1. Two concentric spherical metallic shells of radii r_i and r_0 , $r_i < r_0$, are separated by a solid with thermal diffusivity of α . the outer surface of the inner shell and the inner surface of outer shell are at temperatures of T_i and T_0 respectively.

   a) Derive a mathematical model that describes the solid unsteady temperature distribution , $T(r,t)$

   b) Solve the model and compare your result with the following equation and find the parameters of A, B, C_n, β and γ.

$$T(r,t) := A + \frac{B}{r} + \sum_{n=1}^{\infty} \frac{C_n}{r} \sin[\beta(r - r_i)] e^{\gamma t}$$

2. A cylindrical block of radius R, thermal diffusivity of α and at uniform temperature of T_0 is isolated from its circular surface. The temperature of the curved surface is increased suddenly to T_1.

   a) Derive a mathematical model that describes the transient response of the cylinder temperature, $T(r,t)$

   b) Solve the formulation and compare your result with the following equation and find the parameters of A, β_n , Z , υ and γ .

$$\frac{T_1 - T(r,t)}{T_1 - T_0} := A \sum_{n=1}^{\infty} \frac{Z_\nu(\beta_n r)}{\beta_n Z_{\nu+1}(\beta_n R)} e^{\gamma t}$$

3. Consider a semi-infiite body at initial temperature of T_0 between $y = 0$ and $y = \infty$. Suddenly the body s surface at $y = 0$ is exposed to a constant flux of q_0 .

   (a) Derive unsteady state model of the system describing its thermal flux distribution. $q(y,t)$. compare the model with the following formula and find the parameter of α .

$$\alpha \frac{\partial^2 q}{\partial y^2} := \frac{\partial q}{\partial t}$$

   (b) Solve the model and find the thermal flux distribution.