CHE-872 Adsorption Since and Technology

Credit Hours: 3
Pre-requisites: Nil
Course Objectives:

- To study the principles and state -of- the- art advances in
- adsorption processes.
- To apply thermodynamics, material science, nanotechnology in
- adsorbent material synthesis, characterization, and adsorption
- process design.
- To measure the pore textural properties of porous media
- To prepare Chemical engineering / Energetic materials engineering
- students for working on adsorption related research projects.

Course Contents:
Overview of Adsorption Technology: (1) Importance of adsorption in a separation process (2) Historical perspective (3) Advantages and limitations (4) Brief overview of representative industrial processes. Forces and Energetics of Adsorption: (1) Physical adsorption vs. chemisorption (2) Van der Waals forces (3) Electrostatic forces (4) Polar/Non-Polar adsorbents (5) Heats of adsorption Experimental Adsorption Isotherms: (1) Adsorbent Materials (2) Selectivity and Capacity (3) Amorphous/Crystalline Experimental Adsorption Isotherms: (1) Adsorption Equilibrium (2) Brunauer classification (3) Henry's Law
(4) Langmuir, Freundlich Isotherms Experimental Adsorption Isotherms: (1) Isosteric heat of adsorption (2) Gibbs isotherm (3) Representation of equilibrium data Adsorption Kinetics: (1) Sorption kinetics and measurement of transport properties (2) Diffusion in porous media (3) Diffusion in macro/mesopores (4) Kinetics of adsorption in batch systems (5) Adsorption Separation Processes (6) Regeneration methods - T Swing, P Swing (7) Design of complete adsorption system Adsorbents and Characterization: (1) Commercial adsorbents (zeolites, activated carbon, cavitants) (2) Adsorbent characterization (3) Experimental procedures for measuring pore textural properties of porous media (BET, Langmuir etc) (4) Fundamental factors for designing adsorbent Applications of Adsorption Processes: (1) Novel adsorbents-latest trends (2) Case studies/ Research articles will be discussed. Applications of Adsorption Processes: (1) Gas separation and purification (2) Water treatment and air pollution control
Course Outcomes:

- An understanding of the fundamental equilibrium and transport properties of adsorption.
- A capability to model transient adsorption processes.
- An understanding of the basic design of adsorption systems.

Recommended Reading (including Textbooks and Reference books)

- Ruthven, Douglas M. Principles of adsorption and adsorption processes. John Wiley & Sons, 1984.
- Ruthven, Douglas M., Shamsuzzaman Farooq, and Kent S. Knaebel. Pressure swing adsorption. John Wiley & Sons, 1996.
- Haul, R., J. Kärger, and D. M. Ruthven. "Diffusion in zeolites and other microporous solids." (1993).
- Yang, R. T. "Adsorbents: Fundamentals and Applications." (2003).
- Rouquerol, Jean, et al. Adsorption by powders and porous solids: principles, methodology and applications. Academic press, 2013.
- Perry, R. H., D. W. Green, and J. O. Maloney. "Perrýs Chemical Engineerś Handbook." (1997).