Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	CHC302	Chemical Kinetics and Reaction Engineering	3	1	0	11

Course Objective
The objectives of this course are to study the kinetics of homogeneous and heterogeneous reactions and interpret the kinetic data that helps to perform the design of chemical reactors.
Learning Outcomes
At the end of the course, the student would be able to understand the ideal and non-ideal reactor systems under isothermal and non-isothermal conditions. Design methodology of reactors for homogeneous and heterogeneous reactions would be understood by the students.

Unit No.	Topic to be covered	Class Hours	Learning Outcome
1	**Kinetics of Homogeneous Reactions:** Introduction to chemical reaction engineering, kinetics of homogeneous reactions, kinetic models, testing kinetic models, effect of temperature on reaction rates	**3 L + 1 T**	Develop rate expressions for homogeneous reactions
2	**Interpretation of Kinetic Data:** Interpretation of batch reactor data for single and complex reactions, differential and integral methods of analysis of batch reactor data, half-life and fractional life methods	**3 L + 2 T**	Know about testing of kinetic models
3	**Ideal Reactors:** Design of single homogeneous reactors: ideal reactors, design equations for ideal batch reactor, plug flow reactor (PFR) and mixed flow reactor (MFR), size comparison of single ideal flow reactors, optimum reactor size problems	**3 L + 2 T**	Design ideal reactors for single reactions
4	**Design for Single Reactions:** Combination of ideal flow reactors, recycle reactor, autocatalytic reactions	**4 L + 2 T**	Design recycle reactors for auto catalytic reaction
5	**Design for Multiple Reactions:** Series reactions, parallel reactions, series–parallel reactions, special reactions schemes (Denbigh, van de Vusse, etc.), product distribution in various types of ideal reactors	**3 L + 1 T**	Design ideal reactors for complex reactions
6	**Design of Non-isothermal Reactors:** General graphical design procedure, steady state non–isothermal design of ideal reactors for single and multiple reactions, stability of reactor	**4 L + 1 T**	Design steady-state non-isothermal reactors and perform calculations on heat exchange

7	**Basics of Non–ideal Reactors:** Reasons for non–ideal flow behavior, interpretation of residence time distribution (RTD) functions, calculation of mean residence time and variance from the RTD data, limitation of RTD	**4 L + 1 T**	Understand basics of non-ideality
8	**Design of Non–ideal Reactors:** Conversion in non–ideal reactors, concepts of micro- and macro-mixing, segregated flow model, tanks in series model, axial dispersion model, two–parameter models for stirred tank flow reactor	**6 L + 2 T**	Propose design alternatives to carry out reactions in real reactors.
9	**Heterogeneous Reactions:** Introduction to heterogeneous reactions, shrinking core model (SCM) for particles of constant size	**6 L + 1 T**	Apply the SCM for non-catalytic reactions
10	**Solid Catalyzed Reactions:** Kinetics of solid catalyzed reactions, reaction and diffusion in porous catalysts: effectiveness factor, Thiele modulus, global rate equations	**6 L + 1 T**	Apply pore diffusion criteria to catalytic reactions

Textbooks:
1. Levenspiel, O. (2006). Chemical Reaction Engineering, 3rd Ed., Wiley.
2. Fogler, H. S. (2008). Elements of Chemical Reaction Engineering, 4th Ed., Prentice Hall.

Reference Books:
1. Smith, J. M. (2013). Chemical Engineering Kinetics, 3rd Ed., McGraw–Hill.
2. Hayes, R. E., and Mmbaga, J. P. (2013). Introduction to Chemical Reactor Analysis, 2nd Ed., CRC Press.