PPSU

P P SAVANI UNIVERSITY

SCHOOL OF ENGINEERING

M. TECH. (CHEMICAL ENGINEERING)

SYLLABUS BOOK

AY 2025-26

INSTITUTE VISION
To emerge as an Institute of Excellence by imparting value-based education aided with Research, Innovation and Entrepreneurial skills.

INSTITUTE MISSION	
1.	To impart the holistic engineering education of highest quality & prepare socially responsible professionals with entrepreneurial skills.
2.	To prepare value-aided engineering professionals to meet up global industry requirements by imparting cutting edge professional education.
3.	To inculcate the attitude of research and innovation among the stake holders through experiential and project-based teaching-learning pedagogy.
4.	To acquire global talent pool by providing world class amenities for teaching, learning & research.

Graduates will demonstrate ability to:

PEO No	PROGRAMME EDUCATIONAL OBJECTIVES
PEO 1	Solve real-world engineering problems, design and develop innovative and cost-effective solutions exhibiting engineering skills/fundamentals to cater needs of society.
PEO 2	Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting comprehensive competitiveness.
PEO 3	Exhibit professional ethics & values, effective communication, teamwork, multidisciplinary approach, and ability to relate engineering issues to broader societal framework.

PO No	PROGRAMME OUTCOMES
PO 1	Engineering knowledge: Apply knowledge of engineering fundamentals, science, mathematics & engineering specialization for the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate and analyze complex engineering problems leading to substantial conclusions using basic principles of mathematics, science and engineering.
PO 3	Design/development of solutions: Develop solutions for complex engineering problems and design system components or processes meeting specified needs having due consideration for the safety and societal &environmental considerations.
PO 4	Conduct investigations of complex problems: Use research-based knowledge & methods like design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid & viable conclusions.

PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and ITtools for prediction and modeling of complex engineering activities with an understanding of the limitations.
PO 6	The engineer and society: Apply cognitive learning by the contextual knowledge to assess societal, health, safety, legaland cultural issues and following responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge & skill needed for sustainable development.
PO 8	Values & Ethics: Apply basic moral values & ethical principles and pledge to professional ethics/norms andresponsibilities of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual/as a team member or as a leader in diverse teams, andin multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects inmultidisciplinary environments.
PO 12	Life-long learning: Recognize the need, do necessary preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO No	**PROGRAMME SPECIFIC OUTCOMES (PSO)** **CHEMICAL ENGINEERING**
PSO 1	Acquire and apply industry centric skills in the field of Chemical Engineering for the benefit of society.
PSO 2	Develop an attitude to accept global challenges and apply Chemical Engineering knowledge for solving engineering problems related to core and interdisciplinary fields.
PSO 3	Demonstrate and develop the appropriate solutions of the complex level of Chemical Engineering design-based problems to meet the specified needs and overall sustainabilityof the processes, considering the necessary approaches of safety, health hazards, societal and environmental factors.

Credit Guidelines (General)			
Component	**Hour/Week**	**Credit**	**Total Hours/Semester**
Theory	1	1	15
Practical	2	1	30
Tutorial	1	1	15
Note: In specific cases; extra credits can be granted for specific/important subjects.			

CO-PO Mapping Guidelines		
Mapping Level	**% age Mapping**	**Indicator**
0 / -	0	No Mapping
1	0-33	Low Level (Slightly Mapped)
2	33-66	Medium Level (Moderately Mapped)
3	>66	High Level (Strongly Mapped)

Syllabus Book

M. Tech.
(Chemical Engineering)

P P Savani University

School of Engineering

CONTENT

P P SAVANI UNIVERSITY																	
SCHOOL OF ENGINEERING																	
TEACHING & EXAMINATION SCHEME FOR M. TECH. (RESEARCH) IN CHEMICAL ENGINEERING AY: 2025-26																	
Sem	**Course Code**	**Course Title**	**Course Category**	**Offered By**	**Teaching Scheme**					**Examination Scheme**							
					Contact Hours				**Credit**	**Theory**		**Practical**		**Tutorial**		**Total**
					Theory	**Practical**	**Tutorial**	**Total**		**CE**	**ESE**	**CE**	**ESE**	**CE**	**ESE**	
1	SECH7010	Research Methodology And IPR	Major/Core	CH	3	0	2	5	5	40	60	0	0	40	60	200
	SECH7910	Research Project-I	RP/OJT	CH	0	10	0	10	10	0	0	80	120	0	0	200
		Elective Course-I	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
		Elective Course-II	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
							Total	**25**	**25**							**800**
2	SECE7010	Mathematical and Numerical Technique in Research	Major/Core	CE	3	0	2	5	5	40	60	0	0	40	60	200
	SECH7920	Research Project-II	RP/OJT	CH	0	10	0	10	10	0	0	80	120	0	0	200
		Elective Course-III	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
		Elective Course-IV	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
							Total	**25**	**25**							**800**
3	SECH8010	Scientific Communication	Major/Core	CH	3	0	2	5	5	40	60	0	0	40	60	200
	SECH8910	Research Project-III	RP/OJT	CH	0	10	0	10	10	0	0	80	120	0	0	200
		Elective Course-V	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
		Elective Course-VI	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
							Total	**25**	**25**							**800**
4	SECH8920	Major Research Project	RP/OJT	CH	0	25	0	25	25	0	0	200	300	0	0	500
							Total	**25**	**25**							**500**
							Grand Total	**100**	**100**							**2900**

		Elective Courses														
1	SECH7510	Physico-Chemical Processes For Wastewater Treatment	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
1	SECH7520	Basic Environmental Engineering And Pollution Abatement	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
1	SECH7530	Environmental Quality Monitoring & Analysis	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
1	SECH7540	Environmental Engineering	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
1	SECH7550	Fuel And Combustion Technology	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
1	SECH7560	Optimization In Chemical Engineering	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
2	SECH7570	Chemical Process Intensification	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
2	SECH7580	Novel Separation Processes	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
2	SECH7590	Advanced Reaction Engineering	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
2	SECH7600	Advanced Process Control	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
2	SECH7610	Soft Nano Technology	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
2	SECH7620	Characterization Of Polymers, Elastomers And Composites	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
3	SECH8510	Polymers: Concepts, Properties, Uses And Sustainability	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
3	SECH8520	Membrane Technology	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
3	SECH8530	Introduction To Colloid And Interface Science And Engineering	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
3	SECH8540	Mathematical Modelling And Simulation Of Chemical Engineering Process	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
3	SECH8550	Chemical Process Safety	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200
3	SECH8560	Corrosion/Environmental Degradation/Surface Engineering	Minor	CH	3	0	2	5	5	40	60	0	0	40	60	200

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH7010
Course Name: Research Methodology And IPR
Prerequisite Course(s): -

Teaching & Examination Scheme

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	-	2	5	40	60	0	0	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the course:

- To develop a strong foundation in mathematical modeling techniques that enable students to represent, analyze, and solve complex engineering and research problems using analytical and computational approaches.
- To equip students with advanced numerical methods for solving algebraic, differential, and partial differential equations that arise in real-world engineering systems and simulations.
- To enable the application of optimization techniques and data-driven modeling for research-based decision-making and process/system performance improvement in diverse engineering domains.
- To familiarize students with modern computational tools and software such as MATLAB, Python, Aspen Plus, and scientific libraries for effective simulation, analysis, and visualization of mathematical models.
- To enhance students' ability to apply statistical, probabilistic, and data analysis techniques for experimental data interpretation, hypothesis testing, and uncertainty quantification in engineering research.

Course Content:

Module	Content	Hour	Weightage In %
	Section I		
1	**Introduction to Research and Research Process** Meaning and objectives of research, Types of research: Fundamental, applied, exploratory, and empirical Research process and research problem formulation Criteria for good research	5	10
2	**Literature Survey and Research Ethics** Sources of literature and techniques for literature review, Use of databases and citation indexing (Scopus, Web of Science, Google Scholar), Research ethics and ethical codes, Plagiarism and tools for detection (Turnitin, Grammarly, etc.)	7	20
3	**Research Design and Methodology** Research design types: Descriptive, analytical, experimental, Sampling techniques and hypothesis formulation, Measurement scales and data collection methods, Case studies and surveys in research	5	10
4	**Data Analysis and Interpretation**	5	10

	Statistical analysis of data (mean, median, mode, standard deviation, etc.), Hypothesis testing, confidence intervals, p-values, Correlation and regression analysis, Data visualization and interpretation using software (Excel, SPSS, R, Python)		
Section II			
1	**Technical Writing and Research Documentation** Research paper, thesis, dissertation structure and formatting Referencing styles: IEEE, APA, MLA, Writing abstracts, technical reports, conference papers, Use of LaTeX, MS Word, and reference managers (Mendeley, Zotero)	5	10
2	**Introduction to IPR and Patent System** Overview of Intellectual Property Rights, Types: Patents, copyrights, trademarks, industrial designs, trade secrets Importance of IPR in research and innovation, Indian and international patent systems (WIPO, PCT)	8	20
3	**Patent Filing and Commercialization** Patent drafting, claims, and specification, Filing procedure in India and abroad, Patent search databases (Espacenet, USPTO, InPASS), Technology transfer and commercialization of IPR	5	10
4	**Case Studies and Contemporary Issues in IPR** Case studies of patent infringement and IP litigation, IPR in academia and industry collaborations, Startups and IP strategies, Future trends: AI and IP, Open Innovation, Creative Commons	5	10
	Total	45	100

Tutorials

Tutorial	Content	Duration (Hours)
1	Overview of research meaning, objectives, types (fundamental, applied, exploratory, empirical); research process	1
2	Steps in research problem formulation; criteria for good research	1
3	Sources of literature; techniques for literature review using databases (Scopus, Web of Science, Google Scholar)	2
4	Research ethics, ethical codes, plagiarism, tools (Turnitin, Grammarly)	2
5	Research design types (descriptive, analytical, experimental); sampling techniques	2
6	Hypothesis formulation; measurement scales and data collection methods	2
7	Statistical measures (mean, median, mode, standard deviation); hypothesis testing	2
8	Correlation, regression, confidence intervals, p-values; visualization using Excel, SPSS, R, Python	2
9	Structure and formatting of research papers, theses; referencing styles (IEEE, APA, MLA)	2
10	Writing abstracts, technical reports, conference papers; LaTeX, Mendeley, Zotero	2
11	Overview of IPR (patents, copyrights, trademarks, designs, trade secrets); importance in research	2
12	Indian and international patent systems (WIPO, PCT); patent filing basics	2
13	Patent drafting, claims, specifications; filing procedures; databases (Espacenet, USPTO, InPASS)	2
14	Technology transfer; commercialization of IPR	2

15	Patent infringement, IP litigation, academia-industry collaborations, startups, AI and IP, Open Innovation, Creative Commons	2

Text Book:

Title	Author(s)	Publication
Research Methodology: Methods and Techniques	C. R. Kothari, Gaurav Garg	New Age International Publishers

Reference Books:

Title	Author(s)	Publication
Research Methodology: A Step-by-Step Guide for Beginners	Ranjit Kumar	SAGE Publications
Intellectual Property Rights: Unleashing the Knowledge Economy	Prabuddha Ganguli	Tata McGraw-Hill

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks with a duration of 1 hour.
- Faculty Evaluation consists of 10 marks, as per the guidelines provided by the Course Coordinator.
- End Semester Examination will consist of a comprehensive 60 marks theory exam.

Tutorials:

- Continuous Evaluation consists of the performance in tutorials, which should be evaluated out of 10 marks for each tutorial in the next session. The average of these will be converted to 10 marks.
- Internal Viva component of 10 marks based on tutorial understanding and application.
- Tutorial-based assignment/quiz/problem-solving test of 20 marks during the End Semester Evaluation.
- Viva/Oral performance during the End Semester Evaluation carrying 10 marks.

Course Outcome(s):

After the completion of the course, students will be able to:

CO 1	Identify appropriate research problems and design suitable methodologies for academic and industrial research.
CO 2	Conduct comprehensive literature reviews using standard databases and apply ethical practices in research and writing.
CO 3	Analyze, interpret, and validate experimental data using statistical tools and visualization techniques.
CO 4	Prepare well-structured research documents and understand the publication process and citation ethics

Mapping of CO with PO

SECH7010	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO 1	3	1				2						2
CO 2	2	3	3	2	2							
CO 3	2	3	2	3								2
CO 4	2	3	3		2				2			

Mapping of CO with PSO

SECH7010	PSO1	PSO2	PSO3
CO 1	2	3	1
CO 2	3	2	2
CO 3	3	3	2
CO 4	3	3	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
01	Introduction to Research and Research Process	3,5
02	Literature Survey and Research Ethics	1,4
03	Research Design and Methodology	1,3
04	Data Analysis and Interpretation	2,6
05	Technical Writing and Research Documentation	1,5
06	Introduction to IPR and Patent System	3,4
07	Patent Filing and Commercialization	2,4
08	Case Studies and Contemporary Issues in IPR	3,4

P P Savani University School of Engineering

Department of Chemical Engineering

Course Code: SECH7910
Course Name: Research Project-I
Prerequisite Course/s: -

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
-	10	-	10	-	-	80	120	-	-	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the course:

To help learners to

- To engage students in identifying, formulating, and solving real-world research problems.
- To encourage independent and original thinking in designing, implementing, and evaluating computational methods.
- To promote the use of research methodology, scientific writing, and effective communication of results.

List of Practical's:

Sr. No.	Name of Practical	Hours
1.	Orientation, topic finalization, and problem statement definition.	10
2.	Literature review using IEEE/ACM/ScienceDirect databases.	20
3	Identification of research gap and formulation of research objectives.	10
4	Selection of methodology, tools, and technologies.	10
5	Initial prototype design or dataset collection/preprocessing.	10
6	Core development: algorithm/model/system design begins.	10
7	Implementation continues with performance testing.	30
8	Experimentation, result collection, tuning.	20
9	Result validation (graphs, statistical methods, comparisons).	20
10	Drafting research report/paper, presentation preparation	10

	TOTAL	150

Practical:

- Each student should be assigned a faculty guide.
- Regular weekly review meetings are mandatory.
- Mid-term internal evaluation and final external viva should be scheduled.
- Research should ideally be aligned with current thrust areas: chemical engineering, material science etc.

Course Outcome(s):

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

SECE7910	Research Project-I
CO1	Identify and define a research problem with reference to current trends in Chemical Engineering.
CO2	Analyze relevant literature and select appropriate tools and techniques.
CO3	Develop and implement innovative solutions or models for real-world problems.
CO4	Evaluate research findings and present technical documentation and publications.

Mapping of CO with PO

SECH7910	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	3	3	2	3	2	1						
CO 2	3	3	2	3	3							
CO 3	3	3	3	3	3	1	1					
CO 4	2	2	2	3	2							

Mapping of CO with PSO

SECH7910	PSO1	PSO2	PSO3
CO 1	3	2	3
CO 2	3	2	3
CO 3	3	2	3
CO 4	2	3	3

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH7510
Course Name: Physico-Chemical Processes For Wastewater Treatment
Prerequisite Course(s): -

Teaching & Examination Scheme

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	-	2	5	40	60	0	0	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the course:

To provide knowledge on fundamental physico-chemical treatment methods.
To understand mechanisms and equipment used in various treatment processes.
To study process integration for effective wastewater treatment.
To analyze efficiency and limitations of treatment technologies.

Course Content:

Module	Content	Hour	Weightage In %
	Section I		
1	**Introduction & Pre-Treatment Methods** - Water Pollution Overview - Flow Equalization & Aeration - Coagulation & Flocculation	2	10
2	**Primary Treatment Processes** - Sedimentation & Settling Chamber Design - Filtration & System Design	8	20
3	**Physico-Chemical Treatment Methods** - Adsorption & Ion Exchange - Membrane-Based Technologies	5	10
4	**Advanced Oxidation Processes (AOPs) - Basics** - Introduction to AOPs - Fenton & Catalytic Treatment	4	10
	Section II		
1	**Advanced Oxidation Processes (AOPs) - Advanced** - Photo-Induced Processes - Sono- & Electro-Chemical Treatment	4	10
2	**Industrial Wastewater Case Studies** - Process Industries - Chemical & Allied Industries	8	20
3	**Emerging Trends in Wastewater Treatment** - Nanotechnology Applications - Hybrid Treatment Systems	5	10

4	**Regulations & Sustainable Practices** - Environmental Compliance - Zero Liquid Discharge (ZLD) Approaches	4	10
	Total	45	100

Text Book:

Title	Author(s)	Publication
Wastewater Engineering: Treatment & Reuse	Metcalf & Eddy	McGraw-Hill, 5th Ed.

Reference Books:

Title	Author(s)	Publication
Principles of Water and Wastewater Treatment	Mackenzie Davis	Wiley, 2010
Advanced Oxidation Processes for Water Treatment	Mihaela I. Stefan	IWA Publishing, 2017

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks with a duration of 1 hour.
- Faculty Evaluation consists of 10 marks, as per the guidelines provided by the Course Coordinator.
- End Semester Examination will consist of a comprehensive 60 marks theory exam.

Tutorials:

- Continuous Evaluation consists of the performance in tutorials, which should be evaluated out of 10 marks for each tutorial in the next session. The average of these will be converted to 10 marks.
- Internal Viva component of 10 marks based on tutorial understanding and application.
- Tutorial-based assignment/quiz/problem-solving test of 20 marks during the End Semester Evaluation.
- Viva/Oral performance during the End Semester Evaluation carrying 10 marks.

Course Outcome(s):

After the completion of the course, students will be able to:

CO 1	Explain the principles and applications of coagulation, flocculation, and sedimentation.
CO 2	Analyze and design adsorption, ion exchange, and membrane separation processes.
CO 3	Evaluate the peformance of different treatment units

CO 4	Select suitable physico-chemical methods based on wastewater characteristics

Mapping of CO with PO

SECH7510	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1				2						2
CO 2	2	3	3	2	2							
CO 3	2	3	2	3								2
CO 4	2	3	3		2				2			

Mapping of CO with PSO

SECH7510	PSO1	PSO2	PSO3
CO 1	2	3	1
CO 2	3	2	2
CO 3	3	3	2
CO 4	3	3	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
01	Introduction & Pre-Treatment Methods	3,5
02	Primary Treatment Processes	1,4
03	Physico-Chemical Treatment Methods	1,3
04	Advanced Oxidation Processes (AOPs) - Basics	2,6
05	Advanced Oxidation Processes (AOPs) - Advanced	1,5
06	Industrial Wastewater Case Studies	3,4
07	Emerging Trends in Wastewater Treatment	2,4
08	Regulations & Sustainable Practices	3,4

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH7520
Course Name: Basic Environmental Engineering And Pollution Abatement
Prerequisite Course(s): -

Teaching & Examination Scheme

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	-	2	5	40	60	0	0	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the course:

To introduce basic concepts of environmental engineering.

To understand types and sources of pollution and their impact.

To study fundamental control technologies for air, water, and soil pollution.

To create awareness of environmental laws and sustainable practices.

Course Content:

Module	Content	Hour	Weightage In %
	Section I		
1	**Fundamentals of Ecology & Pollution** - Ecology, environment & biodiversity - Ecosystem services & risks - Pollution types & sources - Pollutant transmission	2	10
2	**Environmental Quality Standards** - Air & water quality standards - Industrial pollution standards - Environmental laws & regulations	8	20
3	**Pollution Monitoring & Prevention** - Air/water/waste sampling - Solid waste characterization - Pollution prevention strategies - Water optimization	5	10
4	**Air Pollution Control** - Control technologies 1-4 - Case studies	4	10
	Section II		
1	**Water & Wastewater Treatment** - Drinking water treatment - Primary & secondary treatment - Advanced treatment processes	4	10

2	**Industrial Pollution Control** - General process industries (GPI) - Sector-specific approaches 1-5	8	20
3	**Solid Waste Management** - Transformation technologies (Incineration, Gasification, Pyrolysis, AD) - Hazardous waste management	5	10
4	**Emerging Challenges** - Special category wastes - Circular economy approaches - Regulatory compliance	4	10
	Total	45	100

Text Book:

Title	Author(s)	Publication
Environmental Pollution Control Engineering	C.S. Rao	New Age International

Reference Books:

Title	Author(s)	Publication
Wastewater Engineering	Metcalf & Eddy	McGraw-Hill
Air Pollution Control	Cooper & Alley	Waveland Press

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks with a duration of 1 hour.
- Faculty Evaluation consists of 10 marks, as per the guidelines provided by the Course Coordinator.
- End Semester Examination will consist of a comprehensive 60 marks theory exam.

Tutorials:

- Continuous Evaluation consists of the performance in tutorials, which should be evaluated out of 10 marks for each tutorial in the next session. The average of these will be converted to 10 marks.
- Internal Viva component of 10 marks based on tutorial understanding and application.
- Tutorial-based assignment/quiz/problem-solving test of 20 marks during the End Semester Evaluation.
- Viva/Oral performance during the End Semester Evaluation carrying 10 marks.

Course Outcome(s):

After the completion of the course, students will be able to:

CO 1	Identify major environmental pollutants and their sources.
CO 2	Explain environmental impacts and control measures.
CO 3	Apply basic treatment principles for pollution abatement.
CO 4	Demonstrate knowledge of environmental regulations and standards.

Mapping of CO with PO

SECH7520	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1				2						2
CO 2	2	3	3	2	2							
CO 3	2	3	2	3								2
CO 4	2	3	3		2				2			

Mapping of CO with PSO

SECH7520	PSO1	PSO2	PSO3
CO 1	2	3	1
CO 2	3	2	2
CO 3	3	3	2
CO 4	3	3	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
01	Fundamentals of Ecology & Pollution	3,5
02	Environmental Quality Standards	1,4
03	Pollution Monitoring & Prevention	1,3
04	Air Pollution Control	2,6
05	Water & Wastewater Treatment	1,5
06	Industrial Pollution Control	3,4
07	Solid Waste Management	2,4
08	Emerging Challenges	3,4

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH7530
Course Name: Environmental Quality Monitoring & Analysis
Prerequisite Course(s): -

Teaching & Examination Scheme

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	-	2	5	40	60	0	0	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the course:

To develop understanding of environmental sampling and monitoring techniques.

To study analytical methods for assessing air, water, and soil quality.

To learn instrumentation used in environmental analysis.

To interpret analytical results and assess environmental compliance.

Course Content:

Module	Content	Hour	Weightage In %
	Section I		
1	**Introduction to Environmental Fate and Transport** - Definition of Environment - Source/Environment/Receptor Link - Exposure & Health Effects - Toxicology Basics	2	10
2	**Chemicals of Concern & Equilibrium Partitioning** - Properties (Solubility, Vapor Pressure, Henry's Constant, Koc, Kow) - Phase Partitioning	8	20
3	**Environmental Parameters & Monitoring** - Screening Parameters (BOD, COD, TOC, TDS) - Sampling Methods & QA/QC	5	10
4	**Sampling & Analysis Techniques** - Methods for Air/Water/Soil/Sediment - Organic & Inorganic Analysis	4	10
	Section II		
1	**Introduction to Environmental Transport Models** - BOX Models - Multimedia Transport	4	10
2	**Atmospheric Dispersion & Mass Transport** - Gaussian Dispersion Model	8	20

	- Intraphase & Interphase Flux - Diffusion & Convection Coefficients		
3	**Chemical Exchange Mechanisms** - Air-Water Exchange - Sediment-Water Exchange - Soil-Air Exchange	5	10
4	**Integrated Transport Models & Case Studies** - Scenario Analysis - Real-world Applications	4	10
	Total	45	

Text Book:

Title	Author(s)	Publication
Environmental Fate and Transport Analysis	John Smith & Jane Doe	ABC Publishers, 2020

Reference Books:

Title	Author(s)	Publication
Principles of Environmental Chemistry	William Brown	XYZ Publications, 2018
Chemical Fate and Transport in the Environment	Mark Davis	DEF Press, 2019

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks with a duration of 1 hour.
- Faculty Evaluation consists of 10 marks, as per the guidelines provided by the Course Coordinator.
- End Semester Examination will consist of a comprehensive 60 marks theory exam.

Tutorials:

- Continuous Evaluation consists of the performance in tutorials, which should be evaluated out of 10 marks for each tutorial in the next session. The average of these will be converted to 10 marks.
- Internal Viva component of 10 marks based on tutorial understanding and application.
- Tutorial-based assignment/quiz/problem-solving test of 20 marks during the End Semester Evaluation.
- Viva/Oral performance during the End Semester Evaluation carrying 10 marks.

Course Outcome(s):

After the completion of the course, students will be able to:

CO 1	Perform appropriate sampling for environmental media.

CO 2	Use laboratory instruments and techniques for pollutant analysis.
CO 3	Interpret and analyze environmental data.
CO 4	Prepare technical reports in compliance with regulatory norms.

Mapping of CO with PO

SECH7530	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1				2						2
CO 2	2	3	3	2	2							
CO 3	2	3	2	3								2
CO 4	2	3	3		2				2			

Mapping of CO with PSO

SECH7530	PSO1	PSO2	PSO3
CO 1	2	3	1
CO 2	3	2	2
CO 3	3	3	2
CO 4	3	3	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
01	Introduction to Environmental Fate and Transport	3,5
02	Chemicals of Concern & Equilibrium Partitioning	1,4
03	Environmental Parameters & Monitoring	1,3
04	Sampling & Analysis Techniques	2,6
05	Introduction to Environmental Transport Models	1,5
06	Atmospheric Dispersion & Mass Transport	3,4
07	Chemical Exchange Mechanisms	2,4
08	Integrated Transport Models & Case Studies	3,4

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH7540
Course Name: Environmental Engineering
Prerequisite Course(s): -

Teaching & Examination Scheme

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	-	2	5	40	60	0	0	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the course:

To study engineering principles related to water supply, sanitation, and waste management.

To understand the design and operation of treatment systems.

To learn about integrated environmental management systems.

To promote sustainable engineering practices in environmental applications.

Course Content:

Module	Content	Hour	Weightage In %
	Section I		
1	**Introduction to Environmental Pollution** • Environment & industrial pollution • Emission/effluent characterization • Environmental laws & standards (air, noise, water)	2	10
2	**Pollution Prevention Strategies** • Process modification & raw material alternatives • Waste recovery/recycling • Material & energy balances • Water minimization & leak control	8	20
3	**Air Pollution Control Technologies** • Particulate control (cyclones, ESP, scrubbers) • Gaseous treatment (absorption/adsorption) • Design of control equipment	5	10
4	**Water Pollution Control - Physical Treatment** • Pre-treatment & sedimentation • Filtration/centrifugation • Coagulation-flocculation	4	10
	Section II		
1	**Biological Wastewater Treatment** • Aerobic/anaerobic systems	4	10

	• Activated sludge & trickling filters • Aeration & sludge drying		
2	**Solid Waste Management** • Composting & landfilling • Thermal methods (incineration/gasification) • Briquetting	8	20
3	**Emerging Technologies** • Advanced oxidation processes • Zero-liquid discharge systems • Circular economy approaches	5	10
4	**Case Studies & Regulatory Compliance** • Industry-specific applications • CPCB guidelines implementation • Environmental auditing	4	10
	Total	45	100

Text Book:

Title	Author(s)	Publication
Industrial Water Pollution Control	W.W. Eckenfelder	McGraw-Hill, 2nd Ed.

Reference Books:

Title	Author(s)	Publication
Wastewater Engineering: Treatment & Reuse	Tchobanoglous et al.	McGraw-Hill, 4th Ed.
Handbook of Solid Waste Management	Kreith & Tchobanoglous	McGraw-Hill, 2nd Ed.

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks with a duration of 1 hour.
- Faculty Evaluation consists of 10 marks, as per the guidelines provided by the Course Coordinator.
- End Semester Examination will consist of a comprehensive 60 marks theory exam.

Tutorials:

- Continuous Evaluation consists of the performance in tutorials, which should be evaluated out of 10 marks for each tutorial in the next session. The average of these will be converted to 10 marks.
- Internal Viva component of 10 marks based on tutorial understanding and application.
- Tutorial-based assignment/quiz/problem-solving test of 20 marks during the End Semester Evaluation.
- Viva/Oral performance during the End Semester Evaluation carrying 10 marks.

Course Outcome(s):

After the completion of the course, students will be able to:

CO 1	Design and analyze water and wastewater treatment processes.
CO 2	Understand the principles of solid waste and air pollution control.
CO 3	Apply engineering solutions to environmental problems.
CO 4	Integrate environmental and sustainability principles in engineering design.

Mapping of CO with PO

SECH7540	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1				2						2
CO 2	2	3	3	2	2							
CO 3	2	3	2	3								2
CO 4	2	3	3		2				2			

Mapping of CO with PSO

SECH7540	PSO1	PSO2	PSO3
CO 1	2	3	1
CO 2	3	2	2
CO 3	3	3	2
CO 4	3	3	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
01	Introduction to Environmental Pollution	3,5
02	Pollution Prevention Strategies	1,4
03	Air Pollution Control Technologies	1,3
04	Water Pollution Control - Physical Treatment	2,6
05	Biological Wastewater Treatment	1,5
06	Solid Waste Management	3,4
07	Emerging Technologies	2,4
08	Case Studies & Regulatory Compliance	3,4

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH7550
Course Name: Fuel And Combustion Technology
Prerequisite Course(s): -

Teaching & Examination Scheme

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	-	2	5	40	60	0	0	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the course:

To understand the properties and classifications of fuels.
To study combustion principles and thermodynamics.
To evaluate combustion systems and fuel performance.
To learn pollutant formation and emission control in combustion processes.

Course Content:

Module	Content	Hour	Weightage In %
	Section I		
1	Introduction to Fuels: History and origin, production, scenario and consumption, fundamental definitions and measurement of fuel properties.	2	10
2	Solid Fossil Fuels (Coal): Classification, mining, preparation, combustion, coke making, liquefaction (direct & indirect), gasification.	8	20
3	Liquid Fossil Fuels (Petroleum): Exploration, evaluation, distillation (atmospheric & vacuum), secondary processing, cracking, reforming, refinery units.	5	10
4	Gaseous Fuels: Natural gas, LPG, producer gas, water gas, hydrogen, acetylene, and other gaseous fuels.	4	10
	Section II		
1	Thermochemistry: Fundamentals and heat of combustion.	4	10
2	Combustion Calculations: Air requirement, calorific value, adiabatic flame temperature.	8	20
3	Combustion Mechanism: Reaction kinetics, flame structure, ignition phenomena.	5	10
4	Combustion Appliances: Burners, furnaces, internal combustion engines, design aspects.	4	10
	Total	45	100

Text Book:

Title	Author(s)	Publication
Fuels and Combustion	Samir Sarkar	Universities Press, 3rd Edition

Reference Books:

Title	Author(s)	Publication
Petroleum Refinery Engineering	W.L. Nelson	McGraw-Hill
Fuels Combustion and Furnaces	John Griswold	McGraw-Hill

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks with a duration of 1 hour.
- Faculty Evaluation consists of 10 marks, as per the guidelines provided by the Course Coordinator.
- End Semester Examination will consist of a comprehensive 60 marks theory exam.

Tutorials:

- Continuous Evaluation consists of the performance in tutorials, which should be evaluated out of 10 marks for each tutorial in the next session. The average of these will be converted to 10 marks.
- Internal Viva component of 10 marks based on tutorial understanding and application.
- Tutorial-based assignment/quiz/problem-solving test of 20 marks during the End Semester Evaluation.
- Viva/Oral performance during the End Semester Evaluation carrying 10 marks.

Course Outcome(s):

After the completion of the course, students will be able to:

CO 1	Classify fuels and analyze their properties.
CO 2	Apply combustion equations and analyze energy efficiency.
CO 3	Design basic combustion systems with emission considerations.
CO 4	Evaluate environmental impacts of fuel usage and suggest alternatives.

Mapping of CO with PO

SECH7560	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1				2						2
CO 2	2	3	3	2	2							
CO 3	2	3	2	3								2

CO 4	2	3	3		2				2			

Mapping of CO with PSO

SECH7560	PSO1	PSO2	PSO3
CO 1	2	3	1
CO 2	3	2	2
CO 3	3	3	2
CO 4	3	3	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
01	Introduction to Fuels	3,5
02	Solid Fossil Fuels (Coal)	1,4
03	Liquid Fossil Fuels (Petroleum)	1,3
04	Gaseous Fuels	2,6
05	Thermochemistry:	1,5
06	Combustion Calculations	3,4
07	Combustion Mechanism	2,4
08	Combustion Appliances	3,4

P P Savani University

School of Engineering

Department of Chemical Engineering

Course Code: SECH7560

Course Name: Optimization in Chemical Engineering

Prerequisite Course(s): -

Teaching & Examination Scheme

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	-	2	5	40	60	0	0	40	60	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the course:

To introduce basic concepts of optimization in chemical processes.

To develop mathematical models for process optimization.

To apply optimization techniques in design and operation.

To use software tools for solving engineering optimization problems.

Course Content:

Module	Content	Hour	Weightage In %
	Section I		
1	**Introduction to Optimization**: Importance, scope, applications in chemical engineering, classification (linear, nonlinear, integer, dynamic), real-world examples.	5	10
2	**Problem Formulation & Basic Concepts**: Decision variables, objective functions, constraints, convexity, optimality, feasible region, convex/concave sets and functions.	8	20
3	**Unconstrained Optimization**: Single-variable and multivariable optimization; analytical and numerical techniques; direct and gradient-based methods (Nelder-Mead, steepest descent, Newton's method).	5	10
4	**Constrained Optimization - Linear Programming**: Standard form, graphical methods, simplex method, duality, sensitivity analysis.	5	10
	Section II		
1	**Constrained Nonlinear Programming**: Lagrange multipliers, KKT conditions, penalty and barrier methods, quadratic programming.	4	10
2	**Optimization Algorithms and Tools**: Search methods, gradient-based and evolutionary algorithms, convergence, software solvers (e.g., MATLAB, LINGO, Python - Pyomo).	8	20

3	**Applications in Chemical Engineering**: Reactor design, heat exchanger networks, separation processes, process control, resource allocation problems.	5	10
4	**Case Studies & Project Work**: Real industrial case studies, interpretation of results, multi-objective optimization, project formulation.	5	10
	Total	45	100

Text Book:

Title	Author(s)	Publication
Optimization: Theory and Practice	Prof. Debasis Sarkar	NPTEL, IIT Kharagpur (Online Course)

Reference Books:

Title	Author(s)	Publication
Introduction to Linear Optimization	Bertsimas and Tsitsiklis	Athena Scientific
Nonlinear Programming	Dimitri P. Bertsekas	Athena Scientific
Engineering Optimization	R. T. Haese, Kalyanmoy Deb	Wiley / PHI

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks with a duration of 1 hour.
- Faculty Evaluation consists of 10 marks, as per the guidelines provided by the Course Coordinator.
- End Semester Examination will consist of a comprehensive 60 marks theory exam.

Tutorials:

- Continuous Evaluation consists of the performance in tutorials, which should be evaluated out of 10 marks for each tutorial in the next session. The average of these will be converted to 10 marks.
- Internal Viva component of 10 marks based on tutorial understanding and application.
- Tutorial-based assignment/quiz/problem-solving test of 20 marks during the End Semester Evaluation.
- Viva/Oral performance during the End Semester Evaluation carrying 10 marks.

Course Outcome(s):

After the completion of the course, students will be able to:

CO 1	Formulate and solve linear and nonlinear optimization problems.

CO 2	Apply optimization in reactor, separation, and utility systems.
CO 3	Interpret optimization results for process improvement.
CO 4	Use numerical and software tools for decision-making in engineering design.

Mapping of CO with PO

SECH7560	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1				2						2
CO 2	2	3	3	2	2							
CO 3	2	3	2	3								2
CO 4	2	3	3		2				2			

Mapping of CO with PSO

SECH7560	PSO1	PSO2	PSO3
CO 1	2	3	1
CO 2	3	2	2
CO 3	3	3	2
CO 4	3	3	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
01	Introduction to Optimization	3,5
02	Problem Formulation & Basic Concepts	1,4
03	Unconstrained Optimization:	1,3
04	Constrained Optimization - Linear Programming	2,6
05	Constrained Nonlinear Programming	1,5
06	Optimization Algorithms and Tools	3,4
07	Applications in Chemical Engineering	2,4
08	Case Studies & Project Work	3,4