1. Consider an infinite cylinder of a radius $r_0$ with initial temperature $T_0$. Find the temperature distribution in the cylinder at $t > 0$, assuming that the temperature at its surface is held at 0. The cylinder is described by

$$T_t = \kappa \Delta T, \quad r < r_0.$$ 

2. Find the temperature of an infinite cylinder of radius $r_0$ at $t > 0$ assuming the temperature at its surface is held at 0 and the initial temperature distribution is $T|_{t=0} = \alpha \frac{r}{r_0} \cos \phi$, where $\alpha$ is a constant.

3. Find the steady state temperature distribution in an infinite hollow cylinder assuming that its inner surface ($r=r_0$) is held at $T(r=r_0)=T_0$, and its outer surface ($r=r_1$) is held at $T(r=r_1)=T_1$. Graph the solution. Compare with the temperature distribution for linear 1D problem with $T(x=0)=T_0$ and $T(x=L)=T_1$.

4. Consider oscillations of a circular membrane with fixed boundary. The oscillations are described by $U_{tt} = c^2 \Delta U$. Find $U(x,y,t)$ assuming that $U|_{r=0} = \alpha (r - r_0)^2$ and $U_t|_{r=0} = 0$. Here, $r_0$ is the radius of membrane.

5. The motion of a body falling in a resisting medium may be described by

$$m \frac{d^2 x(t)}{dt^2} = mg - b \frac{dx(t)}{dt}.$$ 

Using the Laplace transform, find $x(t)$ and $\frac{dx(t)}{dt}$ for the following initial conditions: $x(0) = \frac{dx}{dt} \big|_{t=0} = 0$. 