MECM 101 - SEPARATION PROCESSES

UNIT- I

Mechanisms of Mass Transport, steady and molecular diffusion, Equimolar counter diffusion, Diffusion as a Mass flux, Thermal Diffusion, Multicomponent gas phase system: Molar Flux in terms of effective diffusivity,Maxwells law of Diffusion, Diffusivities in solids liquids, gases. Steady state molecular diffusion in fluids at rest and in laminar flow, Unsteady State Diffusion.

UNIT - II

Mass transfer in turbulent flow- eddy diffusion and prandtl mizing length,Mass Trasfer through a phase boundry Two film theory, Penetration Theory The Film Penetration theory,Surface Renewal theory,Diffusion in Liquids. Velocity in Mass Transfer. Mass Transfer in Turbulent Flow:Renolds Analogy,Chilton Colburn Analogy

UNIT - III

Boundry Layer: Introduction, Momentum Equation , The Turbulent Boundary Layer: The turbulent portion, The laminar sub layer,Boundary Layer Theory applied applied to a pipe flow: Entry Conditions,Application of the Boundary layer theory.

UNIT – IV

Principle of membranes separation process, classification characterization & preparation of membrane, membranes modulus &application ,liquid membranes and industrial application.

UNIT - V

Ternary and multicomponent system fractionation theories: Multicomponent Mixture: Equilibrium Data, Feed and Product Composition, Light and Heavy key components,Calaulation of a number of plates required for a given separation, Minimum Reflux Ratio,No of Plates at total reflux, Relation bet Reflux ratio and no of plates. Brief Description about Azeotropic and Extractive distillation.

REFERENCE BOOK

1. Coulson &Richardson Volume 1, Edition 6(Chemical Engineering)
2. Coulson &Richardson Volume 2, Edition 6(Chemical Engineering)
3. B.K. Datta. “Separation process Technology“
4. J.D. Seader “Separation process principles” Second Edition
5. Nath K. Membrance separation Technology PHI

MECM 102 - ADVANCED TRANSPORT PHENOMENON

UNIT-I

Velocity distribution in laminar flow The equations of change for isothermal flow: creeping flow around a solid sphere Equations of continuity, equation of motion, the equation of mechanical energy, application of Navier-Stokes equation to solve problems like falling film, flow in a tube, shape and surface of a rotating fluid.

Unit-II

Velocity distribution in turbulent flow, microscopic balance for isothermal system macroscopic balance for non isothermal system.

UNIT-III

Temperature distribution in solids and in laminar flow , The equations of change for non-isothermal flow:Equations of energy, ,use of equations of change to set up steady state heat transferproblems,

UNIT – IV

Temperature distribution in turbulent flow energy transport by radiation. Temperature fluctuations and the time smoothed temperature . time smoothing energy equation semi empirical expression for the turbulent energy flux.

UNIT-V

Concentration distribution in solid and in laminar flow The equations of change for multi component systems: Concentration distribution in turbulent flow macroscopic balance for multicomponent system.

REFERENCE BOOKS:

1. Transport Phenomena R.B.Bird, W.E.Stewart and E.N.Lightfoot, Wiley international Edition, NewYork 2002.
2. Advanced transport Phenomena, J.C. Slattery Cambridge series in Chemical Engg., 1999.
3. Transport Processes And Unit Operations-Geankoplis

MECM 103- REACTOR DESIGN

UNIT-I

Models for Non-Ideal flow Reactors: Two- parameter models- Real CSTR modeled using bypass and dead space, real CSTR modeled as two CSTR interchange, testing a model and determining its parameters.

UNIT-II

Catalysis and catalytic reactors: Design of reactors for gas solid reactions. Heterogeneous data analysis for reactor design; catalyst deactivation – Types of Deactivation, Moving bed Reactors, Packed Bed Catalytic Reactor, Reactors with Suspended Solid Catalyst.

UNIT-III

External diffusion effects on heterogeneous reactions- External resistance to mass Transfer: Mass transfer coefficient, mass transfer to a single particle, mass transfer limited reactions in packed beds, The Shrinking Core Model.

UNIT-IV

Introduction of Heterogeneous Reactions, Diffusion and reaction in porous catalysts- Diffusion andreaction in spherical Catalyst pellets, internal effectiveness factor, Falsified Kinetics, Overall effectiveness factor.G/L Reactions on Solid Catalyst: Trickle Beds, SlurryReactors, Fluidized Bed Reactors.

UNIT-V

Non- isothermal reactor design- energy balance, nonisothermal adiabatic , CSTR, PFR, Flow, reactors at steady state, equilibrium conversion; multiple steady states- ignition- extinction curve.

UNIT-VI

Distribution of residence times for chemical reactors- ResidenceTime Distribution (RTD) Function, Measurement of the RTD, and Characteristics of the RTD, RTD in Ideal Reactors, Zero-Parameter Models, RTD and Multiple Reactions.

REFERENCE BOOKS:

1. Octave Levenspiel, "Chemical Reaction Engineering", Wiley Eastern University, 3rd Edition New Delhi (2001).
2. Fogler, H.S., "Elements of chemical reaction engineering", Prentice Hall, 4th Ed. New Jersey (1986).
3. Lannyd. Schmidt, "The Engineering of Chemical Reaction", University of Minnesota.
4. Stanley M. Walas, " Chemical Reaction Engineering Handbook Of solved Problems", University of Kansas, Lawrence.

MECM 104- ADVANCED HEAT TRANSFER

Unit-I

General equation of change for energy. heat conduction equation in cylindrical coordinate, spherical coordinates. Heat conduction through a hollow cylinder. Critical thickness of insulation.

Unit-II

Steady and unsteady state conduction is one, two and three dimensional cases. Finite difference method in steady and unsteady conduction. Two dimension steady state heat conduction in rectangular plates and semi infinite plates. Transient heat conduction in solid with finite conduction and convective resistance.

Unit-III

Forced Convection: Laminar flow over flat plate Momentum equations of hydrodynamic boundary layer over a flat plate. Blasius solution of laminar boundary layer flows. Laminar and turbulent flow over a flat plate, turbulent flow in tube, cylinder and sphere. Analytical and semi analytical solutions.
Free convectionMomentum and energy equations for laminar free convection heat transfer on a flat plate. Equations for velocity and temperature in vertical and horizontal planes for cylinders and spheres.

Unit-IV

Radiation heat transfer concepts. Angle factor calculation. Network method of analysis of radiation exchange. Radiation calculation through gas and vapors.

Unit - V

Design of compact heat exchanges, Heat transfer due to boiling liquefied metal heat transfer. Heat exchanger effectiveness and number of transfer unit.

References Books:

1. Process Heat Transfer, D.Q. Kern
2. Heat Transfer J.P. Holman
3. Heat and mass transfer R.K. Rajput
4. Fundamental of engineering heat and mass transfer. R.C.Sachdeva

MECM105 - PROCESS MODELLING AND SIMULATION

Unit-I
Introduction to modeling, a systematic approach to model building, classification of models.Conservation principles, thermodynamic principles of process systems.

Unit-II
Development of steady state and dynamic lumped and distributed parameter models based onfirst principles.

Unit-III
Development of grey box models. Empirical model building. Statistical model calibration and validation. Population balance models. Examples.Solution strategies for lumped parameter models. Stiff differential equations.

Unit-IV
Solutionmethods for initial value and boundary value problems. Euler's method. R-K methodshooting method, finite difference methods. Solving the problems using matlab library package.

Unit-V
Solution strategies for distributed parameter models. Solving parabolic, elliptic andhyperbolic partial differential equations. Finite element and finite volume methods.

REFERENCES:

1. K. M. Hangos and I. T. Cameron, "Process Modelling and Model Analysis",Academic Press.
2. W.L. Luyben, "Process Modelling, Simulation and Control for Chemical Engineers",2nd Edn., McGraw Hill Book Co., New York.
3. W. F. Ramirez, "Computational Methods for Process Simulation", 2nd ed.,Butterworths.
4. Mark E. Davis, "Numerical Methods and Modelling for Chemical Engineers", John Wiley & Sons.
5. Singiresu S. Rao, "Applied Numerical Methods for Engineers and Scientists" Prentice Hall, Upper Saddle River, NJ.