B.TECH DEGREE EXAMINATIONS: MAY/JUNE 2013

Fourth Semester

BIO TECHNOLOGY

BTY110: Unit Operations

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Which of the following is the most suitable for handling fibrous and dense slurries?

    a) Propeller agitator   b) Cone type agitator

    c) Turbine agitator   d) Radial propeller agitator

2. In large tanks with vertical agitators, the preferable method of reducing swirling is

    a) To install baffles   b) The impeller can be mounted off center

    c) Operating without baffles   d) Increase the speed

3. Which of the following is a pressure filter?

    a) Leaf filter (Moore filter).   b) Plate and flame filter.

    c) Rotary drum filter.   d) Sand filter.

4. Tabular bowl centrifuges as compared to disk bowl centrifuges

    a) Operate at higher speed.   b) Employ bowl of larger diameter.

    c) Cannot be operated under pressure or   d) Cannot be used for separation of fine
        vacuum.   suspended solids from a liquid.

5. Which one is not a mode of heat transfer?

    a) Conduction   b) Convection

    c) Radiation   d) Reflection

6. Thermal conductivity has the unit of

    a) W/ m °C   b) m^2/s

    c) ft^2/h d) Btu/lb. °F

7. _____ are used as extended surface when the direction of flow of the fluid is parallel to the axis of the tube.

    a) Transverse fins   b) Longitudinal fins

    c) Both fins   d)   None of these

8. The action occurring at temperature drops below the critical temperature drop is called

    a) Sub cooled boiling   b) Transition boiling

    c) Nucleate boiling   d) Film boiling

9. Number of kilograms vaporized per kilogram of steam fed to the unit is

   a) Economy
   b) Capacity
   c) Efficiency
   d) None of these

10. In multiple effect evaporator the method of pumping the thin liquid into the first effect and send it in turn through the other effects is called

    a) Backward feed
    b) Forward feed
    c) Mixed feed
    d) Parallel feed

PART B (10 x 2 = 20 Marks)

11. What are the types of agitators?

12. Define flow number.

13. Write a note on constant rate filtration.

14. What is filter aid? Give example.

15. State Fourier's law.

16. Define thermal diffusivity.

17. Define heating effectiveness.

18. Define effectiveness of heat exchanger.

19. Define flash evaporation.

20. State Duhring's rule.

PART C (5 x 14 = 70 Marks)

21. a) Write a brief note on power consumption and power correlations in the design of agitator tank.

(OR)

b) Write a brief account on agitator selection and scale up.

22. a) Explain the working principle of rotary drum filter with neat sketch.

(OR)

b) Data for the filtration of $CaCo_3$ slurry in water 298.2 K are reported as follows(R1, R2, M1) at a constant pressure (-ΔP) of 338 kN/m^2. The area of the plate-and-frame press was 0.0439 m^2 and the slurry concentration was $Cs = 23.47$ kg/m^3. Calculate the constants α and R_m from the experimental data given, where t is time in s and V is filtrate volume collected in m^3.

t	4.4	9.5	16.3	24.6	34.7

V x 10³	0.498	1.000	1.501	2.000	2.498
t	46.1	59.0	73.6	89.4	107.3
V x 10³	3.002	3.506	4.004	4.502	5.009

23. a) Derive the equations for one dimensional steady state conduction of heat through a hollow cylinder and a hollow sphere.

(OR)

b) A tube of 60 mm outer diameter is insulated with a 50 mm layer of silica foam, for which the conductivity is 0.055 W/m °C, followed with a 40 mm layer of cork with a conductivity of 0.05 W/m °C. if the temperature of the outer surface of the pipe is 150° C and the temperature of the outer surface of the cork is 30 °C, calculate the heat loss in W/m of pipe.

24. a) Explain the design consideration and working principle of 2-4 shell and tube heat exchanger.

(OR)

b) A 1-2 heat exchanger containing one shell pass and two tube passes heats 2.52 kg/s of water from 21.1 to 54.4 °C by using the hot water under pressure entering at 115.6 °C and leaving at 48.9 °C. the outside surface area of the tubes in the exchanger is A_o = 9.30 m². Calculate the mean temperature difference ΔT_m in the exchanger and by taking F_T = 0.74 calculate the overall heat transfer coefficient U_o.

25. a) Explain the working principle and various method of feeding of a triple effect evaporator with neat sketch.

(OR)

b) A continuous single effect evaporator concentrates 9072 kg/h of a 1.0 wt% salt solution entering at 311.0 K to a final concentration of 1.5 wt%. The vapour space of the evaporator is at 101.325 kPa and the steam supplied is saturated at 143.3 kPa. The overall coefficient U= 1704 W/m². K. Calculate the amount of vapour and liquid product and the heat transfer area required. Given that: The heat capacity of the feed is assumed to be 4.14 kJ/kg K. The latent heat of water at 373.2 K is 2257 kJ/kg and the steam at 143.3 kPa and T_s = 383.2 K is 2230 kJ/kg. The boiling point of the dilute solution in the evaporator is assumed to be that of water at 101.32 kPa, and T_1 = 373.2 K, as the datum temperature.

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