Exercise 01. Consider the linear time-invariant system in IO representation

$$\frac{d^3 y(t)}{dt^3} + 6\frac{d^2 y(t)}{dt^2} + 13\frac{dy(t)}{dt} = 2\frac{d^2 u(t)}{dt^2} + 3u(t)$$

1. Determine the characteristic polynomial and its roots;

2. Determine the modes of the system, classify and plot them;

3. Let $t_0 = 0$, determine the free evolution from initial conditions.

$$y(t)\Big|_{t=t_0} = 1$$

$$\frac{dy(t)}{dt}\Big|_{t=t_0} = 1$$

$$\frac{d^2 y(t)}{dt^2}\Big|_{t=t_0} = 1$$

Exercise 02. Consider the linear time-invariant system in IO representation

$$2\frac{d^2 y(t)}{dt^2} + 4\frac{dy(t)}{dt} + 2y(t) = 3\frac{du(t)}{d} + u(t)$$

1. Define and determine the system's impulse evolution;

2. Determine the forced evolution of the system when subject to an input $u(t) = e^t \delta_{-1}(t)$.