GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. SEMESTER: V

BIO-TECHNOLOGY

Subject Name: **Chemical Reaction Engineering**
Subject Code: **150403**

Teaching Scheme				Evaluation Scheme		
Theory	**Tutorial**	**Practical**	**Total**	**University Exam (Theory) (E)**	**Mid Sem Exam (Theory) (M)**	**Internal Assessment (I)**
4	0	3	7	70	30	50

Sr. No.	Course content
1.	**Kinetics of Homogeneous Reactions:** Classification of reaction, Definition of reactions rate, Variables affecting reaction rate, Concentration dependent term of rate equation for elementary, non elementary, single and multiple reactions, Molecularity and order of reaction, Kinetic models for non elementary reactions, Testing kinetic models, Temperature dependent term of rate equations, Arhenius theory, Collision theory, Temperature dependency from thermodynamics, Comparison of theories, Prediction of reaction rate by theories.
2.	**Kinetics of Electrode Process:** Kinetics of hydrogen evolution hydrogen over potential and current density, Electrode material, Effect of composition and nature on hydrogen over potential of temperature and other factors, Mechanism kinetics of the oxygen evolution, General description of process and mechanism of anodic oxygen evolution. Kinetics of electrochemical reduction and oxidation, General redox reaction, Experimental data, Effect of electrode material and electrode potential, Effect of solution composition, Theory of electrochemical reduction and oxidation reactions, Rate determination electron addition step, Rate determining addition of hydrogen atoms, Rate determining addition of activated hydrogen atom.
3.	**Kinetics of Reactions in Solutions:** Collision theory and reaction in solutions, Rate of chemical reactions in solutions, Very rapid, Normal and slow reactions, Activated complex theory and reactions in solutions, Influence of dipoles ionic strength of solution on rates, Reaction between ions, Influence of pressure on reaction rate, Effect of substitutes in organic molecules, Hetrolytic and homolytic reactions, Nucleophilic and electrophilic reactions electron transfer reactions and conjugated reactions, Kinetics of enzymes catalysis, Enzymes. Kinetics of enzymes, Kinetics of photo chemical/ reaction quantum yield and classification of photochemical process, Overall and local rate of photochemical reactions, Temperature dependence of rate of photochemical reactions.

4.	**Kinetics of Chain and High Molecular Compound Formation:** REACTION: General example of chain reaction length of chain and branch, Chain branching, Kinetics of unbranching reactions, Branching chain reaction kinetics of oxidation of hydrogen, Radical polymerization, Copolymerization ionic co-ordination polymerization, Polymerization wit ring ening of poly condensation.
5.	**Interpretation of Batch Reactor data:** Integral and differential methods of analysis of data for constant volume and variable volume cases, First order, second order, Autocatalytic reaction related reversible and irreversible reactions, Searching a rate equation and mechanism to fit experimental data.
6.	**Introduction to Reactor Design:** Mass and energy balance around a volume element, Single ideal reactors under steady state conditions, Batch, Mixed flow & plug flow reactor, Space time and space velocity, Introduction to Semibatch reactor.
7.	**Reactor Design for Single Reactions:** (With reference to first and second order reactions) the comparison of single reactors, Batch reactor mixed versus plug flow reactor, General graphical comparison, Multiple reactor system, Plug flow reactors in series, Mixed flow reactors in series, Reactors of different types in series, Recycle reactors and autocatalytic reactions.
8.	**Reactor Design for Multiple Reactions:** Reversible and irreversible reactions of various order: series, parallel and complex reactions, Contacting patterns and product distribution, Performance characteristics, Kinetic study and design for mixed and plug flow reactor.
9.	**Temperature and Pressure Effects:** (Single Reactions) Calculations of heat of reactions and equilibrium constants, General graphical design procedure, Optimum temperature progression, Energy balance equations in adiabatic and non adiabatic case, Performance of mixed, Plug flow and Semibatch reactors.
10.	Temperature and pressure effects (Multiple reactions), Product distribution and temperature, Temperature and vessel size for maximum production.
11.	**Industrial applications:** Nitration, Sulfonation & sulfation, Hydrolysis, Alkylation Esterification, Polymerization, Oxidation, Reduction, Fermentation, Chlorination, Photochlorination cracking, etc., Should be discussed with reference to types of reactors utilised in these unit process.

Practical and Term Work:

Experiments based on the kinetics of Homogenous reactions, Kinetics of electrode process, rate determining reaction etc.

Reference Books:

1. Chemical Reaction Engineering, Octave Levenspiel Wiley Eastern Pvt. Ltd.
2. Chemical Kinetics and Catalysis, G. M. Panchencov and V.P. Lebedav, Mir.Publishers, Moscow.
3. Chemical Engineering Kinetics by J. M. Smith, McGraw Hill.
4. Reaction Kinetics for Chemical Engineering by S. N. Walesm McGraw Hill.
5. Chemical Reactor Theory by K. G. Denbigh and D. C. R.