CHEMICAL REACTOR ANALYSIS AND DESIGN

Course Code: 15CH2104	**L**	**P**	**C**
	3	**0**	**3**

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

Course outcomes: On successful completion of the course, the student should be able to

CO1: Describe the two parameter models for non-ideal flow reactors.
CO2: Explain and Design the various types of contacting in gas-solid operations.
CO3: Explain and Design the various factors to be considered in selecting a gas liquid contact.
CO4: Define catalysis, catalyst deactivation, diffusion and reaction in porous catalysts.
CO5: Discuss the non isothermal reactor design and multiple steady states and solve the problems on adiabatic flow reactors at steady state.

UNIT-I (10-Lectures)

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 (10-Lectures)

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 (10-Lectures)

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 (10-Lectures)

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 (10-Lectures)

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",*4thEdition, Prentice Hall, New Jersey, 1986.
2. Levenspiel, O., *"Chemical Reaction Engineering"*, 3rd Edition, John Wiley and Sons, 2007.