Bartlett Publishers.
5. Hobbs, P. V. (2000). *Introduction to atmospheric chemistry*. Cambridge University Press.
6. Jacob, D. J. (1999). Introduction to atmospheric chemistry. Princeton University Press.
7. Lutgens, F. K.; Tarbuck, E. J. and Tasa, D. (2009). *The Atmosphere: An Introduction to Meteorology*, Prentice-Hall, Englewood Cliffs, New Jersey.
8. Manahan, S. E. (2022). *Environmental chemistry*. CRC press.
9. Masters, G. M. (2014). *Introduction to Environmental Engineering and Science*, 3rd Edn. Englewood Cliffs, NJ: Prentice Hall.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 9 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTE305 | **Title: Environmental Toxicology and Health Hazards**

Credits: 4
Duration of Examination: 3hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

Objectives:

This course is designed to equip the students with the knowledge and skills to understand the sources, fate, and effects of environmental pollutants on ecosystems and human health, explore mechanisms of toxicity at molecular, cellular, and organismal levels. To enable them to analyze risk assessment, bioaccumulation, and regulatory frameworks. Also, to familiarize the students with various forms of life substances, forces and conditions in the surroundings of man that may exert an influence on man's health and well-being. This would help the students in understanding and assessing the current environmental hazards which are result of man's activities or his modification of environment and have adverse impacts on human health. The main aim is to make students understand importance of health and well-being.

UNIT 1: ENVIRONMENTAL TOXICOLOGY

1.1. Toxicology: Basic concepts, scope, and importance
1.2. Principles of toxicology; Toxicants and Toxicity: Factors affecting toxicity
1.3. Toxicity of chemical mixtures; Dose-effect and response; Dose-response relationships
1.4. Toxicokinetics- Absorption, Distribution, Metabolism, and Elimination of toxicants (ADME)

UNIT 2: TOXICITY OF ENVIRONMENTAL POLLUTANTS

2.1. Toxicity of Persistent Organic Pollutants (POPs) – pesticides, insecticides, polychlorinated biphenyls
2.2. Toxicity of heavy metals – chromium, cadmium, mercury, arsenic, lead; biohazards of radioactive substances
2.3. Health effects of emerging contaminants
2.4. Bioavailability, bioaccumulation, biotransformation, and excretion of xenobiotics

UNIT 3: ANALYTICAL METHODS FOR TOXICITY TESTING

3.1. Toxicity testing – testing for acute and chronic toxicity, measurements of LC_{50} and LD_{50}
3.2. Monitoring approaches: indicator populations and indicator species, Model ecosystems – microcosms and mesocosms
3.3. Bioassays – *in vitro* and *in-vivo*; biosensors, biomarkers and bioindicators; genotoxicity, mutagenesis and carcinogenesis
3.4. Mode of action of toxicants: biochemical and molecular mechanisms (oxidative stress, enzyme inhibition)

UNIT 4: ENVIRONMENT AND HEALTH

4.1. Health: Definition, historical perspective, and dimensions and determinants of health
4.2. Health indicators and health situation in India
4.3. Concept of disease and its prevention, dynamics of disease transmission
4.4. Etiology, pathogenesis and remedial measures of water-borne infections (diarrhoea and dysentery) and Air-borne infections (COVID-19 and Swine influenza)

UNIT 5: ENVIRONMENTAL HAZARDS WITH REFERENCE TO OCCUPATIONAL HAZARDS

5.1. Environmental hazards: physical, chemical, biological, sociological, and psychological
5.2. Occupations hazards with particular-reference to dust diseases and occupational cancers
5.3. Prevention of occupational hazards
5.4. Ecological Risk Assessment and Risk Management

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTE305 | **Title: Environmental Toxicology and Health Hazards**

Credits: 4
Duration of Examination: 3hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

LITERATURE RECOMMENDED

1. Benjamin, O. Alli. (2008). *Fundamental Principles of Occupational Health and Safety*. International Labour Office, Geneva.
2. Connell, D. W., Lam, P., Richardson, B., and Wu, R. (2009). *Introduction to Ecotoxicology*. John Wiley & Sons.
3. Edward, A. (2013). *Laws. Environmental Toxicology: Selected entries from the encyclopedia of Sustainability Science and Technology*. New York, Springer-Verlag.
4. Gilbert, S. G. (2005). *A small dose of toxicology: The Health Effects of Common Chemicals of Environmental Health*, 5(2), 82.
5. Hayes, A. W. (2008). *Principles and Methods of Toxicology, 5th Edition*, Boca Raton, FL, Taylor and Francis.
6. Landis, W., Sofield, R. and Yu, M.H. (2017). Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes, Fifth Edition. Canada, CRC Press.
7. Park, K. (2005). *Park's Textbook of Preventive and Social Medicine*. Preventive Medicine in Obstet, Paediatrics and Geriatrics.
8. Sarkar, A., Panigrah, S. K. and Anand, M. (2012). Vector Borne diseases in India: Environmental health and policy perspective.
9. Timbrell, J. and Barile, F. A. (2023). *Introduction to toxicology*. CRC Press.
10. Walker, C.H., Sibly, R.M., Hopkin S.P. and Peakall, D.B. (2012). Principles of Ecotoxicology. Fourth Edition. USA, CRC Press.
11. Walker, C. (2014). *Ecotoxicology: effects of pollutants on the natural environment*. CRC Press.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTE306 | **Title: Environmental Microbiology and Biotechnology**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

Objectives:

The main objective of this course is to make the students familiar with microorganisms without which humans could not survive as these microbes occur in large numbers in most natural environments and bring about many desirable and undesirable changes. Besides their role in the evolution of life on this planet, microbial activity is linked directly with processing and removal of dead bodies and sewage. This course will help the students to protect the environment from pollution & to conserve natural resources because the rapid industrialization, urbanisation and other developments are constant threat to the clean environment and to the depleting natural resources. Moreover, the threats to the environment are also from release of genetically engineered organisms in the atmosphere and due to release of effluents from biotechnological companies. Thus, the study of course will help to develop cleaner and sustainable environment in future.

UNIT 1: MICROBIAL ENVIRONMENT

1.1. Nature and function of microorganisms in soil
1.2. Nature and function of microorganisms in air
1.3. Microbes and Biogeochemical cycles: carbon cycle, sulphur cycle, nitrogen cycle, phosphorus cycle and iron cycle
1.4. Potability of water: microbial assessment of water quality

UNIT 2: FOOD MICROBIOLOGY

2.1. Contamination and microbial spoilage of food
2.2. Sources and types of microbes in milk, pasteurization of milk
2.3. Preservation and dehydration of food
2.4. Fermented foods: vegetables and dairy products

UNIT 3: INDUSTRIAL MICROBIOLOGY

3.1. Types of fermentation process, alcoholic fermentation
3.2. Production of vinegar, lactic acid and citric acid
3.3. Production of antibiotics, amino-acids, vitamins, vaccines, steroid transformation
3.4. Microorganisms in bioassays

UNIT 4 : INTRODUCTION TO BIOTECHNOLOGY & POLLUTION CONTROL

4.1. Definition, historical background, scope & importance of biotechnology
4.2. Biosorption - use of bacteria, fungi and algae in biosorption
4.3. Biotechniques for air pollution abatement & odour control-bioscrubbers, biobeds, biotrickling filters
4.4. Biodegradation of pesticides, microbial treatment of oil pollution

UNIT 5 : RECYCLING AND RECLAMATION

5.1. Conventional waste water treatment strategies using biosystem, activated sludge process, Trickling filter, Rotating Biological contactor (RBC) and Fluidized Beds
5.2. Role of Biotechnology in energy production from biomass, fuel alcohol and hydrogen production
5.3. Reforestation of degraded land through micro-propagation, use of mycorrhizae and microbes
5.4. Use of microbes as bioinsecticide, biofungicide and bioherbicides

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESTE306 | **Title: Environmental Microbiology and Biotechnology**

Credits: 4
Duration of Examination: 3 hrs

Maximum Marks : 100
a) Minor Test-I : 20 Marks
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

LITERATURE RECOMMENDED

1. Abbasi, S.A. and Ramasami, E. (1999). Biotechnological Methods of Pollution Control.
2. Alemander, M. (1983). *Soil Microbiology*, Wiley Eastern Limited.
3. Chaterjii, A. K. (2002). Introduction to Environmental Biotechnology. Prentice Hall of India. Co. New Delhi.
4. Frazier, W. C. and Westheff, D. C. (1978). *Food Microbiology*, TATA McGraw Hill Publishing Company Ltd.
5. Frobisher, M., Hinsdill, R. D., Crabtree, K. T. and Goodheart, C. R. (1974). *Fundamentals of microbiology*. W. B. Saunders and Company. Heinemann, U.S.A.
6. Gupta, P.K. (1994). Elements of Biotechnology. Rastogi & Co. Meerut
7. Pelczar, M. J. Reid, R. D. and Chan, E. C. S. (1977). *Microbiology*. McGraw Hill, New York.
8. Purohit, S. S. & Mathur, S. K. (1996). Biotechnology Fundamentals &Applications. Agro botanical Publication, New Delhi.
9. Schlegel, H. G. (1985). *General Microbiology*, Cambridge University Press.
10. Sohal, H.S. & Srviastava, A.K. (1994). Environment & Biotechnology. Ashish Pub. House, Unviersities Press (India) Ltd., Hyderabad.

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESPC315

Title: Lab Course-2 (Based on P2ESTC301 and P2ESTC302)

Credits: 2

Duration of Examination: 4 hrs

Maximum Marks : 50
a) Internal : 25 Marks
b) External : 25 Marks

Objectives:

To make students familiar with the experimental work based on Course No. P2ESTC301 and Course No. P2ESTC302

1. To equip students with the knowledge and skills for designing and setting up a bioremediation laboratory.
2. To engage students in assessing site conditions and applying selection criteria to identify suitable bioremediation technologies for field-scale applications.
3. To acquaint students with designing rain gardens and evaluating their applications for stormwater management and landscape sustainability.
4. To apprise students in designing green walls and evaluating their applications for environmental improvement and urban sustainability.
5. To familiarize students with designing green roofs and evaluating their applications for stormwater management, energy efficiency, and enhancing urban sustainability.
6. To analyze the case studies of major natural disasters that hit Jammu and Kashmir in last one decade and prepare a brief report about the causes, effects, lapses (if any) and suggest a way forward for prevention.
7. To prepare a vulnerability/disaster profile of Jammu city with the help of map.
8. To study disaster management cycle with the help of case studies in and around Jammu.
9. To conduct disaster related mock drills including first aid training exercise.
10. To prepare a disaster preparedness and mitigation plan for University of Jammu.

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

[SEMESTER-III]

Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESPC316 — **Title: Lab Course-3 (Based on P2ESTC303 and P2ESTC304)**

Credits: 2
Duration of Examination: 4 hrs
Maximum Marks : 50
a) Internal : 25 Marks
b) External : 25 Marks

Objectives:

Objectives:

To make students familiar with the experimental work based on Course No. P2ESTC303 and P2ESTC304

1. To formulate hypotheses and research questions based on real-world environmental issues.
2. To perform hands-on simulations of random, stratified, systematic, and cluster sampling designs and analyses the data using appropriate statistics.
3. To carry out a systematic literature review using academic library and summarize key trends.
4. To prepare visualizations like histograms and boxplots using Excel or R programming language on a given dataset.
5. To conduct inferential statistics such as t-tests, chi-square tests, ANOVA, correlation and regression on a given dataset.
6. To measure the Particulate Matter (PM2.5 & PM10) concentration using gravimetric method and/or real-time monitors.
7. To determine the mass concentration and chemical composition (ions/metals) of PM.
8. To measure the Nitrogen Oxides (NO_2) in air using sodium arsenite method (also known as the modified Jacobs and Hochheiser method).
9. To determine the Sulfur Dioxide in Ambient Air using Improved West–Gaeke method.
10. To quantify recent warming trends by downloading historical surface temperature datasets (e.g., NOAA/GISTEMP), compute anomalies, plot time series and linear/LOESS trend.
11. To conduct survey-based studies to assess the perception of climate change and its impacts.

SCHEME OF EXAMINATION

Practical Test	Time allotted for the examination	% Weightage (Marks)		Remarks
Mid Term appraisal	4 hours	25% (Total Marks=13)		After completion of 40% of syllabus Written Exam (9 marks) + Viva-voce (4 marks)
External Examination	4 hours	75%	50% (Total Marks=25)	Written Exam (20 marks) + Day to Day performance and Attendance (5 marks)
			25% (Total Marks=12)	Viva-Voce (8 Marks) + Practical file (4 marks)
Total	**50**			

UNIVERSITY OF JAMMU
SYLLABUS FOR
TWO-YEAR P.G. IN ENVIRONMENTAL SCIENCES (NEP-2020)

[SEMESTER-III]
Examinations to be held in December 2026, 2027 & 2028

Course No.: P2ESMO350 **Title: MOOC through SWAYAM**

Credits: 4 **Maximum Marks : 100**

The students shall be required to complete a four-credit MOOC / SWAYAM course, preferably related to their core domain of study. This course shall be compulsory in the second semester. The students are expected to register for the said course in the month of December / January of the first year of the two year PG Programme. The credits earned through the said course shall be reflected in the third semester and shall be in addition to the required core and elective credits during the third semester.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESTC401 | **Title: Environmental Law and Policy**

Credits: 4

Duration of Examination: 3 hrs

Maximum Marks	**: 100**
a) Minor Test-I	**: 20 Marks**
b) Minor Test-II	**: 20 Marks**
c) Major Test	**: 60 Marks**

Objectives:

The main objective of this course is to acquaint the students with elementary principles of environmental Laws for ensuring protection of environment, promotion of sustainable development, and ensuring legal accountability. The scientific gains can be put into use only within the parameters of a legal system and science and law must be subservient to the needs of society. Through this course, the students shall learn about the legislative measures and spirit of Indian Constitution for environmental protection. The students would be made familiar with the overall environmental legal regime of the country as well as the international obligations.

UNIT 1: INTRODUCTION TO ENVIRONMENTAL PROTECTION

1.1. Introduction to International Environmental Law (IEL); General Principles of IEL
1.2. Environmental Protection in India: Origin and sources of domestic environment law and protection policy; Indian Constitution and Environmental Protection
1.3. Key international efforts for Environment Protection; Climate change law
1.4. Concept of sustainability; Millennium Development Goals vs. Sustainable Development Goals

UNIT 2: KEY ENVIRONMENTAL LAWS IN INDIA

2.1. Water (Prevention & Control of Pollution) Act, 1974 and the related rules
2.2. Air (Prevention & Control of Pollution) Act, 1981 and the related rules
2.3. The Environment (Protection) Act, 1986
2.4. Noise pollution (Regulation and Control) Rules, 2000
(Note: Only relevant provisions of the above Acts supported by cases)

UNIT 3: NATURAL RESOURCE CONSERVATION AND LAW

3.1. Wildlife (Protection) Act, 1972 with latest amendments; key institutions for protection of wildlife
3.2. Indian Forest Act, 1927 vs. Forest Conservation Act, 1980
3.3. Biological Diversity Act, 2002
3.4. National Forest Policy, 1988 and National Environment Policy, 2006
(Note: Only relevant provisions of the above Acts supported by cases)

UNIT 4: REGULATORY LAWS

4.1. Public Liability Insurance Act, 1991
4.2. National Green Tribunal Act, 2010
4.3. Right to Information Act, 2005
4.4. Strategies for conservation–Project Tiger, Project Elephant, Project Snow leopard

UNIT 5: JUDICIAL TRENDS & PUBLIC INTEREST INITIATIVES

5.1. Introduction to Public Interest Litigation and writ petitions
5.2. Judicial remedies in Environmental cases
5.3. Indian Penal Code (IPC 1860) vs Bharatiya Nyaya Sanhita (BNS) 2023
5.4. Criminal Procedure Code, 1973 vs Bharatiya Nagarik Suraksha Sanhita (BNSS) 2023

LITERATURE RECOMMENDED

1. Divan, S. and Rosencranz, A. (2005). *Environmental Law and Policy in India*, Oxford University Press, New Delhi.
2. Diwan, P. (1997). *Environmental Administration - Law & Judicial Attitude, Vol. I, II.* Deep & Deep Pub. New Delhi.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESTC401 | **Title: Environmental Law and Policy**
Credits: 4 | **Maximum Marks : 100**
Duration of Examination: 3 hrs | **a) Minor Test-I : 20 Marks**
b) Minor Test-II : 20 Marks
c) Major Test : 60 Marks

3. Jaswal, P. S. and Jaswal, N. (2014). *Environmental Law*. Allahabad Law Agency, Allahabad.
4. Leela Krishnan, P. (1999). *Environmental Law in India*. Butterworths Publications, New Delhi.
5. Shastri, S.C. (2005). *Environmental Law (2nd Ed.)*, Eastern Book Company, Lucknow.
6. Singh, G. (1995). *Environmental Law: International & National Perspectives*.

ARTICLES:

1. Dari, S. S. and Sharma, R. (2014). An Overview of Environmental Jurisprudence in India. Journal of General Management Research. 1(1): 1–13.
2. Faure, M. G. and Raja, A. V. (2010). Effectiveness of Environmental PIL in India: Determining the Key Variables. Fordham Environmental Law Review. 21(2) Art.3: 239-292.
3. Jasrotia, A. (2003). Survival of the Earth: Vedic Profundity in Raina, S. C. *et al.* (Ed.) Law & Development: An anthology of topical legal studies. Regency Pub. New Delhi. 102-109.

SUGGESTED CASES:

1. Municipal Council, Ratlam vs. VardhichandAIR1980 SC 1622
2. Rural Litigation and Entitlement Kendra, Dehradun vs. State of UP AIR 1988 SC 2187.
3. T. Damodar Rao vs. Municipal Corporation of Hyderabad AIR 1987 AP 171.
4. M.C. Mehta vs. Kamal Nath AIR 2000 SC 1997.
5. Indian Council for Enviro-Legal Action vs. Union of India, 1996 (3) SCC 212.
6. Vellore Citizens Welfare Forum vs. Union of India AIR 1996 SC 2715.
7. M. C. Mehta vs. Union of India 1987 (4) SCC 463
8. M. C. Mehta vs. Union of India 1988 (1) SCC 471

SCHEME OF EXAMINATION

The theory paper will carry 100 marks and the distribution of marks in each theory paper shall be as under

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	10 (MCQs on LMS) 10 (Subjective-type)
Major test (after 90 days)	100%	3 hours	60
	Total		**100**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of ten (10) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of five (05) marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of eight (08) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of three (03) long answer type questions from last three units with internal choice of twelve (12) marks each.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESTE402 | **Title: Environmental Impact Assessment**

Credits: 2
Duration of Examination: 2 hrs

Maximum Marks	**: 50**
a) Minor Test-I	**: 10 Marks**
b) Minor Test-II	**: 10 Marks**
c) Major Test	**: 30 Marks**

Objectives:

The Environment Impact Assessment is among the tools which in recent years have been employed widely to determine the impacts of various activities on the environment with a view to avoid or mitigate such impacts. Deterioration in environmental quality increased with the increase in human activities. The main purpose of this course is to apprise the students of various principles and methodologies used for Environmental Impact Assessment and the consequences of developmental projects and other human activities, both detrimental and beneficial, on the different parameters of environment in order to enhance their understanding and decision-making ability for optimal management.

UNIT 1: BASIC CONCEPTS OF ENVIRONMENTAL IMPACT ASSESSMENT

1.1. Environmental Impact Assessment (EIA): concept, objectives, and origin with respect to India
1.2. Legal, policy and regulatory framework of EIA in India
1.3. EIA: types, procedures and methodologies
1.4. Environmental components of EIA

UNIT 2: ENVIRONMENTAL APPRAISAL, IMPACT ASSESSMENT AND CLEARANCE

2.1. Environmental health impact assessment and risk analysis (air, water and soil quality)
2.2. Environmental impact statement and clearance: components and procedures
2.3. Social dynamics of environmental impact assessment
2.4. Case studies: River valley projects, mining projects, cement industry and civil infrastructure projects (one each)

UNIT 3: ENVIRONMENTAL MANAGEMENT

3.1. Environmental Management Plan, an outcome of EIA: components and significance
3.2. Environmental Management System and auditing: concept, components and guidelines in India
3.3. Environmental priorities *vis-a-vis* Sustainable Development Goals (SDGs) in India
3.4. Concept of green / smart cities: attributes and success stories

LITERATURE RECOMMENDED

1. Anjaneyulu Y., Manickam Valli. (2011). *Environmental Impact Assessment Methodologies*, CRC Press.
2. Baldwin, J. H. (1985). *Environmental Planning & Management*. International Book Distributors, Dehradun, India.
3. Bandhu, D.; Bongartz, H.; Ghazuawl, A. C. and Gopal, B. (1994). *Environmental Education for Sustainable Development.* Indian Environmental Society, New Delhi.
   Bryant, E. A. (1991). *Natural Hazards*. Cambridge University Press, Cambridge, New York.
4. John, G. R. and Hooten, D. C. (1990). *Environmental Impact Analysis Handbook*, McGraw Hill Book Company.
5. Judith, P. (1999). *Handbook of Environmental Impact Assessment Vol. I & II*. Blackwell Science.
6. Prakash, I. (1995). *Disaster Management.* Rashtra Prahari Prakashan, Ghaziabad.
7. Sapru, R. K. (1987). *Environmental Management in India*. Ashish Publishing House, New Delhi.
8. Shrivastava A.K., Baxter Nicola, Grimm Jacob (2003). "*Environmental Impact Assessment*", APH Publishers.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESTE402 | **Title: Environmental Impact Assessment**

Credits: 2
Duration of Examination: 2 hrs

Maximum Marks : 50
a) Minor Test-I : 10 Marks
b) Minor Test-II : 10 Marks
c) Major Test : 30 Marks

SCHEME OF EXAMINATION

The theory paper will carry 50 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	05 (MCQs on LMS) 05 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	05 (MCQs on LMS) 05 (Subjective-type)
Major test (after 90 days)	100%	2 hours	30
	Total		**50**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of five (05) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of 2.5 marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of four (04) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of four (04) long answer type questions of nine (09) marks each with internal choice from last two units.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESTE403 | **Title: Environmental Monitoring and Instrumentation**

Credits: 2
Duration of Examination: 2 hrs

Maximum Marks	**: 50**
a) Minor Test-I	**: 10 Marks**
b) Minor Test-II	**: 10 Marks**
c) Major Test	**: 30 Marks**

Objectives:

This course will help students to understand the applications of various instrumental and analytical techniques for qualitative and quantitative analysis of different environmental matrices. Students will also learn about various environmental quality standards and the importance of quality control in environmental analysis.

UNIT 1: ENVIRONMENTAL MONITORING

1.1. Principles of environmental analysis: quantitative vs. qualitative analysis; QA/QC, Environmental quality standards and environmental monitoring: key aspects, compliance, and enforcement
1.2. Ambient air quality monitoring: sampling strategies, collection techniques, and analytical methods for gaseous and particulate pollutants
1.3. Analytical methods for water quality assessment: sampling, preservation, and determination of physico-chemical parameters
1.4. Soil sampling and analysis: sample collection, processing, and evaluation of key environmental indicators

UNIT 2: SPECTROSCOPIC TECHNIQUES

2.1. Principle, components, working, and environmental applications of Atomic Absorption Spectroscopy (AAS) and UV-Visible Spectrophotometry (UV-VIS)
2.2. Principle, components, working, and environmental applications of Fourier Transform Infrared (FTIR) spectroscopy
2.3. Principle, components, working, and environmental applications of Flame Photometry
2.4. Principle, components, working, and environmental applications Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES)

UNIT 3: CHROMATOGRAPHIC AND MICROSCOPIC TECHNIQUES

3.1. Planar chromatographic methods: principles, procedures, and environmental applications of Paper Chromatography and Thin Layer Chromatography (TLC)
3.2. High Performance Liquid Chromatography (HPLC): working principle, instrumentation, and applications in environmental sample analysis
3.3. Ion Chromatography (IC) and Gas Chromatography: principle, instrumentation, and applications
3.4. Microscopic Techniques: Compound Microscope, Scanning Electron Microscope

LITERATURE RECOMMENDED

1. A.P.H.A. (2005). *Standard Methods for the examination of water & Wastewater, 20th Ed.* Am. Pub. Hlth. Asso., Washington.
2. Down, R. D., & Lehr, J. H. (Eds.). (2005). *Environmental instrumentation and analysis handbook.* John Wiley & Sons.
3. Khandpur, R. S. (2007). *Handbook of analytical instruments*. McGraw Hill Professional.
4. Rajvaidya, N. and Markenday, D. K. (2005). *Environmental Analysis and Instrumentation (Vol. 2)* APH Publishing Corporation.
5. Skoog, D. A.; Holler, F. J. and Crouch, S. R. (2017). *Principles of instrumental analysis*. Cengage learning.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESTE403 **Title: Environmental Monitoring and Instrumentation**

Credits: 2
Duration of Examination: 2 hrs

Maximum Marks : 50
a) Minor Test-I : 10 Marks
b) Minor Test-II : 10 Marks
c) Major Test : 30 Marks

SCHEME OF EXAMINATION

The theory paper will carry 50 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	05 (MCQs on LMS) 05 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	05 (MCQs on LMS) 05 (Subjective-type)
Major test (after 90 days)	100%	2 hours	30
	Total		**50**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of five (05) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of 2.5 marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of four (04) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of four (04) long answer type questions of nine (09) marks each with internal choice from last two units.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESTE404 | **Title: Artificial Intelligence for Sustainable Development**

Credits: 2
Duration of Examination: 2 hrs

Maximum Marks : 50
a) Minor Test-I : 10 Marks
b) Minor Test-II : 10 Marks
c) Major Test : 30 Marks

Objectives

This course introduces students to the transformative potential of Artificial Intelligence (AI) in addressing critical environmental challenges and advancing the United Nations Sustainable Development Goals (SDGs). As the world grapples with climate change, biodiversity loss, and resource scarcity, AI offers powerful tools for monitoring, modelling, and managing complex environmental systems. The primary objectives of this course are to provide a foundational understanding of AI, Machine Learning (ML), Internet of Things (IoT) and Deep Learning (DL) concepts relevant to environmental science. The students will explore the direct applications of AI across various domains such as climate action, conservation, and resource management.

UNIT 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE

1.1. Introduction to AI and ML: definitions, history, AI vs. traditional computing, relevance to sustainability
1.2. Data Science for Environment: types and sources of environmental data; big data; remote sensing data; IoT sensors
1.3. AI techniques overview: machine learning, deep learning, natural language processing, computer vision
1.4. Global and National Initiatives: AI for Earth (Microsoft), climate change AI, India's AI for all, and related SDG frameworks

UNIT 2: AI APPLICATIONS FOR SUSTAINABLE DEVELOPMENT

2.1. Climate Change and Disaster Management: AI in climate modelling, extreme event prediction, early warning systems
2.2. Biodiversity and Ecosystem Conservation: Species identification, population modelling, habitat suitability mapping
2.3. Sustainable Agriculture and Water Management: Precision farming, irrigation optimization, water quality monitoring
2.4. Energy and Resource Efficiency: AI in renewable energy forecasting, smart grids, circular economy

UNIT 3: TOOLS, ETHICS, AND CASE GOVERNANCE

3.1. AI tools and platforms for environmental applications: Google Earth Engine, TensorFlow, PyTorch, QGIS with ML plugins
3.2. Case Studies: air quality monitoring in cities, glacier melt prediction, plastic waste tracking
3.3. Ethics, bias, and equity in AI: Algorithmic bias, data privacy, inclusivity, sustainable AI practices
3.4. Policy, governance, and future directions: AI policy frameworks, environmental governance, responsible innovation

LITERATURE RECOMMENDED

1. Haldorai, A., R, B. L., Murugan, S., and Balakrishnan, M. (2024). *Artificial Intelligence for Sustainable Development. Springer Nature Switzerland.*
2. Ghai, D., Rawal, K., Dhir, K., and Tripathi, S. L. (Eds.). (2025). *Artificial Intelligence Techniques for Sustainable Development.* CRC Press, Taylor & Francis Group.
3. Mondal, S. R., Vartiak, L., and Das, S. (Eds.). (2025). *Generative AI for a Net-Zero Economy: Managing Climate Change and Business Innovation in the Digital Era.* Springer Nature Singapore.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESTE404 | **Title: Artificial Intelligence for Sustainable Development**

Credits: 2
Duration of Examination: 2 hrs

Maximum Marks : 50
a) Minor Test-I : 10 Marks
b) Minor Test-II : 10 Marks
c) Major Test : 30 Marks

4. Reichstein, M. et al. (2019). Deep learning and process understanding for data-driven Earth system science. *Nature*, 566, 195–204.
5. UNEP (2022). *Artificial Intelligence in Environmental Science*.
6. Climate Change AI. *https://www.climatechange.ai/*

SCHEME OF EXAMINATION

The theory paper will carry 50 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	05 (MCQs on LMS) 05 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	05 (MCQs on LMS) 05 (Subjective-type)
Major test (after 90 days)	100%	2 hours	30
	Total		**50**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of five (05) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of 2.5 marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of four (04) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of four (04) long answer type questions of nine (09) marks each with internal choice from last two units.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESTE405 | **Title: Energy and Environment**
Credits: 2 | **Maximum Marks : 50**
Duration of Examination: 2 hrs | **a) Minor Test-I : 10 Marks**
b) Minor Test-II : 10 Marks
c) Major Test : 30 Marks

Objectives:

This course will provide students with a scientific understanding of energy, energy choices, and their implications for sustaining Earth's living systems. In addition, the course will present different conceptual approaches to the ongoing energy problem that confronts human society. Energy conservation, energy efficiency and the transition to renewable and alternative energy sources.

UNIT 1: ENERGY: BASIC CONCEPTS

1.1. Energy basics: Units and measures, laws of thermodynamics, carnot efficiency
1.2. Earth's energy budget, energy balance of earth, solar electromagnetic spectrum
1.3. Major energy flows in global hydrological cycle, ocean, currents and heat flux, atmospheric circulation
1.4. World energy use and Indian scenario, trends in energy use of oil, coal and gas

UNIT 2: ALTERNATIVE RESOURCES AND GREEN TECHNOLOGIES

2.1. Solar energy: collection and storage, present scenario in India, Indirect and direct solar energy conversion
2.2. Wind energy and management, conversion to wind flow, wind energy converters, commercial wind power development, wind energy storage and transfer
2.3. Nuclear energy, tidal and wave energy, geothermal energy, bio-gas plants
2.4. Geoengineering and green technologies related to energy

UNIT 3: ENERGY AND CLIMATE

3.1. Energy and carbon emissions, environmental problems associated with fossil fuels
3.2. Global climate change: Greenhouse effect, greenhouse gases; sources, trends, radiative forcing, warming potential of gases
3.3. Global warming and climate change: Ecological and socio-economic impacts
3.4. Climate mitigation, Technological interventions and eco-innovative solutions

LITERATURE RECOMMENDED

1. Byrne, J. and Rich, D. (Eds.). (2021). *Energy and Environment: The Policy Challenge*. Routledge.
2. Efstathios, E. (2012). *Alternative Energy Sources*. Springer.
3. Elliott, D. (2004). *Energy, Society and Environment*. Routledge.
4. Goldemberg, J. and Lucon, O. (2010). *Energy, environment and development*. Earthscan.
5. Farret, F. A. and Simoes, M. G. (2006). *Integration of Alternative Sources of Energy*. John Wiley & Sons.
6. Hinrichs, R. A. and Kleinbach, M. H. (2012). *Energy: Its Use and the Environment*. Cengage Learning.
7. Hodge, B. K. (2017). *Alternative Energy Systems and Applications*. John Wiley & Sons.
8. Kaltschmitt, M.; Streicher, W. and Wiese, A. (Eds.). (2007). *Renewable Energy: Technology, Economics and Environment*. Springer Science & Business Media.
9. Kruger, P. (2006). *Alternative Energy Resources: The Quest for Sustainable Energy*. Hoboken: Wiley.
10. Michaelides, E. E. S. (2012). *Alternative Energy Sources*. Springer Science & Business Media.
11. Nelson, V. (2009). *Wind Energy: Renewable Energy and the Environment*. CRC press.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESTE405 | **Title: Energy and Environment**
Credits: 2 | **Maximum Marks : 50**
Duration of Examination: 2 hrs | **a) Minor Test-I : 10 Marks**
b) Minor Test-II : 10 Marks
c) Major Test : 30 Marks

12. Schlager, N. and Weisblatt, J. (2006). *Alternative Energy*. Thomson Gale.
13. Wilson, R. (2012). *Energy, Ecology and the Environment*. Elsevier.
14. Foster, R.; Ghassemi, M. and Cota, A. (2009). *Solar Energy: Renewable Energy and the Environment*. CRC press.

SCHEME OF EXAMINATION

The theory paper will carry 50 marks and the distribution of marks in each theory paper shall be as under:

MCQ on LMS+ Subjective Test	Syllabus to be covered in the examination	Time allotted for the examination	% Weightage (Marks)
Minor I (after 30 days)	20%	1 hour	05 (MCQs on LMS) 05 (Subjective-type)
Minor II (after 60 days)	21-40%	1 hour	05 (MCQs on LMS) 05 (Subjective-type)
Major test (after 90 days)	100%	2 hours	30
	Total		**50**

Minor Examination: Question paper will have two parts *viz.*, Part-I (MCQs on LMS) and Part-II (subjective-type). Part-I is compulsory and will consist of five (05) multiple choice questions of one (01) mark each. Part-II will consist of three (03) short answer type questions of 2.5 marks each, out of which two questions are to be attempted.

Major Examination: Question paper will have two sections, Section-A and Section-B. Section-A will be compulsory, comprising of four (04) short answer type questions (minimum 01 from each unit) of three (03) marks each. Section B will consist of four (04) long answer type questions of nine (09) marks each with internal choice from last two units.

[SEMESTER-IV]

Examinations to be held in May 2027, 2028 & 2029

Course No.: P2ESRC430 | **Title: Research Project / Dissertation**
Credits: 16 | **Maximum Marks : 400**

Research Project / Dissertation Examination

The course shall comprise of the following :

A) Educational tour / Short field trips / Industrial visit / Experiential learning (100 marks)

The evaluation shall be as per the break-up below :

Tours / Trips / Others*	Marks
Educational tour	50
Short field trips / Industrial visit / Experiential learning	50
Total Marks	**100***

* The overall evaluation shall be based upon the field visit reports submitted by the students

B) Research Project / Dissertation

The Research Project / Dissertation shall be based on the research problem given to each student during the commencement of Semester – III. The Research Project / Dissertation shall comprise of the following chapters :

Chapter – 1	**Introduction**
Chapter – 2	**Review of Literature**
Chapter – 3	**Material and Methods**
Chapter – 4	**Results and Discussion**
Chapter – 5	**Summary and Conclusions**
–	**References / Bibliography**

Examination / Evaluation for Research Project / Dissertation

a) The Mid-term Evaluation shall be based on the report submitted on following chapters :

Chapter – 1	**Introduction**
Chapter – 2	**Review of Literature**
Chapter – 3	**Material and Methods**

b) The End-term Evaluation of Research Project / Dissertation shall be based on the external examination conducted by the Board of Examiners consisting of :

1. Head of the Department
2. Faculty members of the department
3. Concerned Supervisor
4. External Expert (to be appointed by the Vice Chancellor out of the panel provided by the Convener / Head of the Department who shall evaluate final Research Project / Dissertation of the student).

EXIT POINT (AFTER ONE YEAR)

Students enrolled in the Two-Year PG Programme will have a single exit option at the end of first year (after semester – I). Students opting to exit at this stage shall be awarded a **POSTGRADUATE DIPLOMA.**

VOCATIONAL COURSE

Credits: 4 **8 Weeks**

The students intending to exit after first year ((after semester – II) of the two-Year PG Programme and desirous of getting a Postgraduate Diploma must earn an additional 4 credits through vocational course during the summer term.

The following Vocational Courses are being offered by the Department of Environmental Sciences:

Course Code	Course Name
P2ESVC251	Environmental quality monitoring and analysis
P2ZOVC252	Parataxonomy with special focus on plants, birds, and butterflies
P2ZOVC253	Vermitechnology and solid waste management
P2ZOVC254	Tools and techniques in wildlife monitoring