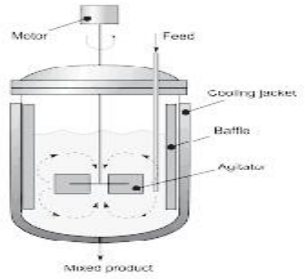
16CH302 CHEMICAL REACTION ENGINEERING-I



Hours Per Week :

L	T	P	C
3	-	2	4

Total Hours :

L	T	P
45	-	30

WA/RA	SSH/HSH	CS	SA	S	BS
20	45	1	3	5	5

Course Description and Objectives:

This course encompasses methodologies to design chemical reactors and also to solve related problems in process industries. The objective of this course is to train students to apply knowledge from calculus, differential equations, thermodynamics, chemistry and process calculations for designing chemical reactors.

Course Outcomes:

The student will be able to :

- develop rate laws for homogeneous reactions.
- develop the mechanism for non-elementary reactions.
- estimate the kinetics of the given reaction from the experimental data.
- design ideal reactors for simple and complex reactions.
- choose the right reactor among single and multiple reactors.

SKILLS:

- ✓ *Estimate the temperature and concentration dependency of rate equation.*
- ✓ *Carry out experiments to obtain the kinetic data.*
- ✓ *Determine the kinetic model parameters.*
- ✓ *Design ideal reactor for the given duty.*

ACTIVITIES:

- *Analyzing kinetic data using excel.*
- *Estimate Kinetic parameters using excel.*
- *Case study on Industrial applications of reactors.*

UNIT - 1 **L-9**

KINETICS OF HOMOGENEOUS REACTIONS : Rate equation. Concentration dependency of rate equation: Elementary and non-elementary reactions, Kinetic models for elementary and non-elementary reactions, Testing of kinetic models. Temperature dependency of rate equation: Arrhenius Law, Activation energy and temperature dependency.

UNIT - 2 **L-10**

INTERPRETATION OF BATCH REACTOR DATA : Constant volume batch reactor, Analysis of pressure data. Integral method of analysis: Irreversible zero, First, Second order reactions, Parallel and series reactions, Reversible first and second order reactions. Differential method of analysis.

VARIABLE VOLUME BATCH REACTOR : Analysis of pressure data. Integral method of analysis: Integral analysis of zero, First, Second order reactions.

UNIT - 3 **L-8**

IDEAL REACTORS : Performance of ideal batch reactor, Steady state mixed flow reactors, Steady state plug flow reactor.

UNIT - 4 **L-9**

MULTIPLE REACTIONS: Parallel reactions, Series reactions, Series – parallel reactions, Maximizing the productivity of desired reactant. An alternative approach to use fractional conversion, Net reaction rates and stoichiometry.

UNIT - 5 **L-9**

TEMPERATURE AND PRESSURE EFFECTS : Single reactions, Heat of reactions from thermodynamics, Heat of reaction and temperature, Equilibrium constant from thermodynamics, Conversion, Graphical design procedure.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS Total hours: 30

1. Kinetic studies in batch reactor with equimolar feed.
2. Kinetic studies batch reactor with using non equimolar feed.
3. Kinetic studies in C.S.T.R.
4. Kinetic studies in PFR.
5. Kinetic studies in adiabatic batch reactor.
6. Estimation of activation energy and frequency factor.
7. Kinetic studies of first order reaction in batch reactor.
8. Determination of best pattern.
9. Simulation of product distribution in series reactions.
10. Simulation of product distribution in parallel reactions.

TEXT BOOK:

1. Octave Levenspiel, “Chemical Reaction Engineering”, 3rd edition, John Wiley & Sons, 2012.

REFERENCE BOOKS :

1. Fogler H. S., “Elements of Chemical Reaction Engineering”, 3rd edition, PHS Publishers, 2014.
2. Simth J. M., “Chemical Engineering Kinetics’, 3rd edition, McGraw-Hill, 2014.