

# Catalyst Science and Technology - Web course

## COURSE OUTLINE

Heterogeneous catalysis plays a very important and defining role in most of the chemical industry.

This course will be very useful for undergraduate and post-graduate students, teachers and practitioners to understand heterogeneous catalytic processes.

This 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.

Topics will include Modeling, parameter estimations and model discriminations.

Catalyst deactivation which is the main problem faced in heterogeneous catalytic process will be covered in details.

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.

The latest methods of catalysts designing and corresponding simulations techniques will also be included in the course.

Each topic will be developed progressively and associated with up-to-date informations along with references. Wherever required the concepts will be illustrated with case studies and solved problems.

### Contents:

Introduction to Heterogeneous catalytic processes, Adsorption on solid surfaces , Solid catalyst: types, formulations and preparation methods, various catalysts characterization methods : catalysts testing and types of reactors, Effect of external and internal transport processes on reactions rate,

Mechanism and kinetics study , Kinetic modeling and Parameter estimations, Catalyst deactivations, Industrial catalytic processes , New development in solid catalysis, nanocatalysts, monoliths, environmental catalysts, fuel cell catalysts, Design of catalysis, simulation techniques.

## COURSE DETAIL

S.No	Topics	No. of Hours
1	Heterogeneous catalytic processes, types of heterogeneous reactions.	1



NP-TEL

# NPTEL

<http://nptel.iitm.ac.in>

## Chemical Engineering

### Pre-requisites:

Chemical reaction engineering I.

### Additional Reading:

Literature on Heterogeneous catalysis.

### Coordinators:

**Dr. Mahuya De**  
Department of Chemical Engineering IIT Guwahati

2	Absorption, absorption isotherms, rates of absorption, Physisorption and chemisorptions.	2
3	Solid catalysis, types of catalysts, catalyst formulations and Preparation methods.	3
4	Catalysts Characterization methods : Surface area and pore volume determinations, XRD, various Spectroscopic techniques, Temperature programmed reduction & oxidation, Electron microscopy.	7
5	Testing of catalysts , various types of reactors, activity and selectivity studies.	2
6	Effect of external transport processes on observed rate of reactions.	2
7	Effect of internal transport processes: reactions and diffusion in porous catalysts.	2
8	Mechanism of catalytic reactions, Rates of adsorption, desorption, surface reactions, rate determining steps.	3
9	Kinetic modelling and Parameter estimations, Model discriminations.	3
10	Catalysts promoters, Inhibitors, catalyst deactivations, kinetics of catalyst deactivations.	2
11	Industrial processes involving heterogeneous solid catalysts.	5
12	New development in solid catalysis, monolith catalysts , nanocatalysts, Fuel cell catalysts, Environmental catalysts, Insitu characterization.	5
13	Design of catalysts ; simulation techniques.	3
	<b>Total</b>	40

#### References:

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. J. M. Thomas and W. J. Thomas, "Principles and Practice of Heterogeneous Catalysis", Wiley- VCH.

5. H. S. Fogler, "Elements of Chemical reaction engineering" Prentice - Hall of India.
6. J.J. Carberry , "Chemical and catalytic reaction Engineering", Dover Publications.
7. C. H. Bartholomew and R. J. Farrauto "Fundamentals of Industrial catalytic Processes", Wiley- VCH.