CEPC3001 CHEMICAL REACTION ENGINEERING (3-0-0)

Overall Course Objectives:
To understand the effect of non-ideal flow on reactor performance and to design reactors for heterogeneous reaction systems.
Course Outcomes :
CO1: Analyze and determine reaction rate laws by utilizing concentration-time data obtained from batch reactors.
CO2: Calculate the volumes of ideal reactors (batch, mixed flow, and plug flow) for a specified conversion using relevant model equations.
CO3: Optimize the arrangement of ideal reactors (in series or parallel) to maximize conversion efficiency.
CO4: Calculate the volumes of mixed flow reactor, adiabatic plug flow reactor, adiabatic recycle reactor, and plug flow reactor with optimal temperature progression.
CO5: Interpret C, E, and F curves, elucidating residence time distribution concepts, while defining catalysis mechanisms and related principles.

Module I: (15 hrs)
Introduction and overview of the subject, kinetics of homogeneous reactions, elementary and non- elementary reactions, concentration and temperature dependent term of a rate equation, collision theory, transition - state theory and Arrhenius theory. Interpretation of batch reactor data for both reversible and irreversible reactions. Various methods of analysis of batch reactor data (including variable volume and variable pressure (data). Isothermal batch reactor design.

Module II: (12 hrs)
Homogeneous flow reactors: Design equations for steady state plug flow reactor (PFR) and steady state continuous stirred tank reactor (CSTR), data analysis in flow reactors, mean residence time, space time, space velocity. Combined reactors, reactors in parallel and in series, size comparison of single reactors, recycle reactors.

Module III: (15 hrs)
Design for parallel reactions, product distributions, contacting patterns for reactions in parallel, quantitative treatment of product distribution, selectivity, multiple reactions, and qualitative treatment of batch, PFR, and mixed reactors. Basics of non-ideal flow, RTD, age distribution of fluid, pulse experiment, relationship between F and E curves.

Text Book:
1. Chemical Reaction Engineering, 3rd ed. by O Levenspiel, Wiley.

Reference Book:
1. The Engineering of Chemical Reactions, Lanny D. Schmidt, Oxford University Press
2. Elements of Chemical Reaction Engineering, 4th ed. by H S Fogler, PHI.
3. Chemical Reactor Analysis and Design, 3rd ed. by G F Froment, K B Bischoff, and J De Wilde, Wiley.
4. Chemical Engineering Kinetics, 3rd ed. by J M Smith, McGraw-Hill.