1. Derive the general heat conduction equation in cylindrical coordinates systems.

2. Consider a long rectangular bar of length *a* in the x-direction and width *b* in the y-direction. The temperatures of the surfaces at $x = 0$, $y = 0$, and $x = a$ are all equal to T_1, while the temperature of the surface at $y = b$ is equal to T_2. Assuming constant thermal conductivity and steady state heat conduction with no heat generation, (a) determine the general relation for temperature distribution inside the rectangular bar; (b) draw isotherms in the bar if ($b = 1.5a$).

3. Consider a water pipe of length $L = 17$ m, inner radius $r_1 = 15$ cm, outer radius $r_2 = 20$ cm, and thermal conductivity $k = 14$ W/m·K. Heat is generated in the pipe material uniformly by a 25-kW electric resistance heater. The inner and outer surfaces of the pipe are at $T_1 = 60$°C and $T_2 = 80$°C, respectively. Obtain a general relation for temperature distribution inside the pipe under steady conditions and determine the temperature at the center plane of the pipe.

4. Heat is generated uniformly at a rate of 4.2×10^6 W/m^3 in a spherical ball ($k = 45$ W/m·K) of diameter 24 cm. The ball is exposed to iced-water at 0°C with a heat transfer coefficient of 1200 W/m^2·K. (*a*) express the differential equation and the boundary conditions for steady one-dimensional heat conduction through the spherical ball, (*b*) obtain a relation for the variation of temperature in the ball by solving the differential equation, and (*c*) Determine the temperatures at the center and the surface of the ball.

5. Watch Chap. 3 videos for undergraduate lectures on steady heat conduction and find answers to Chap. 3 review questions. Written answers are not required. Please be prepared to answer the review questions in the next lecture.