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

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech. Winter 2019 - 20 Examination

Semester: 5/6 **Date: 10/12/2019**
Subject Code: 03109354 **Time: 10:30 am to 01:00 pm**
Subject Name: 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 Objective Type Questions – **(15)**

1. Unit of thermal conductivity is
   a) w/mk b) w/m^2k c) w/k d) k/w

2. In pool boiling process, the region after the natural convection in which the vapour bubbles form with increase in heat flux, is called as
   a) impure boiling regime
   b) pure boiling regime
   c) nucleate boiling regime
   d) non-nucleate boiling regime

3. What is the approximate wavelength range of thermal radiation?

   a) 0.1 to 100 μm (micrometer)
   b) 0.1 to 100 nm (nanometer)
   c) 0.1 to 100 cm (centimeter)
   d) none of the above

4. Number of transfer unit (NTU) is defined as
   a) $\frac{U\,A}{(m\,Cp)minimun}$ b) $\frac{U\,A}{(m\,Cp)maximun}$ c) $\frac{(m\,cp)minimimum}{(m\,Cp)maximun}$ d) $\frac{(mcp)minimum}{(U\,A)}$

5. Nusselt number is

   a) $\frac{hk}{L}$ b) $\frac{h\,L}{k}$ c) $\frac{kL}{h}$ d) none of these

6. Unit of thermal diffusivity is _____.
7. Emissivity of black body is _____. (0 or 1)
8. Body which has negligible transmissivity is also known as _____.
9. Equation for thermal conductive resistance of cylinder is _____.
10. Value of Stefan Boltzmann constant is _____.
11. With increase in temperature, thermal conductivity of gas increases. True or False
12. Heat transfer will always reduce on application of insulation on wall. True or False
13. Lumped heat capacity method can be used for unsteady state problem if biot number is greater than 0.1. True or False
14. Define: Fourier number
15. Define: Prandtl number

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

A) Explain Fourier's law of heat conduction with all assumptions.
B) Explain electrical analogy of combined heat conduction and convection in composite plane wall.
C) Explain Newton's law of cooling and convective thermal resistance.
D) Define: Stefan boltzman law, White body, Gray body, Wein displacement law, Emissive power.

Q.3 A) What do you understand by critical radius of insulation? Derive an expression for critical radius of insulation in case of sphere. State its physical significance. **(07)**

B) An engine oil is to be cooled from 100 °C to 50 ° C in a thin walled concentric parallel flow heat exchanger. The cooling water available at 20 °C to act as a coolant. The internal diameter of the tube is 0.3 m through which water flows at the rate of 9000 kg/hr and the oil flows in the outer tube of internal diameter of 0.5 m at the rate of 7200 kg/hr. The overall heat transfer coefficient is 300 w/m^2k. Assuming C_p(oil)=2.1 kJ/kg k , C_p(water)=4.19 kJ/kg k. Find the length of tube required. **(08)**

OR

B) Define fin efficiency and Derive an expression for heat transfer of adequately long fin with insulated tip. **(08)**

Q.4 A) The junction of a thermocouple can be considered as a sphere. The thermal conductivity of the junction is 30 w/mk and material properties are: Density (ϱ) =8000 kg/m^3, specific heat (c) =400 J/kg k.This thermocouple is used to measure the temperature of a gas having convective heat transfer coefficient as 300 w/m^2k.The stream temperature is 400 °C and thermocouple is required to reach the temperature 390 °C within 3 seconds. Initial temperature of the junction is 30 °C. Find the required diameter of thermocouple junction using lumped heat capacity theory. **(07)**

OR

A) Find out heat transfer rate due to radiation between two infinitely long parallel planes. One plane has emissivity of 0.4, is maintained at 200 ° C. Other plane has emissivity of 0.2 and is maintained 30 °C. If a radiation shield (emissivity of 0.5) is introduced between the two planes, find percentage reduction in heat transfer rate and steady state temperature of the shield. **(07)**

B) Derive an expression of LMTD for counter flow heat exchanger. **(08)**