## Advanced Heat Transfer

HW#6

1. Consider a long rod of radii R in temperature of  $T_i$ . Suddenly it is exposed to an environment with temperature of  $T_{\infty}$ . For the case of large convection heat transfer coefficient, Find the rod transient heat transfer distribution, T(r, t).



2. Consider a sphere with radius of *R* and uniform initial temperature of  $T_i$ . It is suddenly exposed to an environment at temperature of  $T_{\infty}$  having a heat transfer coefficient of *h*. Find the sphere unsteady state temperature.



3. Consider a long tube with internal radius of  $r_i$  and external radius of  $r_0$  with temperature distribution of f(r). It is suddenly immersed in a liquid having temperature of  $T_{\infty}$  and large heat transfer coefficient. Find the tube unsteady state temperature distribution.

4. (Note: use Laplace transforms method only) Consider a long thin rod in thermal equilibrium with an environment having temperature of  $T_{\infty}$ . The cross section temperature of the rod is suddenly increased to  $T_0$ . The convection heat transfer coefficient between the rod and its environment is h and the ratio of the rod cross section area to its perimeter is  $\beta$ .

(a) Find a model that describes the rod transient temperature, T(x, t).

(b) compare the model with the following differential equation and find parameters of A and B..

$$\frac{\partial^2 T}{\partial x^2} = A \frac{\partial T}{\partial t} + B(T - T_{\infty})$$

(c) Solve the equation by implementing the following conditions :

$$T(0,t) = T_0$$
$$T(\infty,t) = T_{\infty}$$
$$T(x,0) = T_{\infty}$$