Student Exam No. _____

GANPAT UNIVERSITY

B. Tech. Semester: VI Mechanical Engineering

CBCS Regular Examination April-June 2016

Sub: 2ME603- HEAT &MASS TRANSFER

Time: 3 Hours **Total Marks: 70**

Instruction: *1. Attempt all Question.*
2. Don't write anything on the question paper.
3. Use of non-programmable scientific calculator is permitted.
4. Also use heat and mass Transfer Data Book.

SECTION-I

Que. – 1 (a) Define the velocity boundary layer and thermal boundary layer thicknesses for flow over a flat plate. **6**

(b) Determine the radiant heat exchanger in W/m^2 between two large parallel steel plates of emissivities 0.8 and 0.5 held at temperature of 1000 K and 500 K respectively, if a thin copper plate of emissivity 0.1 is introduced as a radiation shield between the two plates. Use $\sigma = 5.67 \times 10^{-8}$ W/m^2K^4. **6**

OR

Que. – 1 (a) Consider a cylindrical furnace, whose radius is 1 m and equal to its height. The base and top surface of the furnace have emissivities 0.4, and 0.8, respectively, and are maintained at uniform temperatures of 700 K and 500 K. The curved cylindrical surface approximation a blackbody and is maintained at a temperature of 400 K. Calculation the net rate of radiation heat transfer at each surface during steady state conditions. **6**

Que. – 1 (b) Explain the following: **6**
(i) Efficiency of fin; (ii) Effectiveness of fin.

Que. – 2 (a) A counter flow double pipe heat exchanger using superheated steam is used to hot water at the rate of 10500 kg/h. The steam enters the heat exchanger at 180°C and leaves at 130°C. The inlet and exit temperature of water are 30°C and 80°C respectively. If overall heat transfer coefficient from steam to water is 814 W/m^2C, calculate the heat transfer area. What would be the increase in area if the fluid flow were parallel? **6**

(b) The velocity distribution in the boundary layer is given by : $\frac{u}{U} = \frac{y}{\delta}$, where **u** is the velocity at a distance **y** from the plate and **u=U at y=δ** being boundary layer thickness, Find: **5**

The Displacement thickness(δ*) (ii) The Momentum thickness (θ) (iii) The value(δ*/ θ)

OR

Que. – 2 (a) Derive an energy equation for thermal boundary layer over a flat plate. **6**

(b) A steel pipe with 50 mm OD is covered with a 6.4 mm asbestos insulation (k=0.166 W/m K) followed by a 25 mm layer of fiber glass insulation (k=0.0485 W/m K) .the pipe wall temperature is 393 K and outside insulation temperature is 311 K. calculate the interface temperature between the asbestos and fiber glass. **5**

Que. – 3 (a) Estimate the coefficient of heat transfer from a vertical plat 2m x 2m to the surrounding air at 25 °C. The plate surface temperature is 150°C. Also calculate the rate of heat transfer from the plate. For air assume the Kinematic viscosity as 1.6×10^{-5} m^2/s. The properties of air at film temperature are density 0.972 Kg/m^3 ,sp. Heat 1.009 KJ/Kg K , thermal conductivity 3.13×10^{-2} Nusselt no. equation are 0.15 & 1/3 respectively. **7**

(b) What do you mean by critical radius of insulation? Explain it concept with help of material and surface resistances. **5**

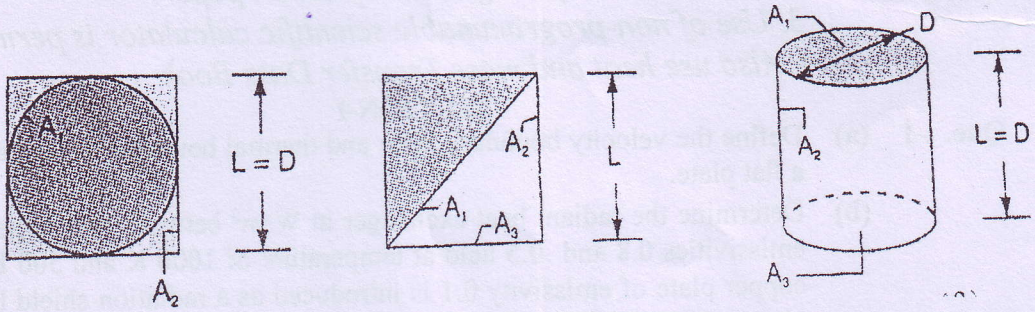
SECTION-II

Que. – 4 (a) What is Fourier's Law? And the steady state radial conduction H.T. through a cylinder, Derive Equation and also write assumptions

(b) What is the natural convection? How does is differ from the forced convection? What force causes natural convection currents?

OR

Que. – 4 (a) Calculate the view factor F_{1-2} and F_{2-1} for the following geometries: 6



1. Sphere of diameter D inside a cubical box of length D.
2. Diagonal partition within a long square duct.
3. End and side of a circular tube of equal length and diameter.

(b) Define the following terms: 6

(i) Total emissive power (ii) Monochromatic emissive power
(iii) Emissivity and (iv) Lamberts law of radiation

Que. – 5 (a) A large window glass 0.5 cm thick (k=.78 W/ m.K) is exposed to warm air at 25°C, over its inner surface, with convection coefficient of 15 W/m^2 .K .The outside air is at −15°C with convection coefficient of 50 W/m^2.k. Determine the heat transfer rate and temperature at the inner and outer surface of the glass. 7

(b) Distinguish between irradiation and radiosity 4

OR

Que. – 5 (a) The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 75°C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficients on both sides are 650 W/m^2C, calculate the area of the heat exchanger. 7

(b) Define absorptivity, reflectivity and transmissivity. 4

Que. – 6 (a) Derive an expression for logarithmic mean temperature difference (LMTD) in case of 6

(i) parallel flow, and (ii) Counter-flow heat exchangers.

(b) What do you understand by local and average value of heat transfer coefficient? 3

(c) A plane wall is 0.15 m thick and its wall area is 5.5 m^2. if its conductivity is 9.33 w/m^2K and surface temperatures are at 160 °C and 500°C, determine 3

(i) Heat flow across the plane wall

(ii) Temperature gradient in the flow direction

END OF PAPER