MECM-301(A) Data Base for Process Plant Design

UNIT-I

Shell and Tube Heat Exchanger Design: 1-2 parallel –counter flow: Shell and Tube Exchanger, Flow arrangements for increased heat recovery, Calculations for Process conditions.

UNIT-II

Multiple Effect Chemical Evaporation: Calculations of Chemical Evaporators, Solution of industrial problems: concentration of cane sugar liquors – forward feed, Evaporation of paper pulp waste liquors – backward feed, caustic soda concentration – forced circulation evaporators.

UNIT-III

Vaporizers and Reboilers: Vaporizing processes, Reboiler arrangements, Classification of vaporizing exchangers, Heat flux and temperature difference Limitations, Relation between maximum flux and maximum film coefficient,

UNIT-IV

Towers: Introduction, Contacting Devices, Choice between Packed Columns and Plate columns, Tower Packings, Choice of plate types, Transfer unit calculations, Column diameter. Packed Towers: Introduction, Type and Size of Packings, Flooding, Pressure Drop, Foam, Holdup, Degree of Wetting, Column Diameter, Height of Packing,

UNIT-V

Introduction, Sieve Trays: Tower Diameter, Plate Spacing, Entrainment, Weepage, Tray Layout, Valve trays: Flooding and Entrainment, Tray Spacing, Foaming Tray type, Tray diameter and Lay out, Hydraulic Parameters.

REFERENCE BOOK:

1. Process Heat Transfer by D.Q.Kern, Mc Graw Hill Co., 1997.
2. Process Plant Design by Backhurst and Harker Amercian ElservierPub.Co., Heinmann Chemical Engineering Series, 1973.
3. Process Equipment Design by M.V.Joshi, McMillan India,1996.
4. Coulson and Richardson Chemical Engineering Volume 6 Pergamon Press.

MECM -301(B) BIOCHEMICAL ENGINEERING

Unit-I

Introduction to microbiology: Biophysics and the cell doctrine, the structure of cells, important cell types,from nucleotides to RNA and DNA, amino acids into proteins.

Unit-II

Kinetics of enzyme catalyzed reaction: the enzyme substrate complex and enzyme action, simple enzyme kinetics with one and two substrates, other patterns of substrate concentration dependence, modulation and regulation of enzyme activity, other influences on enzyme activity.

Unit-III

Immobilized enzyme technology: enzyme immobilization, industrial processes, utilization and regeneration of cofactors. Immobilized enzyme kinetics: effect of external mass transfer resistance, analysis of intra particlediffusion and reaction.

Unit-IV

Kinetics of cellular growth in batch and continuous culture, models for cellular growth – unstructured,structured and cybernetic models. Thermal death kinetics of cells and spores

Unit-V

Introduction to metabolic pathways, biosynthesis, transport across cell membranes, end products ofmetabolism, stoichiometry of cell growth and product formation.

Unit- VI

Transport phenomena in bioprocess systems: Gas-liquid mass transfer in cellular systems, determination ofoxygen transfer rates, overall kLa' estimates and power requirements for sparged and agitated vessels, scaling of mass transfer equipment, heat transfer.

REFERENCE

1. Biochemical engineering fundamentals by J.E.Bailey and D.F.Ollis, 2nd Ed,1986,McGraw Hill.
2. Bioprocess Engineering by Michael L. Shuler and Fikret Kargi, 2nd edition, Pearson education education
3. Biochemical engineering by James M.Lee – Prentice-Hall-1992.
4. Biochemical engineering by Aiba, Humphrey and Mells, academic press.
5. Bioprocess engineering principles, Pauline M. Doran, Academic Press.
6. Biochemical Engineering, H.W. Blanch and D.S. Clark, Marcel Dekker, 1997

MECM -301(C) NANOTECHNOLOGY IN CHEMICAL ENGINEERING

UNIT- I

Nano materials and nano composites: Introduction, surface of nanoparticles, thermal phenomena, surface energy-general considerations, phase transitions, thermodynamics, heat capacity of nano particles, Phase transformations of nanoparticles, nanoparticle
Structure fluctuations.

UNIT- II

Gas Phase Synthesis of Nanoparticle: Fundamental considerations, inert gas condensation, physical and chemical vaporsynthesis, laser ablation, Microwave plasma process, flame aerosolprocess, coated particle synthesis of nano particles, sol-gel and Hydrothermal processes, freeze drying attrition, Chemical vapor deposition methods for producing nano particles.

UNIT- III

Properties of nano particles:
a) Magnetic properties: super paramagnetic properties, applications, exchange coupled magnetic nano materials.
b) Optical properties: quantum confinement, quantum dots and other lumophores, metallic and semiconducting nano particles, special luminescent nano particles, electroluminescence, electrochromic and photochromic materials, magneto-optic applications.14

UNIT- IV

Electrical properties: electrical conductivity in nano-rods andnanotubes, Photoconductivity of nano-rods, electrical conductivity of nano composites.
Mechanical Properties: General considerations, influence ofgrain size, sintering temperature, super plasticity, filled polymer composites, nano fluids and applications of nano fluids.

UNIT- V

Carbon Nanotubes: nano rods and nano plates, Layeredstructures, compounds with layers structures, nano tubes and nanorods from materials other than carbon.
Thin films: Kinetic theory of gasses, concepts vacuum, Thermal evaporation, sputtering, ion implantation concepts in nanomaterial science.

REFERENCE BOOKS

1. Nano Materials & Introduction to Synthesis, Properties &Application. Dieter Vollath, Wiley VCH 2006.
2. Handbook of nanophase and nanostructured materials Vol1,2,3,4 Zhong Lin Wang, Yi Liu and Ze Zhang, Academic-Plenum Pblisher, 2002.
3. Nano technology, Richard booker, Earl Baysen Wiley Cheamtech, 2005.
4. Nano Materials, A.K. Bandyopadhyay New Age International Publishers, 2008 .

MECM -302 (A) Design of Piping Systems for Chemical Plants

Unit-I

Fundaments of fluid flow through pipes-Calculation of pressure drop for Newtonian & non-Newtonian fluids, incompressible & compressible fluids and two-phase flow, Calculation of economic pipe diameter, insulation thickness, equivalent length, Slurry transport and pipelines

Unit-II

Engineering flow diagram, nomenclature and equipment elevation Piping layout, line pressure drop, piping analysis, stress analysis of curved pipelines, yard piping

Unit-III

Piping codes, standards and specifications-ASME, ASTM, API Piping components-pipes, pipe ends, pipe fittings, end fittings, flanged joints, valves, valve codes and standards, valve classification, valve components, bolts, gaskets (fasteners and sealing elements)

Unit-IV

Piping materials-selection, cost and installation Design of heat exchanger piping, Thermosyphon reboiler piping, Pressure relief piping Steam tracing design, Thermowell design, Expansion loops and expansion joints

Unit-V

Design of pipeline network-Pinch analysis Pipeline operation and maintenance-friction reduction, cleaning, coating, wear, leak detection, water hammer

References

1. Peter Smith, Fundamentals of piping design, Gulf Publishing HouseKellog, Design of pipeline systems
2. Sahu, Handbook of Piping Design

MECM 302-(B) ENERGY MANAGEMENT

UNIT-I

Introduction to sources of Energy : Solar Energy, WindEnergy , Bio Mass , Chemical Energy, Magneto hydro dynamics, Geothermal, Ocean Energy, Nuclear Energy. Present usage levels.

UNIT-II

Solar Energy: Solar Radiation and its measurements, solar energy collectors: Flat plate collectors, concentrating collectors, Storage of Solar energy techniques: Thermal storage, Latent heat storage, Electrical, Chemical Storage, Mechanical Energy storage, solar pond.

UNIT-III

Energy from Biomass: Solid, liquid and gaseous biofuels conversion Techniques: Anaerobic digestion, Fermentation, Chemical reduction, Liquefaction, gasification, Hydrogenation and oil extraction. Bio gas generation: Factors affecting biodigestion for Biomass, energy audit,energy conservation & reuse.

UNIT-IV

Chemical Energy Sources : Fuel Cell : Operation of afuel cell, Classification of fuel cells , Advantages and disadvantages of a fuel cell, conversion efficiency of a fuel cell, Polarization in fuel cells Hydrogen Energy: Hydrogen production methods: Electrolysis, Thermo-Chemical methods, Fossil Fuel methods.

UNIT- V

Electrochemical Energy Conversion & Storage:EMF, reversible cells and irreversible cells, reversible electrodes, free energy changes and emf in cells, effect of cell temperature on batteries, derivation of number of electrons involved in a cell reactions, constant power, effect of battery design. Primary batteries, secondary batteries – lead acid, nickel cadmium, nickel metal hydride, silver oxide zinc system, energy management in chemical process plants

REFERENCE BOOKS

1. Culp, A, " Principles of Energy Conversion" MCGraw Hill,1979.
2. G.D. Rai, " Energy Sourses" , Khanna Publishers, 2008.
3. Mr. Barak, "Electrochemical Power sources", I.E.E. series Peter Peregrinus Ltd. Steverage,U.K 1980, reprint 1997.
4. Linden D and Thomas B.Reddy, "Hand Book on Batteries and Fuel Cell", McGraw Hill Book Co.,New York, 3rd Edition, 2002.
5. J.P. Gabano, "Lithium Batteries", Academic Press, London, 1983.

MECM-302(C) Fluidization Engineering

Unit-I

INTRODUCTION

The fluidized state, Nature of hydro dynamic suspension particle-particle forces, species of fluidization, Regimization of the fluidized state, operating models for fluidizations systems, Application of fluidization systems.

Unit-II

HYDRODYNAMICS OF FLUIDIZATION SYSTEMS

General bed behavior pressure drop, Flow regimes, Incipient fluidization, pressure fluctuations, phase hold ups, Measurement techniques, Empircial correlations for soilds holdup, liquid holdup and gas holdup, Flow models - generalized wake model, structural wake model and other important models.

Unit -III

SOLIDS MIXING AND SEGREGATION

Phase juxtaposition operation shifts, Reversal points, Degree of segregation, Mixing segregation equilibrium, Generalized fluidization of poly disperse systems, liquid phase mixing and gas phase mixing.

Unit-IV

HEAT AND MASS TRANSFER FLUIDIZATION SYSTEMS

Mass transfer - gas-liquid mass transfer, Liquid soild mass transfer and wall to bed mass transfer, Heat transfer - column wall - to - bed heat transfer, Immersed vertical cylinder-to-bed heat transfer, Immersed horizontal cylinder to-bed heat transfer.

Unit-V

MISCELLANEOUS SYSTEMS

Conical fluidized bed, Moving bed, Slurry bubble columns, Turbulent bed contactor, Two phase and three phase inverse fluidized bed, Draft tube systems, Semi fluidized bed systems, Annular systems, typical applications, Geldart's classification for power assessment, Powder characterization and modeling by bed collapsing.

References:

1. Gas-Liquid-Solid Fluidization Engineering, Liang-Shih Fan, Butterworths, 1989.
2. Fluidization Idealized and Bubbleless, with Applications, Mosoon Kwauk, Science Press, 1992.
3. Fluidization Engineering, O. Levenspiel and D. Kunii, John Wiley, 1972.