Suggested plan of study for II Year B.E (Chemical Engineering)

III SEMESTER

Sl No.	Course Code	Title of the Course	Credits
1	MA 200	Mathematics -III	4
2	CH 200	Technical Chemistry	3
3	CH 201	Chemical Process Calculation	4
4	CH 202	Momentum Transfer	4
5	CH 203	Mechanical Operations	4
6	CH 204	Chemical Engineering Drawing	2
7	CH 205	Technical Chemistry Lab.	1.5
8	CH 206	Mechanical Operations Lab	1.5
Total Credits			**24**

IV SEMESTER

Sl No.	Course Code	Title of the Course	Credits
1	MA 250	Mathematics - IV	4
2	CH 250	Process Heat Transfer	4
3	CH 251	Chemical Engineering Thermodynamics -I	4
4	CH 252	Material Science	3
5	CH 253	Mass Transfer-I	4
6	CH 254	Pollution Control Engineering	3
7	CH 255	Computer Aided Numerical Methods	1.5
8	CH 256	Momentum Transfer Lab	1.5
Total Credits			**25**

III SEMESTER

MA200	ENGINEERING MATHEMATICS-III (Common to all branches)	(4-0-0) 4

1) **Fourier Series:** Periodic functions, Fourier expansions even and odd functions. Half range expansions, Complex form of Fourier series, Practical harmonic analysis. **6 Hrs.**
2) **Fourier Transforms:** Finite and Infinite Fourier transforms, Fourier sine and cosine transform properties. Inverse transforms. **6 Hrs.**
3) **Partial Differential Equations (P.D.E):** Formation of P.D.E, Solution of non homogeneous P.D.E by direct integration, method of separation of variables. (First and second order equations). Solution of Lagrange's linear P.D.E. of the type P p +Q q =R **6 Hrs.**
4) **Applications of P.D.E:** Derivation of one dimensional wave and heat equations. Various possible solutions of these by the method of separation of variables. D'Alembert's solution of wave equation. Two imensional Laplace's equation various possible solutions. Solution of all these equations with specified boundary conditions. (Boundary value problems**).** **6 Hrs.**
5) **Numerical Methods:** Numerical solutions of algebraic and transcendental equations:- Newton-Rap son and Regular- Falsi methods. Solution of linear simultaneous equations:- Gauss elimination and Gauss Jordon methods. Gauss - Seidel iterative method. Definition of eigen values and eigen vectors of a square matrix. Computation of largest eigen value and the corresponding eigen vector by Rayleigh's power method. Finite differences (Forward and Backward differences) Interpolation, Newton's forward and backward interpolation formulae. Divided differences- Newton's divided difference formula. Lagrange's interpolation and inverse interpolation formulae. Numerical differentiation using Newton's forward and backward interpolation formulae. Numerical Integration - Simpson's one third and three eighth's rule, Weddle's rule.(All formulae/rules without proofs). **13 Hrs.**
6) **Calculus of Variations:** Variation of a function and a functional Extermal of a functional, Variational problems, Euler's equation, Standard variational problems including geodesics, Minimal surface of revolution, hanging chain and Brachistochrone problems**.** **6 Hrs.**
7) **Difference Equations and Z-transforms:** Difference equations – Basic definitions. Z-transforms – Definition, Standard Z-transforms, Linearity property, Damping rule, Shifting rule, Initial value theorem, Final value theorem, Inverse Z-transforms. Application of Z-transforms to solve difference equations. **7 Hrs.**

BOOKS:

1) Higher Engineering Mathematics by Dr. B.S. Grewal (36th Edition)
2) Higher Engineering Mathematics by B.V Ramana (Tata-Macgraw Hill).
3) Advanced Modern Engineering Mathematics by Glyn Jame Pearson Education.

CH 200	TECHNICAL CHEMISTRY	(3-0-0) 3

1) **Chemical kinetics**: Introduction, rate, order and molecularity of reactions, rate law expressions of zero, first & second order reactions; Half-life times of reactions; Methods of determining the order of a reaction; Factors influencing rates of reactions; Numerical problems. **6 Hrs.**
2) **Catalysis:** Introduction, General characteristics; Types of catalysis with examples, Homogenous Catalysis- acid-base catalysis with Mechanism, Enzyme catalysis with Mechanism and kinetics; effect of temperature on Enzyme catalysis; Heterogeneous Catalysis explanations with examples; Effect of temperature; Auto-catalysis & Negative catalysis Numerical problems **6 Hrs.**
3) **Chemical bonding:** Introduction, Ionic bond – definition steps involved in the formation of Ionic bond condition and factors effecting the formation of Ionic bond, properties of Ionic compounds; Covalent bond definition , Lewis concept ; types –Single; Double; Triple, polar and non polar , Sigma & pi bonds; Valance bond theory (VBT)- - postulates & explanations, limitation of VBT; Molecular orbital theory – comparison between atomic orbitals & molecular orbitals Linear combination of atomic orbitals (LCAO), conditions for effective combination of atomic orbitals, Molecular orbital configuration of simple molecules (H_2 and He); comparison between valence bond theory and molecular orbital theory. **6 Hrs.**
4) **Colligative properties:** Concept of mole and mole fraction, Colligative properties- Meaning and types, Lowering of vapour pressure & osmotic pressure, their relation with mlecular weight of solute; Measurement of vapour pressue lowering by Ostwald's and Walker's method and osmotic pressure by Berkeley and Hartley's method, Abnormal collegative effects and van't Hoff's factor; Numerical problems. **6 Hrs.**
5) **Organic reactions and their mechanisms:** Electron displacement effects– inductive, electrometric, mesomeric and hyper conjugative; Bond fission – homolytic and heterolytic; Carbanions, Carbocations; Types of reagents– electrophilic and nucleophilic, Types of reactions – (a) Substitution – free radical; nucleophilic - S_N1 and S_N2, Electrophilic – halogenation; nitration; sulphonation; Friedel-Craft's alkylation and acylation, Electronic interpretation of orienting influences of substituents in aromatic electrophilic substitution of toluene, chlorobenzene, benzoic acid and nitrobenzene, (b) Addition – free radical; electrophilic and nucleophilic; (c) Elimination – unimolecular and bimolecular; (d) Rearrangement – intra molecular and inter molecular. **14 Hrs**

BOOKS:

1) Organic Reactions Mechanism by Peter Sykes, ULBS Publishers, New Delhi.
2) Organic Chemistry by Tiwari, Melhrotra and Vishnoi, S. Chand and Co., New Delhi
3) Physical Chemistry by B.R. Puri, L.R. Sharma and M.S. Pathania, S. Chand and Co., New Delhi
4) Chemical Kinetics by K.J. Laidler
5) Inorganic Chemistry by J.D. Lee
6) Selected Topics in Inorganic Chemistry by Madan, Tuli and Malik

CH 201	CHEMICAL PROCESS CALCULATIONS	(3-2-0) 4

1) **Units and dimensions:** Fundamental and derived units, Conversion, Dimensionless groups and constants. **6 Hrs.**
2) **Basic chemical calculations:** Methods of expressing chemical compositions, Ideal gas law. **10 Hrs.**
3) **Material balance without reaction:** typical steady state material balances, recycling, bypass and purging. **14 Hrs.**
4) **Material balance with reaction:** Principles of stoichiometry, definition of terms. **8Hrs.**
5) **Ultimate and proximate analyses of fuels:** calculations involving burning of solid, liquid and gaseous fuels. **8 Hrs.**
6) **Energy balance:** steady state, laws, heat capacity, enthalpy, theoretical flame temperatures. **8 Hrs.**

BOOKS:

1) Bhatt.B.L. and Vora S.M "Stoichiometry (SI Units)", Third Edition, 1996, Tata McGraw - Hill.
2) Himmelblau, D.M., "Basic Principle sand calculations in Chemical Engineering", 6th edn, Prentice Hall.
3) Hougen O.A., Watson K.M. and Ragatz R.A., "Chemical Process Principles"

CH 202	MOMENTUM TRANSFER	(3-2-0) 4

1) **Fluid statics and application:** nature of fluids, pressure, hydrostatic equilibrium, barometric equation, manometers, decanters. **8 Hrs.**
2) **Fluid flow phenomena:** Newtonian and Non-Newtonian fluids, types of flows, Reynold's stress, Eddy viscosity, Boundary layer, Average and Mass velocity, fluid flow equations. **10 Hrs.**

3) **Incompressible fluids:** Laminar and turbulent, velocity distribution, friction factor, flow through various pipe fittings and thin layers. **8 Hrs.**
4) **Transportation and metering of fluids:** Pipe fittings and valves, flow measurements, flow through open channels. Performance characteristics of pumps, Fans, Blowers and Compressors, introduction to unsteady state. **10 Hrs.**
5) **Compressible fluids:** Continuity equation, Mach Number, total energy balance, velocity of sound, Ideal gas equation, adiabatic and isothermal flow, Flow through convergent-divergent section. **8 Hrs.**
6) **Dimensional analysis:** Dimensional homogeneity, Rayleigh's and Buckingham-Pi methods, dimensionless numbers, models and prototypes **6 Hrs.**

BOOKS:

1) McCabe & Smith, "Unit operations of chemical engineering" 7th edition, Mc Graw Hill.
2) Coulson J.H and Rischardson.J.F., "Chemical Engineering" Vol-1,5th Edn.
3) Badger. W.L. and Banchero J.T., "Introduction to Chemical Engineering," Tata Mc Graw –Hill.
4) Kumar. K.L., "Engineering Fluid Mechanics", 3rd Edn.

CH 203	MECHANICAL OPERATIONS	(4-0-0) 4

1) **Particle technology:** characterization, Screening-determining particle size, screen analysis, Industrial screening equipment, sub-sieve analysis. Size reduction-objectives, operating variables, classification of size reduction quipment, energy requirements. **15 Hrs.**
2) **Flow of fluids past immersed bodies:** Drag, pressure drop - Kozeny Carman, Blake-Plummer and Ergun equation, Fluidization- types, applications, convey. **8 Hrs.**
3) **Motions of particles through fluids:** maximum velocity, motion of spherical particles in different regions, hindered settling, centrifugal separators, cyclones and hydrocyclones. **8 Hrs.**
4) **Sedimentation:** Gravity sedimentation-batch & continuous. thickeners & clarifiers – types, construction, settling area. Centrifugal sedimentation. **5 Hrs.**
5) **Filtration:** classification of filtration, rate of filtration, filter media, filter aids, industrial filters. **8 Hrs.**
6) **Mixing:** principles, types of impellers, standard turbine design, power correlation, types of mixers. storage of solids, conveyors-belt conveyors, chain conveyors, apron conveyors, bucket conveyors, screw conveyors. **8 Hrs.**

BOOKS:

1) McCabe & Smith, "Unit Operations of Chemical Engineering" V.Edn., Mcgraw Hill International,
2) Brown.G.G et., al., "Unit Operations", 1 Edn., CBS Publisher, New Delhi
3) Foust A.S. et. al., "Principles of Unit Operations" , John Wiley and Sons.
4) Badger, W.L, and Banchero, J.T., "Introduction to Chemical Engineering". , McGraw Hill International Edition, Singapore.
5) Coulson, J.M. and Richardson, J.F., "Coulson and Richardson's Chemical Engineering Vol, 2 Particle Technology and Separation Process" IV Edn,

CH 204	CHEMICAL ENGINEERING DRAWING	(0-0-4) 2

1) **Sectional views:** Representation of the sectional planes, Sectional lines and hatching, Selection of section planes and types of sectional views. **5 Hrs.**
2) **Proportionate drawing of process equipment:** Equipment and piping symbols, Jackets-types, Supports for vessels. Flanges & Nozzles, Vessel enclosures, Storage vessel, Reaction vessel **6 Hrs.**
3) **Assembly drawings:**
   i) Shaft Joints: Cotter joint with sleeve, Gib & Cotter joint, Socket and Spigot joint. **8 Hrs.**
   ii) Pipe joint: Flanged type, Union Joint, Stuffing box **8 Hrs.**
   iii) Valves:Stop valve, Lever safety valve, Rams Bottom safety valve, Non-return valve. **15 Hrs.**
   iv) Pumps: Centrifugal pump, **4 Hrs.**
4) **Process flow diagram** – with conventions & blocks, P&ID **6 Hrs.**

Note: First angle projection to be followed.

BOOKS:

1) Gopal Krishna, K.R., "Machine Drawing," 2nd Revised edn.
2) Joshi, M.V., "Process Equipment Design" 3rd Edn, Macmillan India publication.
3) Wales, S. M. "Chemical Process Equipment" Buterworth Heinemann pub.
4) Coulson, J.M. and Richardson, J.F., "Coulson and Richardson's Chemical Engineering Vol, 6 Design.
5) Bhat N.D., "Machine Drawing".
6) Vilbrant & Dryden., "Chemical Engineering Plant Design" Mc Graw Hill

CH 205	TECHNICAL CHEMISTRY LAB	(0-0-3) 1.5

List of Experiments:

1) Determination of partition coefficient of iodine between carbon tetrachloride and water.
2) Study of the kinetics of acid hydrolysis of methyl acetate.
3) Study of the kinetics of reaction between $K_2S_2O_8$ and KI.
4) Estimation of dissolved oxygen in given sample of water by Winkler's method.
5) Estimation of zinc in brass by volumetric method.
6) Estimation of iron gravimetrically.
7) Estimation of ester by hydrolysis.
8) Estimation of amine by acetylation.
9) Preparation of benzoic acid form benzaladehyde.
10) Preparation of bromoacetanilide from acetanilide.

BOOKS:

1) Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing House, Meerut.
2) Systematic Experimental Physical Chemistry, S.W.
3) Rajbhoj and T.K. Chondhekar, Anjali Publication,
4) Aurangabad Applied Chemistry, O.P. Varmani & A.K. Narula, New Age International Publishers Practical Organic Chemistry, F.G. Mann and B.C. Saunders

A Practical Organic Chemistry, A.I. Vogel

CH 206	MECHANICAL OPERATIONS LAB	(0-0-3) 1.5

List of Experiments

1) Air permeability
2) Ball mill
3) Settling velocity.
4) Beaker decantation
5) Cyclone separator
6) Drop weight crusher
7) Jaw crusher
8) Leaf filter
9) Plate and frame filter press
10) Screen effectiveness
11) Sieve analysis

12) Thickener
13) Basket Centrifuge
14) Froth Flotation
15) Air Elutriation

Minimum of 10 experiments are to be conducted.

IV SEMESTER

MA250	Engineering Mathematics-IV (Common to all branches)	(4-0-0) 4

1) **Numerical Methods:** Numerical solutions of first order and first degree ordinary differential equations - Taylor's series method, Modified Euler's method, Runge – Kutta method of fourth order, Milne's and Adams-Bashforth predictor and corrector methods (No proofs). **6 Hrs.**
2) **Complex Variables:** Function of a complex variables, Limit, Continuity Differentiability – Definitions. Analytic functions, Cauchy –Riemann equations in Cartesian and polar forms, Properties of analytic functions. Conformal Transformation Definition Discussion of transformations. $w = z^2$, $w = e^z$, $w = z + (1/z)$ (z not equal to 0), Bilinear transformations. **6 Hrs.**
3) **Complex Integration:** Complex line integrals, Cauchy's theorem, Cauchy's integral formula. Taylor's and Laurent's series (Statements only) Singularities, Poles, Residues, Cauchy's residue theorem **6 Hrs.**
4) **Bessel's Equation:** Series solution of Bessel's Equation leading to first kind Recurrence formulae, Generating function orthgonlity, Bessel's integral formulae. **6 Hrs.**
5) **Legendre's equation:** Series solution of Legendre's D.E Recurrence formulae, Rodriges formula Generating function, Orthogonality. **6 Hrs.**
6) **Statistical Methods:** Curve fitting by the method of least squares: $y = a + bx$, $y = a + bx+cx^2$, $y = ax^b$ $y = ab^x$, $y = ae^{bx}$, Corrélation and Régression. **6 Hrs.**
7) **Probability:** Addition rule, Conditional Probability, Multiplication rule, Baye's theorem. Discrete and Continuous random values, P.D.F, C.D.F., Binomial, Poisson, Normal and Exponential distributions. Mean & standard deviation of these distributions. **7 Hrs.**
8) **Concept of joint probability -** Joint probability distribution, Discrete and independent random variables, Expectation, Covariance, Correlation coefficient Probability vectors, stochastic matrices, fixed points, Regular stochastic matrics, Markov chains, Higher transition probabilities. Stationary distribution of regular Markov chains and absorbing states. **7 Hrs.**

BOOKS:

1) Higher Engineering Mathematics by Dr. B.S. Grewal (36th Edition)
2) Higher Engineering Mathematics by B.V Ramana (Tata Macgraw Hill)
3) Advance Modern Engineering Mathematics by Glyn James Pearson Education
4) Probability by Seymour Lipschutz (Schaum's series) Chapter 5 & 7

CH 250	PROCESS HEAT TRANSFER	(4-0-0) 4

1) **Modes of heat transfer:** mechanism of thermal conduction in solids, liquids and gases, thermal conductivity, steady state unidirectional heat conduction. **8 Hrs.**
2) **Insulation:** properties, types, critical and optimum thickness of insulation, extended surfaces. **8 Hrs.**
3) **Convection:** Dimensionless correlation for free and forced convection, analogies **10 Hrs.**
4) **Heat transfer with phase change:** Boiling, Condensation. **8 Hrs.**
5) **Heat exchangers:** LMTD and NTU method for heat exchanger calculation, Double pipe heat exchangers, Shell and tube heat exchangers, Condenser, Evaporators **10 Hrs.**
6) **Radiation:** black body radiation, laws, radiation between surfaces, radiation shields, solar radiation **8 Hrs.**

BOOKS:

1) J.P.Holman, " Heat Transfer " 9th Edn. Tata McGraw-Hill.
2) Rao., Y.V.C., "Heat Transfer", Universities Press.
3) McCabe & Smith. "Unit Operations of Chemical Engineering".
4) Coulsion & Richardson -"Unit Operations of Chemical Engineering" Vol.1

CH 251	CHEMCIAL ENGG.THERMODYNAMICS- I	(4-0-0) 4

1) **Basic concepts:** System, surrounding, state and Properties, state and Path functions, Equilibrium, phase rule, Zeroth law, reservoirs and heat engine. **8 Hrs.**
2) **First law of thermodynamics:** statement, cyclic process and non flow processes, Heat capacity. **8 Hrs.**
3) **P-V-T behaviour:** pure fluids, Equations of state, Processes involving ideal gas law: Constant volume, constant pressure, Constant temperature, adiabatic and polytrophic processes, cubic equations of state, Compressibility charts, principles of corresponding states. **10 Hrs.**

4) **Heat effects accompanying chemical reactions:** Standard heat of reaction, formation, combustion. Hess's law of constant heat summation, effect of temperature. **8 Hrs.**
5) **Second law of thermodynamics:** statementments, law, entropy, Carnot engine, entropy changes, Clausiusinequality, irreversibility, third law **8 Hrs.**
6) **Applications of thermodynamics to flow processes**: Duct flow of compressible fluids, Turbines (expanders), compression processes. **10 Hrs.**

BOOKS:

1) Smith J.M and Vanness H.C., "Introduction to Chemical Engineering Thermodynamics", 6th edition, McGraw Hill.
2) Narayanan, K.V. "Textbook of Chemical Engineering Thermodynamics", Prentice Hall.
3) Y.V.C. Rao, "Chemical Engineering Thermodynamics".

CH 252	MATERIAL SCIENCE	(3-0-0) 3

1) **Introduction:** material classifications, Level of structure, Structure property relationships, modern atomic concept, atomic models, periodic table, Chemical Bonding**.** **6 Hrs.**
2) **Crystallography and imperfections:** Geometry of crystals-the Bravais lattices, Crystal directions and planes-the miller indices, Structure determination, Point imperfections, Line imperfections-edge and screw dislocations, the Burgers vector, Surface imperfections. **6 Hrs.**
3) **Phase diagram, transformations and heat tretment:** Single component systems, Binary phase diagrams, Lever rule, Typical phase diagrams for Mg-Al, Cu-Zn, Fe-C, nucleation and growth, solidification, allotropic transformation, Isothermal transformations (TTT curves), heat treatment methods. **10 Hrs.**
4) **Deformation of materials and fracture:** elastic deformation, plastic deformation, creep, Visco-elastic deformation, mechanism and theory of fracture, ductile, brittle fracture, fatigue fracture, creep fracture. **8Hrs**.
5) **Corrosion and its prevention:** corrosion types, Galvanic cells, passivity, factors influencing corrosion, control and prevention of corrosion, modification of corrosive environment, inhibitors, cathodic protection, Protective coatings. **8Hrs.**
6) **Engineering materials and properties:** ferrous and non ferrous metals, ceramic materials, refractories, glasses, abrasives, organic materials. mechanism of polymerization, additions to polymers, plastics, fibre and elastomers, organic protective coatings,composites, types and synthesis, fabrication and processing techniques,nanomaterials,biomaterials. **12 Hrs.**

BOOKS

1) Raghavan V., "Materials Science and Engineering-A Fine Course" 3rd Edn., Prentice Hall of India Pvt Ltd.
2) Van Vlack, H.L, "Elements of Material Science", 2nd Edn, Addision-Wesly Publishing Company, New York.
3) Hajra Choudhury S.K "Material Science and Processes" .

CH 253	MASS TRANSFER-I	(4-0-0) 4

1) **Diffusion:** Fluids-Measurement and calculation of diffusivities, mass transfer coefficients and their correlations, analogies, theories of mass transfer, N.T.U and H.T.U and J_D factor, mass transfer and diffusion in turbulent flow, diffusion in solids. **16 Hrs.**
2) **Inter phase mass transfer:** Equilibrium diffusion between phases, material balance, Stages. **7 Hrs.**
3) **Crystallization:** Factors governing nucleation and crystal growth rates, controlled growth of crystals, supersaturation methods, material and energy balance, crystallizers. **8 Hrs.**
4) **Humidification:** General theory, psychometric chart, fundamental concepts in humidification and dehumidification cooling towers and related equipments. **8 Hrs.**
5) **Drying:** Equilibria, drying rate curves, batch and continuous drying, drye. **7 Hrs.**
6) **Adsorption:** theories of adsorption, industrial adsorbents, adsorption calculations and equipment. **6 Hrs.**

BOOKS:

1) Robert E. Treybal-"Mass Transfer Operation"- 3rd Edition, Mc Graw Hill
2) Coulson and Richardson – "Chemical Eng Vol 1 and Vol 2" 4th Edn.
3) Foust et.al-"Principles of Unit Operations", 2nd edn., John Wiley,
4) Geankoplis, C.J-"Transport Processes and Unit Operations", Prentice Hall (1), 3rd Edn,
5) Mc Cabe & J.M.Smith-"Unit Operations in Chemical Engineering"-7th Edn.,

CH 254	POLLUTION CONTROL ENGINEERING	(3-0-0) 3

1) **Introduction:** Importance of environment, Biosphere, hydrologic cycles nutrient cycles, damages from pollution. regulatory bodies, environment Impact assessment, and statement. **6 Hrs.**

2) **Waste water treatment:** evaluation, classification and characterization, analysis and estimation of water pollutants, primary, secondary and tertiary treatments, sludge treatment and disposal. **12 Hrs.**
3) **Air pollution treatment:** classification, sources, air quality criteria and standards, Meteorological conditions, methods of estimation of pollutants, air pollution from automobiles. Control methods and equipment **12 Hrs.**
4) **Solid waste treatment:** classification, microbiology and properties, functional elements, Thermal processes, 4R's **10 Hrs.**
5) **Noise pollution:** effect of noise levels, monitoring and high frequency vibrations. control criteria and techniques. **4 Hrs.**
6) **Case studies:** pulp and paper industry and dairy industry. **6 Hrs.**

BOOKS

1) C. S. Rao - "Environmental Pollution Control Engg".
2) S .P. Mahajan - "Pollution Control in Process Industries" - Tata McGraw Hill,
3) Lund, H.F.- "Industrial Pollution Control Handbook", McGraw hill, 1971.
4) Metcalf and Eddy - "Waste Water Engineering Treatment Disposal Reuse" Tata McGraw Hill, 4th Edn, 2003.
5) Frank Kreith and George Tchobanoglous- "Hand book of Solid waste Management", Tata Mc-Graw Hill, 2nd Edn.

CH 255	COMPUTER AIDED NUMERICAL METHODS LAB	(0-0-3) 1.5

List of Experiments:

1) Review of C language programs.
2) Numerical integration of Polynomial equation– Simpson's rule-Average specific heat of gas.
3) Numerical integration of ordinary differential equation-Runge-Kutta method.
4) Nonlinear algebraic equation-Newton Raphson method-Specific volume determination.
5) Simu ltaneous linear algebraic equation-Gauss Jordan method-Distillation Column.
6) Simultaneous linear algebraic equation-Gauss Siedel method-Mixing of acids.
7) Curve fitting-Linear regression- Pressure drop in pipe.
8) Numerical Integration of partial differential equation-finite differences.
9) Estimation of power requirement of centrifugal pump and annual cost.
10) Finding the roots of transcendental equation.
11) Calculate the average particle sizes of a material from sieve analysis data.

Any 9 out of 11 listed above.

BOOKS

1) Dr.M. Shantha Kumar, “Computer Based Numerical Analysis”.
2) S.S.Sastry, ”Introductory Methods of Numerical Analysis”
3) Dr.V.N.Vedamurthy,”Numerical Methods”.

CH-256	MOMENTUM TRANSFER LAB	(0-0-3) 1.5

List of Experiments

1) Fluidized bed.
2) Study and development of characteristics for centrifugal pump
3) Local velocity measurement using pitot tube.
4) Positive Displacement Pump Characteristics
5) Packed Bed
6) Reynolds Experiment
7) Flow through spiral coil
8) Orifice meter & venture meter characteristics
9) Friction in circular pipes
10) Pipe fittings
11) Weir characteristics

Minimum 10 experiments are to be conducted.

Evaluation System

1) Theory courses:

- **Maximum Marks: 100**
- **Continuous Internal Evaluation (CIE):**
  - Maximum Marks: **50**
  - Assignment, Case study, Problem solving, Report writing, Class room interaction etc., **10** marks (to be awarded by the Course instructor)
  - **CIE Tests: 40 Marks**

Sl. No.	Timing of the tests	Particulars	Max. Marks	Remarks
1	6th week (Sat, Mon, Tue)	**CIE Test – 1** Duration of Test: 1 Hour Portion: First 25% of the syllabus	**20**	1) Sum of best scores of any two tests to be considered for **40** marks. 2) Two papers per day.
2	10th week (Thu, Fri, Sat)	**CIE Test – 2** Duration of Test: 1 Hour Portion: Second 25% of the syllabus	**20**	
3	14th week (Sat, Mon, Tue)	**CIE Test - 3** Duration of Test: 1 Hour Portion: Third 25% of the syllabus	**20**	

- Students are expected to attend all the tests.
- Students are required to score a minimum of **20** marks to be eligible for **Semester End Examination (SEE).**
- **Question paper pattern for CIE tests:**

Parts	Questionnaire details	Max. Marks	Remarks
PART – A	Multiple choice, Fill in the blanks, Match the following, True/False and Make corrections	**05**	**No choice**
PART – B	Analytical and problem oriented questions involving short steps but demanding thorough knowledge and appreciation of the course.	**05**	**No choice**
PART – C	Standard questions that are objectively evaluated (describe, explain, short notes to be avoided)	**10**	**One choice**

- **Semester End Examination (SEE):**
  - Maximum Marks: **50**
  - Conducted in the 18th week of the semester for a maximum mark of **100** and the duration of the exam will be 3 Hrs..

- Marks obtained for 100 will be proportionally reduced to **50** marks.
- Attendance to the exam is compulsory.
- **Question paper pattern for SEE:**

Parts	Questionnaire details	Question No.	Max. Marks	Remarks
PART - A	Multiple choice, Fill in the blanks, Match the following, True/False and Make corrections	**1** **2**	Each question carries **10** marks	**No choice**
PART - B	Analytical and problem oriented questions involving short steps but demanding thorough knowledge and appreciation of the course.	**3** **4**		**No choice**
PART - C	Standard questions (maximum three sub divisions), which can be objectively evaluated (describe, explain, short notes to be avoided) on the entire syllabus.	**5 to 12**		**6 questions out of 8**

- **Total score = CIE + SEE**
- Relative grading using statistical approach will be done on this total score.

2) Practical courses:

- **Maximum Marks: 100**
- Interaction, preparation, journal writing etc., in each practical session spread over the entire semester carries **50** marks and this is to be awarded by the course instructor. Students are required to score a minimum of **20** marks to be eligible for the practical examination.
- **Practical examination:**
  - Maximum Marks: **50**
  - To be conducted in the **15th and/or 16th** week.
  - Practical batch for the exam shall have a maximum of 15 students.
  - Duration of the examination: **3 Hrs..**
  - Two examiners are to be nominated by the HOD.
  - Attendance to the exam is compulsory.
  - Total score will be the sum of the above components.
  - Relative grading using statistical approach will be done on this total score.