GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering (Minor/Honours Degree Syllabus)

Subject Code : 117AS01

Subject Name : Catalysis for Sustainability and Photo and Bio-catalysis

WEF Academic Year:	2022-23
Semester:	7
Category of the Course:	Compulsory

Prerequisite : Student should possess the basic knowledge of reactions and catalysis.

Rationale :

In this course, importance of catalysis and greener route of catalyst synthesis is covered. Photocatalysis and biocatalysis are studied in detail as an emerging area in greener technology. Application of photocatalysis widely helps in environmental remediation. Replacement of bio/photo catalyst significantly contributes towards sustainability.

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	00	02	04	70	00	30	00	100

Course Content :

Sr. No.	Course Content	No. of Hours	% of Weightage
1	Types of catalysis: Heterogeneous and Homogeneous catalysis. catalytic cycles. TON, TOF, energetic of catalysis.	4	10
2	Synthesis of solid catalysts: synthesis of bulk and supported catalysts-, skeletal metal catalysts, undoped and dopped semiconductor photocatalysts.	6	15
3	Characterization of catalysts: Bulk and surface characterization of catalysts – chemical composition, phase analysis, surface area, surface acidity and basicity, XPS, UPS, AES, EXAFS, XANES, XRD TPD techniques, band gap measurements with case studies.	6	10
4	Adsorption and catalysis – adsorption isotherms of various types, kinetics of catalytic reactions, Langmuir and Rideal Eley mechanisms of surface catalysed reactions, heterogenous catalysis in industrial reactors , promoter effects in catalysis, mass and heat transfer in heterogeneous catalysis.	6	15
5	Catalysis using solid acids and bases: Zeolites, mesoporous materials and clays as catalysts, shape selectivity. catalysis by metals, metal oxides. application in bulk and fine chemical synthesis chemicals, environmental applications.	5	10

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	15
8	Biocatalysis- Introduction, overview, advantages and drawbacks, types, synthesis, application of various biomaterial as catalyst, design of biocatalytic processes.	5	15
	Total	**42**	

Reference Books :

1) Concepts of modern catalysis and kinetics - I. Chorkendorff, J.W. Niemantsverdriet- wiley VCH.
2) Industrial catalysis – optimizing catalysts and processes – R J Wijngarden Wiley – VCH.
3) Heterogeneous Catalysis - Fundamentals and Applications Julian R.H. Ross – Elsevier.
4) Principles of catalyst development – James T Richardson – Springer.
5) Principles of heterogenous catalysis – J M Thomas and W J Thomas – VCH.
6) Biocatalysis- Fundamentals and Applications By Andreas S. Bommarius, Bettina R. Riebel-Bommarius.

Course Outcome :

After Completion of the Course, Student will able to :

Sr. No.	Course Outcomes	RBT Level*
1	CO 1- Interpret the importance of catalysis in green synthesis.	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

Suggested Course Practical List :

1) Synthesize detailed reaction networks for catalytic reactions on solid catalyst surfaces, such as zeolites or TiO_2.
2) Effect of parameters on synthesis of photocatalyst (ZnO/TiO_2 etc.).
3) Experiment on fluidized bed catalytic reactor.
4) Wastewater treatment using photocatalysis.
5) Hydrolysis of starch to glucose using gluxoamylase alpha amalyse.
6) Ethanol production using yeast.
7) Photocatalysis for metal removal/recovery. (As)

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