UNIT 3

PART A

1. What is a Heat Exchanger?
2. How heat exchangers are Classified?
3. Give examples of non mixing type heat exchangers.
4. Sketch temperature distribution graph for condensers & evaporators.
5. What is overall heat transfer coefficient in a heat exchanger?
6. What is LMTD?
7. What is effectiveness of a heat exchanger?
8. Discuss the advantage of NTU method over the LMTD method.
9. What are the assumptions made during LMTD analysis?
10. What are the factors are involved in designing a heat exchangers?
11. In what way Boiling & Condensation differs from other types of heat exchange?
12. What is Excess temperature in boiling?
13. What is meant by sub cooled or local boiling?
14. What is Nucleate boiling?
15. Give expression for heat transfer coefficient in Nucleate boiling.
16. What is flow boiling?
17. What is meant by condensation?
18. Draw heat flux curve for various regions of flow boiling.
19. Define Film wise condensation.
20. Define Drop wise condensation.
21. How is the Reynolds number in condensation defined?

UNIT 3 (Part B Quest ions)

A tube of 2 m length and 25 mm outer diameter is to be used to condense saturated steam at 100°C while the tube surface is maintained at 92°C. Estimate the average heat transfer coefficient and the rate of condensation of steam if the tube is kept horizontal. The steam condenses on the outside of the tube.

(16)

22. Steam condenses at atmospheric pressure on the external surface of the tubes of a steam condenser. The tubes are 12 in number and each is 30 mm in diameter and 10 m long. The inlet and outlet temperatures of cooling water flowing inside the tubes are 25°C and 60°C respectively.

If the flow rate is 1.1 kg/s, calculate

(i) The rate of condensation of steam

(ii) The number of transfer units

(iii) The effectiveness of the condenser. (16)

24. (i) It is desired to boil water at atmospheric pressure on a copper surface which electrically heated. Estimate the heat flux from the surface to the water, if the surface is maintained at 100°C and also the peak heat flux. (8)

(ii) A tube of 2 m length and 25 mm OD is to be used to condense saturated steam at 100°C while the tube surface is maintained at 92°C. Estimate the average heat transfer coefficient and the rate of condensation of steam if the tube is kept horizontal. The steam condenses on the outside of the tube. (8)

25. (i) Give the classification of heat exchangers. (4)

(ii) It is desired to use a double pipe counter flow heat exchanger to cool 3 kg/s of oil (C_p = 2.1 kJ/kgK) from 120°C. Cooling water at 20°C enters the heat exchanger at a rate of 10 kg/s. The overall heat transfer coefficient of the heat exchanger is 600 W/m^2K and the heat transfer area is 6 m^2. Calculate the exit temperatures of oil and water. (12)

26 (i) Discuss the general arrangement of parallel flow, counter flow and

cross flow heat

exchangers. (6)

(ii) In a Double pipe counter flow heat exchanger 10000 kg/h of an oil having a specific heat of 2095 J/kgK is cooled from 80°C to 50°C by 8000 kg/h of water entering at 25°C. Determine the heat exchanger area for an overall heat transfer coefficient of 300 W/m^2K. Take Cp for water as 4180 J/kgK. (10)

27. (i) Discuss the various regimes of pool boiling heat transfer. (8)

(ii) Dry saturated steam at a pressure of 2.45 bar condenses on the surface of a vertical tube of height 1 m. The tube surface temperature is kept at 117°C. Estimate the thickness of the condensate film and the local heat transfer coefficient at a distance of 0.2m from the upper end of the tube. (8)

28. (i) With a neat and labeled sketch explain the various regimes in boiling heat transfer. (8)

(ii) A vertical plate 0.5 m2 in area at temperature of 92°C is exposed to steam at atmospheric pressure. If the steam is dry and saturated estimate the heat transfer rate and condensate mass per hour. The vertical length of the plate is 0.5m. Properties of water at film temperatures of 96°C can be obtained from tables. (8)

29. (i) Compare LMTD and NTU method of

heat exchanger analysis. (6)

(ii) Hot exhaust gases which enters a finned tube cross flow heat exchanger at 300°C and leave at 100°C, are used to heat pressurized water at a flow rate of 1 kg/s from 35 to 125°C. The exhaust gas specific heat is approximately 1000 J/kgK, and the overall heat transfer co-efficient based on the gas side surface area is U_h= 100W/m^{2}K. Determine the required gas side surface area A_h using the NTU method. Take Cp_c at T_c = 80°C is 4197 J/kg.K and Cp_h = 1000 J/kg.K . (10)

30. Water is to be boiled at atmospheric pressure in a mechanically polished stainless steel pan placed on top of a heating unit. The inner surface of the bottom of the pan is maintained at 108°C. The diameter of the bottom of the pan is 30 cm. Assuming Csf = 0.0130. calculate (i) the rate of heat transfer to the water and (ii) the rate of evaporation of water. (16)

31. Define effectiveness of a heat exchanger. Derive an expression for the effectiveness of a double pipe parallel flow heat exchanger. State the assumptions made. (16)

32 Water enters a cross flow Heat exchanger (both fluids unmixed) at 5°C and flows at the rate of 4600 kg/h to cool 4000 kg/h of air that is initially at 40°C. Assume the overall heat transfer Coefficient value to be 150 W/m^{2}K For an exchanger surface area of 25m^2, Calculate the exit temperature of air and water. (16)

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(i)

33 (i)

(ii)