

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI, PILANI CAMPUS
DEPARTMENT OF CHEMICAL ENGINEERING
First Semester 2017-18

Course Title: Advanced Separation Techniques (CHE G551)
Comprehensive Examination (Closed Book)

Marks: 70

Date: 14/12/17 Time: 02:00 – 05:00 p.m. Room No. 2204

Note: Make the necessary assumptions, if required.

1. (4+4+4+4+4+4+3+3 = 30 Marks)

- (a) What are the factors considered essentially to characterize the stream coming from upstream processing while designing the downstream process?
- (b) Why is it easy to measure the amount of adsorption of a pure gas, but difficult to measure adsorption of a pure liquid?
- (c) What is the difference between a true-moving-bed (TMB) system and a simulated-moving-bed (SMB) system?
- (d) When is reactive distillation method preferred? What are the important factors to be considered while designing the configuration of reactive distillation column?
- (e) Discuss the minimum and maximum boiling azeotropic mixtures.
- (f) How do the solution-diffusion equations differ for liquid and gas transport through dense membrane? How is Henry's law used for solution-diffusion for gas transport? Why are the film resistances to mass transfer on either side of the membrane for gas permeation often negligible?
- (g) Differentiate between three fixed angled and swing-out rotors used for the centrifugation of bioproduct separation.
- (h) Explain why steepness of breakthrough curve is considered as an important factor in design of fixed-bed adsorption column.

2. (4 × 10 = 40 Marks)

- (a) Describe the electro-thermal Swing Adsorption (ESA) process and discuss its advantages over traditional thermal swing adsorption (TSA) process.
- (b) Why are Photocatalytic Membrane Reactors (PMRs) better for organic pollutants removal from waste water? Discuss the working principle of two types of PMRs (sequential and combined or integrated) and their basic difference.
- (c) At what circumstances will one prefer Supercritical Fluid Chromatography (SFC) over High Pressure Liquid chromatography (HPLC). Also discuss the advantages and disadvantages of SFC.
- (d) Discuss the difference between membrane distillation and solar powered membrane distillation. Explain the working principle of solar powered membrane distillation.
- (e) Discuss the working principle of Membrane bioreactor (MBR) for the treatment of wastewater. How is it better than the conventional bioreactors for wastewater treatment? What is the major problem faced during operation of MBR and how this problem can overcome?
- (f) What are the four technological advancement in Supercritical fluid extraction for the recovery of bioactive compounds from natural resources?

- (g) Discuss the ways by which one will minimize the expensive energy requirement of refrigeration cycle in cryogenic distillation.
- (h) What are the advantages of cross flow filtration technique over the conventional techniques for bio-molecule separation? Discuss the working principle of silicon based bio-filter for bio-molecule separation.
- (i) What is the major problem of oxy combustion plant for CO₂ capture? How would the self-heat recuperation for oxy-combustion plants would help in the improvement of existing process?
- (j) Discuss the process enhancement mechanism of Supercritical Fluid Extraction due to ultrasonic field extraction. What are the advantages and disadvantages of this enhancement technique?

ALL THE BEST