MTH-301
<u>COMPUTATIONAL TECHNIQUES</u>

UNIT I

MATRICES:- Eigenvalues and Eigenvectors of a real matrix , Characteristic equation , Properties of Eigenvalues and eigenvectors, Cayley-Hamilton Theorem , Diagonalization of matrices , Reduction of a quadratic form to canonical form by orthogonal transformation

UNIT II

INFINITE SERIES:- Sequences , Convergence of series , General properties , Series of positive terms , Tests of convergence (Comparison test, Integral test, Comparison of ratios and D'Alembert's ratio test) , Alternating series , Series of positive and negative terms , Absolute and conditional convergence , Power Series , Convergence of exponential, logarithmic and Binomial Series.

UNIT III

FUNCTIONS OF SEVERAL VARIABLES:- Limits and Continuity , Partial derivatives , Homogeneous functions and Euler's theorem ,Total derivative ,Differentiation of implicit functions , Change of variables , Partial differentiation of implicit functions , Taylor's series for functions of two variables . Errors and approximations, Maxima and minima of functions of two variables

UNIT IV

IMPROPER INTEGRALS:-Improper integrals of the first and second kind and their convergence, Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions, Properties, Evaluation of integrals using Beta and Gamma functions , Error functions.

UNIT V

MULTIPLE INTEGRALS:- Double integrals , Change of order of integration ,Area enclosed by plane curves, Triple integrals, Volume of Solids, Change of variables in double and triple integrals, Area of a curved surface.

TEXT BOOKS :
1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd.,

CMC – 302
ADVANCED ENGINEERING CHEMISTRY

UNIT I

Electronic Effect: Chemical properties of molecules, hyper conjugation and steric effects, studies on formation and stability of carbonation and Carbonium ions (with Inductive effects, conjugation & resonance and their effects)

UNIT II

Chemical Kinetics: Rate constant, order and molecularity of a reaction, zero, orders of reactions, methods of determination of order of reactions, Kinetics of opposing reactions Reaction rate theories, Arrhenius, parameters, Catalysis (including enzyme catalysis), effect of catalyst on reaction rate

UNIT III

Electrochemistry: Galvanic cell, EMF and its determination, free energy concept, Nernst equation of electrode potential, standard electrode potential; PH value, its measurement and pH metric titration, Conductance, its measurement in polar and non polar solvents; Debye & Huckel theory and its modifications in case of strong electrotypes, conductometric titration. Phase Rule: Phases, Degrees of freedom, component definition and derivation of phase rule, phase diagram study of Pb-Ag & Zn-Mg systems.

UNIT IV

Properties of simple monomers: Production, properties & industrial applications of following monomers – Ethylene Styrene, Vinyl Chloride, Vinyl alcohol, Acrylic acid, Methyl Acrylate, Ethyl Acrylate & Methyl Methacrylate.

UNIT V

Oils and Fats: Vegetable oils by solvent extraction, processing of animal fats, hydrogenation and esterification of oils; Soaps and Detergents Bathing & laundry soaps, cationic and anionic detergents; Specially cleaning, polishing and sanitation proportions, surface active agents, sulphonate oils.

REFERENCES:
1. B.S.Bahl & G. D. Tuli- Essentials of physical Chemistry. S. Chand & Publishers.
2. Glasstone – Textbook on Physical Chemistry – Prentice Hall, India, New Delhi.
3. Dryden CE- Outlines of Chemical Technology- Prentice Hall, India, New Delhi
4. Levine; Physical Cheistry; TMH.
5. Sivasamkar; Engg Chemistry; TMH
6. Jain & Jain- Engineering Chemisry – Dhanpat Rai Publishing Company, Delhi.
7. Austin G.T, Shreeves; Chemical Process Industry – McGraw Hill – Kogmina

LIST OF EXPERIMENTS:

1. To determine the viscosity of a viscous liquid by falling sphere method
2. Determination of saponification value of oil sample
3. Application of pH meter to find acidity and alkalinity of a solution.
4. To study the hydrolysis of cane sugar solution in the presence of an acid by Fehling's solution method and to find out the reaction constant.
5. Determination of the strength of unknown hydrochloric acid (app. 0.1N) by titrating it against caustic soda by
6. conductometric method.
7. To determine the % composition of a given binary liquid solution by polarimeter.
8. To determine the solubility of a sparingly soluble salt in water by conductance measurement.
9. Determination of pH of mixture of CH_3COOH and CH_3COONa and the dissociation constant of the acid.
10. Preparation of laundry soap and to determine its yield.

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<u>CHEMICAL ENGINEERING THERMODYNAMICS - I</u>

UNIT I
Fundamental concepts in thermodynamics: heat and work, the first law of thermodynamics, Joule's experiment, internal energy, state functions, enthalpy, steady-state, steady-flow processes, equilibrium and the phase rule, reversible processes, processes at constant volume and constant pressure, heat capacities, thermodynamics analysis of control volume, unsteady flow processes, charging and discharging of vessel.

UNIT II
Volumetric properties of pure fluids, P-V-T diagrams, Ideal gas, Virial equation and its applications, cubic equations of state, generalized correlations for gases and liquids.

UNIT III
Sensible heat and latent heat. Standard heat of formation, heat of reaction and heat of combustion, effect of the temperature on the heat of reaction, the second law of thermodynamics, statement of the second law, heat engines, Carnot cycle, thermodynamic scale of temperatures, Entropy, the third law of thermodynamics.

UNIT IV
Thermodynamic properties of pure fluids, Maxwell's equations, Helmholtz and Gibbs functions, residual properties, two - phase systems, tables and diagrams of thermodynamic properties of gases and liquids.

UNIT V
Compression & expansion of fluids; single stage, multiple stage requirements & efficiency along with effect & engineering along with effects clearance, compression of real gas.

REFERENCES:

1. Smith J.M and Van Ness- Introuction to Chemical Engg Thermodynamics – 6th edition
2. Daubert; chemical engg thermodynamic; TMH
3. K V Narayan- Chemical engineering thermodynamics
4. Rathakrishnan E; Fundamentals of Engg Thermodynamics; PHI
5. Dodge B.F. Chemcail Engineering –Thermodynamics –McGraw Hill
6. Balzhiser Samules and Eliassen-Chemical Engg- Thermodynaics Prentic Hall
7. Sandler S.I Chemical Engg-Thermodynamics-John Wiley and son
8. Rastogi and Mishra-Chemical Engg Thermodynaics

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CHEMICAL PROCESS CALCULATIONS

UNIT I
Mathematical and Engineering Calculation. Units, different unit systems, conversion of unit from one system to other dimensions. Dimensional analysis, dimensional group. Fundamental of conservation of mass conservation of energy. Basic of calculation.

UNIT II
Ideal and real gas laws - Gas constant - calculations of pressure, volume and temperature using ideal gas law, Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation, calculation of absolute humidity, molal humidity, relative humidity and percentage humidity, use of humidity in condensation and drying, Humidity chart, dew point.

UNIT III
Material balance-Introduction of component balance solving material balance, with and without simultaneous equation at steady state material balance, with and without simultaneous at unsteady state, recycle bypass and purge calculations.

UNIT IV
Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction, effect of pressure and temperature on heat of reaction, Energy balance for systems with and without chemical reaction, unsteady state energy balances.

UNIT V
Stochiometry & unit operations-Introduction of unit operation, Distillation Crystallization Drying, Evaporation, Stochiometry and its application. Introduction to Computer aided calculations-steady state material and energy balances.

REFERENCES:

1. Bhatt, B.L., VORA, S.M., "Stoichiomentry ", Tata McGraw-Hill, 1976.
2. Hougen, O.A., Watson, K.M and Ragatz, R.A., " Chemical Process Principles Part-I ",John   Wiley and Asia Publishing, 1970.
3. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering ",Fourth Edition, Prentice Hall Inc., 1982.
4. Whitwell, J.C., Tone, R.K. "Conservation of Mass and Energy ", McGraw -Hill, 1973.
5. Process Calculation for Chemical Engineering, Second Revised Edition, Chemical Engineering Education Development Centre, I.I.T., Madras, 1981.
6. O.A. Hougen, K.M. Watson, R.A. Ragatz; Chemical Process Principles Part I –CBS pub.

LIST OF EXPERIMENTS:

1. Determination of boiling point relation wrt concentration of caustic soda and verify Dehring' rule.
2. Application of dry and wet bulb thermometer to find out atmospheric humidity
3. Use of humidity chart to find enthalpy dew point humid heat and saturation.
4. Solubility at room temperature and boiling point of urea in water and verify the material balance.
5. Crystallization of copper sulfate in saturated solution by cooling and finding out the crystal yield.
6. To find out the heating value of coal using a calorimeter
7. Combustion of coal & performing the material balance
8. Proximate analysis of coal sample
9. Measurement of flame temp & compare actual & theoretical temp.
10. To find the heat of reaction using calcium oxide and water.

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CHEMICAL INSTRUMENTATION

UNIT I
Introduction to chemical process instrumentation, Process Variables, Static and Dynamic characteristics of instruments & their general classification.

UNIT II
Elements of measuring systems & their functions, principles, construction & operation of instruments for measurement, Process Flow Diagram (PFD), Actuator, Solenoid, Sensors

UNIT III
Control / Indication / Recording of process variables like pressure, flow, level, humidity and composition. Temperature Measuring Devices: Thermocouple, Resistance Temperature Detector (RTD). Pressure Measuring Devices: Differential Pressure Cell, Bellows Resistance Transducer. Flow Measuring Devices: Hot-wire anemometer, Nutating Disc displacement meter. Level Measuring Devices: Ball float, Magnetic Bond Level Indicator

UNIT IV
Principles of Transducers, Electro-Pneumatic transducers, Pneumatic transducers, Electrical & Multi-pressure devices. Actuator, Primary elements, Regulators and safety valves, Math function.

UNIT V
Piping and Instrumentation Diagram (P&ID), Instrumentation symbols Process instrumentation diagram and symbols, process instrumentation for process equipment's such as distillation column, heat exchanger, fluid storage vessel

REFERENCES:
1. Albert D. Cooper- Modern Electronic Instrumentation, PHI
2. Eckman-Industrial Instrumentation
3. H.S. Kalsi- Electronic Instrumentation
4. Curties Johnson- Process Control Instrumentation Technique, IV Edn, PHI
5. Harriot; Process control; TMH
6. Patranabis; Principles of process control; TMH
7. Jaggi, Mathur; Engineering Mathematics; Khanna Publisher.
8. B.G. Liptak- Instrument Engineering 'Handbook, Volume 1 : Process Measurement
9. Austin E. Fribance- Industrial Instrumentation Fundamentals, new York: Mcgraw-Hill 1962
10. Ernest Doebelin- Measurement Systems: Application and Design, McGraw-Hill

LIST OF EXPERIMENTS:
1. Time constant of pH-meter
2. Study of pressure gauge
3. Bellow tube pressure gauge
4. Calibration of different instruments used in chemical processes

5. Study of electro-pneumatic transducers for pressure, flow, level
6. Measurement of water level using differential pressure meter
7. Measurement of flow using electromagnetic flow meter
8. Measurement of flow using differential pressure cell across orifice/ venturimeter

CMC -306
INORGANIC CHEMICAL PROCESS INDUSTRY

UNIT I
Chlor-Alkali Industries: Solvay process of manufacturing soda ash, caustic soda and chlorine manufacture by electrolytic process: mercury, diaphragm and membrane cells, Bleaching powder, Sodium chloride.

UNIT II
Sulfur: Elemental Sulfur mining, Sulfur from ores, Oxides of Sulfur (SO_2, SO_3). Acids: Sulfuric acid, Nitric acid, Hydrochloric acid, Phosphoric acid and phosphates.

UNIT III
Fertilizers: Ammonia, Urea, Ammonium chloride, Ammonium nitrate, Ammonium phosphate, Ammonium sulfate, DAP, Biofertilizers, N-P-K Fertilizers and micronutrients

UNIT IV
Cement: Various kinds of cements and their major constituents, cement manufacture by cement rock (limestone) beneficiation and Portland process. Glass: Nature, types, composition and uses of glass, its manufacture: melting, shaping, annealing and finishing operations.

UNIT V
Coal gasification technologies: various types of fuel gases: producer, water, coke oven, synthesis, LPG & natural gases, various industrial gases: carbon dioxide, hydrogen, oxygen, nitrogen, helium, acetylene, carbon monoxide, sulphur dioxide, their sources and applications.

REFERENCES:
1. Austine G.T.and Shreeves; Chemicals Process Industries; Mc GrawHill
2. Dryden C.E., M. Gopala Rao; Outlines Of Chemical Technology. Affiliated East-West Press
3. Pandey G.N.; Chemical Technology Volume- I; Lion Press, Kanpur.
4. Bose, P.K., Chemical Engineering Technology, Vol. 1,2, Books and Allied (Pvt Ltd, 2011.
5. Desikan and Sivakumar , Unit Processes in Organic Chemical Industries (Eds., CEDC, IITM, 1982.
6. G.T. Austin, Shreve‟ s Chemical Process Industries, Mc Graw Hill.
7. Shreve‟ s, Chemical Process Industries, McGraw Hill, 4th Edition.