SIR ISSAC NEWTON COLLEGE OF ENGINEERING AND TECHNOLOGY

PAPPAKOIL, NAGAPATTINAM

DEPARTMENT OF MECHANICAL ENGINEERING

MODEL EXAM

SUB.CODE/NAME: ME8693/HEAT&MASS TRANSFER **DATE: 14.06.2021**

PART-A

ANSWER THE ALL QUESTIONS **(10×2=20)**

1. Define fouriers law of heat conduction.
2. Define efficiency and fin effectiveness.
3. Define velocity and thermal boundary layers.
4. Define bulk temperature.
5. State Newtons law of cooling.
6. Define LMTD of a heat exchanger.
7. Define pool boiling.
8. What is thermal radiation? what is its wavelength bond?
9. Define mass concentration.
10. Define mole fraction

PART-B

ANSWER THE FOLLOWING QUESTIONS **(5×13=65)**

11 (A). Derive the general heat conduction equation in cylindrical coordinates.

(OR)

11 (B) (i) Explain Newton's law of cooling and Stefan-Boltzmann's law of thermal radiation.

(ii) A composite wall consists of 2.5 cm thick Copper plate, a 3.2cm layer of asbestos insulation and a 5 cm layer fibre plate. Thermal conductivities of the materials are respectively 355,0.110 and 0.0489 W/m.K. The temperature difference across the composite wall is 560°C (560°C on one side and 0°C on the other side. Find the heat flow through the wall per unit area and the interface temperature between asbestos and fibre plate.

12 (A) (i) Explain the development of velocity boundary layer for flow over a flat plate.

(ii) Engine oil at 60°C flows with a velocity of 2 m/s over a 5 m long flat plate whose temperature is 20°C. Determine the drag force exerted by oil on the plate and the rate of heat transfer for a plate width of 1 m.

(OR)

12(B) (i) Define bulk temperature and thermal entry length for tube flows.

(ii) A metallic cylinder of 12.7 mm diameter and 94 mm length is heated internally by an electric heater and its surface is cooled by air. The free stream air velocity and temperatures are respectively 10 m/s and 26.2°C. Under steady operating conditions, heat dissipated by the cylinder is 39.1 W and its avenge surface temperature is 128.4°C.

13. (A) (i) Discuss critical heat flux and Leidenfrost point.

(ii) A 10 by 10 array of horizontal tubes of 1.27 cm diameter is exposed to pure steam at atmospheric pressure. If the tube wall temperature is 98°C, estimate the mass of steam condensed assuming a tube length of 1.5 m.

(OR)

13 (B) (i) List the assumptions made in the analysis of heat exchangers.

(ii) In a cross flow heat exchanger, air is heated by water. Air enters the exchanger at 15°C and a mass flow rate of 2 kg/s while water enters at 90°C and a mass flow rate of 0.25 kg/s. The overall heat transfer coefficient is 250 W/m2.K. If the changer has a heat transfer area of 8.4 m2, find the exit temp -r utes of both the fluids and the total heat transfer rate.

14 (A) A furnace is approximated as an equilateral triangular duct of sufficient length so that end effects can be neglected. The hot wall of the furnace is maintained at 900 K and has an emissivity of 0.8. The cold wall is at 400 K and has the same emissivity. Find the net radiation heat flux leaving the wall. Third wall of the furnace may be assumed as a reradiating surface.

(OR)

14 (B) (i) Considering radiation in gases, obtain the exponential-decay formula.

(ii) Consider two concentric cylinders having diameters 10 cm and20 cm and a length of 20 cm. Designating the open ends of the cylinders as surfaces 3 and 4, estimate the shape factor, F3-4.

15. (A) (i) How does mass transfer differ from bulk fluid motion? State Fick's law of diffusion.

(ii) An open pan of 20 cm diameter and 8 cm depth contains water at 25°C and is exposed to dry atmospheric air. Assuming therate of diffusion of water as 8.54 x l0-4 kg/h, find the diffusion coefficient.

(OR)

15 (B) Analogy between heat and mass transfer

PART-C

16 .Derive the radiation exchange between

(i) Large parallel gray surfaces and (ii) Small gray bodies