1. Consider a large 3 cm thick stainless steel plate($k = 15.1\ W/m\,.°C$) in which heat is generated uniformly at a rate of $5 * 10^5\ W/m^3$. Both sides of the plate are exposed to an environment at 30°C with a heat transfer coefficient of $60\ W/m^2\,.°C$. Obtain a relation for the variation of temperature in the wall by solving the differential equation, and determine the location and value of maximum temperature.

2. Consider a large 5 cm thick brass plate ($k = 111\ W/m\,.°C$) in which heat is generated uniformly at a rate of $2 * 10^5\ W/m^3$. One side of the plate is insulated while the other side is exposed to an environment at 25°C with a heat transfer coefficient of $44\ W/m^2\,.°C$. Obtain a relation for the variation of temperature in the wall by solving the differential equation, and determine the location and value of maximum temperature.

3. A semiconductor material of thermal conductivity $k = 2\ W/m.°C$ and electrical resistivity $\rho_e = 2 * 10^{-5}\ \Omega.m$ is used to fabricate a cylindrical rod 10 mm in diameter and 40 mm long. The longitudinal surface of the rod is well insulated, while the ends are maintained at temperatures of 0 and 100°C. If the rod carries a current of 10 A, what is its midpoint temperature?

4. Consider a large plane wall of thickness $L = 0.05$ m. The wall surface at $x = 0$ is insulated, while the surface at $x = L$ is maintained at a temperature of 30°C. The thermal conductivity of the wall is $k = 30\ W/m\,.°C$, and heat is generated in the wall at a rate of $\dot{q} = Bx^2\ W/m^3$ where $B = 9.6 * 10^7\ W/m^5$. Assuming steady one-dimensional heat transfer. Obtain a relation for the variation of temperature in the wall by solving the differential equation and determine the temperature of the insulated surface of the wall.

5. Consider a large 5 cm thick brass plate ($k = 111\ W/m\,.°C$) in which heat is generated uniformly at a rate of $2 * 10^5\ W/m^3$. One side of the plate is exposed to an environment at 40°C with a heat transfer coefficient of $52\ W/m^2$ while, the other side is exposed to an environment at 25°C with a heat transfer coefficient of $44\ W/m^2\,.°C$.

a) Drive the relation for the variation of temperature in the wall by solving the differential equation,
b) Determine the location and value of maximum temperature,
c) Determine both surfaces temperatures.

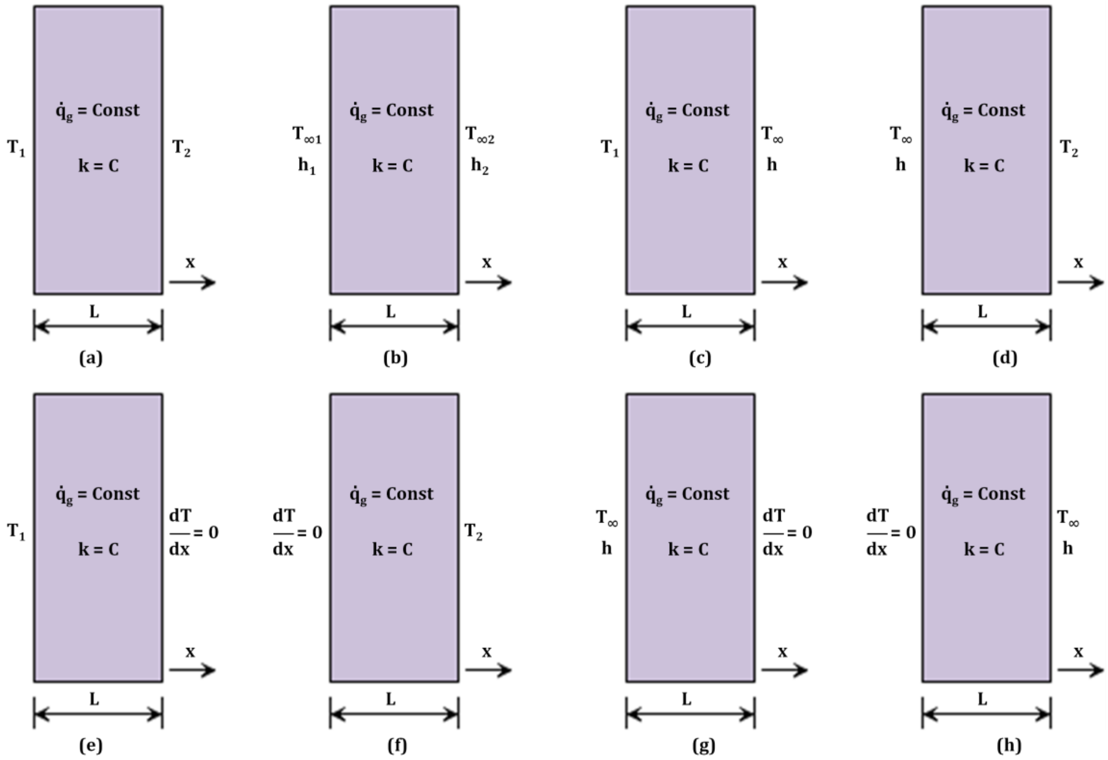
6. In a nuclear reactor, 1 cm diameter cylindrical uranium rods cooled by water from outside serve as the fuel. Heat is generated uniformly in the rods ($k = 29.5\ W/m\,.°C$) at a rate of $7 * 10^7\ W/m^3$. If the outer surface temperature of rods is 175°C, determine the temperature at their center.

7. A copper cable ($k = 400\ W/m.°C$) of 30 mm diameter has an electrical resistance of $5 * 10^{-3}\ \Omega/m$ and is used to carry an electrical current of 250 A. The cable is exposed to ambient air at 20°C, and the associated convection coefficient is $25\ W/m^2\,.°C$. What is the centerline and surface temperature of the wire?

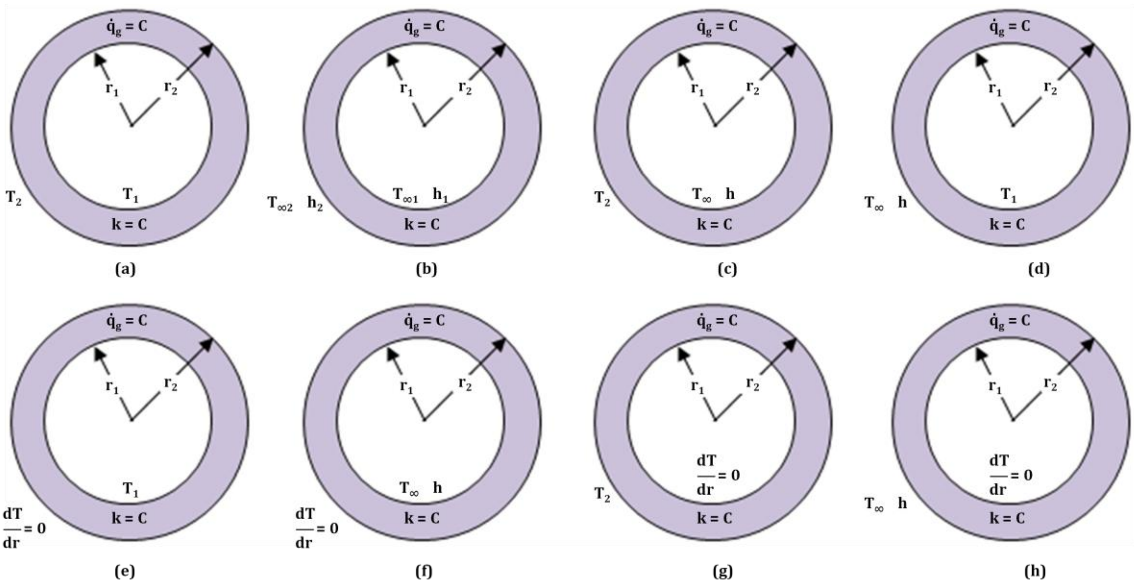
8. In a long cylindrical fuel element in a nuclear reactor; energy generation occurs uniformly in the thorium fuel rod, which is of diameter $D = 25$ mm and is wrapped in a thin aluminum cladding. It is proposed that, under steady state conditions, the system operates with a generation rate of $\dot{q} = 7 * 10^8\ W/m^3$ and cooling system characteristics of $T_\infty = 95°C$ and $h = 7000\ W/m^2 °C$. The thermal conductivity and melting point temperature of the thorium fuel are $60\ W/m\,.K$ and 2023 K respectively, while the melting point temperature of aluminum is 933 K. Is this proposal satisfactory?

9. A chemical reaction takes place in a packed bed between two coaxial cylinders with radii 1 cm and 3 cm. The inner is at 500°C and it is insulated. Assuming the reaction rate of $6 * 10^5\ W/m^3$ in the reactor volume, find out the temperature at the outer surface of the reactor. Take k (packed material) $= 0.5\ W/m.K$.

10. Drive the temperature distribution, T(x), and heat flow rate, q(x), for one-dimensional, plane wall with the following boundary conditions where the thermal conductivity, k, and internal volumetric heat generation $\dot{q}_g$ are constants.



11. Drive the temperature distribution, T(r), and heat flow rate, q(r), for one-dimensional, hollow cylinder with the following boundary conditions where the thermal conductivity, k, and internal volumetric heat generation $\dot{q}_g$ are constants



12. Drive the formulas of radial distributions of temperature, and heat rate for a solid wire carrying an electric current I and the electrical resistance of the wire is R. The external surface with the following boundary condition