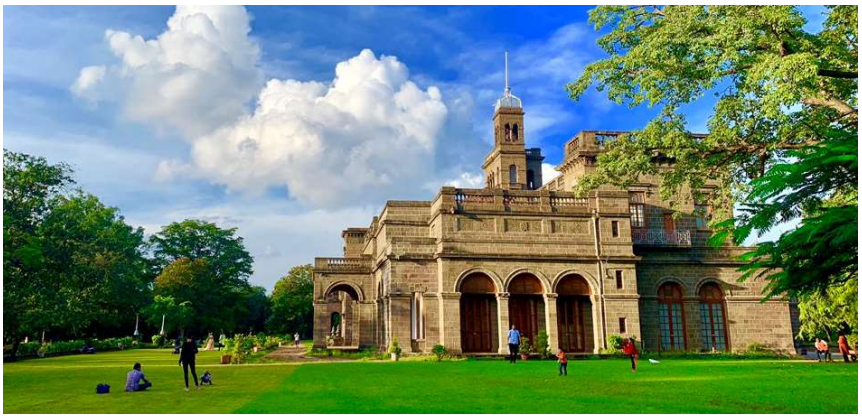
सावित्रीबाई फुले पुणे विद्यापीठ

Savitribai Phule Pune University, Pune, Maharashtra, India

Faculty of Science and Technology



M.E (2025 Pattern)

M. E. Environmental Engineering - Chemical

(With effect from Academic Year 2025-26)

Preface by Board of Studies

Dear Students and Teachers,

We, the members of the Board of Studies in Chemical & Petroleum Engineering, are pleased to present the ME Environmental Engineering - Chemical syllabus, effective from the Academic Year 2025-26 (2025 pattern).

This revised curriculum offers a comprehensive blend of core subjects, interdisciplinary electives, practical training, internships, seminars, and research projects. Our goal is to provide a holistic educational experience that equips students with a strong foundation in environmental engineering while also offering opportunities to explore emerging areas and gain real-world experience in Chemical and allied engineering and technological field.

The updated syllabus aligns with the academic vision of Savitribai Phule Pune University**,** AICTE New Delhi**,** UGC**,** and other accreditation bodies. It reflects current technological trends, innovations, sustainability goals, and the evolving needs of industry and society.

The curriculum has been developed through extensive consultation with academic scholars, environmental professionals, alumni, and industry stakeholders. It is designed not only to meet industry demands but also to prepare students for higher studies**,** research, and development in the field of Environmental Engineering.

As you begin this new academic journey, we encourage you to make the most of the learning opportunities available, engage deeply with the subject matter, collaborate with faculty and peers, and contribute meaningfully to sustainable development and environmental stewardship.

We sincerely thank all faculty members, students, industry experts, and stakeholders who contributed their insights and support in crafting this curriculum.

With best wishes,

Dr. Somnath Nandi
Coordinator
Board of Studies in Chemical & Petroleum Engineering
Savitribai Phule Pune University

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Nomenclature

PEO	Programme Educational Objectives
PSO	Program Specific Outcomes
WK	Knowledge and Attitude Profile
PO	Program Outcomes
PCC	Programme Core Course
MDM	Multidisciplinary Minor
OEL	Open Elective
VSEC	Vocational and Skill Enhancement Course
VSC	Vocational Skill Courses
SEC	Skill Enhancement Courses
AEC	Ability Enhancement Course
EEM	Entrepreneurship/Economics/ Management
VEC	Value Education Course
CEP	Community Engagement Project
FP	Field Project

Program Educational Objectives (PEOs)

Program Educational Objectives (PEOs) are broad statements that describe the career and professional accomplishments that engineering graduates are expected to achieve 2 years after completing the program.

PEO	PEO Focus	PEO Statement
PEO1	Core Competency	Postgraduates will demonstrate technical ability and skillset to compete on the global scale with enhanced domain knowledge supported with modern technological tools.
PEO2	Ethical, Social, and Global Responsibilities	Postgraduates will demonstrate professionalism, ethical conduct, and a strong sense of societal and environmental responsibility, while effectively collaborating in multidisciplinary teams and contributing to both national and global development.
PEO3	Professionalism and Lifelong Learning	Motivated postgraduates will conduct cutting-edge research, with a passion for lifelong learning with an investigative approach, and multidisciplinary thinking to succeed in the career in industry/academia/research
PEO4	Team Building	Postgraduates demonstrating strong managerial and communication skills to work effectively as an individual as well as in teams in technological and other domain.

Knowledge and Attitude Profile (WK)

A Knowledge and Attitude Profile (KAP), also referred to as Knowledge and Attribute Profile (WK) in some contexts, is a framework or assessment tool used to evaluate an individual's knowledge and attitudes within a specific area, topic, or domain.

PO No	Title	Program Outcome Description
WK1	Natural Science and Social Sciences	A systematic, theory-driven framework for understanding natural sciences, with applications in both specific discipline and the social sciences.
WK2	Mathematics and Data Analysis	Conceptually grounded mathematics, numerical analysis, statistics, and computer science knowledge used to understand, support, and model phenomena relevant to the discipline.
WK3	Engineering Fundamentals	A systematic, theory-based formulation of fundamental engineering principles essential to the discipline.
WK4	Engineering Specialist Knowledge	Specialist engineering knowledge that offers theoretical frameworks and established bodies of knowledge underpinning accepted practice areas, much of which is at the forefront of the discipline.
WK5	Engineering Design and Environmental Considerations	Knowledge encompassing efficient resource usage, environmental impact, whole-life cost, net-zero carbon, and related concepts that inform and support engineering design and operations within specific practice area.
WK6	Engineering Practice (Technology)	Knowledge of engineering practices and technologies relevant to the core and allied areas of the discipline.
WK7	Role of Engineering in Society	Understanding the role of engineering in society and key issues in professional practice, including an engineer's responsibility for public safety and commitment to sustainable development.
WK8	Research and Critical Thinking	Engagement with current research literature in the discipline, coupled with an awareness of the value of critical thinking and creative approaches in evaluating emerging issues.
WK9	**Ethics and Inclusive Behavior**	Understanding of professional ethics, responsibilities, and standards of engineering practice, alongside a commitment to ethical conduct, inclusive behavior, and respect for diversity across ethnicity, gender, age, physical ability, and other attributes.

Program Outcomes (POs)

Program Outcomes (POs) are statements defining knowledge, skills, and abilities students are expected to demonstrate upon graduating from the program. These outcomes align with the program's educational objectives and encompass the competencies, attitudes, and behaviors developed throughout the students' academic experience. Upon successful completion of the B.E. in Chemical Engineering, graduates will be able to:

PO No	Title	Program Outcome Description
PO1	Engineering Knowledge	Apply knowledge of mathematics, chemistry, physics, and core chemical engineering principles as specified in WK1 to WK4 respectively to solve complex engineering problems.
PO2	Problem Analysis	Identify, formulate, and analyze chemical engineering problems using scientific principles, computational tools, and experimental data (WK1 to WK4).
PO3	Design/Development of Solutions	Design processes, equipment, and systems (reactors, distillation columns, heat exchangers, etc.) considering safety, sustainability, and economic constraints (WK5).
PO4	Conduct Investigation of Complex Problem	Conduct experiments, analyze data, and interpret results using modern instrumentation, simulation software and statistical tools (WK2, WK3 and WK8).
PO5	Engineering Tool Usage	Use industry-standard software, programming, and AI/ML techniques for process modeling, optimization, and automation (WK2 and WK6).
PO6	The Engineer and the World	Understand the social, environmental, and ethical responsibilities of chemical engineers in areas like pollution control, green chemistry, and sustainable development and comply with environmental regulations (WK1, WK5 and WK7).
PO7	Ethics	Follow professional ethics, safety protocols and workplace standards in chemical industries (WK9).
PO8	Individual and Collaborative Teamwork	Function effectively as an individual or in multidisciplinary teams in plant operations and R&D (WK 8 and WK9).
PO9	Communication	Communicate technical concepts clearly through reports, presentations, and documentation for industry and academia (WK 6, WK 8 and WK9).
PO10	Project Management and Finance	Apply engineering economics, risk assessment, and project management principles to optimize industrial processes (WK1, WK4 and WK6) .
PO11	Lifelong Learning	Engage in continuous learning through various certifications, higher studies (GATE, GRE, CAT, GMAT etc.), or adapting to new technologies (Industry 4.0, circular economy) (WK8).

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 behaviour 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 shall be conducted in two different parts Comprehensive Continuous Evaluation (CCE) and End-Semester Examination (ESE).

- **Comprehensive Continuous Evaluation (CCE) of 50 marks:**
  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:

Comprehensive Continuous Evaluation (CCE):

Sr. No.	Parameters	Marks	Coverage of Units
1	Written Unit Test	10 Marks	Units 1 and 2
2	Open Book Test	10 Marks	Units 3 and 4
3	Assignments / Case Studies	10 Marks	Unit 5
4	Seminar Presentation / Field Visit	10 Marks	
5	Mini Project	10 Marks	
6	Term Paper	10 Marks	
7	Project Based Learning	10 Marks	

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:**

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

First Year M.E. (2025 Pattern)

Environmental Engineering – Chemical

Level 6.0

Course Code	Course Type	Course Name	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-ENV	Program Core Course	Environmental Management	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-502-ENV	Program Core Course	Environmental Chemistry	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-503-ENV	Program Core Course	Wastewater Treatment Technology and Design	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-504-ENV	Program Core Course	Membrane Technology in Environmental Engineering	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-505-ENV	Program Core Course	Advance Environmental Laboratory - I	-	-	4	-	-	25	-	25	50	-	-	2	2
PEC-521A-ENV	Program Elective Course (Elective –I)	Modeling of Environmental Systems	3	-	-	50	50	-	-	-	100	3	-	-	3
PEC-521B-ENV		Environmental Auditing													
PEC-521C-ENV		Environmental Policies and Legislations													
PEC-521D-ENV		Air and Noise Pollution Control													
PEC-522-ENV	Program Elective Course	Skill Based Laboratory - I	-	-	2	-	-	25	-	25	50	-	-	1	1
Total			**19**	**-**	**6**	**250**	**250**	**50**	**-**	**50**	**600**	**19**	**-**	**3**	**22**

First Year M.E. (2025 Pattern)

Environmental Engineering – Chemical

Level 6.0

Course Code	Course Type	Course Name	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-551-ENV	Program Core Course	Industrial Pollution Prevention & Cleaner Production	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-552-ENV	Program Core Course	Solid Waste Management	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-553-ENV	Program Core Course	Industrial Waste Remediation	4	-	-	50	50	-	-	-	100	4	-	-	4
PCC-554-ENV	Program Core Course	Advance Environmental Laboratory - II	-	-	4	-	-	25	-	25	50	-	-	2	2
PEC-561A-ENV	Program Elective Course (Elective –II)	Modern trends in Environmental Engineering	3	-	-	50	50	-	-	-	100	3	-	-	3
PEC-561B-ENV		Unit Operations in Environmental Engineering													
PEC-561C-ENV		Agriculture Pollution and Control													
PEC-561D-ENV		Environmental Impact Assessment and Economics													
PEC-562A-ENV	Program Elective Course (Elective –III)	Environmental Biotechnology	3	-	-	50	50	-	-	-	100	3	-	-	3
PEC-562B-ENV		Remote Sensing and GIS applications in Environmental Engineering													
PEC-562C-ENV		Applied Statistics for Environmental Engineers													
PEC-562D-ENV		Water Resources Optimization and Water Quality Modeling													
SEM-571-ENV	Seminar	Technical Seminar I	-	-	4	-	-	25	-	25	50	-	-	2	2
Total			**18**	**-**	**8**	**250**	**250**	**50**	**-**	**50**	**600**	**18**	**-**	**4**	**22**

Second Year M.E. (2025 Pattern)

Environmental Engineering – Chemical

Level 6.5

Course Code	Course Type	Course Name	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-631-ENV	Research Methodology	Research Methodology	5	-	-	50	50	-	-	-	100	5	-	-	5
OJT-641-ENV	OJT / Internship	On Job Training / Internship	-	-	10	-	-	100	-	-	100	-	-	5	5
SEM-632-ENV	Seminar	Technical Seminar II	-	-	6	-	-	25	-	25	50	-	-	3	3
RP-642-ENV	Research Project	Research Project - I	-	-	18	-	-	25	-	25	50	-	-	9	9
Total			**5**	**-**	**34**	**50**	**50**	**150**	**-**	**50**	**300**	**5**	**-**	**17**	**22**

Course Code	Course Type	Course Name	Teaching Scheme (Hrs./wee k)			Examination Scheme and Marks						Credits			
			Theory	Tutorial	Practical	CCE	End-Sem	Term work	Practical	Oral	Total	Theory	Tutorial	Practical	Total
Semester IV															
SEM-671-ENV	Seminar	Seminar / Publication on Research Project II	-	-	8	-	-	50	-	50	100	-	-	4	4
RP-681-ENV	Research Project	Research Project II	-	-	36	-	-	150	-	50	200	-	-	18	18
Total			**-**	**-**	**28**	**-**	**-**	**200**	**-**	**100**	**300**	**-**	**-**	**22**	**22**

CCE*: Comprehensive Continuous Evaluation

Task Force for Curriculum Design and Development

Course Coordinator

Dr. Bhausaheb Pangarkar

Team Members for Course Design

Dr. Annasaheb Warade

Dr. Sachin Shirsath

Mr. Milind Bava

Dr. Sandip Pawar

Coordinator

Dr. Somnath Nandi

Coordinator – Board of Studies
Chemical and Petroleum Engineering
Savitribai Phule Pune University, Pune

Dean

Dr. Pramod D. Patil
Dean – Science and Technology
Savitribai Phule Pune University, Pune

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PCC-501-ENV Course Name: Environmental Management

Teaching Scheme	Credit	Examination Scheme
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End-Semester: 50 Marks**

Course Objectives:

The objective of the course is to,

1. 1. To study the fundamentals of environmental management
2. To study the environmental impact on business
3. To study the environmental legislation
4. To study the environmental act and safety rules
5. To study the public policy for industry and business

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand the basic concept of the environmental management
CO2: Analyze the environmental sub-systems and its impact on business
CO3: Understand the Parliament functions related to environmental legislation
CO4: Understand and Apply the environmental act and safety rules in industry
CO5: Understand the public policies for industry and business

Course Contents

Unit I	Environmental Management	(08 Hours)

Concept and scope, Systems and approaches, Standards -international and national; Ecomark; Environmental accounts and auditing, Green funding and taxes, Trade and environmental management.

Unit II	Environment Impact on Business	(08 Hours)

Social, Economic, Political, Cultural, Legal and constitutional sub-systems of environment and their impact on Business. Constitution of India: Fundamental rights and duties, Directive Principles of State Policy, 74th Amendment of the Constitution pertaining to local Governments.

Unit III	Environmental Legislation	(08 Hours)

How the Parliament functions- Bill to Act to Rules. How a Bill is issued in parliament and how it becomes an Act, How a rule is notified/Gazetted. Difference between Regulation, Law and Notification Bills.

Unit IV	Environmental Act and safety rules	(08 Hours)

Introduction to Environmental Acts, Factory Act, Safety Related rules. Environmental Policy of the Government of India for Industrial Location with respect to Ecology. The Command & Control Regime and The Economics Instruments Regime.

Unit V	Public Policy for Industry and Business	(08 Hours)
Environmental Policy of the Government of India and the working of the Ministry of Environment and Forests, Central Pollution Control Board, State Pollution Control Boards. Annual Report of the Ministry of Environment and Forests (current year)		

Learning Resources

Reference Books:

1. Government & Business – by Amarchand, Tata McGraw Hill.
2. Government & Business Management – by Kumar & Ghosh
3. Business Law – Bulechandani. K. R.
4. Mercantile Law – Barra and Kelra.
5. The Economics of Development and Planning – by M. L. Jhingan.
6. Microeconomic Theory & Welfare Economics – by P. N. Chopra
7. Economic Development – Problems, Principles & Ploicies – by Benjamin Higgins.
8. Economic Development – Past & Present – by Gill
9. Economic Development of Business – by Dr. M. Adhikari

e-Books:

1. https://archive.nptel.ac.in/content/storage2/courses/120108004/module1/lecture1.pdf

MOOC/NPTEL/YouTube Links:

1. http://kcl.digimat.in/nptel/courses/video/114106017/L01.html
2. https://www.youtube.com/watch?v=4mvGAfgvrAI

Savitribai Phule Pune University
M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)
Course Code: PCC-502-ENV Course Name: Environmental Chemistry

Teaching Scheme	Credit	Examination Scheme
Theory: 04 Hours/Week	04	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To study the fundamentals of environmental chemistry and chemical kinetics
2. To study the environmental aquatic chemistry
3. To study the fundamentals of atmospheric chemistry
4. To study the fundamentals of soil chemistry
5. To study the emerging areas of the environmental chemistry

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand the environmental chemistry and chemical kinetics
CO2: Analyze the environmental aquatic chemistry
CO3: Understand and analyze the atmospheric chemistry
CO4: Analyze the nature of soil and its chemistry
CO5: Understand the emerging areas of the environmental chemistry

Course Contents

Unit I	INTRODUCTION	(08 Hours)

Stoichiometry and mass balance-Chemical equilibria, acid base, solubility product(Ksp), heavy metal precipitation, amphoteric hydroxides, CO2 solubility in water and species distribution – Chemical kinetics, First order, Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation

Unit II	AQUATIC CHEMISTRY	(08 Hours)

Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation– Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction, Eh – pH diagrams, redox zones, Fe – sorption- Chemical speciation

Unit III	ATMOSPHERIC CHEMISTRY	(08 Hours)

Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion, greenhouse gases and global warming, CO2 capture – Acid rain - origin and composition of particulates. Air quality parameters-effects and determination

Unit IV	SOIL CHEMISTRY	(08 Hours)

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil. Reclamation of contaminated land.

Unit V	EMERGING AREAS	(08 Hours)
Principles of green chemistry, Atom economy, mass index - Nano materials, CNT, titania, composites, environmental applications		

Learning Resources

Reference Books:

1. Sawyer, C. N., MacCarty, P.L. and Parkin, G.F., Chemistry for Environmental Engineering and Science, Tata McGraw – Hill, Fifth edition, New Delhi 2003.
2. Colin Baird 'Environmental Chemistry', Freeman and company, New York, 1997.
3. Manahan, S.E., Environmental Chemistry, Eighth Edition, CRC press, 2005.

Ronbald A. Hites ,Elements of Environmental Chemistry, Wiley, 2007.

e-Books:

1. **https://tech.chemistrydocs.com/Books/Environmental/Environmental-Chemistry-by-Stanley-E.-Manahan.pdf**

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/playlist?list=PLLy_2iUCG87CZ8WsOQA3WWb1IqAuAlAuB**
2. **https://www.youtube.com/watch?v=bnLE4YxHsyA&list=PLLy_2iUCG87CZ8WsOQA3WWb1IqAuAlAuB&index=2**
3. **https://www.youtube.com/watch?v=cAooAgQVvec&list=PLLy_2iUCG87CZ8WsOQA3WWb1IqAuAlAuB&index=3**

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PCC-503-ENV

Course Name: Wastewater Treatment Technology and Design

Teaching Scheme	Credit	Examination Scheme
Theory: 04 Hours/Week	04	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To study the fundamentals of calculation in the design of wastewater treatment technologies.
2. To study the design of fluid flow operation for wastewater treatment
3. To study the design of filtration process for wastewater treatment
4. To study the design of adsorption and ion exchange for wastewater treatment
5. To study the design of biological processes for wastewater treatment

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Apply the basic calculations in the design of wastewater treatment technologies
CO2: Design of fluid flow operation processes for wastewater treatment
CO3: Design of filtration equipments for wastewater treatment
CO4: Design of adsorption and ion exchange processes for wastewater treatment
CO5: Design of biological processes for wastewater treatment

Course Contents

Unit I	Fundamental calculations in design of wastewater treatment	(08 Hours)

Mass transport processes, Mass balance analysis, types of reactions, reaction kinetics, Configurations of ideal and non-ideal reactors, principles of ideal reactor design. Basic principle of mass transfer, Gas-liquid mass transfer, Two film theory Introduction to process selection

Unit II	Design of fluid operations	(08 Hours)

Coagulation processes, stability of colloids and destabilization, coagulants Flocculation theory, orthokinetic and perikinetic Design of slow and rapid mixers. Sedimentation, particle settling theory, types of settling and related theory, types of clarifier, high rate clarification, design of clarifiers.

Unit III	Design of filtration process	(08 Hours)

Introduction to depth filtration, filtration processes, principal mechanisms of filtration, filter hydraulics, backwash hydraulics, Rate control patterns and methods, design and operation of slow sand, rapid sand and dual media filters

Unit IV	Design of Adsorption and Ion exchange process	(08 Hours)

Adsorption processes, causes and types of adsorption, influencing factors, adsorption equilibria and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of GAC and PAC contactors, Ion exchange, exchange materials, exchange capacity, ion exchange chemistry and

reactions, applications for hardness and TDS removal, design of ion exchange softener

Unit V	Design of biological Processes	(08 Hours)

Objectives and fundamentals of biological treatment, types of biological treatment processes. Conventional activated sludge process, process kinetics and design considerations, process control measures, operational problems, Introduction to modifications. Trickling filter, classification, process design considerations. Fundamentals of anaerobic treatment, general design considerations, types of anaerobic reactors.

Learning Resources

Reference Books:

1. METCALF & EDDY, INC. " Wastewater Engineering - Treatment, Disposal, and Reuse", Third Edition, Tata McGraw-Hill Publishing CompanyLimited, New Delhi 1995.
2. CASEY. T.J. " Unit Treatment Processes in Water and Wastewater Engineering ", John Wiley & Sons England 1993.

e-Books:

1. **Wastewater treatment technologies : Design consideration by Mariyunjay Chaubay**
   https://onlinelibrary.wiley.com/doi/book/10.1002/9781119765264

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=4GvxExPqvfY**
2. **https://www.youtube.com/watch?v=RBUyY9e1SmY**
3. **https://archive.nptel.ac.in/courses/103/107/103107217/**

Savitribai Phule Pune University

M.E. Second Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PCC-504-ENV

Course Name: Membrane Technology in Environmental Engineering

Teaching Scheme	Credit	Examination Scheme
Theory: 04 Hours/Week	04	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To study the basic concept of membrane technology
2. To study the application of membrane processes in environmental engineering
3. To study the preparation techniques of synthetic membrane
4. To study the membrane characterization
5. To study the membrane modules and process design

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Understand the basic concept of membrane used and membrane technology
CO2: Apply the membrane processes in environmental engineeringCO3: Develop and prepare the synthetic membrane
CO4: Analyse the characterization of the membrane
CO5: Design of various types of the membrane modules

Course Contents

Unit I	**Introduction to Membrane Processes, Membranes and Modules**	**(08 Hours)**

Principles of Membrane processes; Types and uses of membranes; Recent development in membranes; Types and uses of modules; Washing procedures

Unit II	**Applications of Membrane Processes in Environmental Engineering**	**(08 Hours)**

Membrane bioreactors; Pervaporation and its applications; Reverse Osmosis, Ultrafiltration and Microfiltration and their applications; Dialysis and Electrodialysis and their applications; Others

Unit III	**Preparation of Synthetic Membranes**	**(08 Hours)**

Introduction, preparation of synthetic membranes, phase inversion membranes, preparation technique for immersion precipitation, preparation technique for composite membranes.

Unit IV	**Characterization of Membranes**	**(08 Hours)**

Introduction, membrane characterization, characterization of porous membranes, characterization of ionic membranes, characterization of non porous membranes.

Unit V	**Module and process design**	**(08 Hours)**

Introduction, plate and frame model, spiral wound module, tubular module, capillary module, hollow fiber model, comparison of module configurations.

Case studies of Selected Environmental Processes with Membrane Technology

Learning Resources

Reference Books:

1. M.H.V. Mulder, Membrane Separations. Kluwer Publications
2. S.P. Nunes, and K.V. Peinemann, membrane Technology in the chemical industry, Wiley-VCH.
3. R. Rautanbach and R.Albrecht, Membrane Process, John Wiley & Sons.
4. R.Y.M. Huang, Pervaporation Membrane Separation Processes, Elsevier.
5. J.G. Crespo, K.W. Boddekes, Membrane Processes in Separation and Purification, Kluwer Academic Publications.
6. Larry Ricci and the staff of chemical engineering separation techniques, Mc Graw Hill publications

e-Books:

1. **Membrane Technology and Environmental Application:**
   https://ascelibrary.org/doi/book/10.1061/9780784412275
2. **Membrane Technology and Application:**
   https://www.eng.uc.edu/~beaucag/Classes/Properties/Books/Richard%20W.%20Baker(auth.)%20-%20Membrane%20Technology%20and%20Applications,%20Third%20Edition%20(2012).pdf

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=TFEiSRV-UzM**
2. **https://www.youtube.com/watch?v=ZLtqnDJXEgc**

Savitribai Phule Pune University
M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PCC-505-ENV **Course Name: Advanced Environmental Laboratory- I**

Teaching Scheme	Credit	Examination Scheme
Practical : 04 Hours/Week	**02**	**Term Work : 25 Marks** **Oral : 25 Marks**

Course Objectives:

The objective of the course is to,

1. To perform the experiments of water analysis
2. To determine the environmental data and find out the solution to environmental model

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Analyze the water characteristics by using analytical equipment.
CO2: Find the environmental data and develop the model

Course Contents & Guidelines

Each student should perform at least 8 experiments/ assignments from the list given below and submit the journal which will form the term-work for the subject

1. Determination of pH of water
2. Determination of Turbidity of water
3. Determination of Conductivity (Organic and Inorganic)
4. Determination of Total Dissolved Solids (Organic and Inorganic)
5. Determination of Alkalinity
6. Determination of Acidity
7. Determination of Chlorine
8. Determination of Iron
9. To measure common parameters using Ion Selective Methods
10. Analysis of water quality
11. Water analysis for physico-chemical characteristics
12. Analysis of water samples for metals using AA Spectrometer
13. Analysis of Phosphate by using ascorbic acid method
14. Analyze and modeling of selected problems and design of algorithms appropriate to their solution
14. Use of iteration technique in environmental modeling
15. To study the comparison between discrete and continuous models.
16. To validate a model and sensitivity analysis.

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-521A-ENV : [Elective-I]

Course Name: Modeling of Environmental systems

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	**03**	**CCE: 50 Marks** **End-Semester: 50 Marks**

Course Objectives:

The objective of the course is to,

1. To study the fundamentals of modeling of environmental systems
2. To study the different air quality models
3. To study the climate change model
4. To study the environmental models of river
5. To the application of environmental model

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Understand the fundamentals of modeling of environmental systems
CO2: Develop the different air quality models
CO3: Develop the climate change model
CO4: Develop the environmental models for river
CO5: Apply the environmental models

Course Contents

Unit I	**Modeling Concept**	**(06 Hours)**

Definition, Classification, Examples and Models of Environmental Systems. modeling objectives and choices, sensitivity analysis and sources of error, introduction to numerical methods, reaction type and orders of reactions conservation of mass, energy and momentum, river/stream quality

Unit II	**Air quality models**	**(06 Hours)**

Introduction to air quality models; Air pollution meteorology; Atmospheric turbulence; Gaussian Plume model and Modifications; Simulations of special meteorological and topographic conditions; urban diffusion models, Model Calibration. Sensitivity Analysis, Applications.

Unit III	**Climate change**	**(06 Hours)**

Climate change and the Models for Climatic change

Unit IV	**Water Characteristics Model**	**(06 Hours)**

Introduction to river, estuarine and lake hydrodynamics, Dissolved Oxygen Models; Temperature Models, prediction of fate of organism and toxic substances.

Unit V	**Environmental models**	**(06 Hours)**

Models for management applications, case study

Learning Resources

Reference Books:

1. R.V. Thompson and J.A. Muller Principles of Surface water Quality Modeling and Control Harper International Edition, N.D. 1987.
2. Richard W. Boubel, Donald L. Fox, D. Bruce Turner and Arthur C. Stera: Fundamentals of Air Pollution, Academic Press, 1994.
3. J.H. Seinfeld: Air Pollution, Physical and Chemical fundamentals, McGraw Hill 1990.
4. G.M.Masters, Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 1997
5. J.G. Henry and G. W. Heike, Environmental Science & Engineering", Prentice Hall International Inc., New Jersy, 1996.
6.Process Dynamics in Environmental System by W.J. Weber and F. Digiamo 1995 Wiley Intisene

e-Books:

1. **Modeling and simulation of environmental system:**

https://www.taylorfrancis.com/books/edit/10.1201/9781003203445/modeling-simulation-environmental-systems-satya-prakash-maurya-akhilesh-kumar-yadav-ramesh-singh

MOOC/NPTEL/YouTube Links:

1. https://www.youtube.com/watch?v=7V88Er4r2a0
2. https://www.youtube.com/watch?v=OBqrM9V1tjE
3. https://www.youtube.com/watch?v=1dKVK1oo9vg

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-521B-ENV : [Elective I]

Course Name: Environmental Auditing

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	03	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To study the concept of environmental audit process
2. To study the principles of environmental management systems
3. To study the various elements of successful environmental management
4. To study the legal and regulatory concerns of environmental audit
5. To study the environmental audit case studies

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Understand the concept of environmental audit
CO2: Understand the principles of environmental management systems
CO3: Identify and apply the various elements of successful environmental management
CO4: Understand the legal and regulatory concerns of environmental audit
CO5: Prepare the environmental audit reports by analyze the various case studies

Course Contents

Unit I	Concepts of Environmental Audit	(06 Hours)

Concepts of Environmental Audit, Objectives of audit. Types of audits, Features of effective auditing, Programme Planning, Organization of auditing programme, Pre-visit data collection, Audit protocol, Onsite audit, Data Sampling: Inspections, Evaluation and presentation, Exit interview. Audit Report – Action Plan – Management of audits. Waste management contractor audits, Life cycle approach.

Unit II	Successful environmental management	(06 Hours)

Introduction, Principles of Successful environmental management. ISO Principles, EMS, Creating an environmental management system in line with ISO 14000. Benefits of an environmental management system

Unit III	Elements of environmental management	(06 Hours)

Elements of successful environmental management: Leadership, Environmental management planning, Implementing an environmental management system, Measurement and evaluations required for an environmental management system, Environmental management reviews and improvements

Unit IV	Audit legal and regulation	(06 Hours)

Legal and regulatory concerns. Integrating ISO 9000 and ISO 14000

Unit V	Audit Report	(06 Hours)
Environmental audit case studies, audit reports		

Learning Resources

Reference Books:

1. Maheswar Dayal, "Renewable Energy Environment & Development", Konark Pub. Pvt. Ltd., 1998.
2. Girdhar Gyani and Amit Lunia, "Planning & Implementation of ISO 14001, Environmental Management System", Raj Publishing House, Jaipur, 2000
3. Joseph Caseion (Ed.) "The ISO 14000 Handbook", CEMM Information Services.
4. Don Sayre, "INSIDE ISO 14000 – The Competitive Advantage of Environmental Management", Vinity Books International, New Delhi, 2001
5. Ritchie, I & Hays, W., "A Guide to Implementation of the ISO 14000 Series on Environmental Management", Prentice Hall, New Jersy, 1998.

e-Books:

1. Environmental Auditing ebook, by Cliff VanGuilder

https://ebooks.inflibnet.ac.in/esp12/chapter/environmental-auditing/

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=0RZhK-lLp6E**
2. **https://www.youtube.com/watch?v=fTYenZ_5-yQ**
3. **https://www.youtube.com/watch?v=kAfe8FpzNOs**

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-521C-ENV : [Elective I]

Course Name: Environmental Policies and Legislations

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	03	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To study the national and international environmental policies
2. To study the clean water and air act significant legislations
3. To study the various norms and standards environmental policies
4. To study the various issues related to the design and decision making for controlled environment

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Understand the various aspects of national and international environmental policies
CO2: Understand the clean water and air act significant legislations
CO3: Understand the various norms and standards environmental policies
CO4: Identify the various issues related to the design and decision making for controlled environment

Course Contents

Unit I	Introduction	(06 Hours)

Role of national, international, and UN agencies in dealing with the environmental aspects. Standards and setting criteria

Unit II	Historical aspects	(06 Hours)

Major legislations: USEPA 1969 to Clean Water and Air Act. Significant legislations in developing and developed countries

Unit III	Legislations in Indian context	(06 Hours)

Indian Forest Act 1950, 1980, and amendments. Acts related to air and water pollution

Unit IV	Norms & Standards	(06 Hours)

OHSHAS 18001 and its significance. ISO 14000 and its significance, other acts in ESE and case studies. Feasibility Studies and Management issues

Unit V	Related Issues	(06 Hours)

Principles of sustainable development and implications of finite biosphere and complexities for engineering design and decision-making. Design of controlled environments to enhance health and protection of natural resources for sustainable development. Resource problems and design with ecological, economic, demographic and social dimensions. Techniques to integrate knowledge and define policy

Learning Resources

Reference Books:

1. Meyers A. Robert (Eds.) Encyclopedia of Environmental Analysis and Remediation Vol. 1-8, John Wiley & Sons, 1998.
2. Handbook of Accident prevention, ILO Publication, 1998.
3. Encyclopaedia of Industrial Safety and Health, 1999.
4. G.M.Masters, Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 1997
5. J.G. Henry and G. W. Heike, Environmental Science & Engineering", Prentice Hall International Inc., New Jersy, 1996

e-Books:

1. Environmental Policy And Law Kindle Edition by Rishi Kapoor (Author), Ashish Pandey (Author)

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=0bkA4aWwHu4**

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-521D-ENV [Elective I]

Course Name: Air and Noise Pollution Control

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	03	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To study the sources, classification and characteristics of air pollutants
2. To study the fundamentals of various equipments for control of particulates
3. To study the design of adsorption equipments using for gaseous pollution control
4. To study the control measures of gaseous pollutions and its industrial applications
5. To study the basic concept of noise pollution

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Identify the various sources, classification and characteristics of air pollutants
CO2: Understand the principal and working process of various equipment used for control of particulates
CO3: Design of adsorption equipment using for gaseous pollution control
CO4: Identify the control measures of gaseous pollutions and its industrial applications
CO4: Understand the noise pollution sources and characteristics and its control measures.

Course Contents

Unit I	INTRODUCTION	(06 Hours)

Sources and classification of Air Pollutants: Natural contaminants - aerosol -gases and vapour. Air quality standards - Meteorology and Air pollution: Atmospheric stability and inversions-mixing height-plume behaviour - plume rise estimation - effluent dispersion theories-Isokinetic sampling- Modeling.

Unit II	CONTROL OF PARTICULATES	(06 Hours)

Objectives - Filters, gravitational, centrifugal-multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory-particle charging-particle collection-ESP design procedure.

Unit III	GASEOUS POLLUTANT CONTROL	(06 Hours)

Absorption: principles, description of equipment-packed and plate columns, design and performance equations. Adsorption: principal adsorbents, equipment descriptions-PSA-adsorption cycle-solvent recovery system continuous rotary bed-fluidized bed, Design and performance equations. Condensation: contact condensers-shell and tube condensers, design and performance equation. Incineration : hydrocarbon incineration kinetics, equipment description, design and performance equations.

Unit IV	CONTROL MEASURES FOR INDUSTRIAL APPLICATIONS	(06 Hours)

Control methods - Processes based control mechanisms - mineral products -asphaltic concrete, cement plants and glass manufacturing plants; Thermal power plants, Petroleum refining and storage plants, Fertilizers, Pharmaceuticals and wood processing industry. Field Study.

Unit V	Noise Pollution	(06 Hours)

Introduction, Characteristics. Sources, their Effects and Control Measures

Learning Resources

Reference Books:

1. Air Pollution Control Engineering by N.D. Nevers (1995) MC Graw Hill
2. Air Pollution by H.C. Perkins MC Graw Hill (latest edition)
3. Noise Pollution by Tripathy, Debipras (latest edition)

e-Books:

1. **https://link.springer.com/book/10.1007/978-1-4612-6236-7**
2. **https://www.scribd.com/document/668122689/Air-and-Noise-Pollution-Control**

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=u142u-wJFwI**
2. **https://www.youtube.com/watch?v=StL9XX7qwCc**
3. **https://www.youtube.com/watch?v=z4YFkK3Wtsg**
4. **https://www.youtube.com/watch?v=LzceTg1qdiw**
5. **https://www.youtube.com/watch?v=rU54fNc9vEc**

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-522-ENV **Course Name: Skill Based Laboratory-I**

Teaching Scheme	Credit	Examination Scheme
Practical : 02 Hours/Week	**02**	**Term Work : 25 Marks** **Oral: 25 Marks**

Course Objectives:

The objective of the course is to,

1. To analyses the data through case studies
2. To study the practical application of environmental technologies

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Analyze the environmental data through case studies related to environment.

CO2: Apply the environmental technologies and analyses the experimental data

Course Contents & Guidelines

Each student should complete 02 industrial case studies from the list given below and submit the report which will form the term-work for the subject

i. Industrial gaseous pollution control
ii. Environmental Audit
iii. Climate change model
iv. Water characteristics model
v. Environmental Management
vi. Noise pollution control
vii. Norms and standards environmental policies

SEMESTER-II

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PCC-551-ENV

Course Name: Industrial Pollution Prevention & Cleaner Production

Teaching Scheme	Credit	Examination Scheme
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End-Semester: 50 Marks**

Course Objectives:

The objective of the course is to,

1. To study the industrialization activities and sustainable development environment
2. To study the concept of pollution prevention and cleaner production
3. To study the project development and its implantation of pollution prevention and cleaner production
4. To study the life cycle assessment of environmental management systems.
5. To study the various industrial case studies related to pollution prevention and cleaner production

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Understand the industrial activities and environment pollution prevention
CO2: Understand the concept of pollution prevention and cleaner production
CO3: Develop the project of pollution prevention and cleaner production
CO4: Analyze the life cycle assessment of environmental management systems
CO5: Analyze the various case studies related to pollution prevention and cleaner production

Course Contents

Unit I	Industrial Activity and Environment	(08 Hours)

Industrialization and Sustainable Development – Indicators of Sustainability-Sustainability Strategies – Barriers to Sustainability – Industrial Ecology – Pollution Prevention (PP) and Cleaner Production (CP) in achieving Sustainability- Prevention versus Control of Industrial Pollution – Environmental Policies and Regulations to encourage Pollution Prevention and Cleaner Production – Regulatory versus Market-based approaches.

Unit II	Concept of Pollution Prevention and Cleaner Production	(08 Hours)

Definition – Importance - Historical Evolution – Benefits - Promotion - barriers – Role of Industry, Government and Institutions - Environmental Management Hierarchy – Source Reduction techniques – Process and Equipment Optimization, Reuse, Recover, Recycle, Raw material substitution - Internet information and Other PP and CP Resources

Unit III	Project development and implementation	(08 Hours)

Overview of CP Assessment steps and skills, Preparing the site, Information gathering, and Flow diagram, Material balance, PP and CP Option generation, Technical and Environmental Feasibility analysis, Total Cost analysis - PP and CP Financing, Establishing a Program - Organizing a Program- Preparing a program plan - Measuring progress – Pollution Prevention and Cleaner Production Awareness Plan - Waste Audit-Environmental Statement.

Unit IV	Life Cycle Assessment and Environmental Management Systems	(08 Hours)
Elements of LCA - Life Cycle Costing – Eco labeling – Designs for the Environment – International Environmental Standards- ISO 14001 - Environmental Audit.		
Unit V	**Case Studies**	**(08 Hours)**
Industrial Applications of PP and CP, LCA, EMS and Environmental Audits		

Learning Resources

Reference Books:

1. Paul L. Bishop, "Pollution Prevention: Fundamentals and Practice", McGraw-Hill International, 2000.
2. World Bank Group, "Pollution Prevention and Abatement Handbook-Towards Cleaner Production", World Bank and UNE, Washington D.C., 1998.
3. Freeman, H.M, Industrial Pollution Prevention Handbook", McGraw Hill", 1995.
4. James G. Mann and V.A. Liu, "Industrial Water Reuse and Wastewater Minimization", McGraw Hill, 1999.
5. Prasad Modak, C. Visvanathan and Mandar Parasnis, "Cleaner Production Audit Environmental System Reviews", No. 38, Asian Institute of Technology; Bangkok, 1995.

e-Books:

1. **Hand book: https://www.sciencedirect.com/book/9780080964461/handbook-of-pollution-prevention-and-cleaner-production**

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=b0MHNxxWQjM**
2. **https://www.youtube.com/watch?v=ixKUUwOS73g**
3. **https://www.youtube.com/watch?v=B1Ku8uAehxU**

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PCC-552-ENV **Course Name: Solid Waste Management**

Teaching Scheme	Credit	Examination Scheme
Theory: 04 Hours/Week	04	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To study the solid waste management and properties
2. To study the solid waste generation rate
3. To study the sorting and material recovery methods of solid waste generation
4. To study the composting of solid waste
5. To study the landfill method and present Indian scenario of solid waste management

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Understand the solid waste management and analyse the solid waste properties
CO2: Analyze the solid waste generation rate
CO3: Analyze the sorting and material recovery methods of solid waste generation
CO4: Apply the knowledge of composting of solid waste in industry
CO5: Apply the landfill methods and understand the present Indian scenario of solid waste management system.

Course Contents

Unit I	**Solid waste management Overview**	**(08 Hours)**

Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties

Unit II	**Solid waste generation rate**	**(08 Hours)**

Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location, Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles

Unit III	**Sorting and material recovery**	**(08 Hours)**

Objectives, Stages of sorting, Sorting operations, Guidelines for sorting for material recovery, Typical material recovery facility for a commingled solid waste

Unit IV	**Composting of solid waste**	**(08 Hours)**

Principles, Methods, Factors affecting, Properties of compost, Vermicomposting. Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options.

Unit V	**Landfills**	**(08 Hours)**

Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.
Indian scenario: Present scenario and measures to improve system for different functional elements of solid waste management system. Elements of financial management plan for solid waste system.

Learning Resources

Reference Books:

1) Manual on municipal solid waste management – Government of India publication.
2) Integrated solid waste management – George Tchobanoglous. McGraw Hill
3) Solid waste management handbook– Pavoni

e-Books:

1. **Handbook:** https://www.accessengineeringlibrary.com/content/book/9780071356237
2. **Solid waste management_UNEP_2005:** https://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/E-Learning/Moocs/Solid_Waste/W2/Solid_waste_management_UNEP_2005.pdf

MOOC/NPTEL/YouTube Links:

1. https://www.youtube.com/watch?v=k0ktJRoRcOA&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=2
2. https://www.youtube.com/watch?v=ZHdBK5QDd54&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=3
3. https://www.youtube.com/watch?v=jZhEe4q2GzE&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=4
4. https://www.youtube.com/watch?v=at5NuSbIiW8&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=5
5. https://www.youtube.com/watch?v=cV9Vjw9ky5c&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=6
6. https://www.youtube.com/watch?v=c1t-P8zgmsw&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=7
7. https://www.youtube.com/watch?v=Hi4zFTqzf7Q&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=8
8. https://www.youtube.com/watch?v=bTgTp70_TtE&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=9
9. https://www.youtube.com/watch?v=Ac1d2aOw4Qw&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=10
10. https://www.youtube.com/watch?v=mnontR8NKqk&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=11
11. https://www.youtube.com/watch?v=ilI4Qi5cU00&list=PLwdnzlV3ogoXAap_BHeApkcF7M8nt13hv&index=13

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PCC-553-ENV **Course Name: Industrial Waste Remediation**

Teaching Scheme	Credit	Examination Scheme
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End-Semester: 50 Marks**

Course Objectives:

The objective of the course is to,

1. To study the flow of water use in industry and wastewater generation
2. To study the reuse and recycle concept of water in industry
3. To study the various treatment techniques for removal of pollutants from water
4. To study the sewage treatment plant
5. To study the water usage, Sources, Quantities, and characteristics of effluents, Pollution effects, Methods of treatment, utilization and disposal, in various industries

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Analyze the flow of water use in industry and wastewater generation
CO2: Develop the concept of reuse and recycle of water in industry
CO3: Analyze the various treatment techniques for removal of pollutants from water
CO4: Analyze the sewage treatment methods
CO5: Analyze the water usage and effluent generation and treatment methods of various industries.

Course Contents

Unit I	Industrial Water Quality	(08 Hours)

Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Monitoring of wastewater flow in industries, Quality and quantity variations in waste discharge, Water budgeting

Unit II	Industrial Wastewater reuse and recycle	(08 Hours)

Waste volume reduction, Waste strength reduction, Neutralization, Proportioning, Equalization. Reuse and recycling concepts

Unit III	Treatment Techniques of Wastewater	(08 Hours)

Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium, toxic organics, heavy metals, radioactivity.

Unit IV	Treated industrial wastewater with domestic sewage	(08 Hours)

Treatability aspects of raw industrial wastewater with domestic sewage, Partially treated industrial wastewater with domestic sewage, Completely treated industrial wastewater with domestic sewage. Stream and Effluent standards.
Common Effluent treatment plant: Concept, Objectives, Methodology, Cost benefit analysis, Design, Operation and maintenance.

Unit V	Water Usage in Industry	(08 Hours)

Classification of industries. Manufacturing processes, Water usage, Sources, Quantities, and characteristics of effluents, Pollution effects, Methods of treatment, utilization and disposal, in industries

viz. sugar, distillery, dairy, pulp and paper mill, fertilizer, tanning, steel industry, textile, petroleum refining, chemical and power plant

Learning Resources

Reference Books:

1) Theories and Practices of Industrial waste treatment- Nelson Nemerow.
2) Waste water treatment: M. N. Rao & Datta.
3) IS Standard guide for treatment and disposal of various industries

e-Books:

1. **https://techknowledgebooks.com/?product=industrial-waste-treatment-2**
2. **Handbook: https://www.sciencedirect.com/book/9780750679633/industrial-waste-treatment-handbook**

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=Ee8RqLKgGUg**
2. **https://www.youtube.com/watch?v=fHRxhuMQQnE&list=PLbRMhDVUMngdeOSgQOe399aBKqdxkxNCp**
3. **https://www.youtube.com/watch?v=fHRxhuMQQnE&list=PLbRMhDVUMngdeOSgQOe399aBKqdxkxNCp&index=1**

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PCC-554-ENV

Course Name: Advanced Environmental Laboratory – II

Teaching Scheme	Credit	Examination Scheme
Practical: 04 Hours/Week	**02**	**Term Work : 25 Marks** **Oral : 25 Marks**

Course Objectives:

The objective of the course is to,

1. To perform the experiments of water analysis
2. To analyze the characteristics of water

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Analyze the water characteristics by using analytical equipment.
CO2: Design of water treatment plant and preparation of filed visit report

Practical List

Each student should '**perform**' at least **08** experiments from the list given below and submit the journal which will form the term-work for the subject.

The laboratory work will be based on completion of assignments confined to the courses of that Semester.
The assessment will be done jointly by the pair of internal and external examiners along with the oral examination of the same.

Experiments:

1. Determination of Dissolved Oxygen (DO) in Water
2. Determine the Nitrate Nitrogen
3. Determination of Optimum Dose of Coagulant
4. Determination of Chlorine Demand
5. Determination of Total Phosphorus
6. Determination of Chemical Oxygen Demand (COD) of Waste water
7. Determination of Biochemical Oxygen Demand (BOD) of Waste water
8. Test for Coliforms in Water
9. Determination of phenol.
10. To study the adsorption Characteristics of the given cation exchange resins.,
11. Determination of heavy metals.
12. To study the performance Ion Exchange Column
13. Development of flow sheet of effluent treatment plant.
10. Designing of plant using software such as EnviroPro / SuperPro
11. Field visit to a water treatment plant and preparation of visit report.
12. Field visit to a wastewater treatment plant and preparation of visit report.
13. Analysis of water quality

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-561A-ENV: Elective II

Course Name: Modern Trends in Environmental Engineering

Teaching Scheme	Credit	Examination Scheme
Theory: 04 Hours/Week	**04**	**CCE: 50 Marks** **End-Semester: 50 Marks**

Course Objectives:

The objective of the course is to,

1. To study the emerging fields in environmental science engineering
2. To study the environmental pollution monitoring sensors
3. To study the Anthropogenic Endocrine Disruption
4. To study the land pollution and its methods
5. To study the composting and its methods

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Understand the emerging fields in environmental science engineering
CO2: Analysis of environmental pollution monitoring sensors
CO3: Understand the anthropogenic endocrine disruption scientific basis
CO4: Apply the treatment methods of land pollution
CO5: Understand the composting and apply the incineration for air pollution control

Course Contents

Unit I	Emerging fields in ESE	(06 Hours)

Emerging fields in ESE: Cleaner Production Technologies, Environmental Bio-Technology, Bioremidiation, Risk Analysis, Software and Information Systems, Global Issues.

Unit II	Environmental pollution monitoring sensors	(06 Hours)

Environmental pollution monitoring sensors. Basic understanding of the interaction of electromagnetic radiation, sound, laser etc. with matter. Familiarization with a variety of sensors and platforms

Unit III	Anthropogenic Endocrine	(06 Hours)

Anthropogenic Endocrine Disruption. The Scientific Basis of the Endocrine Hypothesis. Scientific Uncertainty, Risk Analysis and Policy Response.

Unit IV	Land Pollution	(06 Hours)

Land pollution- Definition and scope, necessity and importance, Treatment methods: Various methods of refuse processing, fertilizer, fuel and food values. Sanitary land filling - definition, methodology, trench, area, ramp, pit method, site selection, basic steps involved, cell design, prevention of site pollution, Leachate treatment, gas collection and recirculation.

Unit V	Composting and incineration	(06 Hours)

Composting – Aerobic and anaerobic composting, Factors affecting composting Indore and Bangalore processes of composting. Incineration - Processes 3Ts to control high temperature incinerators, design approach prevention of air pollution.

Learning Resources

Reference Books:

1. Special issue and reviews articles on the relevant topics in Science, Scientific American, Nature, Current Science and Environmental Science and Engineering.
2. C.S. Foster and D.A. Johnwase, Environmental Biotechnology, (Ellis Harwood) (1987).
3. B. Vallely, '1001Ways to Save the Planet', (Ivy Books) New York (1990)
4. Solid Waste Management , Van Nostrand Reinhold Co. 1975.
5. C.L. ell, Solid Waste Management, John Wiley, 1975.
6. P.W. Powers. How to dispose of toxic substances and industrial Waste, Noyes Data Corporation, England, 1976.

e-Books:

New Trends in environmental engineering: https://www.mdpi.com/books/reprint/3993-new-trends-in-environmental-engineering-agriculture-food-production-and-analysis

MOOC/NPTEL/YouTube Links:

1. https://www.youtube.com/watch?v=NRoFvz8Ugeo
2. https://www.youtube.com/watch?v=8FjhsODW1q4
3. https://www.youtube.com/watch?v=Ar04qG1P8Es

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-561B-ENV: Elective II

Course Name: Unit Operations in Environmental Engineering

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	03	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To study the selection of preliminary physical unit operations in environmental engineering
2. To study the concept of sedimentation and floatation in environmental engineering
3. To study the concept of filtration and gas transfer in environmental engineering
4. To study the chemical unit processes used in environmental engineering
5. To study the biological unit processes used in environmental engineering

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Identify and apply the preliminary physical unit operations for environmental engineering
CO2: Apply the sedimentation and floatation concept in environmental engineering
CO3: Apply the concept of filtration and gas transfer in environmental engineering
CO4: Apply the chemical unit processes used in environmental engineering
CO5: Apply the chemical unit processes used in environmental engineering

Course Contents

Unit I	PRELIMINARY PHYSICAL UNIT OPERATIONS	(06 Hours)

Factors in selection of unit operations and processes - Principal type of Reactors – Flow measurement – Screening - Flow Equalization - Mixing - Static and Mechanical mixers - Coagulation and Flocculation - Perikinetic and Orthokinetic flocculation.

Unit II	SEDIMENTATION AND FLOATATION	(06 Hours)

Sedimentation - Type of settling - Removal ratio - Tray and Titled plate settlers - Flotation - Dissolved air flotation

Unit III	FILTRATION AND GAS TRANSFER	(06 Hours)

Filtration - Type of filters - Headloss through filters - Carmen-Kozeny equation - Gas Transfer -Two film Theory - Mass transfer coefficient - Oxygenation capacity.

Unit IV	CHEMICAL UNIT PROCESS	(06 Hours)

Chemical precipitation - phosphate removal - Adsorption – Manufacturing of Activated carbon - ADSORPTION kinetics , Isotherms - Disinfection – Factors Influencing – Breakpoint chlorination, Leaching, Leaching calculations, Ion Exchange.

Unit V	BIOLOGICAL UNIT PROCESSES	(06 Hours)

Kinetic of Biological growth - Suspended and attached growth processes - Aerobic and Anaerobic - Determination of kinetic coefficients.

Learning Resources

Reference Books:

1. METCALF & EDDY, INC. "Wastewater Engineering - Treatment, Disposal, and Reuse", Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 1995.
2. CASEY. T.J. "Unit Treatment Processes in Water and Wastewater Engineering ", John Wiley & Sons England, 1993

e-Books:

1. Unit operation in environmental engineering by Louis Theodore , 2018:

   https://onlinelibrary.wiley.com/doi/book/10.1002/9781119283706

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=6u9L0nVUYPY**
2. **https://www.youtube.com/watch?v=eknrvqLtbsc**
3. **https://www.youtube.com/watch?v=Q3oBgiEdcNU**
4. **https://www.youtube.com/watch?v=C8ghKCUfcQk**
5. **https://www.youtube.com/watch?v=wUl5E1SZqBo**

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-562C-ENV : Elective II

Course Name: Agriculture Pollution and Control

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	**03**	**CCE: 50 Marks** **End-Semester: 50 Marks**

Course Objectives:

The objective of the course is to,

1. To study the agricultural environmental issues and air pollution control in agriculture
2. To study the water pollution and its control in agriculture
3. To study the soil pollution and its control in agriculture
4. To study the waste management in agriculture
5. To study the agricultural environmental management best practices and implementation

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Analysis of agricultural environmental issues and air pollution control in agriculture
CO2: Analysis of water pollution and its control in agriculture
CO3: Analysis of soil pollution and control in agriculture
CO4: Analysis and control of waste management in agriculture
CO5: Apply the best practices of agricultural environmental management

Course Contents

Unit I	**Introduction to Environmental Issues and Pollution**	**(06 Hours)**

Environmental Basics, Pollution in Agriculture, Impact of Agriculture on the Environment, Air Pollution and Control in Agriculture: dentifying and characterizing air pollutants associated with agriculture, such as dust, particulate matter, ammonia, and volatile organic compounds, Sources of Air Pollution, Air Pollution Control Technologies, Regulations and Standards.

Unit II	**Water Pollution and Control in Agriculture**	**(06 Hours)**

Water Pollutants: Identifying and characterizing water pollutants from agriculture, including nutrient runoff, pesticides, and pathogens. Sources of Water Pollution: Analyzing sources of water pollution in agriculture, such as agricultural runoff, irrigation practices, and livestock waste. Water Pollution Control Technologies: Exploring water pollution control technologies, such as stormwater management, waste treatment, and best management practices. Water Quality Monitoring: Discussing methods for monitoring water quality and assessing the impact of agricultural practices on water resources.

Unit III	**Soil Pollution and Control in Agriculture**	**(06 Hours)**

Soil Pollutants: Identifying and characterizing soil pollutants in agriculture, including heavy metals, persistent organic pollutants, and excess nutrients. Sources of Soil Pollution: Analyzing sources of soil pollution in agriculture, such as pesticide and fertilizer use, livestock waste, and industrial agriculture. Soil Restoration and Remediation: Exploring methods for restoring and remediating contaminated soil, including phytoremediation and bioremediation.

Unit IV	Waste Management in Agriculture	(06 Hours)
Agricultural Waste: Identifying and characterizing different types of agricultural waste, including livestock waste, crop residues, and processing waste. Waste Management Practices: Discussing waste management practices, such as composting, anaerobic digestion, and land application of waste. Resource Recovery: Exploring opportunities for resource recovery from agricultural waste, such as biogas production and nutrient recycling.		
Unit V	**Environmental Management in Agriculture**	**(06 Hours)**
Sustainable Agriculture: Promoting sustainable agriculture practices that minimizes environmental impact. Integrated Pest Management: Discussing integrated pest management techniques to reduce pesticide use. Nutrient Management: Exploring strategies for efficient nutrient management to reduce fertilizer runoff. Best Management Practices: Implementing best management practices for various agricultural activities. Environmental Auditing: Discussing the importance of environmental auditing in agriculture.		

Learning Resources

Reference Books:

1. Bucharest, Code of Good Agricultural Practices for Farmers' Use Vol. I - Water Protection against Pollution With Fertilizers From Agriculture And Prevention Of Soil Degradation Phenomena Caused By Agricultural Practices, 2002
2. C. D. Sawyan, Chemistry of Environmental Engineers. Mc Graw Hill Publ.
3. J.W. Moore and E.A. Moore, Environmental Chemistry
4. T.V.Ramachandra, Soil & Ground Water Pollution from Agricultural activities, TERI

e-Books:

1. **Pollution control for Agriculture :** https://shop.elsevier.com/books/pollution-control-for-agriculture/loehr/978-0-12-455270-8

MOOC/NPTEL/YouTube Links:

1. https://www.youtube.com/watch?v=zXMmrS_PeFQ
2. https://www.youtube.com/watch?v=kjFVYYyCMEQ
3. https://www.youtube.com/watch?v=AkUFQLNj6SI

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-561D-ENV :Elective II

Course Name: Environmental Impact Assessment & Economics

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	**03**	**CCE: 50 Marks** **End-Semester: 50 Marks**

Course Objectives:

The objective of the course is to,

1. To study the environmental impact assessment
2. To study the prediction and assessment impact on the biological, cultural and socio-economic environment
3. To study the Economic operation and environmental issues
4. To study the Economic Incentive and Environmental Protection
5. To study the tradable pollutions and its issues

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Analysis of environmental impact assessment and apply the environment decisions
CO2: Analysis of assessment impact on the biological, cultural and socio-economic environment
CO3: Analysis of Economic operation and handle the environmental issues
CO4: Analysis of Economic Incentive and Environmental Protection
CO5: Analysis of tradable pollutions and related issues and its control techniques.

Course Contents

Unit I	Environmental impact assessment	(06 Hours)

Introduction, Concepts and aims, Impact statement, Methods and Processes, Mitigation processes. Prediction and assessment of impact on air, water and noise. Public participation in environment decision making: Environment education and awareness, Environmental economics, Economics of Pollution control, Cost benefit analysis.

Unit II	Prediction and assessment of impacts	(06 Hours)

Prediction and assessment impact on the biological, cultural and socio-economic environment, Introduction and basic concepts. Environmental impact assessment of major development projects, industries, mining, thermal power plants, atomic power stations, transport (rail, road, highway), tourism (Hotels, beaches and resorts , EIA of different xenobiotics (chemicals, fertilizers, heavy metals).

Unit III	Economy and Environment	(06 Hours)

Economic operation and environmental issues, adversities on the economy. Markets and Environmental Assets Incomplete markets, externalities, non-exclusion, non- rivalry and public good, non-convexities, asymmetric information.

Unit IV	Economic Incentive and Environmental Protection	(06 Hours)

(i) Price rationing: Charges and subsidies,
(ii) Liability rules: Non-compliance fees, bonds and deposit refunds.
(iii) Quantity rationing: Marketable permits.

(iv) Evaluation criteria
(v) Practical Conditions for use of economic incentives.
(vi) Pollution Taxes, Efficiency properties of a tax on emissions, problems with pollution taxes.

Unit V	Tradable Pollution	(06 Hours)

Permits, Basic theory of tradable pollution permits, issues in tradable permits. Transboundary pollution problem, international organizations for environmental protection. WTO agreements on environment. Agrochemical pollution and measures undertaken: national and international scenario, bio-diversity and economy.

Learning Resources

Reference Books:

1. W. Canter " Environmental Impact Assessment" Mc Graw Hill (1996).
2. Peter Watten (Eds.) - `Environmental Impact Assessment Theory and Practice', Unwin Hyman, London (1988)
3. John G. Rau and David C. Woolen (Eds.) `Environmental Impact Analysis Hand Book', McGraw Hill, (1980).
4. Levy, Leboyer, C. Psychology and Environment (1982). London : Sage.
5. Cone, J.D. and Hayes, S.C. Environmental Problems / Behavioural Solutions (1980) California : Brooks Kole.
6. Altman, I. And Stokols, D. (Eds.) Handbook of Environmental Psychology (1987). New York : Wiley

e-Books:

1. **https://www.iitr.ac.in/wfw/web_ua_water_for_welfare/education/Teachers_Manual/Teacher_manual_master_EIA.pdf**
2. **Environmental impact Assessment : https://link.springer.com/book/10.1007/978-3-031-66797-8**

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=_iLdyhgFv1U**
2. **https://www.youtube.com/watch?v=DbZq9dlx6dY**
3. **https://www.youtube.com/watch?v=W1mGWQ1PCNM**
4. **https://www.youtube.com/watch?v=48cr5fCHeec**
5. **https://www.youtube.com/watch?v=TSOV3V3tYr0**
6. **https://www.youtube.com/watch?v=3iPdTrVxin8**
7. **https://www.youtube.com/watch?v=ck2g4TdsiE4**

Savitribai Phule Pune University

M.E. Second Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-562A-ENV : Elective-III

Course Name: Environmental Biotechnology

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	03	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To study the fundamentals of biotechnology and genetic engineering
2. To study the microbiology of wastewater treatment
3. To study the air pollution control through biotechnology
4. To study the bioremediation in detail
5. To study the novel methods of pollution control in biotechnology

Course Outcomes:

After successful completion of the course, learner will be able to:
CO1: Understand and apply the concept of biotechnology in the environment process
CO2: Apply the microbiology concept for waste water treatment
CO3: Apply the biotechnology concept in air pollution
CO4: Apply the bioremediation in biotechnology
CO5: Analyse and apply the biotechnology novel methods for pollution control

Course Contents

Unit I	Introduction	(06 Hours)

Concept of Environmental Biotechnology and Environmental Engineering, scope and importance. Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis. Introduction to Genetic Engineering and Recombinant DNA Technology (RDT), Restriction endonucleases, Steps in gene cloning, cDNA and genomic library, Chemical synthesis of gene, Polymerase Chain Reaction (PCR), Vectors and their types, Selection of recombinant clones.

Unit II	Microbiology of wastewater treatment	(06 Hours)

Microbiology of waste water treatment. a) Aerobic processes: Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes : Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industry.

Unit III	Air pollution control through biotechnology	(06 Hours)

Air pollution and its control through biotechnology, Biotechnology in reduction of CO2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.

Microbiology of degradation of xenobiotic in environment – ecological considerations, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biological detoxification of cynide, oxalate, urea, petrochemical industry effluents, toxic organics, phenols.

Unit IV	Bioremediation	(06 Hours)
Bioremediation, Types of bioremediations, Bioaugmentation for bioremediation, Bioreactors, Bioremediation of herbicides, pesticides, hydrocarbons, oil spills.		
Unit V	**Novel methods of pollution control**	**(06 Hours)**
Novel methods of pollution control – Vermitechnology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics.		

Learning Resources

Reference Books:

1. Microbial Biotechnology : A. N. Glazer and H. Nikaids .
2. Molecular Biotechnology : Gleek and Pasternack.
3. Biotechnology : A Text Book of Industrial Microbiology, T. D. Brock,
4. Industrial Microbiology : Presscott and Dunn.
5. Biotechnology : B. D. Singh , Kalyani Publishers

e-Books:

1. **Environmental biotechnology: Principles and applications:** https://www.accessengineeringlibrary.com/content/book/9781260441604
2. **Environmental biotechnology: Theory and applications:** https://www2.hcmuaf.edu.vn/data/quoctuan/Environmental%20Biotechnology%20-%20Theory%20and%20Application,%20G%20M%20Evans%20&%20J%20C%20Furlong.pdf

MOOC/NPTEL/YouTube Links:

1. https://www.youtube.com/watch?v=1mDNWdaOb9g&list=PLhsRFiX--f_bD6OWi2X1TFyq2EhmtoTZe&index=1
2. https://www.youtube.com/watch?v=TW4nJcyNBlA&list=PLhsRFiX--f_bD6OWi2X1TFyq2EhmtoTZe&index=2
3. https://www.youtube.com/watch?v=MyaIefUTS4E&list=PLhsRFiX--f_bD6OWi2X1TFyq2EhmtoTZe&index=3
4. https://www.youtube.com/watch?v=tY10w2wuu8I&list=PLhsRFiX--f_bD6OWi2X1TFyq2EhmtoTZe&index=5

Savitribai Phule Pune University

M.E. Second Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-562B-ENV : Elective-III

Course Name: Remote Sensing and GIS Application in Environmental Engineering

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	03	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To understand the fundamentals of remote sensing
2. To understand the platforms and sensors application in environment
3. To analyses the data processing
4. To understand the concept and data base structure of GIS
5. To apply the remote sensing and GIS in environmental engineering
6.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand the fundamentals of remote sensing
CO2: Understand the platforms and sensors application in environment
CO3: Analyses the data processing
CO4: Understand the concept and data base structure of GIS
CO5: Apply the remote sensing and GIS in environmental engineering

Course Contents

Unit I	FUNDAMENTALS OF REMOTE SENSING	(06 Hours)

Definition, Physics of Remote Sensing, Electromagnetic Radiation and its interactions with atmosphere, Spectral reflectance of earth materials and vegetation

Unit II	PLATFORMS AND SENSORS	(06 Hours)

Aerial Photographs, Active and passive sensors, Data products, Various satellites in orbit and their sensors

Unit III	DATA PROCESSING	(06 Hours)

Data analysis - Visual Interpretation and Digital Image Processing – classification

Unit IV	GIS	(06 Hours)

Introduction to GIS, concepts and Data base structure, various GIS softwares

Unit V	REMOTE SENSING AND GIS APPLICATIONS	(08 Hours)

Management and monitoring of land, air, water and pollution studies, conservation of resources, coastal zone management – Limitations

Learning Resources

Reference Books:

1. Lillies and T.M. and Kiefer, R.W., " Remote Sensing and Image Interpretation ", John Wiley and Sons, 1994.
2. Burrough, P.A. and McDonnell, R.A., " Principles of Geographical Information Systems", Oxford University Press, 1998.
3. Lintz, J. and Simonet, " Remote Sensing of Environment ", Addison Wesley Publishing Company, 1994.

e-Books:

1. Remote sensing & GIS application in environmental science
   https://ebooks.inflibnet.ac.in/esp06/
2. Overview of Remote Sensing and GIS Applications E-Book
   https://www.scribd.com/document/787280965/Overview-of-Remote-Sensing-and-GIS-Applications-E-Book

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=j2JuIIp5Eag**
2. **https://www.youtube.com/watch?v=QqICGe0TXhk**
3. **https://www.youtube.com/watch?v=Snc_p4eR4c0**
4. **https://www.youtube.com/watch?v=1zwg-siuvuc&list=PLp76zJxzEriMstHWJssWiczio7rtIAU6r**
5. **https://www.youtube.com/watch?v=rd16otLMbVw&list=PLp76zJxzEriMstHWJssWiczio7rtIAU6r&index=7**

Savitribai Phule Pune University

M.E. Second Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-562C-ENV: Elective-III

Course Name: Applied Statistics for Environmental Engineers

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	03	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. To understand and analyses the empirical statistics
2. To estimate the sampling distribution
3. To analyze the testing of hypothesis
4. To analyze the design methods of experiments
5. To apply the various methods of linear programing

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Understand and analyses the empirical statistics
CO2: Estimate the sampling distribution
CO3: Analyze the testing of hypothesis
CO4: Analyze the design methods of experiments
CO5: Apply the various methods of linear programing

Course Contents

Unit I	EMPIRICAL STATISTICS	(06 Hours)

Measures of Central tendency, dispersion, skewness and kurtosis. Principle of least squares - Correlation and regression - rank correlation

Unit II	SAMPLING DISTRIBUTIONS AND ESTIMATION	(06 Hours)

Sampling distributions - Point and interval estimates for population proportions, mean and variance – Maximum likelihood estimate method - Method of moments

Unit III	TESTING OF HYPOTHESIS	(06 Hours)

Sampling distributions - Tests based on Normal, t, Chi-square and F distributions - Analysis of variance – one-way and two-way classifications

Unit IV	DESIGN OF EXPERIMENTS	(06 Hours)

Completely randomized design - Randomized block design – Latin square design - 2 power 2 factorial design

Unit V	LINEAR PROGRAMMING	(06 Hours)

Basic concepts - Graphical and Simplex methods – Transportation problem - Assignment Problem.

Learning Resources

Reference Books:

1. Berthouex, P.U., " Statistics for Environmental Engineers ", Lewis Publ., 1994.
2. Freund, J.E. and Miller, I.R., " Probability and Statistics for Engineers ", Prentice – Hall of India, 5th Edition, New Delhi, 1994.
3. Gupta, S.C. and Kapur, V.K., "Fundamentals of Mathematical Statistics ", Sultan Chand & Sons, New Delhi, 1999.
4. Ang, A.H.S. and Tang W.H., "Probability concepts in Engineering Planning and Design – Basic Principles Vol.1 ", John Wiley and Sons, Inc. New Delhi, 1975.
5. Taha, H.A., " Operations Research: An Introduction ", Prentice - Hall of India, 6th Edition, New Delhi, 1997.
6, Wayne, R. Ott Environmental Statistics and Data Analysis, CRC Press. (1995).

e-Books:

Applied statistics and probability for engineers

https://industri.fatek.unpatti.ac.id/wp-content/uploads/2019/03/088-Applied-Statistics-and-Probability-for-Engineers-Douglas-C.-Montgomery-George-C.-Runger-Edisi-5-2011.pdf

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=Tay0rqeeMyg**
2. **https://www.youtube.com/playlist?list=PLMc0PsvITOku19afGWLhtA63gWPZpWBuK**

Savitribai Phule Pune University

M.E. Second Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: PEC-562D-ENV : Elective-III

Course Name: Water Resources Optimization and Water Quality Modelling

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	03	CCE: 50 Marks End-Semester: 50 Marks

Course Objectives:

The objective of the course is to,

1. Introduction to modelling, identifying problems, conceptualization and using mathematical tools to solve surface water quality and ground water quality problems
2. To understand simulation, optimization techniques and multi objective programming including dynamic programming
3. To understand field applications by going through case studies which use algorithms as problem solving techniques

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Identify problems, conceptualise, formulate a model using few basic parameters

CO2: Application of optimization techniques to water resources problems like water allocation from reservoir to different users

CO3: Apply the Linear Programming (LP to Water Resources Problems

CO4: Ability to distinguish between various water quality models and optimization techniques and choose an appropriate one to suit the objectives to be satisfied.

Course Contents

Unit I	Water Resources System Modeling	(06 Hours)

Introduction to modeling; Definition and purpose of modeling; Types of models; Modeling protocol; Model development; Calibration and verification; Application of modeling techniques to water resource development and management.

Unit II	Optimization of Water Resources System	(06 Hours)

Introduction to optimization and its application in water resources system management Problem formulation: decision variables, objective function Constraints, water resources planning process Systems analysis techniques: simulation, optimization, linear programming, dynamic programming, integer programming multi objective programming and nonlinear programming problems.

Unit III	Linear Programming (LP): Application to Water Resources Problems	(06 Hours)

Assumptions, problems formulation and solutions, graphical methods, simplex algorithm, duality concept, sensitivity analysis Examples, reservoir for irrigation and power production, water resources systems River water quality optimization Water supply and drainage network optimization, Dynamic programming application.

Unit IV	Surface Water Quality Modeling	(06 Hours)
Nature of problems; Modeling rivers, streams, eustaries and lakes, indicator bacteria, Dissolved oxygen eutrophication and toxic substances.		
Unit V	**Ground Water Quality Modeling**	**(06 Hours)**
Nature of problems; Modeling ground water aquifers contamination, salt water intrusions; Major application of groundwater models; Numerical Modeling of groundwater systems; Numerical examples; Groundwater modeling by Finite element method (FEM) and Finite difference method (FD).		

Learning Resources

Reference Books:

1. Douglas A.H (1982) Environmental System Optimization, John Wiley & Sons, New York.
2. Steven C.C. (1993) Surface Water-Quality Modeling, McGraw Hill Boston.
3. Vedula S. and Mujumdar P. P. (2005) Water Resources Systems: Modeling Techniques and Analysis, Tata MacGraw-Hill Publishing Company Limited.

Suggested readings

1. Douglas A.H. (1982) Environmental System Optimization, John Wiley & Sons, New York.
2. Rastogi A.K. (2008) Numerical Groundwater Hydrology, Penram International Publishing Pvt. Ltd., Bombay.
3. Robert V.T. and John A.M. (1987) Principles of Surface Water Quality Modeling and Control, Harper and Row Publisher, New York.
4. Steven C.C. (1993) Surface Water-Quality Modeling, McGraw Hill Boston.

e-Books:

Journals

1. American Society of Civil Engineers Journal of Water Resources Planning
2. Management International Journal of Water Resources Development

MOOC/NPTEL/YouTube Links:

1. https://www.youtube.com/watch?v=x1mD79Vk7RE
2. https://www.youtube.com/watch?v=jQnb2nZfzSM

Savitribai Phule Pune University

M.E. Second Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: SEM-571-ENV Course Name: Technical Seminar-I

Teaching Scheme	Credit	Examination Scheme
Practical: 04 Hours/Week	**02**	**Term Work : 25 Marks** **Oral : 25 Marks**

Course Objectives:

The objective of the course is to,

1. To identify the research problem
2. To conduct the literature review
3. To Analyze the research data
4. To improve the communication and presentation skills
5. To develop the critical thinking

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Identify and develop the research problem

CO2: Analysis of the experimental or research data

CO3: Develop the knowledge of conducting the literature review.

CO4: Develop the communication skill through the presentation and report writing

Guidelines

The assessment of the student should be conduct based on-

i. Research Literature review
ii. Data Analysis
iii. Presentation skill
iv. Seminar report

SEMESTER-III

Savitribai Phule Pune University M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern) Course Code: RM-631-ENV Course Name: Research Methodology		
Teaching Scheme	**Credit**	**Examination Scheme**
Theory: 05 Hours/Week	**05**	**CCE: 50 Marks** **End-Semester: 50 Marks**

Course Objectives:

The objective of the course is to,

1. To study the fundamentals of research methodology
2. To study the various quantitative methods and analysis for problem solving
3. To study the representation of data by tabular and graphical and role of computer in research
4. To study the structure and components of research report preparation
5. To study the nature and process of Intellectual Property Rights

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Formulate the research problem through the literature review and prepare the steps of research process.

CO2: Identify and analysis of quantitative methods for problem solving and design of experiments

CO3: Develop the research data and represent it by tabular and graphically and undersant the role of computers in research work.

CO4: Develop the research report preparation

CO5: Understand the process of Intellectual Property Rights

Course Contents

Unit I	Introduction	(08 Hours)

Research methodology: Definition of scientific and technical research, Objectives of research Types of research, Various steps in research process, Problem formulation, Literature search and information management, Research plan, Mathematical tools for analysis, Developing a research question-choice of a problem, Literature review: surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research purposes, Ethics in research – APA Ethics code.

Unit II	Quantitative methods for problem solving	(08 Hours)

Statistical modeling and analysis, Time series analysis probability distributions, Fundamentals of statistical analysis and inference, Multivariate methods, Concepts of correlation and regression, Fundamentals of time series analysis and spectral analysis, Error analysis, Applications of spectral analysis, Evaluation of results.

Design of Experiments:

a) Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic

principles-replication, randomization, blocking, Guidelines for design of experiments.
b) Single Factor Experiment: Hypothesis testing, Analysis of Variance components (ANOVA)for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components, Model adequacy checking.
c) Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two-factor factorial design; Models-Effects, means and regression, Hypothesis testing.

Unit III	Tabular and graphical description of data	(08 Hours)

Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables, Relation between frequency distributions and other graphs, Preparing data for analysis.

Soft Computing:

Computer and its role in research, Use of statistical soft ware SPSS, GRETL etc. in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

Unit IV	Structure and Components of Research Report and Presentation	(08 Hours)

Types of report, Layout of research report, Mechanism of writing a research report, Referencing in academic writing, Research report preparation: abstract, description of instruments and materials, experimental procedures, description of results, discussion of results, conclusions.
Citation methods: Foot Note, Text Note, End Note and Bibliography. Writing a blogSpot, Article, Essay, Research Paper, Research Project, Legislation Drafting, Judgment Writing, Thesis, Dissertation, Book, Reviews - Book Review; Case Review. Presentation: Scientific and technical presentations, Planning the presentation (formulation of objectives, analysis of audience), Preparing the presentation, Presentation delivery techniques, Organizing the presentation forum

Unit V	Introduction to Intellectual Property Rights	(08 Hours)

Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. Recent Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Softwares etc. Traditional knowledge Case Studies, IPR and IITs.

Learning Resources

Text Books:

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa, Prakashan, 2006
2. Donald H. McBurney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315- 0047-0,2006

Reference Books:

1. Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw- Hill Co. Ltd., 2006.
2. Fuzzy Logic with Engg Applications, Timothy J. Ross, Wiley Publications, 2nd Ed[d]
3. Simulated Annealing: Theory and Applications (Mathematics and Its Applications, by P.J. van Laarhoven & E.H. Aarts[e]
4. Genetic Algorithms in Search, Optimization, and Machine Learning by David E. Goldberg.
5. Beach, D. P. and T.K.E. Alvager, 1992, Handbook for Scientific and Technical Research, Prentice-Hall, Englewood Cliffs, N.J.
6. Day, R. A., 1988, How to Write and Published Scientific Paper, Oryx Press, Phoenix, AZ, 1988
7. Hautala, P.C., 1989, Technical and Managerial Communication, Univ. of Idaho Press, Moscow, ID

8. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007
9. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New”

e-Books:

1. **Research Methodology by C.T. Kothari, https://repository.dinus.ac.id/docs/ajar/Kothari_-_Research_Methodology_Methods_and_Techniques_-_2004.pdf**
2. **Research Methodology by Dr. Nishikant Jha, https://www.drnishikantjha.com/papersCollection/Research%20Methodology%20.pdf**

MOOC/NPTEL/YouTube Links:

1. **https://www.youtube.com/watch?v=E2gGF1rburw**
2. **https://www.youtube.com/watch?v=e_qZ1UWSXAo**
3. **https://www.youtube.com/watch?v=Jccuwu18c5A**
4. **https://www.youtube.com/watch?v=mgudvPjuiU0**
5. **https://www.youtube.com/watch?v=ePLCKVrl4SI**
6. **https://www.youtube.com/watch?v=WVIi1teYnGU**
7. **https://www.youtube.com/watch?v=olLZ5UNT8Xs**
8. **https://www.youtube.com/watch?v=aQM3M8o-VvA**
9. **https://www.youtube.com/watch?v=WvNionbk4rU**

Savitribai Phule Pune University

M.E. First Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: OJT-641-ENV Course Name: Internship / On-job Training

Teaching Scheme	Credit	Examination Scheme
Practical: 10 Hours/Week	05	Term Work : 100 Marks

Course Objectives:

The objective of the course is to,

1. To gain the knowledge for apply the theoretical knowledge in practical demonstration
2. To analyses the troubleshoot in the process and safety of industry
3. To gain the environmental knowledge of the industry

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: To enable students to learn the basic concepts and apply the theoretical knowledge in practical demonstration

CO2: To enable students to implement Project Planning in their Industrial In-plant Training Project work.

CO3: To be capable of self-education and clearly understand the value of achieving Perfection in the respective industrial work

CO4: To understand the concept of Facility, Location & Layout & implement in their Industrial In-plant training work.

CO5: An understanding of the impact of engineering solutions and industrial safety in a global and social context.

CO6: An ability to function on Multi-disciplinary teams and familiar with organizational behavior and management.

Guidelines

The T&P cell will arrange internship for students in industries/organization after second, fourth and six/seventh semester(s) or as per AICTE/ affiliating University guidelines. Institutions may also device online system for arranging &managing internships. The general procedure for arranging internship is given below:

- **Step 1: Request Letter/ Email from the office of Training & Placement cell** of the college should go to industry to allot various slots of 4-6 weeks during summer vacation as internship periods for the students. Students request letter/profile/ interest areas may be submitted to industries for their willingness for providing the training. (Sample attached)

- **Step 2: Industry will confirm the training slots** and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students in the office of Training & Placement through concerned department. Based on the number of slots agreed to by the Industry, TPO will allocate the students to the Industry. In addition, the internship slots may be conveyed through Telephonic or Written Communication (by Fax, Email, etc.) by the TPO or other members of the T&P cell / Faculty members who are particularly looking after the Final/Summer Internship of the students.

- **Step 3: Students on joining Training** at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

- **Step 4: Students undergo industrial training** at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department office/TPO with the consent of Industry persons/ Trainers. (Sample Attached)
- **Step 5: Students will submit training report** after completion of internship.
- **Step 6: Training Certificate** to be obtained from industry.
- **Step 7: List of students** who have completed their internship successfully will be issued by Training and Placement Cell.

Savitribai Phule Pune University

M.E. Second Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: SEM-632-ENV **Course Name: Technical Seminar-II**

Teaching Scheme	Credit	Examination Scheme
Practical: 06 Hours/Week	**03**	**Term Work : 25 Marks** **Oral : 25 Marks**

Course Objectives:

The objective of the course is to,

1. To identify the research problem
2. To conduct the literature review
3. To Analyze the research data
4. To improve the communication and presentation skills
5. To develop the critical thinking

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Identify and develop the research problem

CO2: Analysis of the experimental or research data

CO3: Develop the knowledge of conducting the literature review.

CO4: Develop the communication skill through the presentation and report writing

Guidelines

The assessment of the student should be conduct based on-

v. Research Literature review
vi. Data Analysis
vii. Presentation skill
viii. Seminar report

Savitribai Phule Pune University

M.E. Second Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: RP-642-ENV Course Name: Research Project-I

Teaching Scheme	Credit	Examination Scheme
Practical: 18 Hours/Week	**09**	**Term Work : 25 Marks** **Oral : 25 Marks**

Course Objectives:

The objective of the course is to,

1. The student should be able to choose and evaluate the problem based on current interest of research at national and international level.
2. To train the student to acquire the technical data.
3. To develop analyzing ability amongst the students.
4. To train the students to make use of available resources and to procure the resources to carry out his/her project work.
5. To initiate and orient the students with R & D skills.
6. To give the students the exposure of recent advances at national and international level
7.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Conduct the research literature survey and to identify and formulate the engineering problem.

CO2: Apply the mathematical concepts, science concepts, engineering concepts, management principles and engineering tools necessary to solve the identified engineering problem.

Project Work

The project work shall be based on the knowledge acquired by the student during the coursework and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.

Project Work Stage – I

Project work Stage – I is an integral part of the project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation (Mathematical Model/SRS/UML/ERD/block diagram/ PERT chart, etc.) and Layout & Design of the Set-up. As a part of the progress report of Project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected dissertation topic. The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

The assessment will be done jointly by the pair of internal and external examiners along with the oral/presentation examination of the same.

Important instructions:

1. The ME candidate is required to work on Original Topic.
2. It should not be the repetition earlier reported work.
3. The student is required to carry out broad literature survey in the area of work.
4. The justification for selection of project topic and originality of the topic is to be mentioned in the Project Report.
5. The student will make presentation of his project work for assessment purpose.
6. All supporting documents, samples, products, soft copies to be preserved and presented at the time of examination.

SEMESTER-IV

Savitribai Phule Pune University

M.E. Second Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: SEM-671-ENV

Course Name: Seminar / Publication on Research Projet-II

Teaching Scheme	Credit	Examination Scheme
Practical: 08 Hours/Week	**04**	**Term Work : 50 Marks** **Oral : 50 Marks**

Course Objectives:

The objective of the course is to,

1. To identify the research problem
2. To improve the communication and presentation skills
3. To conduct the literature review
4. To develop the critical thinking

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Identify and develop the research problem

CO2: Develop the communication skill through the presentation and report writing

CO3: Develop the knowledge of conducting the literature review.

CO4: Develop the knowledge of paper writing and publication skill

Guidelines

The assessment of the student should be conduct based on-

ix. Seminar report
x. Presentation skill
xi. Paper writing skill
xii. Paper publication skill

Savitribai Phule Pune University

M.E. Second Year of Environmental Engineering (Chemical) (2025 Pattern)

Course Code: RP-681-ENV Course Name: Research Project-II

Teaching Scheme	Credit	Examination Scheme
Practical : 36 Hours/Week	**18**	**Term Work : 150 Marks** **Oral : 50 Marks**

Course Objectives:

The objective of the course is to,

1. The student should be able to choose and evaluate the problem based on current interest of research at national and international level.
2. To train the student to acquire the technical data.
3. To develop analyzing ability amongst the students.
4. To train the students to make use of available resources and to procure the resources to carry out his/her project work.
5. To initiate and orient the students with R & D skills.
6. To give the students the exposure of recent advances at national and international level.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Conduct the research literature survey and to identify and formulate the engineering problem

CO2: Apply the mathematical concepts, science concepts, engineering concepts, management principles and engineering tools necessary to solve the identified engineering problem.

CO3: Analyze and interpret results of experiments conducted on the designed solution(s) to arrive at valid conclusions

CO4: Demonstrate professionalism with ethics; present effective communication skills, writing skills and relate engineering issues to broader societal context

CO5: Apply the ethical principles, social benefits, environmental, health and safety issues, individual and team work and leadership knowledge.

Project Work Stage - II

In Project Work Stage – II, the student shall complete the remaining part of the project which will consist of the fabrication of set up required for the project, work station, conducting experiments and taking results, analysis & **validation of results and conclusions**. The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

It is mandatory for every student that his Project Outcomes (results and conclusion) are validated' in the form of minimum one Publication (published or accepted) in a refereed and peer reviewed journal of international repute till the date he/she appears for the Project Work Stage II examination. (Communicated papers will not be considered as publication)

The assessment will be done jointly by the pair of internal and external examiners along with the oral examination of the same.

Important instructions:

1. The ME candidate is required to work on Original Topic.
2. It should not be the repetition earlier reported work.
3. The student is required to carry out broad literature survey in the area of work.
4. The justification for selection of project topic and originality of the topic is to be mentioned in the Project Report.
5. The student will make presentation of his project work for assessment purpose.
6. The project report is to be submitted in Standard Hard Bound format.
7. It is mandatory for the candidate to participate and present his work at any (national/international) conference/seminar or publish his/her work in any (national/international) journal during the tenure till oral exam is conducted. (In some cases paper accepted (before the date of oral examination) for presentation or publication in conference or journal will be considered.
8. All supporting documents to be maintained

ME Environmental Engineering – Chemical 2025 Pattern

Task Force for Curriculum Design and Development

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