UCH501 CHEMICAL REACTION ENGINEERING-I

L	T	P	Cr
3	1	2	4.5

Course Objective:

To understand the kinetics of single and multiple reactions and the effect of temperature on reaction systems.

Introduction: Overview of chemical reaction engineering, Classification of reactions, Variables affecting rate, Definition of reaction rate, single and multiple reactions, Elementary and non-elementary reactions, Molecularity and order of reaction, Reaction pathways, Effects of temperature, pressure, Heat and mass transfer on rate, Arrhenius law**,** Activation energy, Reversible and irreversible reactions, Reaction equilibrium.

Kinetics: Constant volume and variable volume batch, CSTR and PFR reactor data, Analysis of total pressure data obtained from a constant-volume batch reactor, Integral and differential methods of analysis of data, Autocatalytic reactions, Reversible reactions, and Bio-chemical reactions.

Homogeneous Single Reactions: Performance equations for ideal batch, Plug flow, Back-mix flow and semi batch reactors for isothermal condition, Size comparison of single reactors, Multiple-reactor systems, Recycle reactor, Autocatalytic reactions, Optimum recycle operations.

Multiple Reactions: Parallel reactions of different orders, Yield and selectivity, Product distribution and design for single and multiple-reactors, Series reactions: first-order reactions and zero-order reactions, Mixed series parallel complex reactions, Choice of reactors for simple and complex reactions.

Temperature Effects for Single and Multiple Reactions: Thermal stability of reactors and optimal temperature progression for first order reversible reactions, Adiabatic and heat regulated reactions, Design of non-isothermal reactors, Effect of temperature on product distribution for series and parallel reactions.

Laboratory work: Experiments on batch reactors, Semi-batch reactors, Continuous stirred tank reactors, Tubular reactors, RTD, Fluid-solid reactions.

Course Learning Outcomes (CLO):

Upon completion of this course, the students will be able to:

1. develop rate laws for homogeneous reactions.
2. analyze batch reactor data by integral and differential methods.
3. design ideal reactors for homogeneous single and multiple reactions.
4. select the appropriate type reactor/scheme.
5. demonstrate the temperature effect on reaction rate and design non-isothermal reactors..

Text Books:

1. *Fogler, H.S., Elements of Chemical Reaction Engineering, Prentice Hall of India (2003).*
2. *Levenspiel, O., Chemical Reaction Engineering, John Wiley & Sons (1998).*

Reference Books:

1. *Smith, J.M., Chemical Engineering Kinetics, McGraw Hill, New York (1990).*
2. *Denbigh, K.G., and Turner, J.C.R., Chemical Reactor Theory - An Introduction, Cambridge University Press, UK (1984).*

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1	MST	25
2	EST	35
3	Sessional (May includes lab/tutorials/ assignments/ quiz's etc)	40