SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

DEPARTMENT OF MECHANICAL ENGINEERING

Course Code & Name: 19MEB302 – Heat & Mass Transfer **Semester: VI**

Class: III MECH B

Academic Year: 2024-2025 (Even Semester)

QUESTION BANK

UNIT – I CONDUCTION

PART – A

1. What is Fourier's Law of heat conduction?
2. What is temperature gradient?
3. What is coefficient of Thermal conductivity?
4. Give some examples of heat transfer in engineering.
6. Define Temperature field.
7. Define heat flux.
8. Define thermal Diffusivity.
9. What is Lap lace equation for heat flow?
10. What is Poisson's equation for heat flow?

PART-B

01. A pipe consists of 100 mm internal diameter and 8 mm thickness carries steam at 170°C. The convective heat transfer coefficient on the inner surface of pipe is 75 W/m2C. The pipe is insulated by two layers of insulation. The first layer of insulation is 46 mm in thickness having thermal conductivity of 0.14 W/m°C. The second layer of insulation is also 46 mm in thickness having thermal conductivity of 0.46 W/mC. Ambient air temperature = 33°C. The convective heat transfer coefficient from the outer surface of pipe = 12 W/m2C. Thermal conductivity of steam pipe = 46 W/m°C. Calculate the heat loss per unit length of pipe and determine the interface temperatures. Suggest the materials used for insulation.

02. A long rod is exposed to air at 298°C. It is heated at one end. At steady state conditions, the temperature at two points along the rod separated by 120 mm are found to be 130°C and 110°C respectively. The diameter of the rod is25mmOD and its thermal conductivity is 116 W/m°C. Calculate the heat transfer coefficient at the surface of the rod and also the heat transfer rate.

03. (i) A furnace wall consists of three layers. The inner layer of 10 cm thickness is made of firebrick (k =1.04 W/mK). The intermediate layer of 25 cm thickness is made of masonry brick (k = 0.69 W/mK) followed by a 5 cm thick concrete wall (k = 1.37 W/mK). When the furnace is in continuous operation the inner surface of the furnace is at 800°C while the outer concrete surface is at 50°C. Calculate the rate of heat loss per unit area of the wall, the temperature at the interface of the firebrick and masonry brick and the temperature at the interface of the masonry brick and concrete.

(ii) An electrical wire of 10 m length and 1 mm diameter dissipates 200 W in air at 25°C. The convection heat transfer coefficient between the wire surface and air is 15 W/m2K. Calculate the critical radius of insulation and also determine the temperature of the wire if it is insulated to the critical thickness of insulation.

04. (i) An aluminium rod (k =204 W/mK) 2 cm in diameter and 20 cm long protrudes from a wall which is maintained at 300°C. The end of the rod is insulated and the surface of the rod is exposed to air at 30°C. The heat transfer coefficient between the rod's surface and air is 10 Vl/m2K. Calculate the heat lost by the rod and the temperature of the rod at a distance of 10 cm from the wall.

(ii) A large iron plate of 10 cm thickness and originally at 800°C is suddenly exposed to an environment at O°C where the convection coefficient is 50 W/m2K. Calculate the temperature at a depth of 4 em from one of the faces 100 seconds after the plate is exposed to the environment. How much energy has been lost per unit area of the plate during this time?

05. (i) Explain the different modes of heat transfer with appropriate expressions.

(ii) A composite wall consists. of 10 cm thick layer of building brick, k = 0.7 W/mK and 3 cm thick plaster, k = 0.5 W/mK. An insulating material of k = 0.08 W/mK is to be added to reduce the heat transfer through the wall by 40%. Find its thickness.

06. Circumferential aluminium fins of rectangular profile (1.5cmwide and 1mm thick) are fitted on to a 90 mm engine cylinder with a pitch of 10 mm. The height of the cylinder is 120 mm. The cylinder base temperature before and after fitting the fins are 200°C and 150°C respectively. Take ambient at 30°C and h(average) =100 W/m2K. Estimate the heat dissipated from the finned and the unfinned surface areas of cylinder body.