

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**B.E. SEMESTER : VIII**  
**CHEMICAL ENGINEERING**

Subject Name: **CHEMICAL REACTION ENGINEERING II**

Sr. No.	Course Contents	Total Hrs
1.	Non Ideal Flow, Residence time distribution, The E,F and C Curves, their inter relationship, ways of using age distribution function, Single parameter model for non ideal flow, Dispersion model, Chemical Reaction and dispersion, Intensity of fluid mixing. Tanks in series model, conversion, Deviation from plug flow, Models for real stirred tanks.	9
2.	<b>Kinetics and Design for uncatalyzed Heterogeneous system:</b> Rate equation for heterogeneous reactions, Combining linear rate expressions, Combining non-linear rate equations, Contacting patterns for two-phase systems.	3
3.	Fluid Fluid Reactions , Rate equation, Kinetic regimes for mass transfer and reaction, Rate equations for instantaneous reactions, Fast and intermediate rate equations. Rate equation for slow reaction, Rate equation for infinitely slow reaction, film conversion parameter $M$ , Towers for fast and slow reactions, mixer settlers. Semi batch contacting patterns, Slurry reactors.	4
4.	Fluid particle Reactions, Selection of a model, Unreacted core models for unchanging size spherical particles, Spherical particles of changing size, Diffusion through gas film and through ash layer controlling, Chemical reaction controlling, Shrinking core model, its limitations, Determination of rate controlling step, Plug and mixed flow of unchanging size solids under uniform gas composition, particles of single size and mixture of particles of various sizes, Fluid and fixed beds with solids entrainment, instantaneous reactions.	9
5.	Catalysts, Physical properties of catalyst, surface area, void volume, solid density pore volume distribution, Classification and preparation of catalyst, catalyst promoters. Catalyst inhibitors, Catalyst poisons, Nature and Mechanism of Catalytic reactions.	7
6.	Poisoning and deactivation of Catalyst, Mechanism and rate equation for catalyst deactivation, rate for independent deactivation, Parallel, series and side by side deactivation.	3
7.	Solid catalyzed reactions rates of chemisorption, Adsorption isotherms and rates of adsorption and desorption. Adsorption desorption rate controlling surface reaction rate controlling, Quantitative interpretation of kinetic data, Experimental methods of finding rates, differential, integral, mixed batch and recycle reactors, determining reactor size from rate equations. Product distribution in multiple reactions. Staged adiabatic packed reactors with inter cooling. Staged mixed reactors, Bubbling bed models.	6
8.	Fixed bed Reactors global reaction rates. Mass energy balance equation for fluid flowing through bed of catalyst. Isothermal and adiabatic reactors, heat transfer through reactor wall, wall film coefficient thermal conductivity, one and two dimensional model, calculations of external concentration. One and two dimensional model, Calculations of external concentration difference and temperature difference with negligible and finite diffusion resistances. Effect of external resistance on selectivity.	4
9.	Slurry Reactors effect of external transport resistance on global rate of reaction, Mass transfer between gas bubble and bulk liquid, mass transfer between bulk liquid to catalyst particle, Effect of mass transfer on observed rates. Determination of volume and conversion in slurry reactors.	3
10.	Fluid bed Reactors heat transfer and mixing in fluidized bed. Heat transfer to wall, conversion in plug flow with axial dispersion, model. Bubbling bed model. Dual reactors trickled reactors.	6

**Term Work and Practical:**

Experiments based on above topics should be given to the students

**Text Book:**

- 1 Octave Levenspiel, "Chemical Reaction Engineering", 3rd Edition, John Wiley & Sons (Asia) pvt. Ltd.
- 2 J.M.Smith, "Chemical Engineering Kinetics", 2<sup>nd</sup> edition, McGraw-Hill

**Reference Book:**

- 1 H. Scott Fogler, "Elements of Chemical Reaction Engineering" 3rd Edition November, Prentice Hall of India Pvt Ltd
- 2 L. D. Schmidt, "The Engineering of Chemical Reactions", Oxford Press