

# CHEMICAL ENGINEERING

## PAPER-I

### SECTION-A

1. Answer all questions : (a) Explain the basic concepts of compressible and incompressible flow. 3  
(b) Explain the significance of Grashof number and show that it is dimensionless. 5  
(c) Determine the pressure drop per unit length in pascallm in fluidized bed if porosity or volume fraction of voids in a bed is 0.7. The density of solids is 2800 kg m<sup>-3</sup> and that of water is 1000 kg m<sup>-3</sup>. 4  
(d) State Bond's crushing law. What do you mean by "the work index of bauxite is 8.5"?  
(e) Using Fenske equation, determine the minimum number of plates required in distillation using the following data :  $O.AB = 2.5$ ,  $XD = 0.8$ ,  $Xw = 0.01$  where the terms have their usual meanings.  
(f) What is reflux? Explain about minimum reflux, optimum reflux and partial 3/6 condenser in the context of a distillation column. 7  
(g) Why is it possible to cool water to a temperature below the dry-bulb temperature of the entering air in cooling towers? Explain. 7  
(h) State and explain various laws of radiation. 5
2. (a) Explain the merits and demerits of centrifugal and reciprocating pump. 10  
(b) A tall vertical column contains solid packing and a fluid is passing through the column in upward direction. Depict pictorially the change in pressure drop across the bed with increase in velocity-of the fluid. Explain about fluidization and pneumatic conveying. 10  
(c) Explain with a neat sketch the working principle of Bollman's extractor. 10  
(d) Draw the temperature profiles for countercurrent and cocurrent heat exchanger, and show the temperature approaches on the diagram. What is LMTD? When and why is correction factor necessary in LMTD? 10
3. (a) What are the differences between Pitot tube and Venturi meter in the context of flow measurements? Describe, with a neat sketch, the operation of a venturi meter.

(b) Develop the expression for overall heat transfer coefficient in terms of individual heat transfer coefficients considering the heat transfer to take place between the fluids in a shell and tube heat exchanger by convection and 8 conduction. 10

(c) Explain the operating principles of leaf filter. Indicate its merits and demerits. 8

(d) Define free moisture, equilibrium moisture, critical moisture, bound moisture and unbound moisture in drying operation.

4. (a) Depict the velocity profile for laminar and turbulent flow in a pipe. Show the relationship between average and maximum velocity of fluid in both the cases. 10

(b) Explain various feeding arrangements in a multiple effect evaporator and explain their merits and demerits. 12

(c) Explain clearly the principles of azeotropic and extractive distillation. 8

{d} (i) Explain the significance of absorption factor and stripping factor. 5

(ii) How does the temperature approach affect the height of the cooling tower?

#### SECTION-B

5. Answer all questions :

{a} Explain the concentration polarization in membrane-based extraction processes. Indicate the influence of polarization factor. 6

(b) What is meant by supercritical fluid extraction? Mention the criteria to be considered in selecting the solvent of the operation. 6

(c) What are different types of stainless steels used in construction of equipments for an industry?

(d) Mention different types of heads generally used as enclosure of cylindrical vessel. 5

(e) Explain reproducibility and sensitivity. How are they related?

(f) Explain about manipulated variable and load variable citing examples. 5

(g) Define time constant and state its significance. 4

(h) List out the instruments/devices used for measurement of level of liquid. 3