

M.Tech. Second Semester (Chemical Engineering) (CBS)
13013 : Process Design & Plant Utilities : 2 CE 3

P. Pages : 2

Time : Three Hours



AU - 3283

Max. Marks : 80

- Notes :
1. All question carry marks as indicated.
 2. Answer **any six** questions.
 3. Question No. 1 is compulsory.
 4. Assume suitable data wherever necessary.
 5. Diagrams and chemical equations should be given wherever necessary.
 6. Use of slide rule logarithmic tables, Steam tables, Moller's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.

1. Discuss the term pinch Technology. Explain the different steps in pinch analysis. 15
2. Explain the heat integration of spray dryer in milk powder plant. 13
3. Discuss the construction & working of cooling tower with diagram and explain its design procedure with its applications. 13
4. Name the few commercial software programs for heat integration techniques. Explain the heat integration design procedure in chemical industry. 13
5. What are the various non-cryogenic methods to produce various inert gases? Explain the PSA process to produce nitrogen gas. 13
6. Discuss the designing procedure of packed Distillation column by the use of Height of Transfer unit concept. 13
7. What do you mean by Technical evaluation of projects? Explain the different parameters involved in it. 13
8. What is Heat regenerators? Explain its two major types with calculation of thermal efficiency. 13
9. A dryer has to reduce the moisture content from 42% to 11% the capacity is 400 kg/hr on wet basis. 13
Temp of wet material fed to dryer is 18°C Temp. of dried material leaving the dryer is 47°C.
Temp of Air entering the heater is 15°C. Temp. of air leaving the dryer is 45°C.
Heat capacity of the dried material is 2350 J/kg°C. Heat loss from dryer & air heating system is 12%. Dryness fraction of steam is 0.94 initial moisture content of air is 0.0077 kg/kg dry air. Final moisture content of air is 0.038 kg/kg dry air. Enthalpy of air at inlet = 35 kJ/kg of dry air. Enthalpy of air leaving the dryer is 145 kJ/kg of dry air. Weight of a steel belt conveyor used for material conveying is 850 kg. Heat capacity of conveyor belt is 500 J/kg°C, Temp. of air leaving the air heater is 138°C. Steam is used for air heating. temp of steam is 148°C. Latent heat of condensation of steam is 2122 kJ/kg. Calculate the flow rate of air required for moisture removal and the total heat required for on air heater.

10. A chemical solution available at 90°C is to be cooled in a parallel flow heat exchanger by using water as cooling medium. Inlet temperature of cooling water is 15°C . A heat exchanger with effective heat transfer area 10m^2 is available. Overall heat transfer coeff. is $700\text{ W/m}^2\text{ }^{\circ}\text{C}$. Flow rate of chemical solution is 3 kg/sec . Flow rate of cold water is 4.2 kg/sec . Estimate : 13
- i) The outlet temperature of chemical solution and water.
ii) Effectiveness of heat exchanger. If the counter flow conditions are used, how much heat transfer are will be required?
Specific heat of chemical solution = $3600\text{ J/kg}^{\circ}\text{C}$.
Specific heat of water = $4180\text{ J/kg }^{\circ}\text{C}$.

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