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FACULTY OF ENGINEERING
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ME 313 HEAT TRANSFER

Fall 2016

HW 1

1) Determine the flux q and the heat transfer rate across an iron plate with area A = 0.5 m^2 and thickness L = 0.02 m [k = 70 W / (m. ^{o}C)] when one of its surfaces is maintained at T_1 = 60 ^{o}C and the other at T_1 = 20 ^{o}C.

2) The heat flow rate through a wood board L = 2 cm thick for a temperature difference of ΔT = 25 ^{o}C between the two surfaces is 150 W / m^2. Calculate the thermal conductivity of the wood.

3) The inside and outside surface temperatures of a window glass are 20 and – 12 ^{o}C, respectively. If the glass is 80 cm by 40 cm, is 1.6 cm thick and has thermal conductivity 0.78 W / (m. ^{o}C), determine the heat loss through the glass over 3 h.

4) An electrically heated plate dissipates heat by convection at a rate of q = 8000 W / m^2 into the ambient air T_f = 25 ^{o}C. If the surface of the hot plate is at T_w = 125 ^{o}C, calculate the heat transfer coefficient for convection between the plate and the air.

5) A 25 cm diameter sphere at 120 ^{o}C is suspended in air at 20 ^{o}C. If the natural convection heat transfer between the sphere and the air is 15 W / (m^2. ^{o}C), determine the rate of heat loss from the sphere.

6) Heat is supplied to a plate from its back surface at a rate of 500 W / m^2 and is removed from its front surface by air flow at 30 ^{o}C. If the heat transfer coefficient between the air and the plate surface is h = 20 W / (m^2. ^{o}C), what is the temperature of the front surface of the plate?

7) A heated plate of D = 0.2 m diameter has one of its surfaces insulated, and the other is maintained at T_w = 550 K. If the hot surface has an emissivity ε_w = 0.9 and is exposed to a surrounding area at T_s = 300 K with atmospheric air being the intervening medium, calculate the heat loss by radiation from the hot plate to the surroundings.

8) A sphere 10 cm in diameter is suspended inside a large evacuated chamber whose walls are kept at 300 K. If the surface of the sphere has emissivity ε = 0.8 and is maintained at 500 K, determine the rate of heat loss from the sphere to the walls of the chamber.

9) A small, thin metal plate of area A m^2 is kept insulated on one side and exposed to the sun on the other side. The plate absorbs solar energy at a rate of 500 W / m^2 and dissipates it by convection into the ambient air at T_∞ = 300 K with a convection heat transfer coefficient h_c = 20 W / (m^2. ^{o}C)

and by radiation into a surrounding area which may be assumed to be a blackbody at T_{sky} = 280 K. The emissivity of the surface is ε = 0.9. Determine the equilibrium temperature of the plate.