सावित्रीबाई फुले पुणे विद्यापीठ

Savitribai Phule Pune University,

Pune, Maharashtra, India

Faculty of Science and Technology

National Education Policy (NEP)-2020 Compliant Curriculum

ME – Civil Engineering (2025 Pattern)

Master of Engineering (Environmental Engineering)

(With effect from Academic Year 2025-26)

Contents

Preface by Board of Studies

Dear Students and Teachers,

We, the members of Board of Studies Civil Engineering, are very happy to present ME – Civil Engineering (2025 Pattern) Master of Engineering (Environmental Engineering) syllabus effective from the Academic Year 2025-26.

Civil Engineering is a dynamic discipline that lies at the intersection of engineering, design, and environmental stewardship. It provides the foundation for the planning, design, construction, and maintenance of infrastructure systems that support modern society. This curriculum is designed to provide students with a comprehensive understanding of the fundamental principles, theories, and practices of civil engineering, while also preparing them to address the challenges of an ever-evolving built environment and sustainable development.

The revised syllabus falls in line with the objectives of NEP-2020, Savitribai Phule Pune University, AICTE New Delhi, UGC, and various accreditation agencies by keeping an eye on the technological developments, innovations, and industry requirements. Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skill sets. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

This curriculum is the result of extensive consultation with academic experts, industry professionals, and alumni to ensure relevance and excellence. It is designed not only to meet the current industry standards but also to prepare students for higher studies and research in the field of Civil Engineering.

We hope that this curriculum will inspire students to become competent professionals, responsible citizens, and contributors to the technological advancement of society.

Dr. S. B. Thakare
Chairman
Board of Studies

Members of Board of Studies - Civil Engineering	
Dr. Ganesh A Hinge	Dr. Pratibha M. Alandkar
Dr. U. R. Awari	Dr. Jyotiba B. Gurav
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Dr. Vinaykumar C. H.	Er. Ramesh D. Raskar

Program Specific Outcomes (PSO)

PSO1: Graduate will be able to develop sustainable and innovative solutions for water, wastewater, solid and hazardous waste, and air quality management.

PSO2: Graduate will be able to use computational tools, experiments, and modelling techniques to analyse and optimize environmental engineering systems.

PSO3: Graduate will be able to address environmental challenges by ensuring technical, economic, and societal needs & sustainability for climate resilience and resource security.

Program Educational Objectives (PEO)

Program Educational Objectives (PEOs): Program Educational Objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

PEO1: Core Competency and Professional Excellence

Graduates will establish themselves as successful Civil Engineering professionals by applying their technical knowledge, problem-solving abilities, and ethical values in planning, designing, and executing infrastructure projects that meet societal needs.

PEO2: Higher Education and Lifelong Learning

Graduates will pursue advanced education, research, or professional development to stay current with emerging trends, technologies, and practices in Civil Engineering and related interdisciplinary fields.

PEO3: Leadership and Social Responsibility

Graduates will demonstrate leadership, teamwork, effective communication, and a commitment to sustainable development by engaging in projects that contribute to environmental conservation and the betterment of society.

Program Outcomes (PO)

Graduate Attributes (GAs) are measurable outcomes that indicate the competencies a postgraduate student is expected to achieve. They represent the qualities and skills required for professional practice at the postgraduate level. The NBA defines the following Graduate Attributes for all PG programmes.

1. Scholarship of knowledge

Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

2. Critical thinking

Analyze complex engineering problems critically, apply independent judgement for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

3. Problem solving

Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

4. Research skill

Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.

5. Usage of modern tools

Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.

6. Collaborative and multidisciplinary work

Possess knowledge and understanding of group dynamics, recognize opportunities and Contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

7. Project management and finance

Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economic and financial factors.

8. Communication

Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

9. Life-long learning

Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

10. Ethical practices and social responsibility

Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

11. Independent and reflective learning

Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

General Rules and Guidelines

- Course Outcomes (CO): Course Outcomes are narrower statements that describe what students are expected to know, and are able to do at the end of each course. These relate to the skills, knowledge and behavior that students acquire in their progress through the course.
- Assessment: Assessment is one or more processes, carried out by the institution, that identify, collect, and prepare data to evaluate the achievement of Program Educational Objectives and Program Outcomes.
- Evaluation: Evaluation is one or more processes, done by the Evaluation Team, for interpreting the data and evidence accumulated through assessment practices. Evaluation determines the extent to which Program Educational Objectives or Program Outcomes are being achieved, and results in decisions and actions to improve the program

Guidelines for Examination Scheme

Theory Examination: The theory examination consists of two parts, Comprehensive Continuous Evaluation (CCE) and End-Semester Examination (ESE).

Comprehensive Continuous Evaluation (CCE):

Comprehensive Continuous Evaluation (CCE) of 50 marks based on all units of course, to be scheduled & conducted at institute level. CCE consists of parameters and weightage as mentioned below:

Sr.	Parameters	Marks	Coverage of Units
1.	Written Unit Test	10 Marks	Units 1 and Unit 2
2.	Open Book Test	10 Marks	Units 3 and Unit 4
3.	Assignments / Case Study	10 Marks	Unit 5
4.	Seminar Presentation/Field Visit	10 Marks	Any Units
5.	Mini Project	10 Marks	Any Units
6.	Term Paper	10 Marks	Any Units
7.	Project-Based Learning	10 Marks	Any Units

HoD /PG Coordinator may select any parameter from above list. One Unit text is mandatory. At the end of the semester, the final marks for CCE shall be assigned based on the performance of the student and is to be submitted to the University.

Format and Implementation of Comprehensive Continuous Evaluation (CCE)

- Unit Test and Open Book Test

Format: Questions to be designed as per Bloom's Taxonomy guidelines to assess various cognitive levels (Remember, Understand, Apply, Analyze, Evaluate, Create).

Implementation: Schedule the Unit test after completing Units 1 and 2. Ensure the question paper

is balanced and covers key concepts and applications. Schedule the open book test after completing Units 3 and 4.

Sample Question Distribution

- Remembering (2 Marks): Define key terms related to [Topic from Units 1 and 2].
- Understanding (2 Marks): Explain the principle of [Concept] in [Context].
- Applying (3 Marks): Demonstrate how [Concept] can be used in [Scenario].
- Analyzing (4 Marks): Compare & contrast [Two related concepts] from Units 1 and 2.
- Evaluating (4 Marks): Evaluate the effectiveness of [Theory/Model] in [Situation].

- Assignments / Case Study

Students should submit one assignment or case study report based on Unit 5.

Format: Problem-solving tasks, theoretical questions, practical exercises, or case studies that require in-depth analysis and application of concepts.

Implementation: Distribute the assignments or case study after covering Units 5.

Provide clear guidelines and a rubric for evaluation.

- Seminar Presentation

Format: Presentation on any topic from syllabus followed by a Q & A session.

Deliverables: Presentation slides, a summary report in 2 to 3 pages, and performance during the presentation.

Implementation: Schedule the seminar presentations at the end of the course.

- Mini Project

Each student shall carry out an individual mini project on any topic from syllabus.

Format: The mini project report structure should include: Title page (project and student details), Certificate and acknowledgement, Abstract (summary of work), Introduction (problem, objectives and scope), Literature review (related studies), Methodology (tools, design, process), Implementation (step-by-step procedure, with photos/screenshots), Results (tables, graphs, visuals), Conclusion (achievements & future scope), References and appendix (if required).

Implementation: Students should independently identify the problem, carry out the work, and present outcomes. Reports must demonstrate originality, clarity in methodology, and result presentation (tables/graphs/diagrams).

- Project Based Learning (PBL)

Format: It can be carried out in small groups (2–3 students). Students shall work on a realistic, open-ended problem relevant on any topic from syllabus. The PBL task may involve design,

analysis, simulation, model development, field-based study, or innovative solutions to practical challenges. The PBL report structure should include: Title page (problem and student / group details), Certificate and acknowledgement, Abstract (summary of problem and approach), Problem definition and objectives, Literature survey / background study, Proposed methodology (tools, models, design, assumptions), Implementation / solution development (steps, models, or prototypes), Results and discussion (analysis, comparisons, visuals), Conclusion (outcomes, limitations, and scope for future work) References and appendix (if required).

Implementation: Students should identify the problem, define objectives, and work towards a solution through design, analysis, simulation, or model development. Reports must highlight clarity in methodology, originality, and proper presentation of results (tables/graphs/diagrams), along with conclusions and future scope.

- Schedule for conducting CCE
  - Weeks 1 - 5: Cover Units 1 and 2
  - Week 6: Conduct Unit Test
  - Weeks 7 - 9: Cover Units 3 and 4
  - Week 10: Conduct Open Book Test.
  - Weeks 11-12 : Cover Unit 5
  - Week 13: Distribute and collect Assignments / Case Study

HoD /PG Coordinator may decide schedule for other parameters from above list.

Evaluation and Feedback:

Unit Test: Evaluate promptly and provide constructive feedback on strengths and areas for improvement.

Assignments / Case Study: Assess the quality of submissions based on the provided rubric. Offer feedback to help students understand their performance.

Seminar Presentation: Evaluate based on content, delivery, and engagement during the Q&A session. Provide feedback on presentation skills and comprehension of the topic.

End-Semester Examination (ESE)

End-Semester Examination (ESE) of 50 marks theory examination based on all the units of course scheduled by the university. Question papers will be sent by the University through QPD (Question Paper Delivery). University will schedule and conduct ESE at the end of the semester. The paper setting, conduct of examination and paper assessment for the End-Semester examination of the subjects Elective I, Elective II and Elective III shall be done by the respective

college, as per the schedule of Savitribai Phule Pune University. Director/Principal approve the panel of paper setters in consultation with the head of the department. Out of Three Question papers sets, Director/Principal shall choose any one question paper for distribution during the examination on the day of the examination.

- Format and Implementation: Question Paper Design:

Below structure is to be followed to design the End-Semester Examination (ESE) for a theory subject of 50 marks on all 5 units of the syllabus with questions set as per Bloom's Taxonomy guidelines.

Balanced Coverage: Ensure balanced coverage of all units with questions that assess different cognitive levels of Bloom's Taxonomy: Remember, Understand, Apply, Analyze, Evaluate, and Create. The questions should be structured to cover the Bloom's Taxonomy as applicable:

- Remembering: Basic recall of facts and concepts.
- Understanding: Explanation of ideas or concepts.
- Applying: Use of information in new situations.
- Analyzing: Drawing connections among ideas.
- Evaluating: Justifying a decision or course of action.
- Creating: Producing new or original work.

- Detailed Scheme

Unit-Wise Allocation: Unit wise allocation 10 Marks per unit. Each unit will have a combination of questions designed to assess different cognitive levels. By following this scheme, you can ensure a comprehensive and fair assessment of students' understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.

NEP 2020 Compliant Curriculum Structure

First Year ME – Civil Engineering (2025 Pattern)
Master of Engineering (Environmental Engineering)
Semester I

Credit Level 6.5															
Course Code	**Type of Course**	**Course Title**	**Teaching Scheme (Hrs./week)**			**Examination Scheme and Marks**						**Credits**			
			Theory	**Tutorial**	**Practical**	**CCE***	**End-Sem**	**Term work**	**Practical**	**Oral**	**Total**	**Theory**	**Tutorial**	**Practical**	**Total**
	Semester I														
PCC-501-ENE	Major Mandatory	Advanced Water & Wastewater Treatment	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-502-ENE	Major Mandatory	Geo-informatics for Environmental Engineering	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-503-ENE	Major Mandatory	Advanced Environmental Chemistry & Microbiology	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-504-ENE	Major Mandatory	Environmental Impact Assessment	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-505-ENE	Major Mandatory	Laboratory- I (On core Subject)	-	-	4	-	-	25	-	25	50	-	-	2	2
PEC-510-ENE	Major Elective I	Elective – I	3	-	-	50	50	-	-	-	100	3	-	-	3
PEC-511-ENE	Major Elective I	Laboratory- II (On Elective Subject)	-	-	2	-	-	25	-	25	50	-	-	1	1
Total			**19**	**0**	**6**	**250**	**250**	**50**	**0**	**50**	**600**	**19**	**--**	**3**	**22**

CCE*: Comprehensive Continuous Evaluation

PEC-510-ENE Elective I Courses	
PEC-510A-ENE	Statistical Analysis for Environmental Engineering
PEC-510B-ENE	Hydraulic Design & Soft Computing in Water Distribution Network
PEC-510C-ENE	Biomedical Waste Management

First Year ME – Civil Engineering (2025 Pattern)
Master of Engineering (Environmental Engineering)
Semester II

Credit Level 6.5															
Course Code	**Type of Course**	**Course Title**	**Teaching Scheme (Hrs./week)**			**Examination Scheme and Marks**						**Credits**			
			Theory	**Tutorial**	**Practical**	**CCE***	**End-Sem**	**Term work**	**Practical**	**Oral**	**Total**	**Theory**	**Tutorial**	**Practical**	**Total**
	Semester II														
PCC-506-ENE	Major Mandatory	Solid and Hazardous Waste Management	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-507-ENE	Major Mandatory	Advanced Industrial Wastewater Treatment	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-508-ENE	Major Mandatory	Air Pollution & Sustainability Measures	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-509-ENE	Major Mandatory	Laboratory-III (On Core Subject)	-	-	4	-	-	25	-	25	50	-	-	2	2
PEC-512-ENE	Major Elective II	Elective - II	3	-	-	50	50	-	-	-	100	3	-	-	3
PEC-513-ENE	Major Elective III	Elective - III	3	-	-	50	50	-	-	-	100	3	-	-	3
SEM-514-ENE	Seminar I	Technical Seminar- I	-	-	4	-	-	25	-	25	50	-	-	2	2
Total			**18**	**0**	**8**	**250**	**250**	**50**	**-**	**50**	**600**	**18**	**-**	**4**	**22**

Elective II Courses	
PEC-512A-ENE	Climate Change & Sustainable Development
PEC-512B-ENE	Artificial Intelligence and Environmental Engineering
PEC-512C-ENE	Air & Water Quality Modelling
Elective III Courses	
PEC-513A-ENE	Hydraulic Design & Soft Computing in Design of Sewerage System
PEC-513B-ENE	Environmental Sanitation
PEC-513C-ENE	Environmental Legislation & Management Systems

Second Year ME– Civil Engineering (2025 Pattern)
Master of Engineering (Environmental Engineering)

Semester III

Credit Level 7															
Course Code	**Type of Course**	**Course Title**	**Teaching Scheme (Hrs./week)**			**Examination Scheme and Marks**						**Credits**			
			Theory	**Tutorial**	**Practical**	**CCE***	**End-Sem**	**Term work**	**Practical**	**Oral**	**Total**	**Theory**	**Tutorial**	**Practical**	**Total**
	Semester III														
RM-601-ENE	Research Methodology	Research Methodology	4	-	-	50	50	-	-	-	100	4	-	-	4
OJT-602-ENE	On Job Training / Internship	On Job Training / Internship	-	-	10	-	-	100	-	-	100	-	-	5	5
SEM-603-ENE	Seminar II	Technical Seminar II	-	-	8	-	-	25	-	25	50	-	-	4	4
PRJ-605-ENE	Research Project	Research Project Stage I	-	-	18	-	-	25	-	25	50	-	-	9	9
Total			**4**	**0**	**36**	**50**	**50**	**150**	**0**	**50**	**300**	**4**	**0**	**18**	**22**

Second Year ME– Civil Engineering (2025 Pattern)
Master of Engineering (Environmental Engineering)

Semester IV

Credit Level 7															
Course Code	**Type of Course**	**Course Title**	**Teaching Scheme (Hrs./week)**			**Examination Scheme and Marks**						**Credits**			
			Theory	**Tutorial**	**Practical**	**CCE***	**End-Sem**	**Term work**	**Practical**	**Oral**	**Total**	**Theory**	**Tutorial**	**Practical**	**Total**
	Semester IV														
SEM-604-ENE	Seminar III	Technical Seminar III	-	-	8	-	-	50	-	50	100	-	-	4	4
PRJ-606-ENE	Research Project	Research Project – Stage II	-	-	36	-	-	150	-	50	200	-	-	18	18
Total			**0**	**0**	**44**	**0**	**0**	**200**	**0**	**100**	**300**	**0**	**0**	**22**	**22**

Savitribai Phule Pune University, Pune

Maharashtra, India

ME– Civil Engineering (2025 Pattern)
Master of Environmental Engineering

Semester I

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code-PCC-501-ENE
Course- Advanced Water and Wastewater Treatment

Teaching scheme	Credit	Examination	
Theory- 04 hours / week	04	CCE ESE	50 marks 50 marks

Prerequisite- Basic understanding of environmental engineering, waste management systems, and public health.

Companion Course- Laboratory- I

Course Objectives-

1. To understand the dynamics of chemical and biological reactions occurring in water and wastewater treatment reactors.
2. To explore physicochemical processes such as coagulation, flocculation, sedimentation, and filtration with focus on their scientific principles and design.
3. To evaluate advanced disinfection methods and their applications under varying environmental conditions.
4. To design and assess the performance of aerobic and anaerobic biological treatment systems for wastewater.
5. To study sludge management practices and disposal techniques. To investigate tertiary and advanced treatment processes for water reuse and polishing.

Course Outcomes-

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

CO1- Explain reaction kinetics and reactor configurations, and apply mass balance concepts for reactor design in water and wastewater treatment.

CO2- Analyse coagulation, flocculation, and sedimentation mechanisms and design respective treatment units.

CO3- Evaluate filtration and disinfection techniques and design appropriate systems based on water quality requirements.

CO4- Design and interpret the performance of biological treatment systems including activated sludge and trickling filters.

CO5- Understand and design anaerobic digestion and sludge handling systems, including UASB reactors.

Course Contents

Unit I	Reactor Theory and Treatment Dynamics	12 hours

Types of reactors used in treatment systems, Mass transport and mass-balance principles, Reaction kinetics and rate expressions, Ideal and non-ideal reactors, Design of Completely Mixed Batch Reactors (CMBR), Completely Mixed Flow Reactors (CMFR), Plug Flow Reactors (PFR), Estimation of kinetic parameters in CMFR

Unit II	Physicochemical Treatment – Coagulation, Flocculation & Sedimentation	12 hours
Concept and design of aeration and gas transfer, Coagulation Process, Stability of colloids, Repulsive and Attractive Potentials, destabilization of Colloids, Transport of colloidal particles, Orthokinetic and Perikinetic flocculation, Destabilization in Water and Wastewater Treatment by Al (III) and Fe (III), Synthetic Organic polymers, Activated Silica, Selection of a coagulant, Sedimentation Processes, Zone Settling, Compression, Sedimentation tank design for water and wastewater, Design of tube settlers.		
Unit III	**Filtration and Disinfection Technologies**	**12 hours**
Filtration- Filtration process; principle mechanisms of filtration, Filter Hydraulics backwash hydraulics, Rate control Patterns and Methods, Head loss patterns at Constant Rate, Slow sand and Rapid sand Filtration and their performances, Design of Gravity filters, Design and Operating variables for deep Granular Filters- Filter media, Fluidization, and bed expansion in backwashing, Under drainage systems with design, operational problems. Disinfection- History and modes of disinfection, rates of disinfection, disinfection concentration Factors affecting disinfection such as temperature, pH and organic matter, Chemical Disinfectants – chlorine and Chlorine derivatives; Non-Chemical Methods for Disinfection- Ozonation; UV radiation.		
Unit IV	**Biological Treatment Systems**	**12 hours**
Design principles of- Activated Sludge Process (ASP) and its modifications, Trickling Filters, Concept of package, compact, and mobile sewage treatment units, Suitability for decentralized and small-scale applications		
Unit V	**Anaerobic Treatment and Sludge Management**	**12 hours**
Operational and economic aspects of treatment plant management energy consumption, cost-benefit analysis, and maintenance strategies Theory & Design of Anaerobic Digestion (Low & High Rate), Theory of Sludge Dewatering (sludge drying beds & mechanical methods), Membrane Filtration- Reverse Osmosis (RO)- osmosis, membrane characteristics, design Pretreatment needs and flux maintenance, Adsorption- Types, influencing factors, isotherms , GAC & PAC systems, breakthrough analysis, reactor design, Ion Exchange- Exchange materials and resins, Equilibrium, isotherms, and regeneration, Microfiltration and Ultrafiltration- pore size, pressure requirements, Electrodialysis- principle and applications, Advanced Oxidation Processes (AOPs)		

Learning Resources

Text Books

1. Metcalf & Eddy. *Wastewater Engineering – Treatment and Resource Recovery*, 5th ed., McGraw-Hill Education, New York, 2014.
2. Hammer, M. J., & Hammer Jr., M. J. *Water and Wastewater Technology*, 7th ed., Pearson, New Jersey, 2012.
3. CPHEEO. *Manual on Sewerage and Sewage Treatment Systems*, Ministry of Housing and Urban Affairs, Government of India, New Delhi, 2013.
4. Bureau of Indian Standards (BIS). *IS 10500: Drinking Water – Specification*, BIS, New Delhi, 2012 (Reaffirmed 2017).

Reference Books

1. World Health Organization (WHO). Guidelines for Drinking Water Quality, 4th ed., WHO Press, Geneva, 2017.

2. Baker, R. W. Membrane Technology and Applications, 3rd ed., Wiley, Chichester, 2012.
3. Ranade, V. V., & Bhandari, V. M. Industrial Wastewater Treatment, Recycling and Reuse, Butterworth-Heinemann, Oxford, 2014.
4. Asano, T., Burton, F. L., Leverenz, H. L., Tsuchihashi, R., & Tchobanoglous, G. Water Reuse – Issues, Technologies, and Applications, McGraw-Hill, New York, 2007.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PCC-502-ENE
Course- Geoinformatics for Environmental Engineering

Teaching scheme	Credit	Examination	
Theory- 4 hours / week	04	CCE ESE	50 marks 50 marks

Prerequisite- Basic understanding of physics, mathematics, and computer

Companion Course - Laboratory- I

Course Objectives-

1. Understand the fundamental concepts, history, and physical principles of remote sensing, including electromagnetic radiation interactions and satellite imaging systems**.**
2. Apply digital image processing techniques and GIS concepts to enhance, interpret, and analyze remotely sensed data for geospatial applications.
3. Interpret aerial photographs using photogrammetric principles, understand stereoscopy and apply techniques for flight planning and image rectification.
4. Develop foundational programming skills using Python or R to process and manage geospatial data in raster, vector, and tabular formats.
5. Understand and apply fundamental probability, statistics, fuzzy logic, and optimization techniques for decision-making in geospatial data analysis.

Course outcomes-

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

CO1- Explain the fundamental principles of remote sensing, understand radiation interaction, technologies, and interpretation techniques relevant to environmental systems.

CO2-Apply digital image processing methods, GIS tools, and GPS technologies for environmental data acquisition, analysis, and spatial decision support.

CO3-Apply principles of aerial photography and photogrammetry to analyze image geometry, plan aerial surveys, and generate accurate orthophotos.

CO4-Develop basic geospatial data processing programs using Python/R and perform spatial queries using SQL.

CO5- Applying probability and optimization methods along with hyperspectral and thermal remote sensing techniques for solving spatial problems and environmental applications.

Course Contents

Unit I	Fundamentals of Remote Sensing	12 hours

Introduction to Geoinformatics (RS, GIS, GPS), Fundamentals and history of Remote Sensing, Types of Remote Sensing – active and passive, Sources of energy, Electromagnetic Radiation reflectance, transmission, absorption, thermal emissions, Interaction of EMR with atmosphere, Atmospheric windows, Spectral reflectance of Earth's surface features, Multi-concept of Remote Sensing, Remote Sensing platforms and sensors, Data acquisition through various platforms, Cameras and sensor parameters, Elements of satellite images, Concepts of bands, pixel, digital number, and metadata, Multispectral

Remote Sensing, Hyperspectral, thermal, microwave, and laser remote sensing (introductory concepts), False color composite, Interpretation of multispectral images, Spectral signatures and indices, Sensor combinations, Image interpretation parameters, Image formation, Resolutions – spatial, spectral, temporal, and radiometric, Radiometric and geometric distortions.		
Unit II	**Digital Image Processing**	**12 hours**
Digital image processing fundamentals, Atmospheric, radiometric, and geometric corrections, Histograms, Density slicing, Contrast stretching, Principal Component Analysis (PCA), Image transformations, Intensity transformations, Spatial filtering, Image formats, Noise reduction, Image segmentation, Classification techniques – supervised and unsupervised, Introduction to GIS, Components of GIS – hardware and software, GIS functionality – data capture, management, analysis, and visualization, Projections and georeferencing, Concepts and types of map projections and their applications, Topological data models – TIN, spaghetti, polygon structures, Digitization techniques, Introduction to GPS, Fundamental concepts, Coordinate and reference systems, Components of the GPS system, GPS for land navigation and survey reconnaissance, Static/Differential positioning, Dynamic/Kinematic positioning, GPS equipment, National GPS applications, Ground truthing – importance and techniques.		
Unit III	**Fundamentals of Aerial Photography**	**12 hours**
History and Development- Introduction to the evolution of aerial photography and photogrammetry, significance in mapping and remote sensing. Photographs- Vertical, low oblique, high oblique photographs, infrared and multispectral images, their uses, and characteristics. Aerial Cameras- Types of cameras based on format size, lens type, focal length, and applications. Stereoscopy- Definition and calculation of scale, forward and side overlaps for 3D viewing, principles of stereoscopy for depth perception, Use of stereoscopes, optical and digital plotters, analytical tools for interpreting and measuring aerial photos. Parallax Equation- Concepts linking photo image points to ground coordinates, use of floating mark and parallax equations to derive height and depth. Height Information- Techniques for extracting elevation data, effects of camera tilt on image quality, displacement due to terrain variation. Rectification- Correction of tilt and distortions to produce geometrically accurate orthophotos. Flight Planning- Basics of aerial survey planning, computation of number of photos, flying height, overlaps, ground coverage area. Aerial Mosaics- Creation of mosaics by combining images, types of mosaics such as uncontrolled, semi-controlled, and controlled.		
Unit IV	**Basics of Programming for Geospatial Data**	**12 hours**
Introduction to geospatial data types such as raster, vector, and tabular formats, understanding the role of programming in processing geospatial information, introduction to Python and R as commonly used programming languages, learning syntax, variables, data types, and input/output operations, introduction to simple data structures like lists and dictionaries, understanding abstract data types (ADTs) and their role in organizing spatial data, basic understanding of spatial ADTs and their common operations, introduction to spatial indexing for faster data searching and retrieval, understanding the concept and importance of spatial databases, using SQL (Structured Query Language) to interact with databases, creating databases and defining simple tables for spatial data, introduction to spatial queries to retrieve location-based data, Use of satellite imagery and drones for monitoring illegal dumping, deforestation, or water body quality		
Unit V	**Hyperspectral Remote Sensing and Thermal Properties**	**12 hours**
Reflectance spectroscopy, Dimensionality reduction, Feature selection, Subspace modelling, Endmember extraction – identifying pure surface materials such as soil, water, or vegetation, Hyperspectral band ratios, Vegetation indices, Hyperspectral classification methods, Target detection, Spectral unmixing, Spectral libraries, Applications of hyperspectral remote sensing – includes agriculture, forestry, water quality monitoring, mineral exploration, and environmental studies. Thermal conductivity, Specific heat, Heat capacity, Thermal diffusivity, Thermal inertia, Energy transformation,		

Radiant temperature – temperature measured by remote sensors, Kinetic temperature, Black body – an ideal surface that absorbs and emits all radiation perfectly, Planck's law, Stefan–Boltzmann law, Wien's displacement law, Kirchhoff's law, Radiative transfer model, Emissivity, Causes of emissivity – depend on surface texture, color, material type, temperature, and wavelength.

Learning Resources

Text Books

1. Ott, W. R. *Environmental Statistics and Data Analysis*, McGraw-Hill, New York, 1995.
2. Walpole, R. E., & Myers, R. H. *Probability and Statistics for Engineers and Scientists*, 5th ed., Macmillan, New York, 1993.
3. Heywood, I., Cornelius, S., & Carver, S. *An Introduction to Geographical Information Systems*, 4th ed., Pearson Education, London, 2011.
4. Lillesand, T. M., & Kiefer, R. W. *Remote Sensing and Image Interpretation*, 7th ed., John Wiley & Sons, Hoboken, 2015.

Reference Books

1. Jensen, J. R. *Introductory Digital Image Processing – A Remote Sensing Perspective*, 4th ed., Pearson, New York, 2021.
2. Gonzalez, R. C., & Woods, R. E. *Digital Image Processing*, 4th ed., Pearson India, New Delhi, 2018.
3. Campagna, M. *GIS for Sustainable Development*, CRC Press, Boca Raton, 2005.
4. Borengasser, M., Hungate, W. S., & Watkins, R. *Hyperspectral Remote Sensing – Principles and Applications*, CRC Press, Boca Raton, 2008.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- PCC-503-ENE
Course- Advanced Environmental Chemistry & Microbiology

Teaching scheme	Credit	Examination	
Theory- 04 hours / week	04	CCE ESE	50 marks 50 marks

Prerequisite - Basic understanding of environmental engineering, waste management systems, and public health

Companion course- Laboratory- I

Course Objectives-

1. To provide a strong foundation in fundamental concepts of chemistry relevant to environmental engineering applications.
2. To develop an understanding of the chemistry, transformation, and environmental impacts of atmospheric, solid, liquid, gaseous, and radioactive pollutants.
3. To impart knowledge of organic and inorganic environmental compounds, including their persistence, degradation mechanisms, ecological effects, and human health implications.
4. To familiarize students with the toxicity and environmental behavior of synthetic and natural toxic compounds, with emphasis on polymers, heavy metals, microplastics, and biotoxins.
5. To equip students with analytical and microbiological techniques, including modern spectroscopy, chromatography, and microscopy methods, for monitoring pollutants and characterizing microbial processes in environmental systems.

Course Outcomes-

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

CO1- Understand the fundamentals of general, physical, equilibrium, organic, biochemistry, colloid, and nuclear chemistry relevant to environmental engineering.

CO2-Explain the chemistry, formation, transformation, and environmental effects of various air pollutants under different physical and chemical processes.

CO3- Analyse the properties, persistence, degradation pathways, and ecological/health impacts of organic and inorganic environmental compounds including hydrocarbons, surfactants, pesticides, and persistent pollutants.

CO4- Evaluate the toxicity, environmental persistence, degradation, and health impacts of synthetic and natural toxic compounds such as polymers, lead, microplastics, aflatoxins, and mycotoxins.

CO5-Apply advanced analytical, chromatographic, and microbiological techniques, including spectroscopy and microscopy, for environmental monitoring, pollutant analysis, and microbial characterization in water and wastewater systems.

Course Contents

Unit I	Fundamentals of Chemistry for Environmental Engineering	12 hours

Introduction, Basic Concepts from General Chemistry, Physical Chemistry, Equilibrium Chemistry, Organic, Biochemistry, Colloid Chemistry and Nuclear Chemistry.

Unit II	Chemistry of Pollutants	12 hours

Chemistry of pollutants in the Atmosphere, Solid, liquid, gaseous and radioactive pollutants in the atmosphere, formation of physical processes of pollutants in the atmosphere, Effects of temperature, solar radiation and wind current on the various pollutants, Effect of gravitational force and rain scrubbing on air pollutants, Chemical properties of air pollutants chemisorption, effect of solar radiation on acidic basic

characteristics.

Unit III	Chemistry of Organic and Inorganic Environmental Compounds	12 hours

Environmental relevance of various organic and inorganic compounds, especially those known for their persistence and toxicity, carcinogenic compounds, their chemical properties, environmental fate, and health implications, Hydrocarbons- their sources, degradation mechanisms, and ecological impacts, Surfactants- their chemical structure cationic, anionic, non-ionic, and modified types and their environmental degradation and toxicity profiles, froth formation and their management, Pesticides- highlighting their classification, chemical stability, degradation pathways, and role in environmental pollution, persistent pollutants such as DDT, including historical context, chemical resilience, and its long-term ecological consequences.

Unit IV	Toxicity of Synthetic and Natural Compounds	12 hours

Introduction to toxicity of synthetic and naturally occurring toxic compounds, Synthetic polymers, their chemical structure, environmental persistence, and susceptibility to microbial and photochemical degradation, Types of Photosensitizers and biodegradable additives, their role and applications in enhancing environmental breakdown, Lead, its compounds, their physicochemical properties, pathways of environmental dispersion, mechanisms of human exposure, and its toxicological effects, Microplastics, sources, degradation mechanism, effects on water bodies, ground and humans, control measures, Introduction to aflatoxins, mycotoxins, food systems, chemical composition, metabolic pathways, acute toxicity, and carcinogenic potentials.

Unit V	Analytical Techniques and Environmental Microbiology	12 hours

Introduction to analytical methods and advance types commonly used in environmental monitoring and pollutant analysis, and in environmental microbiology, Principles, and applications of optical techniques such as UV-V is absorption spectrophotometry and their types, applications, flame photometry and their types, applications, and fluorometry and their types, applications, specifically in water and wastewater analysis. Chromatographic methods, gas chromatography (GC), high-performance liquid chromatography (HPLC), and ion chromatography, introduces the structure and function of microbial cells, microbial classification systems, and fundamental enzyme-mediated metabolic reactions. Introduction to microbial observation, identification, and application in environmental contexts, basics of microscopy, introduction to advanced microscopy like atomic force microscopy, Super-resolution microscopy, FESEM, EDS, etc and micrometry techniques, including measurement, imaging, and interpretation of microbial structures, Methods isolation, methods of microbial isolation, culturing, and staining.

Learning Resources

Text Books

1. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. Chemistry for Environmental Engineering and Science, 5th ed., Tata McGraw-Hill, New Delhi, 2003**.**
2. Tortora, G. J., Funke, B. R., & Case, C. L. Microbiology – An Introduction, 4th ed., Benjamin/ Cummings Publishing Company, California, 1992.

Reference Books

1. VanLoon, G. W., & Duffy, S. J. Environmental Chemistry – A Global Perspective, Oxford University Press, New York, 2000.
2. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. Microbiology, Tata McGraw-Hill, New Delhi, 1993.
3. Benefield, L. D., Judkins, J. F., & Weand, R. L. Process Chemistry for Water and Wastewater

Treatment, Prentice Hall, London, 1987.
4. McKinney, R. E. Microbiology for Sanitary Engineers, McGraw-Hill Book Company, New York, 1962.
5. Walter, W. G., & McBee, R. H. General Microbiology, East-West Press, New Delhi, 1969.
6. Botkin, D. B. Environmental Science, 8th ed., Wiley India, New Delhi, Latest ed.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PCC-504-ENE
Course- Environmental Impact Assessment

Teaching scheme	Credit	Examination	
Theory- 4 hours / week	04	CCE ESE	50 marks 50 marks

Prerequisite- Environmental Laws and Policy, Environmental Science and Engineering

Companion Course- Laboratory- I

Course Objectives-

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

1. Understand the fundamental concepts, principles, and legal frameworks governing Environmental Impact Assessment at the national and international levels
2. Analyze environmental systems and identify the potential impacts of engineering projects on air, water, land, and socio-economic environments.
3. Evaluate methods for impact prediction, assessment, and mitigation planning in complex environmental settings.
4. Develop skills in preparing comprehensive EIA reports in compliance with statutory requirements and professional standards.
5. Apply decision-making tools and techniques, such as cost-benefit analysis, risk assessment, and public participation strategies, in EIA processes.

Course Outcomes-

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

CO1-Explain the procedural and legislative requirements of EIA, including relevant acts, rules, and international conventions.

CO2-Identify and classify environmental impacts associated with engineering projects using systematic approaches.

CO3-Select and apply appropriate methodologies for impact prediction and evaluation (e.g., checklists, matrices, modeling).

CO4-Formulate effective mitigation and monitoring strategies to minimize adverse environmental impacts.

CO5- Evaluate the cultural and socioeconomic impacts of development projects, apply relevant environmental rules and regulations, and prepare Environmental Impact Assessment (EIA) reports including procedures for clearance, public hearing, and post-monitoring.

Course Contents

Unit I	Evolution of EIA	12 hours

Environmental Impact Assessment- Introduction, Stages of EIA, Origin of EIA, Establishments of Procedure- Legislative Option, Project Screening for EIA, Methods, Projects thresholds, Sensitive area criteria Matrices. EIA implementation in India, EIA Notification 1994, Scope studies for Environmental Impact Studies (EIS). Preparation for EIS Planning, Public Participation and Review of EIS.

Unit II	Methods for Impact Assessment	12 hours

Background information, interaction matrix methodologies, network methodologies, environmental setting, environmental impact assessment methodology, documentation and selection process, Water Quality Index, Air Quality Index, environmental indices, and indicators for describing affected

environment, Life cycle assessment. Life Cycle Cost Analysis, Introduction of Open LCA, One Click LCA.

Unit V	Prediction and Assessment of Impact for Air and Noise Environment	12 hours

Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation, collection of PM10, PM2.5, air pollutant removal from sugar industry and foundry industry. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations.

Unit IV	Prediction and Assessment of Impact for Water and Soil Environment	12 hours

Basic information of water quality (Surface water and ground water), water quality standards, identification of impact, prediction of impact and assessment, mitigations, Clean Water Act. Background information of soil environment, soil and ground water standards, prediction and assessment of impact for ground water and soil, mitigations.

Unit V	Prediction and Assessment of Impact on Cultural and Socioeconomic Environment	12 hours

Basic information on cultural resources, rules, and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. Basic information of socioeconomic environment, description of existing socioeconomic environment, prediction and assessment of impact, mitigation, resettlement, and rehabilitation. Documentation of EIA - Consent form I, Generic structure of EIA report, Summery of EIA, EPA 1986, USEPA, E- Waste Management Rule 2016, Construction and Demolition Waste Management Rules 2016.Categorization of Industries for seeking environmental clearance from concerned authorities, procedure for environmental clearance, procedure for conducting environmental impact assessment report, Procedure for public hearing, post environmental monitoring.

Learning Resources

Text Books

1. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. *Chemistry for Environmental Engineering and Science*, 5th ed., Tata McGraw-Hill, New Delhi, 2003.
2. Tortora, G. J., Funke, B. R., & Case, C. L. *Microbiology – An Introduction*, 4th ed.,
3. Benjamin/Cummings Publishing Company, California, 1992.
4. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. *Microbiology*, Tata McGraw-Hill, New Delhi, 1993.
5. Botkin, D. B. *Environmental Science*, 8th ed., Wiley India, New Delhi, Latest ed.

Reference Books

1. Canter, R. L. *Environmental Impact Assessment*, McGraw-Hill International Edition, New York, 1997.
2. Rau, J. G., & Wooten, D. C. (Eds.). *Environmental Impact Analysis Handbook*, McGraw-Hill Book Company, New York, 1980.
3. Watten, P. (Ed.). *Environmental Impact Assessment – Theory and Practice*, Unwin Hyman, London, 1988.
4. Barthwal, R. R. *Environmental Impact Assessment*, New Age International Publishers, New Delhi, 2002.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- PCC-505-ENE
Course- Laboratory- I

Teaching scheme	Credit	Examination	
Practical- 04 hours / week	02	TW OR	25 marks 25 marks

Prerequisite- Basic understanding of environmental engineering, waste management systems, and public health.

Companion course- Advanced Water and Wastewater Treatment, Environmental Chemistry and Microbiology, Geo-Informatics and Applications in Environmental Engineering, Environmental Impact Assessment

Course Objectives-

1. To develop practical skills in sampling, preservation, and chemical and microbiological analysis of environmental samples, particularly water and wastewater.
2. To enable students to apply laboratory and field-based techniques for assessing environmental quality using standard protocols and instruments and to introduce spatial tools such as GIS and GPS for environmental data collection, mapping, and analysis.

Course Outcomes- On completion of the course, students will be able to-

CO1-Perform standard chemical and microbiological analyses (DO, BOD, COD, Chlorine, MPN, Staining etc.) on environmental samples with proper sampling and preservation techniques.

CO2-Demonstrate the ability to use microscopes, apply staining techniques, isolate and identify microbial populations, and assess microbiological quality of water and Practical experience in GPS-based field data collection

Course Contents

Perform all Practicals from Sr. 1 to 5, Any 3 From Sr. 6 to 9, any 2 From Sr. 10 to 13

1. Study on Sampling and preparation of standard solutions and preservation of samples.
2. Determination of Optimum Dose of Coagulant by Jar Test
3. Determination of Available Chlorine in Bleaching Powder Determination of Residual Chlorine & Chlorine Demand
4. Chemical analysis for the following from Domestic wastewater- Dissolved Oxygen, Biochemical Oxygen Demand, Chemical Oxygen Demand.
5. Microbiological techniques- 1 Microscopy, staining techniques. 2. Isolation and growth of bacteria. 3. Microbiological quality of water - MPN and membrane filtration technique and E coli test.
6. Calculating Area and Distance Using GIS to Measure area of land parcels, forests, water bodies, or distance between pollution sources.
7. GPS-Based Field Data Collection and Mapping.
8. Collect GPS coordinates for environmental data (e.g., waste bins, major landmark, bridges etc.) and map them.
9. Understand and apply techniques for digitization of environmental features using satellite imagery or maps, including the extraction of elements such as rivers, roads, vegetation cover, and other land use/land cover components.

10. Task for EIA

Tasks 1:

1. Collect two recent case studies where EIA played a crucial role in project approval/rejection.
2. Make a flow chart of stages of EIA and explain with one real-world example.
3. Prepare a matrix for screening a sample project (e.g., construction of a dam or highway).

11. Tasks 2:

1. Identify 3 environmental indices/indicators and explain their importance in impact assessment.
2. Prepare a case study on Life Cycle Assessment (LCA) for a product (plastic bottle, cement, or car).
3. Group Activity: Compare matrix vs. network methodology and present pros/cons.

12. Tasks 3:

1. Collect air quality data of your city from CPCB/State Pollution Control Board website and compare with standards.
2. Prepare a noise mapping chart of your locality (day vs. night levels).
3. Field Assignment: Interview people near a busy road/industrial area about noise impact on health.

13. Tasks 4:

1. Collect surface water/groundwater quality data (from reports/local authorities) and compare with BIS standards.
2. Prepare a case study on groundwater pollution due to an industry (e.g., tanneries, chemical plants).
3. Conduct a mini survey in your locality about water availability and perceived quality.
4. Suggest mitigation measures for soil and water impacts from a mining project.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PEC-510A-ENE
Course- Statistical Analysis for Environmental Engineering

Teaching scheme	Credit	Examination	
Theory- 3 hours / week	03	CCE ESE	50 marks 50 marks

Prerequisite- Civil Engineering, applied mathematics, basics of computer, environmental engineering

Companion Course - Laboratory- II

Course Objectives-

1. To understand the role of statistics in environmental engineering.
2. To introduce students to statistical tools for analyzing environmental data.
3. To equip students with practical skills in data analysis, probability, hypothesis testing and regression techniques.
4. To prepare students for making informed, data-driven decisions in environmental engineering.
5. To understand time series and spatial techniques with GIS for forecasting and assessing environmental changes.

Course outcomes-

On completion of the course, learner will be able to-

CO1-Interpret and summarize environmental data using descriptive statistics and graphical methods.
CO2-Apply probability distributions, design sampling strategies and calculate confidence intervals.
CO3-Apply hypothesis tests, construct confidence intervals and build/interpret regression models.
CO4-Apply multivariate techniques, assess risk using simulations and calibrate/validate environmental models.
CO5-Apply time series and spatial analysis techniques, to forecast environmental variables and assess climate change impacts, natural hazards, and pollution distribution.

Course Contents

Unit I	**Introduction to Environmental Data and Descriptive Statistics**	**08 hours**

Overview of Environmental Data Types- Continuous, Categorical, Time Series, Spatial Data. Descriptive Statistics- Measures of Central Tendency (Mean, Median, Mode), Measures of Dispersion (Variance, Standard Deviation, Range), Graphical Representation (Histograms, Boxplots, Scatter plots), Data Distribution and Skewness, Introduction to Statistical Software (R/Python).

Unit II	**Probability Distributions and Sampling Techniques**	**08 hours**

Basic Probability Theory- Rules of Probability, Bayes' Theorem, Conditional Probability. Probability Distributions- Discrete Distributions (Binomial, Poisson), Continuous Distributions (Normal, Exponential, Log-Normal). Sampling Techniques- Random, Stratified and Systematic Sampling, Sample Size Determination, Confidence Intervals and Sampling Error.

Unit III	**Inferential Statistics, Hypothesis Testing and Regression Analysis**	**08 hours**

Hypothesis Testing- Null and Alternative Hypotheses, Type I and Type II Errors, Z-tests, T-tests, Chi-square

tests, Confidence Intervals. Regression Analysis- Simple Linear Regression, Multiple Linear Regression, Model Assumptions and Diagnostics.

Unit IV	**Multivariate Analysis and Environmental Modelling**	**08 hours**

Multivariate Analysis- Principal Component Analysis (PCA), Cluster Analysis. Environmental Modelling- Monte Carlo Simulation for Environmental Risk Assessment, Model Calibration and Validation.

Unit V	**Time Series Analysis in Environment**	**08 hours**

Introduction to time series in environmental data (temperature, rainfall, air quality, etc.), Stationarity, Trend and Seasonality, Autocorrelation and Partial Autocorrelation, ARIMA models for forecasting environmental variables, Spatial autocorrelation (Moran's I, Geary's C), Variogram analysis, Kriging and Spatial Interpolation techniques for environmental monitoring (e.g., pollution mapping, groundwater assessment), Climate change data analysis, drought/flood prediction, spatial distribution of pollutants, integration with GIS tools.

Learning Resources

Text Books

1. Berthouex, P. M., & Brown, L. C. Statistics for Environmental Engineers, Lewis Publishers, CRC Press, Boca Raton, 1994.
2. Haan, C. T. Statistical Methods in Hydrology, 2nd ed., Iowa State Press, Ames, 2002.
3. Mendenhall, W., & Beaver, R. J. Introduction to Probability and Statistics, 8th ed., PWS-Kent Publishing Co., Boston, 1991.
4. Ott, W. R. Environmental Statistics and Data Analysis, Lewis Publishers, New Jersey, 1995.

Reference Books

1. Ross, S. M. *Introductory Statistics*, Academic Press, New York, 2017.
2. Maxwell, S. E., & Delaney, H. D. *Designing Experiments and Analysing Data – A Model Comparison Perspective*, Wadsworth Publishing Company, California, 1990.
3. Walpole, R. E., & Myers, R. H. *Probability and Statistics for Engineers and Scientists*, 5th ed., Macmillan, New York, 1993.
4. Spiegel, M. R., Schiller, J., & Srinivasan, R. A. *Probability and Statistics*, 4th ed., McGraw-Hill, New York, 2013.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PEC-510B-ENE

Course- Hydraulic Design and Soft Computing in Water Distribution Network

Teaching scheme	Credit	Examination	
Theory- 3 hours / week	03	CCE ESE	50 marks 50 marks

Prerequisite- Basic Knowledge of Sewerage Systems Sewage Treatment, Fluid Mechanics

Companion Course- Laboratory- II

Course Objectives-

1. To understand the different types and components of water supply system from Raw Water source, Intake upto Final Treatment and Distribution System.
2. To introduce students to Hydraulic Design of Water Distribution Network
3. To introduce students to various software applications in the design of WDN.
4. To introduce students to various Government Initiatives related to WS Projects
5. To provide knowledge and practical skills in the operation, maintenance, and asset management of water distribution systems with emphasis on efficiency, sustainability, and performance benchmarking.

Course outcomes-

On completion of the course, learner will be able to-

CO1: Explain the components, design principles, and hydraulic considerations of water supply and distribution systems, including population forecasting, demand estimation, and head loss evaluation.
CO2: Apply network design methods and simulation tools for creating, analyzing, and calibrating water distribution models under varying demand and operational scenarios.
CO3: Assess government initiatives, policies, smart water management strategies, and institutional frameworks for sustainable and climate-resilient water supply systems.
CO4: Utilize advanced computational and asset management techniques, including soft computing models, IoT integration, leak detection, energy audits, and performance benchmarking,
CO5: To enhance efficiency, sustainability, and reliability of water distribution systems.

Course Contents

Unit I	**Fundamentals of Water Supply and Distribution Systems**	**08 Hours**

Components of water supply systems- Sources, intake structures, treatment, storage, and distribution, Types of water distribution systems- Gravity, pumping, combined, Layouts- Dead-end, grid-iron, radial, ring systems, Design considerations- Population forecasting, water demand estimation, fire demand, Pipe materials and selection, Hydraulic parameters- Pressure, velocity, flow, head loss, Head loss equations- Darcy-Weisbach, Hazen-Williams.

Unit II	**Network Design and Simulation Tools**	**08 Hours**

Pipe network analysis- Continuity, energy equations, Design methods- Hardy Cross method, Linear method, Introduction to software tools (any freeware), Network modelling- Creating, simulating, and analysing networks, Scenario management and demand pattern simulation, Model calibration and validation.

Unit III	Government Initiatives, Policies and Smart Water Management	08 Hours
National Water Policies (1987, 2002, 2012) & Sustainable Development Goals (SDG6), Jal Jeevan Mission (JJM)- FHTC targets, IoT/SCADA/GIS integration, greywater reuse, AMRUT 2.0- Urban water reforms, NRW reduction, SCADA monitoring, Climate-resilient infrastructure and NAFCC funding, Institutional framework- Ministry of Jal Shakti, CPHEEO, NIUA, BIS, National dashboards, IMIS portal, PPP models, capacity building.		
Unit IV	**Soft Computing and Advanced Case Studies**	**08 Hours**
Soft computing applications in WTP and network design, GAs for network optimization, ANNs for demand forecasting, Fuzzy logic for leak detection/fault diagnosis, Hybrid models (ANN-GA, Fuzzy-ANN), Comparison with traditional methods, Smart water networks and IoT integration, Sustainability, resilience, and research trends, Real-world case studies		
Unit V	**Operation, Maintenance and Asset Management**	**08 Hours**
Operation, Maintenance and Asset Management in Water Distribution Systems: routine inspection, valve and pump maintenance, pipeline flushing, pressure management, asset inventory and condition assessment, deterioration modelling, life-cycle costing, leak detection methods, pressure zoning, district metered areas (DMA), smart metering for NRW reduction, pump scheduling, energy audits, renewable energy integration, tariff structures and cost recovery, PPP models in O&M, benchmarking performance indicators (IBNET), case studies on successful O&M and NRW reduction programs.		

Learning Resources

Text Books

1. CPHEEO. Manual on Sewerage and Sewage Treatment, Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, New Delhi, 2013.
2. Weber, W. J. Physicochemical Processes for Water Quality Control, John Wiley & Sons, New York, 1983.
3. Peavy, H. S., Rowe, D. R., & Tchobanoglous, G. Environmental Engineering, McGraw-Hill, New York, 1985.
4. Fair, G. M., & Geyer, J. C. Water and Wastewater Engineering, John Wiley & Sons, New York, 1968.

Reference Books

1. Sastry, C. A. *Water Treatment Plants*, Narosa Publishing House, Bombay, 1996.
2. Sivanandam, S. N., & Deepa, S. N. *Principles of Soft Computing*, Wiley India, New Delhi, 2007.
3. Haykin, S. *Neural Networks and Learning Machines*, 3rd ed., Pearson, New York, 2009.
4. Jang, J.-S. R., Sun, C. T., & Mizutani, E. *Neuro-Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence*, Pearson, New Jersey, 1997.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- PEC-510C-ENE
Course- Biomedical Waste Management

Teaching scheme	Credit	Examination	
Theory- 03 hours / week	03	CCE ESE	50 marks 50 marks

Prerequisite- Basic understanding of environmental engineering, waste management systems, and public health.

Companion course- Laboratory- II

Course Objectives-

1. To understand the sources, types, and classification of biomedical waste and legal framework of it.
2. To understand the techniques of Segregation, Collection, and Storage of Biomedical Waste.
3. To explore technologies for treatment and disposal of biomedical waste in a safe and sustainable way.
4. To explore Waste Minimization and Recycling techniques of biomedical waste.
5. To develop knowledge and skills in occupational safety, risk management, and monitoring practices for ensuring safe and sustainable biomedical waste handling.

Course Outcomes-

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

CO1-Explain the sources, types, characteristics, and classification of biomedical waste and its legal framework.

CO2-Demonstrate the ability to manage biomedical waste using safe, sustainable, and best-practices.

CO3-Evaluate different technologies used for the treatment, disposal of biomedical waste and analyse environmental impacts.

CO4-Demonstrate the ability of applying Waste Minimization and Recycling techniques of biomedical waste.

CO5-Apply safety practices, risk assessment, and monitoring tools for effective and safe biomedical waste management.

Course Contents

Unit I	Overview of Biomedical Waste	08 hours

Introduction to Biomedical Waste- Definition, types, and categories of biomedical waste (infectious, pathological, sharps, pharmaceuticals, etc.) Sources of Biomedical Waste- Hospitals, clinics, laboratories, diagnostic centers, research institutions, etc. Characteristics of Biomedical Waste- Infectivity, toxicity, and other hazards. Global and National Scenario- International guidelines (WHO) and Indian regulations (Bio-Medical Waste (Management and Handling) Rules, 2016). Legal and Regulatory Framework- Biomedical Waste Management and Handling Rules (2016), Basel Convention, WHO Guidelines on Healthcare Waste Management.

Unit II	Segregation, Collection, and Storage of Biomedical Waste	08 hours

Segregation- Color-coded bins and containers, training healthcare staff. Collection- Methods for ensuring

safe handling and transportation of waste. Storage- Guidelines for storing biomedical waste safely in healthcare facilities. Roles and Responsibilities of Stakeholders- Hospitals, waste generators, authorized disposal facilities, regulatory bodies. Health Impacts- Exposure of during BWM and precautions to be taken.

Unit III	Treatment and Disposal Techniques	08 hours

Treatment Technologies- Autoclaving, Incineration, Microwave Treatment, Chemical Disinfection, Mechanical/Physical Treatment (shredding, grinding). Disposal Methods- Landfill disposal, deep burial, and other disposal systems. Factors Affecting Choice of Treatment- Waste composition, volume, toxicity, environmental considerations. Environmental Impacts- Leaching of hazardous materials, Air pollution from incineration, Water contamination.

Unit IV	Waste Minimization and Recycling	08 hours

Waste Minimization Techniques- Reducing generation, substitution of chemicals, and reducing waste through product design. Recycling of Biomedical Waste- Feasibility of recycling pharmaceuticals, sharps, etc. Ethical issues in recycling biomedical waste. Emerging Technologies- Plasma arc treatment, pyrolysis, and bioremediation. Sustainable Waste Management- Zero-waste hospitals, Circular economy in healthcare settings, green certifications for healthcare facilities. Case Studies- National and International- Best practices from hospitals and clinics.

Unit V	Occupational Safety, Monitoring and Risk Management	08 hours

Occupational Safety, Monitoring and Risk Management in Biomedical Waste Handling: occupational health and safety practices, use of personal protective equipment (PPE), exposure pathways and risk groups, training and capacity building of healthcare workers, accident and injury reporting systems, needle-stick injury prevention strategies, risk assessment and hazard ranking of biomedical waste, emergency preparedness and spill management, monitoring and audit mechanisms for biomedical waste facilities, environmental monitoring of air, water and soil near treatment/disposal sites, community awareness and public participation, integration of ICT and digital tracking systems for waste monitoring.

LEARNING RESOURCES

Text Books

1. CRC Press. Biomedical Waste Management – Recycling and Remediation Strategies, 1st ed., CRC Press (Taylor & Francis), Boca Raton, 2025.
2. Sahai, S. Biomedical Waste Management, APH Publishing Corporation, New Delhi, 2009.
3. Palit, S., & Hussain, C. M. Sustainable Biomedical Waste Management, in Handbook of Environmental Materials Management, Springer, Cham, 2018.
4. Tchobanoglous, G. Integrated Solid Waste Management – Engineering Principles and Management ssues, McGraw-Hill, New York, 1993.

Reference Books

1. Vallero, D. A. *Waste – A Handbook for Management*, 2nd ed., Academic Press, London, 2019.
2. ICRO–NPC India. *Segregation Practices, Staff Training, and Efficiency in Indian Hospitals (2020–2024)*, National Productivity Council, New Delhi, 2024.
3. Central Pollution Control Board (CPCB). *Bio-Medical Waste Management Rules 2016 and Guidelines*, CPCB, New Delhi, 2016.
4. PubMed Central (PMC). *Status of Biomedical Waste Management in Nursing Homes of Delhi, India*, PMC, New Delhi, 2020.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- PEC-511-ENE
Course- Laboratory II

Teaching scheme	Credit	Examination	
Practical- 02 hours / week	01	Term Work Oral	25 marks 25 marks

Prerequisite- Basic knowledge of environmental engineering concepts, including water treatment, EIA, GIS, and sustainability principles.

Companion Course- Statistical Analysis for Environmental Engineering, Hydraulic Design and Soft Computing in Water Distribution Network, Biomedical Waste Management

Course Objectives-

1. To provide hands-on experience in designing and evaluating sustainable environmental systems through low-cost and site-based interventions.
2. To develop practical skills in geo-spatial mapping, environmental auditing, and impact assessment using modern digital and field-based tools.

Course Outcomes-

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

CO1-Design and build basic, eco-friendly environmental management systems like greywater filters, composting units, and rainwater harvesting setups.

CO2-Use geospatial and mapping tools for environmental planning, resource audit, and waste/green cover mapping

Course Contents

Statistical Analysis for Environmental Engineering
Any 02 tasks from following:
Assignment 1: Data Analysis Report on Descriptive Statistics
Task:

1. Choose an environmental dataset from a provided list or from a real-world source (e.g., water quality data from a river or air pollution data).
2. Calculate the mean, median, mode, variance and standard deviation for the given data.
3. Create appropriate graphical visualizations (e.g., histograms, box plots).
4. Analyse the data and interpret the statistical findings, focusing on key trends, outliers, or patterns.

Submission: A written report including the dataset, statistical calculations, graphs and interpretations.

Assignment 2: Sampling Plan and Probability Distribution Analysis
Task:

1. Choose an environmental problem (e.g., water quality monitoring in different locations, air pollution levels across regions).
2. Design a sampling plan (random, stratified, or systematic) and determine an appropriate sample size.
3. Model the environmental data using probability distributions (e.g., normal, binomial, Poisson).
4. Calculate confidence intervals for the estimated mean and discuss the results.

Submission: A report detailing the sampling plan, probability distribution analysis and confidence intervals

Assignment 3: Regression Analysis Project

Task:

1. Select a real-world environmental dataset or use a provided dataset.
2. Perform a simple linear regression analysis to model the relationship between two variables.
3. If applicable, conduct a multiple linear regression analysis involving multiple predictor variables.
4. Assess the goodness-of-fit (R-squared, p-values) and perform diagnostics on the regression model.
5. Interpret the regression coefficients in the context of the environmental problem.

Submission: A written report with regression analysis output, diagnostics and interpretation of results.

Assignment 4: Environmental Modeling Case Study

Task:

1. Choose an environmental issue or scenario (e.g., predicting air quality levels, estimating water contamination).
2. Use Principal Component Analysis (PCA) or Cluster Analysis on a multivariate environmental dataset to identify key patterns.
3. Perform a Monte Carlo simulation to model uncertainties and risks in the environmental scenario.
4. Validate the model and discuss potential improvements or assumptions.

Submission: A comprehensive report including PCA/cluster analysis results, simulation results and model interpretation.

Hydraulic Design and Soft Computing in Water Distribution Network

Any 04 experiments from following:

1. Study of network design methods.
2. Study and design of water distribution network of minimum 8 to 10 nodes from the given data.
3. Study and design of rising main.
4. Exercise of design of water distribution network (same data as 02 above) using suitable software and comparison of the two.
5. Study and design of water networks using GAs.
6. Visit to rural water supply schemes for single village and multi village schemes (one each)

Biomedical Waste Management

Any 04 tasks from following:

1. Survey on Biomedical Waste Sources: Conduct a short survey of a local clinic or hospital and document various sources and types of waste.

2. Critical Review of BMW Management Rules (2016): Prepare a detailed report on BMW management rules 2016 and its amendments.

3. Laboratory Demonstration of Autoclaving and Disinfection: Demonstration of autoclaving of waste simulants and chemical disinfection methods.

4. Field Visit to a BMW Treatment Facility: Visit to BMW Treatment Facility and prepare a detailed report on technologies used (incineration, autoclave, shredding, etc.), monitoring protocols, and environmental safeguards.

5. Feasibility Study on Recycling Biomedical Waste Components: Analyze recyclability of sharps, plastics, or pharmaceutical packaging etc. Also assess its environmental and ethical feasibility.

6. Capstone Project: Design a Biomedical Waste Management Plan for a 100-bed Hospital.

Savitribai Phule Pune University, Pune

Maharashtra, India

ME– Civil Engineering (2025 Pattern)
Master of Environmental Engineering

Semester II

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- PCC-506-ENE
Course- Solid and Hazardous Waste Management

Teaching scheme	Credit	Examination	
Theory- 04 hours / week	04	CCE ESE	50 marks 50 marks

Prerequisite- Basic understanding of environmental engineering, waste management systems, and public health.

Companion Course- Laboratory - III

Course Objectives-

1. To understand the types, sources, characteristics, and generation patterns of solid waste along with its environmental and public health impacts.
2. To learn effective methods for segregation, storage, collection, transfer, and transport of solid waste, including the functioning of Material Recovery Facilities
3. To explore different processing and treatment techniques (physical, biological, thermal) suitable for solid waste, and to analyze treatment system performance.
4. To study sanitary landfill design, operations, leachate and gas management, and advanced practices such as bioreactor landfills and landfill mining.
5. To identify and classify hazardous wastes and understand their handling, treatment, storage, and disposal using safe and compliant technologies.

Course Outcomes-

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

CO1-Classify solid waste types, evaluate generation rates, and analyze the environmental impacts of waste mismanagement.

CO2-Design and optimize storage, segregation, collection, and transfer systems including layout and operations of Material Recovery Facilities.

CO3-Select suitable treatment technologies and conduct mass/energy balances for composting, bio methanation, and incineration systems.

CO4-Design sanitary landfill systems and estimate leachate/gas generation and post-closure environmental performance.

CO5-Identify hazardous waste types and recommend compliant treatment and disposal options, including secured landfills.

Course Contents

Unit I	**Introduction to Solid Waste Management**	**12 hours**

Introduction to Solid Waste- Definition, types, classification, and characteristics, Impact of urbanization and consumption patterns, Sustainable Development Goals (SDGs) linkage to waste, Waste management hierarchy and circular economy introduction, Sources and generation rates of solid waste in urban and rural areas, Factors affecting solid waste generation, Sampling and characterization- Physical, chemical,

and biological characteristics, Environmental and health impacts of improper waste management.		
Unit II	**Solid Waste Collection and Transportation**	**12 hours**
On-site waste storage- bins, containers, segregation protocols, Primary and secondary collection systems- Hauled container and stationary container systems, Design considerations- manpower, equipment, frequency, service area, Material Recovery Facility (MRF)- clean and dirty MRF, layout, process flow, Use of smart sensors and IoT for bin monitoring and data analytics, Digital tools for Route optimization, Smart sensors, and IoT for collection optimization		
Unit III	**Solid Waste Processing and Treatment**	**12 hours**
Physical processing- shredding, screening, compaction, magnetic separation, biological treatment- Composting (windrow, in-vessel, vermicomposting), Anaerobic digestion, Thermal treatment- Incineration, RDF, palletization, Plasma gasification, Emerging technologies- Hydrothermal carbonization, Life Cycle Assessment (LCA) of treatment technologies- Energy efficiency, Emission analysis, Resource recovery potential		
Unit IV	**Landfilling and Disposal**	**12 hours**
Site selection, landfill design- cells, liners, leachate collection and treatment, Landfill gas (LFG) generation and utilization (flaring, power generation), Climate impact of landfilling- Methane emissions, Greenhouse gas accounting, Bioreactor landfills- types (aerobic, anaerobic), enhanced stabilization, Long-term monitoring, post-closure care, cover systems, In-situ remediation of legacy dumpsites- Bio-mining for resource recovery, Reclamation for land use. Carbon credits and offsets in waste-to-energy and composting projects, Financing waste management through carbon markets and climate funds, Startups and innovation in the waste sector- Technology development, business models, and impact		
Unit V	**Hazardous Waste Management**	**12 hours**
Definition and classification based on EPA and CPCB guidelines, Characteristics- ignitability, corrosivity, reactivity, toxicity, Sources- industrial processes, hospitals, e-waste, households, Handling, packaging, storage, and transport protocols (manifest system), Risk assessment- Hazard identification, Exposure pathways, Toxicity and impact evaluation, Site remediation strategies- containment, excavation, in-situ methods, Real-time monitoring of emissions, spills, leachate, Emergency response planning and contingency procedures, Global best practices and international case studies (e.g., USA Superfund, EU standards). Overview of Indian regulations- SWM Rules 2016, HWM Rules 2016, Biomedical, Plastic, E-waste, C&D Rules		
Learning Resources		

Text Books

1. Tchobanoglous, G., Theisen, H., & Vigil, S. A. *Integrated Solid Waste Management – Engineering Principles and Management Issues*, McGraw-Hill Education, New York, 1993.
2. Peavy, H. S., Rowe, D. R., & Tchobanoglous, G. *Environmental Engineering*, McGraw-Hill, New York, 1985.
3. Rao, M. N., & Rao, H. V. N. *Solid and Hazardous Waste Management*, Butterworth-Heinemann, Oxford, 2007.
4. LaGrega, M. D., Buckingham, P. L., & Evans, J. C. *Hazardous Waste Management*, 2nd ed., Waveland Press, Illinois, 2010.

Reference Books

1. Asolekar, S. R., & Asolekar, R. N. Waste Management – Principles and Practices, CRC Press, Boca Raton, 2016.
2. Tchobanoglous, G., & Kreith, F. Handbook of Solid Waste Management, 2nd ed., McGraw-Hill, New York, 2002.
3. CPHEEO. Manual on Hazardous Waste Management, Ministry of Environment, Forest and Climate Change, Government of India, New Delhi, 2016.
4. Pichtel, J. Waste Management Practices – Municipal, Hazardous, and Industrial, 2nd ed., CRC Press,

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- PCC-507-ENE
Course- Advanced Industrial Waste Water Treatment

Teaching scheme	Credit	Examination	
Theory- 04 hours / week	04	CCE ESE	50 marks 50 marks

Prerequisite- Basic understanding of various Industries, waste water, treatment processes**.**

Companion course- Laboratory - III

Course Objectives-

1. Develop an in-depth understanding of the nature, sources, and characteristics of industrial wastewater.
2. Introduce advanced treatment technologies including physical, chemical, and biological methods specific to industrial effluents.
3. Familiarize students with industry-specific treatment methods for various sectors like chemical, petrochemical, pharmaceutical, dairy, power plants, etc.
4. Discuss the design, operation, and challenges associated with Common Effluent Treatment Plants (CETPs).
5. Promote awareness of wastewater reuse and the handling, treatment, and disposal of treatment residuals (e.g., sludge, RO rejects).

Course Outcomes-

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

CO1- Analyse the characteristics, environmental impact, and regulatory requirements of industrial wastewater.

CO2- Apply suitable physical, chemical, and biological treatment technologies for industrial effluent management.

CO3- Evaluate industry-specific wastewater treatment processes and identify best treatment and disposal methods.

CO4- Design and assess the performance and operation of Common Effluent Treatment Plants (CETPs) with respect to technical and financial aspects.

CO5- Demonstrate knowledge of wastewater reuse strategies and the management of treatment residuals such as sludge and RO rejects.

Course Contents

Unit I	**Introduction**	**12 hours**

Sources of Pollution- Sources and Characteristics of industrial wastewater, Environmental impacts, Regulatory requirements, generation rates, Prevention vs Control of Industrial Pollution, Toxicity and Bioassay tests, Source reduction techniques, Waste Audit, Evaluation of pollution prevention options. **Wastewater Treatment-** Waste minimization, Zero Effluent Discharge System, Equalization, Neutralization, Oil separation, Flotation, Precipitation, Heavy metal Removal, adsorption, Aerobic and anaerobic biological Treatment, Sequencing batch reactors, High-Rate reactors, Wastewater Reuse.

Unit II	Treatment Methods	12 hours
Treatment Methods- Nitrification and De-nitrification, Phosphorous removal, Heavy metal removal, Membrane Separation Process, Air Stripping, Absorption Processes, Chemical oxidation, Ozonation, Photocatalysis, Wet Air Oxidation, Advanced Oxidation Processes, Evaporation, Ion Exchange, Membrane Technologies, Nutrient removal Disposal of Treated Waste.		
Unit III	**Industrial Waste Water Treatment Process-1**	**12 hours**
Industrial Waste Study- Manufacturing processes and sources of effluents, characteristics, and composition of effluent and different methods of treatment & disposal of effluent for the following industries- Chemical, fertilizer, petroleum, petro-chemical, paper, sugar, distillery, tannery, food processing, dairy and steel manufacturing.		
Unit IV	**Industrial Waste Water Treatment Process-2**	**12 hours**
Industrial Waste Management- Manufacturing processes and sources, Characteristics, and composition of effluent and different methods of treatment & disposal of effluent for the following industries- Pharmaceutical, Thermal Power plant, Petroleum, Refineries, Tanneries, Atomic Energy Plants, and other Mineral Processing Industries.		
Unit V	**Common Effluent Treatment Plant**	**12 hours**
Common Effluent Treatment Plants (CETPs)- Location, Need, Technical Aspects, Financial aspects, General Design considerations and principles, Operation & Maintenance Problems, Zero effluent discharge systems, Wastewater reuse. Common problems encountered in management of CETPs. Quality requirements for Wastewater reuse, Industrial reuse, Present status and issues, Disposal on water and land. Residuals of industrial wastewater treatment, Quantification and characteristics of Sludge, Thickening, digestion, conditioning, dewatering and disposal of sludge, Management of RO rejects.		

Learning Resources

Text Books

1. Arceivala, S. J., & Asolekar, S. R. Wastewater Treatment for Pollution Control and Reuse (3rd ed.). McGraw-Hill Education, New Delhi, 2006.
2. Metcalf & Eddy. Wastewater Engineering – Treatment and Resource Recovery (5th ed.). McGraw-Hill Education, New York, 2014.
3. Davis, M. L. Water and Wastewater Engineering. McGraw-Hill Education, New York, 2010.
4. Patwardhan, A. D. Industrial Wastewater Treatment. PHI Learning Pvt. Ltd., New Delhi, 2008.

Reference Books-

1. Rao, M. N., & Dutta, A. K. Wastewater Treatment – Rational Methods of Design and Industrial Practices. Oxford & IBH Publishing, New Delhi, 1995.
2. CPHEEO. Manual on Industrial Effluent Treatment. Ministry of Environment, Forest and Climate Change, Government of India, New Delhi, 2016.
3. Qasim, S. R. Wastewater Treatment Plants – Planning, Design, and Operation (2nd ed.). CRC Press, Boca Raton, 1999.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PCC-508-ENE
Course- Air Pollution & Sustainability Measures

Teaching scheme	Credit	Examination	
Theory- 4 hours / week	04	CCE ESE	50 marks 50 marks

Prerequisite- Basic understanding of environmental components, pollution types, and their impacts

Course Objectives-

1. Understands the sources, types, and impacts of air pollutants on health, environment, and materials.
2. Learn the principles of meteorology and atmospheric dispersion relevant to air pollution modelling and control.
3. Explore and analyse air pollutant dispersion models including Gaussian and software-based models (e.g., AERMOD, AirQ+).
4. Study the principles and design of equipment used for control of particulate and gaseous pollutants.
5. Gain knowledge of air quality monitoring systems, environmental guidelines, and regulatory standards.

Course Outcomes-

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

CO1- Identify and classify different air pollutants and describe their environmental and health effects.

CO2-Analyse meteorological parameters and their influence on pollutant dispersion and plume behaviour.

CO3- Design and evaluate air pollution control devices such as cyclones, fabric filters, ESPs, and scrubbers.

CO4- Interpret air quality standards, monitoring data, and propose environment management strategies for air quality improvement.

CO5- Develop sustainable solutions for automobile and indoor air pollution control, considering modern technologies and policies.

Course Contents

Unit I	**Introduction of Air Pollution**	**12 hours**

Definition, Sources and classification of Air Pollutants, Photochemical smog, Effects of air pollution on health, vegetation & materials, air quality, Global effects of air pollution, Air Pollution Episodes. Meteorology- The atmosphere, zones of atmosphere, scales of meteorology, meteorological parameters, Heat, Wind, Pressure, Moisture and humidity, Rainfall and precipitation, Temperature lapse rate, Maximum mixing depth (MMD), Plume behavior, Effect of topography on pollutant dispersion, effect of air pollutants on meteorology, Air pollution modeling, Minimum stack height as per CPCB norms.

Unit II	**Modeling of Dispersion of Air Pollutants**	**12 hours**

Dispersion of Air pollutants. Theories on modeling of Air pollutants. Gaussian model etc. Equations of the estimation of pollutant concentrations. Plume Rise – Equations for estimation. Effective stack height and mixing depths. Introduction to Software based models AERMOD, AirQ+ etc.

Unit III	**Theory of Particulate and Gaseous Pollution Control**	**12 hours**

Dilution, Source control, Control by using equipment such as Settling chambers, Cyclones, Fabric Filters, Electrostatic precipitators Wet Scrubbers/Wet Collectors, Design, and principle of these air pollution control units. Types of gaseous pollution control methods – absorption, adsorption and combustion processes, SOx Control Technology, Desulfurization of flue gas emissions, NOx Control Technology

Unit IV	**Air pollution Monitoring and Management**	**12 hours**

Existing & Revised Environmental guidelines for siting of Industries, Environment Management plan, stack emission standard, ambient air quality standards, stack emission monitoring, ambient air quality monitoring, ambient air quality survey, Introduction to National Air Quality Monitoring Programme, Sustainable measures like stricter vehicle regulations, anti-smog technologies, green initiatives, and multi-sectoral action plans

Unit V	**Automobile Pollution**	**12 hours**

Vehicular emissions, Motor fuel combustion, Automobile emission control. Use of Electric Vehicles and sustainable measures to use public transport, cycling etc, Odour pollution- Theory of Odour, Sources of Odour, Measurement of Odour, Odour control method, Indoor Air Pollution- Causes of air pollution, Sources and effects of indoor air pollutants, changes in indoor air quality, Control of indoor air pollutants, air cleaning systems, Cigarette smoke

Learning Resources

Text Books

1. Perkins, H. C. Air Pollution. McGraw-Hill International, New York, 1974.
2. Nevers, N. D. Air Pollution Control Engineering (2nd ed.). McGraw-Hill Education, New York, 2000.
3. Rao, M. N., & Rao, H. V. N. Air Pollution. Tata McGraw-Hill Publishing, New Delhi, 1989.
4. Rao, C. S. Environmental Pollution Control Engineering. Wiley Eastern Limited, New Delhi, 1991.

Reference Books

1. Seinfeld, J. H. Air Pollution – Physical and Chemical Fundamentals. McGraw-Hill Book Company, New York, 1988.
2. Cheremisinoff, P. N., & Young, R. A. Air Pollution Control and Design Handbook, Part I. Marcel Dekker Inc., New York, 1977.
3. Cheremisinoff, P. N. (Ed.). Encyclopedia of Environmental Control Technology, Vol. 2: Air Pollution Control. Gulf Publishing Company, Houston, 1993.
4. Peavy, H. S., Rowe, D. R., & Tchobanoglous, G. Environmental Engineering. McGraw-Hill Education, New York, 1985.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- PCC-509-ENE
Course- Laboratory III

Teaching scheme	Credit	Examination	
Practical- 04 hours / week	02	Term Work Oral	25 marks 25 marks

Prerequisite- Advanced Water and Wastewater Treatment, Environmental Chemistry and Microbiology, Geo-Informatics and Applications in Environmental Engineering

Companion Course- Solid and Hazardous Waste Management, Advanced Industrial Waste Water Treatment, Air pollution & Sustainability Measures

Course Objectives-

1. To learn how to measure pollution in air, water, and waste through practical lab work and field visits.
2. To understand how industries and vehicles cause pollution, and how to study their effects through hands-on activities.
3. To gain knowledge about pollution control methods and waste management by visiting real sites and doing basic tests and analysis.

Course Outcomes-

On completion of the course, students will be able to

CO1- To measure air pollution, check vehicle emissions, and understand how air quality affects health.

CO2- To characterise solid waste and industrial wastewater, and decide the best ways to treat or manage them.

CO3- To visit industries, observe pollution control systems, and prepare reports on how pollution is reduced.

Course Contents

1. Conduct a waste audit of campus/household waste (biodegradable, recyclable, hazardous).
2. Determine physical properties (density, moisture content) and calorific value.
3. Determination of COD, BOD, TDS, TSS of any two Industrial Wastewater.
4. Measurement of Suspended Particulate Matter (SPM) using High Volume Sampler.
5. Ambient Air Quality Monitoring for $PM_{2.5}$, PM_{10}, SO_2, NOx using Ambient Analyzer.
6. Vehicular Pollution Monitoring- Measurement of Emissions using Pollution Under Control (PUC) equipment.
7. Evaluation of AQI and health impacts in a metro city.
8. Visit to Air Polluting Industries like Thermal Power plant /Cement Manufacturing Industry etc. and Detailed Study with report submission on Air Pollution Control Devices with their design principles.
9. Site visit at Solid waste Management Facility.
10. Visits, Detailed Study, and report submission of any two of the following Industries with respect to Total water consumption, Sources of Wastewater generation its characteristics and Treatment methods----- Dairy, Fertilizer, Distillery, Sugar, Pulp & Paper, Iron & Steel, Metal Plating, Oil Refinery.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- PEC-512A-ENE
Course- Climate Change & Sustainable Development

Teaching scheme	Credit	Examination	
Theory- 03 hours / week	3	CCE ESE	50 marks 50 marks

Prerequisite- Basics of Earths climactic systems, interest in modern technology and corporate practices.

Course Objectives-

1. Understand the fundamental Earth climate systems and the scientific basis of climate change, including natural and anthropogenic influences.
2. Analyze the multifaceted impacts of climate change on human health, agriculture, ecosystems, and socio-economic systems and modern technologies for climate change monitoring and mitigation.
3. Evaluate efforts taken for development of policies and technologies at national and international level for sustainability.
4. Examine corporate sustainability practices, carbon accounting standards, green finance mechanisms, and ESG reporting frameworks.

Course Outcomes- Upon successful completion of this course, students will be able to-

CO1- Explain the interactions between atmospheric, oceanic, cryospheric, and terrestrial components of the Earth's climate system and assess climate sensitivity and feedback mechanisms.

CO2- Analyze the effects of climate change on air quality, human health, food systems, biodiversity, and ecosystem resilience and apply modern techniques for climate monitoring.

CO3- Critically evaluate global and national climate agreements, sustainable development policies also design sustainable solutions for industrial application.

CO4- Apply design concepts for sustainable system design

CO5- Interpret corporate sustainability frameworks, including carbon accounting, GHG protocols, and ESG reporting tools, and analyze their implementation challenges

Course Contents

Unit I	**Climate Change- Past, Present and Future**	**08 hours**

Climate Systems and Earth- Atmospheric, oceanic, cryosphere and land interactions, basics of radiation processes, greenhouse gas effects, feedback mechanisms, climate sensitivity, Factors influencing climate, Causes of Climate Change- Natural vs anthropogenic, Impact on Human Society and Economics, The need for mitigation and adaptation strategies. climate-resilient developmental strategy.

Future Climate- Climate feedback mechanisms, climate predictability, future climate projections, potential socio-economic consequences, climate risk assessment for civil, business, agricultural, and financial sectors.

Unit II	Climate Change impacts and Mitigation Strategy	08 hours
Climate Change Impacts- Changing air quality, health issues, heat stress, water scarcity, shrinking glaciers, increasing frequency of droughts and floods, food security, migration, employment, trade, loss of biodiversity, decreased ecological resilience etc. **Mitigation Strategy-** AI and sensor technology for Climate Change prediction, Data collection- satellites, IoT sensors, remote sensing, Sensor networks for air quality, temperature, humidity, soil moisture, Low-power devices (e.g., Arduino, Raspberry Pi) & Application- Smart farming, energy-efficient buildings etc.		
Unit III	**Sustainability at Global and National Level**	**08 hours**
Policies for Sustainability- Sustainable Development Goals (SDG) and its genesis, Rio Earth Summit, Kyoto Protocol, Paris Agreement, Net Zero Targets, Carbon Neutrality, Nationally Determined Contributions (NDC), Indias stride towards achievement of SDG's, SDG India Index, National Indicator Framework, India's Panchamrit Strategy.		
Unit IV	**Sustainable Designs**	**08 hours**
Sustainable Design- Sustainability Challenges, Introduction to NBC with special reference to Sustainability, Green Building Design, Green Material for Green Products, Product Design and Energy Efficiency, Life Cycle Assessment, Circular Economy Business Model, Sustainable Supply Chain Management, Introduction to Green Computing and sustainability in IT. Clean Energy etc.		
Unit V	**Corporate Sustainability**	**08 hours**
Corporate Sustainability- Sustainability reporting, Carbon accounting and its challenges, Carbon Boundary Setting, GHG Inventory, GHG Protocol, Materiality Assesment, Science Based Target Initiatives (SBT's), Emission Trading System, Green Finance, Green Washing, CSR for sustainability, ESG reprting- BRSR, GRI etc., ISO Family of certification, Emission and energy audit of buildings, industries.		
Learning Resources		

Text books

1. Srivastava, A. K., & Kumari, S. *Climate Change Mitigation – An Indian Perspective*. Springer Nature, Singapore, 2023.
2. Rao, S. *Energy Engineering and Technology*. Khanna Publishers, New Delhi, 2012.
3. Sukhatme, S. P., & Nayak, J. K. *Energy Conservation and Management*. Tata McGraw-Hill Education, New Delhi, 2010.
4. Mathez, E. A. *Climate Change – The Science of Global Warming and Our Energy Future*. Columbia University Press, New York, 2009.

Reference Books-

1. Salam, A., Yahya, A., et al. Internet of Things for Sustainable Community Development. Springer, Cham, 2019.
2. Robertson, M. Sustainability Principles and Practice (2nd ed.). Routledge, London & New York, 2017.

3. Brockett, A., & Rezaee, Z. Corporate Sustainability – Integrating Performance and Reporting. Wiley, Hoboken, NJ, 2012.
4. United Nations. UN Sustainable Development Goals (SDGs). Available at: https://sdgs.un.org/goals.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PEC-512B-ENE
Course- Artificial Intelligence in Environmental Engineering

Teaching scheme	Credit	Examination	
Theory- 3 hours / week	03	CCE ESE	50 marks 50 marks

Prerequisite- Civil Engineering, Introductory computer Knowledge, data handling

Course Objectives-

1. To introduce the basics of Artificial Intelligence in the context of environmental engineering
2. To develop regression, classification, and clustering for analyzing environmental data.
3. To understand the environmental monitoring using sensor data, satellite imagery and AI
4. To explore smart approaches for sustainability and climate change adaptation

Course outcomes- On completion of the course, learner will be able to-

CO1- Explain the basic concepts of Artificial Intelligence

CO2- Apply basic leanings of models like regression, classification, and clustering for solving environmental problems

CO3- Analyze environmental monitoring data from sensors, drones, and satellites using AI techniques, and utilize platforms like Google Earth Engine and Bhuvan for smart environmental planning.

CO4- Evaluate and implement AI-based strategies for climate risk assessment, carbon monitoring, and design of sustainable, climate-resilient infrastructure.

CO5- Evaluate impact of AI applications in achieving sustainability and SDG.

Course Contents

Unit I	**Basics of AI and Environmental Data**	**08 hours**

Introduction to Artificial Intelligence (AI) in the context of Environmental Engineering, transparency, fairness, and limitations, introduction to types of learning -supervised, unsupervised, deep learning. Introduction to data such as SCADA, PLC, Cloud integration, and Internet of Things system with respect to application in environmental engineering.

Unit II	**Introduction to Machine Learning**	**08 hours**

Introduction to common machine learning models, introduction to linear regression classification models like decision trees (e.g., labeling contaminated vs safe zones), and clustering (e.g., grouping similar pollution zones). tools like Excel, Python (Colab) and non-coders tools in modelling.

Unit III	**AI and Remote Sensing**	**08 hours**

Introduction to sensors in environmental monitoring, satellite images, and drone data, Support decision-making using AI, smart planning for waste collection, air pollution control, remote sensing platforms such as Google Earth Engine, Bhuvan, ISRO, NRSC, Introduction to smart sensors, their types, and applications.

Unit IV	Management and Applications of AI	08 hours
Applied aspects of AI in achieving sustainability within environmental management. Topics include the use of AI in water resource management such as smart irrigation, water quality prediction, and leakage detection; air quality monitoring through real-time prediction of pollutants and mitigation strategies; and waste management using AI for route optimization, recycling, and circular economy applications. The role of AI in climate change mitigation, carbon footprint estimation, renewable energy optimization, and biodiversity monitoring is also emphasized. The unit concludes with a discussion on ethics, governance, and responsible use of AI in environmental decision-making, along with case studies of successful global and local applications.		
Unit V	**Applications of AI in achieving SDGS**	**08 hours**
The role of AI in climate change mitigation, carbon footprint estimation, renewable energy optimization, and biodiversity monitoring is also emphasized. The unit concludes with a discussion on ethics, governance, and responsible use of AI in environmental decision-making, along with case studies of successful global and local applications.		

Learning Resources

Text books

1. Artificial Intelligence: A Guide for Thinking Humans, Melanie Mitchell, 1st Edition, Farrar, Straus and Giroux, New York, 2019.
2. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, 2nd Edition, Packt Publishing, Birmingham, 2017.
3. Remote Sensing and Geographical Information Systems, M. Anji Reddy, 4th Edition, BS Publications, Hyderabad, 2016.
4. Environmental Data Analysis with MATLAB, Joshua Menke and William Menke, 1st Edition, Elsevier, Amsterdam, 2016.

Reference books

1. Environmental Modelling: Finding Simplicity in Complexity, John Wainwright and Mark Mulligan, 1st Edition, Wiley, Chichester, 2005.
2. Smart Sensors for Health and Environment Monitoring, Chong-Min Kyung, 1st Edition, Springer, Singapore, 2015.
3. Managing Environmental Data: Principles, Techniques, and Best Practices, Gerald A. Burnette, 1st Edition, CRC Press, Boca Raton, 2021.
4. Artificial Intelligence and Data Science in Environmental Sensing, Amin Beheshti, 1st Edition, Academic Press, London, 2022.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PEC-512C-ENE
Course- Air and Water Quality Modeling

Teaching scheme	Credit	Examination	
Theory- 3 hours / week	03	CCE ESE	50 marks 50 marks

Prerequisite- Environmental Chemistry, Fluid Mechanics & Hydraulics, Environmental Engineering Fundamentals.

Course Objectives:

1. Introduce students to the fundamentals of environmental modeling concepts, transport phenomena, and chemical kinetics.
2. Develop understanding of water quality modeling, including surface water, groundwater, and effluent quality assessment techniques.
3. Equip students with knowledge of air pollution modeling, atmospheric processes, and dispersion mechanisms.
4. Enable application of mathematical and statistical models to evaluate water and air quality indices for environmental management and decision-making.

Course Outcomes (CO):

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

CO1: Explain the principles of environmental modeling, including conservation laws, calibration, and verification.

CO2: Apply water quality models for rivers, lakes, and groundwater to predict pollutant behavior and assess waste load allocations.

CO3: Analyze air pollution transport and dispersion processes using mathematical models and meteorological inputs.

CO4: Evaluate Gaussian plume models and assess model accuracy and performance for air quality prediction.

CO5-Evaluate and predict AQI for various prevailing environmental conditions.

Course Contents

Unit I	**Modeling Concepts and Water Quality Modeling**	**08 hours**

Casual and statistical models-Characteristics- Steps in model development - Importance of model building. - conservation of mass and mass balance – calibration and verification of models; Transport phenomena – Advection, diffusion, dispersion, simple transport models; chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles

Water Quality Modeling- Water quality models – Historical development – Mas s balance equation – Streeter - Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries, Water law, Groundwater ownership, Legal aspects of environment systems, Principles of law applied to water rights and water allocation

Unit II	**Water Quality Models and Historical Development**	**08 hours**

Water Quality Models- Surface and sub surface water quality models, Lake Water Quality Models- Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modeling - Contaminant solute transport equation, Numerical methods.

Water Quality Index- Categories of water quality index. Determination of water quality index (WQI)- Industrial and municipal effluent index, ambient water quality index, combined water quality index and Delphi method.

Unit III	**Air Pollution Modelling & Air Quality Models**	**08 hours**

Air Pollution Modeling- Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution – Transport of air Pollutants – Meteorological settling for dispersal of air pollutant's vertical structure of temperature and stability, atmosphere, transport, and diffusion of stack emission –atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.

Air Quality Models- Types modeling technique, modeling for non-reactive pollutants, single source, short term impact, multiple sources and area sources, fixed box models- diffusion models.

Unit IV	**Gaussian Plume Derivative**	**08 hours**

Gaussian plume derivative- modification of Gaussian plume equation- long term average multiple cell model – receptor oriented and source-oriented air pollution models- model performance, accuracy and utilization.

Unit V	**Air Quality Index**	**08 Hours**

Air quality index- categories of air quality index, determination of air quality index (AQI)- National AQI, Extreme value indices, regional indices

Learning Resources

Textbooks-

1. **Environmental Modelling: Fate and Transport of Pollutants in Water, Air and Soil**, J. L. Schnoor, 1st Edition, John Wiley & Sons Inc., New York, 1996.
2. **Surface Water Quality Modelling**, Steven C. Chapra, 1st Edition, Tata McGraw-Hill Companies, Inc., New Delhi, 1997.
3. **Introduction to Environmental Engineering and Science**, Gilbert M. Masters, 2nd Edition, Prentice Hall, New Jersey, 1998.

Reference Books-

1. **Air Pollution: Air Pollutants, Their Transformation, and Transport (Vol. I)**, Arthur C. Stern (Ed.), 3rd Edition, Academic Press, New York, 2006.
2. **Principles of Surface Water Quality Modelling and Control**, G. T. Thomann and J. A. Mueller, 1st Edition, Harper & Row Publishers, New York, 1987.
3. **Water Quality Modelling**, M. D. Palmer, 1st Edition, The World Bank, Washington D.C., 1993.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PEC-513A-ENE
Course- Hydraulic Design and Soft Computing in Design of Sewerage system

Teaching scheme	Credit	Examination	
Theory- 3 hours / week	03	CCE ESE	50 marks 50 marks

Prerequisite- Basic Knowledge of Sewerage Systems Sewage Treatment, Fluid Mechanics

Course Objectives-

1. To understand the need, types and requirements of Sewerage Systems
2. To introduce students to Hydraulic Design of Sewerage System & Network.
3. To equip students with skills in Software Applications and Soft Computing Techniques for Sewerage System Modelling.
4. To equip students with emerging trends in Sewerage

Course outcomes-

On completion of the course, learner will be able to-

CO1- Understand functional requirements for a sewerage system.

CO2- Apply knowledge gained for the hydraulic design of sewerage system.

CO3- Understand software applications in the design of sewerage system.

CO4- Understand and apply knowledge of Soft Computing Techniques to the Design of Sewerage System.

CO5-Understand and apply AI technique to the design of storm water drain and climate resilient systems.

Course Contents

Unit I	**Fundamentals of Sewerage System Design**	**08 Hours**
Types of sewerage systems- separate, combined, partially combined, Estimation of dry weather flow and peak flow factors, Hydraulic characteristics of sewage and stormwater, Design criteria as per CPHEEO, BIS, and local norms, Sewer appurtenances and their functions		
Unit II	**Hydraulic Designs and Software Applications**	**08 Hours**
Open channel vs pressure flow design, Design of sewer sections- circular, egg-shaped, and rectangular, Application of Manning's equation and self-cleansing criteria, Slope and velocity considerations for gravity sewers, Hydraulic modeling under unsteady flow conditions, Optimization of sewer design using GA and PSO, ANN for flow and infiltration forecasting, Fuzzy logic for decision-making in sewer rehabilitation, Hybrid techniques- Neuro-fuzzy and GA-ANN models, Data-driven modeling using machine learning for sewer health monitoring		
Unit III	**Computing for Sewerage System**	**08 Hours**
Overview of soft computing- fuzzy logic, genetic algorithms (GA), artificial neural networks (ANN), particle swarm optimization (PSO), Differences from conventional computation, Applications in civil and environmental engineering, Introduction to Tools and platforms- MATLAB, Python (scikit-learn, TensorFlow)		
Unit IV	**Emerging Technologies in System Design**	**08 Hours**
Optimization of sewer design using GA and PSO, ANN for flow and infiltration forecasting, Fuzzy logic for decision-making in sewer rehabilitation, Hybrid techniques- Neuro-fuzzy and GA-ANN		

models, Data-driven modeling using machine learning for sewer health monitoring, Smart sewer systems and digital twins, Real-world case studies integrating AI and simulation tools, IoT and real-time monitoring in sewer systems, Climate resilience and stormwater adaptation strategies, Capstone project- Complete design and optimization of a sewer network		
Unit V	**Real World Case Studies in Sewer System Design Using AI**	**08 Hours**
Real-world case studies integrating AI and simulation tools, IoT and real-time monitoring in sewer systems, Climate resilience and stormwater adaptation strategies, Capstone project- Complete design and optimization of a sewer network		

Learning Resources

Textbooks

1. Manual on Sewerage and Sewage Treatment (Latest Edition), Central Public Health and Environmental Engineering Organisation (CPHEEO), Ministry of Housing and Urban Affairs, Government of India, New Delhi.
2. Wastewater Engineering: Treatment and Resource Recovery, Metcalf & Eddy, 5th Edition, McGraw-Hill Education, New York, 2014.
3. Wastewater Treatment: Principles and Design, S. R. Qasim, 1st Edition, CRC Press, Boca Raton, 1998.
4. Basic Water and Wastewater Engineering, C. Binnie and M. Kimber, 1st Edition, Thomas Telford Publishing, London, 2009.

Reference Books

1. EPANET 2: User's Manual (for Stormwater Analysis), Lewis A. Rossman, 1st Edition, U.S. Environmental Protection Agency, Cincinnati, 2000.
2. Neural Networks and Learning Machines, Simon Haykin, 3rd Edition, Pearson Education, New York, 2009.
3. Principles of Soft Computing, S. N. Sivanandam and S. N. Deepa, 2nd Edition, Wiley India, New Delhi, 2011.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PEC-513B-ENE
Course- Environmental Sanitation

Teaching scheme	Credit	Examination	
Theory- 3 hours / week	03	CCE ESE	50 marks 50 marks

Prerequisite- Fundamentals of Environmental Studies, Water Supply and Waste Water Engineering

Course Objectives- -

1. Understand Micro-organisms and their role in disease by identifying, describing intestinal and respiratory communicable diseases with control and prevention measures
2. Understand the role of vectors in disease transmission and to explain the transmission routes and the chain of infection
3. Identify the public health standards and sanitary requirements and Evaluate Low-Cost Sanitation Technologies.
4. Understand Plumbing Terminology, designing plumbing components and Understanding Sanitary Plumbing and design the drainage layout for buildings.

Course Outcomes- -

After the successful completion of the course, the student will be able to ,

CO1- Identify and classify disease-causing micro-organisms (bacteria, viruses, fungi, protozoa) and their basic characteristics.

CO2-Assess the Impact of Rodents on Public Health.

CO3-Analyze Environmental Factors in Public and Industrial Buildings and to analyze Water Supply and Sanitation Problems in Rural Areas.

CO4-Apply Principles of Water Supply System Design and Design Drainage Systems for Buildings.

CO5- Understand and apply importance of buiding sanitation, indoor sanitation with special reference to indoor air quality.

Course Contents

Unit I	**Epidemiology and Rodent Control**	**08 hours**

Communicable diseases, Micro-organisms, Methods of communication, Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control. Mosquitoes, life cycles, factors of diseases control methods – natural and chemical, Fly control methods and prevention of fly breeding, Rodents and public health, plague control methods, engineering and bio-control methods, disinfectants (Phenols, Lime, Chlorine, Ammonium compounds), Insecticides (DDT, BHC).

Unit II	**Industrial and Rural Sanitation**	**08 hours**

Schools, Public Buildings, Hospitals, eating establishments, Swimming pools – Study of factors like Light, Heat, Ventilation, Plumbing fixtures, Cleanliness and maintenance and comfort. Industrial Hygiene- Occupational Hazards, Industrial poisons, Dust, Noise, Heat, Compressed air, Vibrations, and shocks- Industrial plant sanitation.

Rural Sanitation- Rural areas, Population habits and environmental conditions, problems of water supply

and sanitation aspects, low-cost excreta disposal systems. Rural sanitation improvement schemes. Case studies on sanitation. Emergency Sanitation practices during Natural calamity. Fecal Sludge Management in India, Methods of Fecal Sludge Management.

Unit III	**Water supply in Buildings and Building Drainage**	**08 hours**

Plumbing terminology. Definitions, Water supply in building. The water connection, The water storage, Storage tanks-domestic storage tanks, Flushing Storage Tanks. Principles Governing Design of Water supply in buildings, Lay out. Estimating Requirements, Design of Water pipes.

Traps, Gully Traps, Intercepting Traps or Interceptors. Sanitary Fittings—Water Closets. Flushing Cistern- Wash Basin or Lavatory Basin, Sink, Urinals. The Plumbing System of Drainage—Single Stack System, One-Pipe System. Choice of System, Principles governing Design of Building Drainage, Layout. Quantity of Flow. Pipes for drainage, Drainage design of high-rise buildings.

Unit IV	**Environmental Quality and Public Health**	**08 hours**

Indoor Environmental Quality and Public Health, addressing sources of indoor air pollution such as CO_2, VOCs, radon, and mold, their health impacts, indoor air quality standards and monitoring techniques, role of HVAC systems in maintaining indoor safety.

Unit V	**Environmental Quality and Public Health**	**08 hours**

Introduction to Sick Building Syndrome (SBS), green building practices and WELL / LEED certifications, and case studies of indoor air quality improvement in public facilities, Unit VI deals with Climate Change and Environmental Health Risks, highlighting its effects on water supply and sanitation infrastructure.

Learning Resources

Textbooks

1. Municipal and Rural Sanitation**,** Victor Ehalers and Ernest W. Steel, 6th Edition, McGraw-Hill Book Company, New York, 1965.
2. Environmental Pollution and Control, H. S. Bhatia, 1st Edition, Galgotia Publications Pvt. Ltd., New Delhi, 2001.
3. The New Public Health**,** Theodore H. Tulchinsky and Elena A. Varavikova, 3rd Edition, Academic Press, London, 2014.

Reference Books

1. Communicable Disease Control in Emergencies: A Field Manual**,** Máire A. Connolly and World Health Organization, 1st Edition, WHO Press, Geneva, 2005.
2. Communicable Disease Control and Health Protection Handbook**,** Jeremy Hawker, Norman Begg and Ralf Reintjes, 4th Edition, Wiley-Blackwell, Oxford, 2018.
3. Laboratory Biosafety Manual, World Health Organization, 3rd Edition, WHO Press, Geneva, 2004.
4. Industrial Safety Management: 21st Century Perspectives of Asia**,** J. Maiti and Pradip Kumar Ray, 1st Edition, Springer, Singapore, 2017.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PEC-513C-ENE
Course- Environmental Legislation and Management System

Teaching scheme	Credit	Examination	
Theory- 3 hours / week	03	CCE ESE	50 marks 50 marks

Prerequisite- Basic knowledge of environmental laws and regulations in India

Course Objectives-

1. Understand the framework of national and international environmental legislation relevant to environmental protection.
2. Analyze various environmental policies, acts, and rules applicable to pollution control, water, air, land, and biodiversity.
3. Learn the structure and implementation process of Environmental Management Systems (EMS), including ISO 14001 standards.
4. Develop a critical understanding of the roles of statutory bodies such as CPCB, SPCB, and MoEFCC.

Course Outcomes-

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

CO1-Interpret key environmental acts like the Water Act, Air Act, and Environment Protection Act with relevance to civil/environmental engineering.

CO2-Demonstrate understanding of environmental impact assessment (EIA) regulations and consent mechanisms.

CO3-Evaluate the applicability and implementation of ISO 14001 and other EMS frameworks in real-world scenarios.

CO4-Identify roles and responsibilities of different environmental regulatory authorities in India.

CO5- Identify contemporary environmental issues and apply the knowledge gained in overcoming these issues as both global and local level.

Course Contents

Unit I	**National Environmental Policies**	**08 hours**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration, Functions and Constitutions of SPCB and CPCB, Various five-year plans.

Unit II	**Power & Functions of Regulatory Agencies**	**08 hours**

Water (P & Cp) Act, 1974- Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit III	Prevention and Control	08 hours
Air (P & Cp) Act, 1981- Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.		
Unit IV	**Coastal Zone Regulation**	**08 hours**
Environment (Protection) Act 1986- Genesis of the Act – delegation of powers – Role of Central Government - Latest EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management.		
Unit V	**Contemporary Environmental Issues**	**08 hours**
Global Environmental Issues – Biodiversity loss, Climate change, Ozone layer depletion. Sea level rise. International efforts for environmental protection. National Action Plan on Climate Change (Eight National missions – National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystem, National Mission for a 10 'Green India', National Mission for Sustainable Agriculture, National Mission on Strategic Knowledge for Climate Change).		

Learning Resources

Text Books

1. Central Pollution Control Board (CPCB). (1997). *Pollution Control Acts, Rules and Notifications Issued Thereunder: Pollution Control Series – PCL/2/1992* (Latest ed.). Central Pollution Control Board, New Delhi.
2. Divan, S., & Rosencranz, A. (2001). *Environmental Law and Policy in India* (2nd ed.). Oxford University Press, New Delhi.
3. McGregor, G. I. (1994). *Environmental Law and Enforcement* (1st ed.). Lewis Publishers, London.
4. Government of India. (Latest ed.). *The Constitution of India (Referred Articles from Part III, Part IV and Part IVA)*. Ministry of Law and Justice, New Delhi.

Reference Books

1. Leelakrishnan, P. (2019). *Environmental Law in India* (5th ed.). LexisNexis Butterworths, New Delhi.
2. Shastri, S. C. (2018). *Textbook on Environmental Law* (8th ed.). Eastern Book Company, Lucknow.
3. Sands, P., & Peel, J. (2018). *Principles of International Environmental Law* (4th ed.). Cambridge University Press, Cambridge.
4. Jain, M. P. (2016). *Environmental Legislation in India* (1st ed.). Ashoka Law House, New Delhi.

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- SEM-514-ENE
Course- Seminar I

Teaching scheme	Credit	Examination	
Practical: 4 hours/week	02	TW OR	25 marks 25 marks

Course objectives

To enable students to explore and critically analyze an advanced or emerging topic from any subject in the Elective I list, and to effectively communicate the findings through a structured report and professional presentation.

Course outcomes

CO1- Select and critically evaluate a topic from any subject in the Elective I list, integrating literature findings to identify knowledge gaps or practical implications.

CO2- Prepare a concise seminar report and deliver a professional oral presentation demonstrating subject understanding, clarity, and effective engagement with the audience.

Course Contents

The seminar shall focus on an advanced or emerging topic from any subject in the Elective I list. The topic shall be selected by the student in consultation with the faculty supervisor and may be based on recent research developments, innovative materials, advanced analysis/design methodologies, notable project case studies, or industry-relevant challenges within the selected elective domain.

The content should demonstrate a clear understanding of the subject, include a critical review of relevant literature, identify knowledge gaps or practical implications, and highlight future directions or applications. The seminar must reflect the student's ability to synthesize technical information, present it logically, and engage the audience with meaningful discussion.

As part of the seminar, students shall prepare a well-structured report summarizing the literature review, identified research gap, rationale, objectives, and methodology or key findings related to the elective topic. They shall also deliver a professional oral presentation of their work, use appropriate visual aids, and respond confidently to questions and feedback.

Savitribai Phule Pune University, Pune

Maharashtra, India

ME– Civil Engineering (2025 Pattern)
Master of Environmental Engineering

Semester III

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- RM-601–ENE
Course- Research Methodology

Teaching scheme	Credit	Examination	
Theory- 4 hours / week	04	CCE ESE	50 marks 50 marks

Prerequisite- Civil Engineering

Course Objectives-

1. To provide foundational understanding of research methodology and formulation of research problems.
2. To develop skills for effective literature review, research proposal preparation, and ethical research practices.
3. To apply appropriate techniques for data collection, measurement, and statistical analysis.
4. To enhance competence in writing research reports, papers, and presentations.

Course outcomes-

On completion of the course, learner will be able to:

CO1- Formulate research problems and hypotheses relevant to construction management.
CO2- Develop structured research proposals with defined objectives and methodology.
CO3- Conduct literature reviews using ethical and valid research practices.
CO4- Apply data collection, sampling, and measurement techniques effectively.
CO5- Prepare and present research reports, papers, and proposals professionally.

Course Contents

Unit I	**Introduction**	**12 hours**

Research: Meaning of research, types of research, process of research, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, formulation of research hypotheses. Search for causation.
Research Proposal: Developing a Research Proposal Format of research proposal, Individual research proposal, Institutional research proposal, Significance, objectives, methodology, Funding for the proposal, Different funding agencies. Framework for the planning

Unit II	**Literature Survey & Research Ethics**	**12 hours**

Definition of literature and literature survey, need of literature survey, sources of literature, elements and objectives of literature survey, styles of literature survey, and strategies of literature survey.
Ethical Issues, Ethical Principles that govern Research, ethically valid Information Sources, Regulatory Compliance.

Unit III	**Data Collection, Sampling, and Scaling**	**12 hours**

Classification of data, benefits and drawbacks of data, evaluation of data, methods of data collection, Sampling, sample size, sampling strategy, attitude measurement and scaling, types of measurements, criteria of good measurements, classification of scales.

Unit IV	**Preliminary and Advanced Data Analysis**	**12 hours**

Testing of hypothesis- concepts and testing, analysis of variance techniques, introduction to non-parametric tests. Validity and reliability, Approaches to qualitative and quantitative data analysis. Correlation and regression analysis, Introduction to factor analysis, discriminant analysis, cluster analysis, multidimensional scaling, Descriptive statistics, Inferential statistics, multi-dimensional measurement, factor analysis.		
Unit V	**Report writing**	**12 hours**
Need of effective documentation, importance of report writing, types of reports, report structure, report formulation, Plagiarism. Research briefing, presentation styles, impact of presentation, elements of effective presentation, writing of research paper, presenting and publishing paper, patent procedure		
Learning Resources		
Text Books: 1. Research Methodology: concepts and cases, Deepak Chawla and Neena Sondhi, Vikas Publishing House Pvt. Ltd. 2. Research Methods for Business, Sekaran Uma and Rogure Boudie, Wiley, India. 3. Research Methodology: Methods and Trends, by Dr. C. R. Kothari, New Age International Publishers.		
Reference books 1. Research Methods in Education, Louis Cohen, Manion, Morrison, Routledge (Taylor & Francis Group)/ Cambridge University Press India Pvt. Ltd. 2. Research Methodology: An Introduction, Wayne Goddard and Stuart Melville. 3. Research Methodology: A Step-by-Step Guide for Beginners, by Ranjit Kumar 4. Research in Education, John Best and James Kahn, Prentice Hall of India Pvt. Ltd.		

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- OJT-602-ENE
Course- On Job Training / Internship

Teaching scheme	Credit	Examination	
Theory- 10 hours / week	05	TW	100 marks

Prerequisite- Basic knowledge of civil engineering and applied sciences and mathematics

Course Objectives:

1. Apply theoretical knowledge to real-world environmental issues.
2. Develop professional competencies in planning, execution, and control of environmental projects.
3. Strengthen problem-solving abilities w.r.t. existing environmental conditions vis a vis environmental protection and sustainability.

Course outcomes:

On completion of the course, learner will be able to:

CO1- Demonstrate the ability to integrate academic concepts with professional practices.
CO2-Apply fundamental knowledge of pollution control to abate various type of pollution.
CO3-Communicate and coordinate efficiently with multi-disciplinary project teams.
CO4-Identify, analyze, and propose solutions to environmental challenges.
CO5-Exhibit professional ethics, responsibility, and adaptability in workplace settings.
CO6-Production of a comprehensive report/logbook meeting industry documentation standard.

Course Contents

Environmental Engineering OJT / Internship Activities

1. **Familiarization with Environmental Setup** – Understanding the organizational structure, environmental functions, regulatory framework, scope of projects (e.g., water supply, wastewater, solid waste, air quality), stakeholder roles, and relevant environmental legislation (CPCB, SPCB, MoEFCC).
2. **Exposure to Environmental Planning & Design** – Participation in preparation of Environmental Management Plans (EMP), Environmental Impact Assessment (EIA) studies, hydraulic and treatment process designs, Work Breakdown Structures (WBS), and use of design/analysis software.
3. **Monitoring & Site Execution** – Involvement in field execution activities such as water supply pipelines, wastewater treatment plants (WWTP/STP/ETP), solid waste management facilities, and air pollution control systems. Recording site observations, preparing Daily Progress Reports

(DPRs), and facilitating coordination among civil, mechanical, electrical, and environmental teams.

4. **Quality Assurance & Laboratory Testing** – Exposure to QA/QC processes including water/wastewater sampling, testing of physicochemical and biological parameters (as per IS/ASTM/APHA standards), sludge analysis, leachate testing, and maintaining laboratory logbooks. Verification of construction quality with checklists and inspection protocols.
5. **Health, Safety & Environment (HSE) Practices** – Participation in safety inspections, toolbox talks, risk assessments (Job Safety Analysis), hazard identification in environmental facilities, and implementation of occupational health and safety guidelines (OHSAS/ISO 45001).
6. **Contract & Cost Management in Environmental Projects** – Assisting in interpreting Bills of Quantities (BOQs), conducting site measurements, verifying material quantities, preparation of Running Account (RA) bills, and exposure to cost monitoring tools like Earned Value Management (EVM) applied in environmental projects.
7. **Sustainable & Smart Environmental Practices** – Observation of sustainable construction and operation practices such as resource recovery, zero-liquid discharge (ZLD), energy-efficient equipment, and green building concepts. Exposure to modern technologies like GIS-based mapping, IoT sensors for real-time monitoring, drones for landfill/stormwater survey, and Building Information Modelling (BIM).
8. **Documentation & Reporting** – Preparation of weekly technical summaries, maintenance of a structured OJT logbook, development of a case study based on field experience, compilation of a comprehensive final internship report, and oral presentation of outcomes to academic faculty and industry professionals.

Term Work Submission

All submissions shall be as per the requirements prescribed in the format, and must be completed on or before the specified deadline.

Assessment Criteria

Assessment shall be based on the technical accuracy of concepts, calculations, and methods; the application of theoretical knowledge to practical or case-based scenarios

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- SEM-603-ENE
Course- Seminar II

Teaching scheme	Credit	Examination	
Practical- 08 hours / week	04	Term Work Oral	25 marks 25 marks

Course objectives:

To enable students to explore and critically analyze an advanced or emerging topic from any subject in the Elective II list, and to effectively communicate the findings through a structured report and professional presentation.

Course outcomes

CO1- Select and critically evaluate a topic from any subject in the Elective II list, integrating literature findings to identify knowledge gaps or practical implications.

CO2- Prepare a concise seminar report and deliver a professional oral presentation demonstrating subject understanding, clarity, and effective engagement with the audience.

Course Contents

The seminar shall focus on an advanced or emerging topic from any subject in the Elective II list. The topic shall be selected by the student in consultation with the faculty supervisor and may be based on recent research developments, innovative materials, advanced analysis/design methodologies, notable project case studies, or industry-relevant challenges within the selected elective domain.

The content should demonstrate a clear understanding of the subject, include a critical review of relevant literature, identify knowledge gaps or practical implications, and highlight future directions or applications. The seminar must reflect the student's ability to synthesize technical information, present it logically, and engage the audience with meaningful discussion.

As part of the seminar, students shall prepare a well-structured report summarizing the literature review, identified research gap, rationale, objectives, and methodology or key findings related to the elective topic. They shall also deliver a professional oral presentation of their work, use appropriate visual aids, and respond confidently to questions and feedback

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PRJ-605-ENE
Course- Research Project Stage I

Teaching scheme	Credit	Examination	
Practical- 18 hours / week	09	TW Oral	25 marks 25 marks

Perquisites - Civil Engineering, Research methodology and basic mathematical statistics

Course Objectives-

1. Enable students to identify and define a real-world problem related to the construction industry or a macro-level issue affecting its performance.
2. Foster the application of scientific research methodologies including design, data collection, and data analysis.
3. Promote analytical and critical thinking in addressing complex engineering problems.
4. Encourage independent learning, originality, and individual contribution in research work.
5. Facilitate the preparation of a technically sound report and the development of effective communication and presentation skills.
6. Encourage scholarly dissemination of research through conference presentations or journal publications.

Course outcomes- On completion of the course, student will be able to-

1. Identify and formulate a research problem relevant to the construction or allied industries.
2. Conduct comprehensive literature reviews and establish the theoretical foundation of the study.
3. Develop a systematic methodology for research including data collection and analytical techniques.
4. Analyze field or experimental data to draw meaningful inferences.
5. Demonstrate effective technical writing and presentation skills in compiling a professional research report.
6. Exhibit the ability to communicate research findings through oral presentations and scholarly publications.

COURSE CONTENTS

Project Stage I is the initial phase of the postgraduate dissertation work where students identify, refine, and plan their research. The aim is to address a real-world problem or significant research question relevant to their branch of specialization like structural engineering, construction management, and civil-environmental engineering.

Students are expected to conduct a comprehensive literature review, identify research gaps, define the scope, and develop a structured methodology to be executed in Project Stage II

Report Guidelines

The Research project Stage I report must be presented in a standard, professional format. It should be submitted as a spiral-bound hard copy, preferably printed double-sided on A4-sized paper. The report must include the following components-

1. **Introduction-** Statement of objectives and Scope and limitations of the study
2. **Literature Review**- Background and context of the research and Summary of relevant studies and findings
3. **Problem Statement and Methodology**- Clear articulation of the research problem and Methodological approach to be adopted
4. **Theoretical Framework**- Concepts and theories relevant to the research topic
5. **Field Applications and Case Studies**- Real-world applications and documented case examples
6. **Data Collection and Experimental Work**- Details of data gathered from field studies or organizations and Description of experimental or analytical procedures
7. **Preliminary Analysis and Inferences**- Initial interpretation of findings and insights obtained
8. **Work Plan for Dissertation Stage II**- Outline of the remaining research tasks and timeline
9. **References** Properly cited sources using a standard referencing style as suggested by concern faculty.

Presentation

Students must prepare a PowerPoint presentation summarizing their work, to be delivered within 25 minutes, followed by a 5-minute Q&A session.

LEARNING RESOURCES

Web Resources

1) Google Scholar (https-//scholar.google.com)

2) NPTEL MOOCs on Research Methodology, Project Management, and Data Analysis

3) MIT Open Course (https-//ocw.mit.edu)

4) Coursera and edX courses on construction engineering and research methods

5) ASCE Library – https-//ascelibrary.org

6) ScienceDirect (Elsevier) – https-//www.sciencedirect.com

7) SpringerLink – https-//link.springer.com

8) IEEE Xplore – https-//ieeexplore.ieee.org

9) Taylor & Francis Online – https-//www.tandfonline.com

10) Shodhganga (INFLIBNET India) – https-//shodhganga.inflibnet.ac.in

Savitribai Phule Pune University, Pune

Maharashtra, India

ME– Civil Engineering (2025 Pattern)
Master of Environmental Engineering

Semester IV

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course Code- SEM-604-ENE
Course- Seminar III

Teaching scheme	Credit	Examination	
Practical- 08 hours / week	04	Term Work Oral	50 marks 50 marks

Course objectives

To develop the student's ability to independently investigate and critically analyze an advanced topic in structural engineering, and to effectively communicate the findings through a well-structured report and professional oral presentation.

Course outcomes

CO1 Select and critically evaluate an advanced topic in structural engineering, integrating literature findings to identify knowledge gaps or emerging opportunities.

CO2 Prepare a comprehensive seminar report and deliver a professional oral presentation demonstrating technical depth, clarity, and effective audience engagement

Course Contents

The seminar should be based on any advanced topic in Environmental Engineering, selected by the student in consultation with the faculty supervisor.

The seminar should demonstrate a strong grasp of the subject, supported by critical evaluation of relevant literature, identification of knowledge gaps or emerging opportunities, and discussion of practical or research implications.

As part of the seminar, students shall prepare a structured report that includes the literature review, identified research gap, rationale, objectives, methodology or findings, conclusions, and future scope. They shall also deliver a professional oral presentation using appropriate visual aids, and respond confidently to questions and feedback

Savitribai Phule Pune University
ME (Civil Environmental Engineering) 2025 Pattern

Course code- PRJ-606-ENE
Course- Research Project Stage II

Teaching scheme	Credit	Examination	
Practical- 36 hours / week	18	Term Work Oral	150 marks 50 marks

Perquisites- Civil Engineering, Research aptitude/methodology, analytical skills

Course Objectives-

1. To enable students to apply scientific research methodologies to investigate and solve real-world or industry-relevant construction problems.
2. To develop students' abilities to critically analyze data, draw meaningful inferences, and formulate viable, practical solutions.
3. To encourage individual contribution and professional reporting skills through comprehensive documentation and effective presentation of research findings.

Course outcomes-

On completion of the course, student will be able to-

CO1- Formulate a well-defined problem statement based on literature survey, field studies, and current industrial challenges in the environment and other allied sectors.

CO2- Demonstrate proficiency in data collection, analytical tools, interpretation of results, and development of conclusions through independent research work.

CO3- Effectively communicate research outcomes through a professionally written dissertation and a formal oral presentation, with an aim to publish or present findings at academic or professional platforms.

Course Contents

The final phase of the project work will be undertaken during Semester IV, building upon the progress made in earlier stages (stage I). The project should preferably address a live industry problem or a macro-level issue with a significant impact on the performance of the environment and other engineering sector. The work must demonstrate a scientific approach, incorporating elements such as research design, data collection and analysis, solution development, innovative step and most importantly, a clear reflection of the student's individual contribution to the research work.

Final Report Submission

The final dissertation report must be compiled and submitted in a standardized black-bound hard copy, preferably printed on both sides of the paper. The report should be structured with the following key components-

1. **Introduction**- Project overview, objectives, and scope, Limitations and challenges encountered
2. **Literature Review**- Summary of previous studies and theoretical background and Identification of research gaps
3. **Research Methodology**- Clear articulation of the problem statement, hypothesis, designing the research and Detailed description of the research methodology

4. Theoretical Framework- Relevant theories, models, and concepts related to the research, Real-world applicability of the research and Documentation of case studies, if any

5. Result and discussion- Field data, organizational inputs, or lab-based experimentation and Tools, instruments, and procedures used/adopted, Comprehensive analysis of the results and Key findings and derived inferences, applications, representations,

6. Conclusion and Recommendations- Summary of contributions, conclusions, and suggested improvements and Recommendations for industry or future research

7. References- Properly formatted citations of all literature and sources used in APA -American Psychological Association referencing style

8. Appendices (if applicable)- Supplementary materials such as publications, sponsored ship, questionnaires, raw data, charts, etc.

Presentation and Evaluation

Each student shall prepare a PowerPoint presentation of their project findings, to be presented within 45 minutes, followed by a 15-minute Q&A session. The presentation should effectively communicate the research problem, methodology, analysis, and conclusions.

Publication Encouragement

Students are strongly encouraged to publish their research findings in a peer-reviewed journal or present them at a recognized conference, thereby contributing to academic and professional knowledge in the field before final oral examination.

LEARNING RESOURCES

Web Resources

1) Google Scholar (https-//scholar.google.com)
2) NPTEL MOOCs on Research Methodology, Project Management, and Data Analysis
3) MIT Open Course (https-//ocw.mit.edu)
4) Coursera and edX courses on construction engineering and research methods
5) ASCE Library – https-//ascelibrary.org
6) ScienceDirect (Elsevier) – https-//www.sciencedirect.com
7) SpringerLink – https-//link.springer.com
8) IEEE Xplore – https-//ieeexplore.ieee.org
9) Taylor & Francis Online – https-//www.tandfonline.com
10) Shodhganga (INFLIBNET India) – https-//shodhganga.inflibnet.ac.in

Nomenclature

AEC Ability Enhancement Course

BOS- Board of Studies

AICTE - All India Council for Technical Education

CEP- Community Engagement Project

EEM- Entrepreneurship / Economics/ Management

MDM- Multidisciplinary Minor

MOOC- Massive Open Online Course

NEP- National Educational Policy

NPTEL- National Programme on Technology Enhanced Learning

OE- Open Elective

PCC- Program Core Course

PO'S - Program Outcomes

PEO'S- Programme Educational Objectives

PSO'S- Program Specific Outcomes

SWAYAM- Study Webs of Active-Learning for Young Aspiring Minds

SPPU- Savitribai Phule Pune University

VEC- Value Education Course

VSE- Vocational and Skill Enhancement Course

WK- Knowledge and Attitude Profile

FP - Field Project