ME 323, Spring 2008, Thurs. April 10

Homework #2, due Tues. April 22 beginning class, (text: Incropera & DeWitt, ID)

Reading (ID) 3.1 (esp. 3.1.4 contact resistance), 3.3-3.7

- 1-D Steady State Heat Conduction
  Cartesian, cylindrical, and spherical systems
- Analytical solutions to Steady State problems w/ w/o constant heat generation
- Steady Heat Transfer from Fins, fin efficiency etc.

Problems (ID): like math?

3.2, **3.4** a), b), **3.7**, **3.52**, **3.86**,
***3.98**
***3.111** a) part 1 Solve this problem first for T_o using a resistance model (i.e. Table 3.4, Case B, eq. 3.76). Part 2 Solve this problem using the governing differential equation for T(x). Confirm the value of T_o at $x = L_{ins}$. Plot T(x).

Supplemental problems:

A. Apply the transient 3-D heat equation with heat generation (q) in cylindrical polar coordinates to model the temperature distribution in a resistively heated wire of radius r_o:
- Begin with full equation
- State all simplifying assumptions
- Identify governing equation and Boundary Conditions
- Solve to determine $T(r; q, k, r_o, T_s)$
- Assuming convection (h) at r_o, determine $T(r; q, k, r_o, T_\infty, h)$

B. The current in high voltage AC wires travels through the "skin" of the wire. Thus, for strength and performance reasons such transmission lines can consist of a cylindrical steel core (radius r_i) and an aluminum or other highly electrically conductive "sheath" (inner radius r_i, outer radius r_o). Assuming the current travels solely through the sheath, apply the transient 3-D heat equation with heat generation (q) in cylindrical polar coordinates to model the temperature distribution in a resistively heated cylindrical annular sheath of inner radius r_i, outer radius r_o:
- Begin with full equation
- State all simplifying assumption
- Identify governing equation and Boundary Conditions
- Solve to determine $T(r; q, k, r_i, r_o, T_s)$
- Assuming convection (h) at r_o, determine $T(r; q, k, r_i, r_o, T_\infty, h)$
- From what you know about the critical radius for radial systems, would adding a lightweight insulation to transmission lines keep them cooler?