SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

DEPARTMENT OF MECHANICAL ENGINEERING

Course Code & Name: 19MEB302 – Heat & Mass Transfer **Semester: VI**

Class: III MECH B

Academic Year: 2024-2025 (Even Semester)

QUESTION BANK

UNIT – III PHASE CHANGE HEAT TRANSFER & HEAT EXCHANGERS

PART – A

1. What is a Heat Exchanger1?
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 exchanger?

PART – B

01. 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.

02. 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.

03. (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 no°c and also the peak heat flux.

(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 ofthe tube.

04. (i) Give the classification of heat exchangers.

(ii) It is desired to use a double pipe counter flow heat exchanger to cool 3 kg/s of oil (Cp = 2.1 kJ/kgK) from 120°C. Cooling water at 20°C enters the heat exchanger at a rate of 10 kg/so The overall heat transfer coefficient of the heat exchanger is 600 W/m2Kand the heat transfer area is 6 m2• Calculate the exit temperatures of oil and water.

05. (i) Discuss the general arrangement of parallel flow, counter flow and cross flow heat exchangers.

(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/m2K. Take Cp for water as 4180 J/kgK

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

(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.

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

(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 0.5 m. Properties of water at film temperatures of 96°C can be obtained from tables.

08. (i) Compare LMTD and NTU method of heat exchanger analysis.

(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/kg.K, and the overall heat transfer co-efficient based on the gas side surface area is Uh = 100W/m2K. Determine the requi red gas side surface area Ah using the NTU method. Take Cp,c at Tc = 80°C is 4197 J/kg.K and Cp,h = 1000 J/kg.K .