

PRAGATI ENGINEERING COLLEGE: SURAMPALEM
(AUTONOMOUS)
III B.Tech II Semester Regular/Supplementary Examinations, April- 2024

HEAT TRANSFER
(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70 M

Answer ONE Question from each Unit
 All Questions Carry Equal Marks

| Q. No. | | Questions | BTL | CO | Marks |
|------------|----|---|-----|-----|-------|
| UNIT – I | | | | | |
| 1. | a) | Derive an expression for temperature distribution under steady state in one dimensional heat conduction for plane wall. | K3 | CO1 | 8M |
| | b) | A furnace wall is made of 25 cm fire brick, 20 cm common brick, 6 cm of magnesia and 4mm of steel plate on the outside. The inside and the outside surface temperatures are 1200 °C and 100 °C respectively. Calculate the temperature between layers and rate of heat transfer. Assume the thermal conductivities of fire brick, common brick, Magnesia and steel are 1.2 W/m-K, 0.75 W/m-K, 0.07 W/m-K and 71 W/m-K respectively. | K3 | CO1 | 6M |
| OR | | | | | |
| 2. | a) | Derive the heat conduction equation in cylindrical co-ordinates. | K3 | CO1 | 8M |
| | b) | Calculate the critical radius of insulation for asbestos($k=0.172\text{W/mk}$) surrounding a pipe and exposed to room air at 300k with $h=2.8\text{w/m}^2\text{k}$.calculate the heat loss from a 475K,60mm diameter pipe when covered with the critical radius of insulation and without insulation. | K3 | CO1 | 6M |
| UNIT – II | | | | | |
| 3. | a) | Derive an expression for instantaneous heat transfer in a lumped body | K3 | CO2 | 7M |
| | b) | An Aluminum sphere weighing 5.5 kg and initially at temperature of 290 ⁰ c is suddenly immersed in a fluid at 15 ⁰ c.the convective heat transfer coefficient is 58 w/m ² k.estimate the time required to cool the Aluminum to 95 ⁰ c.using Lumped capacity method of analysis | K3 | CO2 | 7M |
| OR | | | | | |
| 4. | a) | Derive the expression for temperature distribution and heat transfer for a uniform crosssectional area fin with its end insulated. | K3 | CO2 | 7M |
| | b) | Calculate the rate of heat transfer from a rectangular fin of length2 cm, on a plane wall. Thickness of the fin is 2 mm and its breadth is 20 cm. Take T1 = 200 ⁰ C, h = 17.5/m ² °C, k = 52 W/m °C. Assume the heat loss from the tip is negligible | K3 | CO2 | 7 M |
| UNIT – III | | | | | |
| 5. | a) | Show by dimensional analysis that data for forced convection may be correlated by an equation of the form Nu = f(Re,Pr). | K3 | CO3 | 8M |
| | b) | A vertical plate 0.80 m high and 1 m wide is maintained at 35°C in still air at 25°C. Determine the value of average convection coefficient. | K3 | CO3 | 6M |
| OR | | | | | |

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|------------------|----|--|----|-----|-----|
| 6. | a) | Distinguish between free and forced convection | K2 | CO3 | 7M |
| | b) | Air at 29°C flows over a flat plate at a velocity of 6 m/s. The plate is 1m long and 0.5 m wide. The pressure of the air is 6 kN/m ² . If the plate is maintained at a temperature of 70°C. Estimate the rate of heat removed from the plate. | K3 | CO3 | 7M |
| UNIT – IV | | | | | |
| 7. | | Derive an expression for effectiveness of a counter flow heat exchanger using NTU method. | K3 | CO4 | 14M |
| OR | | | | | |
| 8. | a) | Draw and explain with suitable graph various regimes of pool boiling. | K2 | CO4 | 8M |
| | b) | Discuss the differences between drop-wise and film condensation. Which of the two is the more effective way of condensation and why? | K2 | CO4 | 6M |
| UNIT – V | | | | | |
| 9. | a) | State and explain Lambert's cosine law and its significance | K2 | CO5 | 7M |
| | b) | A long pipe 40 mm in diameter passes through a room and is exposed to air at 35°C. The surface temperature of the tube is 95°C. Assuming the emissivity of the pipe as 0.6, Estimate the radiation heat loss per meter length. | K3 | CO5 | 7M |
| OR | | | | | |
| 10. | a) | Define radiation Intensity. Prove that for a diffusive surface, the emissive power is equal to π times the intensity of radiation. | K2 | CO5 | 8M |
| | b) | Two Large parallel plates of emissivity's 0.9 and 0.6 are at temperatures 427°C and 27°C respectively. A radiation shield of aluminum sheet of emissivity 0.4 is placed between two plates. Determine the shield temperatures heat transfer rate per unit area with the presence of sheet. | K3 | CO5 | 6M |