CHEMICAL REACTOR ANALYSIS AND DESIGN

Course Code: 13CH2104 **L P C**
4 0 3

PREREQUISITES: The student should have knowledge of chemical reaction engineering.

Course Educational Objectives:

This course introduces the student the following aspects

1. Understanding how chemical reactors are modeled and designed.
2. Writing and formulating the equation.
3. Parameter models for modeling of Non-ideal flow reacting vessels.
4. Catalysis, Catalytic & Non-catalytic vacation.
5. Design of fluid- solid reactors.

Course Outcomes:

After Completion of their course the student would be able to

1. Diagnose reactor ills like stagnant zones & bypassing.
2. Calculate Volumes & bypassing flow rates.
3. Synthesize a rate law given the rate controlling step.
4. Find the weight of catalyst needed in design of packed bed reactor

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.

Mixing of fluids: Zero parameter models-Segregation model, and qualitative concept of Maximum Mixedness model.

UNIT-II

Fluid-Particle reactions–Design: Various types of contacting in gas-solid operations; Development of performance equation for frequently met contacting pattern assuming uniform gas composition- Particles of a single size, plug flow of solids, Mixture of particles of different but unchanging sizes, plug flow of solids, Mixed flow of particles of a single unchanging size, Mixed flow of a size mixture of particles of unchanging size. Application to a fluidized bed with entrainment of solid fines.

UNIT-III

Fluid-Fluid Reactions- design: Factors to consider in selecting a gas liquid contactor, Straight mass Transfer: Plug flow G/Plug flow L – counter current flow in a tower. Mass transfer plus not very slow reaction: Plug flow G/Plug flow L – mass transfer and reaction in a countercurrent tower. Plug flow G/Plug flow L – mass transfer in a cocurrent tower.

UNIT-IV

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.

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.

Diffusion and reaction in porous catalysts- Diffusion and reaction in spherical Catalyst pellets, Internal effectiveness factor, Falsified kinetics, Overall effectiveness factor

UNIT-V

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

TEXTBOOKS:

1. Froment G, Bischoff K and De Wilde J, *"Chemical Reactor Analysis and Design",* 3rd Edition, John Wiley and Sons, 2011

REFERENCE:

1. Fogler, H.S., *"Elements of Chemical Reaction Engineering",* 4th Edition, Prentice Hall, New Jersey, 1986.
2. Levenspiel, O., *"Chemical Reaction Engineering"*, 3rd Edition, John Wiley and Sons, 2007.

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