## H 1329

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2006.

Fourth Semester

Industrial Bio-Technology

IB 240 — UNIT OPERATIONS

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Fourier's law of conduction.

2. What are the driving forces and resistances for heat transfer by conduction?

3. What is the Peclet number? Give its significance in heat transfer.

4. What is the Liedenfrost Point?

5. What is meant by boiling point elevation?

6. Define Evaporator Economy.

7. Define filter medium resistance.

8. What is meant by bone dry material?

9. Define separation factor in centrifugal sedimentation.

10. Define bound and unbound moisture.

PART B — (5 × 16 = 80 marks)

11. Saturated steam at 267°F is flowing inside a steel pipe having an inner diameter of 0.824 in. and an outer diameter of 1.050 in. The pipe is insulated with 1.5 in. of insulation on the outside. The convective coefficient for the inside steam surface of the pipe is estimated a $h_i$ = 1000 but/h.ft²°F and the convective coefficient on the outside of the lagging is estimated as $h_0$ = 2 btu/h.ft²°F. The mean thermal conductivity of the metal is 26 btu/h.ft°F and 0.037 btu/h.ft°F for the insulation.

   (i) Calculate the heat loss for 1 ft of pipe using resistances if the surrounding air is at 80°F.

   (ii) Calculate overall $U_i$ based on the insider are $A_i$. (16)

L 1038

12. (a) (i) Explain the boundary layer concept in heat transfer. (8)

(ii) Prove that $Nu = f(Re, Pr)$ by dimensional method of analysis. (8)

Or

(b) (i) Explain the phenomenon of drop–wise and film wise condensation. (8)

(ii) Explain the Reynolds Analogy. (8)

13. (a) Explain with neat diagram, the construction and working principle of spray driers. (16)

Or

(b) Methyl alcohol flowing in the inner pipe of a double–pipe exchanger is cooled with water flowing in the jacket. The inner pipe is made from 25 mm schedule 40 steel pipe. The thermal conductivity of steel is 45 W/m°C. The individual coefficients and fouling factors are given below. What is the overall coefficient based on the outside area of the inner pipe?

Data : The diameter and wall thickness of 1 in schedule 40 pipe are

$D_i = 0.0874$ ft; $D_o = 0.1096$ ft; $X_w = 0.0111$ ft

Alcohol coefficient $h_i = 1020$ w/m²°C

Water coefficient $h_o = 1700$ w/m²°C

Inside fouling factor $h_{di} = 5680$ w/m²°C

Outside fouling factor $h_{do} = 2840$ w/m²°C.

14. (a) (i) Derive effectiveness equation for counter current heat exchanger. (12)

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

Or

(b) (i) Explain with neat diagram the working principle of rotary dryers. (10)

(ii) Explain constant rate period and falling rate period in drying operation. (6)

15. (a) (i) Explain the concepts of constant pressure filtration and constant rate filtration. (12)

(ii) What are filter aids? Give examples. (4)

Or

(b) Explain the various gravity sedimentation processes in mechanical separations. (16)

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2

H 1329