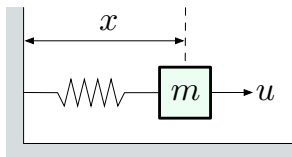


Example 1: Mass-Spring System



$$\ddot{x} + \frac{\rho}{m}\dot{x} + \frac{k}{m}x = \frac{u}{m} \quad \text{2nd-order linear ODE}$$

Canonical form: convert to a *system of 1st-order ODEs*

$$\dot{x} = v \quad (\text{definition of velocity})$$

$$\dot{v} = -\frac{\rho}{m}v - \frac{k}{m}x + \frac{1}{m}u$$