An Autonomous Institute

Shree Warana Vibhag Shikshan Mandal's

Tatyasaheb Kore Institute of Engineering And Technology, Warananagar

NBA Accredited Institute

Department of Chemical Engineering

S. Y. B. Tech. Chemical Engineering

2021-22

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-SemesterExamination-II
4	ESE	End Semester Examination
5	ISA	In-Semester Assessment (Term Work)
6	L	Lecture
7	T	Tutorial
8	P	Practical
9	CH	ContactHours
10	C	Credit

Course/ Subject Categories

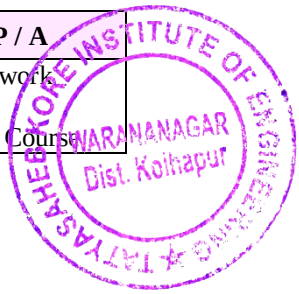
Sr.No.	Acronym	Definition
1	BSC	Basic Science Course
2	ESC	Engineering Science Course
3	PCC	Professional Core Course

Course/ Subject Code

CH	E	3	0	1
Branch Code		Semester	Course Number	

Course Term work and POE Code

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



Second Year B. Tech. In Chemical Engineering

Syllabus Structure under Autonomous Status of TKIET, Warananagar

2021-22

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Second Year B.Tech.(Chemical Engineering)

Semester-III

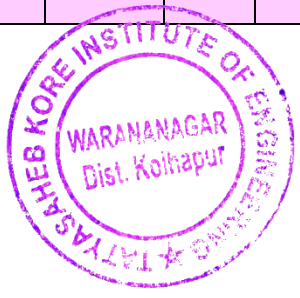
(To be implemented from 2021 - 22)

Credit Scheme

Course Code	Category	Course Title	Teaching and Credit Scheme					Examination & Evaluation Scheme			
			L	T	P	CH	C	Component	Marks	Min for Passing	
CHE301	BSC	Engineering Mathematics III	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE302	BSC	Advanced Chemistry	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE303	PCC	Material Science & Engineering	3*	--	--	2	3	ESE	60	24	40
								ISE	40	16	
CHE304	PCC	Fluid Mechanics	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE305	PCC	Mechanical Operations	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE301T	BSC	Engineering Mathematics III	--	1	--	1	1	ISA	25	10	10
CHE303P	PCC	Material Science & Engineering	--	--	2	1	2	ISA	25	10	10
CHE306P	ESC	Computer Programming (C++)	1*	--	2	1	3	ISA	50	20	20
CHE302P	BSC	Advanced Chemistry	--	--	2	1	2	ISA	50	20	20
								POE	50	20	20
CHE304P	PCC	Fluid Mechanics	--	--	2	1	2	ISA	25	10	10
								POE	25	10	10
CHE305P	PCC	Mechanical Operations	--	--	2	1	2	ISA	25	10	10
								POE	25	10	10
CHE307A	--	Audit Course – III (Environmental Studies)	--	--	--	--	--	--	--	--	--
			16	1	10	20	27	--	800	--	--

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

*indicates the extra lectures provided for the course.



Second Year B. Tech. (Chemical Engineering)

Third Semester Detailed Syllabus

BSC-CHE -301 ENGINEERING MATHEMATICS -III

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.
Credits	**:**	1	**POE**	**:**	NA
Total Credits	**:**	4	**Total Marks**	**:**	125 Marks.

Course Objectives: The objective of the course is to

1. Develop mathematical skills and enhance thinking power of students.
2. Give the knowledge to the students of Linear Differential Equations and its Applications, Laplace transforms, Inverse Laplace Transform, Probability, Numerical Differentiation with an emphasis on the application of solving engineering problems.
3. Prepare students to formulate a mathematical model using Engineering skills & interpret the solution in real world.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Solve Linear Differential equations with constant coefficient	Understanding
CO2	Make use of Linear Differential Equations to solve the chemical engineering problems.	Application
CO3	Solve basic problems in probability theory, including problems involving the binomial, Poisson, and normal distributions.	Applying
CO4	Solve differential equation Numerically.	Understanding
CO5	Find Laplace transforms of given functions.	Understanding
CO6	Use Laplace transform to solve linear differential equations.	Understanding Application

Description:

Engineering Mathematics course is offered as the basic science course. This course contains Mathematical methods and techniques that are typically used in engineering to solve engineering problems. This course has six units namely i) Linear Differential Equations(LDE), ii) Application to Linear differential equations, iii) Probability Distribution, iv) Numerical Differentiation, v)Laplace Transformand vi) Inverse Laplace Transform and its Applications.

Prerequisites	1:	Trigonometric identities and Logarithmic identities
	2:	Differentiation and integration formulae
	3:	Basic knowledge of probability.

Section – I		
Unit 1	**Linear Differential Equations**	
	1.1 Linear Differential equations with constant coefficients. 1.2 Rules to find complementary function. 1.3 Methods to find particular Integral(e^{ax}, or,x^m,$e^{ax}x^m$,$e^{ax}sinax$or$e^{ax}cosax$) 1.4 Cauchy's homogenous linear equation.	**7 Hrs**
Unit 2	**Application to Linear Differential Equations**	
	2.1 System of simultaneous Linear differential with constant coefficients 2.2 Chemical reactions and solutions (mixture problems). 2.3 Conduction of heat. 2.4 Chemical Reactions-Law of mass action	**7 Hrs**
Unit 3	**Probability Distribution**	
	3.1 Random variables. 3.2 Discrete Probability distribution. 3.3 Continuous probability distribution. 3.4 Binomial Distribution. 3.5 Poisson Distribution. 3.6 Normal Distribution	**7 Hrs**
Section – II		
Unit 4	**Numerical Differentiation**	
	4.1 Definition 4.2 Numerical differential by using 4.2.1 Newton's forward difference interpolation formula 4.2.2 Newton's backward difference interpolation formula 4.2.3 Sterling's central difference interpolation formula 4.2.4 Newton's divided difference formula	**7 Hrs**
Unit 5	**Laplace Transform**	
	5.1 Laplace transform of elementary functions 5.2 Properties of Laplace transforms 5.2.1 Linearity Property 5.2.2 First Shifting property 5.2.3 Change of scale property 5.3 Laplace transforms of derivatives and integral. 5.4 Multiplication by t^n and division by t 5.5 Evaluation of integrals by Laplace transform.	**7 Hrs**
Unit 6	**Inverse Laplace Transform and its Applications**	
	6.1 Definition and important formulae 6.2 First shifting property 6.3 Inverse Laplace transform by method of partial fraction 6.4 Convolution theorem (without proof) 6.5 Inverse Laplace transform of derivatives 6.6 Solution of Linear differential equation with constant coefficients using Laplace transform	**7 Hrs**

Mapping of POs & COs:

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

References:

Text Books	
1	Higher Engineering Mathematics, Dr. B. S. Grewal, S. Chand and Company, 40th Edition.
Reference Books	
1	Advanced Engineering Mathematics", H. K. Das, S. Chand Publication, 8th Edition.
2	A Text Book of Applied Mathematics",Vol. I and II, P. N.Wartikar and J. N. Wartikar, Vidyarthi Griha Prakashan, Pune.
3	A textbook of Engineering Mathematics, N. P. Bali, Iyengar, Laxmi Publications (P) Ltd, New Delhi
4	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley India Pvt. Ltd
Web Links/ Video Lectures	
1	https://youtu.be/XU5hUrh6-18
2	https://youtu.be/7C0FXgj6P3Q
3	https://youtu.be/2CP3m3EgL1Q

BSC-CHE-302 ADVANCED CHEMISTRY

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3 hrs per week	**ISE**	**:**	40 Marks.
Credits	**:**	3	**ESE**	**:**	60 Marks.
Practicals	**:**	2 hrs /Batch/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. Provide introduction of solvents in chemical reactions
2. To develop awareness of industrially importance of organic reactions and provide knowledge and concepts of heterocyclic compound.
3. Provide basic understanding of solutions and concentration terms.

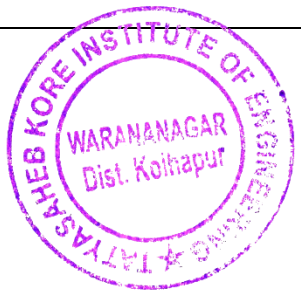
Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	Apply & understand the knowledge of solvents in chemical reactions.	Apply
CO2	Define & apply terms to express concentrations for Nernst and Henry ‘s law .	Apply
CO3	Describe and explain types of Chemical bonding ,Electrochemistry and terms involved in Surface Chemistry	Understand
CO4	Analyze and understand Reactive Intermediates and Types of Organic Reactions	Analyze
CO5	Explain and classify heterocyclic compounds.	Understand
CO6	Interpret multidisciplinary nature of Biochemistry and Implement Nature bio molecules.	Understand

Description:

This course aims to impart fundamental knowledge of Solvents and solutions, and applied knowledge of electrochemistry, analysis of chemical compounds, types of organic reactions and reactive intermediates, and functions of various bio molecules. Students will be expected to communicate knowledge to society and industry.

Prerequisites:	1:	Students should have knowledge about basic chemistry related to electrochemistry and Solvents and solutions.
	2:	Periodic table physical and chemical properties of elements
	3:	Applications of different bio molecules.



Section – I		
Unit 1	**Solvents:**	
	1.1 Introduction, Importance of solvents in chemical reactions, 1.2 Water as universal solvent, Classification of solvents, 1.3. Characteristic properties of solvents 1.3.1 (M.P., B.P., Heat of fusion) 1.3.2 and vaporization, Dielectric constant 1.4 Study of few important non aqueous solvents such as Liquid NH3, 1.5 Liquid HF w.r.t. solvent characters and reactions.	**6 Hrs**
Unit 2	**Solution:**	
	2.1 Defination, types, ways of expressing concentration (Normality , Moarity, Molality,Mole fraction), 2.2. Numericals, 2.3 Solutions of gasses in gasses, Henry's law, 2.4 Nernst distribution law- statement, explanation, limitations and applications. 2.5 Numericals	**6 Hrs**
Unit 3	**Surface Chemistry and Chemical Bonding**:	
	3.1 Introduction, types of chemical bonding . 3.1.1Chemical bonding and Molecular structure 3.1.2 And their impact on the properties 3.2. Electrochemistry and industrial applications. 3.3 Surface Chemistry :- Introduction, 3.3.1 Suspensions, 3.3.2 Coagulations, 3.3.3 Emulsions, 3.3.4 Dispersions there difference and applications	**7 Hrs**
Section – II		
Unit 4	**Organic Reactions & Reactive Intermediates:**	
	4.1 **Types of Organic Reactions:** 4.1.1 Addition, 4.1.2 Substitution, 4.1.3 Elimination, 4.1.4 Rearrangement 4.2 Reactive Intermediates: 4.2.1 Carbocation, 4.2.2 Carbanion, 4.2.3 Carbon Free Radicals 4.2.4 Carbenes – their formation, structure & stability. 4.3 Reactions involving formation of reaction intermediates 4.3.1 Carbocation : Friedal Craft's reactions. 4.3.2 Carbanion : Aldol condensation reaction. 4.3.3 Carbenes : Reimer-Tiemann Reaction	**7 Hrs**
Unit 5	**Chemistry of Heterocycles:**	
	5.1 Introduction. 5.2. Classification of Heterocycles, Synthesis, properties and uses of 5.2.1Five Membered Heterocycles : Pyrrole 5.2.2& Furan 5.2.3.Six Membered Heterocycles : Pyridine 5.2.4Condensed Heterocycles : Quinoline	**6 Hrs**
Unit 6	**Introduction to Biochemistry:**	
	6.1 **Chemistry of living cell:-**Cell & cellular constituents and their functions, Various classes of biological molecules & functions. 6.1.1 Introduction, Multidisciplinary nature of Biochemistry, 6.1.2 Structure and composition ofcell,)	**6 Hrs**

	6.2 molecules of life-Biomolecules – 6.2.1 Carbohydrates 6.2.2 Proteins 6.2.3,Lipids 6.2.4 Enzymes.	

PRACTICALS: (Minimum 10 Experiments should performed)

A) Physical Experiments (Two)

1. To determine partition coefficient of Benzoic acid in benzene and water.
2. To determine molecular conditions of Iodine in Carbon tetrachloride and water.

B) Organic Spotting: (Minimum Four) compounds with one must be liquid) Identification of organic compounds such as ,

1. Acidic (Any one) Benzoic Acid, Salicylic acid, Oxalic acid, Acetic acid
2. Phenolic (Any one) α-Naphthol, β-Naphthol, Phenol
3. Basic (Any one) o/m/p-nitroaniline, Aniline
4. Neutral (Any two) Ethanol, Acetone, Acetamide, Benzamide, Acetanilide, Glucose. Naphthalene

C) Inorganic Quantitative Analysis: (Any 2)

1. Determination of Percentage purity of FAS (Internal Indicator method)
2. Determination of Mg contents in Talcum powder
3. To Prepare Standard solution of EDTA and to estimate Mg from given dolomite ore solution.
4. Determination of Ca contents in pharmaceutical tablets, ores etc.
5. Determination of % purity of H2SO4, NaOH,NH3.
6. Estimation of Acetic acid in given Vinegar sample B) Instrumental Analysis: (Any 2)
7. Estimation of Copper by colorimetric method
8. Estimation of Iron by colorimetric method
9. Estimation of Nickel by colorimetric method

D) Organic Estimations: (Any 2)

1. To determine the amount of vitamin C that is present in certain commercial food Products by the titration method.
2. Determination of amount of Aspirin in given Pharmaceutical Tablets
3. Estimation of Phenol
4. Estimation of Acetone
5. Estimation of Commercial Oxalic Acid
6. Estimation of Aniline

E) Organic Preparations: (Any 1)

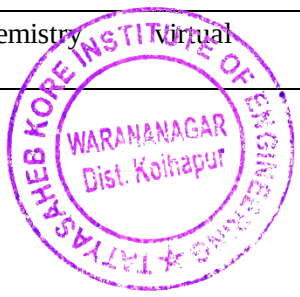
1. Preparation of Aspirin from Salicylic acid
2. Preparation of Phthalic anhydride from Phthalic acid
3. Preparation of Benzoic acid from Benzamide

Mapping of POs & COs:

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

References:

Text Books	
1	Text book of physical chemistry - Gladstone (Macmillan India Ltd.- 1995)
2	Basic Inorganic Chemistry by Cotton & Wilkinson, John Wiley & sons
Reference Books	
1	1. Selected Topics in Inorganic Chemistry by Wahid Malik, G.D.Tuli and R.D. Madan, S. Chand & company, New Delhi,
	2. Concise Inorganic Chemistry by J. D. Lee, ELB
	3. Inorganic Chemistry - A. I. Vogel
2	1. Organic Chemistry – Volume I& II- Finar & Finar (English language book society- 1989)
	2. Organic Chemistry -- Fieser & Fieser
	3. Organic Chemistry -- Bhal & Bhal(S. Chand -2000)
	4. Organic Chemistry -- P.L. Soni (S. Chand -1994)
	5. Organic Reactions and Mechanism – Pitter Sykes (Orient Longman-1986)
3	1. Physical chemistry -- Puri & Sharma (Shobanlal Nagin Chand - 2005)
	2. Essentials of Physical chemistry -- Bhal & Tuli (S. Chand & Co. - 2005)
	3. Principles of Physical chemistry--Prutton & Maron (oxford & IBH Publishing Co. Pvt. Ltd 1972)
Reference Books for Practicals	
4	1. Practical organic chemistry -- A. I. Vogel (CBS-1987)
	2. Laboratory experiments for General, Organic and biochemistry 4th Edition, Bettelheim & Lanesberg
	3. Experiments in applied chemistry –Sunita Rattan (S. K. Kataria & Sons- 2002)
	4. Vogel's Textbook of Quantitative chemical analysis, 5th edition,
Web Links/ Video Lectures	
1	**Experiment Name** - Determination of Viscosity (Lab Name- Viscosity virtual lab) http://vlab.amrita.edu/?sub=2&brch=190&sim=339&cnt=1
2	**Experiment Name-**Water Analysis-Physical Parameter (Lab Name-Inorganic Chemistry virtual lab) http://vlab.amrita.edu/?sub=2&brch=193&sim=575&cnt=1
3	**Experiment Name-**Water Analysis-Chemical Parameter(Lab Name- Inorganic Chemistry virtual lab) http://vlab.amrita.edu/?sub=2&brch=193&sim=1548&cnt=1
4	**Experiment Name-** Acid Base Titration (Lab Name- Inorganic Chemistry virtual lab) http://vlab.amrita.edu/?sub=2&brch=193&sim=352&cnt=1
5	**Experiment Name-** Soil Analysis (Lab Name- Inorganic Chemistry virtual lab) http://vlab.amrita.edu/?sub=2&brch=193&sim=1549&cnt=1
6	**Experiment Name-** Alloy Analysis (Brass) (Lab Name – Inorganic Chemistry virtual lab) http://vlab.amrita.edu/?sub=2&brch=193&sim=1255&cnt=1
7	**Experiment Name –** Spectrophotometry (Physical Chemistry Virtual lab) http://vlab.amrita.edu/?sub=2&brch=190&sim=338&cnt=1



PCC-CHE-303 MATERIAL SCIENCE & ENGINEERING

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3* hrs per week	**ISE**	**:**	40 Marks.
Credits	**:**	2	**ESE**	**:**	60 Marks.
Practicals	**:**	2 hrs /Batch/Week	**ISA**	**:**	25 Marks
Credits	**:**	1	**POE**	**:**	NA
Total Credits	**:**	3	**Total Marks**	**:**	125 Marks.

Course Objectives: The objective of the course is to

1. Learning the principles of material testing and imitation and practice apply them to various engineering programs
2. Understand the basics of metal making - separation and manufacture properties and applications
3. Understand the basics of polymers and composites-separation as well their properties and applications.

Course Outcomes:

Cos	At the end of successful completion of the course the student will be able to	Blooms Taxonomy
CO1	Define Microstructure of the metals with composition	Remember
CO2	Explain the simple phase drawing	Understand
CO3	List the types of failure and explain how you can control them	Apply
CO4	Analyze of stress for cracking	Analyze
CO5	Principles of material testing	Analyze
CO6	Separate the different methods of testing by their machine and their limitations	Evaluate

Description:

This course aims to impart fundamental knowledge of materials, their properties and applications in the field of chemical engineering.

Prerequisites	1:	Engineering mechanics

Section – I		
Unit 1	**Engineering Materials**	
	Engineering Materials: Classification, study of ferrous and non ferrous materials Phase diagrams of steel, brass and cupronickel and the applications of phase diagrams	**7 Hrs**
Unit 2	**Effect of Structure on Properties**	
	Effect of structure on properties: subatomic to macroscopic level Modification and control of material properties	**5 Hrs**
Unit 3	**Materials**	
	Materials: Polymeric materials, Ceramic materials, Composite materials and Smart materials	**6 Hrs**
Section – II		
Unit 4	**Theories of Failure**	
	Theories of Failure: Introduction, Crystal defects, plastic deformation. Types of mechanical failure, fracture , fatigue and creep	**6 Hrs**
Unit 5	**Direct and Bending Stresses**	
	Direct and bending stresses: Introduction, Direct and eccentric loading, limits of eccentricity, core of section for rectangular, circular, section, wind pressure problems on core of the section and stress developed at four corners of section due to eccentric loading	**7 Hrs**
Unit 6	**Introduction to Mechanical Properties of Material**	
	Introduction to Mechanical properties of materials, Criteria for selection of materials in chemical process industry, Materials standards and specifications, Economics in material selection.	**5 Hrs**

PRACTICALS:

1. Micro-analysis of Stainless Steel structure
2. Comparison between Mild Steel and Grey Cast Iron
3. Severity of Quenching
4. Corrosion Assessment in Rebars of RC Structures Using PZT Patches
5. Stress-Strain behaviour in Tensile Testing of Polymer
6. Bending Test on Mild Steel
7. Direct Stress On Mild Steel Rod

Mapping of POs & COs:

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

References

Text Books	
1	The Essence of Materials for Engineers, Robert W. Messler, Jr.
2	Materials Science and Engineering, Raghavan V
Reference Books	
1	Materials Science and Engineering, Van Vlack L.H.
2	Engineering Materials and Applications, Flin R.A., Trojan P.K.
3	Coulson & Richardson 'Chemical Engineering', Volume VI, Pergamen Press .
4	Bhattacharya B.C., 'Selection of materials and fabrication for Chemical Process Equipment, Chemical Engg.', Educational Development Centre, IIT Madras
Web Links/ Video Lectures	
1	

PCC-CHE-304 FLUID MECHANICS

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3 hrs per week	**ISE**	**:**	40 Marks.
Credits	**:**	3	**ESE**	**:**	60 Marks.
Practicals	**:**	2 hrs /Batch/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 purpose of this course is to introduce the undergraduate students with the most important Mechanism of Fluid in the process industry and provide proper understanding of Momentum transfer operations.

Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	Students will learn about Unit systems & Fluid statics with its applications	Remember
CO2	Students will understand the behavior of fluid with Phenomena	Understand
CO3	Student will understand the concept of incompressible fluid, interpret of friction losses.	Apply
CO4	Student will able to recognize the concept of compressible fluid, differentiate the types of flow measuring devices with calculations	Analyze
CO5	Student will able to describe the mechanism of Flow past objects with design parameters.	Understand
CO6	Student will understand the mechanism of Agitation and design calculations.	Understand

Description:

This is one of the most important and fundamental course which deals with fluid behavior in static as well in dynamic phase. The study of all governing laws of fluid flow, flow meters, calculation of friction factor and pressure drop with respect to varying process parameters is included in this course.

Prerequisites	1:	Basic Physics
	2:	Basic Science

Section – I		
Unit 1	**Unit Systems:**	
	Unit systems: Physical quantities, S.I., CGS, FPS Engg. units, Conversion of Units, Units and Equations, dimensional analysis, Application of dimensional analysis, Problems. Fluid statics and its applications: Nature of fluids, Hydrostatic equilibrium, Barometric equation, Hydrostatic equilibrium in centrifugal field, Manometers, Example, U tube	**6 Hrs**
Unit 2	**Fluid Flow Phenomena :**	
	Fluid flow phenomena : Behavior of flowing fluid, Types of flow, Newtonian and non-Newtonian Fluids, viscosity and momentum flux, viscosities of gases and liquids, Turbulence, Reynolds experiment, Flow in boundary layers, Laminar and Turbulent flow in Boundary layers, Boundary layer formation in straight tubes, Boundary layer separation and wake formation Basic equations of fluids flow : Mass balance, mass velocity, momentum balance, Bernoulli's equation without and with friction, kinetic energy correction factor, correction for fluid friction, Pump Bernoulli's equation , Euler's equation, Problems	**7 Hrs**
Unit 3	**Flow of Incompressible Fluids in Conduits and Thin Layers**	
	Flow of incompressible fluids in conduits and thin layers: Shear stress distribution in a cylindrical tube, relation between skin friction and wall shear, the friction factor. Relations between skin friction parameters. Laminar flow in pipes, Laminar flow of Newtonian fluids. Average velocity, kinetic energy correction factor (Derivation), Momentum correction factor (Derivation), Hagen-Poiseullies equation. Turbulent flow in pipes and closed channels. Velocity distribution for turbulent flow, Relations between maximum and average velocities, Effect of roughness, The friction factor chart (Moody's diagram), friction factor in flow through channels of non-circular section, friction from changes in velocity or direction, Effect of fittings and valves, Flow through annuals, Problems.	**7 Hrs**
Section – II		
Unit 4	**Flow of Compressible Fluids:**	
	Flow of compressible fluids: Mach number, continuity equation, Total energy Balance, velocity of sound, ideal gas equations. **Metering of fluids:** Measurement of flowing fluids. Venturimeter, orificemeter, Pitot tube, rotameter, turbine meters, positive displacement meters, magnetic meters: ultrasonic	**6 Hrs**
Unit 5	**Flow Past Immersed Bodies:**	
	Flow past immersed bodies : Drag coefficients of typical shapes, form drag and streamlining, Friction in flow through beds of solids, Erguns equation, Kozeny- Carman equation, Burke Plummer equation, Fluidization, Mechanism of fluidization, minimum fluidization velocity, expansion of -fluidized beds, application of fluidization. (7L	**7 Hrs**
Unit 6	**Agitation of Fluids:**	
	Agitation of fluids: Agitation of liquids, Agitation equipment, flow patterns in agitated vessels, circulation rates, Flow numbers, power consumption, power correlations, power correlations for specific impellers, effect of system geometry and calculations for power	**7 Hrs**

PRACTICALS:

1. Reynold's experiment.
2. Orifice meter.
3. Venturimeter
4. Bernoulli's experiment
5. Flow through annular pipe
6. Flowthrough pipe & pipe fittings.
7. Flow through helical coils
8. Flow through spiral coils
9. Flow through Packed Column
10. Demonstration of – a) Rotameter b) Pitot tube

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		1		2											
CO3	1			3											
CO4		3		1						1					1
CO5	1		2											1	
CO6			3											2	

References:

Text Books	
1	Mc Cabe W.L. and Smith J.C. 'Unit operations of Chemical Engg.' VII ed. Mcgraw Hill Book Co., International ed. 1993
Reference Books	
1	Steeter U.L, 'Fluid Mechanics' V ed. Mc graw Hill Book Co., International Edn.1971.
2	Richardson J.E. and Coulson J.M. Chemical Engg. 3rd ed. Vol. 1 Pergamon Press1985.
3	Miohell B.I. Fluid and Particle Mechanics Pergamon Press 1970.
4	Gupta S.K., Momemtum Transfer Operations, Tata McGraw Hill, 1979.
Web Links/ Video Lectures	
1	

PCC-CHE-305 MECHANICAL OPERATIONS

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3 hrs per week	**ISE**	**:**	40 Marks.
Credits	**:**	3	**ESE**	**:**	60 Marks.
Practicals	**:**	2 hrs /Batch/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.To develop the fundamental/basics of solid phase.
2.To develop the knowledge of Size reduction of solid and screening of solids.
3.To study the mixing and blending of solid-solid and solid-pastes.
4.To study the filtration and sedimentation for solid-liquid separation.
5.To conceive the different solid-gas separation equipments.
6.To conceive the different liquid-solid and solid-solid separation equipments.

Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	Learn fundamentals/basics such as characterization of particles	Remember
CO2	Students will be able to understand the basics of size reduction	Understand
CO3	Students will learn basics of mixing and blending and also learn the principles	Remember
CO4	Students will be able to understand the details of filtration and sedimentation	Understand
CO5	Identify industrial applications and principles	Apply
CO6	Identify industrial applications and principles	Apply

Description:

This course aims to impart fundamental knowledge of Mechanical unit operations course which provides fundamentals of particles. This course focuses on characteristics, properties, storage and settling of solids. Corse provides knowledge of separation of solid-solid, solid-liquid and solid-gas

Prerequisites	1:	Basic science courses

Section – I		
Unit 1	**Properties and Handling of Particulate Solids**	
	Particle characterization, Particle size measuring technologies, Particle size distribution, Mean particle size, Mixed particle sizes and shape, Storage of solids (Bulk and Bin), Angle of repose and angle of friction, Introduction to conveying of solids.	**4 Hrs**
Unit 2	**Size reductions and Screening**	
	Mechanism of size reduction, Energy for size reduction, Crushing laws, Methods of operating crushers, Classification of size reduction equipments, Types of crushing equipment, Factors affecting communication. Screening: Standard test screens, Standards of screen, Screen effectiveness, Comparison of ideal and actual screens, Industrial screening equipment	**12 Hrs**
Unit 3	**Mixing of Solids**	
	The degree of mixing, Rate of mixing, Criteria for mixer effectiveness, Solid-liquid mixing, Solid-Solid mixing.)	**4 Hrs**
Section – II		
Unit 4	**Filtration and Sedimentation**	
	Classification of filtration, Types of filtration, Pressure drop through filter cake, Filter medium resistance, Sp. cake resistance, Washing of cake, Filter media and selection, Compressible filter cakes, , Filtration equipment, Filter press, Vacuum filters, Centrifugal filtration and Filtration calculations, Strainers. Sedimentation: Basic principles, Thickeners, Batch sedimentation test.	**9 Hrs**
Unit 5	**Gas Cleaning**	
	Introduction, Gas cleaning equipment, Gravity separators, Centrifugal separators, Momentum separators, Electrostatic precipitators, Fabric filters, Indusrial applications of each equipment	**3 Hrs**
Unit 6	**Benefaction Process in Chemical Engineering**	
	Jig classification, Heavy medium Separation Wilfiley table.	**4 Hrs**

PRACTICALS:

1. Sieve Analysis
2. Screen Effectiveness
3. Jaw Crusher
4. Ball Mill
5. Batch Sedimentation
6. Beaker Decantation
7. Filter Press
8. Leaf Filter
9. Cyclone Separator

Demonstration of following equipment and include in journal

1. Riffled Table
2. Mineral Jig
3. Forth Flotation

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
CO2	2	2	1	1											1
CO3	2	1	1	1											1
CO4	2	1	1	1											1
CO5	2	1	1	1											1
CO6	2	1	1	1											1

References:

Text Books	
1	Warren McCabe, Julian Smith, Peter Harriott • Unit Operations of Chemical Engg. 7 th edition, Mcgraw Hill International., 2005,
2	C.M.Narayanan, B.C.Bhattacharyya, Mechanical Operations for Chemical Engineers, Computer Aided Analysis, Khanna Publishers.New DELHI
3	J.F.Richardson & J.H.Harker with J.R.Backhurst, coulson & Richardson's, Chemical Engineering, vol 2,1st ed., Pergamon Press.
Reference Books	
1	G.C.Sekhar, unit Operations in Chemical Engineering, Pearson education (Singarore) Pte. Ltd
Web Links/ Video Lectures	
1	

ESC-CHE-306P COMPUTER PROGRAMMING (C++)

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	1* hrs per week	**ISE**	**:**	--
Credits	**:**	--	**ESE**	**:**	--
Practicals	**:**	2 Hrs.	**ISA**	**:**	50 Marks.
Credits	**:**	1	**POE**	**:**	--
Total Credits	**:**	1	**Total Marks**	**:**	50 Marks.

Course Objectives: The objective of the course is to

1.To Understand Introduction to programming languages.
2.To Understand fundamentals of C++ languages.
3.To Understand C++ Programming basics.
4.To Analyze and understand Control Structures.
5.To Apply Arrays and its type.
6.To Analyze and apply Functions.

Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	Understand Introduction to programming languages.	Understand
CO2	Understand fundamentals of C++ languages.	Understand
CO3	Understand C++ Programming basics.	Understand
CO4	Analyze and understand Control Structures.	Analyze
CO5	Use of Arrays and its types.	Apply
CO6	Analyze and apply Functions.	Analyze

Description:

This course aims to impart fundamental knowledge of basics of C++ programming and application of programming to solve chemical engineering problems.

Prerequisites	1:	Basics of Computer organization
	2:	Basic Mathematics
	3:	Basics of C language

Section – I		
Unit 1	**Introduction to C++**	
	Translators , History of C++ , Programming Paradigm.	**2 Hrs**
Unit 2	**Fundamentals of C++**	
	C++ Character Set Identifiers & Keywaords , Data types in C++ , Constants, Variables , Statements , Operators in C++ and types Programs.	**3 Hrs**
Unit 3	**C++ Programming Basics**	
	Input Output statements , Single character Input and Output functions ,Gets and Puts , Manipulator Functions and Programs	**4 Hrs**
Section – II		
Unit 4	**Control Structures**	
	Introduction to control structures, Loop statements, Break statements and programs	**4 Hrs**
Unit 5	**Arrays**	
	Array declarations , Passing array to functions , Sorting array	**4 Hrs**
Unit 6	**Functions**	
	Function definition ,Types of functions , Function Prototypes , Header File , Storage Classes , Introduction of Structure ,Class and Object	**3 Hrs**

PRACTICALS: (Minimum 10 Experiments should performed)

1. Program based on Fundamentals of C++
2. Program based on C++ Programming basic
3. Programs based on Different Control Statements (Any Four)
4. Programs based on Arrays (Any Two)
5. Programs based on Functions (Any Three)
6. Programs based on Structures (Any Two)
7. Programs based on Class and Objects (Any Two)

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	
CO2	2	2			2									2	
CO3	2	2			2									2	
CO4	2	2	2	2	2									2	
CO5	2	2	2	2	2									2	
CO6	2	2	2	2	2									2	

References:

Text Books	
1	Robert Lafore . " Object Oriented Programming in Turbo C++ , Galgotia Publications
Reference Books	
1	R.J.Micheli , " C++ Object Oriented Programming" McMillan London 1993
2	E. Balguruswamy , " Object Oriented Programming in C++ " TaTa McGraw Hill Publishing Company Ltd. New Delhi 1995
3	H.M. Deitel and P.J. Deitel C++ how to program 2 nd edition Prentice hall
Web Links/ Video Lectures	
1	

CHE 307A AUDIT COURSE-III [ENVIRONMENTAL STUDIES]

Teaching Scheme			**Evaluation Scheme**		
Lectures	**:**	2* hrs per week	Audit Point	**:**	2
Credits	**:**	Non-Credit			

Course Objectives: The objective of the course is

The syllabus of Environmental Studies provides an integrated, quantitative and interdisciplinary approach to the study of environmental systems. The students of Engineering undergoing this course would develop a better understanding of human relationships, perceptions and policies towards the environment and focus on design and technology for improving environmental quality. Their exposure to subjects like understanding of earth processes, evaluating alternative energy systems, pollution control and mitigation, natural resource management and the effects of global climate change, shall help the students to bring a systems approach to the analysis of environmental Problems.

Course Outcomes:

COs	**At the end of successful completion of the course, the student will be able to:**	**Bloom's Taxonomy**
CO1	Relate the interdependency of environmental components.	Understand / Apply
CO2	Identify the environmental problems and prevent environmentalpollution	Apply
CO3	Interpret impacts of waste on environmental components.	Analysis
CO4	Analyze environmental change and its social impacts	Analysis

Description:

The Study of Environment is playing important and crucial role for sustainable development of society, particularly to address industrial pollution, living standards and claimant change issues. This course covers essential theory of environment processes and infrastructure for the supply of water, the disposal of waste, and the control of pollution of all kinds.

Prerequisites	1:	Understanding of environment education course.

Practical/Experiment/Tutorial Topic		
Unit 1	**Ecology**	
	Ecosystem, Ecological Pyramids, Food chain, food web, Ecological succession, Natural Resources and Associated Problems. Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources Role of individuals in conservation of natural resources.	**4 Hrs**
Unit 2	**Pollution**	
	Water pollution: causes, effects, control, drinking water quality standards, Arsenic, lead, cadmium, chromium, fluoride contamination & its effects, water treatment, wastewater treatment**.** Air pollution: Causes, effects, control, Air pollution controlling equipments, Air quality standards, National air quality index, vehicular emission, alternative fuels, indoor air pollution, Thermal inversions, Photochemical Smog and Acid Precipitation Noise pollution: Causes, effects, control, noise standards recommended by CPCB, Environmental Protection Act , Air (Prevention and Control ofPollution) Act. Water (Prevention and control of Pollution) Act. WildlifeProtection Act. Forest Conservation Act and International and National efforts for Environmental Protection.	**10 Hrs**
Unit 3	**Waste Management**	
	Solid waste management, biomedical waste management, E waste, plastic waste management, Hazardous waste management, carbon footprint, Recycling of waste, Role of Central Pollution Control Board (CPCB),State Pollution Control Board, Role of NGO‘s	**4 Hrs**
Unit 4	**Social Issues and Environment**	
	Global Warming, Ozone layer depletion, urban problems related to energy, Alternative energy sources, Evolution of Sustainable development: timeline, Evolution of green movements in India, Disaster management: Flood, Earthquakes, Cyclones, Landslides, Draught, Tsunami etc., Swachh Bharat Mission, Role of Information technology in Environment and human health.	**6 Hrs**
Unit 5	**Project Work**	
	Visit to Local Polluted site – Urban/Rural/Industrial/Agricultural Or Study of simple Ecosystems –Ponds, River, Hill slopesOr Preparation of small models or device to resolve the environment problem/issue Project work shall be based on programme	**---**

Mapping of POs & COs:

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

References:

Text Books	
1	Agarwal K.C. ,2001 "Environment Biology" Nidi publications ltd Bikaner.
2	D.K. Asthana ,Meera Astana ,a Textbook of Enviroment studies ,S Chand Publications ,2006
3	S Deswal & A Deswal ,Basic course in environmental studies ,dhanpat rai & co ltd delhi ,second revised ,2009
Reference Books	
1	Eldon D Eagar ,Bradely F Smith "Enviroment science "-a study of inter relationships win c beown publishers 1989
2	Francois Remade,Ecology Of Natural Resourses ,John Wiley And Sons ,2009
3	Robert Leo Smith "Ecology And Field Bilogy "Harper Collins Publishers,1998
4	Gilbert M M Aters ,Introduction to Environment Enginerring and Science ,Prentice Hall International Inc Second Edition
Web Links/ Video Lectures	
1	

Member Secretary
Board of Studies

Chairman
Board of Studies

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

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

Seal of Institute

Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

Second Year B.Tech.(Chemical Engineering)

Semester-IV

(To be implemented from 2021-22)

Credit Scheme

Course Code	Category	Course Title	Teaching and Credit Scheme					Examination & Evaluation Scheme			
			L	T	P	CH	C	Component	Marks	Min for Passing	
CHE401	BSC	Applied Mathematics in Chemical Engg.	3*	--	--	2	3	ESE	60	24	40
								ISE	40	16	
CHE402	BSC	Analytical Chemistry	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE403	PCC	Chemical Process Calculations	3*	--	--	2	3	ESE	60	24	40
								ISE	40	16	
CHE404	PCC	Heat Transfer	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
CHE405	PCC	Chemical Engineering Thermodynamics –I	3*	--	--	2	3	ESE	60	24	40
								ISE	40	16	
CHE401T	BSC	Applied Mathematics in Chemical Engg.	--	1	--	1	1	ISA	25	10	10
CHE403T	PCC	Chemical Process Calculations	--	1	--	1	1	ISA	25	10	10
CHE405T	PCC	Chemical Engineering Thermodynamics –I	--	1	--	1	1	ISA	25	10	10
CHE 406P	ESC	Computing for Engineers	1	--	2	1	3	ISA	75	30	30
CHE402P	BSC	Analytical Chemistry	--	--	2	1	2	ISA	25	10	10
								POE	25	10	10
CHE404P	PCC	Heat Transfer	--	1	2	2	3	ISA	25	10	10
								POE	25	10	10
CHE 407P	PCC	Fluid Moving Machinery	2*	--	2	1	4	ISA	25	10	10
								POE	25	10	10
CHE408A	--	**Audit Course – IV** (General Proficiency (as per the need of Industry depending on Program & no repetition from the course)	--	--	--	--	--	--	-	--	--
			18	4	8	20	30	--	800	--	

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

*indicates the extra lectures provided for the course.

Second Year B. Tech. (Chemical Engineering)

Fourth Semester Detailed Syllabus

BSC-CHE-401 APPLIED MATHEMATICS IN CHEMICAL ENGINEERING

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. Develop mathematical skills and enhance thinking power of students.
2. Give the knowledge to the students of Partial Differential Equations, Partial Differential Equations and its Applications, Numerical Solution of Algebraic and Transcendental Equation**s,** Fourier Series ,Correlation**,** Regression & Curve Fitting, Numerical solution of First and Higher Order ODEs with an emphasis on the application of solving engineering problems.
3. Prepare students to formulate a mathematical model using Engineering skills & interpret the solution in real world.

Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	To equip students with the concepts of partial differential equations and how to solve Partial Differential with different methods	Evaluation
CO2	Study physical phenomena using PDE's (in particular using the heat and wave equations).	Application
CO3	Solve System of Algebraic and Transcendental Equations	Understanding
CO4	To represent Periodic Function by using Fourier Series.	Understanding
CO5	Understand the line of best fit as a tool for summarizing a linear relationship.	Understanding
CO6	Work numerically on the ordinary differential equations using different methods.	Understanding

Description:

Engineering Mathematics course is offered as the basic science course. This course contains Mathematical methods and techniques that are typically used in engineering to solve engineering problems. This course has six units namely i), Partial Differential equations ii)Applications of Partial Differential Equations, iii) Numerical Solution of Algebraic and Transcendental Equations iv) Fourier Series v) Correlation, Regression & Curve Fitting vi)Numerical solution of First and Higher Order ODEs

Prerequisites	1:	Trigonometric identities.
	2:	Differentiation and integration formulae.

Section – I		
Unit 1	**Partial Differential Equations**	
	1.1 Formation of partial differential equation. 1.2 Lagrange's method to solve first order linear partial differential equations 1.3. Standard method to solve first order non-linear partial differential equations of the 1.3.1 Form I f(p,q)=0 1.3.2 form II f(z,p,q)=0 1.3.3 form III f(x,p)=g(y,q) 1.3.4 Clairauts form z= px+qy+f(p,q)	**7 Hrs**
Unit 2	**Applications of Partial Differential Equations**	
	2.1 Classification of Second order Equations 2.2 Method of separation of variables. 2.3 Wave Equation and its solution 2.4 One dimensional heat flow equation 2.5 Solutions of Laplace equations by the Gauss – Seidel iterative method	**7 Hrs**
Unit 3	**Numerical Solution of Algebraic and Transcendental Equations**	
	3.1 Bracketing Methods 3.1.1 Bisection Method 3.1.2 Method of False Position 3.2 Open -end Methods 3.2.1 Secant Method 3.2.2 Iteration Method 3.2.3 Newton- Raphson Method	**7 Hrs**
Section – II		
Unit 4	**Fourier Series**	
	4.1 Introduction 4.2 Definition, Euler's formulae. 4.3 Dirichlet's conditions. 4.4 Change of interval. 4.5 Expansions of odd and even functions. 4.6 Half range series..	**7 Hrs**
Unit 5	**Correlation, Regression & Curve Fitting**	
	5.1 Introduction. 5.2 Lines of regression of bivariate data. 5.3 Fitting of Curves by method of Least-squares: 5.3.1 Fitting of Straight lines. 5.3.2 Fitting of exponential curves. 5.3.3 Fitting of second degree Parabolic curves.	**7 Hrs**
Unit 6	**Numerical solution of First and Higher Order ODEs**	
	6.1 Solution of First order ODE by 6.1.1 Picard's Method 6.1.2 Runge's Method 6.2 Solution of Simultaneous First order ODE by 6.2.1 Picards Methods 6.2.2 Fourth Order Runge – Kutta Method 6.3 Boundary Value Problems by 6.3.1 Finite Difference Method	**7 Hrs**

Mapping of POs & COs:

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

References:

Text Books	
1	Higher Engineering Mathematics, Dr. B. S. Grewal, S. Chand and Company, 40th Edition.
Reference Books	
1	Advanced Engineering Mathematics", H. K. Das, S. Chand Publication, 8th Edition.
2	A Text Book of Applied Mathematics",Vol. I and II, P. N.Wartikar and J. N. Wartikar, VidyarthiGriha Prakashan, Pune.
3	A textbook of Engineering Mathematics, N. P. Bali, Iyengar, Laxmi Publications (P) Ltd, New Delhi
4	Advanced Engineering Mathematics,Erwin Kreyszig, Wiley India Pvt. Ltd
Web Links/ Video Lectures	
1	https://youtu.be/QWcXxdEMiTw
2	https://youtu.be/oYsb4rW2GUU
3	https://youtu.be/LGxE_yZYigI4
4	https://youtu.be/8G5CsTn7pn0
5	https://youtu.be/-NiSN10Y7NA

BSC-CHE-402: ANALYTICAL CHEMISTRY

Course Details:

Teaching Scheme			**Evaluation Scheme**		
Lectures	**:**	3 hrs per week	**ISE**	**:**	40 Marks.
Credits	**:**	3	**ESE**	**:**	60 Marks.
Practical's	**:**	2 hrs /Batch/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. Provide introduction to analytical procedures, Aspects of analysis, preparation of laboratory samples.
2. To develop awareness of environmental monitoring, water, soil, and air quality and BOD COD determination.
3. Provide basic understanding of Instrumental methods, Molecular spectral methods, Thermal methods chromatographic and other separation methods.

Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	Apply & understand the knowledge of Analytical procedures. aspects of analysis	Understand
CO2	Define and classify dyes	Analyze
CO3	Describe and explain types polymerization techniques	Understand and apply
CO4	Analyze and understand spectral methods	Understand
CO5	Understand different separation techniques	Understand
CO6	Explain and classify surfactants	Application

Description:

This course aims to impart fundamental knowledge of hazards and handling of chemicals. and knowledge of applied analysis of water, soil and air. analysis of chemical compounds using instruments, Molecular ,atomic spectral devices, spectral techniques of molecules and atoms. Students will be expected to communicate knowledge to society and industry.

Prerequisites	1:	Students should have knowledge about basic chemistry related to hazards and handling of chemicals
	2:	Sampling preparation, analytical procedures in environmental monitoring.
	3:	Instrumental methods such as Thermal, Atomic and separation methods.

Section – I		
Unit 1	**Analytical Procedure**	
	Introduction, hazards and handling, treatment of waste, good laboratory practices, Errors-types of errors, analytical procedures in environmental monitoring, water, soil and air quality, BOD and COD determinations.	**7 Hrs**
Unit 2	**Chemistry of Dyes**	
	Introduction, qualities of good dye, witt's theory i.e. chromophore-auxochrome theory, colour and chemical constitution, classification of dyes based upon structure and methods of applications, Diazotization and coupling of azo-dyes, synthesis and applications of dyes like methyl orange, malachite green and Alizarin.	**7 Hrs**
Unit 3	**Chemistry of Polymers**	
	Introduction, compounding of plastics, preparation, properties and applications of Teflon, polystyrene, PMMA, Buna rubber, Butyl rubber and Thiokol rubber, silicon rubber, polymerization techniques-bulk, solution, suspension, and emulsion polymerizations.	**7 Hrs**
Section – II		
Unit 4	**Spectral Methods**	
	Spectral methods – UV-Visible, IR and FT-IR Mass spectroscopy. Atomic spectral methods – Atomic emission and Absorption methods Thermal methods – TGA.	**7 Hrs**
Unit 5	**Chromatographic and other Separation Methods**	
	Chromatographic and other separation methods – GC, HPLC , ion exchange and size exclusion chromatography , super critical fluid extraction	**7 Hrs**
Unit 6	**Chemistry of Surfactants**	
	Introduction, types of soaps, structure of soap molecules, cleaning action of soap, saponification and its value, manufacture of soap by modern process. Detergents-types, properties and applications, of varies detergents such as , Non-ionic :- Ethoxylates, Alkoxylates and Cocamide, Anionic detergents DDBS, Cationic detergents-Alkyl ammonium chlorides, Zwitterionic Betaines and amino oxides	**7 Hrs**

Practicals:

Any 10 Experiments are to be conducted from the following

1. Acid-base titration with help of conductometer.
2. Experiment based on Nephelo and turbidity meter.
3. Study of spectrophotometer.
4. Demonstration of HPLC.
5. Measurements of Rl of different liquid samples with Refractometer.
6. Determination of percentage composition with help of Rl measurement.
7. Estimation Of total solids, volatile solids, suspended solids and dissolved solids.
8. Determination of saponification value of given oil sample.
9. Demonstration of super critical solvent extraction.
10. Preparation of methyl orange as azo dye.
11. Preparation of phenol formaldehyde resin.

Mapping of POs & COs:

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

References:

Text Books	
1	D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Fundamentals of Analytical Chemistry
2	J.G. Dick, Analytical Chemistry, R.E. Krieger Pub
3	Environmental Chemistry, A. K. De, Wiley
4	Environmental chemistry; Environmental pollution analysis. S.M.Khopkar.
5	M.S.Creos an dMorr,Environmental Chemical Analysis, American publication (1988).
Reference Books	
1	Instrumental methods of analysis by Chatwal and Anand
2	Garen W.Ewing, Analytical Instrumentation,Handbook,Marcel Dekker Inc. (1997).
3	O.Samuelson: Ion exchange separation in analytical chemistry (Jhon wiley),1963.
4	L.R. Syder and C.H. Harvath, An Introduction to separation Sciences. Wiley Interscience.
Web Links/ Video Lectures	
1	

PCC-CHE-403 CHEMICAL PROCESS CALCULATIONS

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

Course Objectives: The objective of the course is to

1. Perform basic Engg. Calculation
2. Perform Mass balance Calculations on existing processes(Involving single & multiple units)
3. Use basic, applied chemistry/Thermodynamics in material balance calculations
4. Work in team

Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	Define the basic chemical calculations, conversions and the laws of gases system	Remember
CO2	Explain combustion calculations and reactive, non reactive process	Understand
CO3	Develop material balances on unit operations and processes	Create
CO4	Categorize the bypasses, recycle streams and their importance's	Analyze
CO5	Interpret material balance with and without chemical reactions	Apply
CO6	Formulate simultaneous material and energy balances on various chemical operations	Create

Description:

This course aims to impart fundamental knowledge of Basic chemical calculations, Gaseous system calculations, Material balances & Energy balances

Prerequisites	1:	Basic concepts of mathematics, physics and chemistry.
	2:	Knowledge of calculation technique.

Section – I		
Unit 1	**Basic Chemical Calculations**	
	Units and Conversions, Pressure, Temperature, Density, Specific Gravity; Mole Concept, Equivalent Weight, Composition of solids, Liquids and Gases, Mass fraction, Mass percent, Mass Ratios, Mole fraction, Mole percent, Volume fraction and Volume percent, Normality, Morality , Molality Gaseous mixtures, Daltons law, Amagat's law, Average molecular weight, Density of gaseous mixture, Estimation of vapour pressure.	**5 Hrs**
Unit 2	**Material Balances without Chemical Reaction**	
	Material balances; Guidelines for solving material balance problems; Material balance of important industrial operations (Distillation, Absorption and Striping, Extraction and Leaching, Evaporation, Dryer, Mixing, Crystallization etc.); Recycle and Bypass operations, purge	**9 Hrs**
Unit 3	**Material Balances with Chemical Reaction**	
	Definition of terms involved; Generalized approach for solving problems; Material balance problems involving chemical reaction; Minimum air requirement, Excess air requirement ,combustion calculations	**9 Hrs**
Section – II		
Unit 4	**Material Balances with Recycle, Bypass, Purge**	
	Generalized approach for solving problems, Applications of recycle, bypass and purge, Problems involving industrial applications.	**5 Hrs**
Unit 5	**Energy Balances on Non Reactive Processes**	
	Elements of energy balance calculations; Change in pressure at constant temperature; Change intemperature; Phase change operations; Mixing and solutions.	**5 Hrs**
Unit 6	**Energy Balances on Reactive Processes**	
	Heat of reaction Measurement and calculation of standard heat of reaction, Hess law; Heat of formation; Heat of combustion; Effect of temperature on heat of reaction; adiabatic reactions.	**5 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	3	2										1	2
CO2	3	3	3	3										1	2
CO3	3	3	2	2										1	2
CO4	2	2	2	3										1	2
CO5	3	3	3	3										1	2
CO6	3	3	3	3										1	2

References:

Text Books	
1	Bhatt B.I. and Thakore S. B. 'Stoichiometry', Fifth Edition, Tata McGraw-Hill Pub
Reference Books	
1	K. V. Narayanan, B. Lakshmi kutty,' Stoichiometry and Process Calculations', PHI Learning Pvt. Ltd. Dec. 2016.
2	Himmelblau D. M. 'Basic Principles and Calculations in Chemical Engineering', Sixth Edition, Prentice-Hall of India Pvt. Ltd., 2004..
3	Felder R. M. and Rousseau R.W, 'Elementary Principles of Chemical Processes', Third Edition, John Wiley and Sons, Inc.2000.
4	V. Venkataramani, N. Anantharaman & K.M. Meera ,Process Calculations 2nd Ed Sheriffa Begum 2011
5	D.C. SIKDAR, Chemical Process Calculations- PHI Learning Private Ltd ,
Web Links/ Video Lectures	
1	

PCC-CHE-404 HEAT TRANSFER

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	3 hrs per week	**ISE**	**:**	40 Marks.
Credits	**:**	3	**ESE**	**:**	60 Marks.
Tutorial	**:**	1 hrs /Batch/Week	**ISA**	**:**	25 Marks
Practicals	**:**	2 hrs /Batch/Week	**POE**	**:**	25Marks.
Credits	**:**	2	**Total Marks**	**:**	150 Marks.
Total Credits	**:**	5			

Course Objectives: The objective of the course is to

Introduce the undergraduate students with the most important Heat Transfer in the process industry and provide proper understanding of Heat transfer operations

Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	Understand conduction, convection & Radiation and solve the problems.	Understand
CO2	Demonstrate steady and unsteady heat conduction in one and three dimension.	Apply
CO3	Apply heat transfer Principles in solving engineering problems that are related to heat transfer.	Apply
CO4	Deal with practical problems in design of heat exchangers, evaporators, packed bed heat exchanger, Boiling & condensation related to chemical processes and perform such calculations manually & by using software.	Analyze
CO5	Analyze the performance of Heat exchange equipments.	Analyze
CO6	Apply heat transfer concepts for application in process safety, biological sciences, energy and environmental sciences.	Apply

Description

This is one of the most fundamental course which deals with heat flow through various modes of heat transfer viz. Conduction, Convection & Radiation. This course includes all governing principles about evaporation, condensation, correlations, study of individual and overall heat transfer coefficient as well heat exchange equipments and design approach of heat exchangers.

Prerequisites	1:	Basic science
	2:	Concept of Fluid mechanics
	3:	Concepts of thermodynamics

Section – I		
Unit 1	**Mechanism of Heat Flow with Governing Laws**	
	Mechanism of heat flow with governing laws: Conduction, Convection, Radiation. Heat transfer by conduction in solids: Fourier's law, steady state heat conduction through walls, single and multilayer. Heat flow through a cylinder, Sphere, unsteady state heat conduction, equation for one and three dimensional conduction, critical radius of lagging, Problems.	**6 Hrs**
Unit 2	**Principles of Heat Flow in Fluids**	
	Principles of heat flow in fluids: Typical heat exchange equipment, co-current and counter current flow. Energy balances, rate of heat transfer, overall and individual heat transfer coefficient. Calculation of overall heat transfer co-efficients from individual heat transfer coefficients, fouling factors. Transfer units in heat exchangers, Problems.	**7 Hrs**
Unit 3	**Heat Transfer to Fluids without Phase Change**	
	Heat transfer to fluids without phase change: Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow. Laminar flow heat transfer to flat plate, the Graetz and Peclet number. Average heat transfer coefficient in Laminar flow. Heat transfer by forced convection in turbulent flow, dimensional analysis method., effect of tube length, empirical equations, estimation of wall temperature, analogy equations. Heat transfer in transition region, heat transfer to liquid metals, Problems.	**7 Hrs**
Section – II		
Unit 4	**Heat Transfer to Fluids with Phase Change**	
	Heat transfer to fluids with phase change : Heat transfer from condensing Vapors dropwise and film wise condensation, coefficients for film type condensation, derivation and practical use of Nusselt equation, condensation of superheated vapors, effect of non-condensable gases, Problems. Heat transfer to boiling liquids : Types of boiling, boiling of saturated liquid maximum flux and critical temperature drop, minimum heat flux film boiling and subcooled boiling, Problems.	**6 Hrs**
Unit 5	**Heat Exchange Equipment**	
	Heat exchange equipment: Types of heat exchangers, single and multipass exchangers, correction of LMTD for cross flow. Simple design calculations of heat exchangers, introduction to compact heat exchanger i.e. plate type heat exchanger, different types of condensers and boilers, air cooled heat exchangers, introduction to heat transfer in agitated vessel, definition of fin efficiency, problems.	**8 Hrs**
Unit 6	**Evaporation**	
	Evaporation: Liquid characteristics, types of evaporators, single evaporator capacity, economy, boiling point elevation and Duhring's rule. Heat transfer co-efficients Enthalpy balance for single effect evaporator, multiple effect evaporators, types, methods of feeding, enthalpy balance of multiple effect evaporators, problems. Introduction to heat transfer to packed and fluidized beds: General heat transfer characteristics, Calculation for Heat transfer co-efficient	**6 Hrs**

PRACTICALS: (Minimum 10 Experiments should performed)

1. Emissivity measurement apparatus.
2. Heat Transfer by Natural convection.
3. Heat Transfer by Forced convection.
4. Heat transfer through lagged pipe.
5. Thermal conductivity of metal rod.
6. Double pipe heat exchanger.
7. Shell and tube heat exchanger.
8. Fin tube heat exchanger.
9. Packed bed heat exchanger.
10. Heat transfer through agitated vessel.
11. Climbing Film Evaporator
12. Demonstration of
    a. Compact heat exchanger
    b. Dropwise and filmwise condensation.
    c. Critical heat flux.

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	1	1		1
CO2	2	2	1	1										1	
CO3	3	2	2	1	1	1		1			1		1		2
CO4	3	3	2		2	1		1				1	2	2	1
CO5		2	3	1	1						2			2	
CO6	2			2		1	2	2			1			2	2

References:

Text Books	
1	McCabe W.L., Smith J.C. and Harriott P., "Unit Operations in Chemical Engineering", 7th edition McGraw Hill,2005.
2	Sukhatme S.P., "Heat Transfer",5th edition",5th edition., Press India Ltd. University
Reference Books	
1	William H. Mcadams, "Heat transmission", 3rd ed. McGraw Hill Series
2	Alan J. Chapman. "Heat Transfer", 4th ed. Macmilan Publishing Company, New York
3	Frank Kreith & Mark S. Bohn. , "Principles of Heat Transfer", 4th ed. Harper and Row Publishers, New York,
4	Coulson J.M. & Richardson J.F.,"Chemical Engineering" , 3rd ed. Vol.1
5	J.P. Holman. , "Heat Transfer" , 8th ed. Mc-Graw Hill Inc.1997
Web Links/ Video Lectures	
1	

PCC-CHE-405 CHEMICAL ENGINEERING THERMODYNAMICS-I

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

Course Objectives: The objective of the course is to

1. The students completing this course are expected to understand the nature and role of thermodynamic properties of matter and access thermodynamic property data from appropriated sources.
2. They will recognize and understand the laws and limitation of thermodynamics.
3. They are excepted to understand the behavior of power plants based on Carnot cycle, Rankin cycle and performance of refrigeration and heat pump

Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	Define & describe the significance of thermodynamic properties of pure fluids & fluids in mixture.	Remember
CO2	Apply the laws of thermodynamics to chemical engineering processes.	Apply
CO3	Analyze & access thermodynamic properties, data from appropriate sources.	Analyze
CO4	Estimate differences in thermodynamic properties using equation of state, charts, tables & computer resources.	Analyze
CO5	Formulate thermodynamic calculations orientated to the analysis and design & efficiency of various energy related chemical processes.	Create
CO6	Interpret thermodynamic data for application in process safety, biological sciences, energy& environmental sciences.	Apply

Description:

This course has a limitation to performance of processes and equipment. By use of thermodynamics we can design, analyze and simulate performance of chemical engineering operations. It is also used for formulating and insight necessary to do preliminary analysis of process for the purpose of feasibility.

Prerequisites	1:	Basic chemistry and Basic physics
	2:	Applied mathematics
	3:	Physical chemistry

Section – I		
Unit 1	**Introduction**	
	Introduction: Scope & limitations of thermodynamics, Work energy and Heat, Concept of equilibrium, Entropy, Gibbs free energy, Phase rule, Problems.	**4 Hrs**
Unit 2	**First law of Thermodynamics and other Basic Concepts**	
	First law of Thermodynamics and other basic concepts: Joules experiment, Internal energy, First law for non-flow process, Steady state flow processes, Reversible and irreversible processes, Reversible chemical reaction, Enthalpy, Heat capacity, Constant volume and pressure process	**6 Hrs**
Unit 3	**Volumetric Properties of Pure Fluids**	
	Volumetric properties of Pure fluids: PVT behavior of pure substances, Virial equation of state, Ideal gas temperature, Universal gas constant, Two forms of virial equation, The ideal gas and equations for various processes, Problems, Application of the virial equation, Cubic equation of state. The van-der waal equation of state.	**7 Hrs**
Section – II		
Unit 4	**Second Law of Thermodynamics**	
	Second law of Thermodynamics: Statements, Heat engine, Carnot theorem Carnot's equations, Thermodynamic temperature scale, concept of Entropy, Entropy changes of an ideal gas, Significance of Entropy, Third law of Thermodynamics, Problems**.**	**6 Hrs**
Unit 5	**Thermodynamic Properties of Fluids**	
	Thermodynamic properties of fluids :Property relations for homogeneous phases, Maxwell's relation, Enthalpy and Entropy as functions of temperature and pressure, Internal energy as functions of pressure, Ideal gas state, Alternate forms for liquids, Internal energy as function of T and V, Gibbs energy as generating function, Residual properties, Two phase systems, Thermodynamic diagrams, P-H diagram ,T-S diagram ,H-S diagram, etc.	**6 Hrs**
Unit 6	**Conversion of Heat into Work by Power Cycles**	**6 Hrs**
	Conversion of heat into work by power cycles: Steam power plant cycle, Internal combustion engines, Jet engines, Rocket engines. Refrigeration and liquefaction: Carnot Refrigerator, Air refrigeration, vapor compression cycles, Choice of refrigerant. Absorption, refrigeration, Heat pump, Liquefaction processes.	

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	3												
CO3		2		1	3										
CO4				2	3		1						3		
CO5			2		1										1
CO6			1				3				1			2	

References:

Text Books	
1	J.M. Smith and H.C.VanNess,“ Introduction to Chemical Engg.”, Thermodynamics 7th Edition, International student edition, McGraw Hill publication.
Reference Books	
1	B.F.Dodge,”Chemical Engg. Thermodynamics”, International student edition McGraw Hill Publication.
2	D.A.Hougen, K.M.WatsonandR.A.Ragatz,“Chemical Process Principles
3	K.V.Narayanan,“Chemical Engg. Thermodynamics”, Prentice Hall India,New
Web Links/ Video Lectures	
1	

ESC-CHE-406P COMPUTING FOR ENGINEERS

Teaching Scheme			**Evaluation Scheme**		
Lectures	**:**	1* hrs per week	**ISE**	**:**	--
Credits	**:**	--	**ESE**	**:**	--
Practicals	**:**	2 hrs /Batch/Week	**ISA**	**:**	75 Marks.
Credits	**:**	1	**POE**	**:**	--
Total Credits	**:**	1	**Total Marks**	**:**	75 Marks.

Course Objectives: The objective of the course is to

1. Implement applications of MS OFFICE in field of chemical engineering
2. Get knowledge of variety of sensors which are used in domestic and industrial applications
3. Get awareness of cloud computing and its benefits in chemical engineering field

Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	To implement applications of MS Office in field of chemical engineering.	Apply
CO2	To get knowledge of variety of sensors which are used in domestic and industrial applications	Understand
CO3	To get awareness of cloud computing and its benefits in chemical engineering field.	Remember

Description:

This course aims to impart fundamental knowledge of computers and networking applications in field of chemical engineering

Prerequisites	1:	Basic Computer organizations

Section – I		
Unit 1	**Microsoft Office**	
	Word processing skills such as creating a document, using spell check, creating tables, working with headers or footers, mail merge, document formatting etc. and common word processing related keyboard commands; Numeric Skills to deal with numbers and digits, using formulas, references, macros, tables, graphs through spreadsheets and common keyboard Commands for spreadsheets. Presentation skills for sharing and understanding data in form of charts, graphs and data, MS Access	**4 Hrs**
Unit 2	**Introduction to Internet of Things (IoT)**	
	Introduction, History of IoT, About objects/things in the IoT, Object Classification, Sensing and actuating technology, IoT Application Examples (Smart Metering/Advanced Metering Infrastructure, e-Health/Body, Area Network, City Automation, Chemical Engineering Applications Examples)	**4 Hrs**
Unit 3	**Introduction to Cloud Computing**	
	Getting to know the Cloud, Cloud and other similar configurations, Components of Cloud Computing, Cloud Types and Models: Private Cloud, Community Cloud, Public Cloud, Hybrid Clouds, Advantages and disadvantages of Cloud, Applications of Cloud.	**4 Hrs**

PRACTICALS

1. Creating a document on events carried out in F.Y.B.Tech using office tool.
2. Creating a document using spreadsheets in Excel
3. Create a Data Base in MS Access
4. Prepare a Presentation on given problem Statement
5. Use and application of Google Drive
6. Creating a Google Form
7. Open a Google drive/open stag Account of your own and upload documents to the cloud
8. Find out different cloud platforms and identify their Characteristics

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								2	1	
CO2	2	1	1	1	1								1	1	
CO3	1	1	1		1								2	1	

References:

Text Books /Reference Books	
1	Computer Proficiency Certification Test (CPCT)
2	Hakima Chaouchi, “The Internet of Things, Connecting Objects to the Web”, Wiley Publications
3	Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications”, Wiley Publications
4	Cloud Computing Black Book - Jayaswal, Kallakurchi, Houde, Shah, Dreamtech Press.
5	Cloud Computing: Principles and Paradigms – Buyya, Broburg, Goscinski.
Web Links/ Video Lectures	
1	

PCC-CHE-407P FLUID MOVING MACHINERY

Teaching Scheme			Evaluation Scheme		
Lectures	**:**	2* hrs per week	**ISE**	**:**	--
Credits	**:**	--	**ESE**	**:**	--
Practicals	**:**	2 hrs /Batch/Week	**ISA**	**:**	25 Marks.
Credits	**:**	1	**POE**	**:**	25 Marks.
Total Credits	**:**	1	**Total Marks**	**:**	50 Marks.

Course Objectives: The objective of the course is to

1. Inculcate basic concepts of Heat flow, verifying governing laws of various modes of heat transfer viz. conduction, Convection and radiation.
2. To explain working of various heat exchange equipments used in chemical industries and calculation of an Individual and Overall heat transfer coefficients.

Course Outcomes:

Cos	At the end of successful completion of the course the students will be able to	Blooms Taxonomy
CO1	To understand basic concepts of pumps and classification of pumps	Understand
CO2	To study performance characteristics liquid flow machineries	Remember
CO3	Explain mathematical calculations of pumps	Understand
CO4	To select appropriate type of pump	Evaluate
CO5	To study performance characteristics of gas flow machineries	Remember

Description:

This course aims to impart fundamental knowledge for experiments based on pumps, blowers and compressors.

Prerequisites	1:	Fluid mechanics

Section – I		
Unit 1	**Pump Introduction**	
	Centrifugal pumps- classification of pumps, impellers, casings, volute pumps, volute pumps with vortex chamber, diffuser vanes,	**6 Hrs**
Unit 2	**Centrifugal Pumps**	
	Theory of centrifugal pump, Work done, developed head, efficiency pump, minimum speed for functioning of pump, multistage centrifugal pumps, pumps in series, pumps in parallel, specific speed of centrifugal pump, model testing suction lift, priming, cavitation, effect of cavitation, NPSH, calculation of horse power requirement, operating characteristics, comparison, advantages and disadvantages ,Affinity Law, problem	**6 Hrs**
Unit 3	**Positive Displacement Pumps**	
	Positive displacement pumps classification of positive displacement pumps ,reciprocating pumps, volumetric efficiency, single acting, double acting, work done by reciprocating pumps, slip of reciprocating pump, variation in velocity and acceleration in suction and discharge line. Types Of Positive Displacement Pumps	**7 Hrs**
Section – II		
Unit 4	**Selection of Pumps**	
	Selection of pumps operating conditions operating difficulties, comparison between various types of pumps, selection criterion, maintenance of pumps	**7 Hrs**
Unit 5	**Fans**	
	Fans characteristics, operating pressure conditions, types of blowers, centrifugal blower, positive displacement blower, types of compressors, centrifugal compressor, reciprocating compressor, equations for blower and compressors adiabatic compression, isothermal compression, compressor efficiency, power equations, vacuum pumps, its working and principle, steam jet ejector, problems.	**6 Hrs**

PRACTICALS: (Minimum 10 Experiments should performed)

1. To Study the Performance of Centrifugal Pump with Constant Speed.
2. To Study the Performance of Centrifugal Pump with varying Constant Speed.
3. To Study the Performance of Reciprocating Pump with Constant Speed.
4. To Study the Performance of Reciprocating Pump with varying Constant Speed.
5. To Study the Performance of Gear Pump.
6. To Study the Performance of Vacuum Pump.
7. To Study the Performance of Centrifugal Compressor
8. Demonstration of fans and blowers.
9. Study of Peristaltic pumps.

Mapping of POs & COs:

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

References:

Text Books /Reference Books	
1	Fluid Mechanics by R.P. Vyas, Central Techno Publications, Nagpur.
2	Design for Chemical and Petrochemical Plants, Ernest E.Ludwig, Volume I&II, Gulf publishing Company.
3	Pumps: G.K. Sahu, New age international publishers.
Web Links/ Video Lectures	
1	

CHE 408A AUDIT COURSE –IV PROFESSIONAL DEVELOPMENT

Teaching Scheme			**Evaluation Scheme**		
Practicals	**:**	2* hrs per week	Audit points	**:**	2
Credits	**:**	Non credit			

Instruction for audit course
Students have to undergo general proficiency course mentioned below. This course must have minimum Two weeks duration .Students can do this from the training Institutes which are recommended and suggested by the department for respective academic year. At the end of semester, students has to submit the **COURSE COMPLETION CERTIFICATE** to the department

Course Contents		
Unit 1	**Learning the Fundamentals of Grammar**	
	1. Module-I: Root Words, Frequency Words 2. Module-II: Parts of speech- II 3. Module-III: Voice 4. Module-IV: Tense 5. Module-V: Punctuations II	**10 Hrs**
Unit 2	**Writing Skills**	
	1. Module-I: Email 2. Module-II: Passage 3. Module-III: Letter 4. Module-IV: Story/Blog	**10 Hrs**
Unit 3	**Interpersonal Skills**	
	1. Module-I: Team Management 2. Module- II: Attitude Building 3. Module- III: Time Management 4. Module-IV: Goal Setting(Why & How of SMART goals)	**6 Hrs**

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 ★ WARANANAGAR Dist. Kolhapur

Seal of Institute