Birzeit University
Mechanical & Mechatronics Engineering Department
Thermal Fluid Engineering ENMC 4411
Homework # 5
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15.2 A heat transfer rate of 3 kW is conducted through a section of an insulating material of cross-sectional area 10 m^2 and thickness 2.5 cm. If the inner (hot) surface temperature is 415^{o}C and the thermal conductivity of the material is 0.2 W/m. K, what is the outer surface temperature?

15.6 The case of a power transistor, which is of length L = 10 mm and diameter D = 12 mm, is cooled by an air stream of temperature T_∞ = 25^{o}C as shown in Fig. P15.6. Under conditions for which the air maintains an average convection coefficient of on the surface of h = 100 W/m^2. K the case, what is the maximum allowable power dissipation Pe if the surface temperature Ts is not to exceed 85^{o}C?

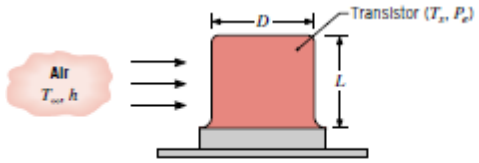

Figure P15.6

15.7 A cartridge electrical heater is shaped as a cylinder of length L = 200 mm and outer diameter D =20 mm. Under normal operating conditions the heater dissipates 2 kW, while submerged in a water flow that is at 20^{o}C and provides a convection heat transfer coefficient of h = 5000 W/m^2. K. Neglecting heat transfer from the ends of the heater, determine its surface temperature Ts. If the water flow is inadvertently terminated while the heater continues to operate, the heater surface is exposed to air that is also at 20^{o}C but for which h = 50 W/m^2. K What is the corresponding surface temperature? What are the consequences of such an event?

15.11 A spherical interplanetary probe of 0.5-m diameter contains electronics that dissipate 150 W. If the probe surface has an emissivity of 0.8 and the probe does not receive radiation from the sun or deep space, what is its surface temperature?

15.20 In an orbiting space station, an electronic package is housed in a compartment having a surface area, As = 1 m^2, which is exposed to space. Under normal operating conditions, the electronics dissipate 1 kW, all of which must be transferred from the exposed surface to deep space (0 K). If the surface emissivity is 1.0 and the surface is not exposed to the sun, what is its steady-state temperature? If the surface is exposed to a solar flux of 750 W/m^2, and its absorptivity to solar radiation is 0.25, what is its steady-state temperature?