**18ME602**

**Hall Ticket Number:**

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| **III/IV B.Tech (Regular\Supplementary) DEGREE EXAMINATION** | | | |
| **June, 2022** | **Mechanical Engineering** | | |
| **Sixth Semester** | **Heat Transfer** | | |
| **Time:** Three Hours | | **Maximum: 5**0 Marks | |
| *Answer Question No. 1 Compulsorily.* | | | (10X1 = 10 Marks) |
| *Answer* ***ANY ONE*** *question from each Unit.* | | | (4X10=40 Marks) |

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| 1. | a) | Define overall heat transfer coefficient. | CO1 | |  |
|  | b) | Define conduction resistance and convective resistance. | CO1 | |  |
|  | c) | Define fin effectiveness. | CO2 | |  |
|  | d) | Differentiate between steady and transient heat conduction. | CO2 | |  |
|  | e) | Why are the heat transfer coefficients for natural convection much less than those in forced convection? | CO2 | |  |
|  | f) | When do you say that the flow is laminar and turbulent in forced convection? | CO1 | |  |
|  | g) | Classify the heat exchangers according to flow arrangements of fluids. | CO3 | |  |
|  | h) | Define Biot number. | CO3 | |  |
|  | i) | Distinguish between Black body and Grey body. | CO4 | |  |
|  | j) | State Stefan Boltzmann law. | CO4 | |  |
| **Unit - I** | | | | | |
| 2. | a) | Derive general heat conduction equation in Cartesian co - ordinate system. | CO1 | **5M** | |
|  | b) | A wall is made of three layers having thicknesses 5 cm, 15 cm and 5 cm with thermal conductivities 3 W/mK, 1.5 W/mK and 3 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 temperatures. | CO1 | **5M** | |
|  |  | **(OR)** |  |  | |
| 3. | a) | Derive expressions for temperature distribution and rate of heat transfer in a plane cylinder. | CO1 | **5M** | |
|  | b) | A longitudinal copper fin (k=3.5 W/m-K), 6 cm long and 5 mm in diameter is exposed to air stream at 20ºC. The connective heat transfer coefficient is 20 w/m2-K. If the fin has the base temperature of 150 ºC, calculate the heat transfer by the fin and fin efficiency. Assume the fin tip is insulated. | CO1 | **5M** | |
| **Unit - II** | | | | | |
| 4. | a) | Air at 2000C flows over a flat plate with a velocity of 5 m/s. The plate is 15 mm wide and 1 m long and maintained at 1000C. Find the thicknesses of Hydrodynamic & Thermal Boundary layers at the trailing edge of the plate. | CO2 | **5M** | |
|  | b) | Briefly explain the growth of velocity and thermal boundary layers when a fluid flows over a flat plate. | CO2 | **5M** | |
|  |  | **(OR)** |  |  | |
| 5. | a) | A cylinder steel ingot (diameter 100 mm, length 300 mm, k=40 W/mK, ρ =7600kg/m3 and c=600 J/kg K) is to be heated in a furnace from 500C to 8500C. The temperature inside the furnace is 13000C and the surface heat transfer coefficient is 100 W/m2 K. calculate the time required for heating. | CO2 | **5M** | |
|  | b) | The wall of a pipe of 2 cm diameter is kept at a constant temperature of 100 0C. Air flows through the tube at 3 kg/min and enters at 30 0C and leaves the pipe at 70 0C. Find the length of the pipe required. | CO2 | **5M** | |
| **P.T.O**    **18ME602**  **Unit - III** | | | | | |
| 6. | a) | Two vertical plates at 55oC are placed in air at 25oC. If the plates are 1 m high, find the minimum space between the plates so as to prevent interference of the free convection boundary layers. | CO3 | **5M** | |
|  | b) | Draw and explain with suitable graph various regimes of boiling. | CO3 | **5M** | |
|  |  | **(OR)** |  |  | |
| 7. | a) | Derive an expression for LMTD in case of a parallel flow heat exchanger. | CO3 | **5M** | |
|  | b) | In a tubular counter flow heat exchanger water is heated from 400C to 800C by hot flue gases (Cpg= 1.0 kJ/kg K). The hot gas enters at 200 C and leaves at 1000C. The overall heat transfer coefficient of the exchanger is 200 W/m2 K. Find the area of the heat exchanger. Assume that the water enters the heat exchanger at 1060 kg/h.Assume specific heat of water as 4.18 kJ/kg K. | CO3 | **5M** | |
| **Unit - IV** | | | | | |
| 8. | a) | State and prove Kirchoff’s law of radiation. | CO4 | **5M** | |
|  | b) | Calculate the shape factors for the following configurations:  (i) A tube with a cross section of an equilateral triangle.  (ii) a hemi spherical surface enclosing a plane circular surface. | CO4 | **5M** | |
|  |  | **(OR)** |  |  | |
| 9. | a) | Define absorptivity, reflectivity and transmissivity of radiation energy. State and explain reciprocity theorem. | CO4 | **5M** | |
|  | b) | Two large parallel plates are maintained at 400⁰C and 600⁰C respectively, and have surface emissivities of 0.6. A radiation shield having an emissivity of 0.1 is placed equidistant between the two heated plates. Calculate the radiant heat transfer between the plates with and without shield per unit area. | CO4 | **5M** | |

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