

Exercises for Chapter 1

Solve the following IVPs and describe the system's behaviour.

1. $\dot{x} = -3x, x_0 = 2$
2. $\dot{x} = -3x + 5, x_0 = 2$
3. $\ddot{x} + 15\dot{x} + 50x = 0, x_0 = 1, x'_0 = 2$
4. $\ddot{x} + 15\dot{x} + 50x = 5, x_0 = 1, x'_0 = 2$
5. $\ddot{x} + 10\dot{x} + 25x = 0, x_0 = 1, x'_0 = 2$
6. $\ddot{x} + 10\dot{x} + 25x = 5, x_0 = 1, x'_0 = 2$
7. $\ddot{x} + 10\dot{x} + 26x = 0, x_0 = 1, x'_0 = 2$
8. $\ddot{x} + 10\dot{x} + 26x = 5, x_0 = 1, x'_0 = 2$

By using the general form of the analytic solution try to predict (without solving the ODE) the response of the following systems. Your answer must describe the system as stable/unstable, convergent to zero/nonzero value/sinusoid...

- a. $5 \frac{dx}{dt} + 6x = 0, \quad x(0) = 0, x(0) = 1, x(0) = -1$
- b. $5 \frac{dx}{dt} - 6x = 0, \quad x(0) = 0, x(0) = 1, x(0) = -1$
- c. $5 \frac{dx}{dt} + 6x = 1, \quad x(0) = 0, x(0) = 1, x(0) = -1$
- d. $5 \frac{dx}{dt} + 6x = -1, \quad x(0) = 0, x(0) = 1, x(0) = -1$
- e. $\frac{dx}{dt} + 3 = 0, \quad x(0) = 0, x(0) = 1, x(0) = -1$
- f. $5 \frac{dx}{dt} + 6x = \sin(50t), \quad x(0) = 0, x(0) = 1, x(0) = -1$

g. $5\frac{dx}{dt} + 6x = \cos(50t), \quad x(0) = 0, x(0) = 1, x(0) = -1$

h. $5\frac{dx}{dt} + 6x = 5 + \sin(50t), \quad x(0) = 0, x(0) = 1, x(0) = -1$

i. $5\frac{dx}{dt} + 6x = \cos(50t) + \sin(50t), \quad x(0) = 0, x(0) = 1, x(0) = -1$