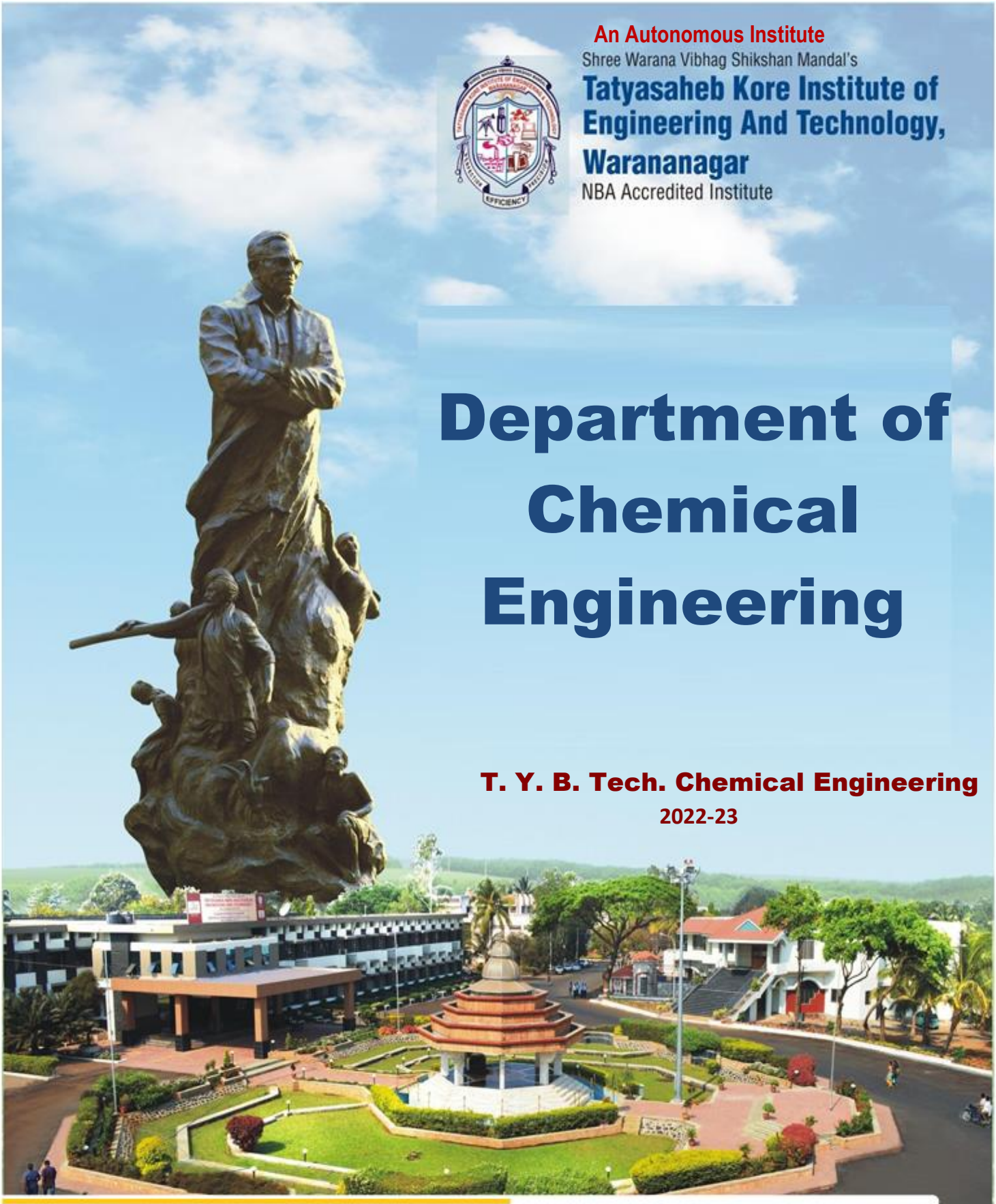
An Autonomous Institute

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

2022-23

B. Tech. In Chemical Engineering

Syllabus Structure and Curriculum under Autonomy

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

An Autonomous Institute

Department of Chemical Engineering

❖ VISION

To become an academy of excellence in technical education and human resource development.

❖ MISSION

- To develop engineering graduates of high repute with professional ethics.
- To excel in academics and research through innovative techniques.
- To facilitate the employability, entrepreneurship along with social responsibility.
- To collaborate with industries and institutes of national recognition.
- To inculcate lifelong learning and respect for the environment.

❖ QUALITY POLICY

To promote excellence in academic and training activities by inspiring students for becoming competent professionals to cater industrial and social needs.

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.

SWVSM'S

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

An Autonomous Institute

Abbreviations

Sr.No.	Acronym	Definition
1	ISE	In-SemesterExamination
2	ISE-I	In-SemesterExamination-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

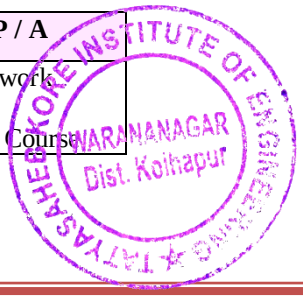
Sr.No.	Acronym	Definition
1	ESC	Engineering Science Course
2	PCC	Professional Core Course
3	PCE	Professional Course Elective
4	OEC	Open Elective Course
5	PEC	Professional Elective Course
6	MP	Mini Project Work
7	IP	Industrial Practices and Case Studies

Course/ Subject Code

CH	E	5	0	1
Branch Code		Semester	Course Number	

Course Term work and POE Code

CH	E	5	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

Syllabus Structure under Autonomous Status of TKIET, Warananagar

2022-23

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Third Year B.Tech.(Chemical Engineering)

Semester-V

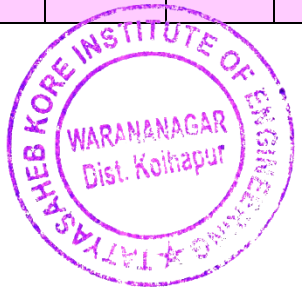
(To be implemented from 2022 - 23)

Credit Scheme

Course Code	Category	Course Title	Teaching and Credit Scheme					Examination & Evaluation Scheme			
			L	T	P	CH	C	Component	Marks	Min for Passing	
CHE501	PCC	Chemical Reaction Engineering-I	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE502	PCC	Mass Transfer-I	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE503	PCC	Chemical Engineering Thermodynamics-II	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE504	PCE	Chemical Equipment Design	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE505	OEC	Electives –I	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE503T	PCC	Chemical Engineering Thermodynamics-II	--	1	--	1	1	ISA	25	10	10
CHE505T	OEC	Electives –I	--	--	--	--	--	ISA*	25	10	10
CHE506T	MP	Mini Project Work	1	--	2	3	2	ISA	75	30	30
CHE501P	PCC	Chemical Reaction Engineering-I	--	--	2	2	1	ISA	25	10	10
								POE	25	10	10
CHE502P	PCC	Mass Transfer-I	--	1	2	3	1	ISA	25	10	10
								POE	25	10	10
CHE504P	PCE	Chemical Equipment Design	--	--	2	2	1	ISA	50	20	20
								POE	25	10	10
CHE507A	--	Audit Course – V Seminar/ Paper Presentation (Depending on Program)	--	--	--	--	--	--	--	--	--
			16	2	8	26	21	--	800	--	--

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

*indicates the ISA will be based on assignments and hands on programming.



List of Open Elective Course Semester-V forT.Y. B.Tech

Sr. No.	OEC-CH-505 Elective-I
1	Applications of MATLAB
2	Advanced Industrial Software's

Third Year B. Tech. (Chemical Engineering)

Fifth Semester Detailed Syllabus

PCC-CHE -501 CHEMICAL REACTION ENGINEERING - I

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

1. Write a rate law and define reaction order and activation energy.
2. Demonstrate the ability to quantitatively predict the performance of common chemical reactors using simplified engineering models.
3. 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 beable to	Blooms Taxonomy
CO1	Ability to size batch reactors, semi batch reactors, CSTRs, PFRs, for isothermal operation given the rate law and feed conditions.	Create
CO2	Ability to define and develop rate equations for homogeneous reactions.	Analyse
CO3	Ability to derive design equations for different types of reactors based on mole and energy balance.	Create
CO4	Ability to relate rate of reaction with design equation for reactor sizing.	Evaluate

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 with Kinetics of Homogeneous Reactions:**	
	Chemical kinetics and thermodynamics of reaction; Classification of reactions – Homogeneous and Heterogeneous reactions. Rate of reaction - broad definition for homogeneous and heterogeneous reactions. Irreversible and reversible reactions, Equilibrium, Order and molecularity of reaction. Elementary and non-elementary reactions, Stoichiometry, Fractional conversion. 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 and their interrelation **Temperature dependency of rate Constant,** Arrhenius law, Transition state theory and collision theory, Introduction to reaction mechanism.	**6 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, Rate equation concept for these reactions. Multiple reactions-stoichiometry and Rate equations for series and parallel reactions; Non elementary single reactions.	**8 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.	**6 Hrs.**
Unit 5	**Design for Multiple Reactions:**	
	Yield and selectivity, Parallel reactions Requirements for high yield. Best operating condition for mixed & plug flow reactors, Series reactions Maximization of desired product rate in a plug flow reactor and back mixed reactor.	**5 Hrs.**
Unit 6	**Temperature Effects in Homogeneous Reactions:**	
	Equilibrium Conversion, Optimum temperature progression, Adiabatic and non-adiabatic operations, Stable operating condition in reactors.	**4 Hrs.**

List of Practicals:- (Any 10)

1)To calculate value of rate constant "K" for the saponification of ethyl acetate with NaOH in batchreactor-I (where M=1)

2) To calculate value of rate constant "K" for the saponification of ethyl acetate with NaOH in batch reactor-II (where M=2)
3) To calculate value of rate constant "K" for the saponification of ethyl acetate with NaOH in straight tube reactor.
4) To calculate value of rate constant "K" for the saponification of ethyl acetate with NaOH in bend tube reactor.
5) To calculate value of rate constant "K" for the saponification of ethyl acetate with NaOH in helical coil reactor.
6) To calculate value of rate constant "K" for the saponification of ethyl acetate with NaOH in spiral coil reactor.
7) To calculate value of rate constant "K" for the saponification of ethyl acetate with NaOH in packed bed reactor.
8) To calculate value of rate constant "K" for the saponification of ethyl acetate with NaOH in mixed flow reactor.
9) To calculate value of rate constant "K" for the saponification of ethyl acetate with NaOH in mixed flow reactors in series.
10) Verification of Arrhenius law.
11) To calculate rate of reaction of auto catalytic reaction in recycle reactor.

Note: Experimental calculations & graphs by using software's 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	1	-	-	-	-	2	2	1	1	1	2
CO2	3	2	1	2	1	-	-	-	-	2	2	1	1	1	2
CO3	3	2	1	2	1	-	-	-	-	2	2	1	1	1	2
CO4	3	2	1	2	1	-	-	-	-	2	2	1	1	1	2
CO5															
CO6															

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.

Web Links/ Video Lectures are to be provided to Theory and Practical /Experiments Lectures.

PCC-CHE -502 MASS TRANSFER-I

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

Course Objectives: The objective of the course is

1. The student completing this course are excepted 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. Application of Navier-Stoke equation in unsteady state convective mass transfer and mass transfer analogy.
2. It gives details about method 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 beable to	Blooms Taxonomy
CO1	Define and describe diffusional operation with rate of mass transfer	Remember
CO2	Identify and differentiate various mass transfer operations	Understand
CO3	Use knowledge of mass transfer operations for designing mass transfer coefficient and cascade system	Apply
CO4	Relate mechanism of absorption,adsorption with designing stages and height of packed tower	Analyze
CO5	Select contacting equipment and its design considerations	Evaluate
CO6	Investigate the problems related to mass transfer operations	Create

Description:

To able to design equipment for mass transfer operations, the rate equations are importantwhich can be utilized for optimization concept.

Concept of steady state & unsteady state diffusional operations studied for controlling parameters in actual industrial process.

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:	Knowledge of chemistry, applied maths,physics
	2:	Knowledge of process calculations,material and energy balance, thermodynamics for equillibrium
	3:	Knowledge of fluid mechanics for convective transfer

Section – I		
Unit 1	**Introduction to Mass Transfer:**	
	Introduction to mass transfer operations, Classification & Applications, Molecular diffusion influids,Concept of diffusivity ,Flux transfer equations for gas and liquid phase based on steady and unsteady state equation, empirical equations used to determine diffusivity through gas andliquid phase, equation of continuity and its application in the form of Navier -Stoke equation. Experimental diffusivity measurement equipments – Arnold cell, Twin bulb,Stefan tube,Diaphragm cell.	**7 Hrs.**
Unit 2	**Mass Transfer Coefficients:**	
	Determination Of mass transfer coefficient through contacting equipment. Eddy diffusion, film theory, penetration theory, surface renewal theory, analogy ofmass transfer, heat Transfer and its significance, mass transfer coefficient in laminar flow and turbulent flow, Simultaneous mass & heat transfer.	**6 Hrs.**
Unit 3	**Interphase Mass Transfer:**	
	Equilibrium, Study of Raults law, Daltons law, Henrys law, Two Film Theory - Concept Of individual and overall masstransfer coefficient, operating line, driving force line. Cascades –cross current, Counter Current stages. Solved examples on stages and driving force lines withinterfacialcompositions	**7 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. **b) Liquid dispersed:** Ventury Scrubber, Wetted wall tower, Spray tower, Spraychamber, Packed tower, Mass Transfer coefficients for packed tower, Random & Stacked packing, End effects and axial mixing, Tray tower Verses packed tower .Liquid hold up – determination of interfacial areabased on hold up and Mass Transfer Coefficients.	**6 Hrs.**
Unit 5	**Gas Absorption:**	
	Choice of solvent, Material balance on crosscurrent and countercurrent absorption or stripping ,Absorption factor and stripping factor, Tray efficiency ,Design equation for packed tower ,HETP,NTU,HTU calculation for packed tower.	**7 Hrs.**
Unit 6	**Adsorption**	
	Adsorption isotherm, Types of adsorbents, Adsorption equipment, Adsorption hysteresis, Heat of adsorption, break through curves, Single and multistage adsorption operation calculations, Principle of Ion Exchange, Principles & Techniques of Ion Exchange.	**7 Hrs.**

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 hold up in 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		
													PSO1	PSO2	PSO3
CO1	2	3		3	2										
CO2	1	3	2	3	1										
CO3	2	3	3	3	2						1				
CO4	2	3	3	3	3							1			
CO5	2	3	3	3	3	1	1	1							
CO6	1	2	2	2	2	2	2			1	2	1			

References:

Text Books	
1	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"InternationalStudent 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

Web Links/ Video Lectures are to be provided to Theory and Practical /Experiments Lectures

PCC-CHE -503 CHEMICAL ENGINEERING THERMODYNAMICS II

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3 hrs per week	**ISE**	**:**	40 Marks
Credits	**:**	3	**ESE**	**:**	60 Marks
Tutorial	**:**	1 hr per Batch	**ISA**	**:**	25 Marks
Credits	**:**	1	**POE**	**:**	--
Total Credits	**:**	4	**Total Marks**	**:**	125 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. Student 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 beable 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, The phase rule & Duhem's Theorem, VLE: Qualitative Behavior, Azeotropes, Simple models for Vapor / Liquid Equilibrium Raoults law, Dew point and bubble point calculations with Raoults law, Henry's law, VLE by modified Raoult's law, problems.	**10Hrs.**
Unit 2	**Solution Thermodyamics: 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.	**7 Hrs.**
Unit 3	**Solution Thermodyamics: 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 theActivity Coefficient	**7 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.	**8 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 .Equilibrium Conversions For Single Reactions, Phase Rule & Duhem's Theorem for reacting Systems.	**8 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		2	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 InternationalEdition.
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.

Web Links/ Video Lectures are to be provided to Theory and Practical /Experiments Lectures:

PCE-CHE -504 CHEMICAL EQUIPMENT DESIGN

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3 hrs per week	**ISE**	**:**	40 Marks
Credits	**:**	3	**ESE**	**:**	60 Marks
Practical	**:**	2 hrs per Batch	**ISA**	**:**	50 Marks
Credits	**:**	1	**POE**	**:**	25 Marks
Total Credits	**:**	4	**Total Marks**	**:**	175 Marks

Course Objectives: The objective of the course is to

1. To introduce the students the Basic concept in design.
2. To introduce the different types of stresses involved, in equipments due to internal and external factors, various types of joints , their fabrication and testing methods.
3. Mechanical design of various types of equipments like pressure vessel, storage vessel,Tall vessel , heat exchanger, evaporator, reaction vessel and their supports.

Course Outcomes:

Cos	At the end of successful completion of the course the student will beable to	Blooms Taxonomy
CO1	Recall their concept in designing the chemical equipments.	Recall
CO2	Interpret causes of failure of chemical equipments.	Interpret
CO3	Model chemical equipments.	Model
CO4	Take part in remedial or preventive measurements to avoid failure of vessel with safe design guidelines.	Take part
CO5	Evaluate and apply their ideas on dimensional analysis to explore the optimum design variables.	Evaluate
CO6	Test the process equipment with prier safety.	Test

Description:

Design preliminaries, Design , Fabrication and Testing of Vessels.Process Hazards and safety procedures.

Prerequisites:	1:	Student should know basic concepts of MOC & Stress analysis.
	2:	Student should know types of equipment used in chemical industry.
	3:	Student should have basic knowledge of designing software.

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	**4 Hrs.**
Unit 2	**Pressure Vessels / Storage Vessels**	
	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, Design of spherical vessels.(Use ASME Sec A Div I and IS 2825 for above design procedure) / Storage of fluids, Different types of storage vessels, Design of cylindrical storage vessels with roof.	**8 Hrs.**
Unit 3	**Design of Tall Vessel**	
	Determination of longitudinal stresses, Period ofvibration, Determination of resultant longitudinal stress. Types of Supports	**6 Hrs.**
Section – II		
Unit 4	**Mechanical Design of Heat Exchanger**	
	Types of heat exchangers, Special type of heat exchangers, Design of Shell & Tube Heat Exchanger.(Use IS 4503 for above design procedure)	**6 Hrs.**
Unit 5	**Mechanical design of Reaction vessel / Mechanical design of Agitator**	
	Classification of reaction vessel, Heating systems, Design consideration / Types of agitators, Baffling, Power requirements for agitation, Design of agitation system components.	**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 in pressure vessels, Safety measure in Equipment Design, Pressure Relief Devices	**4 Hrs.**

List of Practical's:- Design and Drawing with Advanced Software of the following

1. Design of Pressure Vessels with components.
2. Design of Heads, Flanges and Gaskets.
3. Design of Atmospheric Storage vessels.
4. Design of Tall Vertical vessels
5. Design of Heat Exchangers.
6. Design of Reaction vessel.
7. 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	1	2			1					1	1			
CO2	2	1	1	2	1	2	1				1	2	1		
CO3	3		3	2	3	1		1	3	3	2		3	3	
CO4	2		3	1	1	3	1	1	2	2	1	2			3
CO5	2	3	2	2	3	2	2	1	1	3	2	2	1		3
CO6			3	3	2	1	1	1	2	2	1	3		3	

References:

Text Books	
1	B. C. Bhattacharya, “Introduction to chemical equipment design” (Mechanical accepts) 1985.
2	M. V. Joshi, “Process equipment design” McMillan India Ltd. 1981.Coulson J. M. and Richardson J. F.,“Chemical Engg.” Vol. 2 & 6, Pergaman Press, 1970.
3	Dr. S.D. Dawande, “Process Design of Equipment”, Central Techno Publication, 1st Edition1999.
Reference Books	
1	L. E. Brownel and E. H. Young “Process equipment design”, Wiley Eastern Ltd.1977.

Web Links/ Video Lectures are to be provided to Theory and Practical/ExperimentsLectures:

OEC-CHE- 505 APPLICATIONS OF MATLAB

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

Course Objectives: The objective of the course is to

1.To familiarize the student in introducing and exploring MATLAB software.
2.To enable the student on how to approach for solving Engineering problems using simulation tools.
3.To prepare the students to use MATLAB in their project works.

Course Outcomes:

Cos	At the end of successful completion of the course the student will beable to	Blooms Taxonomy
CO1	Able to express programming & simulation for engineering problems.	Understand
CO2	Able to find importance of this software for Lab Experimentation.	Remember
CO3	Able to write basic Chemical Engineering problems in Matlab & to use in research by simulation work.	Apply
CO4	Able to connect programming files with GUI Simulink.	Understand

Description:

This is basic introduction of MATLAB programming concepts and its use in chemical engineeringfield.

Prerequisites:	1:	Basic programming fundamentals

Section – I		
Unit 1	**Introduction MATLAB:**	
	Introduction MATLAB, MATLAB window, Command window , workshop window, workspace, basic command assigning variables, operations with variables, data files and data types, characters and string.	**6 Hrs.**
Unit 2	**Control Loops:**	
	Control statement programming, conditional statement programming, loop and conditional statements, if, else, switch, for, while, continue, break, programming with control statements	**6 Hrs.**
Unit 3	**Functions:**	
	Function definition, User defined function, Built in function, Function calling, Return value, Type of functions, Global Variable	**6 Hrs.**
Section – II		
Unit 4	**Array and Linear Equations:**	
	Array definition, Types of Array, Matrix Arithmetic operations, Array Arithmetic operations, operators and special characters, Relational , mathematical and logical operators, matrix operations, transpose determinant and inverse and matrix function.	**8 Hrs.**
Unit 5	**MATLAB Operations and Plot:**	
	Arithmetic operations, operators and special characters, solving arithmetic equations, matrix operations,. Trigonometric functions, complex numbers, fractions real numbers, M file, plots 2D, 3D, GUI design	**6 Hrs.**
Unit 6	**Debugging M Files:**	
	Debugging process, preparation for debugging, setting break points, running with break points, correcting and ending debugging, correcting Mfile.	**4 Hrs.**

Assignments:- (Any 6)

1. Basic introduction of MATLAB window and its different uses.
2. Different types of Control loops
3. On Functions
4. On Array and its applications
5. On Linear equations
6. On MATLAB operations
7. On MATLAB different types of plots and its applications
8. On Debugging

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	2								2		
CO2		2	2	2	2								2	2	
CO3	2	2	2	2	2								2	2	
CO4			2	2	2										

References:

Text Books	
1	Dr. Rudra Pratap,"Getting started with MATLAB" , Oxford University Press.
Reference Books	
1	David Houcqe, "Introduction to MATLAB for Engineering students", Northwestern
2	University (ver 1.2Aug 2005)
3	Dr. Partha , S. Mallick, "MATLAB & Simulink" ,Scitech publications pvt ltd.
4	Dr. Shailendra Jain & Dr. Sanjeevan Kapshe, "Modeling and simulation using MATLAB Simulink", Wiley.
5	S. J. Chapman, "Essential of MATLAB programming".
6	D. J. Higham and N. J. Higham. "MATLAB Guide". Siam, second edition edition, 2005.
7	Gilat.,"MATLAB: An introduction with Applications", John Wiley and Sons, 2004.
8	D. Houcque, "Applications of MATLAB: Ordinary Differential Equations". Internal communication, Northwestern University.

OEC-CHE- 505 ADVANCED INDUSTRIAL SOFTWARE'S

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

Course Objectives: The objective of the course is to

1. Emphasize the basic concepts of simulation.
2. Impart the knowledge and awareness to understand the validity and physicochemical interpretation of thermodynamic models and their limitations
3. Develop the skills for plant simulation and optimization, solve chemical engineering problems encountered in chemical industries using professional software's.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	To remember and understand basic concepts of simulation.	Remembering Understanding
CO2	Understand and apply open source simulation software DWSIM.	Understanding Application
CO3	To remember and analyse the distillation column using Chemsep.	Remembering Analyzing
CO4	To understand basic concepts of Scilab.	Understanding
CO5	To understand basic concepts of SCADA.	Understanding
CO6	Understand and apply the CHEMCAD software for process simulation.	Understanding Application

Description:

The field of Chemical Engineering and its link to computer science is in constant evolution and new engineers have a variety of tools at their disposal to tackle their everyday problems. Introduction to industrial software for Chemical Engineers provides a quick guide to the use of various computer packages for chemical engineering applications. It covers a range of software from DWSIM , CHEMSEP , Scilab, SCADA and Chem CAD. The different packages are introduced and applied to solve typical problems in fluid mechanics, heat and mass transfer, mass and energy balances, unit operations, reactor engineering, process and equipment design and control.

Prerequisites:	1:	Basic Chemical Engineering knowledge.
	2:	Basic Mathematical concepts.
	3:	Thermodynamic properties.

Section – I		
Unit 1	**General Introduction to Industrial software's:**	
	1.1 General introduction to industrial software's 1.2 Definition of simulation, 1.3 Advantages of simulation, 1.4 Types of simulation, Dynamic and static simulation.	**6 Hrs.**
Unit 2	**Simulation Software's:**	
	2.1 Open simulation software's in chemical engineering, 2.2 Applications of chemical process simulators. 2.3 Introduction to DWSIM, Application 2.4 DWSIM**:** Creating a material stream in DWSIM, Introduction to Flow sheeting. 2.5 Reactor: Plug Flow Reactor, Continuous Stirred Tank Reactor, Conversion Reactor, Equilibrium Reactor. 2.6 Heat Exchanger: Shell and Tube Heat Exchanger. 2.7 Distillation: Shortcut Distillation, Rigorous Distillation.	**6 Hrs.**
Unit 3	**CHEMSEP:**	
	3.1 Introduction, Component Selection 3.2 Elements of ChemSep's Interface, 3.3 Flowsheeting , 3.4 Specification , 3.5 Design calculations and Examples	**6 Hrs.**
Section – II		
Unit 4	**SciLab:**	
	4.1 General Introduction 4.2 Differential calculus, Integration 4.3 Elementary Functions 4.4 Special Functions 4.5 Optimization and Simulation 4.6 Examples	**6 Hrs**
Unit 5	**SCADA:**	
	5.1 Introduction to SCADA, 5.2 Objectives of SCADA, 5.3 Benefits, Elements of System, Advantages, Functions, Usage/Applications, 5.4 Real time monitoring and control using SCADA	**6 Hrs**
Unit 6	**CHEMCAD:**	
	6.1 Overview of Chem CAD functions 6.2 Overview and navigation of the physical property database 6.3 Adding a new component to the database 6.4 Overview of thermodynamic options 6.5 Building a flowsheet for design purposes 6.6 Modeling an existing process 6.7 Quantitative and qualitative use of simulation	**6 Hrs.**

Mapping of POs & COs:

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

References:

Text Books	
1	Introduction to Software for Chemical Engineers,, Mariano Martín Martín, CRC Press, 2nd Edition.
Reference Books	
1	DWSIM - Process Simulation, Modeling and Optimization Technical Manual Version 4.0, August 2016.
2	Mass Transfer Operations by Treybal Robert.
3	The ChemSep Book,Second Edition by Harry A. Kooijman & Amsterdam
4	Introduction to Scilab For Engineers and Scientists by Sandeep Nagar
5	www.Basics of SCADA/instrumentationtools.com/scada- system

Web Links/ Video Lectures are to be provided to Theory and Practical /Experiments Lectures:

1. www.Basics of SCADA/instrumentationtools.com/scada- system.

MP-CHE -506T MINI PROJECT WORK

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	1 hr per week	**ISE**	**:**	--
Credits	**:**	--	**ESE**	**:**	--
Practical	**:**	2 hr per week	**ISA**	**:**	75 Marks
Credits	**:**	2	**POE**	**:**	--
Total Credits	**:**	2	**Total Marks**	**:**	75 Marks

Course Objectives: The objective of the course is to

1. Development of ability to define and design the problem and lead to its accomplishment properly.
2. Planning: Learn behavioral science by working in a group.
3. To develop student's abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.

Course Outcomes:

Cos	At the end of successful completion of the course the student will beable to	Bloom's Taxonomy
CO1	Understand, plan and execute a Mini Project with a team.	Understand
CO2	Implement basic engineering knowledge.	Apply
CO3	Prepare a technical report based on the Mini project.	Analyze
CO4	Deliver technical seminar based on the Mini Project work carried out.	Evaluate

The project can be taken by a group of 4 students and mini projects can be carried out in the dept. under a guide or outside the department/institute/ company under a guide from the dept. and co guide from the outside department/institute/ company.

Evaluation procedure:

1 Report Abstract, Introduction, Literature survey, And parameters planned to study.

2 PPT Presentation Evaluation by the committee/subject incharge.

Mapping of POs & COs:

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

CHE 507A AUDIT COURSE –V

Teaching Scheme		Evaluation Scheme	
Practical's	: --	Audit points	: --
Credits	: Non credit		:

Instruction for audit course
1. Students are required to prepare and deliver review report (Seminar / Paper Presentation)
2. On selected topics in Chemical Engg. and also it is required to submit detail report with certificate to the department.
3. (Above activity should be done at Inter / University / Zonal etc. level by individual student)

Member Secretary
Board of Studies

Chairman
Board of Studies

Academic Dean
T.K.I.E.T, Warananagar

Principal
T.K.I.E.T, Warananagar

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

Seal of Institute

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Third Year B.Tech.(Chemical Engineering)

Semester-VI

(To be implemented from 2022-23)

Credit Scheme

Course Code	Category	Course Title	Teaching and Credit Scheme					Examination & Evaluation Scheme			
			L	T	P	CH	C	Component	Marks	Min for Passing	
CHE601	PCC	Process Plant Utilities	3	--	--	3	2	ESE	60	24	40
								ISE	40	16	
CHE602	PCC	Mass Transfer-II	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE603	PCC	Process Dynamics and Control	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE604	PCC	Chemical Reaction Engineering-II	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE605	OEC	Elective – II	3	--	--	3	2	ESE	60	24	40
								ISE	40	16	
CHE601T	PCC	Process Plant Utilities	--	1	--	1	1	ISA	25	10	10
CHE605T	OEC	Elective – II	--	1	--	1	1	ISA	25	10	10
CHE606P	ESC	Process Simulation Laboratory	1	--	2	3	1	ISA	50	20	20
CHE607P	IP	Industrial Practices and Case Studies	--	--	2	2	1	ISA	50	20	20
CHE602P	PCC	Mass Transfer-II	--	1	2	3	1	ISA	25	10	10
								POE	25	10	10
CHE603P	PCC	Process Dynamics and Control	--	--	2	2	1	ISA	25	10	10
								POE	25	10	10
CHE604P	PCC	Chemical Reaction Engineering- II	--	1	2	3	1	ISA	25	10	10
								POE	25	10	10
CHE608A	--	**Audit Course – VI** Any-one Extracurricular Activity participation such as Sport/ Cultural/ Social etc.	--	--	--	--	--	--	--	--	--
			16	4	10	30	20	--	800	--	--

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

List of Open Elective Course Semester-VI forT.Y. B.Tech

Sr. No.	OEC-CH-605 Elective-II
1	Industrial Economics, Management & Entrepreneurship
2	Project Management & Smart Technology

Third Year B. Tech. (Chemical Engineering)

Sixth Semester Detailed Syllabus

PCC-CHE-601 PROCESS PLANT UTILITIES

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3 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 Marks

Course Objectives: The objective of the course is to

1. Understand the principles of air, water, steam as plant utilities.
2. Interpret & formulate the Boiler classification and thermal efficiency calculation as design aspects in industries.
3. Principle of compressed & instrumental air, fire with industrial safety.

Course Outcomes:

Cos	At the end of successful completion of the course the student will beable to	Bloom's Taxonomy
CO1	Chemistry of water, color codes and process steam as utilities.	Recall
CO2	Different treatments to boilers feed water in process industries.	Understand
CO3	The type of boilers, Indian boiler act.	Understand
CO4	Interpret & formulate the thermal efficiency calculation of boilers as design aspects in industries.	Analyze & Evaluate
CO5	Principle & working of the compressed, instrumental air in process industries.	Understand
CO6	Causes of Fire & protective measurements in industry.	Apply

Description:

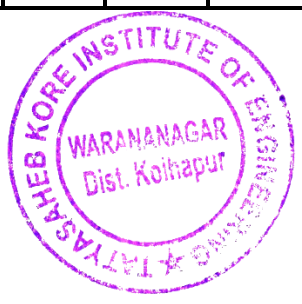
To learn the subject following prerequisites in process and chemical industries.

Prerequisites:	1:	Water Characteristics
	2:	Thermodynamics

Section – I		
Unit 1	**Water Chemistry:**	
	Water source compositions, characterization & properties, Methods of Purification of up-stream water in the processes.	**6 hrs**
Unit 2	**Water Treatment:**	
	Treatment of Boiler Feed Water, Color Codes of water, Introduction to design and operation of DM Water Plant, RO Plant.	**5 hrs**
Unit 3	**Steam:**	
	Steam generators, Classification with, Indian act of Boiler, Mountings and accessories Types of Steam, Types of Steam, Modern Boiler equipment, Super-heaters, Injectors, Condensers.	**6 hrs**
Section – II		
Unit 4	**Boiler Performance:**	
	Thermal Performance of the Boilers & Boiler Calculations. [More Weightage should be given to Boiler Calculations].	**8 hrs**
Unit 5	**Air Fluids:**	
	Introduction of Compressed Air, Blower Air and fan air. Types ofCompressor, Instrumental Air.	**6 hrs**
Unit 6	**Industrial Fire & Safety:**	
	Fire Protection: Process of combustion in fire, Effect of fire load & ventilation condition on enclosure fire, growth and decay of fire in enclosure, Introduction to industrial fire protection system.	**4 hrs**

Mapping of POs & COs:

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



References:

Text Books	
1	Ashutosh Pande, Plant Utilities, Vipul Prakashan, Mumbai. 27.
2	C. S. Rao “Environmental pollution control engineering” Wiley Eastern, Ltd 1994.
3	D.B.Dhone , “ Plant Utilities “, Nirali Prakashan ,Pune.
4	B.I.Bhatt ,S.M. Vora, “Stoichiometry",Tata McGraw Hill Publishing Company Ltd.
Reference Books	
1	Waren Viessman and Mark J. Hammer, “Water supply and pollution control”, Harper & Row, New York, 1985.
2	M.V. Rao and A. K. Datta : “Waste Water Treatment”.
3	Soli Arceivala, “Waste Water Treatment for Pollution Control”.
4	Degrenont, “Water Treatment” Hand Book Wiley, 1979.
5	https://nptel.ac.in/courses/105/102/105102176/ - Fire & Safety

PCC-CHE -602 MASS TRANSFER-II

Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	**ISE**	:	40 Marks .
Credits	:	3	**ESE**	:	60 Marks .
Practicals	:	2 hrs per Batch	**ISA**	:	25 Marks
Tutorial	:	1 hrs per Batch	**POE**	:	25 Marks
Credits	:	1			
Total Credits	:	4	**Total Marks**	:	150 Marks

Course Objectives: The objective of the course is

The student completing this course are excepted to understand mechanism of distillation,extraction,leaching,drying,crystallization For designing of equipment in which two phases are contacted.where themodynamic 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 beable to	Blooms Taxonomy
CO1	Define and describe mass transfer operations with rate of mass transfer	Remember
CO2	Identify and differentiate various mass transfer operations for selection	Understand
CO3	Use knowledge of mass transfer operations for designing contacting equipment with optimizing parameter	Apply
CO4	Relate mechanism of distillation,extraction,leaching,drying,crystallization with designing stages and height of packed tower	Analyze
CO5	Select the specific operation contacting equipment and its design considerations	Evaluate
CO6	Investigate the problems related to mass transfer operations	Create

Description:

To able to design equipment for mass transfer operations, the rate equations are important which can be utilized for optimization concept.

Concept of steady state & unsteady state diffusional operations studied for controlling parameters in actual industrial process.

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:	Knowledge of chemistry, applied maths,physics
	2:	Knowledge of process calculations,material and energy balance, thermodynamics for equillibrium
	3:	Knowledge of fluid mechanics for convective transfer

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 columnby McCabe Thiele method, Ponchon Savarit method, Lewis –Sorrel method, Lewis Matheson, Transfer unit Concept in Packed Column Design.	**10Hrs.**
Unit 2	**Liquid–Liquid Extraction:**	
	Liquid Equilibrium, coordinate systems, cross and counter current operation and its calculation, selection of extractors, Extraction Equipment	**6 Hrs.**
Unit 3	**Leaching:**	
	Leaching Principles, Various Types ofLeaching Operations with application, Methodof Calculations, Leaching equipment.	**6 Hrs.**
Section – II		
Unit 4	**Humidification:**	
	Application of Humidification, Study of Adiabatic Saturation Curve, Humidifier height calculations, definition of wet bulb ,dry bulb and equation for wet bulb depression, Percentage saturation , Percentage Humidity, Water cooling towers, Spray chamber, Evaporative Cooler.	**6 Hrs.**
Unit 5	**Drying:**	
	Theory and Mechanism of Drying, Steady and Unsteady Drying,Definition of moisture content, total time of drying, length of continuous dryer, Material and Enthalpy balance in dryer, Classification and selectionof Industrial dryers.	**7 Hrs.**
Unit 6	**Crystallization:**	
	Nucleation, Crystal Growth, Methods of super saturation, Overall and Individual Growth coefficient, material and enthalpy balance of crystallizer, The Law of Crystal Growth Crystallization Equipment.	**5 Hrs.**

List of Practicals:- Any 08 Experiments are to be conducted from the following

1. Simple Distillation.
2. Packed column distillation
3. Steam distillation.
4. Tray dryer
5. Single stage & Three stage Extraction
6. Cross current leaching.
7. Counter current leaching.
8. Humidification & Dehumidification
9. Spray Dryer
10. Rotary dryer.
11. Packed column Extraction
12. Cooling Tower

Mapping of POs & COs:

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

References:

Text Books	
1	Robert E. Treybal, "Mass Transfer Operations", Third Edition, McGraw Hill, 1980.
2	Richardson & Coulson, "Chemical Engineering", Vol. 2, Pergamon Press, 1970.
Reference Books	
1	McCabe and Smith, "Unit Operation of Chemical Engineering", 5th Edition McGrawHill, Kogakusha Ltd.,1998.
2	C. J Geankolis, Transport Processes and unit operations, 3rd Edition, Prentice hall, India,1993.
3	B.K Datta, Principles of mass transfer & separation process.
4	K. D Patil, Mass Transfer Operation Vol. I & II.

Web Links/ Video Lectures are to be provided to Theory and Practical /Experiments Lectures:

PCC-CHE -603 PROCESS DYNAMICS & CONTROL

Teaching Scheme			Evaluation Scheme		
Lectures	:	3 hrs per week	**ISE**	:	40 Marks
Credits	:	3	**ESE**	:	60 Marks
Practicals	:	2 hrs 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

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 beable to	Blooms Taxonomy
CO1	remember Laplace transform and to understand and model the dynamicbehavior of chemical processes based on their time domain, Laplace domain	Remember
CO2	understand basic fundamentals of first and second order process dynamics and its behavior	Understanding
CO3	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
CO4	evaluate different parameters affecting on the overall transfer function and response of process control system.	Evaluating
CO5	understand stability characteristics for design of process control systems & analyze the frequency response of the control system	Analyzing
CO6	develop the practical skill, team work and ethical thinking to choose right career in allied industries or higher studies	Creating

Description:

The students completing this course are expected to understand the basic principles and problems involved in process control. They are expected to understand dynamic behavior of different order systems with examples and response to various forcing functions. They are able to understand design aspects of process control system, block diagram preparation, various types of controllers and there selection for particular application. 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		
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.	**5 hrs**
Unit 2	**Dynamic Behavior of First Order & Higher Order: Second 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 linearsystem, Response of first order system in series, Non interacting system, Interacting system, examples, second order systems, U tube manometer, , step response for second order systems, terms used to describe second order under damped system, Transportation lag, examples	**8 hrs**
Unit 3	**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	**10 hrs**
Section – II		
Unit 4	**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, PIcontroller for change in set point & load point, examples.	**7 hrs**
Unit 5	**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.	**8 hrs**
Unit 6	**Frequency Response Analysis of Linear Processes**	
	Substitution rule, The Response of a First-Order System to a. Sinusoidal input, Bode diagrams, Rules, Bode plot for a first order system, second order system, Transportation lag., Control of Heat Exchanger/Distillation Column. Microprocessor based controller and distributed control Background, Hardware components, Tasks of a microprocessor based controllers, Distributed control system , PLC.	**8 hrs**

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 converter.
9. Study of Level Transmitter.
10. Study of Pressure Transmitter.
11. Control of temp control 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	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

PCC-CHE -604 CHEMICAL REACTION ENGINEERING - II

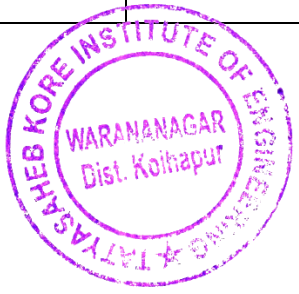
Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3 hrs per week	**ISE**	**:**	40 Marks
Credits	**:**	3	**ESE**	**:**	60 Marks
Practical	**:**	2 hrs per week	**ISA**	**:**	25 Marks
Tutorial	:	1 hrs per Batch	**POE**	**:**	25 Marks
Credits	:	1			
Total Credits	**:**	4	**Total Marks**	**:**	150 Marks

Course Objectives: The objective of the course is to

1.The course focuses on non-deal flow and finding of conversion in actual reactors from experiment and different models for finding non ideality in reactors.
2.The course focuses on mixing of fluids, macro fluid concepts and Turbulent Mixing with chemical reaction in stirred tanks.
3.The course develops understanding of heterogeneous solid catalyst, iotherms, different industrial terms related to solid catalyst & finding different characteristics of solid catalysts with its recent trends.
4.The course develops understandings & 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 catalyst & also describe design. Scale up in reactor.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Apply knowledge of non-ideal flow and will find conversion in actual reactors from experiment and different models for finding non ideality in reactors.	Apply
CO2	Express basic concepts of mixing of fluids, macro fluid and Turbulent mixing with chemical reaction in Stirred Tanks.	Understand, Analyse
CO3	Express working of catalyst & understand industrial terms related to solid catalyst & find different characteristics of solid catalyst with its recent trends.	Understand, Analyse
CO4	Explain underline principles, understanding & designing of fluid particle reactions with different models for it.	Create
CO5	Understand fluid-fluid reaction, its design and applications of fluid-fluid reactions rate equation to equipment design.	Create
CO6	Explain underline basic concepts, important parameters. Mechanism, applications of catalyst with different catalytic reactors and deactivating catalyst & also described scale up in reactor recent.	Evaluate



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: conversion in reactors having non ideal flow; TheResidence 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 Models for predicting conversion from RTD data: One Parameter: Dispersion model, Tank in Series model, Introduction to Multi parameter model	**7 Hrs.**
Unit 2	**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.	**4 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	**Solid Catalyzed Reactions:**	
	Introduction, Rate equation, Film resistance controlling, surface flow controlling. Pure diffusion controlling, Heat effects during reaction, Experimental methods for finding rates, 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 **Deactivating catalysts:** Types of Deactivation, Mechanism of deactivation, Rate equation for deactivation, Regeneration of catalyst **Introduction To Scale-Up in Reactor Design:**	**9 Hrs.**
Unit 5	**Fluid Particle Reactions (Non Catalytic) :**	
	Selection of a model for gas-solid reactions Un-reacted core andShrinking core model, Rate controlling resistances, Determination of the rate controlling steps, Application of models to design problems.	5 Hrs.
Unit 6	**Fluid - Fluid Reaction :**	

	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.	**5 Hrs.**

List of Practical's:-

1) 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 reactor in series.
5) Residence time distribution studies in structures and coils.
6) RTD Studies on packed bed reactor.
7) Determination Surface area of catalysts
8) Determination Pore volume of catalysts
9) Determination of bulk density, apparent density, and true density of catalyst.
10) Studies on general liquid reactions
11) Synthesis of Catalyst

Note: Experimental calculations & graphs by using software's 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	1	-	-	-	-	2	2	1	1	1	2
CO2	3	2	2	3	1	-	-	-	-	2	2	1	1	1	2
CO3	3	2	1	3	2	-	-	-	-	2	2	1	1	1	2
CO4	3	3	3	1	2	-	-	-	-	2	2	1	1	1	2
CO5	3	3	2	3	2	-	-	1	-	2	2	1	1	1	2
CO6	3	2	3	3	2	-	-	1	-	2	2	1	1	1	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.
3	J. M. Smith, "Chemical Engineering Kinetics", McGraw Hill, New York.
Reference Books	
1	T.T. Carbery, —Chemical and Catalytic reaction Engineering‖, McGrawHill, New York - 2001.
2	S. M. - Modeling of Chemical Kinetics and Reactor Design, A. Kayode Coker, Gulf Publishing House New Delhi
3	Chemical Reactor Design, Peter Harriot Marcel Dekker, Inc. New York
4	Chemical Engineering, Vol. III, Pergamon Press, Oxford, 1989.
5	Introduction to Chemical Reaction Engineering and Kinetics, Ronald W. Missen Charles A. Mims Bradley A. Saville *John Wiley & Sons, Inc.*
6	Chemical Reactor Design Optimization and Scaleup, E. Bruce NaumanMcGrawHill, New York - 2001.

Web Links/ Video Lectures are to be provided to Theory and Practical /ExperimentsLectures:

OEC-CHE -605 INDUSTRIAL ECONOMICS, MANAGEMENT AND ENTREPRENEURSHIP

Elective – II

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

Course Objectives:

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

Course Outcomes:

Cos	At the end of successful completion of the course the student will beable to	Blooms Taxonomy
CO1	Define basic models of behavior of firms and industrial organizations.	Define
CO2	Demonstrate the basic models of industrial economics.	Demonstrate
CO3	Solve analytical problems relating to industrial economics.	Solve
CO4	Analyze the models to important policy areas and under the limitations of different behavioral theories.	Analyze
CO5	Compare the effective utilization of resource materials and chemical processes.	Compare
CO6	Modify the present industrial economics, management status and forecast it with the improved feature.	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**	
	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.	**5 hrs**
Unit 2	**National Income Inflation**	
	Concept of national income, estimation of national income, difficulties in measurement of national income, uses of national income figure.	**8 hrs**
Unit 3	**Inflation**	
	Inflation meaning, types of inflation, causes, effects, control of inflation, Business/Trade cycles, phases of business cycles, Classification, theory, control of Business Cycle.	**5hrs**
Section – II		
Unit 4	**Principles of Management**	
	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.	**7 hrs**
Unit 5	**Entrepreneurship Development (ED)**	
	Modern concept of Entrepreneur, Classification of Entrepreneurs , Awareness of ED, EDP -Training design , Development of Women Entrepreneurs.	**7hrs**
Unit 6	**Small Scale Industries(SSI)**	
	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.	**4 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			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

Web Links/ Video Lectures are to be provided to Theory and Practical /ExperimentsLectures:

OEC-CHE -605 PROJECT MANAGEMENT AND SMART TECHNOLOGY

Elective - II

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3 hrs per week	**ISE**	**:**	40 Marks .
Credits	**:**	2	**ESE**	**:**	60 Marks .
Tutorial	**:**	1 hrs per Batch	**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 basic concepts project management and application of PM to process industries
2. To understand project feasibility reports and learn about various clearances required to start an industry
3. To learn various project organizations and basics of contracting
4. To learn various tools and techniques used in PM.

Course Outcomes:

Cos	At the end of successful completion of the course the student will beable to	Blooms Taxonomy
CO1	Concepts and knowledge of project management to manage projects inprocess industries	Knowledge
CO2	Prepare feasibility reports.	Prepare
CO3	Understand various clearances required to start industry	Understand
CO4	Prepare project organization charts and contracts	Prepare
CO5	Prepare contracts	Prepare
CO6	Use tools of PM to solve problems	Use

Description:

It is basic introductory course for different skills required in project management ,implementation ofproject work

Prerequisites:	1:	

Section – I		
Unit 1	**Concepts of project management:**	
	Definition of project, project management, project types, project life cycle: purpose, inputs, project manager's role and outputs, Tools and techniques in project management, major knowledge areas of project management , Difference between project management and formal management, Role-responsibilities and skills of project manager, project overruns . Project management in process industries: project strategy, project specification, project engineering, detailed design, procurement, construction, commissioning and closure	**5 hrs**
Unit 2	**Project:**	
	Conception to commissioning , mile stones, project executions conglomeration of technical and non technical activities, Contract:meaning , contents, types of contracts , lumpsum turnkey (LSTK), Engineering procurement and construction(EPC) , Engineering procurement and construction management(EPCM), Mergers and acquisitions, **Legislation:** Intellectual Property Rights (IPR), Patents, trade marks , copy rights, Features of factories act 1948 with amendment (only salient points) .Features of payment of wages act 1936 (only salient points)	**8 hrs**
Unit 3	**Feasibility report, licensing and clearances**	
	Feasibility reports: Raw material survey, Market survey and demand study, technical study, location survey, financial survey and types of cost estimates, Estimation of project profitability Industrial license and LOI, Various laws & regulations governing industries, need for clearances and influences on project, List of various clearances. PESTLE analysis	**5 hrs**
Section – II		
Unit 4	**Project organization and contracting**	
	Project scope, project priorities, development of WBS, Development of process breakdown structure, Development of responsibility matrix, development of project communication plan. The traditional management structure, Project management organizational structure: pure project, matrix, task force, Project team, responsibilities of various members. Contracts types, selection criteria,3R of contracting, types of reimbursements and tendering procedure	**7 hrs**
Unit 5	**Tools and techniques in project Management:**	
	Health-safety and environmental guidelines for chemical plants Quality assurance, Hazard analysis, Risk analysis and management, Change Management. Cost benefit analysis, Project execution plan (PEP), Bar charts/GANTT charts, LOB, Networking techniques (PERT/CPM), Productivity budgeting techniques, Value engineering (VE) , ABC and VED Analysis , Economic Order Quantity (EOQ), CAT vs. RAT, Time and cost control tools and techniques.	**7 hrs**
Unit 6	**Smart Technology:**	
	Use of Microsoft projects: Use of Microsoft projects: start your plan, adding resources to the model, resources management and crashing, resources rates and using calendars, handling multiple projects, uncertain activity times, , tracking,base line and reports.	**4 hrs**

Mapping of POs & COs:

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

References:

Text Books	
1	Project Management, Choudhary, S., Tata McGraw Hill(module 1 to 4)
2	Total Project Management, Joy, P. K.,(module 1 and 2)
3	Project Management for process Industries, Gillian Lawson, I chem. E(Module 1 and 4)
4	Project Management Case Studies, Harold Kerzner, Second edition, John Wiley and Sons (for case studies)
Reference Books	
1	Project Management Methodology Guidelines, City of Chandler (Module 1)
2	Project Management-The Managerial Process, Clifford Gray, 6th edition, McGraw Hill (module 1, 2, 3)
3	Plant Design and Economics for Chemical Engineers, Klaus D Timmerhaus, 5th edition, McGraw Hill (Module 2 and 4)
4	Chemical Process Economics, Mahajani V.V.& Mokashi .M.
5	Process Plant and Equipment Cost estimation by Kharbanda O.P.
6	Project Management by K. Nagrajan, New Age International 2004
7	Internet of Things by Jeeva Jose, Khanna Publications ,New Delhi
8	.https://www.fundable.com/learn/resorces/guides/startup

ESC-CHE-606 P PROCESS SIMULATION LABORATORY

Teaching Scheme			Evaluation Scheme		
Lectures	:	1 hrs per Batch	**ISE**	:	---
Credits	:	--	**ESE**	:	---
Practical	:	2 hrs per Batch	**ISA**	:	50 Marks
Credits	:	1	**POE**	:	---
Total Credits	:	1	**Total Marks**	:	50 Marks

Course Objectives: The objective of the course is to

1. Introduce the students the Basic concept in Material and Energy Balance.
2. Introduce the different techniques to find optimum pipe diameter
3. Determine the Optimum Insulation thickness for Heat Exchangers & Determination of Optimum Reflux

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Implement basic engineering knowledge to solve problems	
CO2	Understand ,Plan and Execute a chemical processes problems	
CO3	write algorithm for the processs problems	
CO4	Use commercial simulation tool like MATLAB,Scilab,Chemsep to solve chemical engg. problems	

Description:

This course is a study of Material balances for mixing of multiple streams .The students completing this course are expected to understand the Estimation of Optimum Pipe Diameter, Determination of flow rates in branched Sections, Determination of Average velocity from velocity profiles .The students are expected to estimate Optimum insulation thickness for Heat exchangers, and Optimum Reflux .

Prerequisites:	1:	Knowledge of process calculations, material and energy balance, thermodynamics for equillibrium
	2:	Knowledge of chemistry, applied maths , physics
	3:	Chemical Engineering Thermodynamics-I, Computer Programming in C++

Section – I		
Unit 1	**Material Balances for Mixing of Multiple Streams:**	
	Recycling of a multi component Stream without chemical reactions; Curve fitting examples; Specific heats, Vapor pressure, PVT Equations.	**3 hrs**
Unit 2	**Estimation of Pipe Diameter by Trial and Error:**	
	Optimum Pipe Diameter, Determination of flow rates in branched Sections, Determination of Average velocity from velocity profiles	**3 hrs**
Unit 3	**Optimum Insulation Thickness:**	
	Optimum outlet temperature for Heat exchangers, Optimum diameter of Heat exchanger tubes, design of multiple effectevaporators.	**3 hrs**
Section – II		
Unit 4	**Determination of Optimum Reflux:**	
	Product compositions / Temperatures / Flow Rates / Pressures in Multi component flash Distillation, Number of Theoretical stages by McCabeThiele and other methods.	**3 hrs**

List of Practicals:-

Practical's are to be performed using C++ Programming Language , Scilab/Matlab OR Performthe experiments on Open source software

1. Write and execute computer program to find specific heat and vapor pressure.
2. Write and execute computer program to find optimum diameter of pipe.
3. Write and execute computer program to determine flow rates and average velocity.
4. Write and execute computer program to find optimum insulation and optimum temperature for heat exchanger.
5. Write and execute computer program to design a heat exchanger.
6. Write and execute computer program to design multi effect evaporator.
7. Write and execute computer program to find optimum reflux, product composition in distillation.
8. Write and execute computer program to find number of theoretical stages by any method.
9. Write and execute computer program to find mass balance in continuous stirred tank reactor.
10. Write and execute computer program to find the length of a packed bed heat exchanger

Mapping of POs & COs:

	PO1	PO22	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	If applicable		
													PSO1	PSO2	PSO3
CO1	**2**	1	2	2	1									2	2
CO2	3	2	1	1	1								2		
CO3	2	2	2	2	3									3	
CO4	1	1	2	1	2										1

References:

Text Books	
1	Robert E. Treybal, "Mass Transfer Operations", Third Edition, McGraw Hill,1980.
Reference Books	
1	Octave Levenspeil, "Chemical Reaction Engineering", 2nd Edition, John Wiley, London.
2	S. M. Walas, "Reaction Kinetics for Chemical Engineers" McGraw Hill, NewYork.
3	Peter Harriott, "Process Control", Tata McGraw Hill, New Delhi,1977.
4	B. C. Bhattacharya, "Introduction to chemical equipment design"1985.
5	Bansal A.K. ,Goel .M.K. ,Sharma ,"MATLAB and its application in engineering ",Person education,2012.

Web Links/ Video Lectures are to be provided to Theory and Practical /Experiments Lectures:

CHE -607 P INDUSTRIAL PRACTICES AND CASE STUDIES

Teaching Scheme		Evaluation Scheme	
Lectures	: ---	**ISE**	: ------
Credits	: ---	**ESE**	: ------
Practicals	: 2 hrs per Batch	**ISA**	: 50 Marks
Credits	: 1	**POE**	: ------
Total Credits	: 1	**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 beable 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 industrylike Design , Research , Processing , Production, Market and Demand.	Describe
CO3	Opportunities for Employment and Self-Employment in thechemical sector after graduation.	Opportunities
CO4	Acquire through P & ID"s basic information of sources of rawmaterials, products , by- products of production activities andwhere they can be used.	Acquire
CO5	Understand how industrial establishments are administered.	Understand
CO6	Know the Battery limits, Offsite facilities and the Overall Safety procedures.	Know

Description:

MIDC, Industry, Industry manual, MSDS, Administrative setup, Organization structure, Setup ofindustry, 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:	Student 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)** of 50 marks will be done on the basis of 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 IndustryRaw 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 invisited 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 andinflammable chemicals, highly radioactive materials, Safe handling & operation of materials, .Planning & layout.	2 Pages
Unit 5		
	Causes of Industrial Accidents and Remedial measures Taken inVisited 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.	3 Pages
Unit 6		
	P & I Diagram at least for any one plant, which they have visited, should be drawn and Xerox of group colored photo of each industrial visit including company name.	Flow sheet

List of Industrial Interactions

In-House Local Industries:(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.C. :(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	1					1		1				3			
CO2	1	1		2	1	1		1	2		2	2	2		
CO3								2	1	2		3			1
CO4	2	1	1	2	1	3			2	2	1	1	1	1	
CO5							1	3	3	3	3	3			
CO6	1		2			2	2					1		2	

CHE 608A AUDIT COURSE –IV

Teaching Scheme		Evaluation Scheme	
Practicals	: --	Audit points	: --
Credits	: Non credit		:

Instruction for audit course
Anyone Extracurricular Activity Participation such as a sport / Cultural / Social etc. Student is require to complete / Participate / Attend anyone extracurricular activities (Sport / Cultural / Social) earning Semester VI and students are required to submit a detail activity report.
Activities :
1) Sport – Any sport activity in Zonal / Interzonal /University 2) Cultural – Any cultural activity at Institute / University / Zonal level such as Annual Social Function / Youth Festival / Drama Activity / Elocution / Indian Traditional Art / LiteracyActivities 3) Social – NSS Camps / NCC / Medical Camp / Social Diff Activities

Member Secretary **Board of Studies**	**Chairman** **Board of Studies**	**Academic Dean** **T.K.I.E.T, Warananagar**	**Principal** **T.K.I.E.T, Warananagar**

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Autonomous Institute
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Seal of Institute