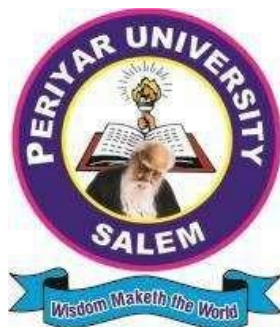


PERIYAR UNIVERSITY

Salem - 636 011

(Reaccredited with 'A⁺⁺' Grade by the NAAC)



DEPARTMENT OF ENVIRONMENTAL SCIENCE

M.Sc. ENVIRONMENTAL SCIENCE

[Choice Based Credit System (CBCS)]

OBE SYLLABUS

(Effective from the academic year 2026-2027 and thereafter)

**M. Sc. ENVIRONMENTAL SCIENCE
OBE REGULATIONS AND SYLLABUS**

(with effect from the academic year 2026-2027 onwards)

1. Preamble

Growing population and high standards of living put increasing pressure on our environment. Since the beginning of industrialization and urbanization, we have been facing increasing number of environmental challenges such as air, water and soil contamination, energy crisis, land degradation, deforestation, loss of biodiversity, global warming and climate change, etc., Considering the above issues, addressing environmental problems from a scientific perspective is utmost important for today's world. Hence, there is a need to develop the next generation graduates as skilled professionals in the multidisciplinary field of Environmental Science through the integrated degree programme to solve the global environmental issues.

2. Vision

- Achieve academic excellence in environmental science through interdisciplinary teaching, innovative research, and community engagement, producing competent professionals for sustainable environmental management.

3. General Graduate Attributes

Graduates of the M.Sc. Environmental Science programme are expected to demonstrate the following attributes:

1. Advanced Scientific Knowledge

Possess strong conceptual understanding of environmental systems, ecological processes, pollution dynamics, and sustainability principles.

2. Research Competence

Design, conduct, and interpret scientific investigations using appropriate methodologies, instrumentation, and statistical tools.

3. Critical Thinking and Analysis

Evaluate environmental problems logically, interpret scientific evidence, and develop data-driven conclusions.

4. Technical Proficiency

Apply modern tools such as GIS, remote sensing, environmental modeling software, and laboratory analytical instruments.

5. Problem-Solving Skills

Develop practical and sustainable solutions for environmental challenges across industrial, urban, rural, and natural ecosystems.

6. Interdisciplinary Perspective

Integrate knowledge from life sciences, physical sciences, social sciences, and policy studies to address environmental issues holistically.

7. Environmental Ethics and Responsibility

Demonstrate commitment to environmental protection, professional integrity, and adherence to environmental laws and regulations.

8. Communication Skills

Effectively communicate scientific findings through technical reports, research publications, presentations, and public outreach.

9. Teamwork and Leadership

Work collaboratively in multidisciplinary teams and exhibit leadership in environmental projects and community initiatives.

10. Lifelong Learning and Adaptability

Stay updated with emerging environmental technologies, policies, and global sustainability trends, demonstrating readiness for continuous professional development.

4. Programme Objectives and Outcomes

Programme Educational Objectives (PEOs)

Graduates of Integrated M.Sc. Environmental Science program will be

PEO1	Utilizing domain knowledge to understand the environment and to provide solutions for the development of society.
PEO2	Applying research and acquired skills with a rich set of communication and leadership skills to sustain in the environment.
PEO3	Expressing constant development in their specialized career through life-long learning, appreciating human values and ethics.

Programme Outcomes (PO)

After successful completion of the Five years Integrated M.Sc. Environmental Science Programme, the students are expected to have

PO1	Advanced Environmental Knowledge Demonstrate in-depth understanding of ecological principles, environmental chemistry, pollution control, biodiversity, and climate science.
PO2	Analytical and Research Skills Apply scientific methods, statistical tools, and laboratory techniques to investigate environmental problems and interpret data.
PO3	Problem-Solving Ability Identify, analyze, and propose sustainable solutions to complex environmental issues at local, regional, and global levels.
PO4	Technical Competence Utilize modern environmental tools such as GIS, remote sensing, modeling software, and analytical instrumentation.
PO5	Sustainability Awareness Evaluate environmental challenges using sustainability principles and recommend eco-friendly technologies and management strategies.
PO6	Interdisciplinary Understanding Integrate concepts from biology, chemistry, geology, policy, and social sciences for holistic environmental assessment.
PO7	Professional and Ethical Responsibility Demonstrate environmental ethics, legal awareness, and professional responsibility in environmental management and research.
PO8	Communication and Leadership Skills Effectively communicate scientific information through reports, presentations, and teamwork while leading environmental projects.

Programme Specific Outcomes (PSOs)

After successful completion of the Five years Integrated M.Sc. Environmental Science Programme, the students will be equipped to

PSO1	Environmental Monitoring Skills: Apply advanced techniques for sampling, analysis, and interpretation of air, water, and soil quality parameters.
PSO2	Pollution Control Expertise: Design and evaluate treatment and remediation methods for environmental pollutants using physical, chemical, and biological approaches.
PSO3	Biodiversity Assessment: Conduct ecological surveys, biodiversity documentation, and conservation planning using standard scientific protocols.
PSO4	Environmental Impact Assessment (EIA): Prepare and critically evaluate EIA reports, risk assessments, and environmental management plans for developmental projects.
PSO5	Geospatial Analysis Proficiency: Utilize GIS, remote sensing, and spatial modeling tools for environmental mapping, monitoring, and decision-making.
PSO6	Climate Change Analysis: Assess climate variability, mitigation strategies, and adaptation measures based on scientific evidence and policy frameworks.
PSO7	Sustainable Resource Management: Develop strategies for sustainable utilization of natural resources, including water, forests, land, and energy systems.
PSO8	Research and Innovation Capability: Design independent research projects, publish scientific findings, and apply innovative technologies to solve environmental challenges.

5. Programme Specific Qualification Attributes

- **Knowledge and understanding level (K1 and K2)**
Students will be able to understand the basic components of ecology and environment, chemistry of pollutants and their toxic effects, biodiversity and natural resources and their process for sustainable development.
- **Application level (K3)**
Students will be capable of applying microbes, plants and animals for potential environmental cleanup and green energy production, and to generate value-added products through waste recycling.
- **Analytical level (K4)**
Students will be able to analyze the environmental quality parameters and to address the issues of different environmental compartments.
- **Evaluation capability level (K5)**
Students can acquire the capability of evaluating the responsible factors for environmental related issues and can be able to apply the acquired knowledge in providing solutions.
- **Scientific or synthesis level (K6)**
Students will be able to synthesize or develop new processes, products and to formulate new scientific tools related to sustainable environmental management

6. Candidate's eligibility for admission

Candidates who have passed the B.Sc. Degree in Environmental Science / Life Sciences/ Botany/Agricultural and allied Sciences/Zoology/ Microbiology/ Biotechnology/Biochemistry/Chemistry/Physics/Bioinformatics/HomeScience/Food Science & Nutrition of this University or an Examination of any other University accepted by the Syndicate as equivalent thereto shall be eligible for admission to M.Sc. Degree Course in Environmental Science.

7. Duration of the programme

The duration of the M.Sc. Environmental Science shall be over a period of Two Years from the commencement of the course.

8. CBCS- Structure of the Programme

The programme structure comprises of two parts

Course Component	No. of Courses	Credit/ Course	Hours of Learning	Marks	Total Credits
Part A (Credit Courses)					
Core Courses	11	5	5 h/ Week / Course	1100	55
Elective Courses	3/6	4	4 h/ Week / Course	300	12
Non-Major Elective Courses	1	2	3 h/ Week	100	02
Practical Courses	3	3	6 h/ Week / Course	300	09
Research Project	1	10	30 h / week	200	10
Summer Internship	1	1	-	150	01
Industrial Visits/ Study Tour	1	1	2 to 5 visits/tours	50	01
Extension Activity	1	1	2 h / week	100	01
Sub Total	22	-	-	2100	90
Part B (Self-Learning Credit Courses)					
Online Courses (MOOC /SWAYAM)	1	2	-	200	02
Human Rights (UGC mandatory course)	1	1	-	100	01
Peace Education (UGC mandatory course)	1	1	-	100	01
Sub Total	3	4		400	05
Grand Total	25	-	-	2500	95

9. Curriculum structure for each semester as per course alignment (Refer Table at the end of this section)

Main syllabus (Attached as Annexure I)

9.1. Semesters

An academic year consists of two semesters namely, Odd Semester (I/III): July to November; and Even Semester (II/IV): December to April. A semester normally extends over a period of 15 weeks. Each week has 30 hours instruction spread over a 5 day week. The duration of each semester shall be 90 working days for the PG Programme inclusive of examinations.

9.2. Credits

Credit defines the quantum of contents/syllabus prescribed for a course and determines the number of hours of instruction required per week. Thus, normally in each of the courses, credits will be assigned on the basis of the number of lectures/tutorial/ laboratory work and other forms of learning required to complete the course contents in a 15-week schedule:

1 Credit=Minimum 1 hour of lecture per week
(1 Credit course= Minimum 15 hours of lectures per semester)

3 Credits = Minimum 3 hours of lecture per week
(3 Credit course = Minimum 45 hours of lectures per semester)

The total minimum credits required for awarding a two year PG degree is 90.

9.3. Project

Each student shall be required to take up an Individual Student Project Work and submit it at the end of the Final Semester of their respective programs. Students shall be allotted to all the faculty members for project guidance in a departmental committee meeting with the concurrence of all the members. A copy of the Project Report shall be submitted to the Department on or before the last date fixed by the Department/University. The Project shall be evaluated by the guide and an external examiner nominated by the University and viva-voce examination be conducted to award the marks as per norms.

9.4. Non Major Elective (Supportive) Course:

Non Major Elective (Supportive) Course should be offered only in second and third semesters of the Programme. Students are expected to opt Non Major Elective (Supportive) Course offered by other departments.

9.5. Swayam Course:

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy namely access, equity and quality. SWAYAM. The courses hosted on SWAYAM are in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, nine National Coordinators (AICTE, NPTEL, UGC, CEC, NCERT, NIOS, IGNOU, IIMB and NITTR) have been appointed

Courses delivered through SWAYAM are available free of cost to the learners, however, students wanting certifications shall be registered, shall be offered a certificate on successful completion of the course, with a little fee. At the end of each course, there will be an assessment of the student through proctored examination and the marks/grades secured in this exam could be transferred to the academic record of the students.

MSc Environmental Science (2 Year Programme)
CBCS CURRICULUM (SEMESTER WISE STRUCTURE)

S. No.	Part	Course Code	Course Title	Weekly Contact Hours	Credits	Internal Marks	External Marks	Total Marks
			Semester -I					
1	I	26UPEVS1C01	Core-I – Biodiversity and Conservation	5	5	25	75	100
2	I	26UPEVS1C02	Core-II – Environmental Chemistry	5	5	25	75	100
3	I	26UPEVS1C03	Core-III- Environmental Geoinformatics	5	5	25	75	100
4	I	26UPEVS1C04	Core-IV- Industrial Health and Safety	5	5	25	75	100
5	I	26UPEVS1EL1 26UPEVS1EL2	Core Elective – I – Wildlife Management / Energy and Environment	4	4	25	75	100
6	I	26UPEVS1CL1	Core Practical - I	6	3	40	60	100
7	II	26UPEVS1MO1	MOOC- (Mandatory Course - Self Study	-	2	-	100	100
			Sub Total	30	29	165	535	700
			Semester -II					
8	I	26UPEVS1C05	Core-V- Environmental Microbiology & Biotechnology	5	5	25	75	100
9	I	26UPEVS1C06	Core-VI –Pollution Control Strategies	5	5	25	75	100
10	I	26UPEVS1C07	Core-VII – Environmental Impact Assessment	5	5	25	75	100
11	I	26UPEVS1C08	Core-VIII- Environmental Toxicology	5	5	25	75	100
12	I	26UPEVS1EL3 26UPEVS1EL4	Core Elective – II- Disaster Management/ Environmental Management Systems	4	4	25	75	100
13	I	26UPEVS1CL2	Core Practical - II	6	3	40	60	100
14	II	26UPPGC1H01	Human Rights (UGC Mandatory Course-Self Study)	-	1	25	75	100
			Sub Total	30	28	190	510	700
			Semester -III					
15	I	26UPEVS1C09	Core-IX – Waste Management	5	5	25	75	100
16	I	26UPEVS1C10	Core-X – Climate Change and Current Issues	5	5	25	75	100
17	I	26UPEVS1C11	Core-XI - Research Methodology and Instrumentation	5	5	25	75	100
18	I	26UPEVS1EL5 26UPEVS1EL6	Core Elective – III – Environmental Nanotechnology/ Environmental Law and Policies	4	4	25	75	100
19	I	26UPEVS1CL3	Core Practical - III	6	3	40	60	100
20	II	26UPEVS1NM1	Non-Major Elective (Supportive)Course	3	2	25	75	100
21	II	26UPGEN1V01	Peace Education (UGC Mandatory Course-Self Study)	-	1	25	75	100
22	II	26UPEVS1EX1	Extension Activity	2	1	50	-	50
			Sub Total	30	26	240	510	750
			Semester -IV					
23	I	26UPEVS1PR1	Core Project	30	10	50	150	200
24	II	26UPEVS1IN1	Summer Internship	-	1	-	100	100
25	II	26UPEVS1IV1	Industrial Visit/Study Tour		1	-	50	50
			Sub Total	30	12	50	300	350
			GRAND - TOTAL	-	95	645	1855	2500

10. Examinations

There shall be examinations at the end of each semester: for odd semesters in October/ November; and for even semesters in April/May.

10.1. Evaluation

The performance of a student in each course is evaluated in terms of percentage of marks with a provision for conversion to grade points. Evaluation for each course shall be done by a Continuous Internal Assessment (CIA) by the course teacher concerned as well as by an end semester examination and will be consolidated at the end of the semester.

10.2. Theory examination

Evaluation of Continuous Internal Assessment

Test	:	5 Marks (Best one out of Two Tests)
Model Examination	:	5 Marks
Seminar	:	5 Marks
Assignment	:	5 Marks
Attendance	:	5 Marks
Total	:	25 Marks

There is no Minimum pass in the internal Assessment.

10.3. End Semester Examination Question Paper Pattern

Time duration: 3 Hours

Max.Marks:75

PART- A: 20 x1 = 20

Answer all the questions

(Four Objective type questions from each unit)

PART- B: 3 x5 = 15

Answer any three questions out of five questions

(One question should be taken from each unit) (Questions must be analytical type)

PART- C: 5 x8 = 40

Answer all the questions

(Either or type one pair from each unit)

The Passing minimum shall be 50% (i.e. 38 marks) out of 75 marks.

10.4. Practical/ Mini Project Examination

Evaluation of Internal Assessment

Test	:	20 Marks (Best one out of Two Tests)
Model Practical	:	20 Marks
Total	:	40 Marks

There is no Minimum pass mark in the Internal Assessment for Practical examinations.

10.5. Grading System

Passing Minimum

A candidate shall be declared to have passed in each course if he/she secures not less than 50% marks in the University Examinations and not less than 50% in the aggregate, including CIA and University Examinations marks.

Marks and Grades

Conversion of Marks to Grade Point and Letter Grade (Performance in a subject) as follows.

Range of Marks	Grade Points	Letter Grade	Description
90 - 100	9.0 – 10.0	O	Outstanding
80 - 89	8.0 – 8.9	D+	Excellent
75 - 79	7.5 – 7.9	D	Distinction
70 - 74	7.0 – 7.4	A+	Very Good
60 - 69	6.0 – 6.9	A	Good
50 - 59	5.0 – 5.9	B	Average
00 - 49	0.0	U	Re-Appeal
ABSENT	0.0	AAA	Absent

C_i = Credits earned for course i in any semester

G_i = Grade Point obtained for course i in any semester

n = The semester in which such courses were credited.

For a Semester:

$$\text{GRADE POINT AVERAGE [GPA]} = \sum_i C_i G_i / \sum_i C_i$$

GPA = Sum of the multiplication of grade points by the credits of the courses /
Sum of the Credits of the courses in a semester

For the Entire Programme:

$$\text{CUMULATIVE GRADE POINT AVERAGE [CGPA]} = \sum_n \sum_i C_i G_{ni} / \sum_n \sum_i C_{ni}$$

CGPA = Sum of the multiplication of grade points by the credits of the entire
Programme / Sum of the Credits of the courses of the entire Programme

Classification of Final Result

CGPA	Grade	Classification of Final Result
9.5 – 10.0	O+	First Class with Exemplary*
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction*
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-Appear

* The candidates who have passed in the first appearance and within the prescribed semester of the PG Program are eligible.

Condonation

Students must have 75% of attendance in each semester to appear for the examination. Students who have attendance between 65% and 74% shall apply for condonation in the prescribed form with the prescribed fee to write the examination in the same semester. Students who have attendance between 50% and 64% shall apply for condonation in prescribed form with the prescribed fee along with the Medical Certificate in the current semester but they can write their examinations only in the next semester. Students who have attendance below 50% are not eligible to appear for the examination. But the student can continue the programme to complete the duration. To complete the programme they shall re- do the semester(s) after completion of the programme duration to acquire required attendance for appearing missed semester examinations.

However, the candidates have to clear all the subjects prescribed for programme within N+3 Years to acquire degree, where N denotes the duration of the programme.

Course Teacher

A teacher offering a course will also be responsible for maintaining attendance and evaluate the performance of all the students registered for the course.

Break of Study

A student intends to temporarily discontinue the programme in the middle of the semester for valid reasons and to rejoin the programme in the next academic year, for which he / she shall apply in advance with applicable Re-admission fees to the Registrar, Periyar University through the Principal/HOD of the respective colleges/University Department.

Student Advisor and Course Registration

Every student will have a member of faculty of the department as his/her student advisor. All teachers of the department shall function as Student Advisors and will have more or less equal number of students. The Student Advisor will advise the students in choosing Elective courses and offer all possible student support services. The student will then register for the course he/she plans to take for the semester before the commencement of the classes.

COURSE REGISTRATION

Name of the Student :

Department :

Registration Number :

Programme :

Semester :

Elective Course Option :

Signature of the Student Advisor/Mentor
Student

Signature of the

Approved by Head of the Department

The entire Program, Curriculum Structure, Teaching Learning Methods, Examination Pattern, Evaluation Methods and Grading Systems given above is governed by the CBCS Regulations of Periyar University.

Semester - I

BIODIVERSITY AND CONSERVATION

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C01/26UPEVS2C10	100	5	4	1	-	5

Course Objectives

The course provides adequate knowledge on types, values and threats to biodiversity and explains the concepts of conservation, bioresource management and its related legal policies

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|--|
| CO1 | Learn the types, values and importance of biodiversity |
| CO2 | Understand the various threats to biodiversity |
| CO3 | Know the in-situ and ex-situ conservation strategies of biodiversity |
| CO4 | Understand the methods of bioresources management |
| CO5 | Know the policies, programmes and acts for biodiversity conservation |

Mappings of course outcomes with programme outcomes

	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
	CO1	S	L	M	L	S	M	M	L
	CO2	S	M	S	L	S	M	M	L
	CO3	S	M	S	M	S	S	M	M
	CO4	S	S	S	M	S	S	M	M
	CO5	M	L	M	L	M	S	S	M
Alignment: S - Strong, M - Moderate, L - Low									

CORE COURSE - I/X
BIODIVERSITY AND CONSERVATION

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C01/26UPEVS2C10	100	5	4	1	-	5

Unit I Introduction

Contact Hours: 10

Types of Biodiversity: Species, Genetic and Ecosystem diversity - Alpha, beta and gamma diversity (K1, K2) - Biodiversity and ecosystem function (K4, K5) - Megadiversity zones and Biodiversity Hot Spots in India (K2, K3) - Endangered and endemic species of flora and fauna in India (K1, K2) - Values of Biodiversity (K4, K5) - Bioprospecting and biopiracy - Role of Traditional/Indigenous Knowledge System for bioprospecting (K2, K5 & K6)

Unit II Threats to Biodiversity

Contact Hours: 12

IUCN Threat Categories - Red Data Book (K2, K4) - *Biodiversity threats under Anthropocene era:* Habitat change - Habitat destruction and Habitat fragmentation - Overexploitation (K2, K4, K5) - Climate change on species extinction - Causes and Impacts of Invasive species to biodiversity (K2, K3, K4, K5) - Threats to soil biodiversity (K2, K4, K5) - Impacts of plastic pollution on marine biodiversity resources - Human-Animal conflict with special reference to elephants (K3, K4, K5& K6)

Unit III Conservation Strategies

Contact Hours: 12

In situ conservation: Protected area network, National parks, Sanctuaries, Community reserves and Conservation reserves - Biosphere reserves, Sacred groves (K1, K2, K3) - *Ex-situ conservation:* Botanical gardens, Zoos and Aquariums, Cryopreservation, Gene bank, Seed bank, Pollen bank, Sperm bank, Reintroduction and Reinforcement - Captive breeding (K1, K2, K3)

Unit IV Sustainable Management of Bioresources

Contact Hours: 13

National Biodiversity Authority (NBA) – Functions of State Biodiversity Board (SBB) and Biodiversity Management Committee's (BMC) – People's Biodiversity Register (PBR) (K3, K4, K5, K6) – *International Organizations and their roles for biodiversity conservation:* Convention on Biological Diversity (CBD), CITES and IUCN - WWF-India for priority and threatened species conservation - UNESCO Man and Biosphere Programme (MAB) - UNDP Biodiversity Finance Initiative (BIOFIN) - UNEP Global Environment Facility (GEF) for biodiversity conservation (K3, K4, K5& K6)

Unit V Policies, Programmes and Acts for Conservation

Contact Hours: 13

Salient features of Biological Diversity Act 2002 and Biological Diversity (Access and Benefit Sharing) Regulation, 2025 (K2, K3) - Status and protection of species in National and International levels - Policies implemented by MoEF & CC for biodiversity conservation (K2, K3, K4) - Nagoya protocol on access and benefit-sharing - Cartagena protocol on biosafety - Monitoring the Illegal Killing of Elephants (MIKE) programme - SAWEN and TRAFFIC Networks - National Red List Roadmap 2025-2030 *CBD CoP15 outcomes:* Kunming-Montreal Global Biodiversity Framework (GBF) - CoP26 Climate Summit pledge to end deforestation by 2030 – CITES CoP20 outcomes (K4, K5& K6)

CORE COURSE - I/X
BIODIVERSITY AND CONSERVATION

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C01/26UPEVS2C10	100	5	4	1	-	5

References:

Text Books & Reference Books:

1. Cardinale, B., & Murdoch, J. D. (2025). *Conservation biology* (2nd ed.). Oxford University Press.
2. Krishnamurthy, K. V. (2023). *An advanced textbook on biodiversity: Principles and practice*. Oxford and IBH Publishing.
3. Maiti, P. K., & Maiti, P. (2017). *Biodiversity: Perception, peril and preservation* (3rd ed.). PHI Learning.
4. Miller, G. T., & Spoolman, S. (2023). *Environmental science* (16th ed.). Cengage Learning.
5. Sher, A., & González-Sargas, E. (2026). *An introduction to conservation biology* (4th ed.). Oxford University Press.

Web References:

1. <http://www.iucn.org>
2. <http://www.cites.org>
3. <http://www.cbd.int>
4. <http://www.wri.org>
5. <http://www.sawen.org>

CORE COURSE - II/XI
ENVIRONMENTAL CHEMISTRY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C02/26UPEVS2C11	100	5	4	1	-	5

Course Objectives

The course aims to provide an understanding of the air, water, soil, pollutant and green chemistry concepts

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|---|
| CO1 | Describe the important chemical reactions and cyclic processes of chemical species in the atmosphere. |
| CO2 | To acquire knowledge about physico chemical and biological properties of water and its reactions in water bodies. |
| CO3 | Understand the soil quality parameters and its importance for maintaining the soil quality. |
| CO4 | To know the different types of toxic, hazardous substances and analyze their toxicological information. |
| CO5 | To acquire knowledge of principles, goals and applications of green chemistry. |

Mappings of course outcomes with programme outcomes

[illegible]

CORE COURSE - II/XI
ENVIRONMENTAL CHEMISTRY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C02/26UPEVS2C11	100	5	4	1	-	5

Unit I Atmospheric Chemistry

Contact Hours: 10

Atmosphere: Structure and Composition - Particles, Ions and Radicals - *Tropospheric Chemistry:* Formation of inorganic and organic particulate matter - *Chemistry of Air Pollutants:* SO₂, NO_x, CO₂ (Acid rain, photochemical smog, greenhouse effect and global warming) - *Stratospheric chemistry:* Chapman mechanism and catalytic process of ozone destruction - Role of CFCs in ozone depletion - Nox - Halogen cycles (K1, K2, K3, K4, K5 & K6)

Unit II Aquatic Chemistry

Contact Hours: 14

Formation of water - Sources and Types of water resource - Hydrological cycle - Unique properties of water - Role of water in the environment - *Physical, chemical and biological properties of water:* Temperature, colour, odour, total dissolved solids and total suspended solids, alkalinity, acidity and hardness - Concept of DO, BOD and COD - *Chemistry of metals in aqueous systems:* Metal complex formation and chelation - Types of reactions in various water bodies including marine environment (K1, K2, K3, K4, K5 & K6)

Unit III Soil Chemistry

Contact Hours: 13

Nature, Formation and Major types of Soil - *Physicochemical properties of soil:* Soil structure, Texture, Inorganic and organic components of soil - Chemical properties of saline, Acidic and Alkaline soils, Macro and Micronutrients in soil and their functions - Relation between organic carbon and organic matter - C/N Ratio - NPK in soil - Chemical reactions in soil (K1, K2, K3, K4, K5 & K6)

Unit IV Pollutant Chemistry

Contact Hours: 13

Pesticides: Classification - Degradation - Analysis - Pollution due to pesticides - DDT and Endosulfan - *Hydrocarbons:* Classification - Hydrocarbon decay - Effects of hydrocarbon on macro and microorganisms - *Heavy metals:* As, Cd, Pb & Hg (K1, K2, K3, K4, K5 & K6)

Unit V Green Chemistry

Contact Hours: 10

Green chemistry – Introduction - Principles (12) - Concept of atom economy in green synthesis - Cleaner production - Green chemical strategies for sustainable development - Applications of green chemistry - Environment and Industries - Eco friendly waste treatment (K1, K2, K3, K4, K5 & K6)

References

Text Books & Reference Books:

- De, A. K. (2017). *Environmental chemistry* (8th ed.). New Age International.
- Doble, M., & Kruthiventi, A. K. (2007). *Green chemistry and engineering*. Book chapter.
- Manahan, S. E. (2022). *Environmental chemistry* (11th ed.). CRC Press.
- Pani, B. (2017). *Text book of environmental chemistry*. I. K. International Publishing House.
- Sharma, B. K. (2019). *Environmental chemistry*. Goel Publishing House.

CORE COURSE - II/XI
ENVIRONMENTAL CHEMISTRY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C02/26UPEVS2C11	100	5	4	1	-	5

Web References:

1. <https://ebooks.inflibnet.ac.in/esp08/chapter/12-atmospheric-chemistry/>
2. <https://egyankosh.ac.in/bitstream/123456789/79935/1/Unit-6.pdf>
3. <https://www.egyankosh.ac.in/bitstream/123456789/79936/1/Unit-7.pdf>
4. <https://www.epa.gov/greenchemistry/basics-green-chemistry>
5. <https://egyankosh.ac.in/bitstream/123456789/86848/1/Unit-1.pdf>

ENVIRONMENTAL GEOINFORMATICS

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C03/26UPEVS2C12	100	5	4	1	-	5

Course Objectives

The course introduces principles, processes and application of Remote Sensing and GIS

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|---|
| C01 | Acquaint adequate knowledge on principles of environmental geoinformatics |
| C02 | Understand the basic concepts of GIS and its data structures |
| C03 | Learn about GPS technologies and its applications |
| C04 | Understand the techniques of image interpretation and analysis |
| C05 | Learns to apply the tools of environmental geoinformatics |

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
C01	S	M	M	M	M	S	L	L
C02	S	S	S	S	S	S	M	L
C03	S	S	S	S	S	S	M	M
C04	S	S	S	S	S	S	M	M
C05	S	S	S	S	S	S	M	S
Alignment: S - Strong, M - Moderate, L - Low								

CORE COURSE – III/XII
ENVIRONMENTAL GEOINFORMATICS

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C03/26UPEVS2C12	100	5	4	1	-	5

Unit I Remote Sensing **Contact Hours: 12**

Introduction – Principles, components and types of Remote Sensing – Electromagnetic Radiation, EMR Spectrum- Properties and interactions –Remote Sensing Satellites and Platforms - Historical Perspectives of Remote Sensing in India (K1, K2, K3, K4, K5 & K6).

Unit II GIS Concepts **Contact Hours: 12**

Introduction to Geographical Information Systems (GIS) -Components of GIS- Data structures: vector, raster and topology- Conversion of Vector and Raster Data – Geo referencing, Digitization and data attributes – map projections - map data representation (K1, K2, K3, K4, K5 & K6).

Unit III GPS Concepts **Contact Hours: 10**

Introduction to Global Positioning Systems (GPS)- Error Sources and Positioning methods - GPS Satellite System - Types of GPS machines and its applications for surveying and mapping- Global Navigation Satellite System (K1, K2, K3, K4, K5 & K6).

Unit IV Image Interpretation and Analysis **Contact Hours: 14**

Principles of visual Interpretation of aerial photos and satellite imagery- Image Registration - Recognition Elements and Interpretation keys- *Image Enhancement Techniques*: Linear, Non- linear Contrast Enhancement and Filtering - *Principles of Image Classification*: Supervised and Unsupervised Classification (K1, K2, K3, K4, K5 & K6).

Unit V Application of Remote Sensing and GIS **Contact Hours: 12**

Applications of remote sensing for land use/land cover, landscape mapping, vegetation analysis, climate change studies, pollution monitoring studies, resource mapping, flood, drought assessment desertification and water shed management - Application of GIS for environmental studies- field surveying and mapping - Emerging new software's for RS and GIS (K1, K2, K3, K4, K5 & K6).

References:

Text Books & Reference Books:

1. Burrough, P. A., & McDonnell, R. A. (1998). *Principles of geographical information systems*. Oxford University Press.
2. Chang, K. T. (2006). *Introduction to geographic information systems*. McGraw-Hill.
3. Chouhan, T. S. (2020). *Geoinformatics: Fundamentals and applications*. Scientific Publishers.
4. Jensen, J. R. (1996). *Introductory digital image processing*. Prentice Hall.
5. Joseph, G. (2003). *Fundamentals of remote sensing*. Universities Press.

Web References:

1. https://webapps.itc.utwente.nl/library/principles_remotesensing.pdf
2. <https://crisp.nus.edu.sg/~research/tutorial/intro.htm>
3. <https://learn.canvas.net/courses/464/pages/unit-6-dot-2-basic-principles>
4. http://www.ai.soc.i.kyoto-u.ac.jp/RemoteSensing_1.pdf
5. <http://www.crea.cat/gis-and-remote-sensing-methodologies-and-applications>

CORE COURSE – IV/XIII
INDUSTRIAL HEALTH AND SAFETY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C04/26UPEVS2C13	100	5	4	1	-	5

Course Objectives

The course aims to provide the students with theoretical knowledge and practical skills in occupational health, industrial safety, hazard recognition and control, statutory requirements, and management systems

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|--|
| C01 | Explain fundamentals of occupational health, industrial hazards and industrial hygiene principles. |
| C02 | Identify, measure and assess physical, chemical, biological and ergonomic workplace hazards. |
| C03 | Design and recommend control measures and emergency response plans. |
| C04 | Interpret and apply major national and international safety standards, codes and legal frameworks. |
| C05 | Develop basic industrial safety audits, risk assessments and workplace health surveillance plans. |

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	M	L	M	S	M	L
CO2	S	S	S	S	S	S	M	M
CO3	S	S	S	S	S	S	S	M
CO4	S	M	S	M	S	S	S	S
CO5	S	S	S	S	S	S	S	S
Alignment: S - Strong, M - Moderate, L - Low								

CORE COURSE – IV/XIII
INDUSTRIAL HEALTH AND SAFETY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C04/26UPEVS2C13	100	5	4	1	-	5

Unit I Introduction Contact Hours: 12

Concepts: Occupational health, industrial safety and industrial hygiene (Anticipation, recognition, evaluation and control) - Health - Disease - Work relationship - Types of occupational diseases (chemical, physical, biological, ergonomic and psychosocial) - Risk, hazard, exposure and dose-response - Hierarchy of controls - Safety culture, safety attitudes, human factors and behavioral safety (K1, K2, K3, K4, K5 & K6)

Unit II Work Place Hazards Contact Hours: 12

Physical hazards: Noise, vibration, heat, radiation, measurement and control - *Chemical hazards:* Industrial toxicants, routes of exposure, TLV, OELs, MSDS and sampling methods - *Biological hazards:* Workplace infections, bioaerosols, control and immunization - *Ergonomic hazards:* MSDs, workstation design, repetitive strain assessment - *Instruments and field methods:* Gas sampling, noise meters, dosimeters, air sampling pumps and basic analytical approaches (K1, K2, K3, K4, K5 & K6)

Unit III Control Measures, Prevention and Protection Contact Hours: 12

Engineering controls: Ventilation (local exhaust), isolation and substitution - *Administrative controls:* Work rotation, training and SOPs - *PPE:* Selection, limitations, maintenance and fit testing - *Fire safety:* Process, safety basics, explosion control and confined space entry procedures - Occupational health surveillance and medical management of exposures (K1, K2, K3, K4, K5 & K6)

Unit IV Safety Management and Risk Assessment Systems Contact Hours: 12

Safety management systems (OHSAS / ISO 45001 principles) and implementation - *Hazard identification and risk assessment tools:* HIRA, JSA, Fault Tree Analysis (FTA) and HAZOP overview - Incident investigation, root cause analysis, near-miss reporting, KPIs and auditing - Training, behavioral safety programmes, contractor management and permit systems (K1, K2, K3, K4, K5 & K6)

Unit V Legal Regulatory and Safety Compliances Contact Hours: 12

Overview of national laws (India): Occupational Safety, health and working conditions code (Related factory/mines rules) - Labour regulations - Role of Directorate General, Factory Advice Service & Labour Institutes (DG-FASLI) - International instruments and conventions (ILO conventions, WHO recommendations) - Ethical, social and economic dimensions of workplace safety (K1, K2, K3, K4, K5 & K6)

References:

Text Books & Reference Books:

1. Friend, M. A., & Kohn, J. P. (2023). *Fundamentals of occupational safety and health* (8th ed.). Bernan Press.
2. Halдар, S. K. (2022). *Occupational health and hygiene in industry*. CBS Publishers & Distributors.
3. Jain, R. K., & Rao, S. S. (2022). *Industrial safety, health and environment management systems*. Khanna Publishers.
4. Kamatchi Sankaran, S., & Prabakaran, T. (2022). *Industrial safety: A textbook*.

CORE COURSE – IV/XIII
INDUSTRIAL HEALTH AND SAFETY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1C04/26UPEVS2C13	100	5	4	1	-	5

5. Taxmann's Editorial Board (Ed.). (2025). *Taxmann's new labour & industrial laws*. Taxmann Publications.

Web References:

1. <https://labour.gov.in>
2. <https://www.ilo.org>
3. <https://www.who.int>
4. <https://www.osha.gov>
5. <https://www.nsc.org>

CORE ELECTIVE – I/III

WILDLIFE MANAGEMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1EL1/26UPEVS2EL3	100	4	3	1	-	4

Course Objectives

The course focuses on the principles, strategies and conservation methods for the protection of wildlife resources

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|---|
| C01 | Understand the importance of wildlife resources |
| C02 | Acquire knowledge on wildlife ecology and its research techniques |
| C03 | Understand the concepts of wildlife conservation strategies |
| C04 | Know the causes and impacts of human wildlife conflicts |
| C05 | Gain knowledge on statutory policies for wildlife conservation |

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	L	M	L	S	M	M	L
CO2	S	S	S	S	S	S	M	L
CO3	S	M	S	M	S	S	M	M
CO4	S	S	S	M	S	S	S	M
CO5	S	M	S	L	S	S	S	S

Alignment: S - Strong, M - Moderate, L - Low

CORE ELECTIVE – I/III
WILDLIFE MANAGEMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1EL1/26UPEVS2EL3	100	4	3	1	-	4

Unit I Introduction

Contact Hours: 10

Historical background of wildlife - Values of wildlife and valuable products of forests and wild animals - Important wild animals of India - Causes of extinction of forests and wildlife (Direct and Indirect) - Importance and necessity of conservation of wildlife and forests - Principles of conservation and management - Conservation ethics and world wildlife conservation strategies (K1, K2, K3, K4, K5 & K6)

Unit II Wildlife Ecology and Research Techniques

Contact Hours: 10

Wildlife behavior: Group living, selfishness and altruism - Evolutionary stable strategies - *Wildlife Habitat Ecology:* Measuring wildlife habitat and wildlife corridors - *Research Techniques:* Census methods (Direct and indirect methods), radio telemetry and GPS tracing (K1, K2, K3, K4, K5 & K6)

Unit III Conservation Strategies

Contact Hours: 10

In situ methods: Protected area network (PAN), sacred groves and biosphere reserves - *Ex situ methods:* Gene banks, seed banks, germplasms, cDNA library, cryopreservation, zoos and aquariums and botanical gardens - Captive breeding - Species recovery - Rehabilitation - Reintroduction (Project Cheetah) - Traditional ecological knowledge (TEK) for conservation (K1, K2, K3, K4, K5 & K6)

Unit IV Human-Wildlife Conflict Management

Contact Hours: 10

Causes: Habitat shrinkage, fragmentation, encroachment and pollution - *Mitigation Measures:* Habitat barriers, translocation, compensation and TEK awareness - Role of IoTs and AI in conflict management (TrailGuard AI, HACMS, Ele-fence and m-Twiga) (K1, K2, K3, K4, K5 & K6)

Unit V Policies, Legislation and International Conventions

Contact Hours: 10

Legislations: Wildlife (Protection) Act 1972, Biodiversity Act 2002 *Conventions:* CITES (Trade), CBD (Biodiversity), CMS (Migratory Species) and Ramsar (wetlands) - *Organizations:* IUCN, WWF, WII, BNHS and MoEF&CC - SAWEN network - Apps and Tools (Wildlife Sentinel and WOOD ID) - Key outcomes of CITES CoP20 - Case studies on wildlife management (K1, K2, K3, K4, K5 & K6)

References:

Text Books & Reference Books:

1. Avery, T. E., & Burkhardt, H. E. (1983). *Forest measurements*. McGraw-Hill.
2. Chaturvedi, A. N., & Khanna, L. S. (1994). *Forest mensuration*. International Book Distributors.
3. Dhyani, S. N. (1994). *Wildlife management*. Rawat Publications.
4. Jerram, M. R. K., & Bourne, R. (1980). *Elementary forest mensuration*. Natraj Publications.

CORE ELECTIVE – I/III
WILDLIFE MANAGEMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1EL1/26UPEVS2EL3	100	4	3	1	-	4

5. Khan, T. I., & Al-Ajmi, D. N. (1999). *Global biodiversity conservation measures*. Pointer Publishers.
6. Nautiyal, S., & Kaul, A. K. (1999). *Forest biodiversity and its conservation practices in India*. Oriental Enterprises.
7. Sinha, P. C. (1998). *Wildlife and forest conservation*. Anmol Publications.

Web References:

1. <https://www.gfc.state.ga.us/resources/publications/ForestsAndWildlife.pdf>
2. https://www.woodlandstewardship.org/page_id=1154.html
3. <https://www.forestasyst.org/wildlife.html>
4. <https://www.bookstore.ksre.ksu.edu/pubs/MF2899.pdf>
5. <http://www.fao.org/biotech/inforestry>
6. <https://www.fs.usda.gov/pnw/units/infor>
7. <https://ntca.gov.in/cheetah>
8. <https://gradestack.com/Management.../Forests-and-Wildlife/15038-2998-4773-study-wtw.html>

CORE ELECTIVE COURSE – I/III

ENERGY AND ENVIRONMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1EL2/26UPEVS2EL4	100	4	3	1	-	4

Course Objectives

The course aims to provide comprehensive knowledge on renewable and non-renewable energy resources, waste to energy conversion and energy conservation methods

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|--|
| CO1 | Understand the different types of energy sources |
| CO2 | Know the various types of non-renewable resources and its impacts |
| CO3 | Understand different types of renewable resources and its generation methods |
| CO4 | Acquire knowledge on waste to energy conversion techniques |
| CO5 | Understand the principles of energy conservation |

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	M	L	S	M	L	L
CO2	S	S	S	M	S	S	M	L
CO3	S	S	S	S	S	S	M	M
CO4	S	S	S	S	S	S	M	M
CO5	S	M	S	M	S	S	S	M
Alignment: S - Strong, M - Moderate, L - Low								

CORE ELECTIVE COURSE – I/III
ENERGY AND ENVIRONMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1EL2/26UPEVS2EL4	100	4	3	1	-	4

Unit I Energy sources Contact Hours: 9

Introduction to nexus between energy, environment and sustainable development- Potential and perspectives of various energy sources in India *Classification of energy resources*: Renewable and non - renewable energy (K1, K2, K3 & K4, K5 & K6)

Unit II Non-renewable Energy Sources Contact Hours: 10

Fossil fuels: Coal, petroleum, LPG and natural gas, composition and classification of coal, crude oil and natural gas - Consumption and demands of coal, crude oil and natural gas - Environmental and economic impacts of fossil fuel consumption (K3 & K4) - Global coal phase out scenario (K4, K5 & K6) - *Nuclear energy*: Fission, fusion process, environmental impacts (K1 & K2)

Unit III Renewable Energy Sources Contact Hours: 11

Solar, wind, geothermal, hydel and tidal energy sources (K1 & K2) - *Ocean Thermal Energy Conversion (OTEC)*: Principle and generation (K3 & K4) - *Critical issues*: Intermittency, grid integration and energy storage solutions - Global energy consumption pattern - Present scenario and recent initiatives of renewable energy sources in India - *The future energy Sectors*: Green hydrogen and EV transition (K4, K5 & K6)

Unit IV Waste to Energy Contact Hours: 10

Bioenergy: Biomass energy as an energy source, characteristics of biomass (K1 & K2) - Energy plantations - Biomass conversion technologies (K3 & K4) - *Types of biofuels*: Biodiesel, bioethanol and biohydrogen - Production technologies and applications (K4, K5 & K6) - India's bioenergy and biofuel policies (K3 & K4)

Unit V Energy Conservation Contact Hours: 10

Energy conservation: Principles and approach (K1 & K2) - *Energy conservation in buildings*: Green buildings, solar passive architecture, eco-housing and GRIHA norms (K3, K4, K5 & K6) - *Energy audit*: Types and methodology (K4 & K5), National and International norms - Energy service companies (ESCOs), National & International standards and protocols (ECBC, ISO 50001) (K5 & K6).

References:

Text Books & Reference Books:

1. Bansal, N. K. (2014). *Non-conventional energy resources*. Vikas Publishing House.
2. Belyakov, N. (2019). *Sustainable power generation: Current status, future challenges, and perspectives*. Academic Press.
3. Bhatia, S. C., & Gupta, R. K. (2018). *Textbook of renewable energy*. Woodhead Publishing India.
4. Cengel, Y. A., Kanoglu, M., & Cimbala, J. M. (2019). *Fundamentals and applications of renewable energy*. McGraw-Hill Education.
5. Dahiya, A. (2015). *Bioenergy: Biomass to biofuels*. Academic Press.
6. Ehrlich, R. (2013). *Renewable energy: A first course*. CRC Press.
7. Galanakis, C. M. (2020). *Biobased products and industries*. Elsevier.

CORE ELECTIVE COURSE – I/III
ENERGY AND ENVIRONMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1EL2/26UPEVS2EL4	100	4	3	1	-	4

8. Jacobson, M. Z. (2020). *100% clean, renewable energy and storage for everything*. Cambridge University Press.
9. Mitra, M., & Nagchaudhuri, A. (2020). *Practices and perspectives in sustainable bioenergy: A systems thinking approach*. Springer.
10. Pandey, A., Larroche, C., Dussap, C. G., Gnansounou, E., Khanal, S. K., & Ricke, S. C. (2019). *Biofuels: Alternative feedstocks and conversion processes for the production of liquid and gaseous biofuels*. Academic Press.
11. Rutledge, D. B. (2020). *Energy: Supply and demand*. Cambridge University Press.
12. Sawhney, G. S. (2012). *Non-conventional energy resources*. PHI Learning.
13. Simon, C. A. (2020). *Alternative energy: Political, economic and social feasibility* (2nd ed.). Rowman & Littlefield.
14. Thomas, L. (2020). *Coal geology* (3rd ed.). Wiley.
15. Tyagi, H., Chakraborty, P. R., Powar, S., & Agarwal, A. K. (2020). *Solar energy: Systems, challenges, and opportunities*. Springer.
16. Viswanathan, B. (2017). *Energy sources: Fundamentals of chemical conversion processes and applications*. Elsevier.

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1. <https://www.iea.org/reports/global-energy-review-2020>.
2. https://climateanalytics.org/media/report_coal_phase_out_2019.pdf
3. https://publications.jrc.ec.europa.eu/repository/bitstream/JRC111438/acd_in_metis_final.pdf
4. <https://www.worldgbc.org/what-green-building>
5. <https://beeindia.gov.in/sites/default/files/ctools/TR-EnergyAudits.pdf>
6. <https://www.irena.org/Innovation-Outlook-Energy-Storage>
7. <https://www.iea.org/energy-system/low-emission-fuels/hydrogen>
8. <https://www.smartgrid.gov/>

CORE PRACTICAL – I/VII
BIODIVERSITY AND CONSERVATION, ENVIRONMENTAL CHEMISTRY,
ENVIRONMENTAL GEOINFORMATICS and INDUSTRIAL HEALTH AND SAFETY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
I/VII	26UPEVS1CL1/26UPEVS2CL7	100	6	-	-	6	3

Experiments:

1. Determination of frequency, abundance and density of plants by Count Quadrat method
2. Vegetation sampling technique by Belt and Line Transect methods
3. Determination of species diversity in a community by different diversity indices (Shannon-Weiner Index and Simpson's Index)
4. Assessment of green belt areas in Periyar University Campus and their carbon sequestration potential
5. Determination of pH and Conductivity of Water and Soil Samples
6. Determination of Alkalinity and Acidity of Water
7. Determination of COD and BOD of Polluted Water
8. Estimation of Organic Matter in Soil
9. Georeferencing of Toposheet
10. Creation of Vector Layers - Digitization Techniques
11. Preparation of Study Area Map through GIS
12. Interpretation of Satellite Images
13. GIS-Based Land Use Classification- Supervised and Unsupervised
14. Workplace Hazard Identification and Risk Assessment (HIRA)
15. Personal Protective Equipment (PPE) Selection and Usage

Semester - II

ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C05/26UPEVS2C14	100	5	4	1	-	5

Course Objectives

The course aims to provide the basic knowledge about microbes and its interactions in the various environmental components, bioremediation of environmental pollutants and production of microbial bioproducts

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|--|
| C01 | Understand the basic concepts of environmental microbiology and its diversity |
| C02 | Explain the microbial interactions and their roles in biogeochemical cycles |
| C03 | Learn the fundamental techniques involved in environmental biotechnology |
| C04 | Explore the applications of microbes in pollution control and environmental remediation |
| C05 | Understand the microbial processes in waste treatment and the production of useful bioproducts |

Mappings of course outcomes with programme outcomes

COs	P01	P02	P03	P04	P05	P06	P07	P08
C01	S	M	M	L	M	S	L	L
C02	S	S	S	M	S	S	M	L
C03	S	S	M	S	M	S	M	L
C04	S	S	S	S	S	S	M	M
C05	S	S	S	S	S	S	M	M
Alignment: S - Strong, M - Moderate, L - Low								

CORE COURSE – V/XIV**ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C05/26UPEVS2C14	100	5	4	1	-	5

Unit I Introduction**Contact Hours: 10**

Introduction and Scope of Environmental Microbiology - Microbial growth and metabolism - Soil microflora - Factors influencing the soil microflora - Role of microorganisms in soil fertility - Extremophiles (Archaeobacteria, acidophilic, alkalophilic, thermophilic, barophilic, osmophilic and radiodurant microbes) (K1, K2, K3, K4, K5 & K6)

Unit II Microbial Interactions and Biogeochemical Cycles**Contact Hours: 12**

Microbial interactions: Mutualism, Commensalism, Competition, Amensalism, Parasitism and Predation - Interactions of microbes with plants, animals and humans - *Microbial role in Biogeochemical cycles:* Carbon, Nitrogen, Phosphorus and Sulphur cycles - Mycorrhizae and its ecological significance - Bioluminescence in microbes (K1, K2, K3, K4, K5 & K6)

Unit III Environmental Biotechnology**Contact Hours: 13**

Scope of Environmental Biotechnology - Restriction Enzymes - *DNA Modifying Enzymes:* Nucleases, Polymerases and DNA Ligases - *Gene Cloning:* Overview - *Cloning vectors:* Plasmids, phages, cosmids, phagemids, Ti plasmids and viral vectors M13 - Cloning strategies, cloning and selection of individual genes - *Polymerase Chain Reaction:* Working principle, types and applications (K1, K2, K3, K4, K5 & K6)

Unit IV Environmental Applications of Microbes**Contact Hours: 13**

Bioindicators and biosensors for detection of pollution - Use of microbes in environmental decontamination of pollutants - *In situ bioremediation strategies:* Bioventing, biosparging, bioaugmentation, biostimulation and bioslurping - *Ex situ bioremediation strategies:* Land Farming, composting, biopiles and bioreactors - Bioleaching and Biomining - Microbial Enhanced Oil Recovery (MEOR) - Microbial Fuel Cells (MFCs) (K1, K2, K3, K4, K5 & K6)

Unit V Biotechnology for Waste Treatment & Microbial Bioproducts**Contact Hours: 12**

Biotechnology for Waste Management - Sewage treatment - Activated Sludge Process - Anaerobic Treatment - Sludge stabilization - Aerobic Composting, Anaerobic Digestion and Biogas Production - *Microbial bioproducts:* Biosorbents, Biosurfactants, Bioflocculants, Bioplastics, Biofertilizers and Biopesticides (K1, K2, K3, K4, K5 & K6)

References:**Text Books & Reference Books:**

1. Atlas, R. M., & Bartha, R. (1998). *Microbial ecology: Fundamentals and applications* (4th ed.). Benjamin/Cummings Publishing.
2. Brown, T. A. (1995). *Gene cloning: An introduction*. Chapman & Hall.
3. Mohapatra, P. K. (2008). *Text book of environmental biotechnology*. IK International Publishers.
4. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2006). *Microbiology* (5th ed.). McGraw-Hill Education.
5. Prescott, L. M., Harley, J. P., & Klein, D. A. (2017). *Microbiology* (10th ed.). McGraw-Hill Education.

CORE COURSE – V/XIV
ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C05/26UPEVS2C14	100	5	4	1	-	5

Web References:

1. <https://www.sciencedirect.com/science/chapter/edited-volume/abs/pii/B9780123946263000016>
2. [https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_\(Boundless\)](https://bio.libretexts.org/Bookshelves/Microbiology/Microbiology_(Boundless))
3. <https://egyankosh.ac.in/bitstream/123456789/95583/1/Unit-1.pdf>
4. <https://microbenotes.com/microbial-biotechnology-environmental-applications/>
5. <https://asm.org/articles/2023/august/microbial-biotech-in-waste-management>

CORE COURSE – VI/XV

POLLUTION CONTROL STRATEGIES

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C06/26UPEVS2C15	100	5	4	1	-	5

Course Objectives

The course gives awareness of environmental pollution, control and treatment technologies

Course Outcomes

On the successful completion of the course, students will be able to

- C01** Learn various methods of air pollution control techniques.
- C02** Gain knowledge about water treatment technologies
- C03** Understand about soil pollution and its control, treatment methods
- C04** Learn the various control measures available for radiation pollution.
- C05** Know about noise and thermal pollution control and treatment techniques.

Mappings of course outcomes with programme outcomes

[illegible]

CORE COURSE – VI/XV
POLLUTION CONTROL STRATEGIES

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C06/26UPEVS2C15	100	5	4	1	-	5

Unit I Air Pollution Control and Treatment **Contact Hours: 10**

Air pollution control methods: Particulate matter (Settling chamber, cyclones, fabric Filter, electrostatic precipitator and wet scrubbers) - Gaseous pollutants (NO_x, SO₂, CO, CO₂ and Hydrocarbons) (K1, K2, K3, K4, K5 & K6).

Unit II Water Pollution Control and Treatment **Contact Hours: 14**

Drinking water - Filtration, chlorination, reverse osmosis and ozonation - *Wastewater Treatment Methods:* Primary treatment (Screening, grit removal, neutralization, coagulation, skimming and sedimentation) - Secondary treatment (Aerobic - Aeration, activated sludge process, trickling filters, biological contact filters, rotating filters and oxidation ponds; Anaerobic – anaerobic digestion, septic tanks and lagoons) - Tertiary treatments (Ozonation, chlorination, activated carbon filtration, UV and reverse osmosis) - Nutrients removal (K1, K2, K3, K4, K5 & K6).

Unit III Soil Pollution Control and Treatment **Contact Hours: 12**

Soil pollution control - *Soil remediation techniques:* In situ and Ex situ - Physical (Soil Covering, excavation, electrokinetic remediation, air sparging and encapsulation) - Chemical (Soil washing, Solidification and Vitrification) - Biological (Bioremediation and Phytoremediation) (K1, K2, K3, K4, K5 & K6).

Unit IV Radiation Pollution Control and Treatment **Contact Hours: 11**

Radioactivity and Radiation - Radiation Units - Radiation sources - Radiation Protection - Time - Distance - Shielding - Exposure and Contamination - Controlled area - Collection, storage and disposal (K1, K2, K3, K4, K5 & K6).

Unit V Noise, Thermal Pollution Control and Treatment **Contact Hours: 13**

Noise Control Measures - Greenbelt and Protective Instruments - Elimination - Substitution - Engineering Control - Administrative Controls - Personal Protective Equipment's - Selection of hearing protection device - Thermal Pollution - Cooling ponds - Cooling Towers - Beneficial use of waste heat (K1, K2, K3, K4, K5 & K6).

References:

Text Books & Reference Books:

1. Chauhan, A. (2020). *Environmental pollution and management*. IK International Publishers.
2. Hung, Y.-T., Wang, L. K., & Shamma, N. K. (Eds.). (2012). *Handbook of environment and waste management: Vol. 1. Air and water pollution control*. World Scientific Press.
3. Khopkar, S. M. (2005). *Environmental pollution monitoring and control*. New Age International.
4. Peirce, J. J., Vesilind, P. A., & Weiner, R. F. (1997). *Environmental pollution and control* (4th ed.). Elsevier.
5. Rao, C. S. (2018). *Environmental pollution control engineering* (3rd ed.). New Age International.

CORE COURSE – VI/XV
POLLUTION CONTROL STRATEGIES

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C06/26UPEVS2C15	100	5	4	1	-	5

Web References:

1. <https://www.bbau.ac.in/dept/UIET/Study%20Materials%20for%20TCE-0.pdf>
2. <https://www.bbau.ac.in/dept/UIET/TCE-033%20%20epdf>.
3. <https://www.studyiq.com/articles/radioactive-pollution/>
4. <https://sathee.iitk.ac.in/article/geography/noise-pollution-and-prevention/>
5. <https://courseware.cutm.ac.in/wp-content/uploads>

**CORE COURSE – VII/XVI
ENVIRONMENTAL IMPACT ASSESSMENT**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C07/26UPEVS2C16	100	5	4	1	-	5

Course Objectives

The course provides knowledge about EIA methodologies and its roles in various decision-making in environmental impact projects

Course Outcomes

On the successful completion of the course, students will be able to

- CO1** Know the components of EIA processes and environmental clearance procedures in India
- CO2** Understand about the methods used for EIA studies
- CO3** Learn to prepare EIA report and understand about public participation in EIA process
- CO4** Communicate the key aspects of EIA process in various developmental projects
- CO5** Understand core elements of Environmental Management System (EMS) Corporate Social Responsibility (CSR) in EMS

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	S	M	S	S	S	M
CO2	S	S	S	M	S	S	M	M
CO3	S	S	S	M	S	S	S	S
CO4	M	M	S	L	S	S	S	S
CO5	S	M	S	M	S	S	S	S
Alignment: S - Strong, M - Moderate, L - Low								

CORE COURSE – VII/XVI
ENVIRONMENTAL IMPACT ASSESSMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C07/26UPEVS2C16	100	5	4	1	-	5

UNIT I Introduction Contact Hours: 14

Definition - Principles of EIA - Short-term and Long-term objectives - Evolution of EIA worldwide and in India - *Types of EIA*: Rapid EIA, Comprehensive EIA and Strategic EIA - Projects subject to EIA (Category A, B1 and B2) - Steps in EIA process - Objectives of the Standard Terms of Reference (TOR) - Stages and time frame for obtaining Environmental Clearance from MoEF & CC according to EIA notification 2006 – Merits and Demerits of EIA (K1, K2 & K3) - Overview of EIA 2020 Draft (K1, K2, K3, K4, K5 & K6)

UNIT II EIA Methodologies Contact Hours: 12

Assessment of impacts: Air, water, soil, noise, biological, social, cultural, economical, and environmental factors (K5 & K6) - *EIA Methodologies*: Adhoc Method - Checklist Approach - Matrix Methods - Network Methods - Overlay Method (K1, K2, K3, K4, K5 & K6)

UNIT III Public Participation, Preparation and Review of EIA Report Contact Hours: 12

Public participation: Objectives of people's participation, public hearing in EIA - Advantages and disadvantages of people's participation - *Preparation and review of EIA Report*: EIA reports content - Basis and criteria for evaluation of EIA Reports (K1, K2, K3, K4, K5 & K6)

UNIT IV EIA Case Studies for Major Development Projects Contact Hours: 10

Major highways projects - Airport - River valley projects - Mining and quarrying - Thermal and hydroelectric power projects - Cement industries (K1, K2, K3, K4, K5 & K6)

UNIT V Environmental Management System Contact Hours: 12

Environmental Management System (EMS): Core elements of EMS - Benefits of EMS - ISO 14001 standard - PDCA (Plan-Do-Check-Act) in ISO 14001 Certification - *Life Cycle Assessment (LCA)*: Stages in LCA - *Key LCA types*: Cradle-to-Grave, Cradle-to-Gate, Cradle-to-Cradle, Gate-to-Gate and Well-to-Wheel - *Environmental auditing*: Pre audit, onsite audit and post audit activities - Benefits of environmental auditing - Corporate Social Responsibility (CSR) plan in India (K1, K2, K3, K4, K5 & K6)

References:

Text Books & Reference Books:

1. Anjaneyulu, Y., & Manickam, V. (2020). *Environmental impact assessment methodologies* (3rd ed.). B.S. Publications.
2. Anji Reddy, M. (2017). *Environmental impact assessment: Theory and practice*. BS Publications
3. Bhateria, R., Sharma, M., Singh, R., & Kumar, S. (2024). *Environmental impact assessment: A journey to sustainable development*. Springer Nature.
4. Canter, L. W. (1995). *Environmental impact assessment* (2nd ed.). McGraw Hill.
5. Ministry of Environment, Forest and Climate Change. (2001). *EIA manual*.

CORE COURSE – VII/XVI
ENVIRONMENTAL IMPACT ASSESSMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C07/26UPEVS2C16	100	5	4	1	-	5

Web References:

1. <http://environmentclearance.nic.in/>
2. <http://www.moef.nic.in/division/eia-manual>
3. <https://www.adb.org/documents/adb-environmental-assessment-guidelines>
4. http://environmentclearance.nic.in/writereaddata/Draft_EIA_2020.pdf
5. <http://environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/GuidanceManual.htm>

CORE COURSE – VIII/XVII

ENVIRONMENTAL TOXICOLOGY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C08/26UPEVS2C17	100	5	4	1	-	5

Course Objectives

The course introduces the basic toxicological principles, toxicity mechanism and testing methods along with risk assessment and management strategies

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|---|
| C01 | Understand fundamental toxicology concepts |
| C02 | Explain how toxicants enter, distribute, transform and leave organisms |
| C03 | Describe major fate processes affecting environmental toxicants |
| C04 | Design and interpret toxicity tests and assess toxicological impacts |
| C05 | Learn the basic risk assessment steps, regulations and risk management strategies |

Mappings of course outcomes with programme outcomes

[illegible]

CORE COURSE – VIII/XVII
ENVIRONMENTAL TOXICOLOGY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1C08/26UPEVS2C17	100	5	4	1	-	5

Unit I Introduction

Contact Hours: 12

Definition, History and Scope of Environmental toxicology - *Branches:* Ecotoxicology - Human toxicology - Molecular toxicology - *Types of toxicants:* Organic, inorganic, persistent organic pollutants and emerging contaminants - Sources and pathways of environmental toxicants - *Terminology:* Dose, toxicant, toxic effect, response curves, toxicokinetics and toxicogenomics (K1, K2, K3, K4, K5 & K6)

Unit II Mechanisms of Toxicity

Contact Hours: 12

Absorption - Distribution - Metabolism and Excretion (ADME) of toxicants - Biotransformation (Phase I & Phase II reactions) - Cellular and Molecular mechanisms of toxicity - *Dose-response relationships:* Quantal, Threshold, LD₅₀, LC₅₀, Bioavailability, Bioaccumulation and Biomagnification (K1, K2, K3, K4, K5 & K6)

Unit III Fate and Transport of Toxicants

Contact Hours: 12

Movement of toxicants in air, water, soil and sediments - *Chemical fate processes:* Volatilization - Adsorption - Degradation - Environmental persistence and half-lives - Exposure pathways and receptor exposure - Biomonitoring principles (K1, K2, K3, K4, K5 & K6)

Unit IV Toxicity Assessment

Contact Hours: 12

Local and systemic toxicity - Acute and Chronic toxicity testing - Bioassays and biomarkers - Ecotoxicological testing (Standard organisms and endpoints) - Population, community and ecosystem effects - *Toxicity interactions:* Additivity - Synergism - Antagonism (K1, K2, K3, K4, K5 & K6)

Unit V Risk Assessment, Regulation and Management

Contact Hours: 12

Human and ecological risk assessment frameworks: Hazard identification - Exposure assessment - Dose-response assessment - Risk characterization - *Regulatory toxicology:* Standards and guidelines (OSHA, OECD, FDA, WHO) - *Risk management strategies:* Avoidance, reduction, transfer and acceptance (K1, K2, K3, K4, K5 & K6)

References

Text Books & Reference Books:

1. Hughes, W. W. (n.d.). *Essentials of environmental toxicology*.
2. Klaassen, C. D. (Ed.). (n.d.). *Casarett & Doull's toxicology: The basic science of poisons*.
3. Loomis, T. A., & Hayes, A. W. (1996). *Loomis's essentials of toxicology* (4th ed.). Academic Press.
4. Sharma, P. D. (1994). *Environmental biology and toxicology*. Rajpal and Sons.
5. Simon, T. A. (2014). *Environmental risk assessment: A toxicological approach*. CRC Press.

Web References:

1. https://academic.oup.com/toxsci/article/120/suppl_1/S49/1616424
2. <https://www.hindawi.com/journals/bmri/2017/4627872/>
3. [https://iubmb.onlinelibrary.wiley.com/doi/pdf/10.1016/0307-4412\(81\)90131](https://iubmb.onlinelibrary.wiley.com/doi/pdf/10.1016/0307-4412(81)90131)
4. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/downloads/
5. <https://envirotox.in/pdf>

CORE ELECTIVE COURSE – II/IV

DISASTER MANAGEMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1EL3/26UPEVS2EL5	100	4	3	1	-	4

Course Objectives

The course focuses on different types of disasters and their impacts and its management strategies

Course Outcomes

On the successful completion of the course, students will be able to

- CO1** Understand the types of disasters and disaster-prone zones.
- CO2** Know different types of geological hazards and its impacts
- CO3** Understand the impacts of hydrological and meteorological hazards.
- CO4** Acquire knowledge on biological disasters and its risks
- CO5** Know about disaster management cycle and its legal frameworks

Mappings of course outcomes with programme outcomes

[illegible]

CORE ELECTIVE COURSE – II/IV**DISASTER MANAGEMENT**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1EL3/26UPEVS2EL5	100	4	3	1	-	4

UNIT I Introduction**Contact Hours: 08**

Key Terms, definitions and concepts related to disaster - Hazard, Risk, Vulnerability, Exposure, Coping Capacity, Resilience, Conflict, Emergencies and related terms - Methods of hazard, vulnerability and capacity assessment (HVCA) - Basics of vulnerability and risk assessment - Concepts of exposure - Sensitivity - Adaptive capacity (K1, K2, K3, K4, K5 & K6)

UNIT II Geological Hazards**Contact Hours: 11**

Earthquake: Origin of Earthquake, its magnitude and intensity - Earthquake prone zones in India - Effects of earthquake - Earthquake prediction and control. *Volcanoes*: Types of volcanic eruptions - Active volcanic belts in the world - Nature and magnitude of volcanic hazards - Prediction of volcanic eruptions - Mitigation of volcanic hazards. *Mass movement hazards*: Landslides and Snow avalanche hazards (K1, K2, K3, K4, K5 & K6)

UNIT III Hydrological and Meteorological Hazards**Contact Hours: 12**

Hydrological Hazards - *Floods*: Flooded geographical land types – Flash flood - Flood management strategies - Regions of flood prone zones in India – Flood forecasting and warning. *Droughts*: Types of droughts - *Drought assessment parameters*: Drought indices (meteorological indices, hydrological indices and agriculture index) - Preventive measures and preparedness plan for drought mitigation - Meteorological hazards - *Cyclones*: Tropical cyclones & Local storms – Heat waves and cold waves - Glacial Lake Outburst Flood (GLOF) – Lightning – Wildfires (K1, K2, K3, K4, K5 & K6)

UNIT IV Biological Disasters**Contact Hours: 08**

Biological hazards: Types and risk groups - Biological warfare and Bioterrorism - Threats, Capacity building, Response - Biosafety and Biosecurity - Agrocime and Agroterrorism - Epidemics and Pandemics with case studies (K1, K2, K3, K4, K5 & K6)

UNIT V DM Cycle, Legal Framework, Policies and Governance**Contact Hours: 11**

Disaster Management Cycle (Mitigation, preparedness, response and recovery) - Disaster Management Act 2005 - National policy on disaster management 2009 - National disaster management plan 2019 - Sendai framework for disaster risk reduction 2015 -2030 – *Institutional arrangements in disaster management*: National disaster management authority (NDMA) - State and district disaster management authorities - National disaster response force (NDRF) - Role of artificial intelligence, unmanned aerial vehicles (UAVs) and robotics - Social media in disaster management (K1, K2, K3, K4, K5 & K6)

CORE ELECTIVE COURSE – II/IV**DISASTER MANAGEMENT**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1EL3/26UPEVS2EL5	100	4	3	1	-	4

References**Text Books and Reference Books:**

1. Bhattacharya, T. (2017). *Disaster science and management*. Tata McGraw Hill Education.
2. Dhage, S. (2024). *Disaster management in India: Study guide*.
3. Hyndman, D. W., & Hyndman, D. (2025). *Natural hazards and disasters* (6th ed.). Cengage Learning.
4. Kumar, P., & Kumar, M. (2025). *A textbook of disaster management*. SPI Publications.
5. Mondal, D., & Basu, D. (2019). *Disaster management: Concepts and approaches* (1st ed.). CBS Publishers & Distributors.
6. Paul, B. K., & Juran, L. (Eds.). (2025). *The Routledge handbook of disaster response and recovery*. Taylor & Francis.
7. Sharma, S. C. (2019). *Disaster management* (2nd ed.). Khanna Book Publishing.

Web References:

1. <http://www.nidmindia.nic.in>
2. <http://www.cambridge.org>
3. <http://epdweb.engr.wise.sedu/dmc>
4. http://www.worldbank.org/html/fpd/dmf/risk_managemnt.htm
5. <https://nidm.gov.in/modules.asp>

CORE ELECTIVE COURSE – II/IV
ENVIRONMENTAL MANAGEMENT SYSTEMS

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1EL4/26UPEVS2EL6	100	4	3	1	-	4

Unit I Introduction

Contact Hours: 10

Concepts and objectives of EMS - Historical evolution and drivers (Regulatory, market and social) - Regulatory frameworks and environmental policy - Environmental performance vs. environmental management - Sustainable development and corporate environmental responsibility (ESGs) (K1, K2, K3, K4, K5 & K6)

Unit II ISO 14001 & EMS Standards

Contact Hours: 10

ISO 14001:2015 structure and high-level requirements (PDCA cycle) - *Key clauses*: Context of organization, leadership, planning, support, operation, performance evaluation and improvement - Integration with other management systems (ISO 9001, OHSAS/ISO 45001) - Environmental aspects and impacts identification (K1, K2, K3, K4, K5 & K6)

Unit III EMS Implementation

Contact Hours: 10

EMS planning and documentation (manuals, procedures and records) - Environmental objective setting and target formulation - Operational control and standard operating procedures (SOPs) - Risk assessment and operational risk control - Legal and other requirements (compliance obligations) (K1, K2, K3, K4, K5 & K6)

Unit IV EMS Auditing & Performance Evaluation

Contact Hours: 10

Internal and external EMS auditing principles: Audit planning, execution, reporting and corrective actions, key performance indicators (KPIs) and environmental metrics - Monitoring, measurement, analysis and evaluation - Management review and continual improvement (K1, K2, K3, K4, K5 & K6)

Unit V Strategic EMS, Sustainability & Emerging Trends

Contact Hours: 10

Leadership commitment and organizational change for EMS - Corporate sustainability reporting (GRI, ESG metrics) - Life Cycle Assessment (LCA) and environmental footprinting - Digital tools for EMS (software, data analytics, IoT) - *Case studies*: Industry best practices and global benchmarks (K1, K2, K3, K4, K5 & K6)

References:

Text Books & Reference Books:

1. Dahlstrom, R., & Massoud, J. (2002). *Implementing ISO 14001: A practical, business-focused approach*. McGraw-Hill.
2. Desrochers, M., & Hoffmann, A. (1998). *EMS in practice: Case studies*. International Institute for Sustainable Development.
3. Johnson, R. H. (Ed.). (1997). *ISO 14000: Environmental management handbook*. McGraw-Hill.
4. United Nations Environment Programme. (n.d.). *Environmental management systems: An implementation guide for small and medium-sized organizations*. UNEP.
5. Young, A. S. (1996). *Environmental performance evaluation*. Wiley.

CORE ELECTIVE COURSE – II/IV
ENVIRONMENTAL MANAGEMENT SYSTEMS

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1EL4/26UPEVS2EL6	100	4	3	1	-	4

Web References:

1. <https://www.unep.org/resources>
2. <https://www.iso.org/iso-14000-family.html>
3. <https://www.epa.gov/ems/implementation>
4. <https://www.globalreporting.org>
5. <https://www.unep.org/resources>

CORE PRACTICAL – II/VIII
ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY,
ENVIRONMENTAL POLLUTION CONTROL STRATEGIES,
ENVIRONMENTAL IMPACT ASSESSMENT and ENVIRONMENTAL TOXICOLOGY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
II/VIII	26UPEVS1CL2/26UPEVS2CL8	100	6	-	-	6	3

Experiments:

1. Enumeration of Microorganisms from Soil and Water
2. Examination of Mycorrhizae – VAM
3. Isolation of genomic DNA from plant
4. Biodegradation of organic pollutants - Phenol, Synthetic Dyes
5. Production of Biosurfactants
6. Jar Test for Coagulation and Flocculation
7. Demonstration of Water Filtration Techniques
8. Demonstration of Stack Monitoring Techniques
9. Noise Level Monitoring
10. Preparation of different checklist methods for EIA studies in Mining industry
11. Preparation of simple check list for EIA in Cement industry
12. Preparation of Leopold Matrix method for Thermal Power project
13. Preparation of EIA report for environmental clearance as per EIA notification 2006
14. Estimation of LD₅₀ for a toxicant
15. Toxicity Assessment of a toxicant using Seed Germination Bioassay

Semester - III

WASTE MANAGEMENT

Course Objectives

Course Outcomes

CO1 Gain adequate knowledge of municipal solid wastes and its disposal methods

C02 Know the management techniques of hazardous and radioactive wastes

C03 Learn the categorization of biomedical waste and its disposal methods

C04 Understand the management techniques of plastic and e-wastes

C05 Understand the industrial specific treatment techniques and energy recovery

C0s	P01	P02	P03	P04	P05	P06	P07	P08
C01	S	M	S	M	S	S	M	L
C02	S	S	S	S	S	S	S	M
C03	S	S	S	M	S	S	S	M
C04	S	S	S	S	S	S	M	M
C05	S	S	S	S	S	S	M	M
Alignment: S - Strong, M - Moderate, L - Low								

CORE COURSE – IX/XVIII**WASTE MANAGEMENT**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1C09/26UPEVS2C18	100	5	4	1	-	5

Unit I Municipal Solid Waste Management**Contact Hours: 14**

Municipal solid wastes (MSW): Definition, source, types, classification, characterization, composition, per capita generation and global scenario - Methods of collection, storage and transportation, waste processing and material recovery (K4) - *Disposal methods:* Aerobic and anaerobic methods (Landfill, sanitary landfill, composting, burning, incineration, pyrolysis and anaerobic digestion) - Management of leachate and landfill gas, Dumpsite rehabilitation - Rules and regulation of MSW, creating public awareness, role of NGO's (K1, K2, K3, K4, K5 & K6)

Unit II Hazardous & Radioactive Waste Management**Contact Hours: 14**

Hazardous waste: Definition, characteristics and classification (Industrial, hospital and domestic) (K1, K2, & K3) - Labelling and handling of hazardous solid wastes (Segregation, recovery of hazardous waste substances) (K3 & K4) - Rules and regulation of hazardous waste - Hazardous wastes disposal techniques (K5) - *Radioactive wastes:* Sources, classification and characterization (K1 & K2) - Radiation units, measurements (K3), effects, control and disposal Methods (Treatment, conditioning, storage and disposal) - Legal framework and regulations (K1, K2, K3, K4, K5 & K6)

Unit III Biomedical Waste Management**Contact Hours: 10**

Biomedical wastes: Sources and types (K1 & K2) - Impacts of biomedical wastes on environment (K3 & K4) - Biomedical waste management rules, 2016 and Amendments - Labelling and transport (K4) - Control measures and disposal (K5) .

Unit IV Plastic & e-waste Management**Contact Hours: 11**

Plastic wastes: Sources, types (K1 & K2) and global Scenario (K3, K4) - Plastic waste management rules 2016 - Effects of plastic wastes and micro plastics on marine life, wildlife, human health and environment - Control measures - 'R' strategies (R0 to R9) Construction of plastic roads - Alternate to plastics (K5 & K6) - *E-wastes:* Sources, types and composition (K2) - Impacts on environment (K3) - Control measures - Recycling and recovery technologies (K3 & K5).

Unit V Industrial Waste Management & Energy Recovery**Contact Hours: 11**

Cradle to Grave processes in pulp and paper, tanneries, textiles, thermal power plants, mining and ore processing, refineries, iron casting, cement, sugar, distillery, pharmaceuticals and asbestos - Sludge dewatering and its disposal - *Energy recovery:* Heat, electricity and fuel recovery (K1, K2, K3, K4, K5 & K6)

References:**Text Books & Reference Books:**

1. Basarkar, S. (2009). *Hospital waste management: A guide for self-assessment and review*. Jaypee Digital.
2. Bhide, A. A., & Sundaresan, B. B. (2000). *Solid waste management in developing countries*. Indian National Scientific Documentation Center.
3. Chandrappa, R., & Brown, J. (2012). *Solid waste management: Principles and*

CORE COURSE – IX/XVIII**WASTE MANAGEMENT**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1C09/26UPEVS2C18	100	5	4	1	-	5

practice. Springer.

4. Kinnaman, T. C., & Takeuchi, K. (Eds.). (2014). *Handbook on waste management*. Edward Elgar Publishing.

5. Kumar, S. (2009). *Solid waste management*. Northern Book Centre.

Web References:

1. <http://www.cpeo.org/techtree/ttdescript/pyrols.htm>
2. <http://web.mit.edu/urbanupgrading/urbanenvironment/sectors/solid-waste-landfills.html>
3. http://www.cement.org/waste/wt_apps_radioactive.asp
4. https://www.researchgate.net/publication/42339862_Biomedical_waste_management
5. http://cbs.teriin.org/pdf/Waste_Management_Handbook.pdf

CORE COURSE – X/XIX

CLIMATE CHANGE AND CURRENT ISSUES

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1C10/26UPEVS2C19	100	5	4	1	-	5

Course Objectives

The course explores climate system functioning, climate change drivers, mitigation and adaptation of climate change and related issues

Course Outcomes

On the successful completion of the course, students will be able to

- CO1** Understand the meteorological elements influence on climate change
- CO2** Acquire the knowledge about various atmospheric processes in climate science
- CO3** Explore more knowledge in sources and impacts of climate change
- CO4** Understand the existing novel technologies used for measurement of climate change and weather forecasting
- CO5** Understand the recent initiatives and policy framework by UNFCCC, IPCC, MoEF & CC and other Ministries

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	S	M	S	S	L	L
CO2	S	M	S	M	S	S	L	L
CO3	S	M	S	L	S	S	M	M
CO4	S	S	S	S	S	S	M	M
CO5	M	L	M	S	S	S	S	M
Alignment: S - Strong, M - Moderate, L - Low								

CORE COURSE – X/XIX
CLIMATE CHANGE AND CURRENT ISSUES

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1C10/26UPEVS2C19	100	5	4	1	-	5

UNIT I Meteorological Elements for Climate Change Contact Hours: 10

Structure of atmosphere: Vertical structure of atmosphere - *Atmospheric stability:* Adiabatic process - Air Temperature, Humidity, *Condensation:* Dew and Frost, Fog, and clouds - *Clouds:* Classification of clouds - *Precipitation processes:* Collision and Coalescence process and Ice-crystal or Bergeron process - Cloud seeding - Precipitation types (Rain, snow, Sleet and freezing rain, snow grains and snow pellets, hail) - *Air Pressure and Winds:* Atmospheric pressure - Forces that influence the wind (Pressure gradient force, Coriolis force, centripetal force, friction) (K1, K2, K3, K4, K5 & K6)

UNIT II Atmospheric Circulation, Air masses and Fronts Contact Hours: 12

Atmospheric circulation: Hadley circulation - Intertropical Convergence Zone (ITCZ) – Jet streams - *Global wind patterns:* Trade winds, Westerlies and Polar Easterlies - *Thermal circulations:* Sea and land breezes, Mountain and valley breezes, Katabatic winds, Chinook (Foehn) winds, Santa Ana winds, Desert winds - *Air masses:* Classification and characteristics of air masses - Types of air masses - *Fronts:* Type of fronts: Stationary fronts, cold fronts, warm fronts, occluded fronts (K1, K2, K3, K4, K5 & K6)

UNIT III Air Quality and Consequences of Climate Change Contact Hours: 12

Global Air Quality and CO₂ concentration scenario - Role of air pollutants in climate change - *Sources of greenhouse gases:* Coal burning, Transportation sectors (vehicle, railways, shipping and aviation) - Facts and figures of current global warming scenarios in the world - El Niño, La Niña and El Niño Southern Oscillation (ENSO) - *Impacts of climate change:* State of India's Climate in 2025 - Changes in the SW and NE monsoon patterns in India - Melting of ice glaciers and Sea levels - Water scarcity - Food security - Species extinction - Human health - Civil Wars and Migration - Global swarming: Locust plague (K1, K2, K3, K4, K5 & K6)

UNIT IV Climate Classification, Measurement of Climate Change and Weather forecasting Contact Hours: 10

Classification of climate: Koppen's and Thornthwaite' scheme - *The measurement of climate change:* Tree rings, ice cores, ocean sediments, pollen records, Boreholes and other proxy measurements - *Weather forecasting tools:* AWIPS computer work station, Doppler radar data, meteogram, satellites and weather forecasting - *Types of forecasts:* Nowcast, short-range forecasts, medium and long-range forecasts (K1, K2, K3, K4, K5 & K6)

CORE COURSE – X/XIX
CLIMATE CHANGE AND CURRENT ISSUES

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1C10/26UPEVS2C19	100	5	4	1	-	5

UNIT V Global/National Action Plans to Combat Climate Contact Hours: 10
Change Issues

Key Takeaways from CoPs Meetings: Kyoto Protocol - Copenhagen Accord 2009 - Cancun Agreements 2010 to establish Green Climate Funds - Paris Climate Agreement 2015; Intended Nationally Determined Contribution (INDC) at CoP 21 - Key outcomes of CoP 26 to CoP 30 - Montreal Protocol for ODS, Kigali Amendment 2016 to phase out hydrofluorocarbons (HFC) - Green climate funds - Clean Development Mechanism (CDM) - National Action Plan on Climate Change (Eight missions) - Recent initiatives related to climate change adaptation and mitigation in Tamil Nadu and India (K1, K2, K3, K4, K5 & K6)

References:

Text Books & Reference Books:

1. Ahrens, C. D., & Henson, R. (2022). *Meteorology today: An introduction to weather, climate, and the environment* (13th ed.). Cengage Learning.
2. Fletcher, W. D., & Smith, C. B. (2024). *The global climate crisis: What to do about it*. Elsevier.
3. Khalil, M. A. K. (2022). *Global climate change and human life*. Wiley & Sons.
4. Letcher, T. (2025). *Indicators of climate change* (1st ed.). Elsevier.
5. Sammonds, P., Guppy, L., & Sun, T. (2026). *Climate and natural hazards risks* (1st ed.). Elsevier

Web References:

1. <https://unfccc.int/>
2. <https://www.ipcc.ch>
3. <https://www.co2.earth/>
4. <https://www.climatecentral.org/>
5. <https://wmo.int/sites/default/files/2025>

RESEARCH METHODOLOGY AND INSTRUMENTATION

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1C11/26UPEVS2C20	100	5	4	1	-	5

Course Objectives

The course aims to impart the concepts of Research Methods and Instrumentation techniques related to environment.

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|---|
| C01 | Know the concepts and methods of research, scientific reports |
| C02 | Understand the principles and method of imaging techniques |
| C03 | Understand the principles and extraction and separation techniques |
| C04 | Understand the principles and apply the chromatographic techniques |
| C05 | Understand the principles and apply the spectrophotometric techniques |

Mappings of course outcomes with programme outcomes

[illegible]

CORE PAPER – XI/XX**RESEARCH METHODOLOGY AND INSTRUMENTATION**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1C11/26UPEVS2C20	100	5	4	1	-	5

Unit I Research Methods**Contact Hours: 12**

Research: Types, Scope, hypothesis, outcomes - Search engines - Experimental findings and interpretations - Collection of data and analysis – Basic Statistical Tests - *Types of articles:* Research, review, short communications, scientific popular articles, reports, commentary note and editorial note - Components of a research article - *Citing of references:* Types and softwares - Publication ethics - Plagiarism - Journal impact factor - *Citation index:* h index and i-10 index (K1,K2, K3, K4, K5 & K6).

Unit II Imaging Techniques**Contact Hours: 12**

Basic principles of microscopy - Sample preparation techniques for light and electron Microscopes - *Light microscopes:* Simple, compound fluorescent, Phase contrast and confocal - *Electron microscope:* SEM and TEM (K1,K2, K3, K4, K5 & K6).

Unit III Separation Techniques**Contact Hours: 12**

Centrifugation - Principle and instrumentation - *Centrifuges:* Types and applications - *Electrophoretic techniques:* Principles, types and applications - *Extraction methods:* Principles, methods of Liquid-Liquid and Solid-Liquid Extraction. (K1,K2, K3, K4, K5 & K6).

Unit IV Chromatographic Techniques**Contact Hours: 10**

Principle and concept of chromatography: stationary phase, mobile phase, partition and adsorption, coefficients (K1, K2, K3) - Instrumentation and applications of thin layer, Ion-exchange, GC, HPLC, GC-MS and LC-MS (K1,K2, K3, K4, K5 & K6).

Unit V Spectrophotometric Techniques**Contact Hours: 14**

Electromagnetic Radiation: Concept and application in spectrophotometry - *Principle, Components, and Applications:* UV-Vis Spectroscopy - Fluorescence Spectroscopy - Fourier transform infrared spectroscopy (FTIR) - Mass spectrometry - X-ray diffraction (XRD) - Atomic Absorption Spectrometry (AAS) – Inductively Coupled Mass Spectrometry (ICP-MS) (K1,K2, K3, K4, K5 & K6).

References**Text Books & Reference Books:**

1. Gurumani, N. (2011). *Research methodology for biological science*. MJP Publishers.
2. Kumar, R. (2010). *Research methodology: A step-by-step guide for beginners*. SAGE.
3. Currell, G. (Ed.). (2003). *Liquid chromatography–mass spectrometry: An introduction*. John Wiley & Sons.
4. Dean, J. R. (2021). *Instrumental methods of analysis* (3rd ed.). BSP Publications.
5. Duarte, R. M. B. O., & Duarte, A. C. (Eds.). (2018). *Multidimensional analytical techniques in environmental research*. Elsevier.

CORE PAPER – XI/XX**RESEARCH METHODOLOGY AND INSTRUMENTATION**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1C11/26UPEVS2C20	100	5	4	1	-	5

- Shivhare, B., Jadhav, N. N., Vegesna, S., Lakshmi, R., & Malviya, Y. (2022). *Textbook of modern analytical techniques*. Shashwat Publication.
- Webster, G., & Kott, L. (Eds.). (2020). *Chromatographic methods development*. Jenny Stanford Publishing.

Web References:

- <https://www.euacademic.org/BookUpload/9.pdf>
- <https://uou.ac.in/sites/default/files/slm/EVS-505.pdf>
- https://en.wikipedia.org/wiki/Analytical_Sciences_Digital_Library
- <https://microbenotes.com/chromatography-principle-types-and-applications/>
- <https://pmc.ncbi.nlm.nih.gov/articles/PMC5206469/>

ENVIRONMENTAL NANOTECHNOLOGY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1EL5/26UPEVS2EL7	100	4	3	1	-	4

Course Objectives

The course aims to provide the fundamental knowledge on the environmental significance of nanoscience and technology

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|--|
| C01 | Understand the background of nanotechnology and its importance |
| C02 | Understand different types of nanomaterials and their use |
| C03 | Obtain knowledge on synthesis and characterization of the of nanomaterials |
| C04 | Acquire knowledge on environmental applications of nanomaterials |
| C05 | Understand the environmental impacts of nanomaterials and nanoremediation techniques |

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
C01	S	M	M	M	M	S	S	L
C02	S	M	S	M	S	S	M	M
C03	S	S	S	S	M	S	M	M
C04	S	S	S	S	S	S	M	M
C05	S	S	S	S	S	S	M	S
Alignment: S - Strong, M - Moderate, L - Low								

CORE ELECTIVE COURSE – III/V
ENVIRONMENTAL NANOTECHNOLOGY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1EL5/26UPEVS2EL7	100	4	3	1	-	4

Unit I Introduction to Nanotechnology Contact Hours: 08

Nanoscience and Nanotechnology: Definition, principles and applications - *Nanoscale Properties:* - Mechanical, Electrical, Optical and Chemical - Environmental regulations of nanomaterials - *Nanotechnology:* Health risk and ethics (K1, K2, K3, K4, K5 & K6)

Unit II Types of Nanomaterials Contact Hours: 11

Natural Nanomaterials: Nano biomaterials, natural adsorbents, polymer adsorbents, viral adsorbents, biopolymers and nanobacterium - *Engineered Nanomaterials:* Carbon-based nanomaterials (Fullerenes, carbon nanotubes and graphenes) - Metal-based nanomaterials (Metal and metal oxide nanoparticles) - Dendrimers - Nanocomposites - Nonporous materials (K1, K2, K3, K4, K5 & K6)

Unit III Nanomaterials - Synthesis and Characterization Contact Hours: 12

General methods for synthesis of nanomaterials: Bottom-up approach - Top-down approach - *Physical methods:* Ball milling, melt mixing, physical vapour deposition, sputter deposition and evaporation - *Chemical methods:* Chemical reduction, sol-gel method, photochemical synthesis, electrochemical synthesis, emulsion synthesis, sonochemical methods and microwave-assisted synthesis - *Biological methods:* Green synthesis (Bacteria, fungi and plants metabolites) - Characterization - SEM, TEM, XRD, Spectroscopy, BET and GC –MS (K1, K2, K3, K4, K5 & K6)

Unit IV Environmental Applications of Nanomaterials Contact Hours: 11

Nanomaterials for environmental remediation: Nanoscale zero-valent iron (NZVI), Titanium dioxide nanoparticles - Bimetallic nanoparticles - Silver nanoparticles - Metal oxide nanoparticles - Nanoadsorbents - Nanocatalysts – Nanoflocculant - *Nanoremediation:* Halogenated organic solvents, POPs, PPCPs, dyes, explosives and heavy metals – Carbon capture – Advanced membrane technologies - Nano biosensors - types and applications (K1, K2, K3, K4, K5 & K6)

Unit V Environmental Impacts of Nanomaterials Contact Hours: 08

Nanomaterials: - Environmental contamination, exposure, behavior, risks and impacts in water and soil environment - Harmful effects of engineered nanomaterials on human, animal health - *Nanotoxicity:* cytotoxic and genotoxic effects (K1, K2, K3, K4, K5 & K6)

References:

Text Books & Reference Books:

1. Joo, S. H. (2016). *Applying nanotechnology for environmental sustainability*. IGI Global.
2. Lofrano, G., Libralato, G., & Brown, J. (2017). *Nanotechnologies for environmental remediation*. Springer.

CORE ELECTIVE COURSE – III/V
ENVIRONMENTAL NANOTECHNOLOGY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1EL5/26UPEVS2EL7	100	4	3	1	-	4

3. Mazari, S. A., Mubarak, N. M., & Tripathi, M. (2022). *Nanomaterials for carbon dioxide capture and conversion technologies*. Elsevier.
4. Mirkin, C. A., & Niemeyer, C. M. (2007). *Nanobiotechnology II: More concepts and applications*. Wiley-VCH.
5. Niemeyer, C. M., & Mirkin, C. A. (2004). *Nanobiotechnology: Concepts, applications and perspectives*. Wiley-VCH.
6. Poole, C. P., Jr., & Owens, F. J. (2003). *Introduction to nanotechnology*. Wiley India.
7. Pradeep, T. (2008). *Nano: The essentials—Understanding nanoscience and nanotechnology*. Tata McGraw-Hill.
8. Rao, C. N. R., Muller, A., & Cheetham, A. K. (2004). *The chemistry of nanomaterials: Synthesis, properties and applications*. Wiley-VCH.
9. Sharma, V. K., & Shami, N. (2013). *Sustainable nanotechnology and the environment: Advances and achievements* (ACS Symposium Series No. 1124). American Chemical Society.
10. Simeonova, P. P., Opopol, N., & Luster, M. I. (2006). *Nanotechnology: Toxicological issues and environmental safety*. Springer.
11. Surampalli, R. Y., Zhang, T. C., Hu, Z., Tyagi, R. D., Lai, K. C. K., & Ong, S. K. (2009). *Nanotechnologies for water environment applications*. American Society of Civil Engineers.
12. Patel, P. S., Patel, V., & Patel, B. (2018). *Characterization tools and techniques for nanomaterials*. [Publisher not specified].
13. Norton, J. (2019). *Green nanotechnology*. Callisto Reference.

Web References:

1. <https://netl.doe.gov/carbon-management/carbon-capture>
2. <https://www.nanolc.org/>
3. <https://doi/10.1021/bk-2013-1124>
4. <https://www.sciencedirect.com/topics/engineering/nanofiltration-membrane>
5. <http://www.gogreenmechanisms.com/service/environment-audit/>
6. <http://cpcbenvis.nic.in/scanned%20reports/PROBES%2050%20Guidelines%20for%20Environmental%20Audit.pdf>
7. <http://kb.icaai.org/pdfs/PDFFile5b28e322df0fd2.63902464.pdf>
8. <https://www.sciencedirect.com/topics/engineering/ecodesign>
9. <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/cleaner-production>
10. <http://www.gdrc.org/sustdev/concepts/02-c-prod.html>
11. <http://www.cprac.org/en/sustainable/production/cleaner>

CORE ELECTIVE COURSE – III/V

ENVIRONMENTAL LAW AND POLICIES

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1EL6/26UPEVS2EL8	100	4	3	1	-	4

Course Objectives

The course introduces the Indian environmental laws and rules along with the international treaties and national policies

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|--|
| C01 | Understand the constitutional provisions for environmental protections |
| C02 | Have an insight into major acts for pollution control and natural resource conservation. |
| C03 | Understand various rules and regulations related to environmental protection |
| C04 | Know various international conventions and treaties for environment |
| C05 | Know the national missions and policies for protecting environment |

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
C01	S	M	S	L	S	S	S	M
C02	S	M	S	M	S	S	S	M
C03	S	S	S	M	S	S	S	M
C04	S	M	S	L	S	S	S	S
C05	S	M	S	M	S	S	S	S
Alignment: S - Strong, M - Moderate, L - Low								

CORE ELECTIVE COURSE – III/V
ENVIRONMENTAL LAW AND POLICIES

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1EL6/26UPEVS2EL8	100	4	3	1	-	4

Unit I Environmental Legislation Contact Hours: 10

Constitutional provisions in India (Article 48A and 51A (g)): Duties and responsibilities of Indian citizens for environmental protection - Environmental regulatory framework in India - Central and state boards for the prevention and control of environmental pollution - Constitution, powers and functions of pollution control boards (K1, K2, K3, K4, K5 & K6).

Unit II Indian Environmental Laws and its recent amendments Contact Hours: 10

Wildlife protection act, 1972 - Water (Prevention and control of pollution) act, 1974 - Forest conservation act, 1980 - Air (Prevention and control of pollution) act, 1981 - Environmental (Protection) act, 1986 - The biological diversity act 2002 - National green tribunal act 2010 (K1, K2, K3, K4, K5 & K6).

Unit III Rules for Environmental Protection in India Contact Hours: 10

Coastal regulation zones (CRZ) 1991 - Noise pollution (Regulation and control) rules, 2000 - National environmental policy, 2006 - National water policy, 2012 - The bio-medical waste management rules, 2016 - The solid waste management rules, 2016 - The e-waste (Management) rules 2016 - Plastic waste management rules, 2022 - Vehicular emission norms in India - Environment protection (Management of Contaminated Sites) rules, 2025 (K1, K2, K3, K4, K5 & K6).

Unit IV International Treaties and Conventions Contact Hours: 10

Ramsar convention on wetlands (1971) - Stockholm conference on human environment 1972 - Montreal protocol 1987 - Basel convention (1989, 1992) - Earth summits - 1992, 2002, 2022 - Global environmental facility (GEF) - Convention on biodiversity (1992) - UNFCCC, IPCC, UNEP, IGBP - Kyoto protocol 1997, Clean development mechanism (CDM), Copenhagen summit 2009, COP 25 Paris agreement 2015, IPCC AR6 synthesis report 2023 - UNDP Sustainable Development Goals (SDGs) 2030 (K1, K2, K3, K4, K5 & K6).

Unit V Major Initiatives/Policies from Union and State Governments Contact Hours: 10

National policies for environmental protection in India: National river conservation plan (NRCP) - National Ganga river basin authority (NGRBA): Ganga action plan phase I and II - Green India mission - National environmental assessment and monitoring authority (NEAMA) - National green corps (NGC) - National missions on environment – National EV policy - National policy on biofuels, 2018 and 2022 - National hydrogen policy 2022 (K1, K2, K3, K4, K5 & K6).

CORE ELECTIVE COURSE – III/V
ENVIRONMENTAL LAW AND POLICIES

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1EL6/26UPEVS2EL8	100	4	3	1	-	4

References:

Text Books & Reference Books:

1. Asthana, D. K., & Asthana, M. (2001). *Environment: Problems and solutions* (2nd ed.). S. Chand.
2. Divan, S., & Rosencranz, A. (2001). *Environmental law and policy in India*. Oxford University Press.
3. Divan, S., & Rosencranz, A. (2005). *Environmental law and policy in India*. Oxford University Press.
4. Khan, I. A. (2002). *Environmental law* (2nd ed.). Central Law Agency.
5. Leelakrishnan, P. (2000). *Environmental law in India*. Butterworths India.
6. Leelakrishnan, P. (2008). *Environmental law case book*. LexisNexis Butterworths.
7. Maheshwara Swamy, N. (2008). *Textbook on environmental law* (2nd ed.). Asia Law House.
8. Maheshwara Swamy, N. (2010). *Textbook on environmental law*. Asia Law House.
9. Paras Diwan. (n.d.). *Environmental administration and law*.
10. Saxena, K. D. (n.d.). *Environmental planning, policies and programs in India*.
11. Shantakumar, S. (2005). *Introduction to environmental law* (2nd ed.). Wadhwa.
12. Shastri, S. C. (2008). *Environmental law* (3rd ed.). Eastern Book Company.
13. Singh, G. (1995). *Environmental law: International and national perspectives*.
14. Singh, G. (2005). *Environmental law in India*. Macmillan.
15. Tamil Nadu Pollution Control Board. (1999). *Pollution control legislation* (Vol. 1-2).

Web References:

1. <https://www.Cpcb.nic.in/>
2. <https://www.tnpcb.gov.in/>
3. <https://www.thesummitbali.com/>
4. <https://www.envfor.nic.in/legis/legis.html>
5. <https://www.edugreen.teri.res.in/explore/laws.html>
6. <https://www.envfor.nic.in/legis/crz/crznew.html>
7. <https://www.rti.gov.in/>
8. <https://www.www.ngosindia.com/resources/pil.php>

CORE PRACTICAL – III/IX
WASTE MANAGEMENT, CLIMATE CHANGE AND CURRENT ISSUES and
RESEARCH METHODOLOGY AND INSTRUMENTATION

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III/IX	26UPEVS1CL3/26UPEVS2CL9	100	6	-	-	6	3

Experiments:

1. Municipal Solid Waste Characterization
2. Determination of Moisture Content in Solid Waste
3. Preparation and Monitoring of Compost
4. Vermicomposting of Organic Waste
5. Household Waste Audit
6. Identification and Segregation of Biomedical, Plastic and E-Waste
7. Analysis of existing scenarios of weather and forecast datasets obtained from TAWN in any agricultural block of your district
8. Analysis of weather datasets obtained from TAWN in Special Protected Agricultural Zones in Tamil Nadu
9. Analysis of weather datasets obtained from TAWN in different agro-climatic zones in Tamil Nadu
10. Trends in global major greenhouse gases (CO_2 , CH_4 , N_2O and SF_6) from datasets of NOAA, USA
11. Literature Survey and Reference Management
12. Paper Chromatography of Plant Pigments
13. Colorimetric Determination Using UV-Visible Spectrophotometer
14. Demonstration of GC and HPLC Analysis
15. Demonstration of SEM and TEM Analysis

Non Major Elective Courses (Supportive Courses)

NON – MAJOR ELECTIVE (SUPPORTIVE) COURSE - I
ECOLOGY AND ENVIRONMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III	26UPEVS1NM1	100	3	3	-	-	2

Course Objectives

The course aims to impart basic knowledge on ecology and environment to the students of other disciplines

Course Outcomes

On the successful completion of the course, students will be able to

- C01** Understand the concepts of ecology and environment
- C02** Know the types, structure and functions of various ecosystems
- C03** Understand the principles and components of population and community ecology
- C04** Acquire knowledge on the types and significance of biodiversity
- C05** Understand the pollution issues and the need for sustainable development

Mappings of course outcomes with programme outcomes

COs	P01	P02	P03	P04	P05	P06	P07	P08
C01	S	L	M	M	M	S	L	S
C02	S	M	M	M	M	S	S	M
C03	S	M	M	L	M	S	M	L
C04	S	M	M	L	S	M	M	M
C05	S	M	S	L	S	M	M	L
Alignment: S - Strong, M - Moderate, L – Low								

NON – MAJOR ELECTIVE (SUPPORTIVE) COURSE - I**ECOLOGY AND ENVIRONMENT**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III	26UPEVS1NM1	100	3	3	-	-	2

Unit I Ecology Contact Hours: 05

Definition, principle, types and scope of ecology - Levels of organization in ecology
Environment: Structure and composition of atmosphere, lithosphere, hydrosphere and biosphere (K1, K2, K3, K4 & K5).

Unit II Ecosystems Contact Hours: 06

Ecosystem concept and types: Terrestrial and aquatic ecosystems. *Structure:* Abiotic and biotic components - *Function:* Food chains, food webs and trophic levels - Ecological pyramids (number, biomass, energy) - Energy flow in ecosystems - *Biogeochemical cycles:* carbon, nitrogen, phosphorus, and water cycles (K1, K2, K3, K4 & K5)

Unit III Population and Community Ecology Contact Hours: 07

Population characteristics: Density, natality, mortality, age structure - *Population growth:* Exponential and logistic growth - *Species interactions:* mutualism, commensalism, parasitism, predation and competition - Species richness - diversity indices – abundance - dominance - frequency - Community structure and stratification - *Ecological succession:* Primary and secondary succession (K1, K2, K3, K4 & K5)

Unit IV Biodiversity Contact Hours: 06

Biodiversity: Species, genetic and ecosystem diversity - Biodiversity hotspots - Values of biodiversity - *Threats to biodiversity:* Habitat loss, invasive species, pollution and climate change - *Conservation strategies:* In-situ and ex-situ conservation - Human animal conflicts (K1, K2, K3, K4 & K5)

Unit V Environmental Management Contact Hours: 06

Environmental Pollution (Air, Water Soil) - Climate change (Causes and effects) - Environmental legislations in India - Concept of sustainable development- Sustainable development goals 2030 (K1, K2, K3, K4 & K5)

References:**Text Books& Reference Books:**

1. Singh, J.S., Singh, S.P. and Gupta, S.R, (2014) Ecology, environmental science and conservations.
2. Singh, J.S., S.P & Gupta, S.R. (2006). Ecology, Environment and Resource conservation. Anamaya Publ., New Delhi, 688 pp.
3. Pranav Kumar (2017) Fundamentals of Ecology and Environment. Second Edition Pathfinder Publications.
4. Sharma P.D. (2012) Environmental Biology. Deep and Deep Publications
5. Odum, E. P. & Barrett, G. W. (2005). Fundamentals of ecology. 5th ed. Belmont, CA: Thomson Brooks/Cole
6. William P C and Mary A C, Environmental Science, McGraw-Hill (2014)
 Pepper, I. L., Gerba, C.P. and Brusseau, M.L (2011). Environmental and pollution science

NON – MAJOR ELECTIVE (SUPPORTIVE) COURSE - I
ECOLOGY AND ENVIRONMENT

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III	26UPEVS1NM1	100	3	3	-	-	2

Web References:

1. <http://www.envfor.nic.in>
2. <http://www.ecology.edu>
3. <https://www.dcceew.gov.au/>
4. <https://www.unep.org/explore-topics/pollution>
5. <https://www.airnow.gov/>
6. <https://www.unep.org/explore-topics/biodiversity>
7. <https://www.iucn.org/our-work/strategy>
8. <https://www.conservation.org/priorities>

NON – MAJOR ELECTIVE (SUPPORTIVE) COURSE – II
ENVIRONMENTAL POLLUTION

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III	26UPEVS1NM2	100	3	3	-	-	2

Course Objectives

The course aims to impart knowledge on different types of pollution and its environmental effects

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|--|
| C01 | Learn about the scope and components of environment |
| C02 | Understand the causes, effects and control of air pollution |
| C03 | Understand the impact of water pollution on environment |
| C04 | Know about soil quality and its pollution issues |
| C05 | Understand about noise, thermal and radioactive pollution issues |

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	L	M	M	M	S	L	L
CO2	S	M	S	L	S	M	M	M
CO3	S	M	S	L	S	M	M	M
CO4	S	M	M	L	S	M	M	M
CO5	S	M	S	M	S	M	M	L
Alignment: S - Strong, M - Moderate, L – Low								

NON – MAJOR ELECTIVE (SUPPORTIVE) COURSE – II**ENVIRONMENTAL POLLUTION**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III	26UPEVS1NM2	100	3	3	-	-	2

Unit I Introduction**Contact Hours: 06**

Environment: Introduction and scope - *Components of Environment:* Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere - *Pollution:* Definition, sources, types and effects (K1, K2, K3, K4 & K5)

Unit II Air Pollution**Contact Hours: 07**

Sources (Natural, anthropogenic, stationary, mobile and area-specific) - Types of air pollutants (Primary and secondary; Organic and inorganic) - History of air pollution - Transport and diffusion of pollutants - *Atmospheric reactions:* Ozone formation and depletion, Acid rain and Photochemical Smog - Effects of air pollutants on the environment - Methods of monitoring and control of air pollution (gaseous pollutants and particulate matter) (K1, K2, K3, K4 & K5)

Unit III Water Pollution**Contact Hours: 06**

Types, sources (Point and non-point) and effects - Water pollution episodes - Eutrophication - Water quality and standards - Wastewater treatment technologies - *Marine Pollution:* Sources and control - *Emerging Water Pollutants:* Microplastics, personal care products, pharmaceuticals and nanomaterials (K1, K2, K3, K4 & K5)

Unit IV Soil Pollution**Contact Hours: 06**

Sources - Soil sampling methods - *Soil quality:* Soil organic carbon, soil organic matter and mineral nutrients - Effects of soil pollution on the environment - Soil pollution control and remediation techniques (K1, K2, K3, K4 & K5)

Unit V Noise, Thermal and Radiation Pollution**Contact Hours: 05**

Sources of noise pollution - Measurement and indices - Effects and control measures - *Thermal Pollution:* Sources and Effects - *Radiation Pollution:* Sources, measurement units and prevention measures (K1, K2, K3, K4 & K5)

References:**Text Books & Reference Books:**

1. Shafi S M (2005) Environmental Pollution. Atlantic Publishers & Dist.
2. Khitoliya R K (2012) Environmental Pollution, 2nd edition, S. Chand Publishing.
3. Khopkar, S M (2013) Environmental Pollution: Monitoring and Control, New Age International Publishers.
4. Cunningham W P and Cunningham M A (2004) Principles of Environment Science. Enquiry and Applications. 2nd ed. Tata McGraw Hill, New Delhi.
5. Sharma B K (2000) Environmental Chemistry, Goel Publishing House, Meerut.

Web References:

1. www.uccee.org/Environmental_Pollution.html
2. www.who.int/topics/environmental_pollution/en/
3. www.nrdc.org/water/environment.nationalgeographic.com/environment
4. www.noisecontrol.com/the-common-causes-of-noise-pollution
5. www.conserve-energy-future.com/causes-and-effects-of-soil-pollution.php

NON - MAJOR ELECTIVE (SUPPORTIVE) COURSE - III
GLOBAL ENVIRONMENTAL ISSUES

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III	26UPEVS1NM3	100	3	3	-	-	2

Course Objectives

The course focuses on major global environmental issues including population explosion, biodiversity loss, pollution, energy use, climate change and global initiatives

Course Outcomes

On the successful completion of the course, students will be able to

- C01** Identify important global, national, and local issues relating to population
- C02** Understand the global consequences of climate change
- C03** Acquire knowledge on overexploitation of natural resources
- C04** Understand various global disasters and their effective management
- C05** Acquire knowledge on global initiatives for environmental issues

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	M	M	M	S	M	L
CO2	S	M	S	L	S	S	M	L
CO3	S	M	S	L	S	M	M	M
CO4	S	M	S	M	S	M	S	L
CO5	S	M	M	M	S	S	S	M
Alignment: S - Strong, M - Moderate, L – Low								

NON – MAJOR ELECTIVE (SUPPORTIVE) COURSE - III**GLOBAL ENVIRONMENTAL ISSUES**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III	26UPEVS1NM3	100	3	3	-	-	2

Unit I Human Population and Environment Contact Hours: 06

Basic demographic concepts: Growth, fertility, mortality and migration - Population growth and explosion - Urbanization - Poverty, food security and waste disposal - Environmental degradation and public health issues - Development versus environment (K1, K2, K3, K4 & K5)

Unit II Global Atmospheric Changes Contact Hours: 06

Global air quality - Air quality index (AQI) and CO₂ concentration scenario - Current status and projections of global warming scenario in the world - El Niño, La Niña and ENSO - Global consequences - Ozone depleting substances (ODS) - Acid rain - Persistent organic pollutants (POPs) - Impact of air pollutants on human health (K1, K2, K3, K4 & K5)

Unit III Overexploitation of Natural Resources Contact Hours: 06

Environment in anthropocene era - Ecological footprint - Earth overshoot day - *Water resources:* Status of groundwater quality in India - Desertification - *Soil and mineral resources:* Global threats for soil quality - Loss of organic carbon (K3) - Mineral resources exploitation (K1, K2, K3, K4 & K5)

Unit IV Global Disasters Contact Hours: 06

Natural disasters - Global earthquake prone zones - Active volcanic belts - Dormant and extinct volcanoes in the world - *Flash Floods:* Causes, impacts and case studies - Forecasting and warning of natural disasters - *Manmade disasters:* Oil spills, forest fire, industrial and nuclear disasters - Recent global disasters (K1, K2, K3, K4 & K5)

Unit V Global Initiatives Contact Hours: 06

Climate action and energy: Key outcomes of CoPs meetings - *Waste management:* Schemes and initiatives - Outcomes of CoPs meetings on biodiversity conservation - UNCLOS treaty - Land degradation neutrality (LDN) by UNCCD - *Integrated disaster risk reduction:* The Sendai framework (2015 - 2030) (K1, K2, K3, K4 & K5)

References:**Text Books & Reference Books:**

1. Frances Harris (2012) Global Environmental Issues, 2nd edition, John Wiley & Sons Ltd., UK.
2. Stavros G. Pouloupoulos and Vassilis J. Inglezakis (2016) Environment and Development: Basic Principles, Human Activities, and Environmental Implications. Elsevier, Netherlands.
3. Amy Long (2021) Global Environmental Issues, 2nd edition, KendallHunt Publishing Company.
4. Donald Hyndman and David (2005) Hyndman Natural Hazards & Disasters, Cengage Learning, USA.

NON – MAJOR ELECTIVE (SUPPORTIVE) COURSE - III**GLOBAL ENVIRONMENTAL ISSUES**

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III	26UPEVS1NM3	100	3	3	-	-	2

5. John V. Walther (2014) Earth's Natural Resources, Jones & Bartlett Learning, USA.
6. Prasad Modak (2018) Environmental Management towards Sustainability, CRC Press, FL, USA.
7. Prasenjit Mondal and Ajay K. Dalai (2017) Sustainable Utilization of Natural Resources, CRC Press, FL, USA.
8. Rajeev Pratap Singh, Anita Singh, VaibhavSrivastava (2017) Environmental Issues Surrounding Human Overpopulation, IGI Global, USA.
9. Raveendranathan D (2018) Development lead to Pollution and Depletion of Natural Resources, Notion Press, Chennai.
10. Serge Morand, Claire Lajaunie, RojchaiSatrawaha (2017) Biodiversity Conservation in Southeast Asia: Challenges in a Changing Environment, Earthscan from Routledge, UK.
11. Thangavel P and Sridevi G (2015) Environmental Sustainability: Role of Green Technologies, Springer, India.
12. Dogra N and Srivastava S (2012) Climate Change and Disease Dynamics in India, TERI, New Delhi.
13. Quaschnig VV (2019) Renewable Energy and Climate Change. John Wiley & Sons
14. Saurabh Sonwani and Pallavi Saxena (2022) Greenhouse Gases: Sources, Sinks and Mitigation, Springer, Singapore.

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1. <https://www.ipcc.ch/report/ar6/wg2/>
2. <https://www.undrr.org/implementing-sendai-framework>
3. <https://unfccc.int/process-and-meetings/the-paris-agreement>
4. <https://www.cbd.int/gbf/>
5. <https://www.stateofglobalair.org/sites/default/files/soga-2018-report.pdf>
6. www.who.int/airpollution/
7. <https://unfccc.int/>
8. <https://.indiaenvironmentportal.org.in/>
9. <https://www.footprintnetwork.org/our-work/earth-overshoot-day>
10. <https://www.elsevier.com/data/assets/pdf.../ElsevierDisasterScienceReport-PDF.pdf>
11. www.siteresources.worldbank.org/INTDISMGMT/Resources/0821363328.pdf
12. https://link.springer.com/chapter/10.1007/978-981-10-1866-4_2
13. <https://climate.nasa.gov/>
14. <https://pressbooks.bccampus.ca/environmentalissues/>

NON - MAJOR (SUPPORTIVE) ELECTIVE COURSE – IV

ENVIRONMENTAL HEALTH AND SAFETY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III	26UPEVS1NM4	100	3	3	-	-	2

Course Objectives

The course aims to provide the students with an integrated understanding of environmental health risks, occupational safety, exposure assessment and control strategies, regulatory frameworks and management systems

Course Outcomes

On the successful completion of the course, students will be able to

- | | |
|------------|---|
| CO1 | Explain core concepts in environmental health, occupational exposures and safety measures |
| CO2 | Understand about the issues of air, water and food safety |
| CO3 | Identify and measure physical, chemical, biological and ergonomic hazards |
| CO4 | Apply risk-assessment methods and recommend engineering, administrative and PPE controls. |
| CO5 | Interpret and apply national/international regulations and standards relevant to EHS. |

Mappings of course outcomes with programme outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S	M	M	L	M	S	S	L
CO2	S	M	M	L	S	M	M	M
CO3	S	S	S	S	M	M	M	L
CO4	M	S	S	S	S	M	S	M
CO5	M	M	S	M	S	M	S	M
Alignment: S - Strong, M - Moderate, L – Low								

NON - MAJOR (SUPPORTIVE) ELECTIVE COURSE – IV
ENVIRONMENTAL HEALTH AND SAFETY

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
III	26UPEVS1NM4	100	3	3	-	-	2

Unit I Introduction to Environmental Health Contact Hours: 06

Definitions, scope and interdisciplinary nature of environmental health and safety - *Human health and environmental determinants*: Air, water, soil, food, housing, sanitation and vectors - *Basic concepts*: Pollution, exposure, risk and hazard - Sources of environmental pollution (K1, K2, K3, K4 & K5)

Unit II Air, Water and Food Safety Contact Hours: 06

Air pollution and health effects - Safe and sanitation of drinking water - Food contamination and hygiene - Household environmental hazards - Exposure pathways, dose-response, vulnerable populations - Environmental justice - Introduction to EHS management systems (Principles of ISO 45001) (K1, K2, K3, K4 & K5)

Unit III Common Environmental Hazards Contact Hours: 06

Physical hazards: Air pollution (criteria pollutants, PM), noise, heat stress and radiation - Monitoring principles - *Chemical hazards*: Industrial chemicals, pesticides and VOCs - Concepts of TLV, OEL, MSDS - Environmental fate basics - *Biological hazards*: Water and vector-borne agents, bioaerosols and workplace biological risks (K1, K2, K3, K4 & K5)

Unit IV Safety Practices and Risk Prevention Contact Hours: 06

Hierarchy of controls: Elimination, substitution, engineering, administrative and PPE - Ventilation design (general vs. local exhaust), containment, wastewater/solid waste handling basics - Occupational health surveillance, medical monitoring, first aid, fitness for work - Fire safety basics, confined spaces, permit systems, hazardous materials handling and storage (K1, K2, K3, K4 & K5)

Unit V Environmental Laws and Public Awareness Contact Hours: 06

National regulatory framework for India: Environmental regulations, labour laws and codes governing occupational safety - Factory/mine rules - International frameworks (ILO, WHO) - Environmental permitting - EIA/EMP interface with workplace safety - Ethical, social and economic implications of EHS decisions - Stakeholder engagement and communication (K1, K2, K3, K4 & K5)

References:

Text Books & Reference Books:

1. Gupta, P. Environmental health and occupational safety. Routledge.
2. Friis, R. H. . Essentials of environmental health. Jones & Bartlett Learning.
3. Occupational and environmental safety and health VII. Springer.
4. National Research Council. (2011). Prudent practices in the laboratory: Handling and management of chemical hazards. National Academies Press.
5. Jain, R. K., & Rao, S. S. (n.d.). Industrial safety, health and environment management systems. Khanna Publishers.

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1. <https://www.ilo.org>
2. <https://www.who.int>
3. <https://en.wikipedia.org/wiki/GEOLibrary>
4. https://en.wikipedia.org/wiki/International_Archives_of_Occupational_and_Environmental_Health

Mandatory Courses

MANDATORY COURSES

HUMAN RIGHTS (UGC Mandatory Course -Self Study)

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
VIII/II	26UPPGC1H01	100	-	-	-	-	1

Course Objective

To impart the basic ideas about Human Rights at post graduations level. This paper provides different aspects of human rights which includes children and women. Students can learn not only their basic rights but also can understand the duties to be carried out in the days to come.

Unit I: Introduction to Human Rights

Human Rights: Meaning Definitions – Origin and Growth of Human Rights in World – Need and types of Human Rights – Constitutional Provision for Protection of Human Rights – UNHRC (United Nations Human Rights Commission).

Unit II: Classification of Human Rights

Right to Liberty – Right to life – Right to Equality – Rights to Dignity – Right against Exploitation – Right to work – Right to Personal Freedom – Right to Freedom of Expression – Right to Education – Right to information – Right to Clean Environment.

Unit III: Rights of Women and Children

Rights of Women – Gender Equity – Female Feticide and Infanticide and Sex Selective Abortion – Physical Assault and Sexual Harassment – Domestic Violence – Violence at Work Place – Right for Equal Pay – Remedial Measures.

Rights to Children – Protection of Rights – Survival Rights – Participation Rights – Development Rights – Role of UN Convention on Rights of Children.

Unit: IV: Multi – Dimensional aspects of Human Rights

Labour Rights – Bonded Labour – Child Labour – Contract Labour – Migrant Labour – Domestic Women Labour – Rights of Ethnic Refugees – Problems and Remedies – Role of Trade Union in protecting the Rights of Labourers.

Unit V: Grievance and Redressal Mechanism

Redressal Mechanisms at National and International Levels – Structure and Functions of National and State level Human Rights Commission – Rights to Information Act, 2005 – Formation of UNO, Universal Declaration of Human Rights, 1948 – Human Rights Act, 1993 – Constitutional Remedies and Directives Principles of State Policy.

MANDATORY COURSES

References:

1. Baradat Sergio and Swaronjali Ghosh. Teaching of Human Rights : Dominant Publishers and distributors, New Delhi,2009.
2. Roy A.N. Human Rights Achievements and challenges : Vista international Publishing house, Delhi, 2005.
3. Asish Kumar das and Prasant Kumar Mohanty. Human Rights in India: Sarup and Sons. New Delhi. 2007.
4. Bani Borgohain. Human Rights Social Justice and Political Challenge. Kaniska Publishers and distributors New Delhi,2007
5. Velan, G.Human Rights and Development Issues: The associated publishers, Ambala cantt.2008.
6. Meena, P.K.Human Rights theory and practice: Murali Lal and Sons, New Delhi, 2008.
7. Bhavani Prasad Panda. Human Rights Development and environmental law: Academic excellence, Delhi,2007.
8. Vishwanathan. V.N.Human Rights – Twenty First Century Challenges: Kalpaz Publications, New Delhi,2008.
9. Ansari, M.R. Protecting Human Rights: Max Ford Books, New Delhi, 2006.
10. Rao, M.S.A. Social Movements in India – Social Movements and Social Transformation in India Vol.1 & 2: Manohar publications, New Delhi.1978.

MANDATORY COURSES

PEACE EDUCATION (UGC Mandatory Course -Self Study)

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
IX/III	26UPGEN1V01	100	-	-	-	-	1

Learning Objectives

After completing this course, the student teacher will be able to

- Acquire the knowledge of Nature, concepts, aims and objectives of peace education.
- Narrate the developments in peace education in India and Abroad.
- Acquire the knowledge of Education for peace.
- Develop skill to integrate peace education in the present curriculum.
- Understand dimensions of culture of peace.
- Understand the suitable methods of teaching peace education.
- Understand the models of Conflict Resolutions.

Course Content :

UNIT-I Peace Education

Peace education – Meaning, Definition, Concepts, Scope; Aims and objectives– at different level of Education - its relevance to the present global scenario; Human Miseries in the Modern World and Quest for Peace - Understanding Peace in the individual, social and international context, Gandhian concept of peace - Approaches to peace, Balance of Power, Establishment of Institutions, Pacifism and Education.

UNIT-II Historical Development of Peace Education

Historical Development of Peace Education in the world - Creation of United Nations, UNESCO, UNICEF, UNO-UNDP (United Nation Development Programmes), UNEP (United Nation Environment Programmes), UNHCR (United Nation High Commissioner for Refugees High Commissioner for Human Rights). Amnesty International –International Committee of Red cross –NGOs; Peace Education in India and its development. Gandhiji's contributions to peace movement: Non – Violence, Non – Aligned Movement– Nuclear Disarmament -Arms Reduction.

UNIT-III Education for peace

Paradigm shift from Peace Education to Education for Peace - Concept and Meaning of Education for Peace - Curriculum Development: Stage specific Approach – Early childhood, Elementary Stage, Secondary Stage, Higher Secondary Stage, Higher Education stage and Adult Education stage.

UNIT-IV Integrating Peace Education in the curriculum

Major Media of Integration: Subject context, subject perspectives, Curricular and Co – Curricular activities, staff development, Class room and School management.

UNIT-V Promoting Culture Of peace

Culture of peace – Focal areas – Fostering culture of peace through education promoting inner peace, understanding, tolerance, solidarity – Participatory Communication – democratic participation, gender equality – sustainable Economic and Social development – Non – Violence, International peace and security.

MANDATORY COURSES

UNIT-VI Pedagogy of Education for Peace

Teaching Methodologies - Enquiry method, Value clarification, Jurisprudential model of Teaching, Role playing, Dramatics and Literacy Activities, Yoga and Meditation, Sports and Games, Counseling. Teacher Education for Peace - Teacher as a Role Model.

UNIT-VII Conflict Resolution

Bases of conflicts – Positive and negative aspects of conflicts – Types of conflicts – Conflict Resolution – Conflict Management; Model of Conflict Resolution: Dual Concern Model: A Concern for self (assertiveness), A Concern for others (empathy); Styles: Avoidance conflict – yielding conflict, competitive conflict – co-operation conflict, conciliation conflict. Thomas and Kilmann's style – Competitive, collaborative, compromising – Accommodating, Avoiding.

Mode of Transaction: Lecture, Discussion, Demonstration, Field Trip, Presentation by students, Online Mode: Google Meet, Zoom, WebEx.,

Course Outcomes:

After completing this course, the student teacher has attained the ability to

- Acquire the knowledge of Nature, concepts, aims and objectives of peace education.
- Narrate the developments in peace education in India and Abroad.
- Acquire the knowledge of Education for peace.
- Develop skill to integrate peace education in the present curriculum.
- Understand dimensions of culture of peace.
- Understand the suitable methods of teaching peace education.
- Understand the models of Conflict Resolutions

REFERENCE

- Bernard Jessie., (1957). The Sociological study of conflict” International sociological Association, The Nature of conflict, UNESCO Paris.
- Barash, P. David (2000). Approaches to Peace, Oxford University Press, New York. Galtung, Johan, (1984). The Struggle for Peace Gujarat Vidyapith, Ahmedabad.

**Bridge Course for M.Sc.
Environmental Science
Programme**

BRIDGE COURSE FOR M.SC. ENVIRONMENTAL SCIENCE

(For Students Entering from Diverse UG Programmes such as Botany, Zoology, Chemistry, Physics, Biotechnology, Microbiology, Geography, Agriculture, Engineering, and Related Disciplines)
Non-credit / Audit Course

Objective: To provide students with fundamental knowledge of environmental science concepts and equip them with basic interdisciplinary skills required for postgraduate study.

Unit I: Fundamentals of Environmental Science

Definition, scope and importance of Environmental Science, Components of the environment: Atmosphere, Hydrosphere, Lithosphere and Biosphere, Structure and functions of ecosystems, Biotic and abiotic factors, Environmental issues at global, national and local levels

Learning Outcome: Understand basic environmental concepts and ecosystem functioning.

Unit II: Ecology and Biodiversity

Levels of ecological organization, Food chains, food webs and ecological pyramids, Population and community ecology, Biodiversity: Types and significance, Threats to biodiversity and conservation strategies

Learning Outcome: Acquire knowledge of ecological principles and biodiversity conservation.

Unit III: Natural Resources and Environmental Pollution

Renewable and non-renewable resources, Water, forest, mineral and energy resources
Air, water, soil and noise pollution, Sources, effects and control measures of pollution
Solid waste management concepts.

Learning Outcome: Understand resource utilization and environmental pollution issues.

Unit IV: Climate Change and Sustainable Development

Climate change: Causes and impacts, Global warming and greenhouse gases, Sustainable development goals (SDGs) Environmental ethics and environmental education
Disaster management and climate adaptation

Learning Outcome: Understand global environmental challenges and sustainability principles.

Unit V: Environmental Monitoring and Digital Tools

Basics of environmental sampling and monitoring, Introduction to environmental data collection, Applications of GIS and Remote Sensing in environmental studies, Introduction to Artificial Intelligence (AI) and Internet of Things (IoT) in environmental monitoring, Environmental mobile applications and citizen science platforms,

Learning Outcome: Gain familiarity with modern environmental monitoring techniques and digital technologies.

[This bridge course provides the common foundation necessary for students from varied academic backgrounds to successfully undertake a M.Sc. Environmental Science programme]

Recommended SWAYAM Courses

RECOMMENDED LIST OF SWAYAM COURSES

MOOC- I & MOOC- II-(Mandatory Course-Self Study)

Semester	Paper Code	Marks	Hours/Week	L	T	P	Credit
V& VII/I	26UPEVS2MO1& 26UPEVS2MO2/ 26UPEVS1MO1	100	-	-	-	-	1 & 2

S No	Course	Institution/ Instructor	Duration	Relevance
1	Environmental Science	IIT Kharagpur	12 Weeks	Comprehensive environmental science course covering sustainability, pollution, climate change, ecology, waste management, and environmental laws.
2	Environmental Impact Assessment	IIT Roorkee	12 Weeks	EIA process, methodologies, public participation, environmental management, and report preparation.
3	Climate Change Science	IISc Bangalore	8 Weeks	Climate system, greenhouse effect, climate modelling, and future climate projections.
4	Fundamentals of Ecology	IISER Pune	8 Weeks	Population ecology, community ecology, ecosystems, biogeochemistry, and Anthropocene ecology.
5	Introduction to Environmental Engineering and Science	IIT Faculty	12 Weeks	Environmental pollution, wastewater treatment, sustainability, circular economy, and green design.
6	Environmental Quality Monitoring and Analysis	NPTEL	12 Weeks	Environmental monitoring techniques, sampling, analysis, and interpretation of environmental data.
7	Climate Hazards and Disaster Mitigation	IIT Indore	8 Weeks	Floods, droughts, heat waves, disaster risk assessment, and mitigation strategies.
8	Sustainable Engineering Concepts and Life Cycle Analysis	IIT Faculty	8 Weeks	Sustainability assessment, Life Cycle Assessment (LCA), industrial ecology, and circular economy.
9	Basic Environmental Engineering and Pollution Abatement	IIT Roorkee	12 Weeks	Air, water, and solid waste pollution control technologies and environmental engineering design.
10	Environment and Development	IIT Guwahati	8 Weeks	Environmental ethics, sustainable development, natural resource management, and policy issues.