Reg. No. : ☐☐☐☐☐☐☐☐☐☐☐☐

T 3098

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Fourth Semester

Biotechnology

BT 1252 — UNIT OPERATIONS

(Regulation 2004)

Time : Three hours

Maximum : 100 marks

Any missing data may be assumed.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is geometric similarity in agitator scale up?

2. State Buckingham Pi theorem used in dimensional analysis.

3. Give two example each of continuous filters and batch filters.

4. How do you define free settling?

5. State the dimensionless number used in lumped heat capacity analysis.

6. Give two examples of application where extended surface heat transfer is used.

7. State Stanton number and Rayleigh's number.

8. Define convection heat transfer.

9. Draw a schematic diagram of a double-pipe heat exchanger and define ΔT_m.

10. Write down the enthalpy balance of a single effect evaporator with a schematic diagram.

PART B — (5 × 16 = 80 marks)

11. (a) Power required for agitation is dependent on

(i)   Speed of rotation – n

(ii) Diameter of impeller – Da

(iii) Viscosity of liquid agitated – μ

(iv) Density of liquid agitated – ρ

(v)   Gravity – g.

Derive

$$\frac{p}{n^3 D_a^5 \rho} = fn\left\{\frac{n.D_a^2.\rho}{\mu}, \frac{n^2 D_a}{g}\right\}.$$ (16)

Or

(b) Explain in clear steps the concept of scale up in agitated system. (16)

12. (a) Explain with a neat diagram indicating the parts, the working of sedimentation equipment (Diagram — 7 Marks, Explanation —9 Marks)

Or

(b) Explain with neat diagrams indicating the parts, the working of plate and frame filter press (Diagram — 8 Marks, Explanation — 8 Marks).

13. (a) (i) Explain with relevant equations steady state heat conduction through a plane wall of thickness ΔZ. (7)

(ii) Explain with relevant equations unsteady state heat conduction through a plane wall of thickness ΔZ. (9)

Or

(b) (i) Why do you use extended surfaces in heat transfer. (3)

(ii) Derive temperature distribution equation in rectangular fins. (13)

14. (a) By dimensional analysis show :

$$\left(\frac{h.L}{k}\right) = \phi\left\{\left\{\frac{L^3 g \beta \Delta T}{\left(\frac{\mu}{\rho}\right)}\right\}, \left(\frac{C_p.\mu}{k}\right)\right\}.$$ (16)

Or

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    (b)   Briefly explain with necessary equations the phenomena of

        (i)   Film wise condensation.   (6)

        (ii)   Boiling.   (10)

15. (a)   Explain with neat diagram the working of a floating head shell and tube heat exchanger — indicate the important parts.

        (Diagram — 8 Marks, Explanation — 8 Marks)

Or

    (b)   With a neat diagram indicating essential parts, describe the working of a forced circulation evaporator.

        (Diagram – 8 Marks, Explanation – 8 Marks).