4. (a) A 50 cm × 50 cm copper slab 6.25 mm thick has a uniform temperature of 300ºC. Its temperature is suddenly lowered to 36ºC. Calculate the time required for the plate to reach the temperature of 108ºC. Take; C_p = 0.38 kJ/kg-K, ρ = 9000 kg/m^3, k = 370 W/mºC and h = 90 W/m^2-K. **15**

(b) Define Biot number and Fourier number with their physical significance. **5**

5. (a) A hot plate 20 cm in height and 60 cm wide is exposed to ambient air at 30ºC. Assuming the temperature of the plate is maintained at 110ºC, find the heat lost from both surfaces of the plate.
Take : C_p = 1005 J/kg-K, ρ = 1.03 kg/m^3, k = 0.0255 W/mºC and $v = 20 \times 10^{-6}$ m^2/s. **10**

(b) Derive energy equation for isothermal boundary layer formed over a flat plate. **10**

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W-533

B. Tech. (Weekend)

EXAMINATION, May 2018

(Fifth Semester)

(Re-appear Only)

(ME)

MEW305

HEAT TRANSFER

Time : 3 *Hours*] [*Maximum Marks :* 100

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt any *Five* questions. Use of properties tables of fluid and related Charts is permissible. All questions carry equal marks.

1. (a) Calculate the temperature gradient and heat transfer per unit area through a copper plate 45 mm thick, whose one face maintained at 400ºC and other face at 50ºC. Take thermal conductivity of copper as 370 W/m-K. **5**

(b) A hot plate 1.5 m × 1.5 m is maintained at 300ºC. Air at 20ºC blows over the plate. If the convective heat transfer coefficient is 20 W/m^2- K, calculate the rate of heat transfer. **5**

(c) A surface having an area of 1.5 m^2 and maintained at 300ºC exchange heat by radiation with another surface at 40ºC. The value of factor due to the geometric location and emissivity is 0.52. Determine :

(i) Heat lost by radiation

(ii) The value of thermal resistance

(iii) The value of equivalent convection coeficient. **10**

2. Derive an expression to determine the heat transfer rate through a composite wall. A furnace wall consists of 200 mm layer of refractory bricks, 6 mm layer of steel plate and 100 mm layer of insulation bricks. The maximum temperature of the wall is 1150ºC on the furnance side and the minimum temperature is 40ºC on the outermost side of the wall. Thermal conductivities of three layers are 1.52, 45 and 0.138 W/m-K. Find heat loss from the wall. **20**

3. (a) The rate of heat generation per unit volume in a long cylinder of radius R is given by $q_g = a + br^2$; where a and b are constants and r is any radius. The cylinder is undergoing heat transfer with a medium at a temperature t_a and surface heat transfer coefficient is h. Find the steady state temperature distribution in the solid. **16**

(b) Define fin effectiveness and fin efficiency. **4**

6. Write notes on the following :

(a) The black body and monochromatic radiation **10**

(b) Shape factors and some special properties of the shape factor. **10**

7. (a) Define : overall heat transfer coefficient, Effectiveness, NTU, Counter flow heat exchanger. **8**

(b) An old heat exchanger with surface area 1 m^2 is available for cooling oil with a capacity rate of 300 kg/h. C_p (oil) = 2200 J/kg-K. The inlet temperature of oil is 110ºC while that of water is 15ºC. Flow rate of water is 0.4 litres/s. Determine the lowest possible temperature in :

(i) Parallel flow

(ii) Counter flow heat exchanger.

Take overall heat transfer coefficient = 600 W/m^2-K. **12**

8. (a) Derive relation of boundary layer thickness formed for laminar film condensation on vertical plate. **15**

(b) Explain briefly the physical mechanism of boiling. **5**