Student Exam No.________________

GANPAT UNIVERSITY

B. Tech. Semester: VI (Mechanical Engineering)

Regular Examination/ May - June 2014

HEAT & MASS TRANSFER (2ME603)

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. *Use of heat and mass Transfer Data Book is allowed.*

SECTION - I

Que. – 1 (A) Explain various Modes of Heat Transfer with practical Examples. 6

(B) Derive the Expression for Heat Dissipation from a fin insulating at the tip. 6

OR

Que. – 1 (A) Derive the general Heat Conduction Equation in Cartesian Co-ordinate. 6

(B) Define the term insulation & applications of insulation also write the factors affecting thermal conductivity. 6

Que. – 2 (A) Define the following terms:- 5

(i) Reynolds Number (ii) Prandtle Number (iii) Nusselt Number
(iv) Peclet Number (v) Grashoff number

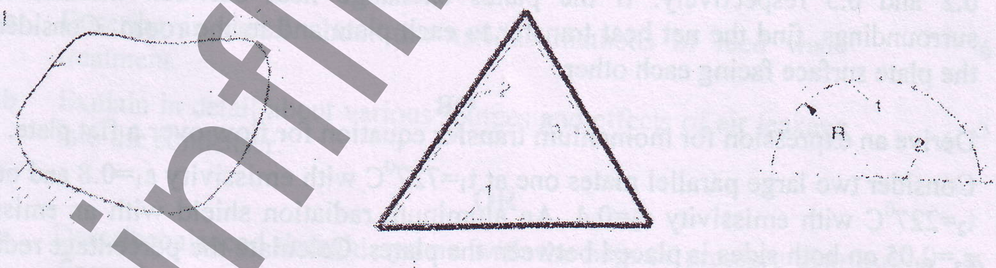
(B) Draw the Spectrum of electromagnetic Radiation and Explain the following 6

(i) Total Emissive Power (ii) Emissivity (iii) Kirchhoff's law
(iv) Stefan-Boltzmann law (v) Wien's law

OR

Que. – 2 (A) Compare parallel flow and counter flow heat exchanger. 3

(B) Calculate the view factor F_{1-1}, F_{1-2} for the following geometries : 8



(i) A black body inside a block enclosure.
(ii) A tube whose section is equilateral triangle.
(iii) Radiation exchange between a hemisphere and a plane surface.

Que. – 3 (A) Define Heat Exchanger with examples and also classify Heat exchangers. 6

(B) Explain Buckingham π theorem. What are its merits and demerits? What are repeating variables? And how are they selected? 6

SECTION II

Que. – 4 (A) Water flow at 50^0C inside a 2.5cm inside dia. Tube such h_i=3500 w/m^2.k , the tube has wall thickness of 0.8 mm, with thermal conductivity of 16 w/m^{0}C, the outside of the tube wall losses heat by Free convectional with h_o=7.6w/m^{2}k 6

(i) Calculate the overall heat transfer coefficient U_0.
(ii) Heat loss per unit length to surrounding air at 20^0C.

(B) Air flow over a heated flat plate at a velocity of 50 m/s. The local skin friction coefficient at a point on the plate is 0.004.Estmate the local heat transfer coefficient at a point. The following property data for air given: Density=0.88 kg/m^3; viscosity=2.286x 10^{-5} kg/m-s; specific heat C_p= 1.001 kJ/kg-K; thermal conductivity =0.035 W/m-K. Use **6**

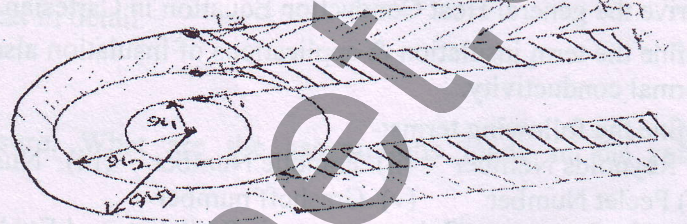
$$S_x P_r^{2/3} = \frac{Cfx}{2}$$

OR

Que. – 4 (A) 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, δ being boundary layer thickness. Find: **6**

(i) The displacement thickness, (ii) The momentum thickness,
(iii) The energy thickness δ_e

(B) A stainless steel tube K_s = 19 W/m-K, 2 cm internal diameter and 5cm outer diameter insulated with 3 cm thick asbestos K_a = 0.2 W/m-K, If the temperature difference between inner most and outer most surface is 600^{0}C and the heat transfer rate per unit length. **6**



Que. – 5 (A) Define the local and average skin friction (drag) coefficients for a flat plat at zero incidences, for laminar flow. **6**

(B) Two parallel plates of size 1.0m x 1.0m spaced 0.5m apart are located in a very large room, the walls of which are maintained at a temperature of 270C. One plate is maintained at a temperature of 9000C and the other at 4000C. Their emissivities are 0.2 and 0.5 respectively. If the plates exchange heat between themselves and surroundings, find the net heat transfer to each plate and to the room. Consider only the plate surface facing each other. **5**

OR

Que. – 5 (A) Derive an expression for momentum transfer equation for flow over a flat plate. **6**

(B) Consider two large parallel plates one at t_1=727^{0}C with emissivity ε_1=0.8 and other at t_2=227^{0}C with emissivity ε_2=0.4. An aluminum radiation shield with an emissivity, ε_s=0.05 on both sides is placed between the plates. Calculate the percentage reduction in heat transfer rate between two plates as a result of shield. **5**

Que. – 6 (A) A hot fluid at 200°C enters a heat exchanger at a mass flow rate of 10^4 kg/h. Its specific heat is 2000 J/kg K .It is to be cooled by another at 25°C with a mass flow rate 2500 kg/h and specific heat 400 J/kg K. The overall heat transfer coefficient based on outside area of 20 m^2 is 250 W/m^2 K. Find the exit temperature of the hot fluid when the fluids are parallel flow. **6**

(B) Which is a batter HE? Counter flow, parallel flow or cross flow why? **2**

(C) What is difference in NTU&LMTD approach? **2**

(D) How do the thermal conductivity of liquids and gases vary with temperature? **2**

ALL THE BEST