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| **S NO** | **QUESTION** | **KNOWLEDGE**  **LEVEL** | **CO** |
| **UNIT I** | | | |
| **1** | **Explain** three different modes of heat transfer and its mechanisms along with its governing equations | **K2** | **CO1** |
| **2** | **Derive** starting from fundamentals, general conduction equation in Cartesian co-ordinates and deduce it to one dimensional steady state condition with no internal heat generation | **K2** | **CO1** |
| **3** | A cubical tank of water of volume 1m3 is kept at a steady state temperature of 650C by a 1KW heater is switched off. **How long** does the tank to cool to 500C if the room temperature is 150C. | **K2** | **CO1** |
| **UNIT 2** | | | |
| 1 | An exterior wall of a house may be approximated by a **100 mm** layer of common brick (**k = 0.7 W/mK**) followed by **50 mm** of gypsum plaster **(k = 0.48 W/mK)**. **What thickness** of loosely packed rock-wool insulation **(k = 0.065 W/mK)** should be added to reduce the heat loss (or gain) through the wall by **80 percent**. | **K3** | **CO2** |
| 2 | Consider two long, slender rods of the same diameter but different materials. One end of each rod is attached to a base surface maintained at **100o C**, while the surfaces of the rods are exposed to ambient air at **20o C.** By traversing the length of each rod with a thermocouple, it was observed that the temperature of the rods were equal at the positions **XA = 0.15 m** and **XB = 0.075 m**, where x is measured from the base surface. If the thermal conductivity of rod A is known to be **KA = 70 W/mK**, **determine** the value of **KB for rod B.** | **K3** | **CO2** |
| 3 | **Derive** a relation for the critical radius of insulation for a sphere. | **K3** | **CO2** |
| 4 | Steel balls **12 mm** diameter are annealed by heating to **1150 K** and then slowly cooling to **400 K** in an air environment for which **T ∞ =325 K and h = 20 W/m 2 K**. Assuming the properties of the steel to be **k = 40 W/mK, and C = 600 J/kg K**, estimate the time required for the cooling process? Analyze the results by changing heat transfer coefficient to **15 W/m2 K and 25 W/m2 K.** | **K4** | **CO2** |
| **UNIT 3** | | | |
| **1** | **Bring out the essential differences** between forced convection and free convection heat transfer. **Give various examples** of forced and free convective heat transfer in industry. | **K2** | **CO3** |
| **2** | Air at **200C** and at a pressure of **1 bar** is flowing over a flat plate at a velocity of **3 m/s.** if the plate is **280mm** wide and at **560C**, **calculate** the following quantities at **X=280mm**. **(a)Boundary layer thickness (b)Local friction coefficient (c) Average friction coefficient,(D) Shear stress due to friction, (e)Thickness thermal boundary layer(f) Local convective heat transfer coefficient, (g) Average convective heat transfer coefficient, (h) rate of heat transfer by convection, (i) Total drag force on the plate and (J) Total mass flow rate through the boundary.** | **K3** | **CO3** |
| **3** | **Describe** the functional form of equation generally used for correlation for free convection heat transfer data. (or) **Sketch** the temperature and velocity profiles in free convection on a vertical wall and also **derive** the expression for heat transfer coefficient in terms of dimensionless parameters. | **K2** | **CO3** |
| **UNIT 4** | | | |
| **1** | **Explain** the Boiling Heat transfer Phenomena , its types and applications. | **K2** | **CO3** |
| **2** | **show** the various regimes in Pool Boiling and discuss the heat transfer mechanisms in each region indetatil. | **K2** | **CO3** |
| **3** | An electrically heated Cu spherical heating element of dia **15 cm** is immersed in water at atmospheric pressure and saturation temperature. The surface temperature of the element is maintained at **1150C**. **Calculate** (a)Surface heat flux (b) Rate of evaporation (c) Peak heat flux. | **K3** | **CO3** |
| **UNIT 5** | | | |
| **1** | **Derive** the expression for LMTD in Counter flow heat exchanger | **K3** | **CO3** |
| **2** | In a double pipe heat exchanger oil flows through the annulus with a convective heat transfer coefficient of **1500 W/m2K** which is heated by using hot water flowing through the Cu tube **(K=300W/mK)** of inside diameter **2cm** and outer diameter **2.54 cm** having convective heat transfer coefficient of **2500 W/m2K**. The fouling factor on water side is **0.0004 m2 0C/W** and the fouling factor on oil side is **0.0009 m2 0C/W**. (a) Determine the overall heat transfer coefficient based on outside area per meter length. (b) Also find the overall heat transfer coefficient neglecting fouling resistances on both sides. | **K3** | **CO3** |
| **3** | In a heat exchanger hot fluid enters at **1800C** and leaves at **1180C.** The cold fluid enters at **990C** and leaves at **1190C**. **Find** the LMTD and Effectiveness in the following cases. (a) Counter flow (b) One shell and multiple tube passes (c) Two shell pass and multiple tube passes, (d) Cross flow both fluids unmixed (e) Cross flow the cold fluid unmixed, Also find the NTU values. | **K3** | **CO3** |
| **UNIT 6** | | | |
| **1** | **Differentiate** Specular reflection and diffuse reflection. | **K4** | **CO4** |
| **2** | After sunset, radiant energy can be sensed by a person standing near the brick wall. Such walls have surface temperatures around **320 K** and typical brick emissivity value are of order of **0.92**. **Make calculation** for the radiant thermal flux per square meter from a brick wall at this temperature. | **K3** | **CO4** |
| **3** | Two large parallel planes at **800 K and 600 K** have emissivities of **0.5 and 0.8** respectively. A radiation shield having an emissivity of **0.1** on one side and an emissivity of **0.05** on the other side is placed between the plates. **Calculate** the heat transfer rate by radiation per square meter with and without radiation shield. Also find the reduction in heat transfer. **Analyze** the results. | **K4** | **CO4** |