Hall Ticket Number :										

R-14

Code: 4G555

III B.Tech. I Semester Supplementary Examinations February 2022

Heat Transfer

(Mechanical Engineering)

Max. Marks: 70 Time: 3 Hours

Answer *any five full questions* by choosing one question from each unit (5x14 = 70 Marks)

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UNIT–I

1. a) Explain Fourier's law of heat conduction. 6M

   b) Differentiate between thermodynamics and Heat transfer. 4M

   c) State Newton's law of cooling and Stefan Boltzman law of radiation. 4M

OR

2. a) Hot air at 80°C is blown over a 2-m by 4-m flat surface at 30°C. If the average convection heat transfer coefficient is 55 W/m^2 °C, determine the rate of heat transfer from the air to the plate, in kW. 8M

   b) Describe different types of boundary conditions applied to heat conduction problems. 6M

UNIT–II

3. a) Spherical shaped vessel of 1.5 m diameter is 75 mm thick. Find the rate of heat leakage, if the temperature difference between the inner and outer surfaces is 300^o C. Thermal conductivity of material is 0.3 kJ /mh^{o}C. 6M

   b) Derive the temperature distribution equation for a lumped system in terms of Fourier and Biot numbers. 8M

OR

4. a) What is critical thickness of insulation? Derive the expression to calculate critical thickness of insulation for a cylinder. 5M

   b) A long carbon steel rod length 40 cm and diameter 10 mm (K = 40 W/mK) is placed in such that one of its end is at 400^0Cand the ambient temperature is 30^0C. The film coefficient is 10 W/m^2K. Determine: (i) Temperature at mid length of the fin. (ii) Fin efficiency. (iii) Heat transfer rate form the fin. 9M

UNIT–III

5. a) Illustrate the development of hydrodynamic boundary layer inside a pipe. 4M

   b) List out the dimensionless numbers used in forced convection situation and their mathematical expressions. 6M

   c) What is the difference between free convection and forced convection? 4M

OR

6. a) Show that Nu=f (Re, Pr) for forced convection by the use of dimensional analysis. 7M

   b) Air at 25^{o}C flows past a flat plate at 2.5 m/s. the plate measures 600 mm X 300 mm and is maintained at a uniform temperature at 95^{o}C. Calculate the heat loss from the plate, if the air flows parallel to the 600 mm side. 7M

UNIT–IV

7. a) How the condensation and boiling phenomenon heat transfer takes place. 4M

   b) Two large parallel planes with emissivities of 0.3 and 0.5 are maintained at temperatures of 527^0 C and 127^0C respectively. A radiation shield having emissivities of 0.05 on both sides is placed between them. Calculate (i) Heat transfer rate between them without shield. (ii) Heat transfer rate between them with shield. 10M

OR

8. a) Write short notes on Black body radiation. 4M

   b) Calculate the net radiant heat exchange per m^2 area for two large parallel plates at temperatures of 427^0 C and 27^0C. Є (hot plate) = 0.9 and Є (cold plate) = 0.6.If a polished aluminum shield(Є=0.4) is placed between them, find the % reduction in the heat transfer. 10M

UNIT–V

9. a) What is a Heat exchanger? Classify the heat exchangers and its applications. 6M

   b) Obtain the expression for LMTD of a Parallel flow heat exchanger. 8M

OR

10. a) A counter flow heat exchanger is used to cool oil at a rate of 0.6 kg/s (C_P = 2.5 Kj/kgK) from 110^oC to 35^oC using water at 20 ^oC. The overall heat transfer coefficient is 1500 W/m^2K. Assuming cooling water outlet temperature 80 ^oC and using NTU method calculate: (i) Water flow rate. (ii) Surface area required. (iii) Effectiveness of heat exchanger 10M

    b) Outline the concept of overall heat transfer coefficient in heat exchangers 4M

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