CHEMICAL REACTION ENGINEERING-I

COURSE CODE:15CH1119

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COURSE OUTCOMES:

At the end of the course the student shall be able to

CO 1 Discuss the various types of reactions, reactors, rate equations and their mechanisms.

CO 2 Interpret batch reactor data and find the rate equation.

CO 3 Design, calculate and compare the volumes and conversions for isothermal batch, CSTR and PFR.

CO 4 Select the best reactor for maximizing yield and selectivity.

CO 5 Solve the problems on adiabatic CSTR & PFR and discuss the optimal temperature progression.

UNIT-I (8 LECTURES)

Introduction to Chemical Reaction Engineering; Elementary and Non-elementary Reactions, Homogeneous and Heterogeneous Reaction, The definition of rate equation. The meaning of Arrhenius Rate law, searching for rate Mechanism.

UNIT-II (10 LECTURES)

Batch Reactor : Design equation for isothermal case. Problems on constant and variable Volume isothermal Batch Reactor.

Find the Rate Equations from:

1. Half life Data.
2. Integral and Differential analysis of CA vs t and P vs t data.
3. CSTR experimental Data at Isothermal operations, non isothermal operations.

UNIT-III (12 LECTURES)

FLOW REACTORS:

Design Equations for isothermal CSTR and PFR. Problems on CSTR and PFR with and without expansion, size comparison of CSTR and PFR (Given volumes calculate conversion and given conversion calculate volumes). Problems on reactor sequencing for CSTR in series and PFR in series and their combination. Autocatalytic reactions and Recycle Reactors (Calculation of volumes needed for different Recycle Ratios and similar problems).

UNIT-IV (10 LECTURES)

MULTIPLE REACTIONS:

Series Reactions in Batch, CSTR and PFR's.

Parallel Reactions: Problems on Calculation of yields and selectivities in CSTR and PFR. Finding the best reactor for maximizing selectivities. Product distribution as a function of Temperature for Parallel and series reactions (Qualitatively only).

UNIT-V (10 LECTURES)

NON ISOTHERMAL REACTORS:

Energy balance derivation for batch CSTR and PFR's. Calculating equilibrium conversion at different temperature.

Problems on Adiabatic CSTR, PFR: Calculating steady state conversion & temperature for a non-isothermal CSTR, concept and problems on interstage cooling, optimal temperature progression for batch reactors (Qualitative only).

TEXT BOOKS:

1. Levenspiel. O., "Chemical Reaction Engineering", 3rd Edition, John Wiley and Sons, 1999.

REFERENCES:

1. Fogler, H.S., "Elements of Chemical Reaction Engineering", 3rd Edition, John Wiley, 1999.
2. Smith, J.M., "Chemical Engineering Kinetics", 3rd Edition, McGraw Hill, 1981.