19CH212 CHEMICAL REACTION ENGINEERING-I

Hours Per Week :

L	T	P	C
3	1	-	4

Total Hours :

L	T	P
45	15	-

WA/RA	SSH/HSH	CS	SA	S	BS
25	50	-	-	5	5

Source:
http://reactor.co.in/chemical-reactor.html

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 :

Upon completion of the course, the student will able to achieve the following outcomes:

COs	Course Outcomes	POs
1	Develop rate laws for homogeneous reactions.	1
2	Conduct experiments for kinetic studies and interpretation of kinetic data to estimate the kinetic parameters.	2
3	Design ideal reactors to meet the desired conversion.	3
4	Design of right contact pattern for multiple reactions.	3
5	Identify the non idealities of the reactor from residence time distribution studies.	2
6	Model the non ideal reactors and estimate conversion of non ideal reactors.	5

SKILLS:

- ✓ *Carry out the experiments to obtain the kinetic data.*
- ✓ *Determine the kinetic parameters.*
- ✓ *Estimate the temperature and concentration dependency of rate of reaction.*
- ✓ *Identification best reactor and sizing of the reactor for the given reaction.*
- ✓ *Optimizing the selectivity in case of multiple reactions.*
- ✓ *Identify the non idealities of reactor.*
- ✓ *Modeling of non ideal reactors.*

UNIT - I **L-9, T-3**

KINETICS OF HOMOGENEOUS REACTIONS : Stoichiometry- limiting reactant, extent of reaction, conversion, selectivity; Rate of reaction; Dependency of rate of reaction; Concentration dependency of rate equation- elementary and non elementary reactions, kinetic models for elementary reactions, testing of models; Temperature dependency of rate equation- Arrhenius law**,** activation energy, temperature dependency of rate constant, numericals on temperature dependency.

UNIT - II **L-9, T-3**

INTERPRETATION OF BATCH REACTOR DATA : Constant volume batch reactor; Analysis of pressure data; Integral method of analysis; Differential method of analysis; Integral method of analysis- irreversible zero order reactions, first order reactions, second order reactions, n^{th} order reactions, reversible first and second order reactions.

VARIABLE VOLUME BATCH REACTOR : Analysis of pressure data; Integral method of analysis- zero, first, second order reactions.

UNIT - III **L-9, T-3**

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

DESIGN FOR SINGLE REACTIONS : Size comparison of mixed flow versus plug flow reactors; Multiple reactor systems- plug flow reactors in series, mixed flow reactors in series, reactors of different types in series.

UNIT - IV **L-9, T-3**

DESIGN FOR PARALLEL REACTIONS : Parallel reactions; Conversion; Selectivity; Yield; Contacting patterns for maximize the productivity of the desired product; Quantitative treatment of product distribution and reactor size.

DESIGN FOR SERIES REACTIONS : Optimizing the productivity of desired product- irreversible first order reactions in series, first order reaction followed by zero order reaction, zero order reaction followed by first order reaction conversion.

UNIT - V **L-9, T-3**

RESIDENCE TIME DISTRIBUTION STUDIES : Non idealities in ideal reactors; Importance of residence time distribution studies; Different input methods of tracer- E, F, C curves; RTD curves from experimental data; RTD curves for Ideal CSTR & PFR.

CALCULATION OF CONVERSIONS : RTD information; Macro fluid; Micro fluid; Tanks in series model; Axial dispersion model.

TEXT BOOK:

1. Octave Levenspiel, "Chemical Reaction Engineering", 3rd edition, John Wiley & Sons, 2016.

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.