

Answer the following questions

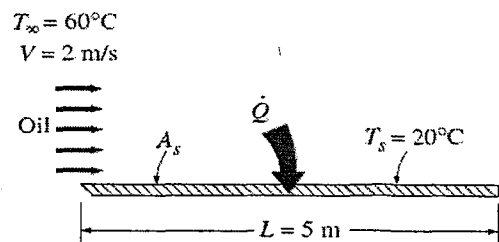
MPE 271 Heat and
Mass Transfer

Question No.1

- Compare between conduction, convection and radiation modes of heat transfer.
- Consider a plane composite wall that is composed of two materials of thermal conductivities $k_A=0.1 \text{ W.m.K}$ and $k_B=0.04 \text{ W/m.K}$ and thickness $L_A=10 \text{ mm}$ and $L_B=20 \text{ mm}$. The contact resistance at the interface between the two materials is $0.3 \text{ m}^2.\text{K/W}$. The material A adjoins a fluid at 200°C for which $h=10 \text{ W/m}^2.\text{K}$ while material B adjoins a fluid at 40°C for which $h=20 \text{ W/m}^2.\text{K}$. Draw the temperature distribution and determine the net rate of heat transfer if the wall has an area of 20 m^2 .
- A rectangular fin 0.1 thickness, 10 cm width and length 15 cm ($k=400 \text{ W/m.K}$) is fitted to a plate which has a base temperature of 120°C . If the ambient temperature is 30°C and convective heat transfer coefficient is $8 \text{ W/m}^2.\text{K}$, find the rate of heat transfer by the fin and fin efficiency.

Question No.2

- Draw the temperature distribution along a certain plate under laminar flow conditions.
- Engine oil at 60°C flows over the upper surface of a 5-m long flat plate, whose temperature is 20°C , with a velocity of 2 m/s . **Determine:**
 - Total drag force
 - The hydrodynamic boundary layer thickness
 - Rate of heat transfer per unit width of plate.



- A horizontal pipe of 8 cm diameter and 10 m length passes through a room whose temperature is 20°C . If the outer surface temperature of the pipe is 80°C , determine both convective heat transfer coefficient and the rate of heat transfer by natural convection from the pipe.

Question No.3

- What is the driving force of mass diffusion?
- Sketch the fully developed velocity in circular pipe.
- Consider the flow of oil at 20°C in a 30-cm -diameter pipeline at an average velocity of 2 m/s . A 200-m -long section of the horizontal pipeline passes through icy waters of a lake at 0°C . Measurements indicate that the surface temperature of the pipe is very nearly 0°C . Disregarding the thermal resistance of the pipe material, **determine** the convective heat transfer coefficient of the fluid, and the pressure losses in the pipe.

Question No.4

- What is the function of heat exchanger?
- A **counterflow**, concentric tube heat exchanger is used to cool the engine oil for a large industrial gas turbine engine. The flow rate of cooling water through the inner tube ($D_i=25 \text{ mm}$) is 0.2 kg/s , while the flow rate of oil through the outer annulus ($D_o=45 \text{ mm}$) is 0.1 kg/s . The oil and water enter at temperatures of 100 and 30°C , respectively. How long must the tube be made if the outlet temperature of the oil is to be 60°C ?

With My Best Wishes

Prof. Dr. Gamal Sultan