S. Y. B. Tech. Curriculum w.e.f.: 2021-2022

D. Y. Patil College of Engineering and Technology

KasabaBawada, Kolhapur.

(An Autonomous Institute)

Accredited by NAAC with 'A' Grade

S. Y. B. Tech Programme Syllabus

(Department of Chemical Engineering)

2021-22

SECOND YEAR B. TECH. IN CHEMICAL ENGINEERING

Semester-III

Sr. No.	Course Code	Course Type	Name of the Course	Teaching Scheme per Week				Total Marks	Evaluation Scheme			
				Lecture Hours	Tutorial Hours	Practical Hours	Credits		Type	Max. Marks	Min. for Passing	
1	201CHL 201	BSC	Engineering Mathematics-III	3	--	--	3	100	ISE MSE ESE	20 30 50	20 20	40
2	201CHL 202	BSC	Industrial and Engineering Chemistry-I	3	--	--	3	100	ISE MSE ESE	20 30 50	20 20	40
3	201CHL 203	PCC	Mechanics of Material	3	--	--	3	100	ISE MSE ESE	20 30 50	20 20	40
4	201CHL 204	PCC	Fluid Flow Operations	3	--	--	3	100	ISE MSE ESE	20 30 50	20 20	40
5	201CHL 205	PCC	Mechanical Unit Operations	3	--	--	3	100	ISE MSE ESE	20 30 50	20 20	40
6	201CHP 206	BSC-LC	Industrial and Engineering Chemistry-I Laboratory	--	--	2	1	50	ISE ESE(POE)	25 25	10 10	20
7	201CHP 207	PCC-LC	Mechanics of Material Laboratory	--	--	2	1	25	ISE	25	10	10
8	201CHP 208	PCC-LC	Fluid Flow Operations Laboratory	--	--	2	1	50	ISE ESE(POE)	25 25	10 10	20
9	201CHP 209	PCC-LC	Mechanical Unit Operations Laboratory	--	--	2	1	50	ISE ESE(POE)	25 25	10 10	20
10	201CHMC 210	MC	Environmental Studies	2	--	--	--	50	ESE	50	20	20
			Total:	**17**	**0**	**8**	**19**	**725**		**725**		
				25								

SECOND YEAR B. TECH. IN CHEMICAL ENGINEERING

Semester- IV

Sr. No.	Course Code	Course Type	Name of the Course	Teaching Scheme per Week				Total Marks	Evaluation Scheme			
				Lecture Hours	Tutorial Hours	Practical Hours	Credits		Type	Max. Marks	Min. for Passing	
11	201CHL 211	ESC	Computer Techniques in Chemical Engineering	3	--	--	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
12	201CHL 212	BSC	Industrial and Engineering Chemistry-II	3	--	--	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
13	201CHL 213	PCC	Chemical Process Calculations	3	1	--	4	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
14	201CHL 214	PCC	Heat Transfer Operations	3	--	--	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
15	201CHL 215	ESC	Chemical Engineering Thermodynamics-I	3	--	--	3	100	ISE	20	20	40
									MSE	30		
									ESE	50	20	
16	201CHP216	ESC-LC	Computer Techniques Laboratory	--	--	2	1	50	ISE	50	20	20
17	201CHP 217	BSC-LC	Industrial and Engineering Chemistry-II Laboratory	--	--	2	1	50	ISE	25	10	20
									ESE(POE)	25	10	
18	201CHP 218	PCC-LC	Heat Transfer Laboratory	--	--	2	1	50	ISE	25	10	20
									ESE(POE)	25	10	
19	201CHP 219	PCC-LC	Fluid Flow Machinery Laboratory	--	--	2	1	50	ISE	25	10	20
									ESE(POE)	25	10	
20	201CHMC 220	MC	Professional Skill Development	2	--	--	--	50	ESE	50	20	20
			Total:	**17**	**1**	**8**	**20**	**750**		**750**		
				26								

*** Mandatory Courses (Non Credit):**

1. Environmental Studies

2. Professional Skill Development

Mandatory Courses will be of self study type and will be assessed by conducting objective type examination for 50 marks. A criterion for passing is 40 % (20 Marks). Result of student will be declared only if the student passes Mandatory Courses.

S. Y. B. Tech. Semester-III Curriculum in Chemical Engineering

w.e.f.: 2021-2022

Course Plan

Course Title: Engineering Mathematics-III	
Course Code:201CHL201	**Semester: III**
Teaching Scheme: L-T-P: 3-0-0	**Credits:3**
Evaluation Scheme: ISE+MSE Marks:20+30	**ESE Marks:50**

CourseDescription: The course contains Differential Equations, Probability, Laplace transform, Vector Calculus, Statistics.

Course Objectives:

1. To develop mathematical skills and enhance thinking power of students.
2. To give the knowledge to the students of Engineering Mathematicswith an emphasis on the application of solving chemical engineering problems.
3. To prepare students to formulate a mathematical model using engineering skills & interpretthe solution in chemical engineering and real world.

Course Outcomes COs: At theend of the course the students will be able to

C201.1	**Make use of** linear differential equation to solve the chemical engineering problems
C201.2	**Solve** basic problems in probability theory, including problems involving the Binomial, Poisson, and Normal distributions.
C201.3	**Apply** Laplace transforms to solve linear differential equations
C201.4	**Describe** the statistical data numerically by using lines of regression and curve fittings.
C201.5	**Apply** knowledge of vector differentiation to find curl and divergence of vector fields.
C201.6	**Use** partial differential equation to **solve** the chemical engineering problems

Prerequisite	Probability, Quadratic equation, Synthetic division,Partial fraction,formulaes of dervatives.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes
(POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C201.1	3	2													3
C201.2	3	2													3
C201.3	3	2													3
C201.4	3	2													3
C201.5	3	2													3
C201.6	3	2													3

Contents	Hours
Unit 1- Linear Differential Equations and Its Applications 1.1 Linear differential equations with constant coefficients. 1.2 Rules to find complementary function. 1.3 Methods to find particular integral $\left(X = e^{ax},\ \sin ax / \cos ax,\ x^n, e^{ax}V, xV\right)$ 1.4 Application to linear differential equations 1.4.1 Chemical reactions and solutions (mixture problems). 1.4.2. Conduction of heat.	6
Unit 2- Probability Distribution 2.1 Random variables. 2.2 Discrete probability distribution. 2.3 Continuous probability distribution. 2.4 Binomial distribution. 2.5 Poisson distribution. 2.6 Normal distribution.	6
Unit 3- Laplace Transformation 3.1 Laplace transform of elementary functions 3.2 Properties of Laplace transform 3.2.1Linearity property 3.2.2 First shifting property 3.2.3 Change of scale property 3.3 Multiplication by t^n and division by t 3.4. Inverse Laplace transform 3.4.1 Definition and important formulae 3.4.2 Inverse Laplace transform by method of partial fraction 3.4.3 Solution of linear differential equation with constant coefficients using Laplace	6

transform	
Unit 4- Correlation, Regression & Curve Fitting 4.1 Introduction. 4.2 Lines of regression of bivariate data. 4.3 Fitting of curves by method of least-squares. 4.3.1 Fitting of straight lines. 4.3.2 Fitting of second degree parabolic curves.	6
Unit 5- Vector Differential Calculus 5.1 Differentiation of vectors. 5.2 Gradient of scalar point function. 5.3. Divergence of vector point function 5.4. Curl of a vector point function. 5.5 Irrotational, solenoidal and scalar potential function of a vector field.	6
Unit 6- Partial Differential Equations and Applications 6.1 Formation of partial differential equation 6.2 Method of separation of variables. 6.3 Wave equation and its solution. 6.4 One dimensional heat flow equation 6.5 Solutions of Laplace equations by the Gauss – Seidel iterative method.	6

Text Books:

1. Higher Engineering Mathematics, by B. S. Grewal (Khanna Publication, New Delhi)
2. Higher Engineering Mathematics, by H. K. Das (S. Chand Publication, New Delhi)

Reference Books:

1. Advance Engineering Mathematics by Erwin Kreyszig (Wiley India.)
2. A text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar& P. N. Wartikar,VidyarthiGrihaPrakashan, Pune.
3. A Text Book of Engineering Mathematics, by N.P.Bali, Manish Goyal(Laxmi Publication, New Delhi)
4. Higher Engineering Mathematics, by B.V. Ramana (Tata McGraw Hill Education Private Limited, Delhi)

Course Plan

Course Title: Industrial and Engineering Chemistry-I	
Course Code : 201CHL202	**Semester : III**
Teaching Scheme : L-T-P : 3-0-0	**Credits : 3**
Evaluation Scheme : ISE + MSE Marks : 20 + 30	**ESE Marks : 50**

Course description:

The course contains chemical kinetics, catalysis, phase rule, organic reactions & intermediates, dyes & aromatic compounds

Course Objectives:

1. To impart the basic concepts of physical chemistry.
2. To give the basic knowledge of chemical reactions using catalyst.
3. To study the different analytical chemistry.
4. To study the concepts of organic reactions & intermediates.
5. To develop awareness of industrially importance of organic reactions.
6. To understand mechanism of organic reactions in soaps and detergents.

Course Outcomes (COs):

At the end of the course the student should be able to:

C202.1	**Explain** the concepts of physical chemistry.
C202.2	**Explain** the application of catalysts for chemical reaction engineering.
C202.3	**Apply** to concepts of phase rule for various chemical engineering concepts.
C202.4	**Apply** concepts organic reactions & intermediates.
C202.5	**Explain** industrially important organic reactions.
C202.6	**Apply** concepts of organic reactions in soaps & detergents.

Prerequisite:	----

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes
(POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C202.1	3	2										2	1		3
C202.2	3	2										2	1		2
C202.3	3	2										2	1		2
C202.4	3	2										2	1		2
C202.5	3	2										2	1		2
C202.6	3	2										2	1		2

Contents	Hours
Unit 1- Chemical kinetics Introduction, Order and Molecularity of reaction, Rate of reaction, Rate constant, First order reaction: Definition, Examples, Derivation Numericals.Second order reaction: Definition, Examples, Derivation with equal concentration Numericals	6
Unit 2- Catalysis Definition, characteristics, types-homogeneous and heterogeneous, theory of catalysis, catalyst:acid base, solid catalysts like metal oxides and zeolites, phase transfer catalysts, enzyme catalysts.	6
Unit 3- Phase Rule Introduction, Gibbs Phase Rule equation and explanation and terms involved in the equation. Phase diagram, One component systems: Water system,two component system-sulphur system	6
Unit 4 - Organic Reactions & Reactive Intermediates Types of Organic Reactions: Addition, substitution, Elimination, Rearrangement reaction .Reactive Intermediates: Carbocation, Carbanion, Carbon Free Radicals and Carbenes – their formation, structure & stability. Reactions involving formation of reaction intermediates like i)Carbocation : Friedal Craft's reactions.ii) Carbanion : Aldol condensation reaction.	6
Unit 5 - Chemistry of Dyes Introduction, Qualities of good dye, Witt's Theory i.e. chromosphere- auxochrome theory,Colour and chemical constitution, Classification of dyes based upon structure & methods of application, Diazotization and coupling for azo dyes.	6
Unit 6 - Aromatic compounds Nomenclature of aromatic nitro compounds, Preparation of aromatic nitro compounds, Chemical properties ,Reduction of nitro compounds, Nitration of nitrobenzene & its	6

mechanism.	

Text books:

1. Physical chemistry – Puri & Sharma (ShobanlalNagin Chand - 2005)
2. Essentials of Physical chemistry -- Bhal&Tuli (S. Chand & Co. - 2005)
3. Organic chemistry -- Bhal&Bhal(S. Chand -2000)
4. Organic chemistry -- P.L. Soni (S. Chand -1994

Reference Books:

1. Principles of Physical chemistry—Prutton &Maron (oxford & IBH Publishing Co. Pvt. Ltd 1972)
2. Text book of physical chemistry - Gladstone (Macmillan India Ltd. - 1995)
3. Inorganic Chemistry - A. I. Vogel
4. Organic chemistry – Volume I& II- Finar&Finar (English language book society-1989)
5. Organic chemistry -- Fieser&Fieser
6. Organic reactions and mechanism – Peter Sykes (Orient Longman-1986)

Course Plan

Course Title : Mechanics of Material	
Course Code : 201CHL203	Semester : III
Teaching Scheme : L-T-P : 3-0-0	Credits : 3
Evaluation Scheme : ISE + MSE Marks : 20 + 30	ESE Marks : 50

Course Description: Mechanics of Material Course provides basics of material testing to understand its behavior under various loads. This course also focuses on concept of failure, composite materials, alloys, and criteria's selection of right material of construction for given application.

Course Objective (COs):

Objective of this course is to:

1. Explain the relations between simple stress and strains.
2. Impart knowledge of two dimensional stress system and torsion in shaft
3. Explain classify thin cylinders, thick cylinders and spheres
4. Inculcate the basic concept of shear force and bending moment
5. Develop understanding about theories of failure and avoid material failure
6. Explain select right material of construction to avoid the material failure and understand concept of alloying and advance composite materials

Course Outcomes (COs):

At the end of the course the student should be able to:

C203.1	**Define** the relations between simple stress and strains.
C203.2	**Analyze** two dimensional stress system and torsion in shaft
C203.3	**Classify** thin cylinders, thick cylinders and spheres
C203.4	**Understand** the basic concept of shear force and bending moment.
C203.5	**Understand** the theories of failure and avoid material failure.
C203.6	**Select** right material of construction to avoid the material failure and understand concept of alloying and advance composite materials.

Prerequisite:	Applied Mechanics, Engineering Physics

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program specific outcome (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C203.1	3	3		2											2
C203.2	2	3		2									3		4
C203.3	2			2									2		2
C203.4		2											3		2
C203.5		2	3										3		2
C203.6			3		2								2		3

Contents	Hours
Unit 1 –Introduction to Mechanics of Material Principles of Mechanics of Material, Concepts of forces, their types, Resolution of forces, Composition of forces, Steps in Engineering Design. Different types supports and free body diagram. Concept of stress and strain, deferent types of stresses and strain, stress stain relation, Hooks law, Elastic limit, Bar of composite section, Posson's Ratio, Temperature stresses, Relation between three moduli, Problems.	6
Unit 2 - Analysis of two-dimensional stress system Principal stresses, Mohr's circle of Stress.Concept of moment of Inertia, Parallel axis theorem. Problems of finding centroid and moment of Inertia of single figures, composite figures, Perpendicular axis theorem, Polar M.I., Radius of gyration, Torsion of shafts: Torsion equation, strength and stiffness of solid and hollow circular shafts. Transmission of power.	6
Unit 3 - Cylindrical and Spherical shells Classification of thin and thick Cylindrical and spherical shells, Cylindrical and spherical shells subjected to fluid pressure. Design of thin cylindrical shell Problems, wire wound cylinders. Thick Cylinder: Lamis theory, Design of thick cylindrical shell, Thick Spherical Shells, Problems.	6
Unit 4 – Direct and Bending Stresses Shear Force and Bending Moment - Basic concept, S.F. and B.M. diagram for cantilever beam. Concept of stability of Column, 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.	6
Unit 5–Theories of Failure Introduction, Material Testing-Non Destructive Testing (NDT), Material Safety and Hazardous.Maximum principal stress theory (Rankine's theory), Maximum shearing stress theory (Tresca's theory), Strain energy theory (Beltrami and Haigh), and maximum strain theory (St. Venant's theory)	6
Unit 6– Mechanical properties of materials Introduction to Mechanical properties of materials, Selection of right material, Materials Failure.Materials standards and specifications,Fabricating characteristics of	6

metals,Introduction to determination of mechanical properties of materials ASTM methods.Introduction types of corrosion and advance methods of corrosion prevention.Concept of alloys, advance composite materials and properties.	

Text Books:

1. Ramamruthm, 'Strength of Materials' , - Dharapatray& Sons, Delhi , 1998.
2. Bhattacharya B.C., 'Selection of materials and fabrication for Chemical Process Equipment, Chemical Engg.' , Educational Development Centre , IIT Madras

Reference Books :

1. William Nash, 'Strength of Materials', IVth Ed. McGraw Hill Publication
2. Robert N. Perry & Don Gress , 'Perry's Chemical Engineers Handbook', VIth ed. McGraw Hills International Ed. Newyork 1984.
3. Corrosion Engineering IIndedition Mars G.Fontana.

Course Plan

Course Title :Fluid Flow Operations	
Course Code : 201CHL204	**Semester : III**
Teaching Scheme : L-T-P : 3-0-0	**Credits : 3**
Evaluation Scheme : ISE + MSE Marks : 20+30=50	**ESE Marks : 50**

Course 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 various process parameters is included in this course.

Course Objective-

Student will be able to….

1. To understand the importance of unit conversion and the static fluid behavior and pressure measurement devices in the field of chemical Engineering.
2. To understand the fluid behavior and basic equations regarding fluid flow.
3. To understand compressible and incompressible fluid behaviors and calculation of friction factor with consideration of all parameters like roughness, pipe fittings.
4. To recognize the fluid behavior changed due to immersed bodies and related friction and pressure drop of fluid due to it along with fluidization concept.
5. To aware about measurement of fluid flow, fluid behavior in case of fluidization and all affecting factors.
6. To aware about measurement of power requirements for agitator, fluid behavior in case of agitations of fluids

Course Outcomes (COs):

At the end of the course the student should be able to:

C204.1	**Explain** the importance of unit conversion and capable to static fluid behaviour and pressure measurement devices in the field of chemical Engineering.
C204.2	**Memorize** the fluid behaviour and **state** basic equations regarding fluid flow.
C204.3	I**nterpret** compressible and incompressible fluid behaviours and able to **solve** numerical calculations of friction factor with consideration of all parameters like roughness, pipe
C204.4	**Compare** the fluid behaviour changed due to immersed bodies and to **examine** related friction and pressure drop of fluid due to it along with fluidization concept.
C204.5	**Discuss** measurement of fluid flow and can **recognize** fluid behaviour in case of fluidization and all affecting factors.
C204.6	**Solve** the measurement of power requirements for agitator and **use** of knowledge about fluid behaviour in case of designing agitation system for various fluids.
Prerequisite:	---

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes
(POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C204.1	2	2	2	2											2
C204.2	3	3	3												1
C204.3	3	3	3	3					2		2		2		3
C204.4				2									2		4
C204.5	3	3	3												2
C204.6	3	3	3	3											3

Contents	Hours
Unit 1 - Unit systems: Physical quantities, S.I., CGS, FPS Engg. units, Conversion of Units, Units and Equations, revision to vectors and its operations, dimensional analysis, Buckingham Theorem, 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, Inclined tube manometers.	6
Unit 2-Fluid flow phenomena : Behavior of flowing fluid, Types of flow, Newtonian and non- Newtonian Fluids, viscosity and momentum flux, flow between two parallel plates (velocity and stress distribution, viscosities of gases and liquids, Reynolds experiment, Eddy viscosity, Boundary layer formation in straight tubes, Boundary layer separation and wake formation Basic equations of fluids flow : Reynolds transport theorem, 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, Navier- Stokes equation, Euler's equation, Problems	7
Unit 3 - Flow of incompressible fluids in conduits and thin layers : Mass and momentum balance in cylinder, Shear stress distribution in a cylindrical tube, relation between skin friction and wall shear, the friction factor (Moody's chart). 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. 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, hydraulic radius, friction from changes in velocity or direction, Effect of fittings and valves, Flow through annuals, flow between two rotating cylinders.	7

Problems.	
Unit 4- Flow of compressible fluids: Mach number, continuity equation, Total energy Balance, velocity of sound, ideal gas equations, the asterisk condition, stagnation temperature. Metering of fluids: Measurement of flowing fluids. Venturimeter, orificemeter, Pitot tube, laser Doppler anemometer, particle image velocimetry, rotameter, turbine meters, positive displacement meters, magnetic meters: ultrasonic meters.	6
Unit 5 - Flow past immersed bodies : Drag coefficients of typical shapes, form drag and streamlining, Friction in flow through beds of solids, Darcy's equation, Erguns equation, Kozeny- Carman equation, Burke Plummer equation, Fluidization, Mechanism of fluidization, particulate and aggregative fluidization, minimum fluidization velocity, expansion of fluidized beds, application of fluidization.	7
Unit 6 - 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 consumption, SH (7L)	3

Text Book:

1. McCabe Smith, Peter Harriot, "Unit operations of Chemical Engineering" McGraw Hill Publications.

Reference Books:

1. Fox, R. W., McDonald, A. T., & Mitchell, J. W. (2020). Fox and McDonald's introduction to fluid mechanics. John Wiley & Sons.
2. White, F. M. (1979). Fluid mechanics, 1999. Me Graw-Hill.
3. Yunus A. Cengel, John M. Cimbala "Fluid Mechanics-Fundamentals & Applications", New York: McGraw-hill

Course Plan

Course Title : Mechanical Unit Operations	
Course Code : 201CHL205	Semester : III
Teaching Scheme : L-T-P : 3-0-0	Credits : 3
Evaluation Scheme : ISE + MSE Marks : 20 + 30	ESE Marks : 50

Course Description: Mechanical unit operations course 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.

Course Objectives:

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-liquid & solid-solid.
4. To study the filtration and sedimentation for solid-liquid separation.
5. To calculate the terminal settling velocity.
6. To conceive the different solid-gas separation equipment.

Course Outcomes (COs): At the end of the course the student should be able to

C205.1	**Explain** fundamentals of solids and calculate the surface area and number of particles in mixture.
C205.2	**Describe** the basics of size reduction, size reduction equipments, designing of equipments and explain the basics of screening and calculating efficiency of screening equipment.
C205.3	**Describe** basics of mixing, blending and mixing equipments.
C205.4	**Describe** the details of filtration and sedimentation, design equations of filtration and explain the filtration and sedimentation equipments.
C205.5	**Calculate** the terminal settling velocity.
C205.6	**Explain** the equipments used for separation of solid-gas.

Prerequisite:	----

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes
(POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C205.1	2	2											2		2
C205.2	2	2	2										2		2
C205.3	2	2											2		2
C205.4	2	2	2										2		2
C205.5	2	2											2		3
C205.6	2												2		2

Contents	Hours
Unit 1 - Properties and handling of particulate solids Particle characterization, Particle size measuring technologies, Particle size distribution, Mean particle size, Mixed particle sizes and size analysis, Specific surface of mixture, Average particle size, Number of particles in mixture, Properties of solid masses, Storage of solids (Bulk and Bin), Angle of repose and angle of friction, Introduction to conveying of solids.	6
Unit 2 - Size reductions and Screening Necessity of size reduction, 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 communiation, Open and closed circuit grinding. Screening: Size measurements with fine particles, Standard test screens, Standards of screen, Screen effectiveness, Comparison of ideal and actual screens, Industrial screening equipment.	10
Unit 3 - Mixing of solids The degree of mixing, Rate of mixing, Criteria for mixer effectiveness, Solid-liquid mixing, Solid-Solid mixing.	4
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, Preliminary treatment of slurries before filtration, Filtration equipment: Pressure filters, Vacuum filters, Centrifugal filters. Sedimentation: Basic principles, Flocculation, Thickeners, Batch sedimentation test.	10
Unit 5 - Particle Dynamics Motion of particle in a fluid, Terminal settling velocity, Free settling, Hindered settling,	3

Stoke's law and Newton's law of settling.	
Unit 6 - Gas Cleaning Introduction, Gas cleaning equipment, Gravity separators, Centrifugal separators, Momentum separators, Fabric filters, Agglomeration and Coal essence.	3

Text Books:

1. Mccabe W. L. & Smith J. C. and Peter Harriott, Unit Operations of Chemical Engg. 5th ed. Mcgraw Hill International.
2. C. M. Narayanan, B. C. Bhattacharyya, Mechanical Operations for Chemical Engineers, Computer Aided Analysis, Khanna Publishers.
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. Foust A. G. et.a- Principles of Unit Operations, 3nd ed. John, Wiley & Sons, New York 1979.
2. G. C. Sekhar, unit Operations in Chemical Engineering, Pearson education (Singarore) Pte. Ltd

Course Plan

Course Title : Industrial and EngineeringChemistry-I Laboratory	
Course Code : 201CHP206	Semester : III
Teaching Scheme : L-T-P : 0-0-2	Credits : 1
Evaluation Scheme : ISE Marks : 25	ESE (POE) Marks : 25

Course description:

The course contains experiments on chemical kinetics, identification of organic compounds, preparation &purification of organic compounds

Course Objectives:

1.To study the concept of chemical kinetics

2.To analyze& to identify various organic compounds

3.To prepare, to purify & to estimate some simple organic compounds

Course Outcomes (COs):

At the end of the course the student should be able to:

C206.1	Explain the concept of chemical kinetics
C206.2	Identify organic compounds
C206.3	Prepare , purify ,estimate simple organic compounds

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes
(POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C206.1	3								1			2			3
C206.2	3								1			2			2
C206.3	3								1			2			2

List of Experiments			
Expt. No.	**Name of Experiment**	**Type**	**Hours**
A) Chemical Kinetics: (Any 4)			
1	Determination of reaction rate constant of catalyzed hydrolysis of methyl acetate in 0.5NHCl.	O	2
2	Determination of reaction rate constant of catalyzed hydrolysis of methyl acetate in 0.5N H_2SO_4	O	2
3	Determination of reaction rate constant of reaction between $K_2S_2O_8$& KI (Unequal conc.)	O	2
4	Determination of reaction rate constant of reaction between $KBrO_3$& KI (Equal conc.)	O	2
5	Study of decomposition of hydrogen peroxide ($KMnO_4$ method)	O	2
B) Organic Spotting: (Minimum 4 compounds with one must liquid) Identification of organic compounds			
6	Acidic(Any one) Benzoic Acid, Salicylic acid, Oxalic acid, Acetic acid	O	2
7	Phenolic(Any one) α-Naphthol, β-Naphthol, Phenol	O	2
8	Basic(Any one) o/m/p-nitroaniline, Aniline	O	2
9	Neutral- Ethanol, Acetone, Acetamide, Benzamide, Acetanilide, Glucose.	O	2
10	Naphthalene	O	2
C) Preparations & Purification of some simple organic compounds (Any 1) Note: Purification can be done by Sublimation, Filtration, Crystallization, Simple Distillation, Steam Distillation, TLC etc.			
11	Preparation of benzene azo-β-naphthol dyestuff	O	2
12	Preparation of Soap	O	2
D) Organic Estimations: (Any 1)			
13	Determination of saponification value of the given oil sample	O	2
14	Estimation of Glucose in Glucon-D	O	2
15	Estimation of Acetone	O	2

- S-STUDY, O-OPERATIONAL
- Minimum 10 Experiments should be conducted

Text books:

1. Physical chemistry -- Puri& Sharma (ShobanlalNagin Chand - 2005)
2. Essentials of Physical chemistry -- Bhal&Tuli (S. Chand & Co. - 2005)
3. Organic chemistry -- Bhal&Bhal(S. Chand -2000)
4. Organic chemistry -- P.L. Soni (S. Chand -1994

Reference Books:

1. Principles of Physical chemistry--Prutton&Maron (oxford & IBH Publishing Co. Pvt. Ltd 1972)
2. Text book of physical chemistry - Gladstone (Macmillan India Ltd. - 1995)
3. Inorganic Chemistry - A. I. Vogel
4. Organic chemistry – Volume I& II- Finar&Finar (English language book society-1989)
5. Organic chemistry -- Fieser&Fieser
6. Organic reactions and mechanism – Peter Sykes (Orient Longman-1986)

Course Plan

Course Title : Mechanics of Material Laboratory	
Course Code : 201CHP207	Semester : III
Teaching Scheme : L-T-P : 0-0-2	Credits : 1
Evaluation Scheme : ISE Marks : 25	ESE (POE) Marks : NA

Course Description: This course includes experiments based on analysis material behavior under different loads.

Course Objectives:

Objective of this course is to:

1. Explain the how to find simple stress and strains and find relation between stress and strain
2. Inculcate the basic concept of shear force and bending moment.

Course Outcomes (COs): At the end of the course the student should be able to:

C207.1	**Define** the relations between simple stress and strains with practical.
C207.2	**Understand** the basic concept of shear force and bending moment with practical

Prerequisite:	Applied Mechanics, Engineering Physics

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C207.1	3	3		1									1		2
C207.2		2											1		2

List of Experiments			
Expt. No.	**Name of Experiment**	**Type**	**Hours**
1	Introduction to Universal Testing Machine: Introduction to UTM and its various components, types of test, uses for different analysis.	O	2
2	Tension test on mild steel: Find tensile strength of mild steel specimen by using universal testing machine, calculation of tensile stress and understand material behaviour under tensile load.	O	2
3	Compression test on mild steel: Find compressive strength of mild steel specimen by using universal testing machine, calculation of compressive stress and understand material behaviour under compressive load.	O	2
4	Compression test on timber Specimen: Find compressive strength of timber specimen (teak wood) by using universal testing machine, calculation of compressive stress and understand material behaviour under compressive load.	O	2
5	Shear test on mild steel specimen: Testing of mild steel specimen by using universal testing machine under shear force, calculation of shear stress and understand material behaviour under shear force.	O	2
6	Rockwells Hardness test: Determination of hardness of test specimen by Rockwells hardness testing machine and understand material behavior under the test conditions.	O	2
7	Impact test- charpy and izod: Determination of toughness of test specimen by Izod and Charpy Impact testing machine and understand material behaviour under impact loading.	O	2
8	Electroplating – Advance method of corrosion presentation: Understand the concept of corrosion and detailed explanation about electroplating as advance method of corrosion prevention.	S	2
9	Advance computational Techniques to analyze material mechanics: Introduction and overview about Advance computational Techniques of industrial importance to analyze material mechanics.	S	2
10	To study the properties of various types of alloys.	S	2

- S-STUDY, O-OPERATIONAL
- Minimum 10 Experiments should be conducted

Text Books:

1. Ramamruthm, 'Strength of Materials' , - Dharapatray& Sons, Delhi , 1998.
2. Bhattacharya B.C., 'Selection of materials and fabrication for Chemical Process Equipment, Chemical Engg.' , Educational Development Centre , IIT Madras

Reference Books:

1. William Nash, 'Strength of Materials', IVth Ed. McGraw Hill Publication
2. Robert N. Perry & Don Gress , 'Perry's Chemical Engineers Handbook', VIth ed. McGraw Hills International Ed. Newyork 1984.
3. Corrosion Engineering IIndedition Mars G.Fontana.

Course Plan

Course Title : Fluid Flow Operations Laboratory	
Course Code : 201CHP208	Semester : III
Teaching Scheme : L-T-P : 0-0-2	Credits : 1
Evaluation Scheme : ISE Marks : 25	ESE (POE) Marks : 25

Course Description – This course 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 various process parameters is included in this lab work.

Course Objective (COs):

Objective of this course is to:

1. Inculcate basic concepts of fluid flow, friction factor and metering of fluids.
2. Verify various governing laws and calculation of equivalent lengths across pipe fittings.

Course Outcomes (COs):

At the end of the course the student should be able to:

C208.1	**Inculcate** basic concepts of fluid flow, calculations of friction factor
C208.2	**Verify** various theorems and calculation of equivalent lengths across pipe fittings.

Prerequisite:	--

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes
(POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C208.1	3	2							1				1		3
C208.2	3	2							1				1		3

List of Experiments			
Expt. No.	**Name of Experiment**	**Type**	**Hours**
1	To evaluate coefficient of discharge at different flow rates for given Venturimeter.	O	2
2	To evaluate coefficient of discharge at different flow rates for given Orifice meter.	O	2
3	To study laminar, transitional & turbulent flow Reynold's experiment.	O	2
4	To study Bernoulli's theorem.	O	2
5	To calculate Critical Reynolds Number & friction factor of a fluid flowing through helical coils.	O	2
6	To determine experimentally the pressure drop due to friction and check friction factor for various pipes at different flow rates.	O	2
7	To obtain equivalent length of bend and elbow.	O	2
8	To calculate Euler's number of fluid flowing through spiral coil.	O	2
9	To obtain equivalent length of reducer and expander.	O	2
10	Demonstration of – a) Rotameter b) Pitot tube c) Flow through annular space	S	2
11	Demonstration of particle image velocimetry – Virtual lab	S	2

- S-STUDY, O-OPERATIONAL
- Minimum 10 Experiments should be conducted.

Text Book:

1. McCabe, W. L., Smith, J. C., &Harriott, P. (1993). Unit operations of chemical engineering (Vol. 5, p. 154,7th edition). New York: McGraw-hill.

Reference Books:

1. Fox, R. W., McDonald, A. T., & Mitchell, J. W. (2020). Fox and McDonald's introduction to fluid mechanics. John Wiley & Sons.
2. White, F. M. (1979). Fluid mechanics, 1999. Me Graw-Hill.
3. Yunus A. Cengel, John M. Cimbala "Fluid Mechanics-Fundamentals & Applications", New York: McGraw-hill

Course Plan

Course Title : Mechanical Unit Operations Laboratory	
Course Code : 201CHP209	Semester : III
Teaching Scheme : L-T-P : 0-0-2	Credits : 1
Evaluation Scheme : ISE Marks : 25	ESE (POE) Marks : 25

Course Description: The course includes experiments based on size reduction, separation of solid-solid, solid-liquid and solid-gas.

Course Objectives:

1. To study the fundamental/basics of solid phase.
2. To develop the knowledge to calculate efficiency of screen, cyclone separator & critical speed of ball mill.
3. To study the batch sedimentation and solid-liquid separation equipments.
4. To study the equipments used to separate solid-solid.

Course Outcomes (COs): At the end of the course the student should be able to:

C209.1	Calculate particle size & particle size distribution of a given material
C209.2	Determine the efficiency of a given screen, cyclone separator & critical speed of ball mill for size reduction
C209.3	Calculate the area of thickener and study the solid-liquid separation equipments
C209.4	Demonstrate working of solid-solid separation equipments

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C209.1	2	2		2									2		3
C209.2	2	2		2									2		3
C209.3	2	2		2									2		3
C209.4	2												2		2

List of Experiments			
Expt. No.	**Name of Experiment**	**Type**	**Hours**
1	Sieve Analysis: To determine mean particle size, surface area of mixture, and number of particles in mixture.	O	2
2	Screen Effectiveness: To determine the efficiency of screen.	O	2
3	Jaw Crusher: To determine the particle size distribution of material.	O	2
4	Ball Mill: To determine critical speed & size reduction ratio of ball mill.	O	2
5	Batch Sedimentation: To determine area of thickener by concentrating a feed of 4% at a rate of 200 tons/day to give an underflow concentration of 55% by carrying out batch sedimentation.	O	2
6	Filter Press: To study batch filtration in plate & frame filter press.	O	2
7	Leaf Filter: To find out the resistance offered by cake & filter medium.	O	2
8	Cyclone Separator: To find the efficiency of cyclone separator.	O	2
9	Beaker Decantation: To determine the amount of given sample in the sub sieve range using beaker decantation method.	O	2
10	To study the principle, construction, working of Riffled Table.	S	2
11	To study the principle, construction, working of Mineral Jig.	S	2
12	To study the principle, construction, working of Gravity Separator.	S	2

- S-STUDY, O-OPERATIONAL
- Minimum 10 Experiments should be conducted.

Text Books:

1. Mccabe W. L. & Smith J. C. and Peter Harriott, Unit Operations of Chemical Engg. 5th ed. Mcgraw Hill International.
2. C. M. Narayanan, B. C. Bhattacharyya, Mechanical Operations for Chemical Engineers, Computer Aided Analysis, Khanna Publishers.
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. Foust A.G. et.a- Principles of Unit Operations, 3nd ed. John, Wiley & Sons, New York 1979.
2. G. C. Sekhar, unit Operations in Chemical Engineering, Pearson education (Singarore) Pte. Ltd.

Course Plan

Course Title: Environmental Studies	
Course Code: 201CHMC210	**Semester: III**
Teaching Scheme:-L-T-P: 2-0-0	**Credits: 0**
Evaluation Scheme: ISE + MSE Marks : NA	**ESE Marks:50**

Course Description: Environmental Studies course enhance a student's knowledge in a variety of currently relevant topics related to environmental awareness and pollution. The course aims to identify environmental problems, come-up with suitable solutions and create awareness for a hygienic and eco-friendly environmental.

Course Objectives:

1. Recognize the structure and functions of ecosystems with their importance.
2. Understand the environmental and social problems with global concern.
3. Understand the importance of environmental management for its protection.
4. Acquire problem solving skills through visits to different locations, identifying the environmental problems, proposing the solution models and exhibiting to the society and government authorities.

Course Outcomes COs: At the end of the course the students will be able to

C210.1	**Understand** the importance of ecosystem and biodiversity in view of its conservation.
C210.2	**Understand** the concept of hazardous waste and to promote healthier environment.
C210.3	**Explain** the importance of environmental management through pollution control boards.
C210.4	**Propose** solutions for problems related with environmental well beings through location visits and model exhibitions.

Prerequisite	Understanding of Environmental Education course.

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes
(POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C210.1						1	3	2							2
C210.2						1	2								2
C210.3						1	3		1	1					2
C210.4						2	3	1	1	1					3

Contents	Hours
Unit 1 -Ecology and Biodiversity Definition,types,importance and examples of ecology,types of community relationships:Symbiosis, predation and competition.Ecosystem:structure and functions,biotic and abiotic components,energy flows,ecological succession,food chain,food web & ecological pyramid,types of ecosystems,degradation of ecosystems and its impact.Biodiversity hotspots: Western ghats,eastern Himalayas, threats to biodiversity and conservation of biodiversity,environmental ethics.	8
Unit 2 -Environment and Health Air Pollution, water pollution. E-waste,waste minimization technology, Plastic waste,Population growth of the world and reduced health content of the environment, energy crisis,biofuels, Occupational health hazards, Concept of Carbon footprint.	7
Unit 3 -Environmental Management Role of Central Pollution Control Board (CPCB) and Maharashtra Pollution Control Board (MPCB) in environmental protection of India.Concept of sustainability, ISO Certification.	5
Unit 4 - Field Work Visit to a local area for documentation of environmental assets-River/forest/grassland/hill/mountain OR Visit to a local polluted site-Urban/Rural/Industrial/Agricultural OR Study of common plants,insects,birds OR Study of simple ecosystems- Ponds, Lakes, Rivers, Hill slopesetc.	5

Text Books:

1. Trivedi R.K. and P.K Goel, Introduction to Air Pollution, Tech-science Publications.
2. Mhaskar A.K, Matter Hazardous, Techno-Science Publication.

Reference Books:

1. Bharucha,Erach,The Biodiversity of India,Mapin Publishing Pvt.Ltd.,Ahmedabad 380013, India
2. Hawkins R.E., Encyclopedia of Indian Natural History,Bombay Natural History Society,Bombay.
3. Trivedi R.K., Handbook of Environmental Laws,Rules,Guidelines,Compliances and Standards,Vol.I&II,Environmental Media.
4. Miller T.G.Jr.,Environmental Science, Wadsworth Publications Co.
5. Sharma B.K.,EnvironmentalChemistry,GokelPubl.House,Meerut.

S. Y. B. Tech. Semester-IV Curriculum in Chemical Engineering

w.e.f.: 2021-2022

Course Plan

Course Title : Computer Techniques in Chemical Engineering	
Course Code : 201CHL211	**Semester : IV**
Teaching Scheme : L-T-P : 3-0-0	**Credits : 3**
Evaluation Scheme : ISE + MSE Marks : 20 + 30	**ESE Marks : 50**

Course Description: The course contains basics of C++ programming and application of programming to solve chemical engineering problems.

Course Objective (COs)

1.To Understand Introduction to programming languages.
2.To Understand C++ Programming basics.
3.To Analyze and understand Control Structures.
4. To Apply Arrays and Structure.
5. To Analyze and apply Functions.
6. To Understand Object Oriented Programming

Course Outcomes (COs):

At the end of the course the student should be able to:

C211.1	**Understand**Introduction to programming languages.
C211.2	**Understand**C++ Programming basics.
C211.3	**Analyze** and understand Control Structures.
C211.4	**Apply** Arrays and Structure.
C211.5	**Analyze** and apply Functions.
C211.6	**Understand**Object Oriented Programming.

Prerequisite:	----

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes
(POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C211.1	2	2			2									2	2
C211.2	2	2			2									2	2
C211.3	2	2	2	2	2									2	4
C211.4	2	2	2	2	2									2	3
C211.5	2	2	2	2	2									2	4
C211.6	2	2	2		2									2	2

Contents	Hours
Unit 1 -Introduction to C++: Development of Computer Languages, Translators ,Types of Programs, History of C++,Fundamentals of C++ C++ Character set, Identifiers & keywords, Data types in C++, Constants, Variables, Different Statements, Programs based on Chemical Engineering Applications.	6
Unit 2 -C++ Programming basics: Operators in C++ and Types, Input Output Statements, Manipulator Functions and Programs, Programs based on Chemical Engineering Applications.	6
Unit 3 -Control Structures: Introduction to Control Structures, Conditional Statements, Loop Statements, Break Statements, Programs based on Chemical Engineering Applications.	6
Unit 4 -Arrays and Structure: Array declarations, passing array to functions, Sorting array, Multidimensional arrays, Programs based on Chemical Engineering Applications. **Structure:**Introduction,Structure declaration, Initialization of Structure, Introduction of Unions, Programs based on Chemical Engineering Applications.	8
Unit 5 - Functions: Introduction, Function definition, Types of Functions,Function Prototypes,Header File, Storage Classes, Scope rules. Recursive Functions, Unary Scope resolution Operator, Programs based on Chemical Engineering Applications.	6
Unit 6 -Object Oriented Programming: Introduction to OOP, OOP Characteristics of C++,Classes and Objects, definition, Programs based on Chemical Engineering Applications.	4

Text Book:

1. Robert Lafore, "Object Oriented Programming in Turbo C++", Galgotia Publication Pvt Ltd.

Reference Books:

1. R.J.Micheli, "C++ Object Oriented Programming", McMillan London.
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" .2nd Edition, Prentice hall, New Jersey.

Course Plan

Course Title : Industrial and Engineering Chemistry-II	
Course Code : 201CHL212	Semester : IV
Teaching Scheme : L-T-P : 3-0-0	Credits : 3
Evaluation Scheme : ISE + MSE Marks : 20 + 30	ESE Marks : 50

Course description:

The course contains inorganic heavy industries, solvents, fertilizers, heterocyclic compounds & petrochemicals.

Course Objectives:

1. To explain & apply the concepts of heavy industries.
2. To acquire&analyse techniques of solvents & fertilizers.
3. To explain the concepts of heterocyclic compounds & petrochemicals.
4. To explain the knowledge of organo metallic compounds.

Course Outcomes (COs):

At the end of the course the student should be able to:

C212.1	**Understand**& apply the concepts of heavy industries.
C212.2	**Understand&analyse** techniques of solvents & fertilizers.
C212.3	**Apply** the concepts of heterocyclic compounds & petrochemicals.
C212.4	**Apply** the knowledge of organo metallic compounds.

Prerequisite:	Basic knowledge of chemistry

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C212.1	2	2										1			2
C212.2	2	2										1			2
C212.3	2	2										1			2
C212.4	2	2										1			2

Contents	Hours
Unit 1 - Inorganic Heavy Industries Le Chatelier's principle, Manufacture of H_2SO_4 (contact process), NH_3 (Haber's process) w.r.t.Reactions, Reactants, Catalyst and Physicochemical principles	6
Unit 2 - Solvents Introduction, Importance of solvents in chemical reactions, water as universal solvent, Classification of solvents, characteristic properties of solvents (M.P., B.P., Heat of fusion and vaporization, Dielectric constant)	6
Unit 3 - Fertilizers Introduction, Classification of fertilizers, Needs and essential requirements of Fertilezers, Fertility and pH value of soil, Mixed fertilizers (NPK fertilizers) , Complex fertilizers, Pollution caused by fertilizers.	6
Unit 4 - Chemistry of Heterocycles Introduction , Classification of Heterocycles, Synthesis, properties and uses of a) Five Membered Heterocycles : Pyrrole b) Six Membered Heterocycles : Pyridine c) Condensed Heterocycles : Quinoline	6
Unit 5 - Chemistry of Petrochemicals Introduction , Composition of Petroleum, Refining of crude oil, Cracking,Types of cracking, Octane number and Cetane number, Additives for improving antiknock properties.	6
Unit 6 - Organometallic compounds Introduction, Preparation, properties, chemical reactions, reactions with ethylene oxide, aldehydes, ketones,carbon dioxide.	6

Text books:

1. Basic Inorganic Chemistry by Cotton & Wilkinson, John Wiley & sons
2. Organic chemistry -- Bhal&Bhal(S. Chand -2000)
3. Organic chemistry -- P.L. Soni (S. Chand -1994)

Reference Books:

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, ELBS
3. Organic chemistry – Volume I& II- Finar&Finar (English language book society-1989)
4. Organic chemistry -- Fieser&Fieser
5. Organic reactions and mechanism – Pitter Sykes (Orient Longman-1986)

Course Plan

Course Title : Chemical Process Calculations	
Course Code : 201CHL213	Semester: IV
Teaching Scheme : L-T-P : 3-1-0	Credits : 4
Evaluation Scheme : ISE + MSE Marks : 20 + 30	ESE Marks : 50

Course Description: The course contains Basic chemical calculations, Gaseous system calculations,

Material balances & Energy balances.

Course Objectives:

1. Provide students thorough understanding of the fundamental principles of units, conversions & laws of gases systems.
2. Provide students thorough understanding ofideal & non-ideal gases system calculations.
3. Make students to develop material balances on different unit operations and unit processes.
4. Make students categorize the bypasses, recycle streams and their importance.
5. Make students to inculcate material balance with and without chemical reactions.
6. Students to formulate energy balances on various chemical operations.

Course Outcomes (COs):

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

CO No.	Course Outcomes
C213.1	**Define** the basic chemical calculations, conversions and the laws of gases system.
C213.2	**Explain** ideal & non-ideal gases system calculations.
C213.3	**Develop** material balances on unit operations and processes.
C213.4	**Categorize** the bypasses, recycle streams and their importance.
C213.5	**Interpret** material balance with and without chemical reactions.
C213.6	**Formulate** energy balances on various chemical operations.

Prerequisite:	----

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C213.1	2	2											2		2
C213.2	2	2											2		2
C213.3	2	2	2										3		3
C213.4	2	2	2										3		3
C213.5	2	2	2										3		3
C213.6	3	2	2										3		3

Contents	Hours
Unit 1 - Basic Chemical Calculations Units and Conversions, Process and process variables - process flow sheet, process unit, process streams.Mole Concept, Equivalent WeightComposition of solids, Liquids and GasesMass fraction, Mass percent, Mass Ratios, Mole fraction, Mole percent, Volume fraction and Volume percent	4
Unit 2 - Gaseous System (Ideal & Non-ideal gases) Ideal Gases: The Ideal Gas Equation of State, Standard Temperature and Pressure, Ideal Gas Mixtures.Non-ideal Gases: Equations of State for Non-ideal Gases, Critical Temperature and Pressure, Virial Equations of State, Cubic Equations of State, Non-ideal Gas Mixtures.Dalton's law, Amagat's law, Average molecular weight, Density of gaseous mixture.Estimation of vapour pressure	5
Unit 3 - Material Balances without Chemical Reaction Material balances; Guidelines for solving material balance problemsMaterial balance of important industrial operations (Distillation, Absorption and Striping, Extraction and Leaching, Evaporation, Dryer, Mixing, Crystallization etc.)Recycle and Bypass operations, purge calculations	8
Unit 4 - Material Balances with Chemical Reaction Definition of terms involved; Generalized approach for solving problemsMaterial balance problems involving chemical reaction; electrochemical reactions; Metallurgical applications,Recycle, bypass and purge calculations.	8
Unit 5 - Energy Balance Thermo-physics Elements of energy balance calculationsChange in pressure at constant temperature; Change in temperaturePhase change operationsMixing and solutions.	5
Unit 6 - Energy Balance Thermo-chemistry 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;	6

Contents	Hours
adiabatic reactions.	

Note - Minimum 10 tutorials should be conducted covering all units.

Text Books:

1. Bhatt B. I. and Vora S. M., 'Stoichiometry', Fourth Edition, Tata McGraw-Hill Pub. Co. Ltd., 2004.
2. Himmelblau D. M. 'Basic Principles and Calculations in Chemical Engineering', Sixth Edition, Prentice-Hall of India Pvt. Ltd., 2004.

Reference Books:

1. Felder R. M. and Rousseau R.W, 'Elementary Principles of Chemical Processes', Third Edition, John Wiley and Sons, Inc.2000.
2. K. V. Narayanan, B. Lakshmi kutty,' Stoichiometry and Process Calculations', PHI Learning Pvt. Ltd. Dec. 2016.
3. V. Venkataramani and N. Anantharaman,' Process Calculations', 2003.
4. Hougen, O.A., Watson. K.M. and Ragatz, R.A., Chemical Process Principles Part-I", John Wiley & Sons, (CBS Publishers & Distributor, New Delhi).

Course Plan

Course Title : Heat Transfer Operations	
Course Code : 201CHL214	**Semester : IV**
Teaching Scheme : L-T-P : 3-0-0	**Credits : 3**
Evaluation Scheme : ISE + MSE Marks : 20+30	**ESE Marks : 50**

Course 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.

Course Objectives - At the end of the course the student should be able to:

1. Understand basic knowledge of modes of heat transfer and various aspect of heat propagation.
2. Understand principal of heat flow.
3. Understand how to calculate heat flux with respect to geometrical dimensions and various modes of heat transfer.
4. Understand heat transfer without and with phase change.
5. To design heat exchange equipments with respect to process requirement as well process conditions in optimistic way.
6. Become aware about evaporation and would technically sound to design and operate evaporator.

Course Outcomes (COs):

At the end of the course the student should be able to:

C214.1	**Explain** the importance of basic knowledge of modes of heat transfer and various aspect of heat propagation.
C214.2	**Understand & memorize** the principal of heat flow.
C214.3	**Interpret** heat flux with respect to geometrical dimensions and various modes of heat transfer. pipe fittings.
C214.4	**Understand and compare** heat transfer without and with phase change.
C214.5	**Understand&distinguish** heat exchange equipments with respect to process requirement as well process conditions in optimistic way.
C214.6	**Solve** and **apply** knowledge about evaporation and would technically sound to design and operate evaporator.

Prerequisite:	----

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes
(POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C214.1	2	2	2	2											2
C214.2	3	3	2												1
C214.3	3	3	3	3							1				3
C214.4				2									2		4
C214.5	3	3	3						2				2		2
C214.6	3	3	2	3											3

Contents	Hours
Unit 1 - 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, introduction to semi-infinite solid and critical radius of lagging, Problems.	6
Unit 2 - 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-efficient from individual heat transfer coefficients, fouling factors, Problems.	6
Unit 3 - 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, effect of tube length, empirical equations, estimation of wall temperature, analogy equations, heat transfer to liquid metals, heat transfer by forced convection outside tubes, natural convection, Problems.	6
Unit 4 - Heat transfer to fluids with phase change: Heat transfer from condensing Vapors drop wise 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
Unit 5 - 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	6

heat transfer in agitated vessel, types, construction, definition of fin efficiency, problems.	
Unit 6 - 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

Text Books:

1. McCabe W.L., Smith J.C. and Herriot P., "Unit Operations in Chemical Engineering" , 7th edition McGraw Hill,2005.
2. Sukhatme S.P., "Heat Transfer",5thedition.,University Press India Ltd.,1996.

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.
6. Text Book: McCabe Smith, Peter Harriot, "Unit operations of Chemical Engineering" McGraw Hill Publications.

Course Plan

Course Title : Chemical Engineering Thermodynamics I	
Course Code : 201CHL215	**Semester : IV**
Teaching Scheme : L-T-P : 3-0-0	**Credits : 3**
Evaluation Scheme : ISE + MSE Marks : 20 + 30	**ESE Marks : 50**

Course Description: Thermodynamics sets hard limits on performance of processes and equipment. This course gives students the formalism and insights necessary to do a preliminary thermodynamic analysis of a chemical process.

Course Objectives (COs):

1. Explain the significance of thermodynamic properties of pure fluids & fluids in mixture.
2. Impart the knowledge of laws thermodynamics to chemical engineering processes.
3. Analyze & access thermodynamic properties, data from appropriate sources.
4. Estimate differences in thermodynamic properties using equation of state, charts, tables.
5. Formulate thermodynamic calculations orientated to the analysis and design & efficiency of various energy related chemical processes.
6. Determine the efficiency of processes involving heat into work, refrigeration and liquefaction.

Course Outcomes (COs):

At the end of the course the student should be able to:

C215.1	**Understand** the significance of thermodynamic properties of pure fluids & fluids in mixture.
C215.2	**Apply** the laws of thermodynamics to chemical engineering processes.
C215.3	**Analyze&** access thermodynamic properties, data from appropriate sources.
C215.4	**Explain** differences in thermodynamic properties using equation of state, charts, and tables.
C215.5	**Understand** thermodynamic calculations orientated to the analysis and design & efficiency of various energy related chemical processes.
C215.6	**Determine** the efficiency of processes involving heat into work, refrigeration and liquefaction.

Prerequisite:	XIIth Standard Physics and Chemistry, Applied Mathematics

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes
(POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C215.1	2	2	2	2									3		2
C215.2	3	2	2	2									2		2
C215.3	2	3	2	2									2		4
C215.4	2	2	2	2									2		3
C215.5	2	2	2	2									2		2
C215.6	2	2	2	2									2		3

Contents	Hours
Unit 1- Introduction to Chemical Engineering Thermodynamics Scope & limitations of thermodynamics, Dimensions and Units, Force, Temperature, Pressure, Work energy and Heat, Problems.	4
Unit 2 -First law of thermodynamics and other basic concepts Joules experiment, Internal energy, First law for non-flow process, Steady state flow processes, Equilibrium, The phase rule, Reversible and irreversible processes, Causes of irreversibility Reversible chemical reaction, Enthalpy, Heat capacity, Constant volume and pressure process, Heat effects .	7
Unit 3-Volumetric properties of pure fluids PVT behaviour of pure substances, Viral equation of state, Ideal gas temperature, First order phase transition, Two forms of viral equation, The ideal gas and equations for various processes, Problems, Application of the viral equation, Cubic equation of state. The Vander wall equation of state, Concept of Supercritical temperature.	7
Unit 4-Second law of thermodynamics Statements, Heat engine, Carnot theorem Ideal gas temperature scale, Carnot's equations,Thermodynamic temperature scale, concept of Entropy, Entropy changes of an ideal gas, Significance of Entropy, Mathematical statement of second law entropy changes for open system, Calculation of ideal work ; lost work, Third law of Thermodynamics.	6
Unit 5-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, Partial properties, Concept of activity, Application of thermodynamic equations to single phase systems, Two phase systems, Thermodynamic diagrams, P-H diagram, H-T diagram, T-S diagram, H-S diagram.	6

Unit 6 -Conversion of heat into work by power cycles Duct flow of compressible fluid, Steam power plant cycle, Internal combustion engines, Jet engines, Rocket engines. Refrigeration and liquefaction: Carnot cycle, Air refrigeration and vapour compression cycles, factors affecting the performance of the cycle, Choice of refrigerant. Absorption refrigeration, Heat pump, Liquefaction processes, Stoichiometric air fuel ratio.	6

Text Book:

1. J.M. Smith and H.C. Van Ness, "Introduction to Chemical Egg.", Thermodynamics 6th Edition, International student edition, McGraw Hill publication.

Reference Books:

1. B.F. Dodge,"Chemical Egg.Thermodynamics", International student edition McGraw Hill Publication.

2. D.A. Hougen, K.M. Watson and R.A. Ragatz, "Chemical Process Principles", (Vol. II 2nd Edn. Asia Publishing House.

3. K.V. Narayanan, "Chemical Engg. Thermodynamics", Prentice Hall India, New Delhi

Course Plan

Course Title : Computer Techniques Laboratory	
Course Code : 201CHP216	**Semester : IV**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 50	**ESE Marks : NA**

Course Description: The course contains application of C++ Programming and applications of programming for solving chemical engineering problems.

Course Objective (COs):

1.To Understand different programming concepts and Analyze programming languages skills.
2.To Apply chemical engineering applications and able to solve chemical engineering problems

Course Outcomes (COs):

At the end of the course the student should be able to:

C216.1	**Understand** different programming concepts and **Analyze** programming languages skills.
C216.2	**Apply** chemical engineering knowledge and Able to solve chemical engineering problems.

Prerequisite:	Chemical Engineering Basic Knowledge, Programming concepts

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C216.1	2	2	2	2	2									2	4
C216.2	2	2	2	2	2									2	3

List of Experiments			
Expt. No.	**Name of Experiment**	**Type**	**Hours**
1	Program to find circumference & area of circle, Program to find no. of months & days Program to convert degree Fahrenheit to degree Celsius	O	2
2	Program to find circumference & area of circle, Program to find no. of months & days Program to convert degree Fahrenheit to degree Celsius	O	2
3	Program to find circumference & area of circle, Program to find no. of months & days Program to convert degree Fahrenheit to degree Celsius	O	2
4	Program of based on different manipulator function, (setbase,setprecision,setfill,setw),	O	2
5	Program to sum of digits of five digit number, Program to reverse five digit no	O	2
6	Program to calculate roots of quadratic equation, Program of swap two no. taking third variable,	O	2
7	Program of find square of no, Program to calculate square & square root of given ’n ‘numbers	O	2
8	Program of Fibonacci No, Program based on addition and Product of given matrices	O	2
9	Calculation of Reynolds number, Calculation of pressure drop, Calculation vapor pressure	O	2
10	Calculation of friction factor, Calculation flow rates and average velocity in pipes.	O	2
11	Estimation of average molecular weight & density of gaseous mixture of n Components	O	2

12	Calculation of heat transfer area of heat exchanger for different flow pattern. Calculation of specific heat of flue gas containing n component gases	O	2

- S-STUDY, O-OPERATIONAL
- Minimum 10 Experiments should be conducted

Text Book:

1. RobertLafore, "Object Oriented Programming in Turbo C++", Galgotia Publication Pvt Ltd.

Reference Books :

1. R.J.Micheli, "C++ Object Oriented Programming", McMillan London.
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" .2nd Edition, Prentice hall, New Jersey.

Course Plan

Course Title : Industrial and Engineering Chemistry-II laboratory	
Course Code : 201CHP217	**Semester : IV**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE (POE) Marks : 25**

Course description:
The course contains experiments on quantitative analysis of compounds, instrumental analysis & organic estimations.

Course Objectives:
1. To estimate & to determine inorganic & organic compounds.
2. To prepare organic compounds & to estimate coloured compounds by Colorimetry.

Course Outcomes (COs):
At the end of the course the student should be able to:

C217.1	To determine inorganic & organic compounds
C217.2	Prepare organic compounds &analysecoloured compounds

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C217.1	3	2										1			3
C217.2	3	2										1			3

List of Experiments			
Expt. No.	**Name of Experiment**	**Type**	**Hours**
A) Inorganic -Quantitative Analysis: (Any 4)			
1	Determination of Percentage purity of FAS (Internal Indicator method)	O	2
2	Determination of Mg contents in Talcum powder.	O	2
3	Estimation of Nitrogen from given given fertilizer sample.	O	2
4	Determination of Ca contents in pharmaceutical tablets, ores etc.	O	2
5	Determination of % purity of H_2SO_4, NaOH,NH_3.	O	2
6	Estimation of Acetic acid in given Vinegar sample.	O	2
B) Instrumental Analysis: (Any2)			
7	Estimation of Copper by colorimetric method.	O	2
8	Estimation of Iron by colorimetric method.	O	2
9	Estimation of Nickel by colorimetric method.	O	2
C) Organic Estimations: (Any 3)			
10	To determine the amount of vitamin C present in certain commercial foodProducts by the titration method.	O	2
11	Determination of amount of Aspirin in given Pharmaceutical Tablets	O	2
12	Determination of Nitrogen content in given ammonium fertilizer samples like ammonium chlorides, ammonium sulphates etc.	O	2
13	Estimation of Phenol	O	2
14	Estimation of Acetone	O	2
15	Estimation of Commercial Oxalic Acid	O	2
16	Estimation of Aniline	O	2
D) Organic Preparations: (Any 1)			
17	Preparation of Aspirin from Salicylic acid.	O	2
18	Preparation of Phthalic anhydride from Phthalic acid.	O	2
19	Preparation of Benzoic acid from Benzamide.	O	2

- S-STUDY, O-OPERATIONAL
- Minimum 10 Experiments should be conducted

Text books:

1. Basic Inorganic Chemistry by Cotton & Wilkinson, John Wiley & sons
2. Organic chemistry – Bhal & Bhal(S. Chand -2000)
3. Organic chemistry -- P.L. Soni (S. Chand -1994)

Reference Books:

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, ELBS
3. Organic chemistry – Volume I& II- Finar&Finar (English language book society-1989)
4. Organic chemistry – Fieser & Fieser
5. Organic reactions and mechanism – Pitter Sykes (Orient Longman-1986)

Course Plan

Course Title : Heat Transfer Operations Laboratory	
Course Code : 201CHP218	**Semester : IV**
Teaching Scheme : L-T-P : 0-0-2	**Credits : 1**
Evaluation Scheme : ISE Marks : 25	**ESE (POE) Marks : 25**

Course Description – This is one of the fundamental course which deals with study of heat flow through various modes of heat transfer Viz. Conduction, Convection & Radiation. In lab work; verification of governing laws by varying various variable parameters is done.

Course Objective (COs):

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 the course the student should be able to:

C218.1	**Calculate** heat flux, thermal conductivity, Temperature gradient and heat transfer area.
C218.2	**Calculate** Individual as well as Overall heat transfer coefficients, LMTD of various heat exchange equipments.

Prerequisite:	--

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C218.1	3	1							1				1		3
C218.2	3	2							1				1		3

List of Experiments			
Expt. No.	**Name of Experiment**	**Type**	**Hours**
1	To determine thermal conductivity of an insulating powder.	O	2
2	To plot radial temperature distribution with determination of thermal conductivity.	O	2
3	To find out thermal conductivity of metal rod.	O	2
4	To determine surface heat transfer coefficients for vertical tube using heat by natural convection.	O	2
5	To find out heat transfer coefficient of forced convection.	O	2
6	To study and compare temperature distribution, heat transfer rate & Overall heat transfer coefficients in parallel flow and counter flow.	O	2
7	To determine the overall and individual heat transfer coefficients in 1:2 Shell & Tube heat exchanger.	O	2
8	To study drop wise and film wise condensation and to calculate average coefficient of entire tube.	O	2
9	To determine emissivity of plate.	O	2
10	To study Critical heat flux.	O	2
11	To determine the overall and individual heat transfer coefficients in Finned tube heat exchanger.	O	2
12	To determine effective thermal conductivity of a packed bed.	O	2
13	Demonstration of – a) Single effect evaporator	S	2

- S-STUDY, O-OPERATIONAL
- Minimum 10 Experiments should be conducted

Text Books:

1. McCabe W.L., Smith J.C. and Herriot P., "Unit Operations in Chemical Engineering" , 7th edition McGraw Hill,2005.
2. Sukhatme S.P., "Heat Transfer",5thedition.,University Press India Ltd.,1996.

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.
6.Text Book: McCabe Smith, Peter Harriot, "Unit operations of Chemical Engineering" McGraw Hill Publications.

Course Plan

Course Title : Fluid Flow Machinery Laboratory	
Course Code : 201CHP219	Semester : IV
Teaching Scheme : L-T-P : 0-0-2	Credits : 1
Evaluation Scheme : ISE Marks : 25	ESE(POE) Marks : 25

Course Description: The course includes experiments based on pumps, blowers and compressors.

Course Objectives:

1. To study the performance characteristics liquid flow machineries.
2. To study the performance characteristics gas flow machineries.

Course Outcomes (COs): At the end of the course the student should be able to:

C219.1	**Operate** different liquid flow machineries and able to test their performance characteristics.
C219.2	**Operate** different gas flow machineries and able to test their performance characteristics

Prerequisite:	Fluid Flow Operation

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C219.1	2	2		2									2		3
C219.2	2	2		2									2		3

List of Experiments			
Expt. No.	**Name of Experiment**	**Type**	**Hours**
1	Centrifugal Pump: To find the characteristics of Centrifugal Pump at Constant Speed.	O	2
2	Centrifugal Pump: To find the characteristics of Centrifugal Pump at Constant Discharge.	O	2
3	Reciprocating Pump: To find the performance of reciprocating pump and draw characteristic curves.	O	2
4	Gear Pump: To find the characteristic of gear pump at rated speed.	O	2
5	Vane Pump: To find the characteristic of vane pump.	O	2
6	Lobe Pump: To find the characteristic of lobe pump.	O	2
7	Peristaltic Pump: To find the characteristic of peristaltic pump.	O	2
8	Centrifugal Blower: To find the performance characteristics of centrifugal blower.	O	2
9	To study the principle, construction, working of fans	S	2
10	To study the principle, construction, working of centrifugal compressors	S	2
11	To study the principle, construction, working of vacuum pump	S	2
12	To study the principle, construction, working of steam jet ejector	S	2
13	To study the different types of valves.	S	2

- S-STUDY, O-OPERATIONAL
- Minimum 10 Experiments should be conducted

Text Books:

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

Reference Books:

1. Unit Operations of Chemical Engineering, Mccabe Smith Harriott, McGraw Hill International Edition, Chemical Engineering Series.
2. Coulson & Richardson's Chemical Engineering, Volume VI, third edition, Chemical Engg. Design.

Course Plan

Course Title : Professional Skill Devlopment	
Course Code : 201CHMC220	**Semester : IV**
Teaching Scheme : L-T-P : 2-0-0	**Credits : 0**
Evaluation Scheme : ISE + MSE Marks : NA	**ESE Marks : 50**

Course Description: The course contains Professional Skill Devlopment for overall development of students for industrial world.

Course Objectives:

1.To Understand Soft Skills Awareness
2.To Summarize methods for effective learning, reviewing and leadership styles
3. To Apply team work skills
4.To Apply knowledge to present effectively
5.To Apply skills to communicate effectively
6.To Analyze skills to develop personal self awareness

Course Outcomes (COs):

At the end of the course the student should be able to:

C220.1	**Understand** Soft Skills Awareness
C220.2	**Summarize** methods for effective learning, reviewing and leadership styles
C220.3	**Apply** team work skills
C220.4	**Apply** knowledge to present effectively
C220.5	**Apply** skills to communicate effectively
C220.6	**Analyze** skills to develop personal self awareness

Prerequisite:	----

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
C220.1									3	3					2
C220.2									3	3					2
C220.3									3	3					2
C220.4									3	3					3
C220.5									3	3					3
C220.6									3	3					4

Contents	Hours
Unit 1- Introduction To Soft Skills What is Soft Skills, Why do students need to learn Soft Skill, Types of Soft Skill, How to practice Soft Skill?	4
Unit 2- Personal Qualities / Leadership Introduction, components of personality, multitask handling, different types of personal qualities, introduction to personal evaluation and appraisal , Leadership skills Definition, types of leaderships, leadership styles difference between manager and leader	4
Unit 3- Business Etiquettes/ Interpersonal Skills Introduction, importance, different types of etiquettes, manners, protocols, corporate culture Interpersonal skills, Definition, significance, different types of interpersonal skills	4
Unit 4- Problem-Solving Skills Introduction, types of conflicts, Different steps in problem solving, barriers in problem solving, negotiation, Decision making, Problem Solving Skill,How to identify and categorize problems, Method for problem solving, Creativity in problem solving	6
Unit 5- Work Ethic	3

Definition of work ethic, Importance of values, types of management's ethics,work attitude	
Unit 6- Career Orientation Summarize industries and types of job,why we need to have career orientation,How to choose the right career, Common misperception about career development	3

Note : Students have to give presentation, seminar and different group activities on above units.

Text Books:

1. Robert M. Sherfield ; Rhonda J. Montgomery ; Pamcia g. Moody "Developing Soft Skills" , 4th Ed.
2. Organizational Behavior by Don Hellriegel, Jhon W. Slocum,Richard W. Woodman.

Reference Books:

1. Effective Technical Communication by M Ashraf Rizvi
2. Professional Communication Skills by Mr. A.K.Jain ,Pravin S. R. Bhatia
3. Behavioral Science by Dr. Abha Singh
4. Soft Skills for Everyone by Jeff Butterfield
5. Human behavior at Work by Keith Davis, Tata Magraw Hill Publication.
6. Management of Organizational Behavior ,Hersey P H I
7. Leadership in organization, by Gary A Yakl, Prentice – hall Igc. , Englewood Cliffs, 1991