**20ME603**

**Hall Ticket Number:**

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| **III/IV B.Tech (Regular) DEGREE EXAMINATION** | | | |
| **July/August, 2023** | **Mechanical Engineering** | | |
| **Sixth Semester** | **Heat Transfer** | | |
| **Time:** Three Hours | | **Maximum:** 70 Marks | |
| ***Answer question 1 compulsory.*** | | | **(14X1 = 14Marks)** |
| ***Answer one question from each unit.***  ***Note: Heat and mass transfer data book is allowed.*** | | | **(4X14=56 Marks)** |
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|  |  |  | CO | BL | M |
| 1 | a) | Why is the negative sign used in Fourier’s law of heat conduction? | CO1 | L2 | 1 |
|  | b) | Differentiate between conductivity and conductance. | CO1 | L2 | 1 |
|  | c) | Define fin efficiency. | CO1 | L1 | 1 |
|  | d) | What is lumped system? | CO2 | L2 | 1 |
|  | e) | State the application of dimensional analysis in heat transfer processes. | CO2 | L1 | 1 |
|  | f) | Mention some of the areas where free and forced convection mechanisms are predominant. | CO2 | L1 | 1 |
|  | g) | What is the significance of Biot number? | CO2 | L1 | 1 |
|  | h) | What is the physical significance of Grash of number with reference to heat transfer by natural convection? | CO3 | L2 | 1 |
|  | i) | Differentiate between dropwise and filmwise condensation. | CO3 | L2 | 1 |
|  | j) | Distinguish between the pool boiling and flow boiling. | CO3 | L2 | 1 |
|  | k) | In a gas -to-liquid heat exchanger, why fins provided on the gas side? | CO3 | L2 | 1 |
|  | l) | Define emissivity. | CO4 | L1 | 1 |
|  | m) | What do you understand by monochromatic emissive power? | CO4 | L2 | 1 |
|  | n) | Give examples of some surfaces which do not appear black, but have high values of absorptivity | CO4 | L1 | 1 |
| **Unit-I** | | | | | |
| 2 | a) | Write down the expressions for the physical laws that govern each mode of heat transfer, and identify the variables involved in each relation. | CO1 | L2 | 7M |
|  | b) | A concrete wall 130 mm thick generates heat at the rate of 4000 w/m3 due to chemical reaction. Its surfaces are exposed to ambient air at a temperature of 20 0C. Calculate the surface temperature of wall and maximum temperature inside the wall. Tae thermal conductivity is 0.6 w/m K convection heat transfer co-efficient is 50 w/m2 K. | CO1 | L3 | 7M |
|  |  | **(OR)** |  |  |  |
| 3 | a) | Derive the general heat conduction equation in Cartesian coordinate system. | CO1 | L3 | 7M |
|  | b) | A composite wall is made up of two layer of 0.3m and 0.15m thickness respectively with outer surfaces of the composite wall held at 6000C and 200C respectively. If conductivities are 20 and 50 W/mK, determine the heat conducted. In order to restrict the heat loss to 5 kW/m2 another layer of 0.15m thickness is proposed. Determine the thermal conductivity of material required. | CO1 | L3 | 7M |
| **Unit-II** | | | | | |
| 4 | a) | A slab of aluminum 10cm thick is originally at a temperature of 500oC. It is suddenly immersed in a liquid at 1000C resulting a heat transfer coefficient of 1200 W/m2K. Determine the temperature at the centerline and the surface 1 minute after the immersion. Also calculate the total thermal energy removed per unit area of the slab during this period. The properties of aluminum for the given conditions are α = 8.4X10-5 m2/s, K = 215 W/mK , ρ = 2700 kg/ m3, C = 0.9 kJ/kg-K. | CO2 | L3 | 7M |
|  | b) | Air at 30oC flows with a velocity of 10 m/s over a flat plate of length 1m and width 0.5 m whose surface is kept at a uniform temperature of 120oC. Determine the average heat transfer coefficient and the rate of heat transfer. | CO2 | L3 | 7M |
| **P.T.O**  **20ME603**  **(OR)** | | | | | |
| 5 | a) | A 12cm diameter long bar initially at a uniform temperature of 40oC is placed in a medium at 650oC with a convective coefficient of 22W/m2 K. Calculate the time required for the bar to reach 255oC. Take k = 20W/m-K, ρ = 580kg/m3 and C = 1050J/kg-K. | CO2 | L3 | 7M |
|  | b) | Engine oil at 25oC is forced over a 30cm X 20cm plate at a velocity of 1.5m/s. The flow is parallel to the 30cm side of the plate, which is heated to a uniform temperature of 55oC. Calculate the rate of heat transfer from the plate to the oil. Properties of engine oil at 40oC are = 876kg/m3,υ= 24\*10-5m2/s, k = 0.144W/mK and Pr = 2870. | CO2 | L3 | 7M |
| **Unit-III** | | | | | |
| 6 | a) | Sketch temperature and velocity profiles in free convection on a vertical wall. | CO3 | L2 | 7M |
|  | b) | Derive an expression for LMTD in a parallel flow heat exchanger. | CO3 | L3 | 7M |
| **(OR)** | | | | | |
| 7 | a) | Draw the boiling curve for pool boiling of water and explain flow regime | CO3 | L2 | 7M |
|  | b) | In a lubricating oil cooler hot oil flowing at the rate of 2000kg/hr is cooled from 100oC to 60oC using cold water at 10oC flowing at the rate of 1500kg/hr. The specific heat of the oil is 2.6 KJ/kg-K and water is 4.2KJ/kg-K. Determine the rate of heat transfer and outlet temperature of the cold fluid. | CO3 | L3 | 7M |
| **Unit-IV** | | | | | |
| 8 | a) | State Wien’s displacement law and explain its significance | CO4 | L2 | 7M |
|  | b) | A black body is kept at a temperature of 1000K. Determine the emissive power of the body. | CO4 | L3 | 7M |
| **(OR)** | | | | | |
| 9 | a) | State and prove Kirchoff’s law of radition. | CO4 | L2 | 7M |
|  | b) | Emissivity of two large parallel plates maintained at 800 °C and 300 °C are 0.5 and 0.6 respectively. Find the percentage reduction in heat transfer when a polished aluminium radiation shield of emissivity 0.05 is placed between them. | CO4 | L3 | 7M |

