UCH701 CATALYTIC PROCESSES

L	T	P	Cr
3	1	0	3.5

Course Objectives:
To gain the knowledge of catalyst characteristics, mechanism of catalytic reactions, and design of catalytic reactors.

Introduction: Catalysis and catalysts – homogeneous & heterogeneous, Classification of catalytic reactions and catalysts, Commercial chemical catalysts, Steps in catalytic reactions.

Preparation and Properties of Catalysts: Methods of catalyst preparation, Physical properties of catalyst – surface area, pore volume, pore size distribution, solid density, particle density, bulk density, void volume, Catalyst promoters & inhibitors, Catalyst accelerators & poisons.

Adsorption and Catalytic Reactions: Adsorption isotherms, Surface reaction, Single site and dual site mechanism, Desorption, Catalyst deactivation, Pore structure and surface area estimation and their significance.

External Transport Processes: Fluid particle mass and heat transfer, Mass transfer-limited reactions in packed beds, Non-isothermal behavior of packed-bed reactors, Staged packed-bed reactors for approaching optimum temperature progression, Stable operating conditions in reactors and hot spot formation, Effect of external transport processes on selectivity under non-isothermal conditions.

Diffusion and Reaction in Porous Catalysts: Intra-pellet mass transfer and diffusion in cylindrical and spherical porous catalyst particles, Thiele modulus, Diffusion controlled and surface reaction controlled kinetics, Effectiveness factor for catalysts, Effects of heat transfer – temperature gradients across fluid-solid film and across catalyst pellet, Fluidized bed reactors, Three phase reactors – slurry and trickle bed reactors.

Generalized Design: Design of catalytic reactors under adiabatic and non-adiabatic conditions, Design of industrial fixed-bed, fluidized-bed and slurry reactors.

Course Learning Outcomes (CLO):

The students will be able to:

1. develop various catalytic reaction mechanisms.
2. characterize a catalyst.
3. assess the effects of external heat and mass transfer effects in heterogeneous catalysis.
4. calculate the effectiveness of a porous catalyst.
5. design different types of reactors for catalytic reactions.

Text Books:

1. *Smith, J.M., Chemical Engineering Kinetics, McGraw-Hill (1981).*
2. *Fogler, H.S., Elements of Chemical Reaction Engineering, Prentice-Hall India (2009).*

Reference Books:

1. *Denbigh, K.G., and Turner, J.C.R., Chemical Reactor Theory: An Introduction, Cambridge University Press (1984).*
2. *Carberry, J.J., Chemical and Catalytic Reaction Engineering, McGraw-Hill, (2001).*
3. *Levenspiel, O., Chemical Reaction Engineering, John Wiley (2006).*

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessional (May includes tutorials/ assignments/ quiz's etc)	25