SHIVAJI UNIVERSITY, KOLHAPUR

SYLLABUS

S. Y. B. Tech.

in

CHEMICAL ENGINEERING

(To be implemented from June, 2019 onwards)

Shivaji University, Kolhapur

Second Year B.Tech. in CHEMICAL ENGINEERING – CBCS PATTERN

SEMESTER - III

Sr. No	Course (Subject Title)	TEACHING SCHEME									EXAMINATION SCHEME										
		THEORY			TUTORIAL			PRACTICAL			THEORY					PRACTICAL			TERM WORK		
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Hours	Mode	Marks	Total Marks	Min	Hours	Max	Min	Hours	Max	Min
1	BSC-CH301	3	3	3	1	1	1	-	-	-		CIE ESE	30 70	100	40	As per BOS Guidelines	-	-	2	25	10
2	BSC-CH302	4	4	4	-	-	-	1	2	2		CIE ESE	30 70	100	40		50	20	2	50	20
3	PCC-CH303	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		-	-	2	25	10
4	PCC-CH304	3	3	3	1	1	1	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10
5	PCC-CH305	4	4	4	-	-	-	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10
6	PCC-CH306	1	1	1	-	-	-	1	2	2		-	-	-	-		-	-	2	50	20
	TOTAL	**18**	**18**	**18**	**2**	**2**	**2**	**5**	**10**	**10**				**500**			**100**			**200**	
	SEMESTER –IV																				
1	BSC-CH401	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40	As per BOS Guidelines	-	-		-	-
2	BSC-CH402	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		50	20	2	50	20
3	PCC-CH403	3	3	3	1	1	1	-	-	-		CIE ESE	30 70	100	40		-	-	2	25	10
4	PCC-CH404	3	3	3	1	1	1	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10
5	PCC-CH405	3	3	3	-	-	-	-	-	-		CIE ESE	30 70	100	40		-	-	2	25	10
6	PCC-CH406	1	1	1	-	-	-	1	2	2		-	-	-	-		-	-	2	50	20
7	PCC-CH407	-	2	2	-	-	-	1	2	2		-	-	-	-		25	10	2	25	10
8	MC-CH408	2	2	2	-	-	-	1	-	-		CIE ESE	30 70	100	10 30		-	-		-	-
	TOTAL	**18**	**19**	**19**	**2**	**2**	**2**	**5**	**8**	**8**				**600**			**100**			**200**	
	TOTAL	**36**	**37**	**37**	**4**	**4**	**4**	**10**	**18**	**18**				**1100**			**200**			**400**	

CIE- Continuous Internal Evaluation
ESE – End Semester Examination

• Candidate contact hours per week : 30 Hours (Minimum)	• Total Marks for S.E. Sem III & IV : **1700**
• Theory and Practical Lectures : 60 Minutes Each	• Total Credits for S.E. Sem III & IV : **50**
• In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.	
• There shall be separate passing for theory and practical (term work) courses.	

Note :

1. **BSC-CH** : Basic Science Course- Chemical Engineering are compulsory.
2. **PCC-CH :** Professional Core course –Chemical Engineering are compulsory.
3. **MC-CH :** Mandatory Course **:** Environmental Studies which is compulsory for theory 70 marks and project work 30 marks.

Shivaji University, Kolhapur

S.Y. B. Tech in Chemical Engineering Syllabus

w.e.f. June 2019-2020

Semester III

Sr. No	Code No.	Subject	Credits
1.	BSC-CH301	Engineering Mathematics-III	4
2.	BSC-CH302	Chemistry-I	5
3.	PCC-CH303	Strength of Materials and Materials of Construction	4
4.	PCC-CH304	Fluid Mechanics	5
5.	PCC-CH305	Mechanical Operations	5
6.	PCC-CH306	Soft Skill	2
		Total=	25

Semester IV

Sr. No	Code No.	Subject	Credits
1.	BSC-CH401	Engineering Mathematics-IV	3
2.	BSC-CH402	Chemistry-II	4
3.	PCC-CH403	Process Calculations	4
4.	PCC-CH404	Heat Transfer	5
5.	PCC-CH405	Chemical Engineering Thermodynamics-I	3
6.	PCC-CH406	Computer Practice-I	2
7.	PCC-CH407	Fluid Moving Machinery	1
8.	MC-CH408	Environmental Studies	3
		Total=	25

S.Y.B. Tech. in CHEMICAL ENGINEERING

Semester – III

1. BSC-CH-301 . ENGINEERING MATHEMATICS III

Teaching Scheme	Examination Scheme
Lectures : 3 hours/week	ESE : 70 Marks
Tutorial : 1 hour/week	CIE : 30 Marks
Credits : 4	Term Work : 25 marks
	Practical: Nil

Course Objectives:

1)To develop mathematical skills and enhance thinking power of students.

2)To give the knowledge to the students of Statistics, Linear Differential Equations ,Laplace transforms ,Probability, with an emphasis on the application of solving engineering problems

3)To prepare students to formulate a mathematical model using engineering skills & interpret the solution in real world.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1) Solve Linear Differential Equations with constant coefficients.
2) Make use of linear Differential Equation to **solve** the Chemical Engineering problems.
3) Solve basic problems in probability theory, including problems involving the binomial, Poisson, and normal distributions.
4) Find Laplace transforms of given functions
5) Apply Laplace transforms to solve Linear Differential Equations
6) Describe the statistical data numerically by using Lines of regression and Curve fittings.

SECTION – I

Unit 1. Linear Differential Equations **07**

1.1 Linear Differential equations with constant coefficients.
1.2 Rules to find complementary function.
1.3 Methods to find particular Integral (e^{ax}, sinax or cosax, x^m, $e^{ax}x^m$, $e^{ax}sinax$ or $e^{ax}cosax$)
1.4 System of simultaneous Linear differential with constant coefficients.

Unit 2 Application to Linear differential equations: 07

2.1 Chemical reactions and solutions (mixture problems).
2.2 Conduction of heat.
2.3 Chemical Reactions-Law of mass action

Unit 3. Probability Distribution: 07

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.

SECTION – II

Unit 4. Laplace Transformation 07

4.1 Laplace transform of elementary functions
4.2 Properties of Laplace transforms
  4.2.1Linearity Property
  4.2.2 First Shifting property
  4.2.3 Change of scale property
4.3 Laplace transforms of derivatives and integral.
4.4 Multiplication by t^n and division by t
4.5 Evaluation of integrals by Laplace transform.

Unit 5. Inverse Laplace Transform: **07**

5.1 Definition and important formulae
5.2 First shifting property
5.3 Inverse Laplace transform by method of partial fraction
5.4 Convolution theorem (without proof)
5.5 Inverse Laplace transform of derivatives
5.6 Solution of Linear differential equation with constant coefficients using Laplace transform

Unit 6. Correlation, Regression & Curve Fitting: 07

6.1 Introduction.
6.2 Lines of regression of bivariate data.
6.3 Fitting of Curves by method of Least-squares:
  6.3.1 Fitting of Straight lines.
  6.3.2 Fitting of exponential curves.
  6.3.3 Fitting of second degree Parabolic curves.

Text Book

1) Higher Engineering Mathematics, by B. S. Grewal (Khanna Publication Delhi.)

Reference Books

1) Advance Engineering Mathematics by Erwin Kreyszig (Wiley India.)
2) Advanced Engineering Mathematics, by H. K. Das (S. Chand Publication.)
3) Differential Equations and Their applications, by Zafar Ahsan (Prentice-Hall of India PVT)
4) A text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar, Vidyarthi Griha Prakashan, Pune.

General Instructions:

1) For the term work of 25 marks, batch wise tutorials are to be conducted. The number of students per batch per tutorial should be as per University rules.
2) Number of assignments should be at least six (All units should be covered).
3) Case studies are to be covered based on chemical engineering.

2. BSC-CH-302. CHEMISTRY –I

Teaching Scheme	Examination Scheme
Lectures : 4 hours/week	ESE : 70 Marks
Practical : 2 hrs/batch/week	CIE : 30 Marks
Credits : 5	Term Work : 50 Marks
	Practical: 50 Marks

Objective:

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

SECTION – I (Physical Chemistry)

Unit 1-a) Chemical kinetics (7 Lectures)

Introduction, Order and Molecularity of reaction, Rate of reaction, Rate constant,
First order reaction: Defination, Examples, Derivation and Characteristics of first order reaction and Numericals.
Second order reaction: Defination, Examples, Derivation with equal concentration and Characteristics of second order reaction and Numericals,

b) Phase Rule (4 Lectures)

Phase Rule : Introduction, Gibbs Phase Rule equation and explanation and terms involved in the equation. Phase diagram, One component systems: Water system.

Unit 2 – Catalysis(7)

Defination, characteristics, types-homogeneous and heterogeneous, theory of catalysis, catalyst: acid base, solid catalysts like metal oxides and zeolites, phase transfer catalysts, enzyme catalysts (Biocatalysts) mechanism of catalysis.

Unit 3 – Solution(6)

Defination, types, ways of expressing concentrations, numericals, solutions of gasses in gasses, Henry's law, Nernst distribution law- statement, explanation, limitations and numericals

SECTION – II (Organic Chemistry)

Unit 4 - Organic Reactions & Reactive Intermediates: (8 Lectures)

Types of Organic Reactions: Addition, substitution, Elimination, Rearrangement and polymerization
Reactive Intermediates: Carbocation, Carbanion, Carbon Free Radicals and Carbenes – their formation, structure & stability. Reactions involving formation of reaction intermediates like
Carbocation : Friedal Craft's reactions.**Carbanion :** Aldol condensation reaction.
Free radical : Free radical polymerization of ethylene to polyethylene.
Carbenes : Reimer-Tiemann Reaction

Unit 5 - Chemistry of Dyes (8 Lectures)
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, Synthesis and applications of dyes like methyl orange ,Malachite green and Alizarin.

Unit 6 – Chemistry of Surfactants (8 Lectures)
Introduction of surfactants,
Soaps: Types of Soaps, Structure of Soap molecule, Cleansing action of soaps, Saponification and its value, Manufacture of soap by Modern process.
Detergents: Types, Properties and applications, Cleansing action of detergents, Comparison of Soaps and detergents, synthesis of anionic detergents(DDBS).

PRACTICALS (Minimum 10 Experiments should performed)

A) Chemical Kinetics: (Any THREE)

1) Determination of reaction rate constant of catalyzed hydrolysis of methyl acetate in 0.5N HCl

2) Determination of reaction rate constant of catalyzed hydrolysis of methyl acetate in 0.5N H_2SO_4

3) Determination of reaction rate constant of reaction between $K_2S_2O_8$ & KI (Unequal conc.)

4) Determination of reaction rate constant of reaction between $KBrO_3$ & KI (Equal conc.)

5) To determine partition coefficient of Benzoic acid in benzene and water.

6) Study of decomposition of hydrogen peroxide ($KMnO_4$ method) B) Organic Spotting: (Minimum FIVE compounds with one must liquid) Identification of organic compounds Compounds Examples

7) Acidic (Any one) Benzoic Acid, Salicylic acid, Oxalic acid, Acetic acid

8) Phenolic (Any one) α-Naphthol, β-Naphthol, Phenol

9) Basic (Any one) o/m/p-nitroaniline, Aniline

10) Neutral (Any two) Ethanol, Acetone, Acetamide, Benzamide, Acetanilide, Glucose. Naphthalene C) Preparations & Purification of some simple organic compounds (Any ONE)

12) Preparation of benzene azo-β-naphthol dyestuff

13) Preparation of Soap Note: Purification can be done by Sublimation, Filtration, Crystallization, Simple Distillation, Steam Distillation, TLC etc. D) Organic Estimations: (Any ONE)

14) Determination of saponification value of the given oil sample

15) Estimation of Glucose in Glucon-D

16) Estimation of Acetone

Reference Books for Physical chemistry:

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)

4. Text book of physical chemistry - Gladstone (Macmillan India Ltd. - 1995)
5.Inorganic Chemistry - A. I. Vogel

Reference Books for Organic Chemistry:

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)

Reference Books for Practicals

1. Practical organic chemistry -- A. I. Vogel (CBS-1987)
2. Laboratory experiments for General, Organicand 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,

3. PCC-CH-303. STRENGTH OF MATERIAL & MATERIAL OF CONTRUCTION

Teaching Scheme	Examination Scheme
Lectures : 3 hours/week	ESE : 70 Marks
Practical : 2 hrs/batch/week	CIE : 30 Marks
Credits : 4	Term Work : 25 Marks
	Practical: Nil

Course Objectives:

The course will help the student to
1. Acquire basic knowledge of material testing
2. Understand various material and its properties and manufacturing methods
3. Describe the scope of material selection in multidisciplinary industries.

Course Outcomes:

The course will help the student to

- Define the relations between simple stress and strains.
- Analyze two dimensional stress system and torsion in shaft
- Classify thin cylinders, thick cylinders and spheres
- Explain the theories of failure.
- Select right material of construction to avoid the material failure
- Estimates economics in material selections

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SECTION – I

Unit 1 - Introduction to strength of materials: Equilibrium of rigid beam under general force system, concept of stress, simple stresses and strain, ultimate and working stress, Properties of materials, elastic constant relation between elastic constants, compound bars, temperature stresses. (6L)

Unit 2 - Analysis of two-dimensional stress system: Principal stresses, Mohr's circle of Stress

Torsion of shafts: Torsion equation, strength and stiffness of solid and hollow circular shafts. Transmission of power. (6L)

Unit 3 - Thin cylindrical and Spherical shells: Subjected to fluid pressure wire wound cylinders.

Thick Cylinder: Lamis theory, Design of thick cylindrical shell, Thick Spherical Shells. (5L)

SECTION – II

Unit 4 - 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 . (6L)

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).

Unit 6 - Introduction to Mechanical properties of materials, Selection of right material, Materials Failure, Materials standards and specifications, Economics in material selection. Fabricating characteristics of metals (4L)

Term Work:

- Tension test on mild steel.
- Compression test on mild steel and timber
- Hardness test – brinell and Rockwells
- Torsion test
- Impact test charpy and izod.
- Shear test-double shear

References :

•Punmia B.C. 'Strength of Materials and Mechanics of Structure'-Vol.I- Standard Publications, Delhi.

- C. Patel, T.D. Bhagia, 'Strength of Materials ' Vol. I, C. Jamnadas & Co. Mumbai
- Ramamruthm, 'Strength of Materials' , - Dharapatray & Sons, Delhi , 1998.
- Sarkar B.K. 'Strength of Materials', -- Allied Publishers, New Delhi , 2001.
- William Nash, 'Strength of Materials', IVth Ed. McGraw Hill Publication.

6. Bhattacharya B.C., 'Selection of materials and fabrication for Chemical Process Equipment, Chemical Engg.' , Educational Development Centre , IIT Madras

7. Coulson & Richardson 'Chemical Engineering', Volume VI, Pergamen Press .

8. Robert N. Perry & Don Gress , 'Perry's Chemical Engineers Handbook', VIth ed. McGraw Hills International Ed. Newyork 1984.

9. D. Venkateswarlu & other, Chemtech -I, ‘First volume of manual of Chemical Technology’, Chemical Engg. Educational Development Centre, IIT Madras.
10. Corrosion Engineering IIndedition Mars G.Fontana.

4. PCC-CH-304. FLUID MECHANICS

Teaching Scheme	Examination Scheme
Lectures : 3 hours/week	ESE : 70 Marks
Tutorial : 1 hour/week	CIE : 30 Marks
Practical : 2 hrs/batch/week	
Credits : 5	Term Work : 25 Marks
	Practical: 25 Marks

Objectives

The students completing this course are expected to understand the importance and the role of fluid mechanics & fluid moving machinery in the field of chemical Engg. They will be able to understand the how the momentum balance can be made by considering the nature of the fluid, as it applies to the internal & external fluid flow systems. They are able to understand the behavior of fluids & their basic equations such as Bernoulli's Equation without friction & with friction and also flow of compressible fluids. They are also expected to understand the transportation, metering of fluids, flow past immersed bodies, Ergun's equation, and concept of fluidization and agitation of fluids.

SECTION – I

Unit 1 - 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, Inclined tube manometers. (6L)

Unit 2 - 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, Eddy viscosity, 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 (7L)

Unit 3 - 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. (7L)

SECTION – II

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, rotameter, turbine meters, positive displacement meters, magnetic meters: ultrasonic meters. (6L)

Unit 5 - 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, particulate andaggregative fluidization, minimum fluidization velocity, expansion of -fluidized beds, application of fluidization. (7L)

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. (7L)

Term Work :

1. Venturimeter

2. Orifice meter.

3. Reynold’s experiment.

4. Bernoulli’s experiment

5. Flow through helical coils

6. Flow through annular pipe

7.Flowthrough pipe & pipe fittings.

8.Flow through spiral coils

9.To study the properties of Newtonian and Non- Newtonian fluids.

10.Demonstration of – a) Rotameter b) Pitot tube

11. Flow through V-Notch and Open channel

Text Book: 1. Mc Cabe W.L. and Smith J.C. 'Unit operations of Chemical Engg.' VII ed. Mcgraw Hill Book Co., International ed. 1993

References: 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. 5. Bansal R.K.' Texbook of Fluid mechanics and hydrolic machines', Firewall media, 2005.

5. PCC-CH-305 MECHANICAL OPERATIONS

Teaching Scheme	Examination Scheme
Lectures : 4 hours/week	ESE : 70 Marks
Practical : 2 hrs/batch/week	CIE : 30 Marks
Credits : 5	Term Work : 25 Marks
	Practical: 25 Marks

Objective

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.

Outcomes

1) Learn fundamentals/basics such as characterization of particles, properties, storage, transporting solid particles and design equations.
2) Students will be able to understand the basics of size reduction, principles, working and construction of various size reduction equipments and designing of equipments.
   Identify principles, working and construction of separation of solid-solid and calculating efficiency of screening equipment.
3) Students will learn basics of mixing and blending and also learn the principles, working and construction of mixing equipments.
4) Students will be able to understand the details of filtration and sedimentation, design equations of filtration and sedimentation, also identify principles, working and construction of separation of solid- liquid.
5) Identify industrial applications and principles, working and construction of separation of solid-gas.
6) Identify industrial applications and principles, working and construction of separation of liquid-solid and solid-solid.

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. Properties of solid masses, Storage of solids (Bulk and Bin), Flow through Hoppers, Angle of repose and angle of friction, Introduction to conveying of solids. (5 L)

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 communiation.

Screening: Standard test screens, Standards of screen, Screen effectiveness, Comparison of ideal and actual screens, Industrial screening equipment. (12 L)

Unit 3 - Mixing of solids

The degree of mixing, Rate of mixing, Criteria for mixer effectiveness, Solid-liquid mixing, Solid-Solid mixing. (5 L)

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, Preliminary treatment of slurries before filtration, Filtration equipment, Filter selection, Filter press, Vacuum filters, Centrifugal filtration and Filtration calculations, Strainers.

Sedimentation: Basic principles, Flocculation, Thickeners, Batch sedimentation test. (10L)

Unit 5 – Gas Cleaning

Introduction, Gas cleaning equipment, Gravity separators, Centrifugal separators, Momentum separators, Electrostatic precipitators, Liquid washing, Odour removal, Fabric filters, Impingement method, Agglomeration and Coal essence. (4 L)

Unit 6 - Benefaction Process in Chemical Engineering

Jig classification, Heavy medium separation, Wilfiley table. (4 L)

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
10. Rotary Drum Filter

Demonstration of following equipement and include in journal

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

Industrial Visit

Industrial visit to Sugar industry, Distillery industry or any other chemical industry. Visit report should be submitted inclusive of following topics conveying, screening, filtration, cyclone separator, crusher etc.

Text Book

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.

References:

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

6. PCC-CH-306 SOFT SKILL

Teaching Scheme	Examination Scheme
Lectures : 1 hours/week	ESE : Nil
Practical : 2 hrs/batch/week	CIE : Nil
Credits : 2	Term Work : 50 Marks
	Practical: Nil

COURSE OUTCOME

- **CO1** Understand Soft Skills Awareness
- **CO2** Summarize methods for effective learning, reviewing and leadership styles
- **CO3** Apply team work skills
- **CO4** Apply knowledge to present effectively
- **CO5** Apply skills to communicate effectively
- **CO6** Analyze skills to develop personal self awareness

SECTION – I

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?

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.

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

SECTION – II

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

UNIT 5- WORK ETHIC

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.

TERM WORK MARKS SHALL BE BASED ON

- IQ and EQ tests,
- Leadership essays
- Time schedules of different organizations Brainstorming
- Technical Presentation
- Team work- case study
- Corporate meeting
- Case study of corporate problem
- Self evaluation

REFERENCE BOOKS:

- Robert M. Sherfield ; Rhonda J. Montgomery ; Pamcia g. Moody "Developing Soft Skills" , 4th Ed.
- Organizational Behavior by Don Hellriegel, Jhon W. Slocum,Richard W. Woodman. Emotional intelligence, Danial Golman
- Human behavior at Work by Keith Davis, Tata Magraw Hill Publication.
- Managemwnt of Organizational Behavior ,Hersey P H I
- Leadership in organization, by Gary A Yakl, Prentice – hall Igc. , Englewood Cliffs, 1991

S.Y.B. Tech. (CHEMICAL ENGINEERING)

Semester – IV

1. BSC-CH-401 ENGINEERING MATHEMATICS-IV

Teaching Scheme	Examination Scheme
Lectures : 3 hours/week	ESE : 70 Marks
Tutorial : Nil	CIE : 30 Marks
Credits : 3	Term Work : Nil
	Practical: Nil

Course Objectives:

1)To develop mathematical skills and enhance thinking power of students.

2)To give the knowledge to the students of Vector Differential Calculus, 2 Partial Differential Equations, Numerical Differentiation, Fourier Series, with an emphasis on the application of solving engineering problems

3)To prepare students to formulate a mathematical model using engineering skills & interpret the solution in real world.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1) Apply knowledge of vector differentiation to find directional derivatives, curl and divergence of vector fields.
2) Form and solve partial differential equations
3) Find values of first, second and third derivative at a particular point
4) Calculate numerical Integration.
5) Develop Fourier series expansion of a function over the given interval.
6) Make use of Partial Differential Equation to solve the Chemical Engineering problems.

SECTION – I

Unit 1. Vector Differential Calculus: 07

1.1 Differentiation of vectors.
1.2 Gradient of scalar point function.
1.3 Directional derivative.
1.4 Divergence of vector point function.
1.5 Curl of a vector point function.
1.6 Irrotational, Solenoidal and Scalar potential function of a vector field.

Unit 2 Partial Differential Equations: 07

2.1 Formation of partial differential equation.
2.2 Lagranges method to solve first order linear partial differential equations of the form
2.3. Standard method to solve first order non-linear partial differential equations of the
2.3.1 Form I $f(p,q)=0$
2.3.2 form II $f(z,p,q)=0$
2.3.3 form III $f(x,p)=g(y,q)$

2.3.4 Clairauts form z= px+qy+f(p,q)

Unit 3: Numerical Differentiation 07

3.1 Definition

3.2 Numerical differential by using

3.2.1 Newton's forward difference interpolation formula

3.2.2 Newton's backward difference interpolation formula

3.2.3 Sterling's central difference interpolation formula

3.2.4 Newton's divided difference formula

SECTION – II

Unit 4. Numerical Integration: 06

4.1 Newton Cotes formulae

4.2 Trapezoidal Rule.

4.3 Simpson's 1/3 rd rule.

4.4 Simpson's 3/8 th rule.

4.5 Weddle's Rule.

Unit 5. Fourier Series: **07**

5.1 Introduction

5.2 Definition, Euler's formulae.

5.3 Dirichlet's conditions.

5.4 Change of interval.

5.5 Expansions of odd and even functions.

5.6 Half range series.

Unit 6 Partial Differential Equations and Applications: 08

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

Text Book

1) Higher Engineering Mathematics, by B. S. Grewal (Khanna Publication Delhi.)

Reference Books

1) Advance Engineering Mathematics by Erwin Kreyszig (Wiley India.)
2) Advanced Engineering Mathematics, by H. K. Das (S. Chand Publication.)
3) Numerical Methods in Engineering and Science, by Dr. B. S. Grewal (Khanna Publication, Delhi)
4) A text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar, Vidyarthi Griha Prakashan, Pune.

General Instructions:

1) Case studies are to be covered based on chemical engineering.

2. BSC-CH-402 CHEMISTRY –II

Teaching Scheme	Examination Scheme
Lectures : 3 hours/week	ESE : 70 Marks
Practical : 2 hrs/batch/week	CIE : 30 Marks
Credits : 4	Term Work : 50 Marks
	Practical: 50 Marks

Objective

1) To study heavy industrial chemistry and its advantages.
2) To study various non aqueous solvents and its applications.
3) To become aware of various introductory Nuclear reactions and its applications.
4) To impart knowledge of heterocyclic chemistry.
5) To study chemistry of petrochemicals and polymers.
6) To study basic concepts and synthesis of biomolecules.

SECTION – I (Inorganic Chemistry)

Unit-1 ***a) Inorganic Heavy Industries: (3Lectures)***

Le Chatelier's principle, Manufacture of H2SO4 (contact process), NH3 (Haber's process) w.r.t. Reactions, Reactants, Catalyst and Physicochemical principles.

b) Inorganic Chemicals used in Industry: (3 Lectures)

Preparation, properties and uses of Ferrous Ammonium Sulphate(FAS), Sodium Hydroxide.

Unit- 2 Solvents (6Lectures)

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) study of few important nonaqueous solvents such as Liquid NH3, Liquid HF w.r.t. solvent characters and reactions**.**

Unit- 3 Nuclear chemistry (6 lectures)

Introduction, nuclear reactions, types of nuclear reactions (artificial transmutation, artificial radioactivity, nuclear fission , nuclear fusion), isotopes and application, nuclear reactors , applications of radioactivity

SECTION – II (Organic Chemistry)

Unit-4 Chemistry of Heterocycles (6 Lectures)

Introduction , Classification of Heterocycles, Synthesis, properties and uses of

a) Five Membered Heterocycles **:** Pyrrole & Furan

b) Six Membered Heterocycles **:** Pyridine

c) Condensed Heterocycles : Quinoline

Unit-5 Chemistry of Petrochemicals and polymers (6lectures)

a) Petrochemicals)-Introduction , Composition of Petroleum, Refining of crude oil, Cracking, Types of cracking, Octane number and Cetane number, Additives for improving antiknock properties.

b) Polymers--introduction, Compounding of Plastics, Preparation, Properties and Applications of Teflon, Polystyrene, BUNA Rubber, Butyl Rubber and Thiokol Rubber

Unit-6 Biotechnology (6Lectures)

Introduction, Multidisciplinary nature of Biotechnology, Structure and composition of cell, molecules of life-Biomolecules – Carbohydrates, Proteins, Lipids ,Enzymes. (Structure, function)

PRACTICALS (Minimum 10 Experiments should performed)

A) Inorganic Quantitative Analysis: (Any 3)

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 H_2SO_4, NaOH,NH_3.
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 C) Organic Estimations: (Any 4)
10) To determine the amount of vitamin C that is present in certain commercial food Products by the titration method.
11) Determination of amount of Aspirin in given Pharmaceutical Tablets
12) Determination of Nitrogen content in given ammonium fertilizer samples like ammonium chlorides, ammonium sulphates etc.
13) Estimation of Phenol
14) Estimation of Acetone
15) Estimation of Commercial Oxalic Acid
16) Estimation of Aniline D) Organic Preparations: (Any 1)
17) Preparation of Aspirin from Salicylic acid
18) Preparation of Phthalic anhydride from Phthalic acid
19) Preparation of Benzoic acid from Benzamide

Reference Books for Inorganic Chemistry:

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) Basic Inorganic Chemistry by Cotton & Wilkinson, John Wiley & sons

Reference Books for Organic Chemistry:

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)

Reference Books for Practicals

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,

3. PCC-CH-403 PROCESS CALCULATIONS

Teaching Scheme	Examination Scheme
Lectures : 3 hours/week	ESE : 70 Marks
Tutorial : 1 hours/week	CIE : 30 Marks
Credits : 4	Term Work : 25 Marks
	Practical: Nil

Outcomes : Student will be able to;

1) define the basic chemical calculations, conversions and the laws of gases system
2) Explain combustion calculations and reactive, non reactive process
3) develop material balances on unit operations and processes
4) categorize the bypasses, recycle streams and their importance's
5) interpret material balance with and without chemical reactions
6) formulate simultaneous material and energy balances on various chemical operations

SECTION – I

Unit I Basic Chemical Calculations (10L)

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 Systems :Gaseous mixtures, Daltons law, Amagat's law, Average molecular weight, Density of gaseous mixture, Estimation of vapour pressure.

Unit II Material Balances without Chemical Reaction(9L)

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

Unit III Material Balances with Chemical Reaction (9)

Definition of terms involved; Generalized approach for solving problems; Material balance problems involving chemical reaction; Electrochemical reactions; Metallurgical applications; Recycle, bypass and purge calculations.

SECTION – II

Unit IV Energy Balances on Non Reactive Processes(9L)

Elements of energy balance calculations; Change in pressure at constant temperature; Change in temperature; Phase change operations; Mixing and solutions.

Unit V Energy Balances on Reactive Processes(8L)

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.

Unit VI Fuels & Combustion (7)

Calorific Value of Fuel ,GCV & NCV OF fuel ,Minimum air required, Excess air, Combustion calculations.

Text Books :

1. Bhatt B.I. and Vora S.M.,'Stoichiometry', Fourth Edition, Tata McGraw-Hill Pub. Co. Ltd., 2004

Reference Books :

1. K.V.Narayanan, B. Lakshmikutty,'Stoichiometry and Process Calculations', PHI Learning Pvt. Ltd. Dec2016.

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 and N.Anantharaman,'Process Calculations', 2003

4. PCC-CH-404 HEAT TRANSFER

Teaching Scheme	Examination Scheme
Lectures : 3 hours/week	ESE : 70 Marks
Tutorial : 1 hours/week	CIE : 30 Marks
Practical : 2 hrs/batch/week	
Credits : 5	Term Work : 25 Marks
	Practical: 25 Marks

Objectives

The students completing this course are expected to understand the nature and the role of the Heat transfer in the various operations of chemical Engg. They will be able to access the property data from the appropriate source which are useful for energy balance. They will recognize and understand the different modes of Heat transfer and restriction of the Energy laws. They will be able to understand the principles of Heat transfer in fluids, Heat transfer to fluids without phase change, and with phase change. They are expected to understand how the heat transfer takes place during Radiation & make the Enthalpy balance across the single effect evaporator & multiple effect evaporators. They will use this knowledge to simple design calculations of Heat Exchanger.

SECTION – I

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, equation for one and three dimensional conduction, and introduction to semi-infinite solid and critical radius of lagging, Problems. (6L)

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-efficients from individual heat transfer coefficients, fouling factors. Transfer units in heat exchangers, Problems. (7L)

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, 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, heat transfer by forced convection outside tubes, natural convection, Problems. (7L)

SECTION – II

Unit 4 - 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. (6L)

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 heat transfer in agitated vessel, types, construction, definition of fin efficiency, problems. (8L)

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 (6L)

Term Work:

1. Emissivity measurement apparatus.

2. Natural convection.

3. Forced convection.

4. Heat transfer through lagged pipe.

5. Thermal conductivity of metal rod.

6. Double pipe heat exchanger.

7. Packed bed heat exchanger.

8. Single and multiple effect evaporator.

9. Heat transfer through agitated vessel.

10. Shell and tube heat exchanger.

11. Fin tube heat exchanger.

12. Compact heat exchanger

13. Dropwise and filmwise condensation.

14. Critical heat flux.

Minimum 10 practicals are to be conducted.

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.,University Press India Ltd.,1996.

References: 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.

5. PCC-CH-405 CHEMICAL ENGINEERING THERMODYNAMICS -I

Teaching Scheme	Examination Scheme
Lectures : 3 hours/week	ESE : 70 Marks
Tutorial : Nil	CIE : 30 Marks
Credits : 3	Term Work : 25 Marks
	Practical: Nil

Course Outcomes : Student will be able to;

1) define & describe the significance of thermodynamic properties of pure fluids & fluids in mixture.
2) apply the laws of 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 & computer resources.
5) formulate thermodynamic calculations orientated to the analysis and design & efficiency of various energy related chemical processes.
6) interpret thermodynamic data for application in process safety , biological sciences , energy & environmental sciences.

SECTION – I

Unit 1

Introduction: Scope & limitations of thermodynamics, Dimensions and Units, Force, Temperature , Pressure, Work energy and Heat, Problems (4L)

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, Reversible chemical reaction, Enthalpy, Heat capacity, Constant volume and pressure process(8L)

Unit 3

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 vander wall equation of state,Concept of Supercritical Temp.(8L)

SECTION –II

Unit 4

Second law of thermodynamics: Statements, Heat engine, Carnot theorem Ideal gas temperature scale, Carnot's quations,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,Third law of Thermodynamics, Problems**.(6L)**

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, Residual properties by equation of state, 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 etc(7L)

Unit 6

Conversion of heat into work by power cycles : Steam power plant cycle, Internal combustion engines, Jet engines,Rocket engines. Refrigeration and liquefaction : Carnot cycle, Air refrigeration and vapor compression cycles, Choice of refrigerant. Absorption refrigeration, Heat pump, Liquefaction processes,Cryogenic Processes(7L)

Text Book:

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

References:

1. B.F. Dodge, "Chemical Engg. 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.

6. PCC-CH-406 COMPUTER PRACTICES

Teaching Scheme	Examination Scheme
Lectures : 1 hours/week	ESE : Nil
Practical : 2 hrs/batch/week	CIE : Nil
Credits : 2	Term Work : 50 Marks
	Practical: Nil

Objective The students completing this course are expected to understand the importance and the role of computer programming in the field of chemical Engg. They will be able to develop the program based on the chemical Engineering application by using C++ language. For example with the help of programming language, they will be able to design the heat exchanger, they can develop the program for vapour pressure, specific heat, flow through branching section, calculation of mole fraction, minimum number of stages, minimum Reflux Ratio & for the estimation of optimum diameter. They are also expected to develop the program for how the concentration will change with time.

Programming in "C++"

Unit 1 – Introduction, History of C++ language. Data Types,Operators,

Expressions, Flowcharts , Algorithms

Unit 2- Control Statements and Loops.

Unit 3- Functions-Defining, Types of functions,Recursive function.

Uni 4-Array , array declaration, array and functions, multidimensional array. Unit 5- Structure

Unit 5- Classes and Objects.

Term Work 1. Quadratic equations

2. Small and Large numbers

3. Ascending and Descending order

4. Fibonacci numbers

5.Recurssive Function

6. Matrix addition , Substraction and multiplication

7.Program on classes

8. Program on structure.

Text Books 1. E. Balagurusamy , Programming in ANSY C, 2nd ed.

Mc-Graw Hills Publishing Co. 1989.

2. K.R. Venugopal and Sudeep R. Prasad , Mastering C++

Mc-Graw Hills Publishing Co. 1997.

References: 1. Byron Gottfried , Programming with C , Mc-Graw Hills

Publishing Co. 1998

2.D. Ravichandran, Programming with C++ IInd Edition, Tata

McHill Publicing Co. Ltd. New Delhi.

3)Sumitabha Das, Unix Concepts and Applications, 2nd ed., Mc-

Graw Hills Publishing Co 1998 3. Microsoft Ms-Dos Users Guide

7. PCC-CH-407 FLUID MOVING MACHINERY

Teaching Scheme	Examination Scheme
Lectures : 2 hours/week	ESE : Nil
Practical : 2 hrs/batch/week	CIE : Nil
Credits : 1	Term Work : 25 Marks
	Practical: 25 Marks

Course Outcomes

CO1 Describe behaviour, components and operation of pumps.
CO2 To introduce the theory of centrifugal pumps in line with performance characteristics.
CO3 To determine and analyze the performance aspects of reciprocating pump
CO4 Identify the differences between the different types of rotary pumps.
CO5 Describe the causes and remedies of common pump operating conditions/ maintenance problems
CO6 Distinguish the working of Fans, Blowers, and Compressors

SECTION – I

UNIT 1 – PUMP INTRODUCTION:

Centrifugal pumps classification of pumps, classification of centrifugal pumps, impellers, casings, volute pumps, volute pumps with vortex chamber, diffuser vanes,

UNIT 2 – BASIC THEORIES OF CENTRIFUGAL PUMPS:

Theory of centrifugal pump, Work done by centrifugal pumps, developed head of centrifugal pump, efficiency of centrifugal pump, minimum speed for functioning of centrifugal pump, multistage centrifugal pumps, pumps in series, pumps in parallel, specific speed of centrifugal pump, model testing suction lift, priming, binding, cavitation, effect of cavitation, NPSH, calculation of horse power requirement, operating characteristics, comparison, advantages and disadvantages, thumb rule, dimensional analysis, Affinity Law, problems.

UNIT 3 – BASIC THEORIES OF 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.

SECTION –II

UNIT 4 – TYPES OF POSITIVE DISPLACEMENT PUMPS

Piston pumps, plunger pump, diaphragm pump, metering pump, rotary pump, rotary gear pump, rotary lobe pump, rotary vane pump, flexible vane pump, peristaltic pump, mono pump.

UNIT 5 –SELECTION, INSTALLATION AND OPERATION:

Selection of pumps operating conditions, operating difficulties, comparison between various types of pumps, selection criterion in industries, maintenance of pumps.

UNIT 6 – FANS, BLOWERS, AND COMPRESSORS OF PUMPS:

Fans characteristics, operating pressure conditions, types of blowers, positive displacement blower, centrifugal blower, types of compressors, centrifugal compressor, reciprocating compressor, equations for blower and compressors adiabatic compression, isothermal compression, polytrophic compression, compressor efficiency, power equations, vacuum pumps, its working and principle, steam jet ejector, theory of compression, problems.

TEXTBOOKS:

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.

REFERENCE BOOKS:

1) Unit Operations of Chemical Engineering, Mc cabe Smith Harriott, McGraw Hill International Edition, Chemical Engineering Series.

2) Coulson & Richardson's Chemical Engineering, Volume VI, third edition, Chemical Engg. Design.

Term Work: Minimum five assignments covering all problems of the syllabus are to be completed by the students.

PRACTICALS:

1) Centrifugal pump test rig

2) Reciprocating test rig

3) Demonstration of fans and blowers

4) Study of centrifugal compressors

5) Study of gear pumps

6) Study of vacuum pumps

7) Study of peristaltic pumps

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8. MC-CH-408 ENVIRONMENT STUDIES

Lecture: 2 hour/week:

Practical: NIL

Credits: 3

ESE: 70

CIE : 30

Term Work: - NIL

Syllabus from University