Course Title: Heterogeneous Catalysis

Course Code: CH-822

Credit Hours: 3-0

Prerequisite: Nil

Course Objectives

This course introduces the fundamentals, sections on adsorption and surface science, catalytic kinetics, experimental methods for preparing and studying heterogeneous catalysts, as well as some aspects of the design of industrial catalytic reactors. In addition, it also includes a range of examples of important catalytic processes.

Course Outcomes

After having completed the course, the candidates would be able to:

a. Have knowledge about the fundamental principles of heterogeneously catalyzed reactions.
b. Give a quantitative description of adsorption/desorption and the kinetics of catalytic reactions on a surface.
c. Account for how the catalytic activity and selectivity is influenced by the physical and electronic surface properties of the catalyst.
d. Account for the physical and/or chemical phenomena behind important techniques for the characterization of catalysts and catalytic reactions and the information offered by these techniques.

Course Contents

Heterogeneous Catalysis: Chemistry in 2-Dimensions: Introduction and Historical Background to Catalysis

Surface and Adsorption: Introduction, Clean surfaces, Langmuir's work on adsorption, Langmuir's isotherm, The chemisorptions of hydrogen, The chemisorptions of more complex molecules.

How does a catalyst work? Introduction, The catalytic process, Bimolecular processes, Unimolecular processes, Reversibility in catalytic processes, Selectivity in catalytic processes, Kinetics and mechanisms, The catalyst and the catalytic sites, Catalysis by metals.

Catalyst Preparation: Importance of active surface area and structure of catalyst, Catalyst preparation, Catalyst Supports: Alumina, Silica, Alumina-Silica and Zeolites, Titania, Zirconia and Carbon, Support formation, Supported Catalysts, Catalyst

Characterization. **Some Catalytic Reactions:** Introduction, Catalysis in the conversion of natural gas: Catalysis in the conversion of crude oil, Petrochemicals and industrial Organic Chemistry, Environmental Catalysis, Catalysis in biomass conversion

Recommended Books

1. Julian R.H. Ross, “Heterogeneous Catalysis: Fundamentals and Applications”, Elsevier, 2012.
2. Jens K. Norskov, “Fundamental Concepts in Heterogeneous Catalysis”, Willey 2014.

G. Ertl, “Handbook of Heterogeneous Catalysis”, Willey 2014.