Roll No.											

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

SUMMER TERM / MAKE UP END TERM EXAMINATION

Summer Term: Summer Term 2019 | **Date**: 24 July 2019

Course Code: MEC 209 | **Time**: 2 Hour

Course Name: Heat and Mass Transfer | **Max Marks**: 80

Program & Sem: B.Tech (Mech) & V Sem (2015 & 2016 Batch) | **Weightage**: 40%

Instructions:

(i) Question paper consists of 3 parts

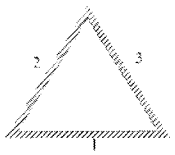
(ii) Scientific and non-programmable calculators are permitted.

(iii) ***HMT data handbook*** *will be provided for the test.*

Part A

Answer **any four** Questions. **Each** question carries **five** marks. (4Qx5M=20)

1. What is fouling? Describe scale heat transfer coefficient and fouling factor.
2. What is Wien's displacement law? Describe its significance in brief.
3. What is shape factor? Find F_{12} in the figure shown below.



A tube with cross-section of an equilateral triangle

4. Describe absorptivity, reflectivity and transmissivity of a surface in brief.
5. What is viscosity and kinematic viscosity? Give their units. Describe Newton's law of viscosity.

Part B

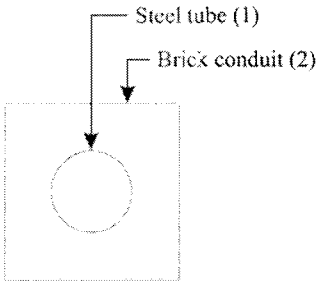
Answer **any three** questions. **Each** question carries **ten** marks. (3Qx10M=30)

6. Describe in detail the various types of heat exchangers on the basis of their classification with suitable figures.

7. Derive the equation for the surface and space resistance for thermal radiation between grey surfaces. Also express the rate heat transfer between 2 parallel planes in terms of these resistances.

8. In a certain double pipe heat exchanger hot water flows at the rate of 5000kg/hr and gets cooled from 95°C to 65°C. At the same time 50000 kg/hr of cooling water at 30°C enters the heat exchanger. The flow conditions are such that the overall heat transfer coefficient remains constant at 2270 W/m^2K. Determine the heat transfer area required and the effectiveness, assuming 2 streams are in parallel flow. Assume for the both streams C_p = 4.2 kJ/kg.K

9. Determine the rate of heat loss by radiation from a steel tube of outside diameter 70mm and 3m long at a temperature of 227°C if the tube is located within a square brick conduit of 0.3m side and at 27C. Take emissivity, ϵ (steel) = 0.70 and ϵ (brick) = 0.93.



Part C

Answer **any two** questions. Each question carries **fifteen** marks. (2Qx15M=30)

10. A **parallel flow** double pipe heat exchanger is using superheated steam is used to heat water. The steam enters the heat exchanger at 170°C and leaves at 130°C. The inlet and exit temperatures of water are 50°C and 80°C. The inner and outer diameter of the inner pipe of the heat exchanger are 1.2m (d_i) and 1.6m (d_o) respectively. For the pipe length of 10m calculate: (1) Mass flow rate of both steam and water in kg/s. (2) The length of a **counter flow** heat exchanger with the same parameters as in the previous heat exchanger.

    Assume specific heat capacity of water and steam as 4.2 kJ/kg°C. Take the heat transfer coefficient at the inner and outer surface of the inner pipe in the heat exchanger as 120 $W/m^{2\circ}C$ (hi) and 195 $W/m^{2\circ}C$ (ho) respectively. Neglect the thermal resistance offered by the pipe walls and due to its fouling.

11. Calculate the net radiant heat exchange per m^2 area for two large parallel plates at temperature of 427°C and 27°C respectively. ϵ (hot plate) = 0.9 and ϵ (cold plate) = 0.6. If a polished aluminium shield is placed between them, Find the percentage reduction in heat transfer, ϵ (shield) = 0.4.

12. What is a boundary Layer? Give the 3 definitions for the boundary layer thickness. Also describe the formation of boundary layer (laminar and Turbulent) over a flat plate with suitable figures.