ANNA UNIVERSITY – 2007

B.E/B.TECH MODEL EXAMINATION

HEAT TRANSFER

(CHEMICAL ENGINEERING)

TIME-3HOUR
MARK-100

ANSWER ALL QUESTIONS

PART A (10 X 2 = 20)

1. Define Thermal conductivity. Also give its SI unit.

2. Define Natural convection.

3. Give Dittus-Boelter equation with Re and Pr ranges.

4. What is the significance of jH factor?

5. Give expression for (i) Graetz number (ii) Grastof number.

6. Write the relationship between individual and overall heat transfer coefficient.

7. What is the importance of extended surfaces.

8. Distinguish between film type and dropwise condensation.

9. Define thermal diffusivity. Also give its unit.

10. Draw temperature – length curve for counter-current heat exchanger.

PART B (5 X 16 = 80)

11.i) Derive an expression for forced convective heat transfer through a conduit using dimensional analysis.

ii) Give expressions for a) Sieder and Tate equation

b) Colburn Analog

12.a)i) Derive an expression for rate of heat transfer by conduction in a series of three compound resistances.

ii) A pipe 5 cm O.D. is lagged with a 4 cm layer of asbestos (k=0.18) which is followed with a 3 cm layer of cork (k=0.05). If the temperature of the outer surface of the pipe is 145 and that of the outer surface of the cork is 45 , Calculate the heat loss in Kcal/hr m of the pipe.

(OR)

12.b)i) A flat furnace wall is constructed of a 10 cm layer of refractory brick with K= 0.12 backed by a 20 cm layer of common brick with K = 1.2 kcal/hr m C. The temperature of the inner face of the wall is 760 C and that of the outer face is 75 C. Calculate the heat flow through this way in Kcal/hr m2.

ii) Derive an expression for conduction through a spherical wall with r1 and r2 inner and outer radii.

13.a)i) Give a neat sketch of a typical heat exchange equipment indicating its components.

ii) Outline the functioning of (a)

iii) Explain Wilson's method for determining film coefficient.

(OR)

13.b)i) Determine the heat transfer surface area required for a heat exchanger constructed from O.D. tube to cool 55,000 litres/hr of a 95% methyl alcohol with from 150 to 103 F using 50,000 lts/hr of H2O available at 50 . Assume U

as 100 Btu/hr ft F. Consider each of the following arrangements.

(i) Parallel flow shell and tube.

(ii) Countercurrent flow shell and tube.

ii) Derive an expression for calculating the effectiveness of a counter-current flow heat exchanger.

14.a)i) Write the help of vs diagram, explain the various stages involved in the boiling of saturated liquid.

ii) Briefly discuss about the influence of boundary layer on heat transfer.

(OR)

14.b) Write short notes on the following.

(i) Transient Heat conduction

(ii) Heisler charts

(iii) Fouling factor

(iv) Three-dimensional steady state heat conduction.

15.a)i) A single effect evaporator is to concentrate 1.25 kgs/hr of a 10% solution of NaOH to 40%. Steam is available at a temperature of . The evaporator operating pressure is 13 KN/m2 U is estimated to be 1.5 Kcal/hr m2K.

The boiling point rise is 30 K. Calculate

(i) amount of steam consumed.

(ii) heating surface required.

Given: Cp of 10% feed =
Cp of 40% product =

ii) A triple effect evaporator is concentrating a liquid that has no appreciable elevation in boiling point. The temperature of the steam to the I effect is , the boiling point of the solution in the last effect is 52 . The overall heat transfer coefficient in arc 2500 in I effect, 2000 in II effect and 1000 in III effect. At what temperature will the liquid boil in the I and II effects.

(OR)

15.b)i) State and Explain Kirchhoff's law of radiation.

ii) Two large parallel plates having emissivities of 0.4 and 0.6 are maintained at and C respectively. The radiation shield having an of 0.03 on both sides is placed between two plates. Determine a) heat transfer rate / unit area before and after placing the shield b) Temperature of shield when placed.