Do An up Kamnar 6/5/23 (m)

# NIT Hamirpur <br> Mechanical Engr Department Heat and Mass Transfer ME-222 

Max. Marks 50

Use of Heat transfer data book is allowed

1. Explain the development of thermal boundary layer in a pipe flow. Water is to be heated from 15 to $65^{\circ} \mathrm{C}$ as it flows through a 3 cm diameter 5 m long tube. An electric heater provides uniform heating throughout the surface of the tube. The outer surface of the heater is well insulated. If the system is to provide water a rate of $10 \mathrm{Litre} / \mathrm{min}$, determine the power rating of resistance heater and surface temperature of the pipe at exit.
2. Discuss Lumped heat capacitance method. A wall of 10 cm width and infinite in other dimensions is initially maintained at $20^{\circ} \mathrm{C}$. Suddenly left face is maintained at $100^{\circ} \mathrm{C}$ and the right face is insulated. Taking five equally spaced grids, determine the value of temperatures at the grid points for two time steps. (take $\mathrm{F}_{\mathrm{o}}=0.4$ )
3. Non dimensionalise the energy equation in boundary layer and discuss the importance of Prandtl number. Engine oil at $60^{\circ} \mathrm{C}$ flows over the upper surface of a 5 m long flat plate maintained at $20^{\circ} \mathrm{C}$ with a velocity of $2 \mathrm{~m} / \mathrm{s}$. Determine the total drag force and rate of heat transfer per unit width of entire plate. Find thickness of velocity and thermal boundary layer at the end of plate.
4. Define and explain spectral intensity and relate it to spectral emissive power. Consider a large isothermal enclosure maintained at a uniform temperature of 2000 K . Calculate the emissive power of radiation that emerges from a small aperture on the enclosure surface. What is the wavelength below which $20 \%$ of emission is concentrated. Determine the maximum spectral emissive power and the wavelength at which this emission occurs.
5. Discuss the characteristics of black body. For following figures determine $F_{12}$ and $F_{21}$. 1. Sphere within a cube, 2. One side of a diagonal partition within a long square duct, and , 3 End and side of a circular tube.

(1)

(2)

(3)
