Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Diploma Engineering College
Semester 5 (Diploma)

Subject: Chemical Reaction Engineering- DETCH15212

Type of course: Professional Core

Prerequisite: Basic knowledge of chemical kinetics and reactor types.

Rationale: Chemical Reaction Engineering at the diploma level focuses on fundamental reaction kinetics, reactor types, and design principles to optimize chemical processes efficiently.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
4	0	2	5	60	30	10	20	30	150

Legends: CI - Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE - Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Sr. No	Course content	Hrs.	Weightage
1	**Introduction:** Basic concepts of reaction engineering, Classification of chemical reactions (Homogeneous & Heterogeneous), Reaction rate and rate equation, Factors affecting reaction rate (Temperature, Pressure, Concentration, Catalyst), Order & Molecularity of reactions, Elementary & Non-elementary reactions	05	15%
2	**Reactor Types & Design Basics:** Classification of reactors (Batch, CSTR, PFR, Semi-batch), Working principles of different reactors, Advantages and disadvantages of each reactor type, Ideal vs. Non-ideal reactors, Selection criteria for reactors, Basic design equations for batch and flow reactors	15	25%

3	**Kinetics of Homogeneous Reactions:** Rate laws and reaction mechanisms, Zero-order, First-order, and Second-order reactions , Integrated rate equations and half-life concept, Temperature dependency of reaction rate (Arrhenius equation), Effect of catalyst on reaction kinetics, Activation energy and its significance	20	30%
4	**Heterogeneous Reactions & Catalysis:** Difference between homogeneous and heterogeneous reactions, Types of catalysts and their applications, Mechanism of catalytic reactions, Concept of adsorption and surface reaction, Industrial applications of catalysis (Petroleum refining, Pollution control), Catalyst deactivation and regeneration	20	30%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1.	**Factors Affecting Reaction Rates:** An explore how temperature, concentration, and catalysts influence reaction rates by analyzing theoretical examples and solving related problems and upload on GMIU Web portal.	10
2.	**Real-Life Applications of Catalysis:** Research and present real-world examples of catalysis to understand the role of catalysts in increasing reaction efficiency. and upload on GMIU Web portal.	10
3.	**A Case Study**: Compare batch and continuous reactors by analyzing their advantages, limitations, and industrial applications. They will present findings with real-world examples like pharmaceutical or chemical production and upload on GMIU web portal.	10
	Total	30

Suggested Specification table with Marks (Theory): 60

Distribution of Theory Marks **(Revised Bloom's Taxonomy)**						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	20%	25%	15%	20%	0%

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course the students should be able to:	
CO1	Explain the fundamentals of reaction engineering, types of reactions, and rate expressions
CO2	Describe different types of chemical reactors and their basic design principles
CO3	Apply the principles of chemical reaction kinetics for homogeneous reactions and determine reaction rates
CO4	Analyze heterogeneous reactions, catalytic processes, and the role of catalysts in reaction engineering

List of Practicals:

Sr. No.	Description	Hours
1	Determination of Rate Constant for a First-Order Reaction (Hydrolysis of Ethyl Acetate)	4
2	Determination of Rate Constant for a Second-Order Reaction (Saponification of Ethyl Acetate)	4
3	To study how temperature affects the reaction rate and determine the activation energy.	2
4	To determine conversion and rate constant for a reaction carried out in a batch reactor.	4
5	To study the steady-state performance of a CSTR and determine the reaction rate.	2
6	To determine the conversion and reaction rate for a reaction in a PFR.	4
7	Residence Time Distribution (RTD) Study in a Reactor	2
8	To study the effect of a catalyst on the reaction rate in a heterogeneous system.	2
9	To study adsorption equilibrium and determine adsorption constants.	4
10	To study how catalyst concentration affects the rate of reaction.	2
Total		30

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students.
The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
From the content 10% topics are suggested for flipped mode instruction.
Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory
The internal evaluation will be done on the basis of Active Learning Assignment
Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] Octave Levenspiel, Chemical Reaction Engineering, 3rd Edition, Wiley-India Pvt. Ltd.
[2] H. Scott Fogler, Elements of Chemical Reaction Engineering, 4th Edition, Prentice Hall of India Pvt. Ltd 3.
[3] Froment, G.B., and K.B. Bischoff, 1990, Chemical Reactor Analysis and Design, 2nd Ed., Wiley, New York
[4] Smith, J.M., 1981, Chemical Engineering Kinetics, 3rd Ed., McGraw-Hill, New York. 5.
[5] L. D. Schmidt, the Engineering of Chemical Reactions, Oxford Press.
[6] Carberry, J.J., 1976, Chemical and Catalytic Reaction Engineering, McGraw-Hill, New York