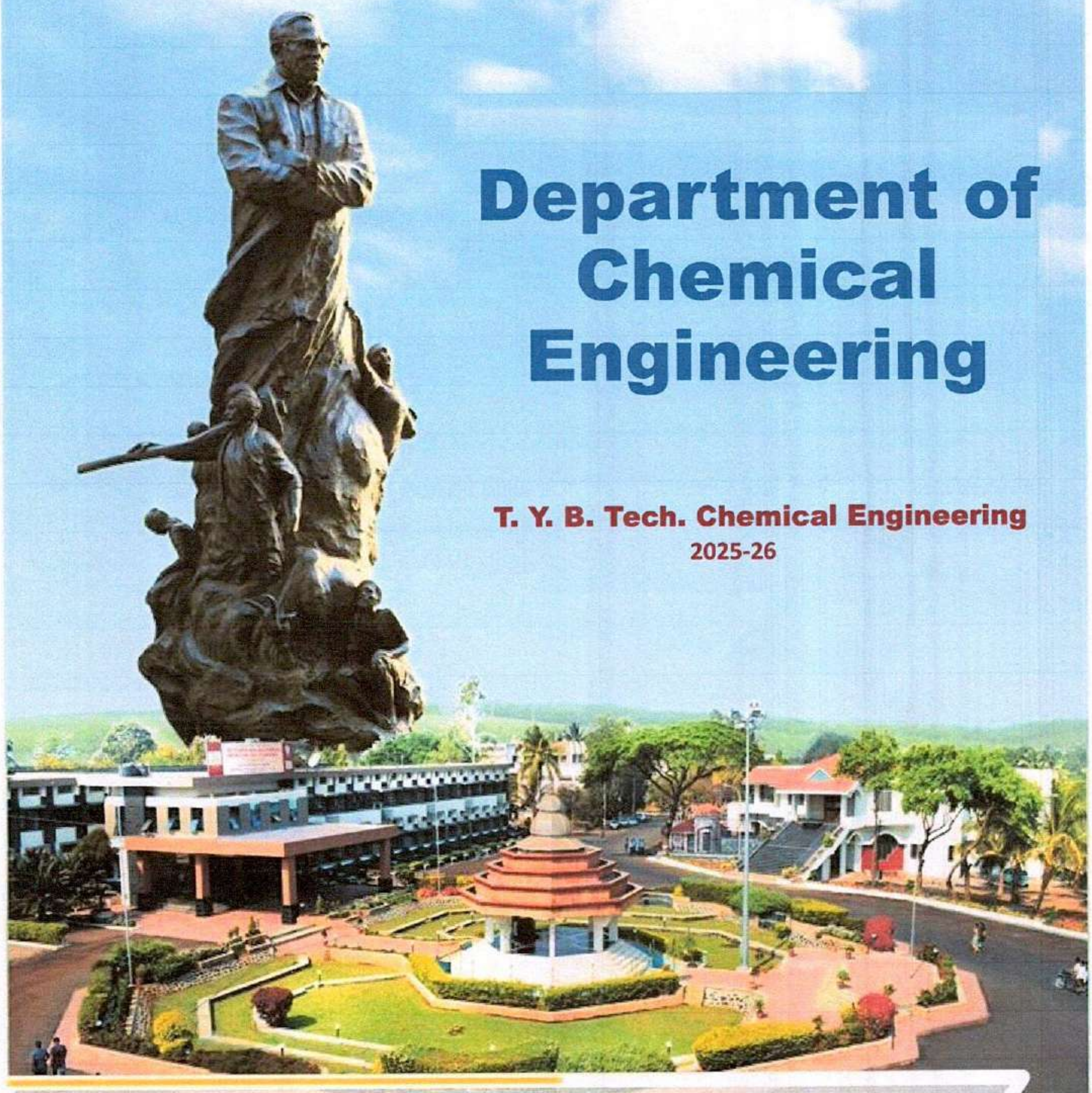
An Autonomous Institute

Shree Warana Vibhag Shikshan Mandal's

Tatyasaheb Kore Institute of Engineering And Technology, Warananagar

NBA Accredited Institute



Department of Chemical Engineering

T. Y. B. Tech. Chemical Engineering

2025-26

T. Y. B. Tech. in Chemical Engineering

Structure and Syllabus (Draft Copy) 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

Graduates will be able to,

1. Model and simulate the chemical processes by using advanced software.
2. Do Economic design and demonstrate safety and environmental aspects in chemical processes.
3. Understand the impact of Chemical Engineering solutions within realistic constraints in global and societal context.

❖ PROGRAM OUTCOMES

After completion of the Program, graduates will,

1. Apply knowledge of science, mathematics and engineering fundamentals to the solution of problems of chemical engineering.
2. Identify and integrate the major elements to formulate and solve chemical engineering problems.
3. Design a system, component or process to meet desired objectives within realistic constraints such as economic, environmental, social, political, ethical, manufacturability, sustainability, health and safety aspect
4. Conduct experiments using research based knowledge and research method safely to analyze and interpret data to provide valid conclusions.
5. Create and use the appropriate techniques, resources, modern engineering tools and advanced software's necessary for model prediction and simulation of chemical engineering processes.
6. Apply reasoning informed by contextual knowledge to assess impact of contemporary issues as societal, health, safety, legal, cultural and consequent responsibilities relevant to chemical engineering practices.
7. Understand the impact of engineering solution in a global, economic, environmental, societal context and need for sustainable development.
8. Understand professional ethics, responsibilities and norms of chemical engineering practices.
9. Work effectively as a member in multidisciplinary teams to have better understanding of leadership.
10. Communicate effectively and comprehensively in oral and written form
11. Apply knowledge of chemical engineering and understand management principle to manage projects in multidisciplinary environment.
12. Recognize the need for and have an ability to engage in lifelong learning.

❖ PROGRAM SPECIFIC OUTCOMES

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 within realistic constraints in global and societal context.

Tatyasaheb Kore Institute of Engineering and Technology, Department of Chemical Engineering, Warananagar - ESTD - 1983, Autonomous Institute

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

Year of Syllabus Change at F. Y. B. Tech.	UG/PG	Subject Category with number	Space	Branch	Semester	Course Number		Theory/ Lab /POE/ Tutorial
23	UG	PCC	-	CH	3	0	1	See Guideline

Course Term work and POE Code

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

Third Year B. Tech. In Chemical Engineering

Structure and Syllabus

under

Autonomy as per the NEP 2020

Tatayasaheb Kore Institute of Engineering and Technology, Warananagar

Third Year B. Tech. (Chemical Engineering)

Semester-V

(Implemented from 2025 - 26)

Credit Scheme as per NEP 2020

T. Y. B. Tech. Chemical Engineering Sem -V

Sr. No.	Category	Sub Category	Course Code	Name of Course	Teaching Scheme L	T	P	C	CH	Examination & Evaluation Scheme Component	Marks	Min for Passing	
1	Programme Course	PCC	23UGPCC-CH501	Chemical Reaction Engineering-I	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
2		PCC	23UGPCC-CH502	Mass Transfer-I	3*	1	--	3	4	ESE	60	24	40
										ISE	40	16	
3		PCC	23UGPCC-CH503	Chemical Engineering Thermodynamics-II	3*	1	--	2	4	ESE	60	24	40
										ISE	40	16	
4		PEC-1	23UGPEC1-CH5041	Chemical Equipment Design	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
5	Multidisciplinary Courses	MDM-3	23UGMDM3-CH505	Basics of Piping	4	--	--	4	4	ESE	60	24	40
										ISE	40	16	
6		OE-2	23UGOE2-CH5061	Energy Audit	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
7	Programme Course	PCC	23UGPCC-CH501LP	Chemical Reaction Engineering-I Lab	--	--	2	1	2	ISA	25	10	20
										POE	25	10	
8		PCC	23UGPCC-CH502LP	Mass Transfer-I Lab	--	--	2	1	2	ISA	25	10	20
										POE	25	10	
9		PEC-1	23UGPCC-CH504LP	Chemical Equipment Design Lab	--	--	2	1	2	ISA	50	20	40
										POE	50	20	
					19	**2**	**6**	**21**	**27**	**--**	**800**	**320**	**320**

Note: In the theory examination, there will be separate passes for ESE and ISE.

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Third Year B. Tech. (Chemical Engineering)

Semester-VI

(Implemented from 2025 - 26)

Credit Scheme as per NEP 2020

T. Y. B. Tech. Chemical Engineering Sem -VI

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	23UGPCC-CH601	Chemical Reaction Engineering-II	3*	--	--	2	3	ESE	60	24	40
										ISE	40	16	
2		PCC	23UGPCC-CH602	Mass Transfer-II	4*	--	--	3	4	ESE	60	24	40
										ISE	40	16	
3		PCC	23UGPCC-CH603	Process Dynamics and Control	3*	--	--	2	3	ESE	60	24	40
										ISE	40	16	
4		PEC-2	23UGPEC2-CH6041	Process Plant Utilities	3	--	--	3	3	ESE	60	24	40
										ISE	40	16	
5		PEC-3	23UGPEC3-CH6051	Industrial Economics, Management & Entrepreneurship	2	--	--	2	2	ESE	60	24	40
										ISE	40	16	
6	Multidisciplinary Courses	MDM-4	23UGMDM4-CH606L	Piping Materials	2	--	--	2	2	ISA	50	20	20
7	Skill Courses	Vocational and Skill Enhancement Course (VSEC)	23UGVSEC-CH6071L	Industrial Practices and Case Studies	1	--	2	2	3	ISA	50	20	20
8	Programme Course	PCC	23UGPCC-CH601LP	Chemical Reaction Engineering-II Lab	--	--	2	1	2	ISA	25	10	20
										POE	25	10	
9		PCC	23UGPCC-CH602LP	Mass Transfer-II Lab	--	--	2	1	2	ISA	25	10	20
										POE	25	10	
10		PCC	23UGPCC-CH603LP	Process Dynamics and Control Lab	--	--	2	1	2	ISA	25	10	20
										POE	25	10	
11		PEC-2	23UGPEC2-CH6041T	Process Plant Utilities	--	1	--	1	1	ISA	25	10	10
12		PEC-3	23UGPEC3-CH6051T	Industrial Economics, Management & Entrepreneurship	--	1	--	1	1	ISA	25	10	10
					18	**2**	**8**	**21**	**28**	**0**	**800**	**320**	**320**

Note: In the theory examination, there will be separate passes for ESE and ISE.

Multidisciplinary Courses (MDM) Course Basket Sem -V			
Open Elective – OE - 2			
Category	**Sub Category**	**Course Code**	**Name of Course**
Multidisciplinary Courses	**Open Elective – OE2**	23UGOE2-CH5061	Energy Audit
		23UGOE2-CH5062	Waste Management

Skill Courses (SC) Course Basket Sem -VI			
Vocational and Skill Enhancement Course (VSEC)			
Category	**Sub Category**	**Course Code**	**Name of Course**
Skill Courses	Vocational and Skill Enhancement Course (VSEC)	23UGVSEC-CH6071L	Teamwork and Collaboration - Industrial Practices and Case Studies
		23UGVSEC-CH6072L	Leadership Skill
		23UGVSEC-CH6073L	Problem Solving & Analytical Skill

Program Electives Courses (PEC) Basket

PEC - 1			
Category	**Sub Category**	**Course Code**	**Name of Course**
Programme Course	**PEC - 1**	23UGPEC1-CH5041	Chemical Equipment Design
		23UGPEC1-CH5042	Applications of MATLAB
		23UGPEC1-CH5043	Introduction to Polymer Science and Engineering

PEC -2			
Category	**Sub Category**	**Course Code**	**Name of Course**
Programme Course	**PEC - 2**	23UGPEC2-CH6041	Process Plant Utilities
		23UGPEC2-CH6042	Process Systems Engineering
		23UGPEC2-CH6043	Chemical and Reactive Systems

PEC - 3			
Category	**Sub Category**	**Course Code**	**Name of Course**
Programme Course	**PEC - 3**	23UGPEC3-CH6051	Industrial Economics, Management &Entrepreneurship
		23UGPEC3-CH6051	Project Management & Smart Technology
		23UGPEC3-CH6051	Advanced Industrial Software's

T.Y. B. Tech Semester-V (Chemical Engineering)

23UGPCC-CH501: Chemical Reaction Engineering - I

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

Course Objectives: The objective of the course is to

- Write a rate law and define reaction order and activation energy.
- Demonstrate the ability to quantitatively predict the performance of common chemical reactors using simplified engineering models.
- Demonstrate the ability to regress the experimental data from which they determine the kinetic model of a multi-reaction system and use this information to design a commercial reactor.

Course Outcomes:

Cos	**At the end of successful completion of the course the student will be able to**	**Blooms Taxonomy**
CO1	define concepts of kinetics of reaction and Temperature dependency of rate Constant	Remember
CO2	describe rate equations for homogeneous reactions in batch reactors,CSTRs, PFRs for isothermal for feed condition.	Understand
CO3	describe design equations for different types of reactors based on mole and energy balance.	Understand
CO4	relate rate of reaction with design equation for reactor sizing.	Apply
CO5	design the reactor for single and multiple reactions.	Apply
CO6	apply the effect of temperature on homogeneous reactions.	Apply

Description:

Chemical Kinetics & Reaction Engineering required in problems which are faced by Chemical Engineers in their professional career. The subject involved are, (1) Introduction with Kinetics of homogeneous reactions,(2) Interpretation of batch reactor data, (3) Ideal flow reactors, (4) Single and multiple reactor system, (5)Design for multiple reactions, (6) Temperature effects in homogeneous reactions.

Prerequisites:	1:	Chemistry, Engineering Mathematics
	2:	Material & Energy Balance Calculations
	3:	Chemical Engineering Thermodynamics

Section – I		
Unit 1	**Introduction of chemical Kinetics:**	
	Classification of reactions– Homogeneous and Heterogeneous reactions. Rate of reaction - broad definition for homogeneous and heterogeneous reactions. Irreversible and reversible reactions, Order and molecularity of reaction. Elementary and non-elementary reactions.Rate of reaction based on all components of the reaction and their inter relation. Rate Constant Based on thermodynamic activity, partial pressure, mole fraction and concentration of the reaction components.Temperature dependency of rate Constant: Different theories, Arrhenius law etc.	**8 Hrs.**
Unit 2	**Interpretation of batch reactor data:**	
	Batch reactor concept, **Constant volume batch reactor system:** Design equation for zero first, Second and third order irreversible and reversible reactions, graphical interpretation of these equations and their limitations, **Variable volume Batch reactors:** Design equation for zero, first and second order irreversible and reversible reactions, graphical interpretation of their limitations, Introduction to catalytic and auto-catalytic reactions.	**7 Hrs.**
Unit 3	**Ideal flow reactors:**	
	Concept of ideality. Types of flow reactors and their differences, Space-time and space velocity. Design equation for plug flow reactor and CSTR; Design equations for first and second order reversible and irreversible constant volume and variable volume reactor. Graphical interpretation of these equations; mean holding time; Development of rate expression for mean holding time for a plug flow reactor.	**7 Hrs.**
Section – II		
Unit 4	**Single and multiple reactor system:**	
	Size comparison of single reactors; Optimum size determination; Staging of reactors, reactors in series and parallel; Performance of infinite number of back mix reactors in series, Back mix and plug flow reactors of different sizes in series and their optimum way of staging; Recycle reactors, Optimum recycle ratio for auto–catalytic (recycle)reactors.	**7 Hrs.**
Unit 5	**Design for multiple reactions:**	
	Rate equation concept for these reactions. Multiple reactions-stoichiometry and Rate equations for series and parallel reactions.Parallel reactions Requirements for high yield. Best operating condition for mixed & plug flow reactors,Yield and selectivity.Series reactions Maximization of desired product rate in a plug flow reactor and back mixed reactor.	**7 Hrs.**
Unit 6	**Temperature effects in homogeneous reactions:**	
	Equilibrium Conversion, Optimum temperature progression, Adiabatic and non-adiabatic operations, stable operating conditions in reactors.	**5 Hrs.**

List of Practical's:- (Any 8)

1) Rate constant in batch reactor-I (where M=1)
2) Rate constant in batch reactor- II (where M=2)
3) Rate constant in straight tube reactor.
4) Rate constant in bend tube reactor.
5) Rate constant in helical coil reactor.
6) Rate constant spiral coil reactor.
7) Rate constant in packed bed reactor.
8) Rate constant in mixed flow reactor.
9) Rate constant mixed flow reactors in series.
10) Verification of Arrhenius law.

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	1	2	2												
CO2	1	2	3	2											
CO3	1	2	3	3											
CO4	1	2	3	2											
CO5	1	2	3	2											
CO6	1	2	2												

References:

Text Books	
1	Octave Levenspeil, "Chemical Reaction Engineering", 2nd Edition, John Wiley, London
2	S.H. Fogler," Elements of Chemical Reaction Engineering", PHI, 4 th Edition.
Reference Books	
1	J. M. Smith, "Chemical Engineering Kinetics", McGraw Hill, New York.
2	S. M. Walas, "Reaction Kinetics for Chemical Engineers" McGraw Hill, New York.
3	J. Rajaram and J. C. Kuriacose, "Kinetics and Mechanics of Chemical Transformation", McMillan India Ltd., 1993.

23UGPCC-CH502: Mass Transfer-I

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

Course Objectives: The objective of the course is to

The students completing this course are expected to understand mass transfer operation with the concept of molecular diffusion, flux rate, theories of mass transfer, mass transfer coefficient, designed for equipment in which two phases are contacted.

It gives details about methods of conducting mass transfer operation, concepts of driving force, operating line, designing of stages for operations like adsorption, absorption, distillation, extraction, leaching, drying. Also, it helps in process design and study of equipment for above mentioned operations. They will understand implication through laboratory experiments performed.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Bloom's Taxonomy
CO1	comprehend diffusion in fluids and solids and solve problems on molar flux and diffusivity.	Understanding
CO2	apply the knowledge of mass transfer to evaluate mass transfer coefficients and understand interphase mass transfer	Apply
CO3	comprehend co-current and counter current operations and apply the knowledge in various mass transfer operations.	Apply
CO4	comprehend the concept and operation of various types of gas-liquid contacts equipments	Understand
CO5	evaluate the number of trays for multistage column and determine height of packed bed	Evaluate
CO6	explain theory of adsorption and solve problems on adsorption	Remember

Description:

Mass Transfer Operations is a core subject in chemical engineering that focuses on the principles and applications of mass transfer— the movement of chemical species from one phase to another. The course covers key mass transfer mechanisms such as molecular diffusion, convective mass transfer, and interphase mass transfer. It introduces various industrial separation processes including gas absorption, distillation, liquid-liquid extraction, leaching, drying, and membrane-based separations.

Prerequisites:		
	1:	Basic Science
	2:	Chemical Process Calculations

	Section – I	
Unit 1	**Introduction to Mass Transfer**	
	Introduction to mass transfer operations, Classification & Applications, Types of diffusion, ficks law , Molar flux, Molecular diffusion in gas and liquids, Concept of diffusivity, Flux transfer equations for gas and liquid, phase based on steady and unsteady state equation,Experimental diffusivity measurement equipments – Arnold cell, Twin bulb, Stefan tube, Diaphragm cell.Problems on diffusion in gas and liquids.	**7 hrs**
Unit 2	**Mass Transfer Coefficients**	
	Mass Transfer coefficients, Determination of mass transfer coefficient through contacting equipment. Eddy diffusion, Interphase mass transfer, Mass transfer theory, two film theory, penetration theory, surface renewal theory, analogy of mass transfer, heat transfer and its significance, mass transfer coefficient in laminar flow and turbulent flow.	**5 hrs**
Unit 3	**Interphase Mass Transfer**	
	Equilibrium, Study of Raults law, Daltons law, Henrys law, Two Film Theory - Concept Of individual and overall mass transfer coefficient, operating line, driving force line, stages, co-current and counter current stages , Cascades –cross current, Counter Current stages and co-current cascades , Mass transfer efficiency.	**6 hrs**
	Section – II	
Unit 4	**Equipment for Gas –Liquid Operations**	
	a) Gas dispersed: Multistage absorption tray towers, Type of trays, flow arrangements on tray, Tray efficiency, Sparged vessels. Gas hold up – concept of sleep velocity, operational difficulty in tray column. b) Liquid dispersed: Venturi Scrubber, Wetted wall tower, Spray tower, Spray chamber, Packed tower, operational difficulty in packed column Random & Stacked packing, types of packing, Tray tower Vs packed tower.	**7 hrs**
Unit 5	**Gas Absorption:**	
	Choice of solvent, Material balance on crosscurrent and countercurrent absorption or stripping, Absorption factor and stripping factor, Tray efficiency, Multistage operation, Design equation for packed tower, HETP, HTU calculation for packed tower, problems.	**5 hrs**
Unit 6	**Adsorption**	
	Adsorption isotherm, Types of adsorbents, nature of adsorbents, Adsorption equipment, Adsorption hysteresis, Heat of adsorption, break through curves, Single and multistage adsorption operation, Problems, Principle of Ion Exchange.	**6 hrs**

List of Practical's:- (Any 8)

1. Diffusivity of acetone in air.
2. Mass transfer through packed bed
3. Wetted wall tower.
4. Liquid –liquid diffusion.
5. Vapour – liquid equilibrium.
6. Surface evaporation.
7. Liquid holds up in a packed column.
8. Batch adsorption.
9. Binodle Curve.
10. Spray Chamber
11. Packed column absorption

Note: Experimental calculations & graphs by using software like Polymath, Excel etc.

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	2	1			1	1	1	1		1	2			1
CO2	3	2	1				1	1	1		1	2			1
CO3	2	2	1			1	1	1	1		1	2			1
CO4	3	2	1				1	1	1		1	2			1
CO5	3	2	1				1	1			1	2			1
CO6	3	2	1			1	1	1			1	2			1

References:

Text Books	
1	Robert E. Treybal, "Mass Transfer Operations", Third Edition, McGraw Hill,1980.
Reference Books	
1	Thomas-K-Sherwood, Robert L. Pigford, Chorles R. Wilke,"Mass transfer"International Student Edition, McGraw Hill, Kogakusha Ltd., 1975.
2	McCabe and Smith, "Unit Operation of Chemical Engineering",5th Edition McGrawHill,Kogakusha Ltd.,1998.
3	Richardson & Coulson, "Chemical Engineering", Vol. 2 ,Pergamon Press, 1970.
4	C. J Geankolis, Transport Processes and unit operations, 3rdEdition, Prentice hall, India,1993.

23UGPCC-CH503: Chemical Engineering Thermodynamics - II

Course Details:					
Teaching Scheme			**Evaluation Scheme**		
Lectures	:	3* hrs per week	**ISE**	:	40 marks
Credits	:	2	**ESE**	:	60 marks
Tutorial	:	1 hrs per week	**ISA**	:	-
Credits	:	–	**POE**	:	-
Total Credits	:	2	**Total Marks**	:	100 marks

Course Objectives: The objective of the course is to

This course builds on the preceding course by developing the concept of non-ideal mixing and provides students with the formalism and insights necessary to tackle real industrial problems like liquid-liquid phase splitting, azeotropy, volume change of mixing, heats of mixing etc. Students who have taken this course may be expected to intelligently analyze practically the full spectrum of industrial chemical processes.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	define and understand the laws associated with ideal and non ideal solutions.	Remembering
CO2	calculate properties of ideal & real mixtures based on thermodynamics principles and apply knowledge of problem solving to thermodynamics	Applying
CO3	explain underlying principles of phase equilibrium in binary component & multicomponent systems.	Evaluating
CO4	Use activity coefficient models to calculate excess properties of liquids and thermodynamics aspects of engineering design.	Analyzing
CO5	estimate equilibrium constant for chemical reactions and criteria for chemical equilibrium in non-ideal mixtures	Creating
CO6	Understand criteria for phase equilibrium and stability	Understanding

Description:

This course is a study of vapor /liquid equilibrium, Azeotropy, calculations of bubble point dew point. The students completing this course are expected to understand the equations relating molar & partial molar Properties. To evaluate and analyze the Fugacity & Fugacity Coefficient, pure Species & Species in Solution. The students are expected to quantify and acquire knowledge of different models of Activity & Activity Coefficient, Excess Gibbs Energy. The students should understand different criteria for chemical and phase Equilibrium and stability.

Prerequisites:	1:	Applied Mathematics- I and II
	2:	Physical Chemistry
	3:	Chemical Engineering Thermodynamics-I

Section – I		
Unit 1	**Vapor / Liquid Equilibrium**	
	The nature of equilibrium, VLE: Qualitative Behavior, Azeotropes, Simple models for Vapor / Liquid Equilibrium Raoult's law, Dew point and bubble point calculations with Raoult's law, Henry's law, VLE by modified Raoult's law, problems.	6 hrs
Unit 2	**Solution Thermodynamics: Theory I**	
	Fundamental Property Relation ,Chemical Potential & Phase Equilibria , Partial Properties, Equations relating molar & partial molar Properties, Partial Properties in Binary Solutions, Relations among partial Properties, Problems.	6 hrs
Unit 3	**Solution Thermodynamics: Theory II**	
	Fugacity & Fugacity Coefficient, pure Species & Species in Solution, the Fundamental Residual Property relation , the ideal Solution, The Lewis Randall Rule, Excess properties, The excess Gibbs Energy and the Activity Coefficient.	6 hrs
Section – II		
Unit 4	**Solution Thermodynamics: Applications**	
	Liquid Phase Properties from VLE Data, fugacity ,Activity & Activity Coefficient, Excess Gibbs Energy, Data Reduction, Models for Excess Gibbs Energy, Property Changes Of Mixing.	7 hrs
Unit 5	**Chemical Reaction Equilibria**	
	The Reaction Coordinate, Application of Equilibrium Criteria to Chemical reactions, The Standard Gibbs Energy change & the Equilibrium Constant, Effect of Temperature On the equilibrium Constant, Evaluation of Equilibrium Constants. Relation Of Equilibrium Constants to Compositions . Phase Rule & Duhem's Theorem for reacting Systems.	7 hrs
Unit 6	**The Phase Equilibria**	
	Criteria of Phase equilibrium, Criterion of Stability . Liquid – Liquid Equilibrium (LLE), Solid – Liquid Equilibrium (SLE), Solid – Vapor Equilibrium (SVE).	6 hrs

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	3			2										
CO2				2	2							1	2		
CO3	2		1			2									
CO4		2			3								3		
CO5	2							2				1			1
CO6									3			2			

References:

Text Books	
1	J.M.Smith, H.C.Vanness," Introduction to Chemical Engineering Thermodynamics" 8th Edition, Tata McGraw Hill Publishing Co.
2	Thomas E Daubert, "Chemical Engineering Thermodynamics "McGraw Hill International Edition.
Reference Books	
1	K.V. Narayanan "Chemical Engineering Thermodynamics", Prentice Hall, India
2	O.A.Hougen, K.M.Watson & R.A. Rogatz "Chemical Process Principles", Vol –II, Asia Publishing House.
3	B.F.Dodge "Chemical Engineering Thermodynamics, International Student Edition,McGraw Hill Publication.
4	Koretsky M.D. "Engineering & Chemical Thermodynamics" – John Wiley & Sons – 2004.

23UGPEC1-CH5041: Chemical Equipment 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	**ISA**	:	50 Marks
Credits	:	1	**POE**	:	50 Marks
Total Credits	:	4	**Total Marks**	:	200 Marks

Course Objectives: The objective of the course is to

1. familiarize students with fundamental design preliminaries.
2. develop competency in designing critical pressure vessel components.
3. impart practical skills for designing storage vessels and tall vertical vessels.
4. enable students to design shell-and-tube heat exchangers by applying TEMA standards.
5. equip learners with methodologies for designing reactor systems
6. emphasize safety protocols in equipment design.

Course Outcomes:

Cos	**At the end of successful completion of the course the student will be able to**	**Blooms Taxonomy**
CO1	apply fundamental design principles, including material selection, stress analysis, and code compliance (ASME/IS), to chemical process equipment.	Apply
CO2	design pressure vessel components (shells, heads, nozzles) following ASME Section VIII and IS 2825 standards, incorporating safety factors and corrosion allowances.	Create
CO3	analyze and design storage vessels and tall vertical equipment (e.g., distillation columns) considering mechanical loads (wind/seismic) and support structures.	Analyze
CO4	develop shell-and-tube heat exchanger designs using TEMA standards, optimizing thermal performance and mechanical integrity.	Create
CO5	propose reactor and agitator systems by selecting appropriate components (impellers, shafts) and calculating power requirements for mixing operations.	Evaluate
CO6	evaluate equipment safety through failure analysis, NDT techniques, and pressure relief device (PRV) selection.	Evaluate

Description:

This course provides a comprehensive foundation in the design, analysis, and operation of critical equipment used in chemical process industries, with emphasis on safety, standardization, and practical applications. Students will learn to:

1. Master Design Fundamentals
    - Apply principles of material selection, stress analysis, and corrosion allowances per

ASME/IS codes.
  - Interpret design parameters (pressure, temperature, mechanical loads) for process equipment.
2. Design Specialized Equipment
   - Develop pressure vessels (shells, heads, nozzles) compliant with ASME Section VIII and IS 2825.
   - Design storage/tall vertical vessels (e.g., distillation columns) considering wind/seismic loads and support structures.
   - Optimize shell-and-tube heat exchangers using TEMA standards for thermal/mechanical performance.
   - Configure reactor and agitator systems, including impeller selection and power calculations.
3. Implement Safety and Standards
   - Evaluate failure prevention strategies (NDT, pressure relief devices).
   - Conduct hazard analysis and risk assessment for equipment integrity.

Prerequisites:	1:	**Strength of Materials -** Understanding of stress-strain relationships, bending moments, and torsion. Knowledge of material properties (yield strength, modulus of elasticity).
	2:	**Fluid Mechanics -** Fluid statics and dynamics. Pressure drop calculations in pipes and fittings.
	3:	**Chemical Engineering Thermodynamics -** Thermodynamic properties (enthalpy, entropy). Phase equilibria and heat transfer principles.
	4:	**Introduction to Process Engineering -** Basics of process flow diagrams (PFDs) and piping & instrumentation diagrams (P&IDs). Familiarity with unit operations (e.g., pumps, heat exchangers).

	Section – I	
Unit 1	**Design preliminaries**	
	Design codes, Maximum working pressure, Design pressure, Design temperature, Design stress & factor of safety, Weld joint efficiency factor, Corrosion allowance, Design wall thickness, minimum actual wall thickness, Design loadings, Moment of inertia, Radius of gyration, Section modulus.	**6 hrs**
Unit 2	**Pressure Vessels**	**9 hrs**
	Classification of pressure vessels, Codes and Standards for pressure vessels, Design of pressure vessels under internal and external pressures, Design of thick walled high pressure vessels, Design of Gasket, Flanges, Nozzle	
Unit 3	**Design of storage and tall vessels**	**5 hrs**
	Storage of fluids, Different types of storage vessels, Design of cylindrical storage vessels with roof. Determination of longitudinal stresses, Period of vibration, Determination of resultant longitudinal stress	
	Section – II	
Unit 4	**Mechanical Design of heat exchanger**	**6 hrs**
	Types of heat exchangers, Special type of heat exchangers, Design of Shell & Tube Heat Exchanger	

Unit 5	**Mechanical design of Reaction vessel and Agitator & Support for process vessels**	
	Classification of reaction vessel, Heating systems, Design consideration,Types of agitators, Baffling, Power requirements for agitation, Design of agitation system components, Design of Bracket Support, Lug Support, Design of Skirt Support & Saddle support.	**8 hrs**
Unit 6	**Equipment testing methods, Process Hazards & Safety**	
	Hydrostatic Pressure test, Pneumatic pressure test, Dye penetrant test, Magnetic test, Ultrasonic test, Freon test, Radiography test, Hazards in Process Industry, Analysis of Hazards, Safety Measures ,Safety measures in Equipment Design, Pressure Relief Devices	**5 hrs**

List of Practical's:- (Any 8)

1. Design of pressure vessels with heads, flanges and gaskets
2. Design of atmospheric storage vessels.
3. Design of head and closures
4. Design of tall vertical vessels
5. Design of supports
6. Design of heat exchangers
7. Design of reaction vessel
8. Design of evaporator
9. Design of agitation system

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	2	1	1	1									2	
CO2	3	3	3	2	2						1			3	
CO3	3	3	3	2	2						1			3	
CO4	3	2	3	1	2						1			3	
CO5	2	2	3	1	1						1			3	
CO6	1	2	2	3	1						2			3	

References:

Text Books	
1	B. C. Bhattacharya, "Introduction to chemical equipment design" (Mechanical aspects) 1985.
2	M. V. Joshi, "Process equipment design" McMillan India Ltd. 1981.
3	Coulson J. M. and Richardson J. F.,"ChemicalEngg." Vol. 2 & 6, Pergaman Press,1970.
4	Dr. S.D. Dawande, "Process Design of Equipment", Central Techno Publication, 1st Edition 1999.
Reference Books	
1	L. E. Brownel and E. H. Young "Process equipment design", Wiley Eastern Ltd.1977

23UGMDM3-CH505: Basics of Piping

Course Details:					
Teaching Scheme			**Evaluation Scheme**		
Lectures	:	4 per week	**ISE**	:	40 marks
Credits	:	4	**ESE**	:	60 marks
Practical	:	–	**ISA**	:	–
Credits	:	–	**POE**	:	–
Total Credits	:	4	**Total Marks**	:	100 marks

Course Objectives: The objective of the course is to

1. Understand the fundamentals of piping components, standards, and materials.
2. Develop skills to read, interpret, and create piping drawings and layouts.
3. Learn revision techniques to analyze, maintain, and improve piping systems.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	describe the types of pipes, fittings, and materials used in industrial systems.	Understand
CO2	interpret piping symbols, drawings, and standard documentation.	Understand
CO3	select appropriate pipe materials and sizing for specific applications.	Apply
CO4	draw Piping and Instrumentation diagrams.	Apply
CO5	design simple piping layouts using codes and standards.	Evaluate
CO6	identify faults in piping systems and suggest corrective measurements.	Analyze

Description:

The *Pipe Basic and Revision* course is designed to provide students with foundational knowledge and practical insights into industrial piping systems, their components, and revision practices. It covers essential topics such as pipe materials, fittings, valves, standards (ASME, ASTM, ANSI), and drawing interpretation including P&ID and isometric views. Students will learn to design simple piping layouts, perform basic calculations for sizing and pressure drop, and understand the procedures for revising and documenting changes in piping systems. The course bridges theoretical knowledge with real-world applications, preparing students for roles in design, construction, and maintenance of piping systems in industries such as oil and gas, chemical, power, and water treatment.

Prerequisites:	1:	Material science and engineering
	2:	Corrosion engineering

	Section – I	
Unit 1	**Introduction to Piping Systems**	
	Definition and scope of piping in industries (chemical, oil & gas, water systems, etc.), Classification of piping systems (process piping, plumbing, HVAC, etc.), Common piping materials and their selection criteria Carbon Steel (CS),Stainless Steel (SS), Polyvinyl chloride (PVC),Chlorinated Polyvinyl Chloride(CPVC),HighDensity Polyethylene (HDPE), Pipe manufacturing methods (seamless, welded), Pipe dimensions: nominal pipe size (NPS), outside diameter (OD), wall thickness, and schedule, Overview of pipe markings and traceability.	**5 hrs**
Unit 2	**Piping Components and Accessories**	
	Types of pipe fittings: elbows, tees, reducers, couplings, unions, Valves: gate, globe, check, ball, butterfly—functions and applications, Flanges: types (weld neck, slip-on, blind, lap-joint), bolt patterns, gaskets, Expansion joints, flexible hoses, bellows, Pipe supports and hangers: spring supports, clamps, brackets, and their placement, Fasteners and seals used in piping systems.	**6 hrs**
Unit 3	**Standards and Codes**	
	Importance of standards in piping design, ASME codes: B31.1 (Power Piping), B31.3 (Process Piping), ASTM standards for materials, ANSI and API relevance to piping, IS and BIS codes, Pressure rating, schedule, and thickness correlation, Pipe testing methods: hydrostatic, pneumatic.	**6 hrs**
	Section – II	
Unit 4	**Piping Drawings and Layout Interpretation**	
	Basics of engineering drawings: orthographic views, symbols, and notations, Reading and interpreting: P&ID (Piping and Instrumentation Diagram), Isometric piping drawings, General Arrangement (GA) drawings.	**7 hrs**
Unit 5	**Pipe Sizing and Layout Design**	
	Pipe sizing based on flow rate and velocity, Head loss and pressure drop calculation, Hydraulic design for pipe networks, Pipe stress considerations, Material take-off (MTO) preparation.	**6 hrs**
Unit 6	**Revision and As-built Practices**	
	Revision types: major vs minor, Redline markup practices on drawings, Change request and approval process, Documentation of field changes, Preparation of as-built drawings, Tools and software for revision management (AutoCAD, SmartPlant).	**6 hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	2	2	1		1	1				2	2			
CO2	3			2	3		1		1				3		
CO3	3	3	3		2		2	1		2	3			2	
CO4		2				1		1		2	2	3			
CO5			3	2	3	2		1				1			1
CO6		3	2			2	2	1		3					

References:

Text Books	
1	**Mohinder L. Nayyar** – *Piping Handbook*, McGraw-Hill Education.
2	**Ronald W. Frankel** – *Piping Systems Manual*, McGraw-Hill.
Reference Books	
1	ASME B31.3 Process Piping Code
2	ASTM Standards for Piping Materials
3	NPTEL Lectures on Mechanical Piping Design
4	IS Codes and BIS Handbook on Piping Standards

23UGOE2-CH5061: Energy Audit

Course Details:					
Teaching Scheme			**Evaluation Scheme**		
Lectures	:	3	**ISE**	:	40 Marks
Credits	:	3	**ESE**	:	60 Marks
Practical	:	NA	**ISA**	:	NA
Credits	:	NA	**POE**	:	NA
Total Credits	:	3	**Total Marks**	:	100 Marks

Course Objectives: The objective of the course is to

- To study the basic concepts of energy, classification & forms of energy.
- To study in detail energy management and policy.
- To know basic principles of energy conservation, energy audit.
- To study the energy conservation act 2001 & standards.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	know the fundamental concepts related to energy and energy conservation.	Remembering
CO2	develop the knowledge of the methodology of energy audits.	Understanding
CO3	use energy audit principles to conduct preliminary audits and measure energy usage.	Understanding
CO4	understand the effect of climate change on energy India, and energy conservation act 2001.	Apply
CO5	study of Energy Audit & Management in Industries	Apply

Description:

Energy conservation, sustainability, and the role of energy audits can be achieved through efficient energy use, as well as cost, water, and energy savings. This course emphasizes on the importance of energy conservation and provides a comprehensive understanding of energy auditing and management principles, methodologies, and practices. It covers the techniques for evaluating energy consumption, identifying areas for improvement, and implementing energy-efficient measures in various sectors.

Prerequisites:	1:	Basic details of physics and chemistry

Section – I		
Unit 1	**Energy Scenario:**	6 Hrs
	Introduction, Classification of Energy – Primary and Secondary, Commercial and Non-commercial Energy, Renewable & Non-renewable, Forms of Energy – potential and kinetic energy etc., Energy reserves and production, Energy consumption, Energy units & conversions. Impact of climate change in India.	
Unit 2	**Energy Audit Methodology and the role of conservation:**	6 Hrs
	Need for energy audit, Energy auditing methodology, Understanding energy costs, Methodology for forecasting, Industrial energy supply and demand, Review of alternative approaches and major models and studies, Method for forecasting industrial energy price and availability, New energy technologies and conservations. (6 L)	
Unit 3	**Energy management and policy:**	6 Hrs
	Comprehensive energy conservation planning (CECP), Motivation for Comprehensive energy planning, Principles of energy conservations, Procedure for Comprehensive energy conservation planning, Significance of CECP, Tasks required for CECP and application of CECP. (6L)	
Section – II		
Unit 4	**Energy audit and management:**	6 Hrs
	Definition & objectives of energy audit, Types of audit, Responsibility of energy management, Targeting and monitoring energy consumption, Scope of energy audit (3L) Benchmarking, Energy performance, Maximizing system efficiency, Instruments and metering for Energy Audit. (3L)	
Unit 5	Energy conservation act 2001 (3L) Bureau of Energy Efficiency (BEE), Energy efficiency standards, Carbon credits and carbon trading.(3L)	6 Hrs
Unit 6	Study of Steam System, Types of boiler with Energy efficiency performance analysis, Types of insulation and types of heat exchanger with Energy efficiency performance analysis. Case study of Energy Audit & Management in Industries (Boilers/Pump/ Steam System,Insulation etc.)	6 Hrs

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2					3	1								
CO2	1					2	1								
CO3	1	1				1	2	1							
CO4	2					1	3	2							
CO5	1					2	2				1				
CO6															

References:

Text Books	
1	Devid Hu. S, -Handbook of Energy Conservation, McGraw Hill Publication.
2	Rao, Diwalkar P.L., -Energy Conservation Handbook, Utility Publication,Hyderabad.
Reference Books	
1	D. Mohan Singh, Col. S. K. Murthy (Retd.) and etc., -Energy Conservation inIndustries, Module I and II, AICTE, CEP, Code 358.
2	General Aspects of Energy Management & Energy Audit, http://www.em-ea.org/gbook11.asp, National Certificate Examination for Energy Managers and Energy Auditors, National Productivity Council of India
3	The Bulletin on Energy Efficiency and Management by IRADA, MITCON, MEDHAetc.
4	Amit Tagi, -A Handbook Energy Audit, Tata McGraw Hill publication, 2000.
5	A Practical Guide to Energy Conservation, PCRA Publication, 2010.

Web Links/ Video Lectures are to be provided to Theory and Practical /Experiments Lectures:
https://beeindia.gov.in/content/energy-auditors

Member Secretary | **Chairman** | **Academic Dean** | **Principal**

Board of Studies

Tatyasaheb Kore Institute of Engineering and Technology
Department of Chemical Engineering
Autonomous Institute
Warananagar - ESTD - 1983

T.Y. B. Tech Semester-VI (Chemical Engineering)

23UGPCC-CH601: Chemical Reaction Engineering - II

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

1. The course focuses on non-deal flow concepts for understanding non-ideality in reactors.
2. The course focuses on finding conversion in actual reactors from experiment and different models. mixing of fluids, macro fluid concepts and Turbulent Mixing with chemical reaction in stirred tanks.
3. The course develops understanding of heterogeneous solid catalyst, isotherms, different industrial terms related to solid catalyst & finding different characteristics of solid catalysts with its recent trends.
4. The course develops understanding & designing of fluid particle reactions with different models for it.
5. The course describes understanding & designing of fluid-fluid reaction and applications of fluid-fluid reactions rate equation to equipment design.
6. The course covers concept, parameters, mechanisms, applications of catalyst with different catalytic reactors and deactivating catalysts & also describe design. Scale up in the reactor.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	understand the concepts of non-ideal flow in reactors.	Understand
CO2	apply basic concepts of non ideality for finding conversion in actual reactors from experiment and different models and Analyze non ideality in mixing of fluids.	Apply, Analyze
CO3	understand working of catalyst & terms related to solid catalyst and find different characteristics of solid catalyst with its recent trends.	Understand
CO4	explain underlying principles, understanding & designing of fluid particle reactions with different models for it.	Create
CO5	explain fluid-fluid reaction, its design and applications of fluid-fluid reactions rate equation to equipment design.	Create
CO6	analyze underlying basic concepts, important parameters. Mechanism, applications of catalysts with different catalytic reactors and deactivating catalysts .	Analyze

Description:		
Chemical Kinetics & Reaction Engineering required in problems which are faced by Chemical Engineers in their professional career. The subject involved are, (1) Non Ideal Flow, (2) Mixing of fluids, (3) Heterogeneous processes and Solid catalysts, (4) Fluid particle reactions (Non catalytic), (5) Fluid -fluid reaction, (6) Solid catalyzed reactions.		
Prerequisites:	1:	Chemistry, Engineering Mathematics,
	2:	Material & Energy Balance Calculations, Chemical Engineering Thermodynamics,
	3:	Chemical Reaction Engineering-I

Section – I		
Unit 1	**Non Ideal Flow:**	
	Basic concept of non ideal reactor ,The Residence Time Distribution Functions and their Relationships, Determining RTD from Experimental Tracer Curves ,Tubular Reactor E- and F-Curves for a Series of Stirred Tank Reactors. Analysis of RTD from Pulse Input and step input.	**8 Hrs.**
Unit 2	**Mixing of fluids:**	
	Conversion for non-ideal reactors:conversion of PFR,MFR. Models for predicting conversion from RTD data:Dispersion model, Tank in Series model. **Mixing of fluids:**Self-mixing of single fluid, Early and late mixing of fluid, models for partial segregation, mixing of two miscible fluids, Model Effect of Micro mixing on Conversion Time-Dependent Turbulent Mixing and Chemical Reaction in Stirred Tanks.	**7 Hrs.**
Unit 3	**Heterogeneous processes and Solid catalysts:**	
	Global rate of reaction, Catalysis, Nature of catalytic reactions, adsorption isotherm, Rates of adsorption. Determination of Surface area, Void volume and solid density, Pore volume distribution, Classification of catalysts, Catalyst preparation, Catalyst characterization, Promoters, accelerators, Support, carrier and inhibitors.	**7 Hrs.**
Section – II		
Unit 4	**Fluid particle reactions (Non catalytic) :**	
	Selection of a model for gas-solid reactions Un-reacted core and Shrinking core model, Rate controlling resistances, Determination of the rate controlling steps, Application of models to design problems.	**7 Hrs.**
Unit 5	**Fluid - fluid reaction (Non catalytic) :**	
	Introduction to heterogeneous fluid - fluid reactions, Rate equation for instantaneous , Fast and slow reaction, Equipment used in fluid- fluid contacting with reaction, Application of fluid -fluid reaction, Rate equation to equipment design, Towers for fast and slow reactions	**7 Hrs**
Unit 6	**Solid catalyzed reactions:(Catalytic reactions)**	
	Introduction, Rate equation, Film resistance controlling, surface flow controlling , Pure diffusion controlling, Heat effects during reaction, Experimental methods for finding rates.	**7 Hrs.**

	Construction, operation and design of Catalytic reactors : Fixed bed reactor, Fluidized bed reactor, Multiphase reactors : Slurry reactor, Trickle bed reactor. Types of industrial catalytic reactors. **Introduction to Deactivating catalysts.**	

List of Practical's:-

1. RTD Studies on homogeneous batch reactor.
2. RTD Studies on tubular flow reactor.
3. RTD Studies on mixed flow reactor.
4. RTD Studies on mixed flow reactors in series.
5. Residence time distribution studies in structures and coils.
6. RTD Studies on packed bed reactor.
7. Determination Pore volume of catalysts.
8. Determination of bulk density, apparent density, and true density of catalyst.
9. Preparation and Synthesis of Catalyst.
10. Preparation and Synthesis of Nano-Catalyst.

Note: Experimental calculations & graphs by using software like Polymath, Excel etc.

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	2	1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	1	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	2	3	-	-	-	-	-	-	-	-	-	-	-
CO6	3	2	3	3	-	-	-	-	-	-	-	-	-	-	-

References:

	Text Books
1	Octave Levenspeil, "Chemical Reaction Engineering", 2nd Edition, John Wiley, London
2	S.H. Fogler," Elements of Chemical Reaction Engineering", PHI, 4 th Edition.
	Reference Books
1	J. M. Smith, "Chemical Engineering Kinetics", McGraw Hill, New York.
2	S. M. Walas, "Reaction Kinetics for Chemical Engineers" McGraw Hill, New York.
3	J. Rajaram and J. C. Kuriacose, "Kinetics and Mechanics of Chemical Transformation", McMillan India Ltd., 1993.

23UGPCC-CH602: Mass Transfer- II

Course Details:					
Teaching Scheme			**Evaluation Scheme**		
Lectures	:	4* hours per week	**ISE**	:	40 marks
Credits	:	3	**ESE**	:	60 marks
Practical	:	2 hour per week	**ISA**	:	25 marks
Credits	:	1	**POE**	:	25 marks
Total Credits	:	4	**Total Marks**	:	150 marks

Course Objectives: The objective of the course is to

The students completing this course are expected to understand the mechanism of distillation, extraction,leaching, drying, crystallization. For designing of equipment in which two phases are contacted where thermodynamic equilibrium, operating line, determination of stages, energy balance, heat requirement calculations are studied. Also, it helps in process design and study of equipment for above mentioned operations. They will understand implication through laboratory experiments performed.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	comprehend the concept of distillation operation and explain different types of distillation process.	Understand
CO2	evaluate the number of plates required in distillation column by McCabe and Thiele method and Ponchon and Savarit method.	Evaluate
CO3	comprehend leaching and extraction operation and working of leaching and extraction equipment.	Understand
CO4	comprehend the concept of humidification and explain cooling tower operations.	Apply
CO5	find time required for drying and to understand the operation of various types of drying equipment.	Apply
CO6	explain theory of crystallization and derive material balance equation for crystallization.	Apply

Description:

- To able to design equipment for mass transfer operations, the rate equations are important which can be utilized for optimization concepts.
- Concept of steady state & unsteady state diffusional operations studied for controlling parameters in actual industrial processes.
- Student can able and to understand the trouble shooting problem in actual operation
- To implement the knowledge of various unit operations in the real plants

Prerequisites:	1:	Basic Science and mathematics
	2:	Chemical Process Calculations and Thermodynamics

	Section – I	
Unit 1	**Distillation**	
	Vapor Liquid Equilibrium, Ideal Solutions, Relative volatility, Azeotropic mixtures, Methods Of distillation: Flash, Differential, Steam, Vacuum, molecular, Continuous, Multicomponent system, Batch rectification, Introduction to reactive distillation. Analysis and determination of stages: Material balance, Analysis of Fractionating column by McCabe Thiele method, types of reflux ratio, Ponchon Savarit method.	**9 hours**
Unit 2	**Liquid–Liquid Extraction**	
	Theory of liquid liquid extraction, Liquid Equilibrium, coordinate systems, Selection of solvent for extraction operation, Single stage, cross and counter current operation, selection of extractors, Extraction Equipment, Problems.	**5 hours**
Unit 3	**Leaching**	
	Leaching Principles, Factors affecting rate of leaching, Single stage leaching operation, cross current leaching operation and counter current leaching operation, Leaching equipment, problems.	**5 hours**
	Section – II	
Unit 4	**Humidification**	
	Humidification and dehumidification, Application of Humidification, Study of Adiabatic Saturation Curve, definition of wet bulb, dry bulb and equation for wet bulb depression, Percentage saturation, Percentage Humidity, dew point, theory of wet bulb temperature, cooling towers and types of cooling, Spray chamber, Humidity chart, problems with and without humidity chart.	**7 hours**
Unit 5	**Drying**	
	Theory and Mechanism of Drying, Steady and Unsteady Drying, Definition of moisture content, equilibrium, free and critical moisture content, critical, constant and falling rate period, drying curve, total time of drying, Material and Enthalpy balance in dryer, Classification and selection of Industrial dryers, drying equipment's and problems on drying.	**7 hours**
Unit 6	**Crystallization**	
	Meir's theory, Nucleation, Crystal Growth, Methods of super saturation, material and enthalpy balance of crystallizer, Crystallization Equipment, problems on crystallization.	**4 hours**

List of Practical's: - Any 08 Experiments are to be conducted from the following

1. Diffusivity of acetone in air.
2. Mass transfer through packed bed
3. Wetted wall tower.
4. Liquid –liquid diffusion.
5. Vapour – liquid equilibrium.
6. Surface evaporation.
7. Liquid holds up in a packed column.
8. Batch adsorption.
9. Binodle Curve.
10. Spray Chamber
11. Packed column absorption

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable PSO 1	PSO 2	PSO 3
CO1	3	2	1				1	1	1	2	1	2			1
CO2	3	2	1			1	1	1	1	2	1	2			2
CO3	3	2	1				1	1	1	2	1	2			2
CO4	2	1	1			1	1	1	1	2	1	2			1
CO5	3	2	1				1	1	1	2	1	2			1
CO6	2	2					1	1	1	1		2			1

References:

Text Books	
1	Robert E. Treybal, "Mass Transfer Operations", Third Edition, McGraw Hill,1980
Reference Books	
1	Thomas-K-Sherwood, Robert L. Pigford, Chorles R. Wilke,"Mass transfer"International Student Edition,McGraw Hill, Kogakusha Ltd., 1975.
2	McCabe and Smith, "Unit Operation of Chemical Engineering",5th Edition McGrawHill,Kogakusha Ltd.,1998.
3	Richardson & Coulson, "Chemical Engineering", Vol. 2 ,Pergamon Press, 1970.
4	C. J Geankolis, Transport Processes and unit operations, 3rdEdition, Prentice hall, India,1993.
5	B.K Datta, Principles of mass transfer & separation process

23UGPCC-CH603: Process Dynamics and Control

Course Details:					
Teaching Scheme			**Evaluation Scheme**		
Lectures	:	3* hours per week	**ISE**	:	40 marks
Credits	:	2	**ESE**	:	60 marks
Practical	:	2 hour 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

Process control plays a very critical role in the context of actual operation of a chemical plant. Most of the core chemical engineering courses focus on the steady state operation. In the real life environment, process is continuously subjected to various disturbances which deviates the operation from the designed steady state. This course specifically prepares students to assess the impact of such disturbances and equip them with the tools available with the chemical engineer to tackle these situations.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	remember Laplace transform and to understand and model the dynamic behavior of chemical processes based on their time domain, Laplace domain	Remembering
CO2	understand basic fundamentals of first order process dynamics and its behavior	Understanding
CO3	understand basic fundamentals of second order process dynamics and its behavior	Understanding
CO4	know about applying fundamental knowledge to design controllers and the control system, the operation of P, I, D and PID controllers and to tune them.	Applying
CO5	evaluate different parameters affecting on the overall transfer function and response of process control system.	Evaluating
CO6	understand stability characteristics for design of process control systems & analyze the frequency response of the control system	Analysing

Description:

The students completing this course are expected to understand the basic principles and problems involved in process control. They are expected to understand the dynamic behavior of different order systems with examples and responses to various forcing functions. They are able to understand design aspects of the process control system, block diagram preparation, various types of controllers and their selection for particular applications. To evaluate and analyze the transfer functions for various elements of the various control systems and processes. The students are expected to quantify and acquire knowledge of different stability methods such as standard algebraic method, Root locus method, frequency response. The students have to perform experiments based on theory to acquire practical knowledge. So that they can understand how the chemical engineering parameters are controlled.

Prerequisites:	1:	Material and Energy Balance Calculations, Chemical Reaction Engineering
	2:	Applied Mathematics I and II
	3:	Momentum, Heat and Mass Transfer,

	Section – I (Process Dynamics)	
Unit 1	**Review of Laplace Transform, Basic Principles & problems involved in process control**	
	Definition of transform, properties of Laplace transform, initial & final value theorem, examples, Principals involved in process control, agitated heating tank control system, steady state and transient design, step input, P control, PI control, Block diagram.	**6 hours**
Unit 2	**Dynamic behavior of First order System**	
	First order system, Mercury in glass thermometer, Transfer Function, Time constant, Transient response of First order system, Single liquid level system, Mixing process, heating process, Linearization of non linear system, Response of first order system in series, Non interacting system, Interacting system, examples	**8 hours**
Unit 3	**Dynamic behavior of Second order System**	
	Second order systems, U tube manometer, step response for second order systems, terms used to describe second order under damped system, Transportation lag, examples	**6 hours**
	Section – II (Process Control)	
Unit 4	**Control System**	
	Introduction, control system for CSTR, Block diagram, Development of block diagram, negative versus positive feedback control system, servo & regulator problem, Introduction to feedback control, final control element, control valves with transfer function, Types of Feedback Controllers like P, PI, PD, PID with transfer function and application, motivation for addition of integral and derivative modes of control, examples	**8 hours**
Unit 5	**Overall transfer function & Transient response of simple control system**	
	Overall transfer function single loop system, Overall transfer function for change in set point load, Overall transfer function multiple loop system, offset, P controller for change in set point & load point, PI controller for change in set point & load point, examples.	**6 hours**
Unit 6	**Stability Analysis of Feedback Systems**	
	Concept of Stability, definition, Stability criterion, The Characteristic Equation, Routh-Hurwitz Criterion for Stability with theorems and limitations, examples, Root-Locus Analysis, concept, plotting root locus diagram, rules for negative feedback system, examples, Introduction to frequency response, SCADA, PLC	**6 hours**

List of Practical's:- Any 10 Experiments are to be conducted from the following

1. Time Constant of Thermometer.
2. Time Constant of Manometer.
3. Liquid Level Control System.
4. Two Tank Interacting System.
5. Two Tank non-interacting System.
6. Transient Response of U Tube Manometer.
7. Study of Control Valve Characteristics.
8. Study of I/P converters.
9. Study of Level Transmitters.
10. Study of Pressure Transmitters.
11. Control of temp control System.

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable PSO 1	PSO 2	PSO 3
CO1	3			2	2										
CO2	2	3			1										
CO3	2	2			3								3		
CO4	1			3											2
CO5	1					2	1								
CO6								3	2			2		2	

References:

	Text Books
1	Le Blanc & Coughanowr, "Process system analysis and C-ontrol", McGraw Hill, Third edition
2	Donald K. Coughanowr, "Process system analysis and control", McGraw Hill, Second edition, New York, 1991
3	Coughanowr Koppel, "Process System Analysis and Control", McGraw Hill, New York.
	Reference Books
1	Peter Harriott, "Process Control", Tata McGraw Hill, New Delhi, 1977.
2	Coulson and Richardson, "Chemical Engineering" Volume – III, Second Edition, Pergmon Press, (UK), 1985
3	Stephanopoulos G, "Chemical Process Control and introduction to theory and practice

23UGPEC2-CH6041: Process Plant Utilities

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

Course Objectives: The objective of the course is to

1. Comprehend industrial water management, fluid systems, and energy processes for efficient resource utilization.
2. Optimize performance, sustainability, and safety in industrial operations.
3. Develop problem-solving skills through numerical analysis of water treatment, steam boilers, air compression, and refrigeration.

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	comprehend water sources, impurities, hardness types, perform basic hardness calculations, and apply purification methods.	Understand
CO2	apply water treatment techniques for impurity removal and hardness reduction.	Apply
CO3	analyze steam boiler efficiency and optimize energy utilization.	Analyze
CO4	evaluate air compression mechanisms and improve operational performance.	Evaluate
CO5	assess refrigeration systems and enhance cooling efficiency.	Evaluate
CO6	implement fire safety measures and industrial protection systems for workplace security.	Apply

Description:

Prerequisites:	1:	Engineering Chemistry
	2:	Chemical Engineering Thermodynamics

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Section – I		
Unit 1	**Water**	
	Importance of water in industries, Challenges in Industrial water use and Innovative solutions. General Water Resource Development & Management Scheme: Estimation of raw water consumption, Source Identification, Source Development, Pipeline system design, Distribution and Storage Systems. Sources of water, Impurities in water, Hardness & types of hardness, numerical on calculation of carbonate (temporary) & non-carbonate (permanent) hardness, Purification of up-stream water in processes.	**6 hours**
Unit 2	**Water Treatment**	
	Boiler feedwater treatment: Lime – Soda process, Zeolite process, Ion Exchange Process, Numerical on calculation of quantity of lime & soda, zeolite process. Membrane Technology: Design and Operation of Reverse Osmosis (RO), the common terms used in membrane process technology.	**6 hours**
Unit 3	**Steam Boilers & Performance of boilers**	
	Formation of steam at constant pressure from water, types of steam, Temperature vs. total heat graph during steam formation, classification of steam boilers, Indian boiler act. Equivalent evaporation, boiler efficiency, heat losses in boiler, heat balance sheet, numerical on equivalent evaporation, boiler efficiency, heat balance sheet.	**6 hours**
Section – II		
Unit 4	**Air Fluids**	
	Air compressors: classification, working of single-stage reciprocating air compressor, work done by single-stage reciprocating air compressor, Power required to drive single-stage reciprocating air compressor, Numerical. Multistage compression: Two-stage reciprocating air compressor with intercooler, work done by a two-stage reciprocating air compressor with intercooler, Minimum work required for a two-stage reciprocating air compressor, Numerical. Rotary air compressor: Centrifugal compressor, Numerical.	**6 hours**
Unit 5	**Refrigeration**	
	Principles of refrigeration, Air refrigeration cycle, Vapor compression refrigeration system, Vapor absorption refrigeration system, Refrigerants. Numerical related to refrigeration capacity, Coefficient of performance, power rating of the compressor-motor.	**6 hours**
Unit 6	**Industrial Fire & Safety**	
	Fire, fire classifications, fire tetrahedron and elements of combustion, fire extinguishing principles, enclosure fires: effect of fire load on enclosure fires, the Role of ventilation in enclosure fires, stages of fire growth and decay, industrial fire protection system: fire detection systems, fire suppression systems, fire extinguishers, passive fire protection systems, and fire alarm control panels.	**5 hours**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2						2								2
CO2	2						2								2
CO3	2	2													2
CO4	2														
CO5	2														
CO6	2					2									

References:

Text Books	
1	D. B. Dhone, Plant Utilities, Nirali Prakashan, 2018.
2	R. S. Khurmi and J. K. Gupta, A Text Book of Thermal Engineering, S. Chand Publishing, 2022.
Reference Books	
1	Ashoutosh Panday, Plant Utilities, Vipul Prakashan, 2009.
2	N. Sesha Prakash, Manual of Fire Safety, CBS publishing, 2017.
3	https://archive.nptel.ac.in/courses/103/107/103107211/

23UGPEC3-CH6051: Industrial Economics, Management & Entrepreneurship

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

Course Objectives: The objective of the course is to

1. To understand economical aspects in the chemical industry.
2. To understand and introduce general common terms related to economics, management and entrepreneurship.
3. To make students develop skills required for entrepreneurship development and leadership.

Course Outcomes:

COs	**At the end of successful completion of the course the student will be able to**	**Blooms Taxonomy**
CO1	define elements of micro and macro economics.	Remember
CO2	demonstrate the basic models of national income.	Understand
CO3	study of inflation and business cycles relating to industrial economics.	Apply
CO4	analyse the functions of management of organisations.	Analyze
CO5	utilize the resource materials, chemical processes and managerial skills for entrepreneurship programs.	Analyze
CO6	modify the present industrial economics, management status and forecast it with the improved feature of SSI	Modify

Description:

Economics , Demand and Supply , Break Evan analysis , National Income , Inflation , Business cycle, Industrialization, Entrepreneurship , Planning , Organizing , Directing , Controlling.

Prerequisites:	1:	Students should have basic knowledge of financial terms and transactions.
	2:	Students should have basic knowledge of an Industry, Organization and Management.
	3:	Students should have basic knowledge of his own individual skill and capacities towards start up activities. (SWOT Analysis)

Section – I		
Unit 1	**Managerial Economics**	**06 hrs**
	Introduction of Micro and Macroeconomics, Law of Demand and Supply, Equilibrium between demand and supply, concepts of costs, cost curves and revenue curves of a firm, equilibrium of a firm under perfect competition.	
Unit 2	**National Income**	**06 hrs**
	Concept of national income, estimation of national income, difficulties in measurement of national income, uses of national income figure.	
Unit 3	**Inflation**	**06 hrs**
	Inflation meaning, types of inflation, causes, effects, control of inflation, Business/Trade cycles, phases of business cycles, Classification, theory, control of Business Cycle.	
Section – II		
Unit 4	**Principles of management**	**06 hrs**
	Functions of Management : Nature, Definition, Levels of management,. Planning: nature, importance, types of plans, planning process, Decision making. Organizing: Principles of organization, process of organizing, organizational structure. Directing: Communication, Motivation, Leadership Controlling: Organization Control techniques.	
Unit 5	**Entrepreneurship Development (ED)**	**06 hrs**
	Modern concept of Entrepreneur, Classification of Entrepreneurs , Awareness of ED, EDP -Training design, Development of Women Entrepreneurs.	
Unit 6	**Small Scale Industries(SSI)**	**06 hrs**
	Tiny, Cottage , Small-scale and Large - scale industries, Role of industries in the Indian economy , Management of SSI, Ancillary Industries ,Procedure to start a SSI, Institutes offering assistance to SSI , problems of small scale industries, remedies.	

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	1	2			1					1	1			
CO2	2	1	1	2	1	2	1				1	2			
CO3	3		3	2	3	1		1	3	3	2		1		
CO4	2		3	1	1	3	1	1	2	2	1	2			
CO5	2	3	2	2	3	2	2	1	1	3	2	2		2	
CO6			3	3	2	1	1	1	2	2	1	3			

References:

	Text Books
1	Principles of Economics by M.L. Seth
2	Industrial Business and Management by M. D. Telsang
3	Macroeconomics by M.L.Seth
	Reference Books
1	Peter F. Drucker "The practice of Management"Allied publishers Pvt. Ltd. Bombay

23UGMDM4-CH606L: Piping Materials

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

Course Objectives: The objective of the course is to

1. Understand the role of piping systems in chemical process industries.
2. Learn material selection criteria for pipes, fittings, and valves under different operating conditions.
3. Familiarize yourself with international codes and standards (ASME, ASTM, API).
4. Analyze piping stresses, corrosion mechanisms, and failure prevention.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	identify piping components and their applications in process industries.	Understand
CO2	select appropriate materials for pipes/fittings based on operational parameters.	Apply
CO3	interpret ASME B31.3 and ASTM standards for piping design.	Analyze
CO4	recommend corrosion protection methods and stress analysis techniques.	Evaluate

Description:

The Piping Materials course provides a comprehensive understanding of piping systems used in chemical process industries, covering design, material selection, and operational standards. Students will learn about metallic and non-metallic piping materials, their properties, and selection criteria based on pressure, temperature, and corrosion resistance. The course emphasizes international codes and standards (ASME B31.3, ASTM, API) for piping design and fabrication. By the end of the course, students will be equipped to design, evaluate, and maintain efficient and safe piping systems in industrial settings.

Prerequisites:	1:	**Strength of Materials** - Understanding of stress-strain relationships, bending moments, and torsion. Knowledge of material properties (yield strength, modulus of elasticity).
	2:	**Fluid Mechanics** - Fluid statics and dynamics. Pressure drop calculations in pipes and fittings.
	3:	**Introduction to Process Engineering** - Basics of process flow diagrams (PFDs) and piping & instrumentation diagrams (P&IDs). Familiarity with unit operations (e.g., pumps, heat exchangers).

Section – I		
Unit 1	**Fundamentals of Piping Systems**	
	Importance of piping in oil/gas, petrochemicals, and pharmaceuticals. Components: Pipes, fittings, flanges, valves, gaskets, supports. Piping networks: Process, utility, and instrumentation lines, Pipe identification and classification.	**5 hrs**
Unit 2	**Materials & Standards**	
	Metallic materials: Carbon steel, SS 304/316, duplex steel, alloys, non-metallic materials: PVC, PTFE, FRP, HDPE, Material selection factors: Pressure, temperature, corrosion, ASME B31.3, ASTM, API standards. Pipe sizing (NPS, DN), Material testing (hardness, tensile strength).	**7 hrs**
Unit 3	**Fabrication & Corrosion-Pipe manufacturing**	
	Seamless vs. welded, Joining methods: Welding, threading, flanged connections, NDT techniques: Radiography, ultrasonic testing, Corrosion types: Galvanic, pitting, stress corrosion cracking, Mitigation: Coatings, cathodic protection, Welding demo and corrosion experiments.	**5 hrs**
Section – II		
Unit 4	**Stress Analysis & Industrial Applications**	
	Thermal expansion, vibration, and mechanical stresses, Pipe supports: Anchors, guides, springs, Valve types: Gate, globe, ball, check, butterfly. Case studies: Failure analysis (leaks, ruptures). **Practical: Stress analysis using CAESAR II (basic).	**7 hrs**

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	3	1	-	-	-						-			2	
CO2	3	2	2	1	1						1			3	
CO3	2	3	2	2	-						2			3	
CO4	1	2	3	3	2						1			3	

References:

Text Books	
1	**Weaver, R. (2012).** *Process Piping Design Handbook.* McGraw-Hill Education, 3rd edition.
2	**ASME (2023).** *ASME B31.3-2023: Process Piping Code.* American Society of Mechanical Engineers, 2023 edition.
Reference Books	
1	**Smith, P. (2015).** *Piping Materials Guide.* Elsevier, 2nd edition.
2	**Fontana, M.G. & Greene, N.D. (2018).** *Corrosion Engineering.* McGraw-Hill Education, 9th edition.

23UGVSEC-CH6071L: Industrial Practices and Case Studies

Course Details:					
Teaching Scheme			**Evaluation Scheme**		
Lectures	:	1 hours per week	**ISE**	:	--
Credits	:	1	**ESE**	:	--
Practical	:	2 hour per week	**ISA**	:	50 marks
Credits	:	1	**POE**	:	--
Total Credits	:	2	**Total Marks**	:	50 marks

Course Objectives: The objective of the course is to

1. Minimize the gap between Institute and Industry
2. Introduce and evaluate the student knowledge during interaction with the industrial culture
3. Make aware the students the importance of communication and safety procedures in the industry

Course Outcomes:

COs	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	understand the difference between class room explanations and real life professional culture.	Understand
CO2	describe various organizations involved in the chemical industry like Design, Research, Processing, Production and Marketing.	Apply
CO3	give opportunities for Employment and Self-Employment in the chemical sector after graduation.	Analyze
CO4	acquire through P & ID's basic information of sources of raw materials, products, by- products of production activities and where they can be used.	Evaluate
CO5	understand how industrial establishments are administered.	Evaluate
CO6	know the Battery limits, Offsite facilities and the Overall Safety procedures.	Apply

Description:

MIDC, Industry, Industry manual, MSDS, Administrative setup, Organization structure, Setup of industry, Plant location & layout, Production operations, Effluent treatment, overall safety procedures

Prerequisites:	1:	Students should know basic elements of an industry
	2:	Students should have enough knowledge of basic ethics, discipline and social responsibilities.
	3:	Students should know about basic safety guidelines.
Mechanism:		Weekly each practical batch with staff in charge should compulsory visit 5 local industries. Also all students together in a class should visit 5 large scale Chemical Process Industries in nearby M.I.D.C.'s. The staff member has to give complete details of the particular industry in the interaction

	In Semester Analysis (ISA) 50 marks will be done on the basis of the number of industrial visits attended by each student. 1 Number of industrial visits (20). 2 Preparation of every Industry visit report (20). 3 Certified Submission and Orals (10).

Each Industry Visit Report shall consist of following units		
Unit 1	History of Industry Raw materials. Process flow chart.	**2 Pages**
Unit 2	Equipment details. Production process details. Cost of production and profits.	**4 Pages**
Unit 3	Quality control aspects. Pollution control aspects. Safety aspects. Suggestions for improvement.	**4 Pages**
Unit 4	Process Hazards and Safety measures available in visited chemical process industries: Safety in chemical process industries, Potential Hazards, Physical job safety analysis. High Pressure High temp operation, Dangerous and toxic chemicals, highly explosive and inflammable chemicals, highly radioactive materials, Safe handling & operation of materials, .Planning & layout.	**2 Pages**
Unit 5	Causes of Industrial Accidents and Remedial measures Taken in Visited Companies : Effective steps to implement safety procedures, periodic inspection, study of plant layout and constant maintenance, Periodic advice and checking to follow safety procedures, Proper selection and replacement of handling equipment, Personal protective Equipment.	**2 Pages**
Unit 6	P & I Diagram at least for any one plant, which they have visited, should be drawn and Xerox of group colored photos of each industrial visit including company name.	**2 Pages**

List of Industrial Interactions

Industries in Warana-Industrial Complex: (Any Five)

1. TKWSSKL, Warananagar
2. TKWSSKL, Warananagar (Distillery Unit).
3. TKWSSKL, Warananagar (ENA Plant) in collaboration with Praj Industries , Pune .
4. Shree Warana Dudh Utpadak Prakriya Sangh Ltd. Tatyasaheb Korenagar.
5. Warana Agricultural Goods Processing Cooperative Society , Tatyasaheb Korenagar.
6. Shree Warana Dudh Utpadak Prakriya Sangh Ltd. Tatyasaheb Korenagar (Cadbury Unit)
7. Tatyasaheb Kore Jaggery Plant.
8. Warana Co-generation Plant.
9. Bill Tube India Plant.
10. Spectrum –Warana CNG Plant / Bio-Earth plant

Outside Industries in M.I.D.Cs: (Any Five)

1. Rashtriya Chemicals and Fertilisers Ltd., Alibaug.
2. Gharda Chemicals, Lote Parshuram Chiplun..
3. Excel Industries, , Lote Parshuram Chiplun..
4. Dow Chemicals, , Lote Parshuram Chiplun..
5. Krishna Antioxides, , Lote Parshuram Chiplun..
6. Vinati Organic Chemicals Ltd. , , Lote Parshuram Chiplun.
7. Privi Organics, Mahad.
8. Vinati Organic Chemicals Ltd. , Mahad.
9. Sudarshan Chemicals,Roha,
10. Deepak Nitrite Ltd.Roha.
11. Anshul Speciality Molecules Ltd. Roha.
12. Excel Industries, Roha.
13. Common Effluent Treatment Plant (CETP), Roha.
14. Galaxy Surfactants , Taloja M.I.D.C.Mumbai.
15. VVF Ltd., Taloja M.I.D.C.Mumbai.
16. Rashtriya Chemicals and Fertilisers Ltd., Chembur, Mumbai.

Mapping of POs & COs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	2	2		1			1	1			2	2			
CO2	3			1	3	1	1		2				3		
CO3		1	2		2		2	1		2	3			2	
CO4		2				1			1	3	2	3			
CO5	3		3	2	2	3		1				1			1
CO6		3	2			2	2	1		3					

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