Shivaji University, Kolhapur

Syllabus Structure of Final Year Chemical Engineering Course

Scheme of Teaching and Examination

Semester –VII

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract. / Oral	Total
1	**Chemical Reaction Engg.-II**	4	--	2	6	100	25	25	150
2	**Chemical Engg. Processes-I**	3	--	--	3	100	--	--	100
3	**CPPD**	4	--	2	6	100	25	25	150
4	**MSCE**	4	--	2	6	100	25	25	150
5	**Elective-I**	3	--	--	3	100	--	--	100
6	**Seminar**	--	--	2	2	--	25	--	25
7	**Comprehensive tests On all subjects from S.E to B.E-I**	--	--	2	2	--	50	--	50
8	**Industrial Training (At the end of VI Semester -- 4 weeks)**	--	--	--	--	--	25	--	25
9	**Project Work**	--	--	4	4	--	25	25	50
	Total	**18**	**--**	**14**	**30 (32)**	**500**	**200**	**100**	**800**

Semester –VIII

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract. / Oral	Total
1	**Chemical Engg. Processes-II**	3	1	2	6	100	25	25	150
2	**Transport Phenomena**	4	--	--	4	100	25	--	125
3	**PEPE**	4	--	--	4	100	25	--	125
4	**Elective – II**	4	--	--	3	100	--	--	100
5	**Elective—III**	4	--	--	3	100	--	--	100
6	**Advanced separation processes**	1	--	2	4	--	25	25	50
7	**Project Work**	--	--	6	6	--	75	75	150
	Total	**20**	**0**	**10**	**30**	**500**	**175**	**125**	**800**

Shivaji University, Kolhapur

Syllabus Structure of Third Year Chemical Engineering Course

Scheme of Teaching and Examination

SEMESTER – V

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract. / Oral	Total
1	**P.I &I.M.A.**	4	--	2	6	100	25	25	150
2	**NMCP**	3	--	2	5	100	25	25	150
3	**Mass Transfer-I**	3	1	2	6	100	25	25	150
4	**Chemical Engg. Thermodynamics-II**	3	1	--	4	100	25	--	125
5	**Chemical Equipment Design-I**	3	1	2	6	100	25	25	150
6	**I.P.& Case Studies**	1	--	2	3	--	50	--	50
7	**Soft Skills**	1	--	2	3	--	25	--	25
	Total	**18**	**03**	**12**	**30 (33)**	**500**	**200**	**100**	**800**

SEMESTER – VI

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract. / Oral	Total
1	**IEM &E**	3	--	--	3	100	25	--	125
2	**Industrial Pollution Control**	4	--	2	6	100	50	--	150
3	**Mass Transfer-II**	3	1	2	6	100	25	25	150
4	**Process Dynamics & Control**	3	1	2	6	100	25	25	150
5	**Chemical Reaction Engg.-I**	3	1	2	6	100	25	25	150
6	**Computer Applications**	2	--	2	4	--	50	25	75
	Total	**18**	**03**	**10**	**30 (31)**	**500**	**200**	**100**	**800**

Shivaji University, Kolhapur

Syllabus Structure of Second Year Chemical Engineering Course

Scheme of Teaching and Examination

SEMESTER – III

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract. / Oral	Total
1	**Engg. Maths-III**	3	1	--	4	100	25	--	125
2	**Chemistry-I**	4	--	4	8	100	50	50	200
3	**SOM & MOC**	3	--	2	5	100	25	--	125
4	**Fluid Mechanics**	4	--	2	6	100	25	25	150
5	**Mechanical Operations**	3	--	2	5	100	25	25	150
6	**ComputerPractice-I**	1	--	2	3	--	50	--	50
	Total	**18**	**01**	**12**	**31**	**500**	**200**	**100**	**800**

**** Engineering mathematics - III**

SEMESTER – IV

Sr. No.	Name of the Subject	Teaching Scheme(Hrs)				Examination Scheme (Marks)			
		L	T	P	Total	Theory	TW	Pract. / Oral	Total
1	**Engg. Maths-IV**	3	1	--	4	100	--	--	100
2	**Chemistry-II**	4	--	4	8	100	50	50	200
3	**Process Calculations**	3	1	--	4	100	25	--	125
4	**Heat Transfer**	4	--	2	6	100	25	25	150
5	**Chemical Engg. Thermodynamics-I**	3	--	--	3	100	25	--	125
6	**Computer Practice-II**	1	--	2	3	--	25	25	50
7	**Fluid Machinery**	2	--	2	4	--	25	25	50
	Total	**20**	**02**	**10**	**30 (32)**	**500**	**175**	**125**	**800**

SECOND YEAR CHEMCIAL ENGINEERING

SEMESTER – III

1. ENGINEERING MATHEMATICS - III

Teaching Scheme		Examination Scheme		
Lectures	:	3 hours/week	Theory :	100 marks
Tutorial	:	1 hour/week	Term work:	25 marks

SECTION -1

Unit 1 Greens Function: Greens Function for ordinary differential equation. Initial value problem, Final value problem, Construction of Greens function for ordinary differential equations.

Unit 2 Linear Differential Equations: Linear Differential Equations with constant coefficients, Homogenous Linear differential equations, Applications of LDE with constant coefficients to chemical engineering problem.

Unit 3 Differential Equations Applications: Applications of Differential Equations of first order to geometry, Trajectories. Application of Linear differential equations to chemical Engineering problems.

SECTION-II

Unit 1 Laplace Transform: Definition, properties of Laplace transforms, transforms of derivatives, transforms of integral, Periodic function, Convolution theorem. Inverse transform, Applications to initial value boundary problems

Unit 2 Vector Differentiation: Differentiation of vectors, normal and tangential components of velocity and acceleration, Gradient of scalar point function, Directional derivative, Divergence of vector point function, Curl of a vector point function. Irrotational and solenoid vector field.

Unit 3 Vector Integration: The line integral, Surface integral, volume integral, Gauss's Divergence theorem, Stoke's theorem, Green's theorem (Without proof). Irrotational and solenoidal vector field.

General Instructions:

1. For the term work of 25 marks, batch wise tutorials are to be conducted. The number of students per batch should be as per university pattern for practical batches.
2. Minimum number of assignments should be 8 covering all topics.

Nature of Question paper:

1. There will be two sections carrying 50 marks each.
2. There will be four questions in each section and three questions should be attempted from each section.

Reference Books:

1. A text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar, Vidyarthi Griha Prakashan, Pune.
2. Higher Engineering Mathematics by Dr. B. S. Grewal.
3. Advanced Engineering Mathematics by Erwin Kreyszig.
4. Operations Research by S. D. Sharma
5. Operations Research by T. A. Taha

6. Mathematical Methods in Chemical Engineering by S.Pushpavanam.

2. Chemistry –I

Teaching scheme
Lectures :- 4 hrs. / week
Practicals: - 4 hrs /batch/week

Examination scheme
Theory : 100 marks
Term work: 50 marks
Practical / Oral: 50 marks

Section –I

1. Chemical kinetics: (4 lectures)

Introduction, order and molecularity of reaction, rates of reaction, first and second order reactions with derivation, Theories of reaction rates- collision and transition state theory, pseudo unimolecular reactions, determination of rates of reaction, numericals.

2. Distribution law: (4 lectures)

Introduction, Nernst distribution law, solubility and distribution law, explaination & limitations of distribution law, Henry's law, determination of equilibrium constant from distribution coefficient, numericals.

3. Photochemistry: (4 lectures)

Introduction, laws of photochemistry, quantum efficiency, kinetics of photochemical reactions, photochemical equilibrium, photosensitized reactions, photochemical phenomenon, photosynthesis.

4. Phase equilibrium: (4 lectures)

Introduction, concept & terminology, Gibbs phase rule with derivation, one component system (sulpher), two component system (Zinc-Cadmium), phase diagram of solid solutions.

5. Catalysis: (4 lectures)

Definition, characteristics, types- homogeneous & heterogeneous, theory of catalysis, catalyst- acid / base, solid catalysts like oxides, metal & zeolites, phase transfer catalysts, enzyme catalysts (biocatalysts), mechanism of catalysis, concept green chemistry with examples

Section II

6. Chemistry of dyes and dye intermediates : (4 lectures)

Colour and chemical constitution, chromophore- auxochrome theory, valency bond theory, classification of dyes based upon structure & methods of application, synthesis and applications of malachite green, methyl orange, alizarine & phenolphthalein.

7.Soaps and detergents (4 lectures)

Soaps and saponification, cleansing action of soaps, manufacture of soap by modern process, detergents, classification, cleansing action, manufacture of anionic detergents (D.B.B.S.)

8.Drugs and pesticides: (4 lectures)

Drugs-Chemotherapy, synthesis and mode of action of sulpha drugs(sulphanilamide), antibiotics (chloramphenicol), analgesics (paracetamol).
Pesticides- Introduction, classification, synthesis, properties and uses of BHC, DDT, Malathion.

9.Microbiology & biomolecules: (4 lectures)

Structure and composition of cell, molecules of life. Biomolecules- Proteins, Enzymes, Nucleic acids (Structure, role & functions)

10.Unit processes in organic synthesis: (4 lectures)

Introduction, types of processes.
Nitration- Nitrating agents, mechanism of aromatic nitration, industrial nitration of benzene to nitrobenzene by continuous processes.
Oxidation- Types of oxidation reactions, oxidizing agents, mechanism of oxidation, manufacture of acetic acid by oxidation of acetaldehyde.

Chemistry – I
PRACTICALS

(Minimum 18 experiments should be completed)

1. Determination of reaction rate constant of catalysed hydrolysis of methyl acetate in N/2 HCl
2. Determination of reaction rate constant of catalysed hydrolysis of methyl acetate
3. in N/2 H_2SO_4
4. To determine partition coefficient of benzoic acid in benzene and water.
5. To determine partition coefficient of iodine in carbon tetrachloride and water.
6. Determination of reaction rate constant of reaction between $K_2S_2O_8$ & KI
7. Determination of reaction rate constant of reaction between H_2O_2 & HI

8. Laboratory preparation of phenol formaldehyde resin.
9. Laboratory preparation of aspirine (acetyl salicylic acid)
10. Laboratory preparation of soap
11. Determination of saponification value of the given oil sample
12. Laboratory preparation of m-Dintrobenzene from benzene
13. Preparation of methyl orange

14 -19 Identification of monofunctional and bifunctional organic compounds (minimum 6 compounds)

REFERENCE BOOKS (Chemistry –I)

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)

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)

Reference books for Practicals

1. Practical organic chemistry -- A. I. Vogel (CBS-1987)
2. Experiments in applied chemistry –Sunita Rattan (S. K. Kataria & Sons- 2002)

3. STRENGTH OF MATERIALS AND MATERIALS OF CONSTRUCTION

Section –I

Teaching Scheme
Lectures : 3 hours / week

Examination Scheme
Practical : 2 hrs/week
Term Work :
Internal : 25 Marks

Strength of materials

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.

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

3. **Torsion of shafts :** Torsion equation, strength and stiffness of solid and hollow circular shafts. Transmission of power.

4. **Thin cylindrical and Spherical shells :** Subjected to fluid pressure wire wound cylinders.

5. **Thick Cylinder** : Lamis theory, Design of thick cylindrical shell, Thick Spherical Shells.

6. **Direct and bending stresses :** Introduction, Direct and eccentric loading, limits of eccentricity, core of section, wind pressure.

Section – II

Materials of construction

7. **Introduction**

8. **Introduction to Mechanical properties of materials**

9. **Selection of right material**

10. **Materials Failure**

11. **Materials standards and specifications**

12. **Economics in material selection**.

13. **Materials available :**
    a) Ferrous metals, alloys and fabrication characteristics
    b) Non-ferrous metals , alloys and fabrication characteristics
    c) In organic Nonmetallic Glass & Glass steel, Porcelain and stoneware,Cement and concrete, Soil, Asbestos & rock wool.
    d) Organic Non-metallic: Thermoplastics, Thermo-setting plastics, Rubber & Elastomers, Asphalt, Carbon and Graphite, wood.
    e) Coatings, Lining/ cladding
    f) High & Low temperature materials
    g) Comparison of various materials

14. **Corrosion :** a) Types of corrosion - Galvanic corrosion, Crevice corrosion, Erosion corrosion, Stress corrosion.
    b) Corrosion Prevention- Material selection, Coatings, Economics.

Term Work :

1. Tension test on mild steel.
2. Compression test on mild steel and timber
3. Hardness test – brinell and rockwells
4. Torsion test
5. Inpact test charpy and izod.
6. Shear test-double shear

References :

1. Punmia B.C. 'Strength of Materials and Mechanics of Structure'-Vol.I- Standard Publications, Delhi.
2. C. Patel, T.D. Bhagia, 'Strength of Materials ' Vol. I, C. Jamnadas & Co. Mumbai
3. Ramamruthm, 'Strength of Materials' , - Dharapatray & Sons, Delhi , 1998.
4. Sarkar B.K. 'Strength of Materials', -- Allied Publishers, New Delhi , 2001.
5. William Nash, 'Strength of Materials', IVth Ed. McGraw Hill Publication.

MATERIALS OF CONSTRUCTION

Reference:

1. Bhattacharya B.C., 'Selection of materials and fabrication for Chemical Process Equipment, Chemical Engg.' , Educational Development Centre , IIT Madras
2. Coulson & Richardson 'Chemical Engineering', Volume VI, Pergamen Press .
3. Robert N. Perry & Don Gress , 'Perry's Chemical Engineers Handbook', VIth ed. McGraw Hills International Ed. Newyork 1984.
4. D. Venkateswarlu & other, Chemtech -I, 'First volume of manual of Chemical Technology', Chemical Engg. Educational Development Centre, IIT Madras.
5. Corrosion Engineering IIndedition Mars G.Fontana.

4. FLUID MECHANICS

Section – I

1. **Unit systems :** Physical quantities, S.I., CGS, FPS engg. units, Conversion of Units, Units and Equations, dimensional analysis, Application of dimensional analysis, Problems.

2. **Fluid statics and its applications :** Nature of fluids, Hydrostatic equilibrium, Barometric equation, Hydrostatic equilibrium in centrifugal field, Manometers, Example, U tube, Inclined tube manometers.

3. **Fluid flow phenomena :** Behaviour 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.

4. **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 , Eulers equation, Problems.

5. **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-poiseuilie equation. Turbulent flow in pipes and closed channels. Velocity distribution for turbulent flow, universal velocity distribution equations for laminar sub layer and buffer layer, 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, couette flow, Layer flow with free surfaces , Flow through annulas, Problems.

Section – II

6. **Flow of compressible fluids :** Mach number, continuity equation,Total energy Balance, velocity of sound, ideal gas equations, the asterisk condition, stagnation temperature.

7. **Transportation and metering of fluids :** Pipe and tubing, joints and fittings. Prevention of leakage around moving parts. Valves- Gate valve, globe valve, check valve butterfly valve, needle valve, ball valve etc. Measurement of flowing fluids. Venturimeter, orificemeter, pitot tube, rotameters, target meters, vortex- shedding meters, turbine meters, positive displacement meters, magnetic meters: ultrasonic meters.

8. **Flowpast immersed bodies :** Drag coefficients of typical shapes, form drag and stream lining, Friction in flow through beds of solids, 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.

9. **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.

Term Work :

1. Venturimeter
2. Orifice meter
6. Flow through annular pipe
7. Flowthrough pipe & pipe fittings.

3. Reynold's experiment
4. Bernoulli's experiment
5. Flow through helical coils
8. Flow through spiral coils.
9. Flow through packed bed
10. Flow through fluidized bed.
11.To study the properties of Newtonian and Non- Newtonian fluids.
12.Demonstration of –
a) Rotameter
b) Pitot tube
13. Two phase flow system

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:

Steeter U.L, 'Fluid Mechanics' V ed. Mc graw Hill Book Co., International Edn.1971.
Richardson J.E. and Coulson J.M. Chemical Engg. 3rd ed. Vol. 1 Pergamon Press 1985.
Miohell B.I. Fluid and Particle Mechanics Pergamon Press 1970.
4 Gupta S.K., Momemtum Transfer Operations, Tata McGraw Hill, 1979.

5. Mechanical Operations

Lectures: 3 hrs
Practical: 2 hrs / batch / week

Theory: 100 marks
Practical:
External- 25 marks
Internal- 25 marks

Section I

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. (4 Lectures)

2 **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, Heat control methods in size reduction.(5 Lectures)

3 **Screening**
Standard test screens, Standards of screen, Screen effectiveness, Comparison of ideal and actual screens, Industrial screening equipment. (3 Lectures)

4 **Mixing of solids and pastes**
The degree of mixing, Rate of mixing, Criteria for mixer effectiveness, Solid-liquid mixing, Mixing for paste and plastic masses, Solid-Solid mixing. (2 Lectures)

Section II

5 **Filtration**
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.(8 Lectures)

6 **Sedimentation**
Basic principles, Flocculation, Thickeners, Batch sedimentation test, Design procedure for gravity sedimentation tanks. (4 Lectures)

7. **Gas Cleaning**
Introduction, Gas cleaning equipment, Gravity separators, Centrifugal separators, Momentum separators, Electrostatic precipitators, Liquid washing, Odour removal, Fabric filters, Impingement method and Miscellaneous methods, Agglomeration and Coal essence.(5 Lectures)

8 . **Benefaction Process in Chemical Engineering**
Froth flotation, Magnetic separators, Scrubbers, Jig classification, Heavy medium separation, Wilfiley table, Gravity settling tank. (3 Lectures)

Practicals:
Any 10 Practicals should be conducted.

1. Sieve Analysis
2. Screen Effectiveness
3. Jaw Crusher
4. Pulverizer
5. Ball mill
6. Sedimentation(Batch)
7. Beaker Decantation
8. Filter Press

9. Leaf Filter
10. Cyclone Separator
11. Air Elutration
12. Rotary Drum Filter

Demonstration of following equipment and include in journal

1. Riffled Table
2. Mineral Jig
3. Froth 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. COMPUTER PRACTICE - I

Teaching Scheme
Lectures : 1 hours / week

Examination Scheme
Practical : 2 hrs/week
Term Work :
Internal : 50 Marks

1. **Introduction to operating system :**
   A) MS -DOS
   B) Unix
   C) Novel Net work

2. **Programming in "C "**
   i. Functions : Defining and accessing, passing, arguments, fuction prototype, recursion, Use of Library Functions.
   ii. Storage classes : Auto static, external register.
   iii. Structures.
   iv. Arrays.
   v. File Handling in C.

Term Work :

1. To practice unix command
2. Making contact with Unix Login and Logout producer.
3. Practice commands like CAT, PG, PR, LE, CP, MV, RM, WC, CH, MODE, DIFF, GREP, SORT, TEXT.
4. To practice Novel network commands.
5. To practice FoxPro commands.
6. Database structure creation.
7. Use of editor and working with command window.
8. Quadratic equations
9. Small and Large numbers
10. Ascending and Descending order
11. Fibonacci numbers
12. Matrix addition , Substraction and multiplication.

Text Books:

1. Yashwant Kanitkar, Let us C, 4th Revised ed. BPB Publication, 1991.
2. E. Balagurusamy , Programming in ANSY C, 2nd ed. Mc-Graw Hills Publishing Co. 1989.
3. K.R. Venugopal and Sudeep R. Prasad , Programming with c, Mc-Graw Hills Publishing Co. 1997.

References:

1. Byron Gottfried , Programming with C , Mc-Graw Hills Publishing Co. 1998
2. Sumitabha Das, Unix Concepts and Applications, 2nd ed., Mc-Graw Hills Publishing Co. 1998
3. Microsoft Ms-Dos Users Guide
4. Unix Users Guide manual
5. Novel Network Users Guide

SEMESTER – IV

1. ENGINEERING MATHEMATICS - IV

Teaching Scheme		Examination Scheme		
Lectures	:	3 hours/week	Theory :	100 marks
Tutorial	:	1 hour/week	Term work:	25 marks

SECTION -1

Unit 1 Curve Fitting: Fitting of Curves by method of Least-squares, Coefficient of correlation, Spearman's rank correlation coefficient and lines of regression of bivariate data

Unit 2 Probability: Random variable, Probability mass function and probability density function, Binomial, Poisson and Normal distributions

Unit 3 Numerical solution of Partial differential equations: Transformation of partial differential equation into Difference equation and solution of Laplace equation by using Jacobi and Gauss-Seidal method

SECTION-II

Unit 1: Partial differential equations: Linear partial differential equation (Lagranges form). Non linear partial differential equations and its four standard forms.

Unit 2: Application of partial equation variable separation method:

Application of P.D Equation to:-

1) Wave equation (vibration of string)
2) One dimensional heat flow.
3) Two dimensional heat flow

Unit 3 Fourier series: Definition, Euler's formulae, Dirchlet's Conditions for a Fourier expansion, Functions having points of discontinuity, change of interval, expansions of odd and even periodic functions, Half range series.

General Instructions:

1. For the term work of 25 marks, batch wise tutorials are to be conducted. The number of students per batch should be as per university pattern for practical batches.
2. Minimum number of assignments should be 8 covering all topics.

Nature of Question paper:

1. There will be two sections carrying 50 marks each.
2. There will be four questions in each section and three questions should be attempted from each section.

Reference Books:

1. Mathematical Methods in Chemical Engineering by S.Pushpavanam.
2. A text book of Applied Mathematics: Vol. I, II and III by J. N. Wartikar & P. N. Wartikar, Vidyarthi Griha Prakashan, Pune.
3. Higher Engineering Mathematics by Dr. B. S. Grewal.
4. Advanced Engineering Mathematics by Erwin Kreyszig.
5. Fundamental of Statistics by S. C. Gupta
6. Numerical methods by Dr. B. S. Grewal
7. Numerical methods by S. S. Sastry.

2. Chemistry – II

Section –I

1.Structure and bonding : (4 lectures)

Molecular orbital & valence bond approaches for diatomic molecules, hybridization & structure of H_2O, NH_3, BF_3, SF_6, PCl_5.

2. co-ordination chemistry(5 lectures)

Introduction, difference between double salt and complex salt, classification, werners coordination theory, effective atomic no. (EAN), valence bond theory and crystal field theory for octahedral complexes.

3. Inorganic heavy industries(4 lectures)

Manufacture of H_2SO_4(contact process), NH_3 (Habers process) w.r.t. reactions, reactants, catalyst and physicochemical principles.

4. Nonaqueous solvents(4 lectures)

Introduction, classification of solvents, characteristic properties of solvents(mp. and bp.,heats of fusion and vaporization, dielectric constant), liquid ammonia and liquid HF, reactions of liquid ammonia-precipitation, acid –base, oxidation- reduction, ammonolysis, reactions of HF-precipitation , acid- base, protonation of organic compounds.

5. Analytical chemistry(3 lectures)

Volumerty, standards, concentration of solutions(molarity, normality, molality, equivalent weight, strength of solution), normality equation, numericals based on calculation of strength.

SECTION –II

6.Named organic reactions(4 lectures)

Mechanism in brief and industrial applications of Friedal crafts reactions, Mannich reaction, Gatterman Koch reaction, Claisen rearrangement, Benzidine rearrangement, Diels Alder reaction, aldol condensation, Kolbe synthesis.

7.Spectroscopy(4 lectures)

Basic principles, instrumentation and applications of I.R. spectroscopy, N.M.R. spectroscopy.

8.Chemistry of petroleum(4 lectures)

Origin of crude, composition , refining of crude, cracking –catalytic cracking- batch process and continuous process, major petrochemicals like ethelene propylene butadiene, benzene toluene, (industrial applications only)

9.Polymers(4 lectures)

Polymers-definition, polymerization techniques (bulk, solution, suspension and emulsion).

Plastics-compounding, preparation, properties and applications of Acrylics,Teflon, polymethyl methacrylate, Buna- S rubber, Buna-N rubber, Butyl rubber.

10.Chemistry of heterocycles(4 lectures)

Introduction, classification, preparation, properties and applications of pyrrole, furan, thiophene, pyridine,quinoline, isoquinoline.

Chemistry – II

PRACTICALS

(Minimum 18 experiments should be completed)

1-3.To prepare standard solution of alkali, acid and to estimate the purity of commercial heavy chemicals like H_2SO_4, HNO_3, NH_3.

4. Preparation of Hexanitrocobaltate.

5. Preparation of Hexammine cobaltic chloride.

6. To prepare standard solution of sodium thiosulphate & to estimate copper from brass solution.

7. To prepare standard solution of potassium dichromate & to estimate Iron from ammonium sulphate using external indicator.

8. To prepare standard solution of potassium dichromate & to estimate Iron from ammonium sulphate using internal indicator.

9. Estimation of nitrogen from given fertilizer solution.

10.To prepare standard solution of EDTA & to estimate magnesium from given dolomite ore solution.

11.To prepare standard solution of $KMnO_4$ & to estimate Oxalic acid.

12. Estimation of copper by colorimetric method.
13. Estimation of Nickel by colorimetric method.
14. Laboratory preparation of phenol formaldehyde resin.
15. Estimation of Phenol
16. Estimation of Aniline
17. Estimation of Acetone
18. Estimation of Acetamide
19. Estimation of Glucose

REFERENCE BOOKS (Chemistry –II)

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)

Inorganic chemistry

1. Inorganic chemistry**-** Cotton & Vilkinson (Wiley Estern Ltd-1985)
2. Inorganic chemistry – Dey & Selbin
3. Advanced inorganic chemistry – Puri & sharma(Shobanlal Nagin Chand - 1996)

Reference books for Practicals

1 Inorganic chemistry -- A. I. Vogel
2. Practical organic chemistry -- A. I. Vogel (CBS-1987)
3. Experiments in applied chemistry –Sunita Rattan (S. K. Kataria & Sons- 2002)

3. Process Calculations

Lectures : 4 hrs per week

Examination:
Theory : 100 marks
Term Work : 25 marks

1. Basic Chemical Calculations. (4)
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, Molarity , Molality.

2. Gases Systems. (4)
Gaseous mixtures, Daltons law, Amagats law, Average molecular weight, Density of gaseous mixture, Estimation of vapour pressure.

3. Material Balances without Chemical Reaction. (6)
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.

4. Material Balances with Chemical Reaction. (6)
Definition of terms involved; Generalized approach for solving problems; Material balance problems involving chemical reaction; Electrochemical reactions; Metallurgical applications; Recycle, bypass and purge calculations.

5. Energy Balance on Non Reactive Processes. (5)
Elements of energy balance calculations; Change in pressure at constant temperature; Change in temperature; Phase change operations; Mixing and solutions.

6. Energy Balance on Reactive Processes. (5)
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.

7. Combustion.[1,5](5)
Minimum air required, Excess air, Combustion calculations.

8. Stoichiometry and Industrial problems.[1](3)

9. Introduction to degree of freedom analysis.[2](2)

Reference 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.

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.

5. P.L.Ballaney, "Thermal Engineering".

Note:-
@ Two test of minimum 25 marks each should be conducted for term work.
Figure in bracket indicates lectures to be conducted

4 HEAT TRANSFER

Teaching Scheme		Examination Scheme	
Lectures :	**3 hours / week**	**Theory :**	**100 Marks**
Tutorial :	**1 hours / week**	**Term Work :**	
		Internal :	**25 Marks**
		External :	**25 Marks**

Section – I

1. **Mechanism of heat flow :** Conduction, Convection, Radiation.

2. **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.

3. **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.

4. **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.

Section – II

5. **Heat transfer to fluids with phase change :** Heat transfer from condensing Vapors, dropwise and film wise condensation, coefficients for film type condensation, derivation and practical use of Nusselt equation, condensation of superheated vapors, effect of non-condensable gases, Problems.

   Heat transfer to boiling liquids : Types of boiling, boiling of saturated liquid maximum flux and critical temperature drop, minimum heat flux film boiling and subcooled boiling, Problems.

6. **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.

7. **Radiation heat transfer :** Fundamentals of radiation, wavelength of radiation. emisivity.Laws of black body radiation, reflectivity, absorptivity of an opaque solids ,Kirchhoff's law,radiation between two surfaces. Calculation of radiation between black surfaces, combined heat transfer by conduction - convection and radiation, problems.

8. **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 evaporator, problems.

9. **Introduction to heat transfer to packed and fluidized beds**: General heat transfer characteristics, Calculation for Heat transfer co-efficient.

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. Climbing film evaporator.
9. Heat transfer through agitated vessel.
10. Shell and tube heat exchanger.
11. Fin tube heat exchanger.
12. Compact heat exchanger.

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. CHEMICAL ENGINEERING THERMODYNAMICS - I

Section – I

1. **Introduction:** Scope & limitations of thermodynamics, Dimensions and Units, Force ,Temperature , Pressure, Work energy and Heat, Problems.

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.

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, Generalized Cubic equation of state. Theorem of corresponding states, Acentric factor.

4. **Heat Effects :** Sensible heat effects, Temperature dependence of heat capacity, Evaluation of sensible heat integral, Standard heat of reaction, Standard heat of formation, Standard heat of combustion, Temperature dependence of ΔH^0, Heat effects of industrial reactions, Problems.

Section – II

5. **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,Third law of Thermodynamics, Problems.

6. **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. Thermodynamic charts and tables.

7. **Application of thermodynamics flow processes :** Duct flow of compressible fluids, pipe flow, nozzles, throttling process, turbines (expanders), compression processes, compressors, pumps, ejectors.

8. **Conversion of heat into work by power cycles :** Steam power plant cycle, Internal combustion engines, Jet engines,Rocket engines.

9. **Refrigeration and liquefaction :** Carnot cycle, Air refregeration and vapor compression cycles, Choice of refrigerant. Absorption refrigeration, Heat pump, Liquefaction processes.

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

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. COMPUTER PRACTICES – II

Teaching Scheme
Lectures : 1 hours / week

Examination Scheme
Practical : 2 hrs/week
Term Work :
Internal : 25 Marks
External : 25 Marks

Programming in FORTRAN

1. **Programming and writing algorithms:** Introduction, Problem Analysis & Algorithm development, Algorithm, Flowcharting, Pseudo code, Flowchart And Pseudo code examples, Transformation of Pseudo code into a program, Program execution, program documentation.

2. **Introduction to FORTRAN** : Introduction, FORTRAN constants and variables, Type Declaration, Integer and real arithmatics, arith operation, the assignment Statement and arithmetic expressions and rules for it, FORTRAN statements Diftt statements in FORTRAN.

3. **Control structures** : Introduction, Selection decision or decision structure, GO TO statement, Repetition structure.

4. **Files and I/P O/P :** Operations Introduction **:** Intro, Files, Programming processes, various statements (e.g. OPEN, CLOSE, READ, WRITE) Various formats, carriage control.

5. **Arrays :** Introduction, structure of Arrays, Array Declaration, one dimentional Array, Multi dimensional Arrays.

6. **Subprograms :** Introduction, function of subprograms statement functions, subroutine sub programs, subprogram structure Diagrams, variable Array Dimension, Various statements (e.g. Equivalence common, text., Int., Return, Save etc)Block Data Subprograms.

Term Work :

1. Matrix
2. Fibonacy numbers
3. Quadratic equations
4. Small and large numbers
5. Descending sorting
6. Ascending sorting
7. Transpose of matrix
8. Addition of matrix
9. Reverse of given numbers

Text Books:

1. P.S. Grover, "Programming and Computing with Fortran 77/90", 2nd ed. Allied Publishers Ltd, 1996.
2. R.S. Salaria , "Programming in Microsoft Fortan 97", 2nd ed., BPB Publications, 1994.
3. K.D. Sharma, "Programming in Fortran", East-West Press Pvt. Ltd, 1976.
4. Seymour Lipschutz and Arthur poe, "Programming with Fortran", Mc-Graw Hill, 1978.
5. V. Rajaraman, "Computer Programming in Fortran 90 and 95" , Prentice Hall of India, 1997.

7. Fluid Moving Machinery Lab.

Lecture: 2 hr. Term work: 25 Marks

Practicals: 2 hr. Oral Exam: 25 Marks

Ch.1) Centrifugal pumps classification of pumps, classification of centrifugal pumps, theory of centrifugal pump, impellers, casings, volute pumps, volute pumps with vortex chamber, diffuser vanes, 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, problems.

Ch 2) 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, 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.

Ch. 3) Selection of pumps operating conditions, operating difficulties, comparison between various types of pumps, selection criterion in industries, maintenance of pumps.

Ch. 4) Fans, Blowers, and Compressors: 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) 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.

Reference books:

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

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 vaccum pumps
7) Study of peristaltic pumps.

Equivalence of S.E.(Chemical Engineering)
Part I&II

The Equivalence for the subject of **Chemical Engineering at S.E.-Part I and Part-II Course** pre-revised course under the faculty of Engineering and Technology

S.E. Part-I (Chemical Engineering)

S.E. Part-I Pre-Revised	S.E. Part-I Revised	Remark
1.Chemistry-I	**1.**Chemistry-I	----------
2.Engineering Math's-III	**2.**Engineering Math's-III	----------
3.Strength of materials &Material of Construction	**3.**Strength of materials &Material of Construction	----------
4.Fluid Mechanics	**4.**Fluid Mechanics	
5.Mechanical Operation	**5.**Mechanical Operation	----------
6.Computer Practice I	**6.**Computer Practice I	----------

S.E. Part-II (Chemical Engineering)

S.E. Part-II Pre-Revised	S.E. Part-II Revised	Remark
1.Chemistry-II	**1.**Chemistry-II	----------
2.Engineering Math's-IV	**2.**Engineering Math's-IV	----------
3.Proces Calculations	**3.**Proces Calculations	----------
4.Heat Transfer	**4.**Heat Transfer	----------
5.Chemical Engineering Thermodynamics-I	**5.**Chemical Engineering Thermodynamics-I	----------
6.Computer Practice II	**6.**Computer Practice II	----------

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