M.Tech. Second Semester (Chemical Engineering) (CBS)

13013 : Process Design & Plant Utilities : 2 CE 3

P. Pages : 1 **AW - 3452**

Time : Three Hours * 0 3 2 8 * Max. Marks : 80

Notes :
1. Answer **any six** questions.
2. Question No. **1** is compulsory.
3. Assume suitable data wherever necessary.
4. Illustrate your answer necessary with the help of neat sketches.
5. Use of slide rule logarithmic tables, Steam tables, Mollier's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.

1. What is Pinch Technology? Explain process integration by pinch analysis with help of simple example. **15**

2. Define Distillation and discuss the methods for calculation of number of trays. **13**

3. Discuss flow sheet synthesis & development with flow diagram. **13**

4. What is mean by Heat Regenerator? Explain its types. **13**

5. What are the various non-cryogenic methods to produce various inert gases? Explain the PSA process of production of nitrogen. **13**

6. Discuss in detail the design considerations of cooling tower and explain the blow down and prevention of fog in cooling tower. **13**

7. Explain the features of CHEM CAD and ASPEN PLUS software and its uses in process industry. **13**

8. Estimate the dimensions of a rectangular oil-water separator for the following conditions. **13**
Max. waste water flow rate = 0.047 m^3/sec.
Temp. of operation = 38 °C.
Sp. gr. of waste water = 0.995.
Absolute viscosity of waste water = 0.0007 N-s/m^2.
Sp. gr. of oil = 0.90.

9. 2500 kg/hr of a wet material is to be dried from 50% to 3.5% moisture content in a continuous counter current dryer. Density of dry material is 650 kg/m^3. Evaporation surface area per kg of dry material is 0.06 m^2. Critical moisture content of the material is 20%. Equilibrium moisture contest is 1.5% on wet basis. Air used for drying has moisture content 0.03 kg/kg dry air. Moisture content of saturated air, at the temperature of material is 0.05 kg/kg dry air. Mass transfer rate is 122.5 kg/m^2 hr ($\Delta x = 1$). **13**

Moisture content of air leaving the falling rate zone & Entering the constant rate zone = 0.0124 kg/kg. Initial moisture content of air = 0.0075 kg/kg dry air. Final moisture content of air = 0.0294 kg/kg dry air.

10. A single effect evaporator is to be used to concentrate 4536 kg/hr of a 20 wt % sodium hydroxide solution in water entering at 60°C to a product of 50 wt % solids. Saturated steam is supplied at 172.4 kPa to the Evaporator. Heat transfer coeff. is 1560 w/m^2k. Estimate the heating surface area required & steam Economy. **13**
Data :-
BPR = 40.6°C
Enthalpy of feed solution = 214 kJ/kg
Enthalpy of product solution = 505 kJ/kg.

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