

COURSE TITLE	CHEMICAL REACTION ENGINEERING-II
COURSE CODE	01CH0610
COURSE CREDITS	4

Objective:

- 1 The course is intended to heterogeneous reaction engineering and non-ideal reactors, catalysis, leading finally to design considerations. The subject deals with residence time distributions, Kinetics and design of reactors for non-catalytic fluid-fluid and fluid-particle reactions and catalysis and catalytic reaction kinetics.

Course Outcomes: After completion of this course, student will be able to:

- 1 Understand the nature and mechanism of catalytic reactions
- 2 Apply the learning of Biochemical Reaction Systems in various industry
- 3 Analyse the RTD studies for any flow reactor, to predict the deviation from ideal reactors by evaluating the dispersion number
- 4 Predict the rate controlling step for the fluid – particle, Fluid-Fluid, and Fluid - Catalytic reactions

Pre-requisite of course:A course on Chemical Reaction Engineering-I

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	Non-Ideal Flow Reactor Design Basics of non-ideal flow, Residence time distribution (RTD), stimulus response techniques, The E,F and C Curves, their interrelationship, conversion in non- ideal flow reactors, Dispersion model, Chemical Reaction and dispersion, Tanks in series model, multiple steady state in CSTR, Adiabatic tubular reactor design	8
2	Heterogeneous Reactions Rate steps involved in heterogeneous systems, Overall rate expression for linear and nonlinear process, contacting patterns for two-phase systems	6
3	Fluid-Fluid systems Rate equation, rate equation for straight mass transfer, kinetic regimes of mass transfer and chemical reaction, rate equation for mass transfer and chemical reactions, film conversion parameter, fluid-fluid reactor design	6

Contents : Unit	Topics	Contact Hours
4	Fluid-Particle systems Fluid partial reaction kinetics, selection of a model, Shrinking Core Model for unchanging and changing size spherical partials, Diffusion through gas film and through ash layer controlling, Chemical reaction controlling, Shrinking core model, its limitations, Determination of rate controlling step	10
5	Solid-Catalysed reactions: Kinetics Adsorption isotherms and rates of adsorption and desorption. Kinetic regimes, rate equations for surface kinetics, Pore diffusion, determining rate controlling step, experimental methods for finding rates, product distribution in multiple reactions, Introduction to Catalytic Reactors: Packed bed catalytic reactors, fluidized bed reactors, trickle beds, slurry reactors	10
Total Hours		40

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Experiment 1 To determine E and C curves using CSTR -Pulse Input	2
2	Experiment 2 To determine E and C curves using PFR-Pulse Input	2
3	Experiment 3 To determine E and C curves using- PBR - Pulse Input	2
4	Experiment 4 To determine E and C curves using Cascade Continuous stirred tank reactor.	2
5	Experiment 5 To determine conversion using PBR	2
6	Experiment 6 To study the Characteristics of absorption with chemical reaction	2
7	Experiment 7 To study the Characteristics of absorption without chemical reaction	2
8	Experiment 8 To study the Characteristics of adsorption with chemical reaction	2
9	Experiment 9 To study the Characteristics of adsorption without chemical reaction	2
10	Experiment 10 Adsorption study using activated charcoal.	2
11	Experiment 11 To find the kinetics of dissolution of benzoic acid.	2
Total Hours		22

Textbook :

- 1 Chemical Engineering Kinetics, J.M.Smith, McGraw-Hill, 1981
- 2 Chemical and Catalytic Reaction Engineering, J. J. Carberry, McGraw Hill, 1976

References:

- 1 Chemical Reaction Engineering, Chemical Reaction Engineering, Octave Levenspiel, John Wiley & Sons (Asia) Pvt. Ltd, 2001
- 2 Elements of Chemical Reaction Engineering, Elements of Chemical Reaction Engineering, H. Scott Fogler, Prentice Hall of India Pvt Ltd, 1999
- 3 The Engineering of Chemical Reactions, The Engineering of Chemical Reactions, L. D. Schmidt, Oxford Press., 2005

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	20.00	25.00	25.00	10.00	10.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etC.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- 4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

Supplementary Resources:

- 1 <http://nptel.ac.in/courses/103103029/>
- 2 <http://www.unitoperation.com/>