GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Computer Aided Process Design

Course / Subject Code: ME01072061

Course / Subject Name : Catalyst Science and Technology

w. e. f. Academic Year:	2024-25
Semester:	1st Semester
Category of the Course:	PEC

Prerequisite:	Student should possess the basic knowledge of reactions and catalysis.
Rationale:	The course starts with basics of catalysis and goes deeper into various aspects of catalytic preparation and characterization techniques. Aspects of catalytic testing and reactor types are to be included. The topics will also include study of reaction mechanism and kinetics of the heterogeneous catalytic reactions. Effect of external and internal transport processes on reaction rates will be covered. Various actual industrial catalytic processes will be discussed. New developments in catalysis will be covered. Concept of Fuel cell catalysts, monolith catalysts and nanocatalysts will be introduced.

Course Scheme :

Teaching Scheme			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Practical		
L	T	PR	C	ESE (E)	PA(M)	ESE (V)	PA (I)	
03	02	00	04	70	30	20	30	150

Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Introduction: Heterogeneous catalytic processes, types of heterogeneous Reactions, Absorption, absorption isotherms, rates of absorption, Physisorption and chemisorptions, Multilayer adsorption & Porecondensation	3	8

2	Heterogenous Catalyst: Solid catalysis, types of catalysts, catalyst formulations and Preparation methods. Catalysts Characterization methods: Surface area and pore volume determinations, XRD, various Spectroscopic techniques, Temperature programmed reduction & oxidation, Electron microscopy	8	15
3	Catalyst Test and Reactor Type: Testing of catalysts , various types of reactors, activity and selectivity studies, Kinetics and Mechanism of catalytic reactions Effect of internal and external transport processes, Industrial processes involving heterogeneous solid catalysts	12	27
4	Homogenous Catalyst: Introduction and types of Reaction, Mechanism and Kinetics, Enzyme catalysis, Industrial homogenous processes	6	15
5	New development in solid catalysis, monolith catalysts , nanocatalysts, Fuel cell catalysts, Environmental catalysts, Insitu characterization.	6	15
6	Catalyst deactivation and reuse – modes of catalyst deactivation and reactivation, catalyst recovery and reuse , Heterogeneous catalysis – examples and case studies	5	10
7	Photo catalysis - principles, synthesis and applications in water splitting and environmental clean up	5	10
	TOTAL	**45**	**100**

Reference Books:

1) G. Ertl, H. Knozinger and J. Weitkamp, "Handbook of Heterogeneous Catalysis" Vol 1-5, Wiley -VCH.
2) B. Viswanathan, S. Sivasanker , A.V. Ramaswamy, "Catalysis : Principles & Applications" CRC Press.
3) J. M. Smith , "Chemical Engineering Kinetics" McGraw-Hill Book Company.
4) Principles of heterogenous catalysis – J M Thomas and W J Thomas – VCH
5) Heterogeneous Catalysis - Fundamentals and Applications Julian R.H. Ross – Elsevier
6) Principles of catalyst development – James T Richardson – Springer
7) H. S. Fogler, "Elements of Chemical reaction engineering" Prentice – Hall of India.
8) C. H. Bartholomew and R. J. Farrauto "Fundamentals of Industrial catalytic Processes", Wiley- VCH.

Course Outcome:

After Completion of the Course, Student will able to :

No	Course Outcomes	RBT Level*
1	CO 1- Interpret the importance of catalysis	UN
2	CO 2 – Analyze the properties of catalyst based on its characterization.	AN
3	CO 3 – Explain practical application of catalyst in various fields.	AP
4	CO 4 – Develop knowledge of advanced catalysis and its relevance.	AP

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

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