Thermodynamics and Heat Transfer

LE6: Heat Transfer, Part 2, 50 Points

Steady Heat Conduction

Problem 1: Find the heat transfer per unit area through the composite wall in Figure 1. Assume one-dimensional heat flow (20 points).

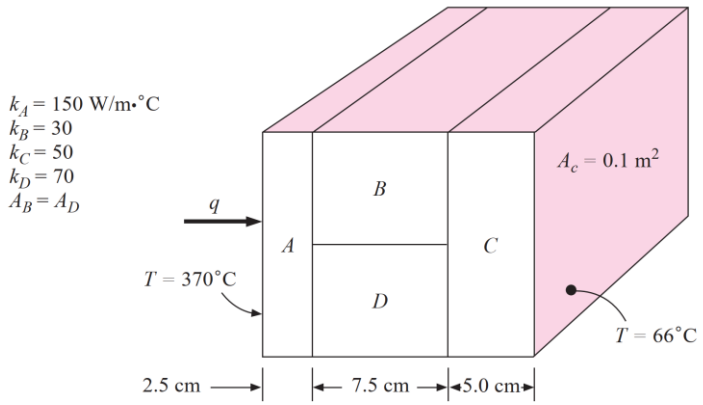

Figure 1

Problem 2: A steel tube having k = 46 W/m.°C has an inside diameter of 3.0 cm and a tube wall thickness of 2 mm. A fluid flows on the inside of the tube producing a convection coefficient of 1500 W/m^2.°C on the inside surface, while a second fluid flows across the outside of the tube producing a convection coefficient of 197 W/m^2.°C on the outside tube surface. The inside fluid temperature is 223°C while the outside fluid temperature is 57°C. Calculate the heat lost by the tube per meter of length (15 points).

Problem 3: A spherical tank, 1 m in diameter, is maintained at a temperature of 120°C and exposed to a convection environment. With h = 25 W/m^2.°C and T_∞ = 15°C, what thickness of urethane foam should be added to ensure that the outer temperature of the insulation does not exceed 40°C? What percentage reduction in heat loss results from installing this insulation (15 points)?