



Shree Warana Vibhag Shikshan Mandal's
**Tatyasaheb Kore Institute of
Engineering And Technology,
Warananagar**

DEPARTMENT OF CHEMICAL ENGINEERING

Final Year B. Tech. Chemical Engineering
Structure & Syllabus under Autonomy as per the NEP 2020

**Tatyasaheb Kore Institute of Engineering and Technology,
Warananagar**

An Autonomous Institute

Department of Chemical Engineering

❖ **Vision of the Department–**

To be a recognized program of chemical engineering with quality education, innovation and skill sets for meeting the needs of Industry and Society.

❖ **Mission of the Department –**

- M1.** To uphold the Chemical Engineering professional standards, with sound skills and ethical values.
- M2.** To facilitate all round development for boosting the abilities in internship, service sector, higher studies and entrepreneurship.
- M3.** To establish strong linkage and partnership with industry as well as research institutes of National repute to promote research activities.
- M4.** To provide technical education through innovative applications to rural fields.
- M5.** To enhance lifelong learning in chemical engineering with due respect to safety, environment and society.

**Tatyasaheb Kore Institute of Engineering and Technology,
Warananagar**

**An Autonomous Institute
Department of Chemical Engineering**

❖ **PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

After graduation in chemical engineering the graduates will be able to,

1. **PEO1:** practice or apply successfully the principles of chemical engineering in variety of employment areas.
2. **PEO2:** identify, formulate and solve the problems of chemical engineering design and acquire modern experimental concepts, techniques and tools.
3. **PEO3:** train to apply software skills to formulate, solve the problems related to chemical process development and economics.
4. **PEO4:** achieve the chemical engineering professional standards, ethics, diversity, social responsibility, both as individual and in team environment.
5. **PEO5:** pursue continued life- long learning through professional practice, higher education or training programs.

❖ **PROGRAM OUTCOMES (POs)**

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy,

health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

❖ PROGRAM SPECIFIC OUTCOMES (PSOs)

1. Graduates will be able to Model and simulate the chemical processes by using advanced software.
2. Graduates will be able to do Economic design and demonstrate safety and environmental aspects in chemical processes.
3. Graduates will be able to understand the impact of Chemical Engineering solutions with in realistic constraints in global and societal context.

SWVSM'S

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

An Autonomous Institute

Abbreviations

Sr. No.	Acronym	Definition
1	ISE	In-Semester Examination
2	ISE-I	In-Semester Examination-I
3	ISE-II	In-Semester Examination-II
4	ESE	End Semester Examination
5	ISA	In-Semester Assessment(Term Work)
6	L	Lecture
7	T	Tutorial
8	P	Practical
9	CH	Contact Hours
10	C	Credit

Course/Subject Categories

Sr.No.	Acronym	Definition
1	PCC	Professional Core Course
2	MDM	Multidisciplinary Minor
3	OE	Open Electives
4	HSSM	Humanities social science and Mgmt
5	ELC	Experiential Learning Courses
6	VSEC	Vocational and skill Enhancement course
7	AEC	Ability Enhancement Course

Course/Subject Code

CH	E	3	0	1
Branch Code		Semester	Course Number	

Course Term work and POE Code

CH	E	3	0	1	T/P/A
Branch Code		Semester	Course Number		T- Term work P-POE A-Audit Course

Final Year B. Tech. in Chemical Engineering

Structure and Syllabus

Under

Autonomy as per the NEP Policy 2020

Implemented from

A.Y. 2026-27

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar
Final Year B. Tech. (Chemical Engineering)

Semester-VII

(National Education Policy – NEP 2020 Structure)

Credit Scheme

(To be implemented from 2026 - 27)

Final Year B. Tech. Chemical Engineering Sem -VII

Sr. No.	Category	Sub Category	Course Code	Name of Course	Teaching Scheme			C H	C	Examination & Evaluation Scheme			
					L	T	P			Component	Marks	Min for Passing	
1	Programme Course	PCC	23UGPCC-CH701	Chemical Process Design	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
2		PCC	23UGPCC-CH702	Chemical Process Synthesis	3	--	--	3	1	ESE	60	24	40
										ISE	40	16	
3	Programme Course	PEC-4	23UGPEC4-CH7031	Mathematical Modeling in Chemical Engineering	3	--	--	2	2	ESE	60	24	40
										ISE	40	16	
4		PEC-5	23UGPEC5-CH7041	Energy Conservation and Resources	3	--	--	3	2	ESE	60	24	40
										ISE	40	16	
5	Multidisciplinary Courses	MDM-5	23UGMDM5-CHE705L	Piping System Design & Lay out	2	--	--	2	2	ISA	50	20	20
6	Experiential Learning Courses	ELC	23UGELC-CH706	Research Methodology	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
7	Programme Course	PCC	23UGPCC-CH701L P	Chemical Process Design Lab	--	--	1	2	1	ISA	25	10	20
										POE	25	10	
8		PEC-4	23UGPEC4-CH7031L P	Mathematical Modeling in Chemical Engineering Lab	--	--	1	2	1	ISA	25	10	20
										POE	25	10	
9	Programme Course	PEC-5	23UGPEC5-CH7041 T	Energy Conservation and Resources	--	1	--	1	1	ISA	25	10	10
10		PCC	23UGPCC-CH702T	Chemical Process Synthesis	--	1	--	1	1	ISA	25	10	10
11	Experiential Learning Courses	ELC	23UGELC-CH707 P	Project Work	--	--	4	8	4	ISA	50	20	20
										POE	50	20	20
					17	2	6	30	21	0	800	320	320

Note: In theory examination, there will be separate passing of ESE and ISE.



Tatyasaheb Kore Institute of Engineering and Technology, Warananagar
Final Year B. Tech. (Chemical Engineering)

Semester-VIII

(National Education Policy – NEP 2020 Structure)

Credit Scheme

Track – I: Capstone Pattern / Academic Pattern

(To be implemented from 2026 - 27)

Final Year B. Tech. Chemical Engineering Sem -VIII

Sr. No.	Category	Sub Category	Course Code	Name of Course	Teaching Scheme			C H	C	Examination & Evaluation Scheme			
					L	T	P			Component	Marks	Min for Passing	
1	Programme Course	PCC	23UGPCC-CH801	Process Economics and Project Engineering	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
2		PCC	23UGPCC-CH802	Process & Plant Safety	3	--	--	3	2	ESE	60	24	40
										ISE	40	16	
3		PEC-6	23UGPEC6-CH8031	Chemical Product Design & Process Development	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
4	Multidisciplinary Courses	MDM-6	23UGMDM6-CH804 L	Piping Insulation	2	--	--	2	2	ISA	50	20	20
5	Programme Course	PCC	23UGELC-CH805LP	Industrial In-Plant Training	--	--	4	8	4	ISA	100	40	40
6		PCC	23UGPCC-CH801T	Process Economics and Project Engineering	--	1	--	1	1	ISA	25	10	10
		PCC	23UGPCC-CH802T	Process & Plant Safety	--	--	--	--	--	ISA	25	10	10
7		PCC	23UGPCC-CH806LP	Advanced Separation Process Lab	1	--	1	3	2	ISA	25	10	10
										POE	25	10	10
8	Experiential Learning Courses	ELC	23UGELC-CH807 P	Project Work	--	--	4	8	4	ISA	100	40	40
										POE	150	60	60
					12	1	09	31	21	0	800	320	320

Note: In theory examination, there will be separate passing of ESE and ISE.



Tatyasaheb Kore Institute of Engineering and Technology, Warananagar
Final Year B. Tech. (Chemical Engineering)

Semester-VIII

(National Education Policy – NEP 2020 Structure)

Credit Scheme

Track – II: Industrial Internship Pattern

(To be implemented from 2026 - 27)

Final Year B. Tech. Chemical Engineering Sem -VIII

Sr. No.	Category	Sub Category	Course Code	Name of Course	Teaching Scheme			C H	C	Examination & Evaluation Scheme			
					L	T	P			Component	Marks	Min for Passing	
1	Programme Course	PCC	23UGPCC-CH801	Process Economics and Project Engineering	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
2		PCC	23UGPCC-CH802	Process & Plant Safety	2	--	--	2	2	ESE	60	24	40
										ISE	40	16	
4	Multidisciplinary Courses	MDM-6	23UGMDM6-CH804 L	Piping Insulation	2	--	--	2	2	ISA	50	20	20
5	Experiential Learning Courses	Internship/ OJT	23UGELC-CH805 LP	Industrial Internship	--	--	8	16	8	ISA	100	40	40
										POE	100	40	40
6	Programme Course	PCC	23UGPCC-CH801T	Process Economics and Project Engineering	--	1	--	1	1	ISA	25	10	10
		PCC	23UGPCC-CH802T	Process & Plant Safety	--	--	--	--	--	ISA	25	10	10
7		PCC	23UGPCC-CH806LP	Advanced Separations Processes Lab	--	--	1	2	1	ISA	25	10	10
										POE	25	10	10
8	Experiential Learning Courses	ELC	23UGELC-CH807 P	Project Work	--	--	4	8	4	ISA	100	40	40
										POE	150	60	60
				Total	07	1	13	34	21	--	800	320	320
				Total Without OE & MDM	05	1	13	32	19				

Note: In theory examination, there will be separate passing of ESE and ISE.



Program Electives Courses (PEC) Basket

PEC - 4			
Category	Sub Category	Course Code	Name of Course
Programme Course	PEC - 4	23UGPEC4-CH7031	Mathematical Modeling in Chemical Engineering
		23UGPEC4-CH7032	Petroleum Refinery Engineering
		23UGPEC4-CH7033	Green Processes

PEC -5			
Category	Sub Category	Course Code	Name of Course
Programme Course	PEC - 5	23UGPEC5-CH7041	Energy Conservation & Resources
		23UGPEC5-CH7042	Nano Technology
		23UGPEC5-CH7043	Down Stream Processing

PEC - 6			
Category	Sub Category	Course Code	Name of Course
Programme Course	PEC - 6	23UGPEC6-CH8031	Chemical Product Design & Process Development
		23UGPEC6-CH8032	Artificial Intelligence in Process Engineering
		23UGPEC6-CH8033	Petro Chemical Technology



**Structure of
Multidisciplinary Minor (MDM) Courses Basket**

**Branch: Chemical Engineering
Piping Engineering**

Sr. No.	Semester	Course Code	Category	Name of Course	Teaching Scheme			C	C H	Examination & Evaluation Scheme			
					L	T	P			Component	Marks	Min for Passing	
1.	III	23UGM DM1-CH306T	MDM - 1	Material Science Engg.	1	1	--	2	2	ISA	50	20	20
2.	IV	23UGM DM2-CH405T	MDM - 2	Corrosion Engg.	1	1	--	2	2	ISA	50	20	20
3.	V	23UGM DM3-CH 505	MDM - 3	Pipe Basic & Revision	4	--		4	4	ESE	60	24	24
										ISE	40	16	16
4.	VI	23UGM DM4-CH 606T	MDM - 4	Piping Material	2	--	--	2	2	ISA	50	20	20
5.	VII	23UGM DM5-CH 705T	MDM - 5	Piping System Design & Layout	2	--	--	2	2	ISA	50	20	20
6.	VIII	23UGM DM6-CH 804T	MDM - 6	Piping Insulation	2	--	--	2	2	ISA	50	20	20
					12	2	--	14	14		350	150	150



Exit Option to Qualify B. Tech. Vocational completion of T. Y. B. Tech. : Any Two (02) Skill based Courses of 8 credits

Sr. No.	Category	Sub Category	Course Code	Name of Course	Teaching Scheme			C	CH	Examination & Evaluation Scheme		
					L	T	P			Component	Marks	Min for Passing
1	Programme Course	PCC	23UG PCCC H703	Plant Design & Project Engg.	3	--	2	4	5	ISA	50	20
2		PCC	23UG PCCC H704	Industrial Safety	2	--	4	4	6	ISA	50	20
3	Experiential Learning Courses	Project	23UG ELCC H708 P	Mini Project (Compulsory)	--	--	8	4	8	ISA	50	20
					5	0	14	12	19	0	150	60



Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Honor Degree Course in Modeling and Simulation (Chemical Engineering)

(Implemented from 2025-26)

Credit Scheme as per NEP 2020

Course Code	Course Title	Semester	Category	Teaching and Credit Scheme					Examination & Evaluation Scheme			
				L	P	T	CH	C	Components	Marks	Min for Passing	
23UGCH-H-501	Process Simulation and control using ASPENPLUS	V	ESC	4	--	--	4	4	ESE	60	24	40
									ISE	40	16	
23UGCH-H-601	Pro Max Software	VI	ESC	4	--	--	4	4	ESE	60	24	40
									ISE	40	16	
23UGCH-H-701	PDMS Aveva (Design Software)	VII	ESC	4	--	--	4	4	ESE	60	24	40
									ISE	40	16	
23UGCH-H-801	Process Simulation using Uni-Sim (Design Software)	VIII	ESC	4	--	--	4	4	ESE	60	24	40
									ISE	40	16	
23UGCH-H-501L	Process Simulation and control using ASPENPLUS Lab	V	ESC	--	--	--	2	1	ISA	25	10	10
23UGCH-H-601L	Pro Max Software Lab	VI	ESC	--	--	--	2	1	ISA	25	10	10
23UGCH-H-701L	PDMS Aveva (Design Software) Lab	VII	ESC	--	--	--	2	1	ISA	25	10	10
23UGCH-H-801L	Process Simulation using Uni-Sim (Design Software) Lab	VIII	ESC	--	--	--	2	1	ISA	25	10	10
				16	--	--	24	20	--	500	--	--

Note: In theory examination, there will be separate passing of ESE and ISE.



23UGPCC-CH701
CHEMICAL PROCESS DESIGN

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	3	ESE	:	60 Marks
Practical	:	2 hrs per week /Batch	ISA	:	25 Marks
Credits	:	1	POE	:	25 Marks
Total Credits	:	4	Total Marks	:	150

Course Objectives: The objective of the course is to

1	Understand the fundamental principles and systematic methodology involved in chemical process equipment design.
2	Design major chemical process equipment such as heat exchangers, evaporators, distillation columns, and cyclone separators using standard design procedures.
3	Interpret process flow diagrams (PFDs), piping and instrumentation diagrams (P&IDs), and process piping systems used in chemical industries.
4	Apply process simulation and piping design software for equipment design, process analysis, piping layout, and engineering decision-making.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Explain the principles of chemical process design, process planning, and preparation of process flow sheets.	Understand
CO2	Design heat transfer equipment such as Double Pipe and Shell & Tube Heat Exchangers.	Apply
CO3	Design Multiple Effect Evaporators for industrial applications.	Apply
CO4	Design Binary Distillation Columns for industrial applications.	Analyze
CO5	Design gas-solid separation equipment such as Cyclone Separators using standard design procedures.	Evaluate
CO6	Apply process simulation, CAD, and piping design software such as Aspen Plus, Aspen HYSYS, DWSIM, ChemCAD, PDMS, and P&ID tools for process analysis, line sizing, pump selection, and equipment layout.	Apply

Description:

This course introduces the systematic approach to the design of chemical process equipment and industrial process piping. It covers the design of shell-and-tube heat exchangers, multiple-effect evaporators, binary distillation columns, and cyclone separators. The course also provides an understanding of industrial piping systems, including pipe sizing, fittings, flanges, valves, materials of construction, and piping standards. Students learn to interpret Process Flow Diagrams (PFDs) and Piping & Instrumentation Diagrams (P&IDs) with equipment numbering, symbols, and stream identification. The role of computer-aided design (CAD), process simulation, and piping software such as Aspen Plus, Aspen HYSYS, DWSIM, ChemCAD, PDMS, and P&ID software is introduced through

industrial case studies involving line sizing, pump selection, and equipment layout.		
Prerequisites:	1:	Basic idea of Chemical equipment and their Nomenclature.
	2:	Basic idea of Heat Transfer, Mass Transfer and Mechanical Operations.
	3:	Completion and Knowledge of Chemical Equipment Design course.

Section – I

	Flow sheet preparation and drawing
--	------------------------------------

Unit 1	The nature and function of process design, sketching techniques, Equipment Lettering and Numbering, Equipment Symbols, Instruments Symbols, Stream designations for Process and Utility. Process Planning, Scheduling and Flow Sheet Design, Organizational structure, Process design scope, Types of Flow sheets, P and I diagrams.	5 Hrs.
Unit 2	Heat Exchangers	
	Process Design of Counter Flow Double pipe heat exchanger (DPHE) Process Design of Counter Flow Shell and Tube heat exchangers (STHE)	7 Hrs.
Unit 3	Multiple Effect Evaporator	
	Process Design of Multiple Effect Evaporator (MEE) design with Forward Feed and Backward Feed Arrangements.	6 Hrs.

Section – II

Unit 4	Distillation	
	Process Design of Binary Distillation Column	7 Hrs.
Unit 5	Cyclone Separator	
	Process Design of Gas-Solid Cyclone Separator	6 Hrs.
Unit 6	Introduction to Piping Systems, P&ID and Design Software	
	Overview of piping systems, functions, and key components, Fundamentals: pipe vs. tube, Nominal Pipe Size (NPS), Schedule numbers, pipe identification and common Materials of Construction (MOC), Detailed study of P&IDs and PFDs, Role of CAD in piping engineering; introduction to PDMS and P&ID software, Case studies using Aspen Plus, HYSYS, DWSIM, ChemCAD, PDMS, and P&ID for line sizing, pump selection, and equipment layout.	5 Hrs.

Mapping of POs & COs:

[illegible]

References

Text Books	
1	G. D. Ulrich, <i>A Guide to Chemical Engineering Process Design and Economics</i> , John Wiley & Sons, New York, 1984.
2	D. Q. Kern, <i>Process Heat Transfer</i> , McGraw-Hill Book Company, New York, 1997.
3	A. K. Jana, <i>Process Simulation and Control Using Aspen</i> , Prentice Hall of India.
4	R. K. Sinnott, <i>Chemical Engineering Design</i> , Volume 6, Coulson & Richardson's Chemical Engineering Series, Butterworth-Heinemann.
Reference Books	
1	E. E. Ludwig, <i>Applied Process Design for Chemical and Petrochemical Plants</i> , Vols. I–III, 3rd Edition, Gulf Publishing Company, Houston, 1994.
2	R. H. Perry, D. W. Green, and J. O. Maloney (Eds.), <i>Perry's Chemical Engineers' Handbook</i> , 7th Edition, McGraw-Hill, New York, 1997.
3	S. D. Dawande, <i>Process Design of Equipment</i> , Central Techno Publication, Nagpur.
4	R. E. Treybal, <i>Mass-Transfer Operations</i> , 3rd Edition, McGraw-Hill Book Company, Singapore, 1980.

NOTE: TKIET Institute Approved DATA BOOK may be provided for ISE/ ESE.

Additional Timing of HALF / ONE HOUR may be given to search Live Data from DATA BOOK during ISE / ESE compared with the other subjects.

TERM - WORK

Drawing and Representation of the following on any Design Software : (Minimum Seven)

1. Equipment symbols
2. Instrument symbols
3. Process and Utility Stream designations
4. Instrumentation diagrams
5. DPHE
6. STHE
7. MEE
8. Binary Distillation Column
9. Batch Reactor
10. Cyclone Separator



23UGPCC-CH702
CHEMICAL PROCESSES SYNTHESIS

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	1	ESE	:	60 Marks
Tutorial	:	1 hrs per week/Batch	ISA	:	25 Marks
Credits	:	1	POE	:	-
Total Credits	:	2	Total Marks	:	125

Course Objectives: The objective of the course is to		
Understand the principles of chemical processing and the role of chemical engineers in chemical process industries.		
Study the manufacturing processes, raw materials, process chemistry, operating conditions, and applications of industrial gases, fuel gases, hydrogen, nitrogen industries, sulfuric acid, fertilizers, phosphate chemicals, and food processing industries.		
Analyze process flow sheets, process equipment, and operating parameters used in major chemical industries.		
Compare conventional and emerging industrial manufacturing processes with emphasis on safety, sustainability, environmental protection, and resource utilization.		
Develop the ability to select and evaluate industrial chemical processes based on technical, economic, and environmental considerations.		
Course Outcomes:		
Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Explain the role of chemical engineers, principles of chemical processing, and the manufacturing processes, properties, and industrial applications of oxygen, nitrogen, carbon dioxide, and acetylene.	Understand
CO2	Explain the classification, production methods, storage, transportation, and applications of fuel gases and hydrogen, including hydrogen economy and fuel cell technology.	Understand
CO3	Explain the manufacturing processes, process chemistry, operating conditions, and industrial applications of synthetic ammonia, nitric acid, ammonium nitrate, urea, sulfur recovery, and sulfuric acid.	Understand
CO4	Explain the classification, manufacturing processes, process flow sheets, raw materials, operating conditions, and environmental aspects of nitrogenous, phosphatic, potassic, mixed, and complex fertilizers.	Understand
CO5	Explain the manufacturing processes, raw materials, process flow sheets, and applications of elemental phosphorus, phosphoric acid, ammonium phosphate, SSP, TSP, and DAP.	Understand
CO6	Analyze various food processing methods, food processing equipment, by-product utilization, and fermentation processes involved in the production of alcohol, beer, wine	Analyze

Description:		
This course provides an overview of the manufacturing processes, chemistry, and industrial applications of major chemical products used in the chemical process industries. It covers the production of industrial gases, fuels and fuel gases, fertilizers, phosphate chemicals, and food and fermentation products, with emphasis on raw materials, process flow, operating conditions, equipment, and by-product utilization. The course also highlights the role of chemical engineers in process industries and develops an understanding of process selection, safety, environmental considerations, and sustainable industrial practices. Through the study of conventional and modern manufacturing processes, students gain the knowledge required to analyze and compare industrial chemical production technologies.		
Prerequisites:	1:	Basic knowledge of Engineering Chemistry, including chemical reactions, stoichiometry, and properties of inorganic and organic compounds.
	2:	Fundamental understanding of Chemical Process Calculations, including material balance concepts and unit conversions.
	3:	Basic knowledge of Unit Operations and Unit Processes, including heat transfer, mass transfer, fluid flow, and separation processes used in chemical industries.
	4:	Familiarity with Industrial Chemistry and Chemical Technology, including common industrial chemicals, raw materials, and basic manufacturing processes.

Section – I		
Unit 1	Chemical Processing and work of chemical engineer	
	Chemical Processing and work of chemical engineer, Industrial Gases: Oxygen, Nitrogen, Carbon Dioxide, Acetylene.	6 Hr
Unit 2	Fuel gases and hydrogen	
	Fuels and Fuel gases: Natural gas, Water gas, Producer gas, LPG. Hydrogen: Classification of hydrogen, production methods, Hydrogen Storage, distribution techniques, fuel cells, industrial applications, safety aspects, challenges, and future prospects of the hydrogen economy.	5 Hr
Unit 3	Nitrogen industries and Sulfuric Acid	
	Nitrogen industries: Synthetic ammonia, Nitric acid, Ammonium nitrate, Urea. Sulfuric Acid- Frasch Process, Manufacturing of sulphuric acid	7 Hr
Section – II		
Unit 4	Fertilizer Industry	
	Fertilizer Industry- Introduction, classification, and importance of fertilizers, Manufacture of nitrogenous, phosphatic and potassic fertilizers, Mixed and complex fertilizers (NPK), process flow sheets, raw materials, applications, and environmental aspects of fertilizer industries.	7 Hr

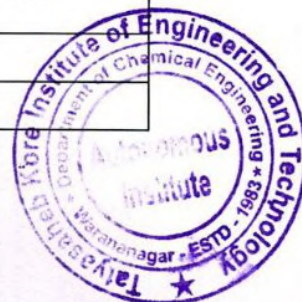
Unit 5	Phosphate Industries.	6 Hr
	Phosphate industries: Elemental phosphorous, Raw materials and process for phosphoric acid, Manufacturing of ammonium phosphate, Single Super Phosphate (SSP), Triple Super Phosphate (TSP), Diammonium Phosphate (DAP)	
Unit 6	Food And Food By-product Industries	5 Hr
	Types of food processing; Food By-products, Food processing equipment. Fermentation Industry: Absolute Alcohol, Beer, wines & liquors.	

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	If applicable		
												PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	1	–	–	–	–	–	1	–
CO2	3	2	–	1	–	–	2	–	–	–	–	–	1	–
CO3	3	3	–	1	–	–	2	–	–	–	–	–	1	–
CO4	3	3	–	1	–	–	2	–	–	–	–	–	1	–
CO5	3	3	–	1	–	–	2	–	–	–	–	–	1	–
CO6	2	3	–	2	1	–	2	–	–	–	–	–	1	–

References

Text Books	
1	George T. Austin, —Shreve's Chemical Process Industries, 5th ed ⁿ ., McGraw Hill Book Company, 1985.
Reference Books	
1	Shukla, S. D., & Pandey, G. N. <i>A Textbook of Chemical Technology</i> . 3 rd ed., Vikas Publishing House Pvt. Ltd., New Delhi.
2	Dryden, C. E. <i>Outlines of Chemical Technology</i> . Affiliated East-West Press Pvt. Ltd., New Delhi, 1973.
3	Venkateswarlu, D. <i>Chemical Technology, Volumes I & III</i> . Chemical Engineering Education Development Centre, Madras, 1977.
4	Faith, W. L., Keyes, D. B., & Clark, R. L. <i>Industrial Chemicals</i> . John Wiley & Sons.
5	Rogers, A. <i>Industrial Chemistry</i> . CBS Publishers & Distributors Pvt. Ltd., New Delhi.



23UGPEC4-CH7031

Mathematical Modeling in Chemical Engineering

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	2	ESE	:	60 Marks
Practical	:	2 hrs per week	ISA	:	25 Marks
Credits	:	1	POE	:	25 Marks
Total Credits	:	3	Total Marks	:	150 Marks

Course Objectives: The objective of the course is to		
- To introduce basic concepts of modeling and fundamental equations for systems in chemical process industries - To develop system and to visualize the effect of various Processes inputs on system performance and state variables - To introduce the basics of simulation software used in chemical engineering		
Course Outcomes:		
Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Explain the fundamental concepts, principles, and methodologies of process modeling and simulation used in chemical engineering.	Understand
CO2	Develop mathematical models for chemical engineering systems using appropriate conservation laws and engineering principles.	Apply
CO3	Analyze the dynamic behavior and performance of chemical process systems using mathematical models.	Analyze
CO4	Analyze chemical reaction, heat transfer, and mass transfer processes through suitable mathematical modeling techniques.	Analyze
CO5	Evaluate the performance of chemical engineering processes using dynamic modeling and simulation approaches.	Evaluate
CO6	Apply process simulation software and computational tools to model, simulate, and interpret the behavior of chemical engineering processes.	Apply

Description:		
Prerequisites:	1:	Students should have a basic understanding of Chemistry and Engineering Mathematics.
	2:	Students should possess fundamental knowledge of Material and Energy Balance calculations.
	3:	Students should be familiar with the basic principles of Chemical Engineering Thermodynamics.

Section – I		
Unit 1	Basic Modeling:	5 Hrs.
	Introduction to modeling–Types of Models, Dependent & Independent Variables, Application and scope coverage, Modeling fundamentals, Chemical engineering modeling, several aspects of the modeling approach, general modeling procedure	
Unit 2	Formulation of dynamic models:	7 Hrs.
	Mass balance equation - Balancing procedure, Case studies: CSTR, Tubular reactor, Total mass balance – Case Studies: Tank drainage, Component balances - Case Studies: Waste holding tank, Energy balance-Heating in a filling tank, Parallel reaction in a semi continuous reactor with large temperature difference, Momentum balances – Dimensionless model equations, CSTR, Gas liquid mass transfer in a continuous reactor.	
Unit 3	Modeling of stage wise processes:	6 Hrs.
	Introduction, Stirred tank reactor, Reactor Configurations, Heat transfer to and from reactors, Steam heating in jacket, Dynamics of the metal jacket walls, Batch reactor – Constant volume, Semi - batch reactor, CSTR - Constant volume CSTR, CSTR cascade, Reactor stability.	
Section – II		
Unit 4	Mass transfer models:	7 Hrs.
	such as liquid-liquid extraction, distillation, multicomponent separation, multicomponent steam distillation, absorber- stage wise absorption, steady state gas absorption with heat effects, evaporator, Heat Transfer Models (Heat exchanger, Evaporator, etc).	
Unit 5	Dynamic modeling:	4 Hrs.
	Plug flow reactor, Plug flow reactor contactors, Liquid– liquid extraction column.	
Unit 6	Simulation of chemical engineering:	7 Hrs.
	Process simulation, Scope of process simulation, Formulation of problem, Step for steady state simulation, Process simulation approaches for steady state simulation, Strategies, Process simulator, Structure of process simulator, Integral process simulation, Simulation tools, ISIM, ICAS– Integrated Computer Aided System, Sequential modular method.	

Practical's:

1. Mathematical modeling and simulation of gravity flow tank.
2. Mathematical modeling and simulation of Interacting tank reservoir system.
3. Mathematical modeling and simulation of CSTR using Aspen plus software.
4. Mathematical modeling and simulation of liquid – liquid extraction column.
5. Mathematical modeling and simulation of Shell and Tube heat exchanger using Aspen plus software.
6. Mathematical modeling and simulation of Batch Distillation
7. Mathematical modeling and simulation of complex Batch reactor.
8. Mathematical modeling and simulation of multicomponent distillation column.

Note- Experiments are conducted by using Aspen Plus software and any Open source software like ChemSep, Berkely madonna

Mapping of POs & COs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	If applicable		
												PSO1	PSO2	PSO3
CO1	3	2	1	—	1	—	—	—	—	—	—	2	—	—
CO2	3	3	2	2	1	—	—	—	—	—	—	2	—	—
CO3	3	3	2	3	2	—	—	—	—	—	—	2	—	—
CO4	3	3	2	3	2	—	—	—	—	—	—	2	—	1
CO5	3	3	2	3	3	—	—	—	—	—	—	2	1	1
CO6	2	2	2	2	3	—	—	—	—	—	—	3	1	

References:

Text Books	
1	John Ingham, Irving, J. Dunn, Elmar, Heinzle Jiri, E. Prenosil, —Chemical Engineering Dynamics, VCH Publishers Inc., New York, 1974.
2	C. L. Smith, R. L. Pike and P. W. Murill, —Formulation Optimization of Mathematical Models□, International Text, Pennsylvania, 1970.
3	R. W. Gaikwad, Dr. Dharendra, — Process Modeling and Simulation, Central Techno Publications, Nagpur, 2003.
Reference Books	
1	W. L. Luyben, —Process Modeling, Simulation and Control for Chemical Engineering, McGraw Hill Book co., 1973.



23UGPEC5-CH7041
Energy Conservation and Resources

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hours/week	ISE	:	40
Credits	:	2	ESE	:	60
Tutorial	:	1	ISA	:	25
Credits	:	--	POE	:	--
Total Credits	:	3	Total Marks	:	125

Course Objectives		
Students should be able to • Understand industrial energy consumption and conservation principles • Grasp the salient features of the energy policy • Identify opportunities for energy recovery in chemical process industries • Evaluate waste heat and energy recovery systems • Understand the different thermal insulation systems and their design • Perform basic industrial energy audits		
Course Outcomes		
COs	Description	Blooms Taxonomy
1	Explain the energy conservation principles from an industrial perspective	Understand
2	Interpret the energy policy, Energy Conservation(Amendment) Act, 2022 and other methods undertaken for energy conservation	Analyzing
3	Identify the sources of heat and energy losses in industry and mitigate them using engineering analysis tools	Apply
4	Understand different heat and energy recovery systems	Understand
5	Identify thermal insulation systems and perform subsequent insulation calculations	Apply
6	Understand the different audits and their methodologies	Evaluate

Description:		
Prerequisites:	1	The students must possess basic knowledge of Chemical Engineering fundamentals
	2	The students must possess basic knowledge of process plant utilities

Section – I		
Unit 1	Energy Conservation Concepts and Industrial Perspective: Energy resources and energy scenario, Industrial energy consumption pattern, Energy intensity and benchmarking, Energy conservation vs. energy efficiency, Energy economics, Sustainability and circular economy, Carbon footprint, Industrial decarbonization, Life Cycle Assessment	4 Hrs
Unit 2	Energy Policy: Energy Conservation (Amendment) Act, 2022, Bureau of Energy Efficiency (BEE), PAT Scheme, Carbon Credit Trading Scheme, Net Zero initiatives	3 Hrs
Unit 3	Energy Analysis in Process Industries Process Energy Analysis: Sources of energy loss, Energy balance for process plants, Sankey diagrams, Specific energy consumption, Energy performance indicators, Benchmarking Process Integration: Heat integration, Utility integration, Composite curves, Pinch Analysis, Minimum utility requirement, Heat exchanger network concepts, Cogeneration Process Intensification: Energy-efficient process design, Intensified separation processes, Heat-integrated distillation	8 Hrs
Section – II		
Unit 4	Waste Heat Recovery and Energy Recovery Systems Waste Heat Recovery: Sources of waste heat, Classification of waste heat, Waste heat recovery potential, Economic evaluation Recovery Equipment: Recuperators, Regenerators, Economizers, Waste heat boilers, Heat pipes, Heat pumps, Organic Rankine Cycle, Kalina Cycle	8 Hrs
Unit 5	Thermal Insulation and Energy Conservation Industrial Insulation: Heat transfer fundamentals, Heat loss from industrial equipment, Selection of insulation materials, Hot insulation, Cold insulation, Cryogenic insulation, Acoustic insulation Insulation Design: Economic insulation thickness, Surface temperature calculations, Heat loss estimation, Energy-saving calculations, Corrosion Under Insulation (CUI), Inspection and maintenance Standards: ASTM C680, ISO 12241, Relevant BIS standards	7 Hrs

Unit 6	Industrial Energy Audit and Energy Management Energy Audit: Preliminary audit, Detailed audit, Audit methodology, Data collection, Instrumentation, Reporting Energy Management: ISO 50001, Energy Management Systems, Energy Performance Indicators, Continuous improvement, Monitoring and targeting Digital Technologies: Smart energy monitoring, IoT, SCADA, Artificial Intelligence applications, Digital twins Industrial Applications: Refineries, Petrochemical plants, Fertilizer plants, Cement plants, Steel plants, Glass industry	6 Hrs
--------	--	-------

References:

Text Books	
1	Stephen A. Roosa, Steve Doty & Wayne Turner (Eds.), <i>Energy Management Handbook</i> , Ninth Edition, River Publishers, 2020
Reference Books	
1	<i>General Aspects of Energy Management and Energy Audit</i> , Fourth Edition, Bureau of Energy Efficiency, 2015
2	<i>Energy Performance Assessment for Equipment and Utility Systems</i> , Fourth Edition, Bureau of Energy Efficiency, 2015
3	Witte L.C, <i>Industrial Energy Management And Utilization</i> , CRC Press, 1987
4	D.A.Raey, <i>Heat Recovery Systems</i> , Spon Press, 1979
5	Robin Smith, <i>Chemical Process Design and Integration</i> , Second Edition, Wiley, 2016
6	Alireza Bahadori, <i>Thermal Insulation Handbook for the Oil, Gas and Petrochemical Industries</i> , Gulf Professional Publishing, 2014
7	Albert Thumann, <i>Handbook of Energy Audits</i> , Ninth Edition, River Publishers, 2012
8	Ian C. Kemp, <i>Pinch Analysis and Process Integration: A User Guide on Process Integration for the Efficient Use of Energy</i> , Second Edition, Butterworth-Heinemann, 2007

Mapping of COs and POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2					3	2				3		2	3
CO2						3					2		3	
CO3	2	2	2										3	
CO4	3	2	2										3	
CO5	2	2	3		2									
CO6		2	2			2			2	2	2		3	2



23UGMDM5-CH705L
MDM-5: Piping System Design & Layout

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	2 hours/week	ISE	:	--
Credits	:	2	ESE	:	--
Practical	:	--	ISA	:	50 marks
Credits	:	--	POE	:	--
Total Credits	:	2	Total Marks	:	50 marks

Course Objectives

The course aims to:

1. Introduce the principles of process plant piping design.
2. Understand the piping standards and codes and interpret engineering documentation
3. Enable interpretation of PFDs, P&IDs, and plant layout drawings
4. Develop understanding of piping layout, routing, and equipment arrangement.
5. Familiarize students with piping standards, codes, and engineering practices.
6. Introduce basic pipe stress and support concepts.

Course Outcomes

COs	Description	Blooms Taxonomy
CO1	Explain the role and scope of piping in process industries	Remember
CO2	Interpret the piping standards and codes in design	Understand
CO3	Read and interpret the piping and instrumentation diagrams	Understand
CO4	Develop basic piping layouts for process plants.	Apply
CO5	Understand pipe stress considerations and flexibility requirements	Analyze
CO6	Apply piping design practices and use modern tools	Create

Description:		
Prerequisites:	1	The student must have prior knowledge of material science and engineering
	2	The student must have prior knowledge of the basics of piping

Section – I		
Unit 1	Unit I: Introduction to Process Plant Piping: Overview of Process Piping: Role of piping in chemical and process industries, Components of a piping system, Classification of piping systems	2 Hrs
Unit 2	Piping Standards and Codes and Documentation Piping Standards and Codes: ASME B31.3 Process Piping, ASME B16 series standards, API standards, ANSI, ASTM, ISO standards Engineering Documentation: Line lists, Equipment data sheets, Piping specifications	3 Hrs
Unit 3	Process Flow Diagrams and P&IDs Process Flow Diagrams (PFDs): Purpose and importance, Symbols and conventions, Material and energy flow representation Piping and Instrumentation Diagrams (P&IDs): Symbols and nomenclature, Control loops, Instrumentation tagging, Utility systems representation Drawing Interpretation: Reading industrial P&IDs, Equipment numbering systems, Line numbering systems	4 Hrs
Section – II		
Unit 4	Plant Layout and Piping Arrangement Plant Layout Principles: Process requirements, Safety considerations, Accessibility and maintenance Equipment Layout: Arrangement of reactors, pumps, heat exchangers, tanks, Plot plans, Equipment spacing requirements Pipe Routing: Pipe rack design concepts, Utility corridors, Above-ground and underground piping Good Engineering Practices: Accessibility for operation, Future expansion provisions, Drainage and venting considerations	6 Hrs
Unit 5	Pipe Stress Analysis and Support Systems Pipe Stress Fundamentals: Sources of piping stress, Internal pressure stresses, Thermal expansion stresses Flexibility Analysis: Expansion loops, Expansion joints, Flexibility criteria Pipe Supports: Types of supports: Anchors, Guides, Hangers, Spring supports, Shoe supports Vibration and Dynamic Loads: Causes of vibration, Basic mitigation measures	5 Hrs

Unit 6	Piping Design Practices and Modern Tools Piping Design Workflow: Conceptual design, Detailed engineering, Construction and commissioning Material Take-Off (MTO): Pipe quantity estimation, Bill of materials preparation Introduction to CAD-Based Piping Design: AutoCAD Plant 3D, PDMS/E3D, SmartPlant 3D Industrial Case Studies: Refinery piping systems, Fertilizer plant piping, Petrochemical installations, Pharmaceutical Piping, Food and Beverage Piping installations	4 Hrs
--------	---	-------

References:

Text Books	
1	Ed Bausbacher & Roger Hunt, <i>Process Plant Layout and Piping Design</i> , Pearson Prentice Hall, 1993
Reference Books	
1	David R. Sherwood & Dennis J. Whistance, <i>The piping guide for the design and drafting of industrial piping systems</i> , Construction Trades Press, Second Edition, 1991
2	Mohinder L. Nayyar, <i>Piping Handbook</i> , McGraw-Hill Professional Pub, 1991
3	John J. McKetta, <i>Piping Design Handbook</i> , CRC Press, 1992
4	ASME B31.3 <i>Process Piping Code</i>
5	Edwin C. Bauman, <i>Introduction to Piping Engineering</i> , Gulf Publishing Co., 1978

Mapping of COs and POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3						2						3
CO2	2	3	1								1			
CO3	1	2												
CO4	3	3	3		2				3		3		3	2
CO5	3	3	3		2	2	2		2		3		2	2
CO6	3	3	3		3	2			3	2	3	3	3	3



23UGELC-CH706
Research Methodology

Course Details:				
Teaching Scheme			Evaluation Scheme	
Lectures	:	3 hours/week	ISE	: 40 Marks
Credits	:	3	ESE	: 60 Marks
Tutorial	:	-	ISA	: -
Credits	:	-	POE	: --
Total Credits	:	3	Total Marks	: 100

Course Objectives: The objective of the course is to		
- To develop an understanding of research methodology - To equip students with research design and data analysis skills - To enable students to prepare and communicate research outcomes effectively		
Course Outcomes:		
Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Explain the fundamentals of research methodology and research ethics. .	Understand
CO2	Apply research methods for problem identification and research design.	Understand
CO3	Analyze research data using statistical techniques.	Analyze
CO4	Evaluate research methods and published research findings.	Evaluate
CO5	Prepare research proposals, reports, and technical presentations.	Create
CO6	Design and conduct research to solve chemical engineering problems.	Create

Description:		
Prerequisites:	1	Basic knowledge of Chemical Engineering fundamentals and experimental techniques.
	2	Basic understanding of statistics, data analysis, and technical report writing.

Section – I		
Unit 1	Introduction to Research Meaning, objectives and significance of research, types of research (basic, applied, exploratory, descriptive), research process steps, criteria of good research, research ethics, plagiarism and academic integrity, role of research in chemical engineering, industrial and academic research differences.	6 hrs.
Unit 2	Problem Identification and Literature Review Research problem formulation, selection of research topic, research questions and objectives, hypothesis development, literature search strategies, use of databases (Scopus, Science Direct, Google Scholar), critical review of literature, gap identification, reference management tools (Mendeley / EndNote).	5 hrs

Unit 3	Research Design Concept of research design, types of design (experimental, quasi-experimental, descriptive), variables (independent, dependent, controlled), sampling methods, design of experiments (DOE basics), validation and verification techniques, pilot studies, reproducibility and reliability in chemical engineering research.	7 hrs
Section – II		
Unit 4	Data Collection and Measurement Primary and secondary data sources, experimental methods in chemical engineering, instrumentation basics, data measurement scales, calibration of instruments, reliability and validity, error analysis, safety considerations during data collection, case studies from chemical process industries.	7 hrs
Unit 5	Data Analysis and Interpretation Statistical techniques (mean, variance, standard deviation), hypothesis testing (t-test, chi-square basics), correlation and regression analysis, introduction to ANOVA, data visualization techniques, use of software tools (Excel, MATLAB, SPSS basics), uncertainty analysis, interpretation of engineering results and validation of outcomes.	6 hrs
Unit 6	Research Writing and Presentation Structure of research report (abstract, introduction, methodology, results, discussion, conclusion), technical paper writing for journals, referencing styles (APA/IEEE), thesis writing guidelines, plagiarism checking tools, poster preparation, oral presentation skills, seminar defense techniques, and publication ethics.	5 hrs.

Mapping of POs & COs:

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	If applicable		
												PSO1	PSO2	PSO3
CO1			1											
CO2						3							1	
CO3										2				
CO4					2									1
CO5									1			2		
CO6				3										

References:

Text Books	
1	C.R. Kothari & Gaurav Garg, <i>Research Methodology: Methods and Techniques</i> , New Age International Publishers.
Reference Books	
1	Donald R. Cooper & Pamela S. Schindler, <i>Business Research Methods</i> , McGraw-Hill Education.
2	Mark N. O. Sadiku, <i>Research Methods for Engineers</i> , CRC Press.
3	Douglas C. Montgomery, <i>Design and Analysis of Experiments</i> , Wiley.
4	Richard A. Johnson & Dean W. Wichern, <i>Applied Multivariate Statistical Analysis</i> , Pearson.
5	Day R.A. & Gastel B., <i>How to Write and Publish a Scientific Paper</i> , Cambridge University Press.



23UGELC – CH707P**Project Work**

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	--	ISE	:	--
Credits	:	--	ESE	:	--
Practical	:	8 hours/week	ISA	:	50 marks
Credits	:	4	POE	:	50 marks
Total Credits	:	4	Total Marks	:	100 marks

Course Objectives

1. To enable students to apply engineering knowledge and systematically analyze complex problems through independent project execution.
2. To develop the ability to design and implement innovative solutions considering sustainability, safety, and societal impact.
3. To cultivate skills in research-based investigation, data analysis, and critical evaluation for valid conclusions and adaptability to emerging technologies.
4. To strengthen proficiency in modern engineering tools and IT applications for modeling, simulation, and project management.
5. To foster professional values of ethics, teamwork, communication, and leadership in multidisciplinary project environments.

Course Outcomes

COs	Description	Blooms Taxonomy
CO1	Apply engineering knowledge, mathematics, and discipline-specific fundamentals to develop solutions for complex project problems.	Apply
CO2	Analyse research literature and project data to identify, formulate, and evaluate engineering problems with sustainable considerations.	Analyze
CO3	Design and develop innovative systems, components, or processes that address societal, environmental, and economic needs.	Create
CO4	Investigate complex engineering problems through experiments, modelling, and data interpretation to draw valid conclusions.	Evaluate
CO5	Utilize modern engineering tools, IT applications, and project management principles to execute and manage multidisciplinary projects effectively.	Apply
CO6	Demonstrate ethical responsibility, effective communication, and collaborative teamwork in diverse project environments.	Evaluate/Apply

Prerequisites	1.	Completion of Core Courses (up to 6th Semester): Students must have successfully completed fundamental courses in mathematics, engineering sciences, and discipline-specific subjects to ensure adequate knowledge base.
	2.	One-Month In-Plant Training in Process Industries (after 6th Semester): Mandatory industrial exposure to gain practical insights into engineering operations, safety, sustainability, and professional practices.

Project Guidelines

The project work shall be carried out under the guidance of internal and/or external supervisors. A typed report must be submitted in duplicate.

Structure of the Project Report

1. Certificate
2. Acknowledgement
3. Statement of Problem
4. Synopsis / Abstract
5. Index
6. Introduction
 - Importance of the Project
 - Market Situation
 - Consumption Data
 - Need for the Plant
7. Literature Survey – Process Selection
8. Theoretical Considerations – Process Parameters, Composition
9. Process Description – Process Flow Sheet (Block Diagram)
10. Basic Engineering Data
 - Physical
 - Chemical
 - Thermodynamic
 - Analytical Methods
11. Details of Experimental Setup & Work
 - Purpose, Method, Chemicals, Calculations
 - Data Analysis, Results, Discussion
12. Material Balance & Energy Balance
13. Equipment Selection & Specifications
14. Design of Specific Equipment

- Process Design
 - Mechanical Design
15. Process Control & Safety
 16. Plant Layout & Location
 17. Cost Estimation & Economic Analysis
 18. Pollution Control, Safety, and Marketing
 19. Conclusion & Remarks
 20. References
 - Books
 - Journals
 21. Appendix
 - List of Tables
 - Sample Calculations
 - Data Tables, etc.

Assessment Scheme

- Each group shall consist of **3–5 students**.
- **Internal Assessment (ISA – 50 marks):** Conducted through regular PPTs, seminars, and an oral exam at the end of the year by departmental faculty. The Head of Department must ensure uniform assessment procedures for all students.
- **External Assessment (50 marks):** Conducted through an oral examination by at least two examiners — one internal and one external (preferably from industry) — at the end of the semester.

The objective of the Viva Voce (internal and external) is to evaluate whether the project objectives have been achieved and to assess the originality, initiative, and technical competence demonstrated by the student.

Implementation Procedure for Final Year Project

The primary objective of the Final Year Project is to provide students with hands-on experience in conducting quality research.

The following guidelines apply:

Problem Statement

A concise statement that initiates the research or design idea. It should address:

- The issue to be solved.
- The need for addressing the issue.
- How the project provides a solution.
- The beneficiaries of the project.

Objectives

Objectives must clearly state the technical goals of the project (e.g., evaluate design performance, test hypotheses, study relationships between variables). Use measurable action verbs such as define, design, identify, describe, analyze, evaluate.

Avoid generic objectives like “to learn project management.”

Scope

The scope defines the boundaries of the project (time, geography, environment, function, etc.) to ensure clarity among

stakeholders and to make the project achievable and realistic.

Literature Review

A literature review summarizes and synthesizes published information in the chosen subject area. It should include:

1. **Introduction** – describing the topic of the review.
2. **Body** – discussion of sources, arranged chronologically, thematically, or methodologically.
3. **Conclusion** – highlighting gaps in existing research and clarifying the contribution of the student's project.

In the discussion, students should:

- Clearly identify variables, techniques, or design decisions.
- Make comparisons and provide technical commentary (tables/graphs may be used).
- For engineering design, discuss trade-offs of specific design decisions.

ISA – Assessment Methods (Project Progress)

Marks						
First Review – Seminar 1				Second Review – Seminar II		
Examination Panel	Presentation ppt	Seminar report on Introduction, Literature Survey, Objectives, Selection, Proposed Methodology	Total	Viva-Voce (Internal) Actual work done	Draft Final Report*	Total
Total	40	10	50	40	10	50

*Students have to submit the final typed reports by making corrections suggested in second review.

Note – For final marks, average of two reviews must be considered.

Draft Report

This document serves as a working version of the final project report. It should be submitted to your supervisor/guide at least two weeks before the final submission deadline, allowing sufficient time for review and feedback. Supervisors are expected to read only one draft version of the report. Therefore, in your own interest, the draft should be as complete and well-prepared as possible to ensure constructive feedback. Your supervisor/guide, who also serves as an examiner for other projects, will provide insights into what evaluators typically expect. If your draft does not meet these expectations, you will still have time to make necessary corrections before the final submission. Please note that the draft report is not formally assessed and should be sent directly to your supervisor/guide for review.



Mapping of COs and POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	–	–	–	–	–	2	2	1
CO2	1	3	–	2	–	2	–	–	–	–	2	1	2	3
CO3	–	1	3	–	–	3	–	–	–	–	–	1	3	3
CO4	–	2	–	3	–	–	–	–	–	–	2	3	2	2
CO5	–	–	–	1	3	–	–	–	–	3	–	3	2	1
CO6	–	–	–	–	–	–	3	3	3	2	–	1	2	3


Prof. V.A.Bhosale
 Member Secretary


Dr. P.B.Dehankar
 Chairman, Board of Studies,
 Chemical Engg.


Dr.P.V.Mulik
 HoD, Mechanical Engg.
 Dean Academics
Dean, Academic
Tatyasaheb Kore Institute of Engg.
& Technology (Autonomous)
Warananagar, Dist. Kolhapur


Dr. K.I.Patil
 Principal
 T.K.I.E.T.
 Warananagar
 Chairman
 Academic Council
Tatyasaheb Kore Institute of Engg.
& Technology (Autonomous)
Warananagar, Dist. Kolhapur



Final Year B. Tech Semester-VIII (Chemical Engineering)

23UGPCC-CH801

PROCESS ECONOMICS AND PROJECT ENGINEERING

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	3	ESE	:	60 Marks
Tutorial	:	1	ISA	:	25 Marks
Credits	:	1	POE	:	-
Total Credits	:	4	Total Marks	:	125 Marks

Course Objectives: The objective of the course is to		
- To understand economical aspects in chemical industry - To understand and introduce general common terms related to economics - To make students to develop skills required for project Engineer		
Course Outcomes:		
Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Understand the core principles of chemical plant design, layout configurations, and industrial process commercialization.	Understanding
CO2	Apply quantitative risk assessment techniques (such as HAZOP, FTA, and SIL) to ensure safety and environmental compliance in chemical processes.	Applying
CO3	Apply asset accounting, cost estimation methods, and break-even analysis to determine the economic viability of an industrial venture.	Analyzing
CO4	Evaluate capital investment strategies, profitability, depreciation, and alternative process equipment choices using time-value-of-money principles.	Evaluating
CO5	Formulate project management frameworks by sequencing activities and developing PERT/CPM networks to optimize critical path schedules.	Creating
CO6	Design comprehensive strategies for contract selection, process optimization, and plant startup execution within realistic economic and organizational constraints.	Evaluating

Description:		
Cost and Asset accounting, Break Even analysis , Interest, Time value of Money, Taxes and Insurance Profitability, Depreciation, Process development and commercialization, Project conception and definition PERT/ CPM		
Prerequisites:	1:	Students should have basic knowledge of Process Design
	2:	Students should have basic knowledge of financial terms and transactions
	3:	should have basic knowledge of an Industry , Organization and Management

Section – I		
Unit 1	Introduction, General design considerations like plant location layout, HAZOP, FTA, SIL, QRA, Process Design Development.	5 Hrs
Unit 2	Cost and Asset accounting, Different ratio in accounting, Analysis of Cost estimation and break even analysis.	7 Hrs.
Unit 3	Interest, Time value of Money, Taxes and Insurance Profitability, Depreciation, Alternative investments and replacements, Optimum design and Design strategy.	6 Hrs.
Section – II		
Unit 4	Process development and commercialization: Introduction, Exploratory research and its types, Process Licensing: Licensing principles, License agreement, and Agreement implementation.	7 Hrs.
Unit 5	Selection of contractor scope and contract types : Introduction, Detailing of scope of work, detailing of contract types, Factors in selecting type of contract. Plant Startup: Introduction, Organization of startup, Budget for startup, Information centre, Plant startup . Procurement and Construction	4 Hrs.
Unit 6	Project conception and definition: Selection of plant capacity Causes for time and cost over runs of a Project. Project Planning, Scheduling and Controlling , PERT/ CPM - Introduction, Activity Sequencing, Network building, Time estimates, Critical path calculations.	7 Hrs.

Assignments:- Minimum 4 Assignments should be completed on above syllabus & 1 assignment should be on your Project i.e. Cost estimation of your project.

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	If applicable		
												PSO 1	PSO 2	PSO 3
CO1	3	1	2			1					1			1
CO2	2	1	1	2	1	2	1				1		2	2
CO3	3		3	2	3	1		1	3	3	2	1	2	
CO4	2		3	1	1	3	1	1	2	2	1		2	1
CO5	2	3	2	2	3	2	2	1	1	3	2		1	1
CO6			3	3	2	1	1	1	2	2	1		1	3

References:

Text Books	
1	M.S. Peters & K.D. Timmerhaus, "Plant Design and Economics for Chemical Engineers", 5th edition, McGraw Hill International Book Co., 2003.
2	J.M. Coulson & J.F Richardson, "Chemical Engineering", Vol.6, 5th edition Pergamon & ELES, 2003
3	Chemical Project Economics, Mahajani V. V. and Mokashi S M.
4	Srinath L.S. "PERT & C.P.M. Principles and Applications"3rd edition, East-West Publication 2003
5	Lundu, "The Chemical Plant".
6	GAEL D. ULRICH, "A Guide to Chemical Engineering Process Design and E" John Wiley & Sons,1984.
Reference Books	
1	Rase, H.F. Barrow, M.H. "Project Engineering of Process Plants", JohnWiley.
2	Chilton, C.H., "Cost Engineering in Process Industries", McGrawHill
3	Schewayer, H.E. "Process Engineering Economics", McGrawHill
4	V.W. Wani. & A.W. Hankins, "Technical Economics for Chemical Engineers" (AIChE) 1971.



23UGPCC-CH802
Process & Plant Safety

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	2	ESE	:	60 Marks
Tutorial	:	--	ISA	:	25 Marks
Credits	:	--	POE	:	--
Total Credits	:	3	Total Marks	:	125 Marks

Course Objectives: The objective of the course is to

- The concept of industrial and social safety.
- Conceptualization of process safety management (PSM).
- Process safety responsibilities for other engineering fields.
- The necessity of process safety as demonstrated by examples of significant process safety incidents.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Bloom's Taxonomy
CO1	Explain the safety.	Recall
CO2	Define the concept of "process safety management."	Understand
CO3	Learn what the Center for Chemical Process Safety (CCPS) calls the 20 process safety elements.	Understand
CO4	Process safety concerns exist with some selected unit operations.	Apply
CO5	Different parts of process safety connect to what is already taught in programs for chemical engineering.	Analysis
CO6	Describe the various responsibilities an engineer new to process safety can anticipate in their first few years on the job in terms of process safety.	Evaluate

Description:

Prerequisites :	1 :	Chemical Processes
	2 :	Unit operations

Section – I		
Unit 1	Role of safety in society	
	Societal approach and method, the concept of societal safety, Dimensions of societal safety: extraordinary stresses and losses, complexity and mutual dependence, Trust in vital social functions, Societal Safety and Other Safety-Related Areas, Some Dilemmas and Value Choices, Influencing societal safety the relationship between knowledge, prevention and societal safety.	
Unit 2	Engineering aspects of process plant safety	
	Process Safety: Risk-Based Process Safety, Process Safety Culture, Process Safety Competency and Hazard Identification. The need for process safety.	
Unit 3	Chemical hazards and worker safety	
	Process Hazards: Chemical Reactivity Hazards, Fires and Explosions Risk assessment methods, General principles of industrial safety, toxicity and radiations, Industrial hygiene, Introduction to industrial safety regulations.	
Section – II		
Unit 4	Process Hazards and Safety Basics	
	Hazards: Classifications and assessment of various types of hazards, hazard and operability studies (HAZOP), key parameters, Hazard operability (HAZOP) hazard analysis (HAZAN), industrial case study.	
Unit 5	The Need for Process safety and Engineering disciplines	
	Process Safety Culture: Methyl Isocyanate Release, Bhopal, India, 1984: Summary, Detailed Description, Key Lessons. Process Safety for Engineering Disciplines: Introduction, Process Knowledge Management and Compliance with Standards.	
Unit 6	Process safety in Design and Process Hazards	
	Process Safety in Design: General Unit Operations and Their Failure Modes, Heat Exchange Equipment, Mass Transfer, Distillation, Leaching and Extraction, Absorption, Reactors and Reactive Hazards, Storage.	

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	If applicable		
												PSO1	PSO2	PSO3
CO1			1											
CO2						3							1	
CO3										2				
CO4					2									1
CO5									1			2		
CO6				3										

References:

Text Books	
1	Dan Crowlet al., "Introduction to Process Safety for Undergraduates and Engineers," CCPS, Wiley.
2	Banerjee, S., Industrial Hazards and Plant Safety, Taylor & Francis, 2003.
3	Trevor A. Kletz, "Hazop & Hazan: Identifying and Assessing Process Industry Hazards", Fourth edition, CRC Press, 1999.
Reference Books	
1	G.D. Ulrich, "A Guide to Chemical Engineering Process Design and Economics", John Wiley and Sons 1934.
2	Daniel A. Crowl, Joseph F. Louvar, "Chemical Process Safety Fundamentals with Applications", Prentice Hall, Third Edition, 2011
2	Moocs/ Swayam/NPTEL Courses on Optimization in Chemical Engineering



23UGPEC6-CH8031
CHEMICAL PRODUCT DESIGN & PROCESS DEVELOPMENT

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	3	ESE	:	60Marks
Practical	:	--	ISA	:	--
Credits	:	--	POE	:	--
Total Credits	:	3	Total Marks	:	100

Course Objectives: The objective of the course is to

- Give up-to-date knowledge for developing the process & equipment such as heat and mass transfer equipment used in chemical process plants.
- Have the knowledge to analyze a problem and finding optimum process & product development methods for the equipment used in chemical process plants.
- Study and Use latest Computer Software and application of these software to solve process & product development problems.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Understand the types of Chemical Processes.	Understand
CO2	Select A strategy for a process from amongst the alternatives.	Select
CO3	Determine strategy for carrying out a particular process for a particular product.	Determine
CO4	Finalize Process and Product Designs with the help of design software.	Finalize
CO5	Prepare specifications for particular equipment required.	Prepare
CO6	Use and Apply the knowledge to execute techno- economical Process and Product Design.	Apply

Description:

Prerequisites	1:	All Chemical Engineering subjects, Material Science and Engineering, Environmental Engineering and Process Safety.
	2:	Basic idea of Chemical Process and Product Design.

Section – I		
Unit 1	Introduction: Process Development and Requirement	
	Importance and Goals of Chemical Process Development. Important considerations for process development.	5 hrs
Unit 2	Challenges of Process Development	
	Challenges and solutions of Chemical Process Development. Importance of Heat and Mass transfer in Chemical Process Development.	6 hrs
Unit 3	Strategies to improve Chemical Process Development.	
	Collaborations, Data Analytics and Machine Learning , Process Modelling and Simulation, Automation , Environmental Sustainability, ERP etc. Modern Technologies for Process Development in Chemical Manufacturing	7 hrs
Section – II		
Unit 4	Introduction to Product Design -	
	The design process. Steps in Product Design and Process Development.	5 hrs
Unit 5	Product Testing & Product Formulation	
	Testing Activities & Techniques in Product Design & Process Development Packaging Development	5 hrs
Unit 6	Process Development Interwoven with Product Design	
	Unit Operations , Unit Processes, Processing Limits, Building the Marketing. Product & Process specifications & marketing strategy. Process scale-up methodology and applications.	8 hrs

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	If applicable		
												PSO1	PSO2	PSO3
CO1	3	1				1	1	1	1			-	1	-
CO2				2	3	1						-	1	-
CO3			3	2								-	1	-
CO4					3		2					-	1	-
CO5						1						-	1	-
CO6			2		2	1	1					2	-	-

References:

Text Books	
1	Seider W.D., D.R. Lewin by Product & Process Design Principles 4 th Ed. Vital source E-Book Wiley 2017
2	Chemical Process Engg. : Design & Economics by Silla H.
3.	Hand Book of Chemical Process Development , Chandalia S.B.
4	Organic Unit Processes by Groggins
Reference Books	
1	Conceptual Chemical Plant Design , Douglas J.M.
2	Industrial Chemical Process Design by D. L. Erwine
3	Product Design & Development 2 nd Ed. McGraw Hill 2000
4	Chemical Product Design 2 nd Ed. Cambridge University Press 2011.



23UGMDM6-CH804L
MDM-6: Piping Insulation

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	2 hours/week	ISE	:	--
Credits	:	2	ESE	:	--
Practical	:	--	ISA	:	50 marks
Credits	:		POE	:	--
Total Credits	:	2	Total Marks	:	50 marks

Course Objectives

The course aims to:

1. Introduce thermal insulation principles used in process industries.
2. Familiarize students with insulation materials and applications.
3. Explain hot, cold, cryogenic, and acoustic insulation systems.
4. Understand and apply the acoustic design principles in piping design
5. Develop understanding of insulation design and installation practices.
6. Highlight energy conservation and safety aspects of insulation.

Course Outcomes

COs	Description	Blooms Taxonomy
CO1	Explain the role of insulation in process plants.	Remember
CO2	Select suitable insulation materials for industrial applications	Understand
CO3	Understand hot and cold insulation practice	Understand
CO4	Understand insulation installation and maintenance practices	Understand
CO5	Design the insulation systems	Apply
CO6	Evaluate energy-saving opportunities through insulation systems	Analyze

Description:		
Prerequisites:	1	The student must have basic knowledge about the concepts of physics, chemistry and mathematics
	2	The student must have prior knowledge about piping design and engineering

Section – I		
Unit 1	Fundamentals of Insulation and Heat Transfer: Review of Heat Transfer: Conduction, Convection, Radiation. Need for Insulation: Energy conservation, Personnel protection, Process temperature maintenance, Environmental considerations. Thermal Properties Thermal conductivity, Density, Specific heat, Emissivity Insulation Terminology: Heat loss, Heat gain, Surface temperature, Critical insulation thickness	3 Hours
Unit 2	Industrial Insulation Materials Fibrous Insulation Materials: Glass wool, Mineral wool, Rock wool Rigid Insulation Materials: Calcium silicate, Cellular glass, Perlite Foam-Based Materials: Polyurethane foam (PUF), Polyisocyanurate (PIR) Selection Criteria: Temperature limits, Moisture resistance, Mechanical strength, Fire resistance Insulation Standards: ASTM insulation standards, Industrial specifications	4 Hours

Unit 3	Hot and Cold Insulation Systems Hot Insulation: Steam pipelines, Hot oil systems, Furnace piping Cold Insulation: Refrigeration systems, Chilled water lines Cryogenic Insulation: LNG systems, Liquid oxygen and nitrogen storage Condensation Control: Vapor barriers, Moisture protection	4 Hours
Section – II		
Unit 4	Acoustic Insulation and Installation Practices Acoustic Insulation: Noise generation in process plants, Noise control methods, Sound absorption materials Insulation Installation: Surface preparation, Installation procedures, Jacketing and cladding systems Weather Protection: Aluminum cladding, Stainless steel cladding Quality Control: Inspection methods, Common installation defects	4 Hours

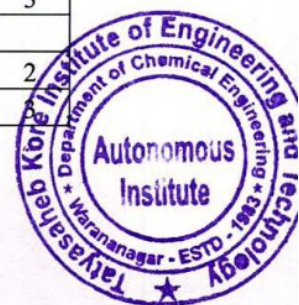
Unit 5	Insulation Design Calculations and Economic Analysis Fundamentals of Insulation Design: Design objectives, Process requirements, Operating and ambient conditions, Design temperature limits Heat Loss and Heat Gain Calculations: Heat loss from cylindrical surfaces, Heat gain in refrigerated systems, Effect of insulation thickness on heat transfer, Surface temperature calculations Critical Radius of Insulation: Concept of critical radius, Critical radius for cylindrical pipes, Engineering significance and applications Economic Thickness of Insulation: Cost of insulation versus energy savings, Optimum insulation thickness, Payback period analysis, Life-cycle cost considerations Software and Industrial Practices: Introduction to insulation design software, Vendor data sheets, Industrial standards and specifications Case Studies: Steam distribution network insulation, Chilled water piping insulation, Refinery and petrochemical plant applications, Pharmaceutical Plant Insulation	5 Hours
Unit 6	Energy Conservation, Maintenance and Industrial Applications Energy Audits: Heat loss assessment, Insulation performance evaluation Maintenance Practices: Inspection schedules, Repair techniques, Life-cycle considerations Safety Considerations: Personnel protection, Fire protection systems, Environmental compliance Industrial Applications: Refineries, Petrochemical plants, Fertilizer plants, Power plants, Pharmaceutical industries	4 Hours

References:

Text Books	
1	Alireza Bahadori , <i>Thermal Insulation Handbook for the Oil, Gas and Petrochemical Industries</i> , Gulf Professional Publishing, 2014
Reference Books	
1	John F. Turner William C.;Malloy , <i>Thermal Insulation Handbook</i> , McGraw-Hill Book Company, 1981
2	Wayne C. Turner , <i>Energy Management Handbook</i> , Fairmont Press, Eight Edition, 2013
	Malcolm J. Crocker (ed.) , <i>Handbook of Noise and Vibration Control</i> , John Wiley & Sons, Inc., 2007
3	<i>ASTM Standards on Thermal Insulation Materials</i>

Mapping of COs and POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	2			3	3	3	3		1		3	2
CO2	3	2	2			2		2			2			
CO3		2	3								1		3	3
CO4	3	3	3			2	2	3	3		3		3	
CO5	3	3	3		3	2		3	3	2	3		3	2
CO6	1	2	3			3	3	2			3		2	



23UGELC – CH805LP**Industrial In –Plant Training**

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	--	ISE	:	--
Credits	:	--	ESE	:	--
Practical	:	8 hours/week	ISA	:	100 marks
Credits	:	4	POE	:	--
Total Credits	:	4	Total Marks	:	100 marks

Course Objectives		
1. Provide students with practical exposure to industrial operations and professional engineering practices. 2. Enable students to apply chemical engineering principles to real industrial processes and problem-solving. 3. Develop technical, analytical, communication, teamwork, and leadership skills in an industrial environment. 4. Familiarize students with industrial safety, health, environmental regulations, and ethical practices. 5. Enhance students' employability through hands-on learning and interaction with industry professionals		
Course Outcomes		
COs	Description	Blooms Taxonomy
CO1	Understand the organization structure, manufacturing processes, utilities, and workflow of a chemical process industry. .	Understand
CO2	Apply chemical engineering fundamentals to analyze industrial operations, equipment, and process performance.	Analyze
CO3	Identify engineering problems in the workplace and propose technically feasible solutions using engineering tools and techniques.	Create
CO4	Demonstrate professional skills including communication, teamwork, documentation, time management, and project execution.	Apply

CO5	Practice industrial safety, environmental protection, sustainability, and professional ethics while working in an industrial environment.	Apply
CO6	Prepare a comprehensive technical report and effectively present the internship work with appropriate conclusions and recommendations.	Create

Prerequisites	1.	Students must have fundamental knowledge of Chemical Engineering subjects.
	2.	Students must have a basic understanding of industrial safety and environmental practices also Students must have Good communication, teamwork, and professional ethics.

Guidelines

- After the end of the seventh semester examination and before the start of the seventh semester, every student will have to undergo an internship.
- The Internship would be of 6 credits.
- The internship (preferably Industrial Internship) would be assigned to the student by the Departmental Internship Coordinator, with the approval of the Head, Chemical Engineering Department.
- The total duration of the internship would be for a period equivalent to 12 Calendar weeks.
- This period typically starts from 1st Jan and ends before 30th May every year.
- This means the end semester examination of B.Tech. Engg. (Semester-VIII) should be completed before the 8th semester examination every year.
- The internship may be completed in one or more organizations as described below.

The internship could be of the following forms:

(i) industrial internship in a company (within India or Abroad) involved in R&D / design / manufacturing (QA/QC/Plant Engineering/Stores and Purchase) / marketing / finance / consultancy / Technical services / Engineering / Projects, etc.

(ii) research internship in reputed Institutes (within India or Abroad) like, ICT, IITs, NITs, IISc, NCL, IICT etc.

- At the end of the internship, each student will submit a written report based on the work carried out during the Internship.

- The report will be countersigned by the Supervisor from Industry / Institute as the case may be.
- Performance of the student will be assessed based on the written report and a presentation to a committee consisting of two faculty members from the Chemical Engineering Department.
- Students will be assigned a grade based on the written report and a presentation; evaluated by a committee of faculty members.

Mapping of COs and POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3											1		
CO2		3												
CO3				2							1			2
CO4									3				1	
CO5							3	3						3
CO6		2								3		1		



23UGPCC-CH806LP
Advanced Separation Process Lab

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	1 hrs per week	ISE	:	--
Credits	:	1	ESE	:	--
Practical	:	2 hrs per week	ISA	:	25 Marks
Credits	:	1	POE	:	25 Marks
Total Credits	:	2	Total Marks	:	50

Course Objectives: The objective of the course is to		
1. Learn novel separation techniques 2. Research potential commercial applications. 3. Learn how to estimate the separation parameter.		
Course Outcomes:		
Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Explain the principles, mechanisms, design parameters, and applications of ultra filtration, microfiltration, and nano filtration processes	Understand
CO2	Analyze the operating principles, membrane characteristics, and performance of reverse osmosis systems for water purification and desalination.	Analyze
CO3	Apply the concepts of ion exchange and pervaporation to solve industrial separation and purification problems.	Apply
CO4	Analyze the design, operation, and applications of pressure swing adsorption and gas permeation processes for gas separation.	Analyze
CO5	Evaluate the performance and suitability of electrostatic precipitators, dialysis, and electro dialysis for pollution control and separation processes.	Evaluate
CO6	Design appropriate separation processes using supported liquid membranes and supercritical fluid extraction for specific industrial applications.	Create

Description:		
Prerequisites:	1:	Water Chemistry
	2:	Basis upstream water treatments
	3:	Membrane Technology

Section – I	
Principle, Mechanism, Design parameters, Applications.	
Unit 1	Ultra filtration, Micro filtration, Nano filtration
Unit 2	Reverse Osmosis
Unit 3	Ion Exchange, Pervaporation
Section – II	
Unit 4	Pressure swing Adsorption, Gas Permeation
Unit 5	Electrostatic Precipitator, Dialysis and Electro dialysis
Unit 6	Supported Liquid Membranes, Supercritical Fluid Extraction etc

List of Practical's:

1. Ion Exchange Column
2. Ion Exchange resin
3. Ion Exchange Equilibrium
4. Electro coagulation
5. Ultra filtration of some dilutes solutions
6. Reverse osmosis
7. Pressure Swing Adsorption
8. Microfiltration of waste water

Mapping of POs & COs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	If applicable		
												PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	–	–	–	–	–	–	–	1
CO2	2	3	2	–	–	–	–	–	–	–	–	1	2	–
CO3	2	2	3	–	–	–	–	–	–	–	–	2	2	–
CO4	2	3	2	2	–	–	–	–	–	–	–	2	1	–
CO5	2	2	–	2	–	2	3	–	–	–	–	–	3	2
CO6	2	2	2	2	1	–	2	–	–	–	1	3	3	2

References:

Text Books	
1	J.D. Seader, Ernest J. Henley, "Separation Process Principles" 2 nd Edition, Wiley India, 2007.
2	C.J.King "Separation Processes" 2nd Ed., Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1986.
3	Sirkar K. & Winston H.O. "Membrane Hand Book" Van Nostrand Reinhold, New York, 1992
Reference Books	
1	McCabe & Smith "Unit Operations of Chemical Engineering" 5th Ed., McGraw Hill
2	Richardson and Coulson, —Chemical Engineering Volume II, Pergamon Press, 1970
3	Schweitzer P.A , —Handbook of Separation Techniques for Chemical Engineering 2nd edn., McGraw Hill Book Co., 1986.
4	Souri Rajan S. "Reverse Osmosis" Logos Press Ltd.



23UGELC – CH807P
Project Work

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	--	ISE	:	--
Credits	:	--	ESE	:	--
Practical	:	8 hours/week	ISA	:	100 marks
Credits	:	4	POE	:	150 marks
Total Credits	:	4	Total Marks	:	250 marks

Course Objectives

6. To enable students to apply engineering knowledge and systematically analyze complex problems through independent project execution.
7. To develop the ability to design and implement innovative solutions considering sustainability, safety, and societal impact.
8. To cultivate skills in research-based investigation, data analysis, and critical evaluation for valid conclusions and adaptability to emerging technologies.
9. To strengthen proficiency in modern engineering tools and IT applications for modeling, simulation, and project management.
10. To foster professional values of ethics, teamwork, communication, and leadership in multidisciplinary project environments.

Course Outcomes

COs	Description	Blooms Taxonomy
CO1	Apply engineering knowledge, mathematics, and discipline-specific fundamentals to develop solutions for complex project problems.	Apply
CO2	Analyze research literature and project data to identify, formulate, and evaluate engineering problems with sustainable considerations.	Analyze
CO3	Design and develop innovative systems, components, or processes that address societal, environmental, and economic needs.	Create
CO4	Investigate complex engineering problems through experiments, modelling, and data interpretation to draw valid conclusions.	Evaluate
CO5	Utilize modern engineering tools, IT applications, and project management principles to execute and manage multidisciplinary projects effectively.	Apply
CO6	Demonstrate ethical responsibility, effective communication, and collaborative teamwork in diverse project environments.	Evaluate/Apply

Prerequisites	1.	Completion of Core Courses (up to 6th Semester): Students must have successfully completed fundamental courses in mathematics, engineering sciences, and discipline-specific subjects to ensure adequate knowledge base.
	2.	One-Month In-Plant Training in Process Industries (after 6th Semester): Mandatory industrial exposure to gain practical insights into engineering operations, safety, sustainability, and professional practices.

Project Guidelines

The project work shall be carried out under the guidance of internal and/or external supervisors. A typed report must be submitted in duplicate.

Structure of the Project Report

11. Certificate
12. Acknowledgement
13. Statement of Problem
14. Synopsis / Abstract
15. Index
16. Introduction
 - Importance of the Project
 - Market Situation
 - Consumption Data
 - Need for the Plant
17. Literature Survey – Process Selection
18. Theoretical Considerations – Process Parameters, Composition
19. Process Description – Process Flow Sheet (Block Diagram)
20. Basic Engineering Data
 - Physical
 - Chemical
 - Thermodynamic
 - Analytical Methods
12. Details of Experimental Setup & Work
 - Purpose, Method, Chemicals, Calculations
 - Data Analysis, Results, Discussion
15. Material Balance & Energy Balance
16. Equipment Selection & Specifications
17. Design of Specific Equipment

- Process Design
- Mechanical Design
- 21. Process Control & Safety
- 22. Plant Layout & Location
- 23. Cost Estimation & Economic Analysis
- 24. Pollution Control, Safety, and Marketing
- 25. Conclusion & Remarks
- 26. References
- Books
- Journals
- 22. Appendix
- List of Tables
- Sample Calculations
- Data Tables, etc.

Assessment Scheme

- Each group shall consist of **3–5 students**.
- **Internal Assessment (ISA – 50 marks):** Conducted through regular PPTs, seminars, and an oral exam at the end of the year by departmental faculty. The Head of Department must ensure uniform assessment procedures for all students.
- **External Assessment (50 marks):** Conducted through an oral examination by at least two examiners — one internal and one external (preferably from industry) — at the end of the semester.

The objective of the Viva Voce (internal and external) is to evaluate whether the project objectives have been achieved and to assess the originality, initiative, and technical competence demonstrated by the student.

Implementation Procedure for Final Year Project

The primary objective of the Final Year Project is to provide students with hands-on experience in conducting quality research. The following guidelines apply:

Problem Statement

A concise statement that initiates the research or design idea. It should address:

- The issue to be solved.
- The need for addressing the issue.
- How the project provides a solution.
- The beneficiaries of the project.

Objectives

Objectives must clearly state the technical goals of the project (e.g., evaluate design performance, test hypotheses, study relationships between variables). Use measurable action verbs such as define, design, identify, describe, analyze, evaluate. Avoid generic objectives like “to learn project management.”

Scope

The scope defines the boundaries of the project (time, geography, environment, function, etc.) to ensure clarity among

stakeholders and to make the project achievable and realistic.

Literature Review

A literature review summarizes and synthesizes published information in the chosen subject area. It should include:

4. **Introduction** – describing the topic of the review.
5. **Body** – discussion of sources, arranged chronologically, thematically, or methodologically.
6. **Conclusion** – highlighting gaps in existing research and clarifying the contribution of the student's project.

In the discussion, students should:

- Clearly identify variables, techniques, or design decisions.
- Make comparisons and provide technical commentary (tables/graphs may be used).
- For engineering design, discuss trade-offs of specific design decisions.

ISA – Assessment Methods (Project Progress)

Marks						
First Review				Second Review		
Examination Panel	Presentation	Seminar report on Introduction, Literature Survey, Objectives, Selection, Proposed Methodology	Total	Viva-Voce (Internal) Actual work done	Draft Final Report*	Total
Total	50	25	75	50	25	75

*Students have to submit the final typed reports by making corrections suggested in second review.

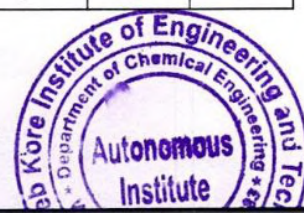
Note – For final marks, average of two reviews must be considered.

Draft Report

This document serves as a working version of the final project report. It should be submitted to your supervisor/guide at least two weeks before the final submission deadline, allowing sufficient time for review and feedback. Supervisors are expected to read only one draft version of the report. Therefore, in your own interest, the draft should be as complete and well-prepared as possible to ensure constructive feedback. Your supervisor/guide, who also serves as an examiner for other projects, will provide insights into what evaluators typically expect. If your draft does not meet these expectations, you will still have time to make necessary corrections before the final submission. Please note that the draft report is not formally assessed and should be sent directly to your supervisor/guide for review.

Mapping of COs and POs & PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	–	–	–	–	–	2	2	1
CO2	1	3	–	2	–	2	–	–	–	–	2	1	2	3
CO3	–	1	3	–	–	3	–	–	–	–	–	1	3	3
CO4	–	2	–	3	–	–	–	–	–	–	2	3	2	2
CO5	–	–	–	1	3	–	–	–	–	3	–	3	2	1
CO6	–	–	–	–	–	–	3	3	3	2	–	1	2	3



Program Electives Courses (PEC) Basket

PEC - 4			
Category	Sub Category	Course Code	Name of Course
Programme Course	PEC - 4	23UGPEC4-CH7031	Mathematical Modeling in Chemical Engineering
		23UGPEC4-CH7032	Petroleum Refinery Engineering
		23UGPEC4-CH7033	Green Processes

PEC - 5			
Category	Sub Category	Course Code	Name of Course
Programme Course	PEC - 5	23UGPEC5-CH7041	Energy Conservation & Resources
		23UGPEC5-CH7042	Nano Technology
		23UGPEC5-CH7043	Down Stream Processing

PEC - 6			
Category	Sub Category	Course Code	Name of Course
Programme Course	PEC - 6	23UGPEC6-CH8031	Chemical Product Design & Process Development
		23UGPEC6-CH8032	Artificial Intelligence in Process Engineering
		23UGPEC6-CH8033	Petro Chemical Technology



23UGPEC4-CH7032

PETROLEUM REFINERY ENGINEERING

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	2	ESE	:	60Marks
Tutorial	:	1	ISA	:	25 Marks
Credits	:	1	POE	:	25 Marks
Total Credits	:	3	Total Marks	:	150

Course Objectives: The objective of the course is to

- What is crude oil, what are various petroleum resources
- Origin of petroleum, exploration techniques and drilling techniques in details
- Composition, classification, distillation & separation techniques including pre-treatment.
- Properties & specification of petroleum products and overall separation processes
- Various conversion processes, Treatment methods and post production operations of Petroleum refineries.
- Recent trends, advancement in Petroleum refineries

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Students will get aware about basic information about crude, resources and overall scenario of refineries in India as well across the world.	Aware
CO2	Students will be able to understand about origin, exploration techniques, Drilling Rig and Drilling techniques in detailed manner..	Understand
CO3	Students will be able to understand composition, Classification of crude oil and able to understand various distillation processes & separation methods.	Understand
CO4	Students will be able to understand properties and specification of petroleum products and Overall separation processes	Understand
CO5	Students will be able to evaluate various steps in conversion processes, treatments and post operations in refinery.	Evaluate
CO6	Students will be able to analyse about recent trends, capacities of petroleum refineries	Analyze

Description: Chemistry and reactions , Unit operations



Section – I		
Unit 1	1 Introduction to petroleum refineries:	4 Hrs
	Resources of petroleum ,Origin and exploration techniques, Origin of petroleum, methods of exploration, drilling rigs, drilling techniques, production methods of crude oil, etc.	
Unit 2	2 Pre-refining operations:	5 Hrs
	Composition of crude, classification of crude, types of distillation methods – ASTM, TBP, pretreatment of crude, Different arrangement of Distillation column, Multi component of atmospheric distillation, vacuum distillation, transportation of crude.	
Unit 3	Separation processes: Solvent extraction processes, solvent de-waxing.	5 Hrs
	Properties and specifications of fuel gas, LPG, gasoline, naphtha, jet fuel, kerosene, diesel, lubricating oils, greases, waxes, coke, etc.	
Section – II		
Unit 4	Conversion process:	8 hrs
	Thermal cracking, visbreaking, coking, catalytic cracking, thermal reforming, catalytic reforming, hydrocracking, hydro processing, alkylation, Isomerization and polymerization.	
Unit 5	Treatment methods:	6 hrs
	Sweetening process, hydrodesulphurization, smoke point improvement.	
Unit 6	Post production operations:	6 hrs
	Blending of additives (ETBE, MTBE, Ethanol, Lead), of products, marketing of petroleum and petroleum products, safety and pollution considerations in refineries. Recent trends in petroleum refineries: Recent trends in petroleum in terms of Distillation, Packing materials, Catalyst, Non conventional fuels, Necessity of Bio-fuels, Trans-esterification process, etc.	

Books:

1. Gary J H, Handwerk G E, _Petroleum refining
2. Nelson W. L., —Handbook of Petroleum Refinery Engg.I, McGra Hill,International, Auckland,1982
3. Petroleum Refinery Engineering , Dr.Ram Prasad.
4. Guthre, V.B., —Petroleum ProductsI, Hand-Book McGraw Hill.
5. B.K.Bhaskara Rao Modern Petroleum Refining Processes

**23UGPEC4-CH7033
GREEN PROCESSES**

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	2	ESE	:	60 Marks
Tutorial	:	1	ISA	:	25 Marks
Credits	:	1	POE	:	25 Marks
Total Credits	:	3	Total Marks	:	150 Marks

Course Objectives: The objective of the course is to

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	To provide basic knowledge on green technology.	Create
CO2	To understand the principles of green chemistry and eco friendly methodologies	Analyse
CO3	To create awareness on Cleaner development mechanisms.	Create
CO4	To develop concepts on various energy efficient Green process systems.	Evaluate
CO5	To implement Green technologies for addressing the problems of different process.	Understand
CO6	To understand Challenges and Practical Implementation	Implement

Description:

Prerequisites:	1:	Environment Engineering
	2:	Engineering Chemistry



Section – I		
Unit 1	Green technology :Definition, importance, factors affecting	9 Hrs.
	Green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of sustainable green production systems Concepts of green chemistry and Process intensification	
Unit 2	Green Synthesis and Catalysis:	8 Hrs.
	Green oxidation and photochemical reactions, Microwave and Ultrasound assisted reactions, Synthesis of Green Reagents, Green solvents, Green nanotechnology and Ionic liquids. Solvent free techniques- Reaction on solid supports. Alternative solvents Ionic liquids- general synthesis, applications.	
Unit 3	Cleaner development technologies:	8 Hrs.
	Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labeling. Oxidation technology for waste water treatment- Cavitation, Fenton chemistry, photo catalysis and hybrid processes.	
Section – II		
Unit 4	Green process : Fuel cell , Green Hydrogen, Ethanol	8 Hrs.
	Advanced Fuel cell Technology, Application Advanced technology for production of green hydrogen Green process in Ethanol Production :1G,2G,3G and 4G	
Unit 5	Industrial case studies:	8 Hrs.
	Green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity- WEHAB (eco-restoration/ phyto-remediation, ecological sanitation, renewable energy technologies, industrial ecology, agro ecology and other appropriate green technologies	
Unit 6	Challenges and Practical Implementation:	9 Hrs.
	Responsibilities and potentials of companies for action. Green Productivity and emerging technologies. Implementation of the practical applications of Green emerging technologies and sustainable development. Case studies in Green Technology. Green laws compliance	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	If applicable		
												PSO1	PSO2	PSO3
CO1	2	1	2	1	-	-	2	1	-	-	-	-	-	-
CO2	2	1	2	1	-	-	2	1	-	-	-	-	-	-
CO3	2	2	2	1	-	-	2	1	-	-	-	-	-	-
CO4	2	2	2	1	-	-	2	1	-	-	-	-	-	-
CO5	2	3	2	1	-	-	2	1	-	-	-	-	-	-
CO6	2	2	2	2	-	-	2	1	-	-	-	-	-	-

References:

Text Books	
1	Paul T. Anastas; —Green Chemistry – Theory and Practice
2	Albert S. Matlack ; —Introduction to Green Chemistry
Reference Books	
1	Anastas, P.; Warner, J. Green Chemistry: Theory and Practice; Oxford University Press: London, 1998.
2	Zimmerman, J.B.; Anastas, P.T. —The 12 Principles of Green Engineering as a Foundation for Sustainability in Sustainability Science and Engineering: Principles. I Ed. Martin Abraham, Elsevier Science. available 2005.
3	Anastas, P.; Zimmerman, J. —Design through the Twelve Principles of Green Engineering, Environmental Science and Technology, 37, 94A – 101A, 2003.



PEC -5			
Category	Sub Category	Course Code	Name of Course
Programme Course	PEC - 5	23UGPEC5-CH7041	Energy Conservation & Resources
		23UGPEC5-CH7042	Nano Technology
		23UGPEC5-CH7043	Down Stream Processing



23UGPEC5-CH7042
NANO TECHNOLOGY

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	2 hrs per week	ISE	:	40 Marks
Credits	:	2	ESE	:	60 Marks
Tutorial	:	1 hrs per week	ISA	:	25 Marks
Credits	:	1	POE	:	--
Total Credits	:	3	Total Marks	:	125

Course Objectives: The students completing this course are expected to understand and learn

- Introduce fundamentals of Nanoscience and Nanotechnology.
- Study the concept of nanomaterials
- Explain the synthesis, purification and application of nanomaterials.
- Study the advances in nanotechnology
- Intellectual property rights of nanotechnology

Course Outcomes:

Cos	At the end of successful completion of the course	Blooms Taxonomy
CO1	To understand the application of Nanoscience in catalysis and green chemistry	Aware
CO2	Characterization of nanomaterials	Understand
CO3	Physico chemical aspects of different types of nanostructures	Understand
CO4	Demonstrate the understanding of length scale concepts, nanostructures and nanotechnology	Understand
CO5	Systematically solve scientific problems related specifically to nano-technological materials using conventional scientific and mathematical notation	Evaluate
CO6	Identify the principles of processing, and synthesis of nonmaterial's and nanostructures	Analyse

Description		
Prerequisites	1:	Basic Science & Engineering
	2:	Material Science & Engineering



Section – I		
Unit 1	Introduction to Nanoscience and Nanotechnology: History, Importance of Nanoscales, Fundamental concepts (Bottom-up and Top-down processes).	6 Hrs
Unit 2	Nanomaterials: Fundamental concept of nanomaterial, Materials used in nanotechnology, carbon nanotubes-properties	6 Hrs
Unit 3	Synthesis, Purification, Application of Nanomaterials	6 Hrs
Section – II		
Unit 4	Fabrication techniques and Application of Nanotechnology	6 Hrs
Unit 5	Recent Advances in Industrial Nanotechnology	6 Hrs
Unit 6	Intellectual property rights on Nanotechnology: Importance of IP Protection, copy rights and trade secrets	6 Hrs

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	If applicable		
												PSO1	PSO2	PSO3
CO1	1													
CO2		1												
CO3		1	2									1		
CO4		1					2						1	
CO5			1											
CO6							1							

References:

Text Books	
1	Principles of Nanotechnology, Phani umar
Reference Books	
1	“Nanomaterials”, Vishwanathan
2	“The Nanoscope” Encyclopedia of Nanoscience and Nanotechnology Vol I to Vol 6, Edited by Dr.Parag Diwan and Ashish Bharadwaj

23UGPEC5-CH7043
DOWN STREAM PROCESSING

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	2	ESE	:	60 Marks
Tutorial	:	1	ISA	:	25 Marks
Credits	:	1	POE	:	--
Total Credits	:	3	Total Marks	:	125 Marks

Course Objectives: The objective of the course is to		
- Understand the methods to obtain pure proteins, enzymes and in general about product development R & D - Have depth knowledge and hands on experience with on Downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion		
Course Outcomes:		
Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Define the fundamentals of downstream Processing for process recovery.	Understand
CO2	Analyze methods of physical and chemical separation.	Analyze
CO3	Understand the requirements of successful operations of downstream processing.	Create
CO4	Apply principles of various unit operations used in downstream processing and enhance problem solving techniques	Apply

Description:		
Prerequisites	1:	Bio molecules, bio products
	2:	Mass Transfer
	3:	Instrumental methods of Analysis



Section – I		
Unit 1	Introduction	9 Hrs
	Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pre treatment and stabilization of bio-products	
Unit2	Methods Of Separation- I	8 Hrs.
	Unit operations for solid-liquid separation insoluble products - filtration and centrifugation. basic principles, design characteristics, Ultracentrifuges: Principles and Applications.	
Unit 3	Methods Of Separation- Ii	7 Hrs.
	Sedimentation, Flocculation cell disruption; Sonication Bead mills, Homogenizers, Chemical lysis, Enzymatic lysis	
Section – II		
Unit 4	Isolation Of Products	7 Hrs.
	Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultra filtration and reverse osmosis, dialysis, precipitation of proteins by different methods.	
Unit 5	Product Purification	8 Hrs
	Chromatography – principles, instruments and practice, adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.	
Unit 6	Final Product Formulation And Finishing Operations	5 Hrs.
	Crystallization, drying and lyophilization in final product formulation.	

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	If applicable		
												PSO1	PSO2	PSO3
CO1			1									1		
CO2				2										
CO3								1					2	
CO4					2						3			2

References:

Text Books	
1	Belter, P.A., E.L. Cussler and Wei-Houhu "Bioseparations – Downstream Processing for Biotechnology", John Wiley, 1988.
2	P.M. Doran, Bioprocess Engineering Principles, Academic press
3	Sivasankar, B. "Bioseparations: Principles and Techniques". PHI, 2005.
Reference Books	
1	Asenjo, Juan A. "Separation Processes in Biotechnology". CRC / Taylor & Francis, 1990.
2	Ghosh, Raja "Principles of Bioseparations Engineering". World Scientific, 2006
3	"Product Recovery in Bioprocess Technology". (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.

PEC - 6			
Category	Sub Category	Course Code	Name of Course
Programme Course	PEC - 6	23UGPEC6-CH8031	Chemical Product Design & Process Development
		23UGPEC6-CH8032	Artificial Intelligence in Process Engineering
		23UGPEC6-CH8033	Petro Chemical Technology



23UGPEC6-CH8032
ARTIFICIAL INTELLIGENCE IN PROCESS ENGINEERING

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	3	ESE	:	60 Marks
Practical	:	--	ISA	:	--
Credits	:	--	POE	:	--
Total Credits	:	3	Total Marks	:	100

Course Objectives: The objective of the course is to		
- Introduce students to statistical tools that are used in process systems engineering problems. - Have the knowledge about appropriate balance between mathematical rigor and to maintain the problem solving skills - Study and Use latest Computer Software and application of these software to solve chemical engineering problems		
Course Outcomes:		
COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Understand the artificial intelligence (AI) in process engineering.	Understand
CO2	Select programming Languages for process engineering	Select
CO3	Select types of problems in AI	Select
CO4	Analyze Expert System Era, Neural Network Era & Data Science Era.	Analyze
CO5	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	Prepare
CO6	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems..	Apply

Description:		
Prerequisites	1:	All Chemical Engineering subjects, Material Science and Engineering, Environmental Engineering and Process Safety.
	2:	Basic idea of Chemical Process and Product Design.



Section – I		
Unit 1	Introduction -	
	History and relation of artificial intelligence (AI) to process engineering: Knowledge representation I-Predicate calculus and Semantic Networks; Search - Forward/Backward. Depth/breadth/best-first search; Production systems.	
Unit 2	History. Components-	
	Knowledge representation II- Frames, Objects; Inexact Reasoning- Introduction, Bayesian certainty factors, Qualitative Physics, Casual Models- Introduction, Backward architecture; Expert Systems - Applications to industry; Programming Languages; Expert System Shells; Neural Nets- Introduction and applications to process engineering.	
Unit 3	What is Artificial Intelligence	
	Types of problems AI addresses like Computer Vision, Natural Language Processing, Robotics, Expert Systems.	
Section – II		
Unit 4	Artificial Intelligence in Chemical Engineering Background:	
	Early Attempts, Expert System Era Neural Network Era, Effects and Lacunae of Expert System Era and Neural Network Era on Chemical Engineering Deep Learning and Data Science Era.	
Unit 5	Applications of AI in chemical engineering -	
	Areas like fault diagnosis, Process control, Process design, Planning and operations, Modeling and simulation and Product design, development and selection like Separation Design, Heat-Exchanger Network Synthesis, Thermodynamic Model Selection and Physical Property Estimation, Oil reservoir image segmentation, Corrosion and crack predictions based on image detection and Machine Learning series.	
Unit 6	Application of AI in modeling -	
	AI in chemical process modelling , AI in optimization of chemical, Application of neural networks in chemical process control, Modelling	

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	If applicable		
												PSO1	PSO2	PSO3
CO1	3	1				1			1					
CO2				2	3									
CO3			3	2								1		
CO4					3		2						2	
CO5						1							2	
CO6					2	1								3

References:

Text Books	
1	Raff, Edward. Inside Deep Learning: Math. Algorithms and Models. Manning Publications, 2022.
2	Quantrile, Thomas, Liu, Y. A, Artificial Intelligence in Chemical Engineering, Academic Press, 1991.
3.	Michael L. Mavrovouniotis, 1990, Artificial Intelligence in Process Engineering, Academic Press
Reference Books	
1	VenkatVenkatasubramanian, 2019, The Promise of Artificial Intelligence in Chemical Engineering: Is It Here, Finally?, AIChE, Vol. 65, No. 2
2	ZeinabHajjar, ShokoufeTayyebi and Mohammad HoseinEghbal Ahmadi, 2018, Application of AI in Chemical Engineering.
3	N.L. Nilsson, "Problem Solving Methods in Artificial Intelligence", McGraw Hill, 1971.
4	T.E. Quantrille and Y.A. Liu, "Artificial Intelligence in Chemical Engineering" Academic Press, 1991.
5	J. Zurada, "Introduction to Artificial Neural Systems", West Pub. Co. Ltd., St. Paul, MN, 1992.
6	J. F. Davis, G. Stephanopoulos and V. Venkatasubramanian, "Intelligent Systems in Process Engineering", AIChE symposium Series, Vol. 92, 1996.
7	Ian Goodfellow, Yoshua Bengio, Aaron Courville. Deep Learning. (Adaptive Computation of oxidative coupling of methane. International Journal of Chemical Reactor Engineering. 2012; 10:1-21



23UGPEC-CH8033
PETROCHEMICAL TECHNOLOGY

Course Details:					
Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	ISE	:	40 Marks
Credits	:	3	ESE	:	60 Marks
Tutorial	:	--	ISA	:	--
Credits	:	-	POE	:	--
Total Credits	:	3	Total Marks	:	100

Course Objectives: The objective of the course is to

- What are petrochemicals, petrochemical Industries.
- Cost consideration, indigenous technology, natural gas & petroleum, classification of petrochemicals.
- Raw Materials like Organic chemicals, coal, biomass petroleum, Chemicals from Methanol & Synthesis gas.
- Chemicals from Ethane, Ethylene & Acetylene, Propane & Propylene, Butanes & Pentanes.
- Chemicals from aromatics, Polymers, elastomers, synthetic fibers, PVC, Nylon & Polyesters.
- Recent trends, advancement in Petroleum refineries, Integrated Petrochemical complex, Energy crises.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Bloom's Taxonomy
CO1	Students will get aware about basic information about petrochemicals, industry venture.	Recall
CO2	Students will be able to understand about raw materials	Understand
CO3	Students will be able to understand about product produced	Understand
CO4	Students will be able to understand process, conditions, variables, controlling parameters	Apply
CO5	Students will be able to understand specialized product like polymers.	Analysis
CO6	Students will be able to quite aware about recent trends, energy efficient process.	Evaluate

Description:		
Prerequisites :	1	Chemical Processes
	2	Unit operations

Section – I		
Unit 1	General Introduction	
	Definition of petrochemicals, history of petrochemical industry, development of petrochemical industry in India, product profile of petrochemicals, economics of petrochemical industry, general cost considerations, indigenous technology v/s foreign know-how, economics of R&D, sources of petrochemicals, natural gas & petroleum, classification of petrochemicals.	4hrs
Unit 2	Raw Materials and Chemicals from Methanol, Synthesis gas	
	Organic chemicals, coal, biomass petroleum, etc., Steam reforming, Oxo-Products, Methanol, Formaldehyde, Carbon-di-sulphide, Hydrogen cyanide.	5hrs
Unit 3	Chemicals from Ethane, Ethylene, Acetylene, Propane and Propylene	
	Synthetic Ethanol, Acetaldehyde, Acetic acid, Vinyl acetate, Ethylene oxide, Ethylene glycols, Acrylonitrile, Isopropanol, Acetone, Glycerol, Propylene oxide, Propylene Glycols, Isoprene, Cumene.	6hrs
Section – II		
Unit 4	Chemicals from Butanes & Pentanes	
	Butadiene, Butone epoxides & Butanol amines, Butyl acetate, Methyl-Ethyl Ketone, MTBE, TAME, TPA & DMT, Maleic anhydride, Adipic acid, Hexamethylenediamine, Aniline, Caprolactum.	6hrs
Unit 5	Chemicals from aromatics and Polymers	
	BHC, Nitrobenzene, Do-decyl benzene, Benzoic acid, Nitrotolune, Phthalic anhydride, Isophthalic acid. Polymers, elastomers, synthetic fibers, PVC, Nylon & Polyesters.	6hrs
Unit 6	Future of Petrochemicals	
	Integrated Petrochemical complex, Energy crises in Petrochemical industry, Natural gas as Petrochemical feedstock, Import of heavy feedstock on Petrochemicals, Ecology & energy crises, Coal as an alternative to oil, Synthetic fuels, Trends in Petrochemical Industry.	4hrs

Mapping of POs & COs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	If applicable		
												PSO 1	PSO2	PSO 3
CO1			1											
CO2						3							1	
CO3										2				
CO4					2									1
CO5									1			2		
CO6				3										

References:

Text Books	
1	B.K. Bhasker Rao, —A Text on Petrochemicals 2nd Edition, Khanna publishers, 1996.
2	SukumarMaiti, —Introduction to Petrochemicals Oxford & IBH publishing Co. Pvt. Ltd., 1991.
3	C.E. Dryden, —Outlines of Chemical Technology , Affiliated East-West Press, 1973.
Reference Books	
1	A.V.G. Halm, —The Petrochemical Industry , McGraw Hill 1970.
2	Astle M.J., —The Chemistry of Petrochemicals , Reinhold.
3	A.L. Waddams, —Chemicals from Petroleum , Chemical publishing Co.
4	MOOC/ Swayam/NPTEL Courses on petrochemical technology



National Education Policy (NEP) 2020 Structure
Multidisciplinary Minor (MDM) Courses Basket
Branch: Chemical Engineering

Piping Engineering

Sr. No.	Semester	Course Code	Category	Name of Course	Teaching Scheme			C	C H	Examination & Evaluation Scheme			
					L	T	P			Component	Marks	Min for Passing	
1.	III	23UGM DM1-CH306T	MDM - 1	Material Science Engg.	1	1	--	2	2	ISA	50	20	20
2.	IV	23UGM DM2-CH405T	MDM - 2	Corrosion Engg.	1	1	--	2	2	ISA	50	20	20
3	V	23UGM DM3-CH 505	MDM - 3	Pipe Basic & Revision	4	--		4	4	ESE	60	24	24
										ISE	40	16	16
4	VI	23UGM DM4-CH 606T	MDM - 4	Piping Material	2	--	--	2	2	ISA	50	20	20
5	VII	23UGM DM5-CH 705T	MDM - 5	Piping System Design & Layout	2	--	--	2	2	ISA	50	20	20
6	VIII	23UGM DM6-CH 804T	MDM - 6	Piping Insulation	2	--	--	2	2	ISA	50	20	20
					12	2	--	14	14		350	150	150


Prof. V.A. Bhosale
Member Secretary


Dr. P.B. Dehankar
Chairman, Board of Studies,
Chemical Engg.


Dr. P.V. Mulik
HoD, Mechanical Engg.
Dean Academics
Dean, Academic
Tatyasaheb Kore Institute of Engg. & Technology (Autonomous)
Warananagar, Dist. Kolhapur


Dr. K.I. Patil
Principal
T.K.I.E.T.
Warananagar



Chairman
Academic Council
Tatyasaheb Kore Institute of Engg. & Technology (Autonomous)
Warananagar, Dist. Kolhapur