**SIR ISSAC NEWTON COLLEGE OF ENGINEERNG AND TECHNOLOGY**

**PAPPAKOIL, NAGAPATTINAM**

**DEPARTMENT OF MECHANICAL**

**CIA-II EXAM**

**SUB CODE/NAME:** ME8693 HEAT AND MASS TRANSFER **DATE: 28-02-2020 YEAR /SEM: III / VI TIME DURATION**: 1.30 Hrs

**PART A (10×2=20)**

1. Define Thermal conductivity

2. What is meant by steady state heat conduction?

3. What is hydrodynamic boundary layer.

4. Define fouling factor.

5. What is meant by free or natural convection.

6. What is meant by Regenerators.

7. What is effectiveness of a heat exchanger?

8. What is Diffusion mass transfer?

9. What are the modes of mass transfer.

10. What is molecular diffusion.

**PART B (5×13=65)**

11.a) A surface wall consists of 2.3cm of fire brick and 11.5cm of insulating brick having thermal conductivities of 0.72W/mk and 0.27W/Mk respectively. Calculate the rate of heat loss per square meter when the temperature difference between inner and outer surface is 650K.

**(OR)**

11.b) An aluminium rod (k =204 W/mK) 2 cm in diameter and 20 cm long protrudes from a wall which is maintained at 300°C. The end of the rod is insulated and the surface of the rod is exposed to air at 30°C. The heat transfer coefficient between the rod's surface and air is 10 w/m2K. Calculate the heat lost by the rod and the temperature of the rod at a distance of 10 cm from the wall.

12.a) Atmospheric air at 150°C with a velocity of 1.25 m/s over a 2 m long flat plate whose temperature is 25°C. Determine the average heat transfer coefficient and the rate of heat transfer for a plate width of 0.5 m.

**(OR)**

12.b) A vertical cylinder 1.5 m high and 180 mm in diameter is maintained at 100°C in an atmosphere of 20°C. Calculate the heat loss by free convection from the surface of the cylinder. Assume properties of air as p = 1.06 kg/m3 and v =18.97x 10-6 m2/s, cp=1.004kJ/kg°C and k = 0.1042 kJ/m.K

13.a) Hot oil with a capacity rate of 2500 W/K flows through a double pipe heat exchanger. It enters at 360 °C and leaves at 300 °C. Cold fluid enters at 30 °C and leaves at 200 °C. If the overall heat transfer coefficient is 800 W/m2K, determine the heat exchanger area required for 1) parallel flow and

2) Counter flow.

**(OR)**

13.b) Water is boiled at the rate of 24 kg/h in a polished copper pan, 300 mm in diameter, at atmospheric pressure. Assuming nucleate boiling conditions calculate the temperature of the bottom surface of the pan.

14.a) Dry air at 27oC and 1 atm flows over a wet flat plate 50cm long at a velocity of 50m/s. Calculate the mass transfer coefficient of water vapor in air at the end of the plate.

**(OR)**

14.b) A steel sphere of radius 60 mm which is initially at a uniform temperature of 325°C  
is suddenly exposed to an environment at 25°C; with convection heat transfer  
coefficient 500 W/m2K. Calculate the temperature at a radius 36 mm and the heat  
transferred 100 seconds after the sphere is exposed to the environment.

15.a) 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.

**(OR)**

15.b)Air at 200 kPa and 200°C is heated as it flows through a tube with a diameter of 25 mm at a velocity of 10 m./sec. The wall temperature is maintained constant and is 20°C above the air temperature all along the length of tube. Calculate:

(i)The rate of heat transfer per unit length of the tube.

(ii) Increase in the bulk temperature of air over a 3 m length of the tube.

**Part-c(1X15=15)**

16.a)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/s. The overall heat transfer coefficient of the heat exchanger is 600 W/m2K and the heat transfer area is 6 m2 Calculate the exit temperatures of oil and water.

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