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| Benha University | Heat Transfer |
| Faculty of Engineering (Shoubra) | 2nd Year (Power) |
| Mechanical Engineering Department | Sheet No. 3 |

1. Define heat generation in a solid. Give examples.
2. Consider a large 3-cm-thick stainless steel plate in which heat is generated uniformly at a rate of. Both sides of the plate are exposed to an environment at with a heat transfer coefficient of. 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. Consider a large 5-cm-thick brass plate in which heat is generated uniformly at a rate of. 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. 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.
4. 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 at a rate of. If the outer surface temperature of rods is 175°C, determine the temperature at their center.
5. A copper cable of diameter has an electrical resistance of and is used to carry an electrical current of. The cable is exposed to ambient air at, and the associated convection coefficient is. What is the centerline and surface temperature of the wire?
6. Consider a long resistance wire of radius and thermal conductivity in which heat is generated uniformly at a constant rate of as a result of resistance heating. The wire is embedded in a 0.4-cm thick layer of plastic whose thermal conductivity is. The outer surface of the plastic cover loses heat by convection to the ambient air at with an average combined heat transfer coefficient of. Assuming one-dimensional heat transfer, determine the temperatures at the center of the resistance wire and the wire-plastic layer interface under steady conditions.
7. Consider a homogeneous spherical piece of radioactive material of radius that is generating heat at a constant rate of. The heat generated is dissipated to the environment steadily. The outer surface of the sphere is maintained at a uniform temperature of 80°C and the thermal conductivity of the sphere is . Assuming steady one-dimensional heat transfer; (a) obtain a relation for the variation of temperature in the sphere by solving the differential equation, and (b) determine the temperature at the center of the sphere.
8. Consider one-dimensional conduction in a plane composite wall. The outer surface of wall A is insulated while the outer surface of wall C is exposed to a fluid at 25 and a convection heat transfer coefficient of 1000. The middle wall B experiences uniform heat generation, while there is no heat generation in walls A and C. The thickness of each wall is, and walls A and B and C have thermal conductivity ofand and . Determine the temperatures at the interfaces and plot the temperature distribution throughout the system.

