KUMARAGURU
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Register Number: …….

B.TECH. DEGREE EXAMINATIONS: MAY 2015

(Regulation 2013)

Fourth Semester

BIOTECHNOLOGY

U13BTT404**:** Mechanical Operations and Heat Transfer

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The unit area of solid has a definite amount of surface energy. Its enlargement in size leads to _____ in specific surface area per unit mass.

   a) Increase b) Decrease

   c) No change d) Sudden increase

2. Burke-Plummer equation is applicable for estimation of pressure drop in packed bed when the flow is _____

3. _____ agitator rotates above 400 rpm.

   a) Propeller b) Paddle

   c) Turbine d) Helical-ribbon

4. A typical laboratory filtration apparatus is _____ funnel.

5. In unit operations, Driving force is equal to the product of rate and_____.

   a) Resistance b) Capacitance

   c) Inductance d) Impedance

6. According to Newton's law of cooling, Heat transfer from a solid to a fluid is given by an equation, Q = h x A x _____.

7. In shell and tube heat exchangers, corrosive liquids are preferable to pass through _____ side of exchanger.

   a) Shell b) Tube

   c) Either shell or tube d) Shell and tube

8. Geometric mean of two temperatures T_1 and T_2 is given by an equation _____.

9. Rubber latex is evaporated in _____ evaporator.

   a) Falling film b) Long-tube vertical

   c) Agitated-film d) Heat-pump cycle

10. Mass of vapour evaporated per mass of steam used is called _____.

PART B (10 x 2 = 20 Marks)

(Not more than 40 words)

11. What do you mean by minimum fluidization velocity?
12. How will you calculate screen effectiveness?
13. List out the purposes of agitation.
14. Differentiate between thickening and clarification.
15. State Fourier's law of conduction.
16. Define Prandtl number.
17. Which types of heat exchangers are used for sterilization?
18. Write short notes on nucleate boiling.
19. Define boiling point elevation.
20. State Duhring's rule.

PART C (5 x 14 = 70 Marks)

(Not more than 400 words)

Q.No. 21 is Compulsory

21. Data for the filtration of $CaCO_3$ slurry in water at 298.2 K are reported as follows at a constant pressure of 338 kPa. The area of the filter was 0.0439 m^2 and the slurry concentration was C_s=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	25	35	46	59	74	89	107
V	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5

22. a) Derive an expression for power number in agitated vessels by dimensional analysis.

(OR)

b) Write detailed account on the size reduction equipments used in process industries.

23. a) Derive the equations for one dimensional steady state conduction of heat through a hollow cylinder and a hollow sphere. (7+7)

(OR)

b) Derive an expression for Nusselt number in natural convection by dimensional analysis.

24. a) Water is flowing at the rate of 10 tph through the tubes of water-water heat exchanger and is heated from 25°C to 70°C. Hot water at 90°C is available, but the minimum discharge temperature of this water has to be 76°C. The overall heat transfer coefficient in a shell and tube heat exchanger is 900 kcal/m^2.h.K. Calculate its area. Suitable assumptions and justifications may be made, wherever necessary.

(OR)

b) Explain the mechanism of the following:

(i) Boiling (7)

(ii) Condensation (7)

25. a) Describe the principle, construction and working of falling film evaporator with a neat sketch and write its merits, demerits and applications

(OR)

b) A single effect evaporator is to be designed to concentrate 10 tph of a solution from 10 to 20% (w/w) solids. Feed enters at 30°C. Saturated steam at 110°C (Latent heat=540 kcal/kg) is available. Condensate leaves at saturation temperature. The solution boils at 45°C (Latent heat=570 kcal/kg). Specific heats of all solutions may be taken as 1. Overall heat transfer coefficient may be taken as 1800 kcal/m^2.h.°C. Calculate steam consumption in kg/h.

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