B.TECH. DEGREE EXAMINATIONS: APRIL / MAY 2010

Fourth Semester

BIOTECHNOLOGY

U07BT402: Unit Operations

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

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

1. The controlling resistance in a rotary drum vacuum filter is the ….resistance.

   A. Piping   B. cake   C. filter medium   D. pressure drop

2. All resistances during washing of cake

   A. increases   B. decreases   C. remain constant   D. vary with flow rate

3. The specific cake resistance for compressible sludges is a function of the pressure drop

   A. over cake   B. over medium   C. overall   D. over rate

4. Which of the following has the highest thermal conductivity?

   A. Brick   B. Air   C. Water   D. Silver

5. The unit of heat transfer coefficient is

   A. $Btu/hr.ft^2\,{}^oF$ B. $Btu/hr.ft\,{}^oF$ C. $Btu/hr.\,{}^oF$ D. $Btu/hr.ft$

6. An insulator should have

   A. low thermal conductivity   B. high thermal conductivity

   C. less resistances to heat flow   D. a porous structure

7. (N_{Gr} x N_{Pr}) is called the ………. Number

   A. Graetz   B. Reyleigh   C. Nusselt   D. Stanton

8. Prandtl and Renolds analogy are same, when Prandtl number is

   A. 0.5   B. 1   C. >2   D. 1.5

9. In a Liquid – liquid heat exchanger, for the same process temperature, the ratio of the LMTD in parallel flow to the LMTD in counter flow is always

   A. <1   B. >1   C. 1   D. ∞

10. In a single effect evaporator system, the steam economy …….. by creating vacuum in the evaporator

    A. increases   B. decreases   C. remain constant   D. depends on the vacuum

PART B (10 x 2 = 20 Marks)

11. State four uses of agitation of fluids.

12. Define gas hold up in gas- liquid agitated system.

13. Define filtration.

14. What are the factors affecting rate of filtration?

15. State Fourier's Law of conduction.

16. Define Biot number.

17. What is meant by bone dry material?

18. Distinguish between Natural and Forced convection.

19. Define dirt factor.

20. What are the types of evaporator?

PART C (5 x 14 = 70 Marks)

21. (a) Explain the steps involved in scaling up a laboratory agitator system to a pilot plant.

(OR)

(b) In liquid agitation using turbine (4 bladed) agitator assume you have to estimate the power. Explain how you would calculate it step by step.

22. (a) Explain with neat sketch rotary drum filter with respect to following aspects principle, construction, working and applications

(OR)

(b) Starting from the basic principles derive equation for rate of filtration in cake filtration for (i) constant pressure filtration (ii) constant rate filtration

23. (a) (i) Derive the steady state heat conduction equation through a spherical wall of inner radius r_1 and outer radius r_2. What is the resistance term in the derived equation? (7)

   (ii) A plane wall of thickness 50 cm is insulated on the outer side. So that heat loss is limited to 1400 J/s. The inner surface of wall is at 1200^oC and outer surface of insulation is at 25^oC. Calculate thickness of the insulation. k_{wall} =1.4W/mK, $k_{insulation}$=0.35w/Mk. (7)

(OR)

(b) Derive overall heat transfer coefficient in case of cylindrical surfaces with combined conduction and convection.

24. (a) (i) State the dimensionless numbers that occur in forced and natural convection Phenomena. (4)

   (ii) Explain how dimensional analysis is useful in estimating the dimensionless number (use forced convetion) (10)

(OR)

(b) Derive the following:

   (i) LMTD for parallel flow heat exchanger (7)

   (ii) Effectiveness equation for parallel flow heat exchanger (7)

25. (a) (i) Derive effectiveness equation for counter current heat exchanger. (10)

   (ii) What is meant by fouling? Give reasons for fouling in heat exchangers. (4)

(OR)

(b) With a neat schematic diagram explain the working of forward feed and backward feed for the multiple effect evaporator system.

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