

Chemical Reaction Engineering

B.E. Sem. VIII [CHEM]

EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical & Oral	–	25
Oral Exam	–	–
Term Work	–	25

SYLLABUS

1. Introduction

Ideal batch reactor and concept of batch time flow reactor and concept of space time / space velocity and holding time / residence time. Ideal mixed flow reactor (MFR) and plug flow reactor (PFR).

Design for single reactions

Single reactor performance of reversible and irreversible first order, pseudo first order, second order reactions for MFR, PFR. Graphical and analytical techniques.

2. Combination of reactors PFR in series / parallel, unequal size MFR in series, performance of the above for the first order and second order reactions. Recycle reactor and auto catalytic reactor. Problems based on semi batch reactor and recycle reactor are to be solved.

Design for complex reactions

Irreversible reactions in series and parallel with same or different order in various combination. Reversible reactions in series parallel. Applications.

3. Temperature and Pressure effects

Single reaction- endo / exothermic effects. Effect of temperature on thermodynamic equilibria and heat of reaction. Effect of temperature on reactor performance for adiabatic and non adiabatic operation. Case of exothermic reactions in mixed reactor, Optimum temperature progression. Multiple reactions- effect on product distribution. Temperature and scale effect on productivity of reactor. Various problems based on design of non-isothermal reactor are to be solved by using various numerical methods.

4. Non-Ideal flow Reactor

Concept of residence time distribution, Segregation, micro and macro mixing in reactors. Methods of obtaining RTD, E, F, C curves, mathematical and experimental techniques. Models of non ideal flow- Dispersion model for the case of small or large extent of dispersion. Effect of dispersion on conversion for general irreversible reaction case. Recycle Model. Multi parameter models. Diagnostic methods of analysis of flow patterns in reactors. Discussion Role of micro and macro mixing and segregation in ideal (MFR, PFR) and non ideal reaction cases.

5. Experimental reactors for heterogeneous Reactions

Non-Catalytic Fluid Solid Reactions in Flow Reactors

(Excluding the portion covered under the reaction kinetics) Application to design of continues solid flow reactors, various design considerations, Application of fluid bed reactors and their design consideration, heat transfer effects.

6. Solid Catalyzed Fluid Phase Reactors

Phenomenon observed in operation of packed, fluid bed, slurry and such reactors. Product distribution in multiple and complex reaction. Thermal Effects, phenomena of stability, instability and run away and it's analysis. Strategies for stable operation of reactors. Design consideration of fluid-solid catalytic reactors, incl. Fluid bed reactors.

Design of gas-liquid and liquid-liquid and gas-liquid-solid Reactors

Heterogeneous reactors, Bubble heterogeneous reactors, cocurrent and counter-current flow packed bed reactors.

Reference Books :

1. Chemical Reaction Engineering (*Smith J. M.*) 3/e Tata McGraw Hill, 1980.
2. Chemical Reaction Engineering (*Levenspiel D.*) Wiley Eastern, 2/e, 1972.
3. Elements of Chemical Engineering (*Fogler H. S.*) PHI, 1972.
4. Reaction Kinetics for Chemical Engineer (*Walas*) McGraw Hill, 1959.
5. Heterogeneous Reaction (*Doraiswamy & Sharma*) Vol-1&2, John Wiley, 1984.
6. Chemical Reaction Engineering (*Walas*) Hand Book of Solved problems, Gordon & Breach, 1995
7. Chemical Reactor Analysis and Design (*Froment G. F. & Bischoff K. B.*) Wiley series in chemical engineering; 2nd Ed.

