सावित्रीबाई फुले पुणे विद्यापीठ

Savitribai Phule Pune University, Pune, Maharashtra, India

Faculty of Science and Technology



Double Minor Program in

Chemical Process Design

(18 Credits)

2024 Pattern

Chemical Engineering

(With effect from Academic Year 2026-27)

Preface by Board of Studies

Dear Students and Faculty,

We, the members of the Board of Studies in **Chemical and Petroleum Engineering**, are pleased to introduce the **Third Year Chemical Engineering** Double Minor Course "**Chemical Process Design**" syllabus, effective from the **Academic Year 2026-27 (2024 Pattern)**. Chemical Engineering is a versatile and dynamic discipline that bridges the gap between molecular sciences and large-scale industrial processes. It encompasses the design, optimization, and operation of processes that transform raw materials into valuable products, playing a pivotal role in industries such as energy, pharmaceuticals, biotechnology, and environmental sustainability.

This curriculum has been meticulously designed to provide students with a strong foundation in core principles**,** hands-on laboratory experience, and industry-relevant problem-solving skills. The syllabus aligns with the objectives of NEP-2020**,** AICTE**,** UGC, and other accreditation bodies, ensuring that it meets global standards while addressing emerging technological advancements and industrial demands.

The syllabus includes enhanced pragmatic learning through laboratory work, simulations, and industry case studies without sacrificing rigor of a strong class-room based teaching and learning process. The other key features are the inherent flexibility of self-paced learning, encouraging students to pursue online courses, certifications, on-job training and research projects to deepen their knowledge in specialized areas.

We extend our sincere gratitude to faculty members, industry experts, students, and stakeholders for their valuable contributions in shaping this curriculum. Their insights have been instrumental in ensuring that this syllabus remains relevant, rigorous, and future-ready.

We hope this program will inspire students to explore the vast opportunities in Chemical Engineering and allied disciplines contributing meaningfully to technological and sustainable advancements.



Dr. Somnath Nandi
Coordinator
Board of Studies (Chemical & Petroleum Engineering)

Members of Board of Studies Chemical & Petroleum Engineering	
Dr. Makrand Naniwadekar	Dr. Jotiram Gujar
Dr. Annasaheb Warade	Dr. Bhausaheb Pangarkar
Dr. Shailesh Ghodke	Dr. Vilas S. Sapkal
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Dr. Sanjay Kamble	Dr. Sandeep Shewale
Mr. Milind Bava	Dr. Sandeep Pawar

DOUBLE MINOR IN CHEMICAL PROCESS DESIGN OFFERED TO

1. Biotechnology
2. Civil Engineering
3. Mechanical Engineering
4. Electrical Engineering
5. Electronics & Telecommunication Engineering
6. Information Technology
7. Production Engineering
8. Computer Engineering
9. Computer Science & Engineering
10. Electronics & Communication Engineering (ECE)
11. Electronics & Instrumentation Engineering
12. Instrumentation & Control Engineering
13. Mechatronics
14. Robotics and Automation
15. Artificial Intelligence and Machine Learning
16. Artificial Intelligence and Data Science
17. All branches except program under BoS **Chemical & Petroleum Engineering**

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 Specific Outcomes

PSO1 (Core Competency): Demonstrate a solid foundation in chemical engineering principles and apply them to real-world problems through conceptual clarity, practical experience, and interdisciplinary integration.

PSO2 (Analysis, Upscaling and Decision-Making Skills): Apply engineering mathematics, numerical methods, and various programming tools to model, simulate, and analyze chemical engineering and allied problems, enabling effective decision-making.

PSO3 (Successful Career and Entrepreneurship): Exhibit readiness for professional careers and entrepreneurial pursuits by leveraging core chemical engineering knowledge, innovation, and problem-solving abilities to create sustainable and practical solutions addressing societal and industrial challenges.

Program Educational Objectives (PEOs)

PEO	PEO Focus	PEO Statement
PEO1	Core Competency	Graduates will establish themselves as competent professionals through application of fundamental chemical engineering principles to analyze, design, and upscale chemical and allied processes.
PEO2	Ethical, Social, and Global Responsibilities	Graduates 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	Professional Growth and Lifelong Learning	Graduates will engage in higher education, professional certifications, or self-directed learning to continuously expand their knowledge and remain updated with recent advancements in chemical engineering 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.

WK No.	Focus Area	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 30 marks:**
  To be based on all the Units of course syllabus to be scheduled and conducted at the institute level. To design a Comprehensive Continuous Evaluation (CCE) scheme for a theory subject of 30 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Sr. No.	Parameters	Marks	Coverage of Units
1	Unit Test	12 Marks	Units 1 and 2 (6 Marks / unit)
2	Assignment / Case Study	12 Marks	Units 3 and 4 (6 Marks / unit)
3	Seminar Presentation / Open Book Test / Quiz	06 Marks	Unit 5

- **Comprehensive Continuous Evaluation (CCE) of 15 marks:**
  To be based on all the Units of course syllabus to be scheduled and conducted at institute level. To design a Comprehensive Continuous Evaluation (CCE) scheme for a theory subject of 15 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Sr. No.	Parameter	Marks	Coverage of Units
1	Unit Test	10 Marks	Units 1 and 2 (5 Marks / Unit)
2	Seminar Presentation / Open Book Test/ Assignments / Case Study	05 Marks	Units 3 and 4

Format and Implementation of Comprehensive Continuous Evaluation (CCE)

• Unit Test

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

– **Implementation:** Schedule the test after completing Units 1 and 2. Ensure the question paper is balanced and covers key concepts and applications.

• 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 (2 Marks): Demonstrate how [Concept] can be used in [Scenario].
– Analyzing (3 Marks): Compare & contrast [Two related concepts] from Units 1 and 2.
– Evaluating (3 Marks): Evaluate the effectiveness of [Theory/Model] in [Situation].

• Assignments / Case Study:

Students should submit one assignment or one Case Study Report based on Unit 3 and one assignment or one Case Study Report based on Unit 4.

– **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 3 and 4. Provide clear guidelines and a rubric for evaluation.

• Seminar Presentation:

– Format: Oral presentation on a topic from Unit 5, 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 towards the end of the course. Provide students with ample time to prepare and offer guidance on presentation skills.

• Open Book Test:

– Format: Analytical and application-based questions to assess depth of understanding.

– Implementation: Schedule the open book test towards the end of the course, ensuring it covers critical aspects of Unit 5.

• Quiz:

– Format: Quizzes can help students practice existing knowledge while stimulating interest in learning about new topic in that course. You can set your quizzes to be completed individually or in small groups.

– Implementation: Online tools and software can be used create quiz. Each quiz is made up of a variety of question types including multiple choice, missing words, true or false etc.

• Example Timeline for conducting CCE:

– Weeks 1-4 : Cover Units 1 and 2
– Week 5 : Conduct Unit Test (12 marks)
– Weeks 6-8 : Cover Units 3 and 4
– Week 9 : Distribute and collect Assignments / Case Study (12 marks)
– Weeks 10-12 : Cover Unit 5
– Week 13 : Conduct Seminar Presentations or Open Book Test or Quiz (6 marks)

• 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.
– Open Book Test: Evaluate based on the depth of analysis and application of concepts. Provide feedback on critical thinking and problem-solving skills.

End Semester Examination (ESE)

End-Semester Examination (ESE) of 70 marks written theory examination based on all the unit of course syllabus scheduled by 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.

• Format and Implementation:

1. **Question Paper Design:** The structure below is to be followed to design an End-Semester Examination (ESE) for a theory subject of 70 marks on all 5 units of the syllabus with questions set as per Bloom's Taxonomy guidelines and 14 marks allocated per unit.

2. **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:
   - **Remembering:** Basic recall of facts and concepts.
   - **Understanding:** Explanation of ideas or concepts.
   - **Applying:** Use of information in new situations.
   - **Analyzing:** Drawing connections among ideas.
   - **Evaluating:** Justifying a decision or course of action.
   - **Creating:** Producing new or original work (if applicable).

3. **Detailed Scheme:**
   - **Detailed Scheme for 70 Marks:** Unit-Wise Allocation (14 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.

   - **Detailed Scheme for 35 Marks:** Unit-Wise Allocation (08 Marks for Unit 1, 09 Marks for Unit 2, Unit 3 and Unit 4): Each unit will have a combination of questions designed to assess different cognitive levels. By following this scheme, you can ensure a comprehensive and fair assessment of students' understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.

NEP 2020 Compliant Curriculum Structure

Curriculum Structure for
Double Minor Program – Chemical Process Design

Course Code	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 V														
DMPD301CEE	Introduction to Chemical Process Engineering	3	-	-	30	70	-	-	-	100	3	-	-	4
DMPD302CEE	Introduction to Chemical Process Engineering Laboratory	-	-	2			25	-	25	50	-	-	1	
Semester VI														
DMPD351CEE	Process Calculations and Fluid Flow Fundamentals	3	-	-	30	70	-	-	-	100	3	-	-	4
MCPD352CEE	Process Calculations and Fluid Flow Fundamentals Laboratory	-	-	2			25	-	25	50	-	-	1	
Semester VII														
DMPD401CEE	Heat and Mass Transfer Fundamentals	3	-	-	30	70	-	-	-	100	3	-	-	4
DMPD402CEE	Heat and Mass Transfer Fundamentals Laboratory	-	-	2			25	-	25	50	-	-	1	
Semester VIII														
DMPD451CEE	Thermodynamics and Reaction Engineering	3	-	-	30	70	-	-	-	100	3	-	-	4
DMPD452CEE	Thermodynamics and Reaction Engineering Laboratory	-	-	2			25	-	25	50	-	-	1	
DMPD453CEE	Minor Project	-	-	4			50		50	100			2	
Total		**12**		**12**	**120**	**280**	**150**	**-**	**150**	**700**	**12**		**06**	**18**

Savitribai Phule Pune University,

Pune, Maharashtra, India

NEP 2024 Pattern

(With effect from Academic Year 2026-27)

Double Minor Course in

Chemical Process Design

SEMESTERS – V, VI, VII, VIII

Savitribai Phule Pune University

Minor Course : Chemical Process Design (2024 Course)

DMPD301CEE: Introduction to Chemical Process Engineering

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	**03**	**CCE: 30 Marks** **End-Semester: 70 Marks**

Prerequisite Courses, if any: Courses of Engineering Mathematics, Engineering Mechanics, Physics and Chemistry

Course Objectives:

The objective of the course is:

1. To introduce students to the fundamentals of chemical process engineering and its industrial applications.
2. To develop an understanding of chemical process industries, process flows, and major unit operations.
3. To familiarize students with material and energy balances used in chemical processes.
4. To introduce the basic principles of process equipment, heat transfer, fluid flow, and separation processes.
5. To develop awareness of process safety, environmental considerations, sustainability, and industrial practices.

Course Outcomes:

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

1. Explain the role and scope of chemical process engineering in various industries.
2. Construct and interpret simple process flow diagrams and identify major process units.
3. Apply basic material and energy balance principles to simple chemical processes.
4. Describe the working principles of common chemical engineering equipment and unit operations.
5. Recognize and evaluate basic process safety, environmental, and sustainability considerations in chemical industries.

Course Contents

Unit I	Introduction to Chemical Engineering	(07 Hours)

Role and scope of chemical engineering, Chemical process industries and their applications, Batch and continuous processes, Basic process terminology and variables, Physical and chemical processes

Unit II	Chemical Process Flow	(08 Hours)

Raw materials, products and by-products, Unit operations and unit processes, Block Flow Diagram (BFD) Process Flow Diagram (PFD), Basic process streams and recycle systems

Unit III	Basic Process Operations	(07 Hours)

Material handling and storage, Fluid flow and pumping, Heat transfer and heat exchangers, Separation processes, Reaction processes

Unit IV	Major Process Equipment	(08 Hours)

Reactors, Distillation and absorption columns, Heat exchangers, Pumps and compressors, Storage tanks and pressure vessels, Basic equipment selection

Unit V	Process Design Perspectives	(08 Hours)

Introduction to process design methodology, Process safety fundamentals, Energy and resource efficiency Environmental considerations, Introduction to sustainable chemical process design, Industrial case studies

Learning Resources

Text Books:

1. Felder, R. M., Rousseau, R. W. & Bullard, L. G. – *Elementary Principles of Chemical Processes*, Wiley.
2. McCabe, W. L., Smith, J. C. & Harriott, P. – *Unit Operations of Chemical Engineering*, McGraw-Hill.
3. Geankoplis, C. J**.** – *Transport Processes and Unit Operations*, Prentice Hall.
4. Sinnott, R. K. & Towler, G**.** – *Chemical Engineering Design*, Butterworth-Heinemann/Elsevier.

Reference Books:

1. Coulson, J. M. & Richardson, J. F. **–** *Chemical Engineering, Volume 6: Chemical Engineering Design*, Butterworth-Heinemann.
2. Crowl, D. A. & Louvar, J. F. **–** *Chemical Process Safety: Fundamentals with Applications*, Pearson.
3. Perry, R. H. & Green, D. W. – *Perry's Chemical Engineers' Handbook*, McGraw-Hill.
4. Ludwig, E. E**.** – *Applied Process Design for Chemical and Petrochemical Plants*, Gulf Professional Publishing.

e-Books:

1. **https://engineeringbookslibrary.wordpress.com/wp-content/uploads/2019/03/fluid-mechanics-fundamentals-and-applications-3rd-edition-cengel-and-cimbala-2014.pdf**
2. **https://www.sciencedirect.com/book/9780081024379/introduction-to-fluid-mechanics**

MOOC/NPTEL/YouTube Links:

1. https://nptel.ac.in/courses/103103165?utm_source=chatgp
2. **Material & Energy Balance Computations** – IIT Kharagpur
3. **Principles and Practices of Process Equipment and Plant Design** – IIT Kharagpur
4. **Chemical Process Safety** – IIT Roorkee

Savitribai Phule Pune University

Minor Course : Chemical Process Design (2024 Course)

DMPD302CEE: Introduction to Chemical Process Engineering Laboratory

Teaching Scheme	Credit	Examination Scheme
Practical: 02 Hours/Week	**01**	**Term Work: 25 Marks** **Oral : 25 Marks**

Prerequisite Courses: Basics Mathematics, Applied Sciences, Momentum Transfer

Course Objectives:

The objective of the course is:

1. To introduce students to the fundamentals of chemical process engineering and its industrial applications.
2. To develop an understanding of chemical process industries, process flows, and major unit operations.
3. To familiarize students with material and energy balances used in chemical processes.
4. To introduce the basic principles of process equipment, heat transfer, fluid flow, and separation processes.
5. To develop awareness of process safety, environmental considerations, sustainability, and industrial practices.

Course Outcomes:

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

1. Explain the role and scope of chemical process engineering in various industries.
2. Construct and interpret simple process flow diagrams and identify major process units.
3. Apply basic material and energy balance principles to simple chemical processes.
4. Describe the working principles of common chemical engineering equipment and unit operations.
5. Recognize and evaluate basic process safety, environmental, and sustainability considerations in chemical industries.

List of Tutorials (Any 8 Tutorials from the given list)

1) Introduction to Chemical Engineering: Discuss the role, scope, major areas and applications of chemical engineering in various industries.
2) Chemical Process Industries: Identify major chemical process industries and discuss their raw materials, products and applications.
3) Batch and Continuous Processes: Compare batch and continuous processes with suitable industrial examples.
4) Process Flow Diagrams: Prepare and interpret simple Block Flow Diagrams (BFD) and Process Flow Diagrams (PFD), including basic process streams and recycle.
5) Unit Operations and Unit Processes: Differentiate between unit operations and unit processes with industrial examples.
6) Basic Process Operations: Study material handling, pumping, heat transfer, separation and reaction processes used in chemical industries.
7) Major Process Equipment: Identify the functions and basic working principles of reactors, distillation columns, absorption columns, heat exchangers, pumps and compressors.
8) Equipment Selection: Discuss basic factors considered in selecting process equipment, including capacity, operating conditions, material of construction, safety and cost.
9) Determination of Diameter of solute molecule by viscosity measurements.

10) Determination of molecular weight of solid by Elevation in Boiling Point.

Completion of any eight tutorials from the prescribed syllabus is mandatory.

Learning Resources

Reference Books:

1. Felder, R. M., Rousseau, R. W. & Bullard, L. G. – *Elementary Principles of Chemical Processes*, Wiley.
2. McCabe, W. L., Smith, J. C. & Harriott, P. – *Unit Operations of Chemical Engineering*, McGraw-Hill.
3. Geankoplis, C. J. – *Transport Processes and Unit Operations*, Prentice Hall.
4. Sinnott, R. K. & Towler, G. – *Chemical Engineering Design*, Butterworth-Heinemann/Elsevier

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1. **https://engineeringbookslibrary.wordpress.com/wp-content/uploads/2019/03/fluid-mechanics-fundamentals-and-applications-3rd-edition-cengel-and-cimbala-2014.pdf**
2. **https://www.sciencedirect.com/book/9780081024379/introduction-to-fluid-mechanics**

MOOC/NPTEL/YouTube Links:

1. https://nptel.ac.in/courses/103103165?utm_source=chatgp
2. **Material & Energy Balance Computations** – IIT Kharagpur
3. **Principles and Practices of Process Equipment and Plant Design** – IIT Kharagpur
4. **Chemical Process Safety** – IIT Roorkee

Savitribai Phule Pune University

Minor Course : Chemical Process Design (2024 Course)

DMPD351CEE: Process Calculations and Fluid Flow Fundamentals

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	**03**	**CCE: 30 Marks** **End-Semester: 70 Marks**

Prerequisite Courses, if any: Courses of Engineering Mathematics, Engineering Mechanics, Physics and Chemistry

Course Objectives:

The objective of the course is:

1. To introduce students to the fundamentals of chemical process engineering and its industrial applications.
2. To develop an understanding of chemical process industries, process flows, and major unit operations.
3. To familiarize students with material and energy balances used in chemical processes.
4. To introduce the basic principles of process equipment, heat transfer, fluid flow, and separation processes.
5. To develop awareness of process safety, environmental considerations, sustainability, and industrial practices.

Course Outcomes:

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

1. Explain the role and scope of chemical process engineering in various industries.
2. Construct and interpret simple process flow diagrams and identify major process units.
3. Apply basic material and energy balance principles to simple chemical processes.
4. Describe the working principles of common chemical engineering equipment and unit operations.
5. Recognize and evaluate basic process safety, environmental, and sustainability considerations in chemical industries.

Course Contents

Unit I	**Fundamentals of Chemical Process Calculations**	(07 Hours)

Units and dimensions, Mole concept and molecular weight, Composition of solids, liquids and gases, Stoichiometric calculations

Unit II	**Material Balance Calculations**	(08 Hours)

Overall and component material balances, material balances with recycle, bypass and purge, Balances involving chemical reactions, conversion, yield and selectivity, simple process flow calculations

Unit III	**Energy Balance and Process Calculations**	(07 Hours)

Basic concepts of energy balance, Sensible and latent heat, Heat capacity and enthalpy, Energy balance for simple processes, Combined material and energy balance

Unit IV	**Fundamentals of Fluid Flow**	(08 Hours)

Properties of fluids, fluid pressure and fluid statics, continuity equation, Bernoulli's equation, laminar and turbulent flow, Reynolds number

Unit V	**Fluid Flow Equipment and Measurement**	(08 Hours)

Flow through pipes and pressure drop, friction factor and pipe fittings, valves and basic piping systems Pumps and their basic operation, flow measurement: orifice meter, venturimeter and rotameter

Learning Resources

Text Books:

1. Felder, R. M., Rousseau, R. W. & Bullard, L. G. – *Elementary Principles of Chemical Processes*, Wiley.
2. McCabe, W. L., Smith, J. C. & Harriott, P. – *Unit Operations of Chemical Engineering*, McGraw-Hill.
3. Geankoplis, C. J**.** – *Transport Processes and Unit Operations*, Prentice Hall.
4. Sinnott, R. K. & Towler, G**.** – *Chemical Engineering Design*, Butterworth-Heinemann/Elsevier.

Reference Books:

1. Coulson, J. M. & Richardson, J. F. **–** *Chemical Engineering, Volume 6: Chemical Engineering Design*, Butterworth-Heinemann.
2. Crowl, D. A. & Louvar, J. F. **–** *Chemical Process Safety: Fundamentals with Applications*, Pearson.
3. Perry, R. H. & Green, D. W. – *Perry's Chemical Engineers' Handbook*, McGraw-Hill.
4. Ludwig, E. E**.** – *Applied Process Design for Chemical and Petrochemical Plants*, Gulf Professional Publishing.

e-Books:

1. **https://web.iitd.ac.in/~hirani/MEL311.pdf**
2. **https://engineeringbookslibrary.wordpress.com/wp-content/uploads/2019/03/fluid-mechanics-fundamentals-and-applications-3rd-edition-cengel-and-cimbala-2014.pdf**
3. **https://www.sciencedirect.com/book/9780081024379/introduction-to-fluid-mechanics**

MOOC/NPTEL/YouTube Links:

1. **Chemical Process Industries** – IIT Madras
2. **Material & Energy Balance Computations** – IIT Kharagpur
3. **Principles and Practices of Process Equipment and Plant Design** – IIT Kharagpur
4. **Chemical Process Safety** – IIT Roorkee

Savitribai Phule Pune University
Minor Course : Chemical Process Design (2024 Course)
DMPD352CEE: Process Calculations and Fluid Flow Fundamentals Laboratory

Teaching Scheme	Credit	Examination Scheme
Practical: 02 Hours/Week	**01**	**Term Work: 25 Marks** **Oral : 25 Marks**

Prerequisite Courses, if any: Courses of Engineering Mathematics, Engineering Mechanics, Physics and Chemistry, Momentum Transfer

Course Objectives:

The objective of the course is:

1. To introduce students to the fundamentals of chemical process engineering and its industrial applications.
2. To develop an understanding of chemical process industries, process flows, and major unit operations.
3. To familiarize students with material and energy balances used in chemical processes.
4. To introduce the basic principles of process equipment, heat transfer, fluid flow, and separation processes.
5. To develop awareness of process safety, environmental considerations, sustainability, and industrial practices.

Course Outcomes:

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

1. Explain the role and scope of chemical process engineering in various industries.
2. Construct and interpret simple process flow diagrams and identify major process units.
3. Apply basic material and energy balance principles to simple chemical processes.
4. Describe the working principles of common chemical engineering equipment and unit operations.
5. Recognize and evaluate basic process safety, environmental, and sustainability considerations in chemical industries.

List of Tutorials/Laboratory Experiments

Tutorials

Section A

1. Problems on units, dimensions and unit conversions.
2. Mole concept, molecular weight and molar calculations.
3. Basic stoichiometric calculations.
4. Simple material balance problems without chemical reaction.
5. Overall and component material balance problems.
6. Material balances involving multiple process streams.
7. Problems on conversion, yield and selectivity.
8. Simple material balance calculations using process flow diagrams.

Section B

1. To determine the density and viscosity of a given fluid.
2. To verify Bernoulli's equation for flow through a pipe.
3. To determine the Reynolds number and identify laminar and turbulent flow.

4. To study the characteristics and operation of a centrifugal pump.
5. To measure fluid flow rate using an orifice meter.
6. To determine flow rate using a venturimeter or rotameter.

Virtual laboratory experiments may also be conducted to reinforce and demonstrate the concepts covered in the above subject contents.

Note: Completion of any four Tutorials from section A and any 4 experiments from section B is mandatory.

Guidelines for Instructor's Manual

• The instructor's manual is to be developed as a hands-on resource and reference.

• Copy of Curriculum, Conduction & Assessment guide lines, List of Experiments to be attached.

Guidelines for Student's Lab Journal

The students Lab Journal should contain following related to every experiment –

1. Title of the experiment
2. Objective
3. Apparatus with their detailed specifications.
4. Brief theory related to the experiment.
5. Connection diagram /circuit diagram.
6. Observation table
7. Sample calculations for one/two reading.
8. Result tables
9. Graph and Conclusions.

Guidelines for Laboratory Conduction

• All the experiments (Any Eight) mentioned in the syllabus are compulsory.

• Use of open source software and recent version can be used.

Guidelines for Lab/TW Assessment

• Continuous assessment of laboratory work is to be done based on overall performance.

• Each lab assignment/experiment assessment will assign grade/marks based on parameters with appropriate weightage.

• Suggested parameters for overall assessment as well as each laboratory assignment include:

✓ Timely completion.

✓ Performance.

✓ Punctuality and neatness

Learning Resources

Reference Books:

1. Y. A. Cengel, J. M. Cimbala, "Fluid Mechanics: Fundamentals and Applications", McGraw Hill, 2017
2. W. L McCabe, J. Smith, and P. Harriot, "Unit Operations of Chemical Engineering", McGraw Hill International Edition, 7th Edition, 2004.
3. F. W. White, "Fluid Mechanics", McGraw Hill, 9th Edition, 2022.
4. Noel de Nevers, "Fluid Mechanics for Chemical Engineers", 3rd Edition; McGraw Hill, 2005.

e-References:

1. **https://fm-nitk.vlabs.ac.in/**
2. **https://me.iitp.ac.in/Virtual-Fluid-Laboratory/**
3. **https://web.iitd.ac.in/~hirani/MEL311.pdf**

Savitribai Phule Pune University

Minor Course : Chemical Process Design (2024 Course)

DMPD401CEE: Heat and Mass Transfer Fundamentals

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	**03**	**CCE: 30 Marks** **End-Semester: 70 Marks**

Prerequisite Courses, if any: Engineering Mathematics, Fluid mechanics, Physics, Chemistry, Applied Mechanics, Basic Heat Transfer / Thermodynamics concepts

Course Objectives:

The objective of the course is:

1. To introduce the fundamental principles and modes of heat transfer, including conduction, convection, and radiation.
2. To develop an understanding of conduction and convection principles and their application to basic heat-transfer calculations.
3. To familiarize students with the principles, classification, and operation of heat exchangers and basic design calculations.
4. To introduce the fundamental concepts of mass transfer, diffusion, concentration driving forces, and mass-transfer coefficients.
5. To provide basic knowledge of mass-transfer operations such as absorption, stripping, distillation, extraction, and drying and their industrial applications.

Course Outcomes:

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

1. Explain the basic principles and mechanisms of heat transfer through conduction, convection, and radiation.
2. Apply Fourier's law, Newton's law of cooling, and dimensionless numbers to perform basic heat-transfer calculations.
3. Analyze basic heat-exchanger problems using overall heat-transfer coefficient and LMTD concepts.
4. Explain and apply the fundamental principles of molecular and convective mass transfer, including Fick's law and mass-transfer coefficients.
5. Describe the working principles and basic applications of absorption, stripping, distillation, liquid–liquid extraction, and drying in chemical industries.

Course Contents

Unit I	**Fundamentals of Heat Transfer**	**(06 Hours)**

Basic concepts of heat transfer, Modes of heat transfer: conduction, convection and radiation , Fourier's law of conduction, Steady-state heat conduction, Basic heat transfer calculations

Unit II	**Convective Heat Transfer**	**(06 Hours)**

Natural and forced convection, newton's law of cooling, boundary layer concept, basic dimensionless numbers: Reynolds, Prandtl and Nusselt numbers, applications of convection heat transfer

Unit III	**Heat Transfer Equipment**	**(06 Hours)**

Heat exchangers and their classification, double-pipe and shell-and-tube heat exchangers, overall heat-transfer coefficient, Log Mean Temperature Difference (LMTD), Basic heat exchanger calculations

Unit IV	**Fundamentals of Mass Transfer**	**(06 Hours)**

Introduction to mass transfer, Molecular and convective mass transfer, Fick's law of diffusion , Concentration and mass-transfer driving forces, Mass-transfer coefficients

Unit V	Basic Mass Transfer Operations	(06 Hours)

Gas absorption and stripping, Distillation fundamentals , Liquid–liquid extraction , Drying fundamentals , Basic applications of mass transfer in chemical industries

Learning Resources

Text Books:

1. Çengel, Y. A., & Ghajar, A. J., *Heat and Mass Transfer: Fundamentals and Applications*, McGraw-Hill Education.
2. Incropera, F. P., DeWitt, D. P., Bergman, T. L., & Lavine, A. S., *Fundamentals of Heat and Mass Transfer*, John Wiley & Sons.
3. Treybal, R. E., *Mass-Transfer Operations*, McGraw-Hill Book Company.
4. Geankoplis, C. J., Hersel, A. A., & Lepek, D. H., *Transport Processes and Separation Process Principles*, Pearson Education.

Reference Books:

1. McCabe, W. L., Smith, J. C., & Harriott, P., *Unit Operations of Chemical Engineering*, McGraw-Hill Education.
2. Dutta, B. K., *Principles of Mass Transfer and Separation Processes*, Prentice Hall of India.
3. Welty, J. R., Wicks, C. E., Wilson, R. E., & Rorrer, G. L., *Fundamentals of Momentum, Heat and Mass Transfer*, John Wiley & Sons.
4. Seader, J. D., Henley, E. J., & Roper, D. K., *Separation Process Principles*, John Wiley & Sons.

e-Books:

1. https://hyominsite.wordpress.com/wp-content/uploads/2015/03/fundamentals-of-heat-and-mass-transfer-6th-edition.pdf
2. https://www.amirajcollege.in/wp-content/uploads/2020/10/3151909-heat-transfer-a-practical-approach-by-y-a-cengel.pdf
3. https://ahtt.mit.edu/wp-content/uploads/2020/08/AHTTv510.pdf

MOOC/NPTEL/YouTube Links:

1. **https://archive.nptel.ac.in/courses/103/105/103105140/**
2. **https://archive.nptel.ac.in/courses/103/103/103103032/**

Savitribai Phule Pune University

Minor Course : Chemical Process Design (2024 Course)

DMPD402CEE : Heat and Mass Transfer Fundamentals Laboratory

Teaching Scheme	Credit	Examination Scheme
Practical: 02 Hours/Week	**01**	**Term Work: 25 Marks** **Oral : 25 Marks**

Prerequisite Courses, if any: Fundamental knowledge of Mathematics and Fluid Mechanics.

Course Objectives:

The objective of the course is:

1. To introduce the fundamental principles and modes of heat transfer, including conduction, convection, and radiation.
2. To develop an understanding of conduction and convection principles and their application to basic heat-transfer calculations.
3. To familiarize students with the principles, classification, and operation of heat exchangers and basic design calculations.
4. To introduce the fundamental concepts of mass transfer, diffusion, concentration driving forces, and mass-transfer coefficients.
5. To provide basic knowledge of mass-transfer operations such as absorption, stripping, distillation, extraction, and drying and their industrial applications.

Course Outcomes:

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

1. Explain the basic principles and mechanisms of heat transfer through conduction, convection, and radiation.
2. Apply Fourier's law, Newton's law of cooling, and dimensionless numbers to perform basic heat-transfer calculations.
3. Analyze basic heat-exchanger problems using overall heat-transfer coefficient and LMTD concepts.
4. Explain and apply the fundamental principles of molecular and convective mass transfer, including Fick's law and mass-transfer coefficients.
5. Describe the working principles and basic applications of absorption, stripping, distillation, liquid–liquid extraction, and drying in chemical industries.

List of Laboratory Experiments (Any 8 experiments from the given list)

Heat and Mass transfer Operations

1) Heat conduction- Determination of thermal conductivity
2) Convection (Natural/Forced)-Calculation of heat transfer coefficient
3) Thermal radiation-determination of emissivity
4) Construction of pool boiling curve
5) Determination of heat transfer coefficient of Double pipe heat exchanger
6) Determination of heat transfer coefficient of Shell and tube heat exchanger
7) Material balance and energy balance of Single effect evaporator
8) Diffusion coefficient determination
9) Mass-transfer coefficient determination

10) Simple distillation

11) Demonstration on Gas absorption in a packed column

12) Diffusion coefficient determination

Note: Completion of any four experiments from Sr no. 1 to 7 and any 4 experiments from Sr no. 8 to 12 is mandatory.

Virtual laboratory experiments may also be conducted to reinforce and demonstrate the concepts covered in the above subject contents.

Guidelines for Instructor's Manual

• The instructor's manual is to be developed as a hands-on resource and reference.

• Copy of Curriculum, Conduction & Assessment guide lines, List of Experiments to be attached.

Guidelines for Student's Lab Journal

The students Lab Journal should contain following related to every experiment –

1. Title of the experiment
2. Objective
3. Apparatus with their detailed specifications.
4. Brief theory related to the experiment.
5. Connection diagram /circuit diagram.
6. Observation table
7. Sample calculations for one/two reading.
8. Result tables
9. Graph and Conclusions.

Guidelines for Laboratory Conduction

• All the experiments (Any Eight) mentioned in the syllabus are compulsory.

• Use of open source software and recent version is to been encouraged.

Guidelines for Lab/TW Assessment

• Continuous assessment of laboratory work is to be done based on overall performance.

• Each lab assignment/experiment assessment will assign grade/marks based on parameters with appropriate weightage.

• Suggested parameters for overall assessment as well as each laboratory assignment include:

✓ Timely completion.

✓ Performance.

✓ Punctuality and neatness.

Learning Resources

Text Books:

1. J. P Holman, Souvik Bhattacharyya, 10th Edition, McGraw Hill Education Private Ltd., 2020.
2. Coulson., Richardson J.E., "Chemical Engineering", Vol-I, Pergamon Press, 2004
3. Sinnott R. K., "Chemical Engineering" Vol- VI, 4th Edition, Chemical Engineering Design, Elsevier, 2008.

e-Books:

1. https://hyominsite.wordpress.com/wp-content/uploads/2015/03/fundamentals-of-heat-and-mass-transfer-6th-edition.pdf
2. https://www.amirajcollege.in/wp-content/uploads/2020/10/3151909-heat-transfer-a-practical-approach-by-y-a-cengel.pdf
3. https://ahtt.mit.edu/wp-content/uploads/2020/08/AHTTv510.pdf

MOOC/NPTEL/YouTube Links:

1. **https://archive.nptel.ac.in/courses/103/105/103105140/**
2. **https://archive.nptel.ac.in/courses/103/103/103103032/**

Savitribai Phule Pune University

Minor Course : Chemical Process Design (2024 Course)

DMPD451CEE: Thermodynamics and Reaction Engineering

Teaching Scheme	Credit	Examination Scheme
Theory: 03 Hours/Week	**03**	**CCE: 30 Marks** **End Sem Exam: 70 Marks**

Course Objectives:

The objective of the course is:

1. To develop a fundamental understanding of thermodynamic principles, laws, properties, and thermodynamic processes.
2. To introduce the concepts of phase equilibrium, vapor–liquid equilibrium, fugacity, activity, and chemical equilibrium.
3. To develop an understanding of chemical reaction kinetics, including reaction rates, rate laws, reaction order, molecularity, and Arrhenius equation.
4. To familiarize students with the principles and performance of ideal chemical reactors, including batch reactors, CSTRs, and PFRs.
5. To introduce multiple reactions, selectivity, yield, reversible reactions, and catalytic/non-catalytic reactions with their industrial applications.

Course Outcomes:

At the end of this course, students will be able to:

1. Explain and apply the fundamental laws of thermodynamics, properties of pure substances, heat and work interactions, and entropy concepts.
2. Analyze phase and chemical equilibrium using phase rule, vapor–liquid equilibrium, fugacity, activity, and equilibrium constants.
3. Determine reaction rates and kinetic parameters using rate laws, reaction order, Arrhenius equation, and activation energy.
4. Analyze and design ideal batch, CSTR, and PFR systems based on conversion, reactor sizing, and reactor performance.
5. Evaluate multiple and reversible reactions in terms of selectivity and yield and explain their catalytic, non-catalytic, and industrial applications.

Course Contents

Unit I	Basic Thermodynamics	(06 Hours)

Fundamental concepts and laws of thermodynamics, properties of pure substances, work and heat interactions, first and second laws of thermodynamics, entropy and thermodynamic processes

Unit II	Phase and Chemical Equilibrium	(06 Hours)

Phase equilibrium and phase rule, vapor–liquid equilibrium, fugacity and activity, chemical equilibrium, equilibrium constant and effect of temperature and pressure

Unit III	Fundamentals of Chemical Reaction Engineering	(06 Hours)

Introduction to chemical reactions, Reaction rate and rate laws, Order and molecularity of reactions, Temperature dependence of reaction rate, Arrhenius equation and activation energy

Unit IV	Reactor Design and Analysis	(06 Hours)
Ideal batch reactor, continuous stirred-tank reactor (CSTR), Plug-flow reactor (PFR), Reactor sizing and conversion, Comparison of ideal reactor performance		
Unit V	**Multiple Reactions and Applications**	
Series and parallel reactions, selectivity and yield, reversible reactions, catalytic and non-catalytic reactions, basic industrial applications of reaction engineering		

Learning Resources

Text Books:

1. Smith, J. M., Van Ness, H. C., Abbott, M. M., & Swihart, M. T., *Introduction to Chemical Engineering Thermodynamics*, McGraw-Hill Education.
2. Fogler, H. S., *Elements of Chemical Reaction Engineering*, Pearson Education.
3. Levenspiel, O., *Chemical Reaction Engineering*, John Wiley & Sons.

Reference Books:

1. Sandler, S. I., *Chemical, Biochemical, and Engineering Thermodynamics*, John Wiley & Sons.
2. Atkins, P., de Paula, J., & Keeler, J., *Atkins' Physical Chemistry*, Oxford University Press.
3. Hill, C. G., *An Introduction to Chemical Engineering Kinetics & Reactor Design*, John Wiley & Sons.

e-Resource:

1. https://ocw.mit.edu/search/?q=thermodynamics&utm_source=chatgpt.com
2. https://learncheme.com/?utm_source=chatgpt.com

MOOC/NPTEL/YouTube Links:

1. https://chatgpt.com/uc/6abcf2fd-6990-83ea-b91f-0bac9f5e95d2
2. https://nptel.ac.in/courses/103103153
3. https://nptel.ac.in/courses/103104151

Savitribai Phule Pune University, Pune

Minor Course : Chemical Process Design (2024 Course)

DMPD452CEE: Thermodynamics and Reaction Engineering Laboratory

Teaching Scheme	Credit	Examination Scheme
Practical: 02 Hours/Week	**01**	**Term Work: 25 Marks** **Oral : 25 Marks**

Prerequisite Courses: Engineering Mathematics, Applied Science, Basic in Environmental Science / Engineering, Fluid Mechanics, Engineering Materials and Process Calculations.

Course Objectives:

The objective of the course is:

1. To develop a fundamental understanding of thermodynamic principles, laws, properties, and thermodynamic processes.
2. To introduce the concepts of phase equilibrium, vapor–liquid equilibrium, fugacity, activity, and chemical equilibrium.
3. To develop an understanding of chemical reaction kinetics, including reaction rates, rate laws, reaction order, molecularity, and Arrhenius equation.
4. To familiarize students with the principles and performance of ideal chemical reactors, including batch reactors, CSTRs, and PFRs.
5. To introduce multiple reactions, selectivity, yield, reversible reactions, and catalytic/non-catalytic reactions with their industrial applications.

Course Outcomes:

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

1. Explain and apply the fundamental laws of thermodynamics, properties of pure substances, heat and work interactions, and entropy concepts.
2. Analyze phase and chemical equilibrium using phase rule, vapor–liquid equilibrium, fugacity, activity, and equilibrium constants.
3. Determine reaction rates and kinetic parameters using rate laws, reaction order, Arrhenius equation, and activation energy.
4. Analyze and design ideal batch, CSTR, and PFR systems based on conversion, reactor sizing, and reactor performance.
5. Evaluate multiple and reversible reactions in terms of selectivity and yield and explain their catalytic, non-catalytic, and industrial applications.

List of Laboratory Experiments (Any 8 experiments from the given list)

Tutorials:

Section A

1. Problems on units, thermodynamic properties and state variables.
2. Numerical problems on work and heat interactions.
3. Application of the First Law to closed systems.
4. Problems on the Second Law and efficiency.
5. Calculation of entropy change for simple thermodynamic processes.
6. Problems based on phase rule and degrees of freedom.

Experiments:

Section B

1. To determine the rate constant of a first-order reaction.
2. To determine the rate constant of a pseudo-first-order reaction by acid-catalysed hydrolysis of ethyl acetate.
3. To determine the rate constant and order of reaction for saponification of ethyl acetate with sodium hydroxide.
4. To study the performance of a Batch Reactor and determine conversion and rate constant.
5. To study the performance of a Continuous Stirred Tank Reactor (CSTR) and determine conversion/rate constant.
6. To study the performance of a Plug Flow Reactor (PFR) and determine conversion/rate constant.

Note: Completion of any four tutorial's from section A and any 4 experiments from section B is mandatory.

Guidelines for Instructor's Manual

• The instructor's manual is to be developed as a hands-on resource and reference.

• Copy of Curriculum, Conduction & Assessment guide lines, List of Experiments to be attached.

Guidelines for Student's Lab Journal

The student's Lab Journal should contain following related to every experiment –

1. Title of the experiment
2. Aim or Objective
3. Equipment with their detailed specifications.
4. Brief theory related to the experiment.
5. Diagram of the equipment or experimental set-up.
6. Observation table
7. Sample calculations for one/two reading.
8. Result tables
9. Graph and Conclusions

Guidelines for Laboratory Conduction

• All the experiments (Any Eight) mentioned in the syllabus are compulsory.

• Use of open source software and recent version is to be encouraged.

Guidelines for Lab/TW Assessment

• Continuous assessment of laboratory work is to be done based on overall performance.

• Each lab assignment/experiment assessment will assign grade/marks based on parameters with appropriate weightage.

• Suggested parameters for overall assessment as well as each laboratory assignment include:

✓ Timely completion.

✓ Performance.

✓ Punctuality and neatness.

Learning Resources

Text Books:

1. Smith, J. M., Van Ness, H. C., Abbott, M. M., & Swihart, M. T., *Introduction to Chemical Engineering Thermodynamics*, McGraw-Hill Education.
2. Fogler, H. S., *Elements of Chemical Reaction Engineering*, Pearson Education.
3. Levenspiel, O., *Chemical Reaction Engineering*, John Wiley & Sons.

e-Resource:

1. https://ocw.mit.edu/search/?q=thermodynamics&utm_source=chatgpt.com
2. https://learncheme.com/?utm_source=chatgpt.com

MOOC/NPTEL/YouTube Links:

1. https://chatgpt.com/uc/6abcf2fd-6990-83ea-b91f-0bac9f5e95d2
2. https://nptel.ac.in/courses/103103153
3. https://nptel.ac.in/courses/103104151

Savitribai Phule Pune University
Minor Course : Chemical Process Design (2024 Course)
MCPD453CEE : Minor Project

Teaching Scheme	Credits	Examination Scheme
Practical: 04 Hours/Week	**02**	**Term Work: 50 Marks** **Oral : 50 Marks**

Prerequisite Courses, if any: Engineering Mathematics, Basic Chemistry, Physics Knowledge

Course Objectives:

1. To develop the ability to identify and formulate chemical engineering problems.
2. To apply fundamental chemical engineering principles to practical problems.
3. To develop skills in literature review, experimentation, simulation, and data analysis.
4. To enhance problem-solving, teamwork, and project management skills.
5. To develop effective technical report writing and presentation skills.

Course Outcomes:

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

1. Formulate a chemical engineering problem based on industrial or research requirements.
2. Apply appropriate chemical engineering concepts and tools to solve the identified problem.
3. Conduct and analyze experimental, computational, or simulation-based investigations.
4. Evaluate project results considering technical, economic, safety, and environmental aspects.
5. Communicate project findings effectively through technical reports, presentations, and discussions.

Course Contents

1. Project Identification and Planning

- Introduction to project work
- Selection of project topic
- Problem identification and objectives
- Literature survey and information collection
- Preparation of project plan and timeline

2. **Literature Review and Methodology**

- Review of relevant technical literature
- Identification of materials, equipment and resources
- Development of experimental/computational methodology

- Safety and environmental considerations
- Preparation of work plan

3. Project Execution

- Experimental or simulation work
- Data collection and documentation
- Process calculations and analysis
- Troubleshooting and modification of methodology
- Maintaining project records

4. Results and Discussion

- Data processing and interpretation
- Graphical and tabular presentation of results
- Comparison with literature/reference data
- Discussion of observations
- Conclusions and future scope

5. Project Report and Presentation

- Preparation of project report
- Technical writing and referencing
- Preparation of charts, drawings and presentations
- Project seminar/presentation
- Viva-voce and evaluation

Guidelines:

1. The project shall be completed under the guidance of an approved project supervisor/guide.
2. The project topic should be relevant to **Chemical Engineering** and approved by the department.
3. Students shall complete the project according to the prescribed **SPPU academic schedule and departmental guidelines**.
4. The project should include appropriate **literature review, methodology, experimental/simulation work, results, discussion, and conclusions**, as applicable.
5. Proper laboratory safety, ethical practices, technical standards, and data-recording procedures shall be followed.

6. Students shall maintain regular consultation with the project guide and submit progress updates as required.
7. The final project report shall follow the **prescribed departmental/SPPU format**, including references and necessary supporting documents.
8. Students shall complete the required **project presentation, evaluation, and viva-voce** before the project is considered complete.
9. The department should prepare a template of the format of the project report and supply it to the students so as to maintain the uniformity in the project reports.
10. Students are encouraged to participate and present their project work in various events, competitions, conferences and seminars etc. in consultation with their guide

Note: *The project guides are required to educate the students about ant anti-plagiarism policy of SPPU and apply the same while doing the project.*

TE – Chemical Engineering 2024 Pattern

National Education Policy (NEP)-2020 Compliant Syllabus

Task Force for Curriculum Design and Development

Course Coordinator

Dr. Sachin Shirsath

Team Members for Course Design

Dr. Makrand Naniwadekar
Dr. Annasaheb Warade
Dr. Bhausaheb Pangarkar
Dr. Sanjay Kamble
Dr. Jotiram Gujar
Dr. Shailesh Ghodke
Mr. Milind Bava
Dr. Sandeep Shewale

Co-ordinator

Dr. Somnath Nandi
Coordinator – Board of Studies
Chemical and Petroleum Engineering
Savitribai Phule Pune University, Pune

Dean

Dr. Gajanan Kharate
Associate Dean – Science and Technology,
Savitribai Phule Pune University, Pune

Dr. Raosaheb Latpate
Dean, Science and Technology
Savitribai Phule Pune University, Pune