

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL ENGINEERING

B. E. SEMESTER: VII

Subject Name: **Chemical Reaction Engineering-I**

Subject Code: **170501**

Teaching Scheme				Evaluation Scheme			
Theory	Tutorial	Practical	Total	University Exam (E)		Mid Sem Exam (Theory) (M)	Practical (Internal)
				Theory	Practical		
3	0	3	6	70	30	30	20

Sr. No.	Course Contents	Total Hrs
1.	Kinetics of homogenous reactions: Classification of reactions, Definitions of reactions rate, variables affecting reaction rate, concentration dependent term of rate equation for single, multiple, elementary and non-elementary reactions. Molecularity and order of reaction. Kinetic models for non-elementary reactions. Testing kinetic models. Temperature dependant term of rate equations from Arrhenius theory and comparison with collision and transition state theory. Activation Energy and Temperature Dependency. Temperature dependency from thermodynamics, comparison of theories. Prediction of reaction rate by theories. Searching for the mechanism.	6
2.	Interpretation of Batch reactor data: Constant volume batch reactor, analysis of total pressure data, Integral and differential methods of analysis of data for constant volume and variable volume cases. Temperature and Reaction rate, search for a rate equation,	12
3.	Introduction to reactor design: Mass and energy balances around a volume element. Single ideal reactors under steady state conditions, Ideal batch reactor, ideal mixed flow & ideal plug flow reactors, space-time and space velocity. Introduction to semi batch reactor.	6
4.	Design of reactor for single reactions: Ideal batch reactor, steady-state mixed flow reactor, steady-state plug-flow reactor, holding and space time for flow reactors, size comparison of single reactors- with reference to first and second order reactions for Batch reactor, mixed versus plug flow reactor, general graphical comparison. Multiple reactor system, plug flow reactors in series and parallel, equal size and	12

	different size mixed flow reactors in series, reactors of different types in series, recycles reactors and autocatalytic reactions.	
5.	Design for parallel reactions: Introduction to multiple reactions, qualitative discussion about product distribution, qualitative treatment of product distribution and of reactor size, the selectivity, irreversible first order reactions in series- qualitative treatment, performance characteristics, kinetic studies, and design of plug flow and mixed flow reactor, first order followed by zero order reaction, zero order followed by first order, successive irreversible reactions of different orders, reversible reactions, irreversible series-parallel reactions- Performance characteristics, kinetic study and design for mixed and plug flow reactor, the Denbigh reactions and their special cases,	12
6.	Temperature and pressure effects: (Single Reactions) Calculations of heats of reactions and equilibrium constants from thermodynamics, equilibrium conversion, General graphical design procedure. Optimum temperature progression, Energy balances equations in adiabatic and non-adiabatic case. Exothermic reaction in mixed flow, Rules for choice of reactors and optimum operation of reactors.	6

Practical and Term Work:

Experiments based on above topics should be given to the students.

Text Book:

1. Octave Levenspiel, "Chemical Reaction Engineering", 3rd Edition, John Wiley & Sons (Asia) Pvt Ltd.

Reference Books:

1. H. Scott Fogler, "Elements of Chemical Reaction Engineering" 3rd Edition November, Prentice Hall of India Pvt Ltd
2. L. D. Schmidt, "The Engineering of Chemical Reactions", Oxford Press
3. J.M. Smith, "Chemical Engineering Kinetics", 2nd, McGraw-Hill