ICH 502: INDUSTRIAL CATALYSIS AND GREEN CHEMISTRY

Course objective:

- To study in detail about the types and applications of catalysts
- Understanding the role of organometallic compounds as catalysts
- To learn about nanocatalysts and their applications
- To understand green chemistry techniques.

UNIT I: **14 hr**

Preparation of catalyst and their behaviour, Selection, preparation and evaluation of catalysts-test reaction, promoters, carriers and stabilisers, Role of supports, preparation & structure of supports, silica, alumina, silica-alumina, zeolites, carbon catalyst manufacture, catalyst size and shape, pre-treatments, deactivation process, sintering, poisoning and catalyst fouling.

Definition of performance criteria of catalysts: Activity, selectivity, temperature response, catalyst life. Surface active agents, classification of surface active agents, micellisation, hydrophobic interactions, critical micellar concentration (CMC), factors affecting the CMC of surfactants.

UNIT II: **14 hr**

Catalysis by Organometallic Compounds:

Transition metal hydrides: Synthetic routes, structure and reactivity, synthetic applications. (Pd, Ni, Fe, Co, Ti complex); Coordinative unsaturation, oxidative addition and reductive elimination and insertion reactions, olefin hydrogenation, Wilkinson's Catalyst, Wacker process, Zeigler-Natta process, olefin metathesis, Monsanto process for the synthesis of acetic acid, heterogenization of homogeneous catalysts using polymer supports.

UNIT III: **14 hr**

Catalysis by Nanocatalysts

Synthesis of Nanoporous Catalysts Microporous materials: Zeolites- Zeotypes – Overall steps in zeolite crystallization- Zeolite synthesis via.- dry gel route- Zeolite Y- determination of surface acidity- shape-selectivity; Mesoporous aluminosilicates: Synthesis of Mesoporous Silica- MCM-41-SBA-15; Aluminophosphates; Mesoporous Carbon- Sulfated Zirconia- Ag/SiO_2 composite nanocatalysts. Nanophotocatalysis and Catalysis of Gold nanocrystals Introduction to photocatalysis: Principle- Band energy engineering- Degradation of dye, Hydrogen generation- Organic synthesis.

UNIT III: **14 hr**

Green Chemistry

Definition and principles, planning a green synthesis in a chemical laboratory, Green preparation- Aqueous phase reactions, solid state (solventless) reactions, photochemical reactions, Phase transfer catalyst catalysed reactions, enzymatic transformations & reactions in ionic liquids. Synthesis using scavenger resins, catalysis and biocatalysis.

Sonochemistry: Introduction, instrumentation, the phenomenon of cavitation, types of sonochemical reaction, Sonochemical esterification, substitution, addition, oxidation, reduction and coupling reactions. Microwave induced organic synthesis: Introduction, reaction vessel and reaction medium, concept, specific effect, atom efficiency, % atom utilisation, advantages and limitations, alkylation of active methylene compounds, N-alkylation, condensation of active methylene compounds with aldehydes, Diels-Alder reaction, Leuckardt reductive amination of ketones, ortho ester Claisen rearrangement and synthesis of enaminoketones.

Course Outcome

The students will learn the following

- Preparation of catalyst and their applications in industry.
- Utility of organometallic compounds in catalysis.
- Synthesis and application nanocatalysts

References

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