Seat No: _____ **Enrollment No: _____**

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech. Summer 2018 - 19 Examination

Semester: 6 **Date: 09/05/2019**
Subject Code: 03101381 **Time: 10:30am to 1:00pm**
Subject Name: Theory of 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 Short Type Questions **(15)**

1) What does the transient conduction mean?
(a) heat transfer for a short time
(b) conduction when the temperature at a point varies with time
(c) very little heat transfer
(d) Heat transfer with a very small temperature difference

2) For a cylindrical rod with a uniformly distributed heat sources, the temperature gradient dt/dr at half the radius location will be _____ of that of the surface
(a) one-fourth (b) one-half (c) twice (d) four times

3) Which of the following statements is correct?
(a) thermal conductivity decreases with increase in density of the substance
(b) heat treatment causes considerable variation in thermal conductivity
(c) thermal conductivity is always higher in the purest form of metal
(d) Thermal conductivity of a damp material is considerably higher than the thermal conductivity of the dry material and water taken individually.

4) Considering a composite wall comprising two layers of thermal conductivities k and 2k, and two equal surface areas normal to the direction of heat flow. The inner and outer surface of the composite wall is maintained at 100^0C *and* 200^0C respectively. If the surface temperature at the junction is desired to be 150^0C and the conduction is the only mode of heat transfer, then the ratio of thickness should be
(a) 1:1 (b) 2:1 (c)1:2 (d) 2:3

5) The efficiency of the pin fin with insulated tip is
(a) $\frac{\tanh(ml)}{\left(\frac{hA}{Pk}\right)^{0.5}}$ (b) $\frac{\tanh(ml)}{ml}$ (c) $\frac{ml}{\tanh(ml)}$ (d) $\frac{\left(\frac{hA}{Pk}\right)^{0.5}}{\tanh(ml)}$

6) Match the sets:

	Set A		**Set B**
(i)	Fourier law	(a)	Forced convection
(ii)	Fourier number	(b)	Free convection
(iii)	Grashoff number	(c)	Conduction heat transfer
(iv)	Wein displacement law	(d)	Transient heat flow
(v)	Stanton number	(e)	Radiation heat transfer

7) The heat dissipation from an infinitely long fin is given by _____.

8) It is desired to increase the heat dissipation rate over the surface of an electronic device of spherical shape of 5mm radius exposed to convection with $h = 10\ W/m^2K$ and encasing it in a spherical sheath of conductivity 0.04 W/mK. For maximum heat flow, the diameter of the sheath should be _____.

9) In the heat flow equation Q = kA $(t_1-t_2)/x$, the term $(t_1-t_2)/x$ is known as _____.

10) For spheres, the critical thickness of insulation is _____.

11) Explain briefly the term thermal diffusivity of material

12) Explain the efficiency of the fin

13) Name and explain briefly the types of convection heat transfer.

14) What are the properties of a grey body?

15) Define the terms absorptivity, reflectivity and transmissivity of radiation

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

1. Derive the Von-Karman momentum equation for the flow past a flat plate

2. Derive general heat conduction equation in Cartesian coordinates

3. Explain how the boiling is being is classified?

4. Hot air at a temperature of 60^0C is flowing through a steel pipe of 100 mm diameter. The pipe is covered with two layers of different insulating materials of thicknesses 50 mm and 30 mm and their corresponding thermal conductivities are 0.23 and 0.37 W/m^{0}C. The inside and outside heat transfer coefficients are 58 and 12 $W/m^{2^0}C$. The atmosphere is at 25^0C.Find the rate of heat loss from a 50 m length of pipe. Neglect the resistance of steel pipe. (2.334kW)

Q.3A) State and explain the following radiation laws **(07)**

i. Stefan-Boltzmann law
ii. Kirchoff's law
iii. Planck's law
iv. Wien's displacement law

Q.3B) Explain and derive the logarithmic mean area for the (i) hollow cylinder and (ii) hollow sphere. **(08)**

OR

Q.3B) Derive the expression for the temperature distribution and heat dissipation in a straight fin of rectangular profile for the fin insulated at the tip. **(08)**

Q.4A) A plate of length 500 mm and width 250 mm has been placed longitudinally in a stream of crude oil which flows with a velocity of 6 m/s. If the oil has a specific gravity of 0.9 and kinematic viscosity of 1 stoke, calculate: **(07)**

(i) Boundary layer thickness at the middle of plate
(ii) Shear stress at the middle of plate
(iii) Friction drag on one side of the plate

OR

Q.4A) Consider two large parallel plates one at $t_1 = 727^0C$ with emissivity $\epsilon_1 = 0.8$ and other at $t_2 = 227^0C$ with emissivity $\epsilon_2 = 0.4$. An aluminum radiation shield with an emissivity, $\epsilon_s = 0.05$on both sides is placed between the plates. Calculate the percentage reduction in heat transfer rate between the two plates as a result of the shield. **(07)**

Q.4B) Define the following dimensionless numbers with their physical significance (any 4) **(08)**

i. Reynolds number
ii. Prandtl number
iii. Nusselt number
iv. Stanton number
v. Grashoff number