DCM 301 Introduction to Chemical Engineering

Unit I

Introduction to chemical engineering; history of chemical engineering and chemical technology; Scope of Chemical Engineering, Nature of Industries.

Unit II

Components of Chemical Engineering: Role of Mathematics, Physics, Chemistry and Biology, Basic Chemical Calculations: units and dimensions, concept of mole, weight percent, mole percent, normality, molarity, molality, vapor pressure, partial pressure.

Unit III

Unit Operations: Introduction, Definition, examples like Size reduction, sedimentation, filtration, Distillation, evaporation, absorption, extraction, fluid handling, fluid-solid contacting, fluid-solid separation, fluid storage.

Unit IV

Unit Processes: introduction to unit processes with simple examples like sulphonation, polymerization, oxidation, hydrogenation, nitration, chlorination.

Unit V

Basic concept of chemical processes: Conversion, Yield, efficiency, Temperature scale, measurement of temperature using bimetallic thermometer, mercury expansion thermometer, gas filled thermometer. Pressure scales & units, measurement of pressure. Level measurement. Flow measurement. Measurement of viscosity.

REFERENCE BOOKS:

1. Unit operations in chemical engineering by W.L. McCabe and J.C. Smith and Peter Harriott, Mc Graw Hill 5th ed. 1993.
2. Himmelblau, D.H, Basic Principles and Calculations in Chemical Engineering, 5th Edn. Prentice Hall, New York, 1990.

3 Coulson J M and Richardson J F, Chemical Engineering, Vol. I and II, Pergamon Press, NY, 1990.

4 Badger and Banchero, Introduction to Chemical Engineering, 1st Edn., McGraw Hill, NewYork,1954.

5 Dryden, C.E., "Outlines of Chemicals Technology", Edited and Revised by Gopala Rao, M. and M.Sittig, 2nd Edition, Affiliated East-West press, 1993.

6 Randolph Norris Shreve, George T. Austin, "Shreve'e Chemical Process Industries", 5th edition, McGraw Hill, 1984

7 McCabe, W.L., Smith, J. C. and Harriot, P. "Unit operations in Chemical Engineering", McGraw Hill, 7th Edition, 2001 2.

DCM 302- Fluid Mechanics

UNIT-I

Properties of fluids, fluid statics, Forces on fluids, pressure depth relationship for compressible and incompressible fluids, Forces on submerged bodies, Bernoulli's theorem.

UNIT-II

Kinematics of flow, description of velocity field, Stream functions, Fluids in circulation, Irrotational flow, Buckingham Pi Theorem, Dimensionless numbers and their physical significance.

UNIT-III

Fluid flow: Laminar and turbulent flows, Pressure drop in pipes, Conservation of mass, momentum and energy, Mechanical engineering Bernoulli's equation.

UNIT-IV

Flow measuring devices for chemical plants, venturimeter, orifice meter, nozzle, Rota meter, pitot's tube.

UNIT-V

Pumping and compressing of chemicals and gases, reciprocating pumps, rotary pumps, centrifugal pumps and blowers, NPSH, mixing and agitation, power requirement, compressible fluid flow.

References: -

1. McCabe Smith;Unit Operation for Chemical Engg. TMH
2. Modi& Seth; Fluid Mechanics; Standard Book House, Delhi
3. Som and Biswas; Fluid Mechnics and machinery; TMH
4. White ; Fluid Mechanics ; TMH
5. Gupta; Fluid Mechanics; Pearson.
6. Rajpoot R. K. ;Fluid Mechanics and Hydrolic Machine.
7. Bansal R.K.; Fluid Mechanics and Hydrolic Machine.

List of experiments

1. To determine the local point pressure with the help of pitot tube.
2. To find out the terminal velocity of a spherical body in water.
3. Calibration of Venturimeter
4. Determination of Cc, Cv, Cd of Orifices
5. Calibration of Orifice Meter
6. Calibration of Nozzle meter and Mouth Piece
7. Reynolds experiment for demonstration of stream lines & turbulent flow
8. Determination of metacentric height
9. Determination of Friction Factor of a pipe
10. To study the characteristics of a centrifugal pump.

DCM303-INORGANIC PROCESS TECHNOLOGY

UNIT-I

Chlor-Alkali Industries: Solvay process of manufacturing soda ash, caustic soda and chlorine manufacture by electrolytic process: mercury, diaphragm and membrane cells.

UNIT-II

Sulfur: Elemental Sulfur mining, Sulfur from ores, 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 and its application.

UNIT-V

Coal gasification technologies: various types of fuel gases: producer, water, coke oven, synthesis, LPG & natural gases.

References:
1. Austine G.T.and Shreeves; Chemicasl 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.

DCM 304 INDUSTRIAL PROCESS CALCULATION

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.

Unit III
Material balance-Introduction of component balance solving material balance, with and without simultaneous equation at steady state material balance, 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.

Unit V
Stochiometry & unit operations-Introduction of unit operation, Distillation Crystallization Drying, Evaporation, Stochiometry and its application.

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.

DCM 305 Advanced 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, Arrhenius, parameters, Catalysis.

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.

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.

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 conductometric method.
6. To determine the % composition of a given binary liquid solution by polarimeter.
7. To determine the solubility of a sparingly soluble salt in water by conductance measurement.
8. Determination of pH of mixture of CH_3COOH and CH_3COONa