F98

TEST - HEN 310 (Heat Transfer)
November 19, 1999

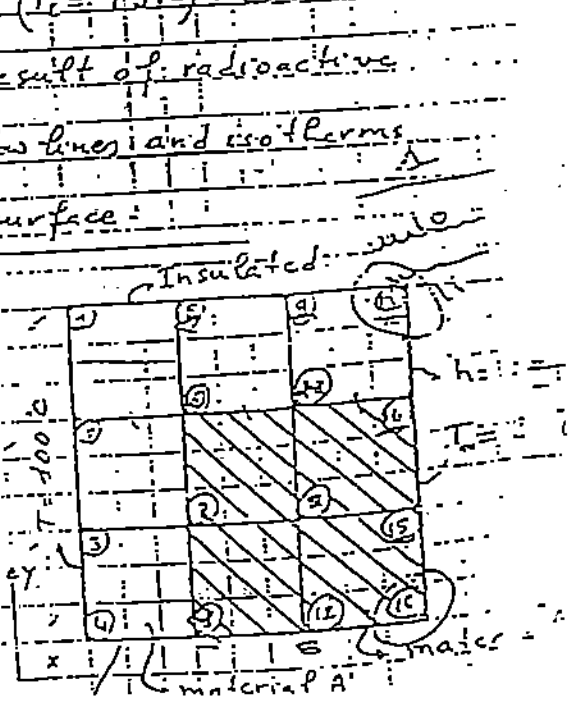
1) A steel tube (5 cm ID, 7.6 cm OD, $k = 15\ W/m^\circ C$) is covered with an insulative covering (Glass Fiber) of thickness ($t = 2\ cm$). A hot gas at ($T_a = 330^\circ C$) and ($h_a = 400\ W/m^2{}^\circ C$) flows inside the tube. The outer surface of the insulation is exposed to cooler air at ($T_b = 30^\circ C$) with ($h_b = 60\ W/m^2{}^\circ C$).

a) Calculate the heat loss from the gas to the air for ($L = 10\ m$) of tube length.

b) Determine the temperature drops resulting from the thermal resistances of the different layers (gas flow, steel tube, insulation and outside air).

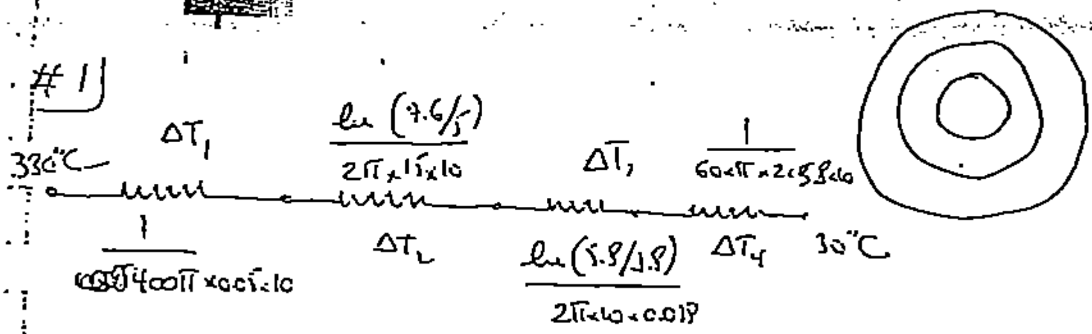
2) A spherical tank of diameter ($d = 0.5\ m$) containing radioactive materials is buried in the earth ($k = 0.8\ W/m^\circ C$) at a depth ($z = 1.25\ m$) from the earth surface to the center of the sphere. The surface of the tank is maintained at a uniform temperature of ($T_1 = 100^\circ C$) as a result of the radioactive decay while the earth surface is at a uniform temperature ($T_2 = 15^\circ C$). Determine the heat generated in the tank as a result of radioactive disintegration and sketch the heat flow lines and isotherms between the tank skin and the earth surface.

3) Consider the following cross-section of an infinite slab with the grid and boundary conditions as shown. Assuming that the mesh size is uniform ($\Delta x = \Delta y = 0.1\ m$) and the conductivities given as ($k_A = 2\ W/m^\circ C$) and



November 19, 1998

#1



↳ $q = 1674.236$ Watts

↳ $\Delta T_1 = 2.6646$ °C

↳ $\Delta T_2 = 0.743805$ °C

↳ $\Delta T_3 = 296.5149$ °C

↳ $\Delta T_4 = 0.0785$ °C

2) $K = 0.8\ W/m°C$

$Z = 1.25\,m = D$

$q = KS\Delta T = K \cdot \frac{4\pi r}{1 - r/2D} \cdot \Delta T = 237.3647783$ Watt.