Seat No: _____ Enrollment No: _____

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

M.Tech. Winter 2017 - 18 Examination

Semester: 1 **Date: 28/12/2017**
Subject Code: 03210102 **Time: 2:00 pm to 4:30 pm**
Subject Name: Advanced Heat Transfer **Total Marks: 60**

Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 A) Consider three consecutive nodes n - 1, n, and n + 1 in a plane wall. Using the finite difference form of the first derivative at the midpoints, show that the finite difference form of the second derivative can be expressed as **(05)**

$$\frac{T_{n-1} - 2T_n + T_{n+1}}{\Delta x^2} = 0$$

B) What is Beer's law? Prove that emissivity of non participating medium doesn't depend on wavelength. **(05)**

C) Write a short note on Emissivity and absorptivity of gases and gas mixtures and their characteristics. **(05)**

Q.2 **Answer the following questions**. (Attempt any three) (Each five mark) **(15)**

A) Define Nusselt number ,Prandtl number, Rayleigh number and Grashoff number

B) Explain weins displacement law with proper diagram

C) Define shape factor and salient features.

D) Define fin efficiency and fin effectiveness.

Q.3 A) Prove that for flow over flat plat $Nu=0.332*Re^{0.5}*Pr^{0.33}$ for liquid metal **(07)**

B) Obtain the shape factor for **(08)**

i) black body inside a black encloser.

ii) A tube with cross section of equilateral triangle

iii) Hemispherical surface and a plane surface

iv) two concentric black cylinders

OR

B) Derive the temperature profile for fin with insulated at the tip. **(08)**

Q.4 A) In a wind tunnel, air at 5 m/s flows over a flat plate and 15°C, 1 m x 0.8 m in size. The surface temperature of plate is 35°C. One of the side of the plate is arranged parallel to the flow direction, such that the heat transfer is lesser, estimate: (i) Rate of heat transfer from the one side of plate (ii) Initial rate of cooling per hour of the plate, if mass of the plate is 5 kg and specific heat is 875 J/kg.K. (iii)If the flow is turned off, compute the heat flow rate from the upper surface of the plate in still air at 15°C. (iv)What is the percentage change in heat flow rate? The thermo-physical properties of air are as follows: $\rho = 1.1707$ kg/m^3 , $\nu = 15.172 \times 10^{-6}$ m^2/s , k= 0.02614 W/mK, Cp=1007 J/KgK, Pr = 0.7075 Use the following correlations: For free convection: $Nu = 0.27 (Gr. Pr)^{0.25}$ For forced convection: $Nu = 0.664 (Re)^{0.5} (Pr)^{0.33}$ **(07)**

OR

A) A long hollow cylinder has inner and outer radii 50 mm and 150 mm respectively. It generates heat at a rate of 1 kW/m^3 (k=0.5 W/m˚C).If the maximum temperature occurs at radius of 100mm and temperature of outer surface is 50˚ C, find: **(07)**

i) Temperature at inner surface, and ii) Maximum temperature in the cylinder.

B) Write the finite-difference equations under steady-state conditions for the following situations: **(08)**