**18ME602**

**Hall Ticket Number:**

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| **III/IV B.Tech (Regular) DEGREE EXAMINATION** | | | |
| **July, 2021** | **Mechanical Engineering** | | |
| **Sixth Semester** | **Heat Transfer** | | |
| **Time:** Three Hours | | **Maximum:** 50 Marks | |
| *Answer Question No.1 compulsorily.* | | | (10X1 = 10 Marks) |
| *Answer ONE question from each unit.* | | | (4X10=40 Marks) |

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| 1. | Answer all questions | | (10X1=10 Marks) | |
|  | a) | Name the metals with higher thermal conductivity. | |  |
|  | b) | List the applications of heat transfer in engineering science. | |  |
|  | c) | Name the modes of heat transfer and name the law that governs conduction heat transfer. | |  |
|  | d) | Name any two types of boundary conditions in conduction heat transfer. | |  |
|  | e) | What is the physical significance of Biot number? | |  |
|  | f) | Define and give significance of critical thickness of insulation. | |  |
|  | g) | How do you classify heat Exchangers? | |  |
|  | h) | Differentiate between free and forced convection. List out the examples. | |  |
|  | i) | State Kirchhoff’s law of black body radiation. | |  |
|  | j) | State the reciprocity theorem of radiative heat transfer. | |  |
| **UNIT I** | | | | |
| 2. | a) | Derive general heat conduction equation in Cartesian co-ordinate system. | | 5M |
|  | b) | A wall is made of three layers having thicknesses 5 cm, 15cm and 5 cm with thermal conductivities 3 W/mK, 1.5 W/mK and 4 W/mK respectively. If the temperatures at extreme ends are 50oC and 30oC, determine the rate of heat transfer per unit area. Also find the interface temparatures. | | 5M |
| **(OR)** | | | | |
| 3. | a) | Derive expressions for temperature distribution and rate of heat transfer in case of infinitely long fin. | | 5M |
|  | b) | A carbon steel (K=54 W/m. K) rod of diameter 5mm is 8mm long and maintained at 400°C. The surrounding temperature is at 50°C. Calculate the heat dissipated by the rod. Take h=90W/m2K. Consider fin is insulated at tip. | | 5M |
| **UNIT II** | | | | |
| 4. | a) | Discuss the lumped heat capacity analysis with an illustration. | | 5M |
|  | b) | Determine the time required to heat a steel plate of 24 mm thick from the initial temperature of 250 C to final temperature of 4500 C by placing the plate into a furnace at 6000 C. Take the following properties of steel k = 45.4 W/m. K, Cp = 0.5 kJ/kg C, ρ = 7800 kg/m3, h (heat transfer coefficient between the plate and surroundings in the furnace) = 23.03 W/m2 C. | | 5M |
| **(OR)** | | | | |
| 5. | a) | What do you understand by the hydrodynamic and thermal boundary layers? Illustrate with reference to flow over a flat heated plate. | | 5M |
|  | b) | A 5 cm diameter, 1.5 m long vertical tube at a uniform temperature of 100oC is exposed to quiescent air at 20oC. Calculate the rate of heat transfer from the surface to air. | | 5M |
| **P.T.O.**  **18ME602**  **UNIT III** | | | | |
| 6. | a) | Explain the boundary layer formation for a plate hangs vertically in stand still ambient? | | 5M |
|  | b) | Air flows over a plate with a velocity of 2m/s. Temperature of air is 10°C. If the width of the plate is 30cm and it is at temperature of 70°C. Determine the rate of heat transfer assuming the length of the plate is 25 cm. | | 5M |
| **(OR)** | | | | |
| 7. | a) | Derive LMTD equation for parallel flow heat exchanger. List out the assumptions made. | | 5M |
|  | b) | Design a single pass counter flow heat exchanger for heating a cold fluid enters at 30°C and having heat capacity 15000 W/K by making use of hot fluid that enters at 120°C and heat capacity 10000 W/K. The overall heat transfer coefficient is 400 W/m2K and the surface area is 20 m2. Calculate the effectiveness of heat exchanger? | | 5M |
| **UNIT IV** | | | | |
| 8. | a) | Distinguish between (i) A black body and gray body  (ii) Specular and diffuse surfaces  (iii) Absorptivity and emissivity of a surface  (iv) Monochromic and spectral emissive power | | 5M |
|  | b) | State the Stefan-Boltzmann Law? Explain the concept of total emissive power of a surface. | | 5M |
| **(OR)** | | | | |
| 9. | a) | Derive an expression of shape factor for the radiation heat exchange between two surfaces. | | 5M |
|  | b) | Calculate the heat exchange by radiation between the surfaces of two long concentric cylinders having radii 120mm and 60mm respectively. The axis of the cylinder is parallel to each other. The inner cylinder is maintained at a temperature of 130ºC and emissivity of 0.6. Outer cylinder is maintained at a temperature of 30ºC and emissivity of 0.5. | | 5M |

**NOTE: Heat and Mass Transfer Data Book should be provided to the student in Examination.**

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