Seat No: _____ Enrollment No: _____

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech. Summer 2018 - 19 Examination

Semester: 5/6 **Date: 30/04/2019**
Subject Code: 03109354 **Time: 10.30 am to 1.00 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 - (Each of one mark) **(15)**

1. Fourier law of heat conduction is best represented by **Q = _____.**
2. Which material has highest thermal conductivity?
   a.Water b.Brick c.Diamond d.Steel
3. Heat transfer takes place in liquids and gases is essentially due to
   a. Radiation b. Conduction c. Convection d. Conduction as well as convection
4. The ratio of surface convection resistance to the internal conduction resistance is known as,
   a. Grashoff Number b. Biot Number c. Stanton Number d. Prandtl Number.
5. In a Shell and Tube heat exchanger, baffles are provided on the shell-side to
   a. Improve heat Transfer b. Provide support to tubes c. Prevent Stagnation of Shell side fluid d. all of these.
6. The unit of overall heat transfer coefficient is _____.
7. The heat of sun reaches to us according to _____ mode of heat transfer.
8. The heat Transfer takes place according to _____ law of thermodynamics
9. The unit of Stefan-Boltzmann constant is _____.
10. Free convection flow depend on
    a. Density b. Coefficient of viscosity c. Gravitational force d. All of these.
11. The emissivity of black body is?
12. Define Reynolds number (Re).
13. Define Condensation.
14. An electric cable of aluminum conductor (k = 240 W/mk) is to be insulate with rubber (k = 0.15 W/mk). The cable is located in air (h = 6 w/m^2). Calculate critical thickness of insulation.
15. State Kirchhoff's law of radiation.

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

A) Explain various regimes of boiling.
B) Define the terms i) Total emissive power, ii) Emissivity, iii) Absorptivity, iv) Black Body, v) Solid Angle.
C) State the Fourier law of heat conduction and Newton law of cooling.
D) Explain the terms fin efficiency and fin effectiveness.

Q.3 A) Derive general heat conduction equation in Cartesian Coordinates. **(07)**

B) A 240 mm steam main, 210 metres long is covered with 50 mm of high temperature insulation (k = 0.092 W/m °C) and 40 mm of low temperature insulation (k = 0.062 W/m °C). The inner and outer surface temperatures as measured are 390 °C and 40 °C respectively. Calculate: **(08)**
(i) The total heat loss per hour,
(ii) The heat loss per m^2 of pipe surface,
(iii) The total heat loss per m^2 of outer surface, and
(iv) The temperature between two layers of insulation. Neglect heat conduction through pipe material.

OR

B) An egg with mean diameter of 4 cm and initially at 20 ^{0}C is placed in a boiling water pan for 4 minutes and found to be boiled to the consumer's test. For how long should a similar egg for same consumer be boiled when taken from a refrigerator at 5 ^{0}C. Take following properties for egg: k = 10 W/m °C, ρ = 1200 Kg/m^3, c = 2 KJ/Kg °C, h = 100 w/m^2 °C. **(08)**

Q.4 A) Derive an expression for log mean temperature difference (LMTD) of parallel flow heat exchanger. **(07)**

OR

A) By dimensional analysis show that for forced convection Nu = ϕ (Re, Pr), where Nusselt No. Nu = hl/k, Reynolds No. Re= ρVl/μ, Prandtl No. = μC_p/K. **(07)**

B) Oil (C_p = 3.6 kJ/kg °C) at 100°C flows at the rate of 30000 kg/h and enters into a parallel flow heat exchanger. Cooling water (C_p = 4.2 kJ/kg °C) enters the heat exchanger at 10°C at the rate of 50000 kg/h. The heat transfer area is 10 m^2 and U = 1000 W/m^2 °C. Calculate the following: **(08)**

(i) Find N.T.U.

(ii) The outlet temperatures of oil, and water.

(iii) The maximum possible outlet temperature of water.