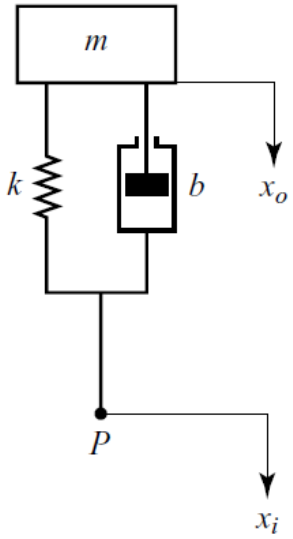
Laboratory Instructions

Course Number:	XMUT220
Laboratory Number:	4
Laboratory Title:	Time & Frequency Characteristics
Exercise 1: Time and frequency responses of a mechanical system. Exercise 2: Time and frequency responses of an electrical system.	

Name: _____

Student Number: _____

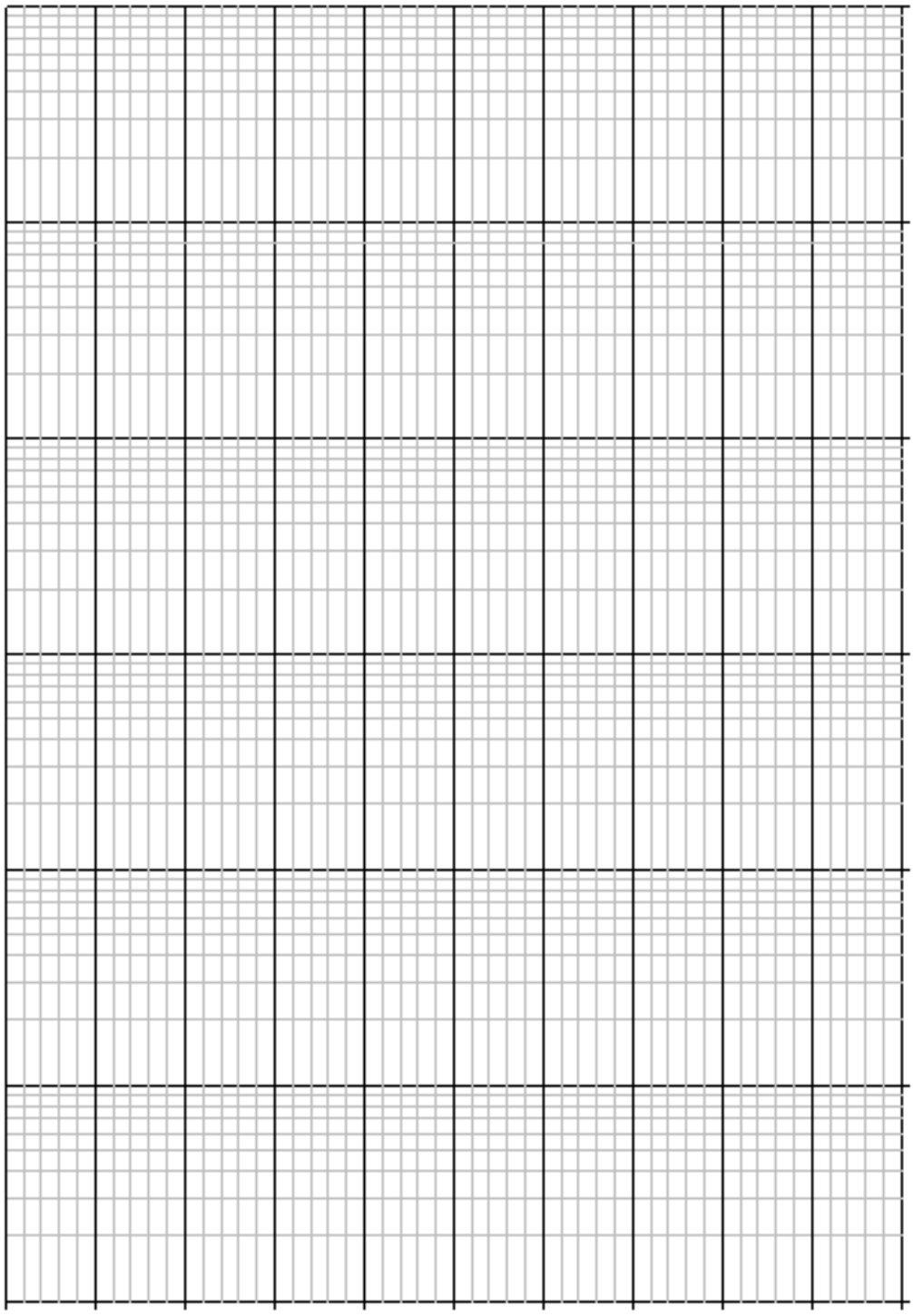
1. You are given with a very simplified version of a car suspension system. Assume that the motion x_i at point P is the input to the system and the vertical motion x_o of the body is the output. Consider that the motion of the body is in the vertical direction only. Displacement x_o is measured from the equilibrium position in the absence of input x_i. Determine and do as follow in Matlab:



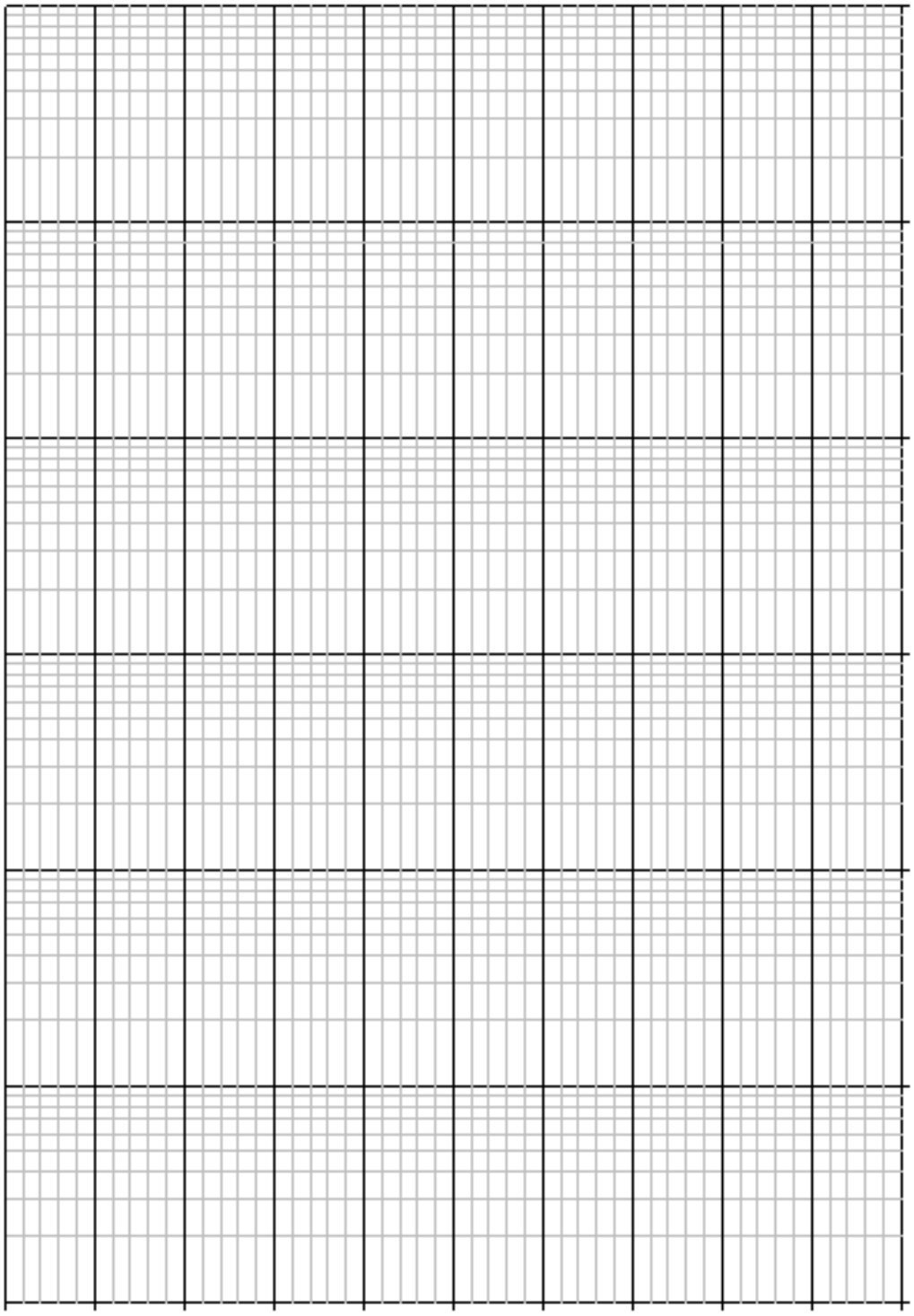
   a. Transfer function of the system. [10 marks]

b. Simulate the time response of the system when k = 2, b = 3 and m = 5. [10 marks]

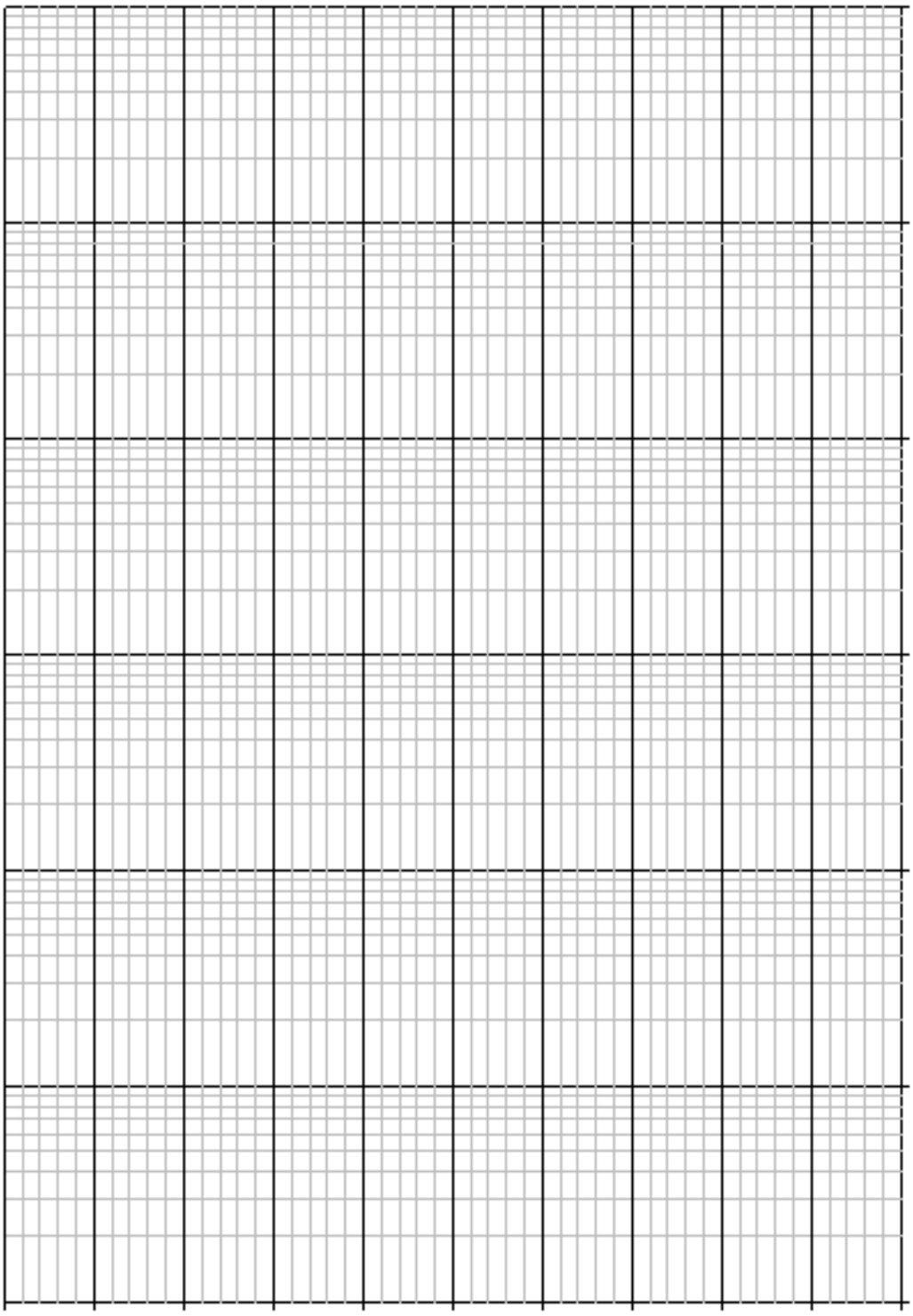
c. Plot frequency response of the system for an impulse input. [5 marks]



d. Plot frequency response of the system for a step input. [5 marks]



e. Plot frequency response of the system when k = 1, b = 5 and m = 2. [10 marks]



f. Describe the frequency response characteristics of the system as in part (e). [10 marks]

2. Knowing that a system has the following transfer function equation, in Matlab:

$$\frac{d^2y(t)}{dt^2} - 2\frac{dy(t)}{dt} + 5y(t) = x(t)$$

   a. Plot the time response of the system. [10 marks]
   b. Determine the time constant (τ), rise time (T_r), settling time (T_s), time to peak (T_p), percentage overshoot ($\%OS$), damping ratio (ζ) and natural frequency (ω_n) of the system. [25 marks]
   c. Plot the frequency response (both magnitude and phase). [10 marks]
   d. Describe of frequency response characteristics of the system as in part (c). [5 marks]

Perform the given tasks in Matlab:

   a. Plot the time response of the system. [10 marks]

b. Determine the time constant (τ), rise time (T_r), settling time (T_s), time to peak (T_p), percentage overshoot ($\%OS$), damping ratio (ζ) and natural frequency (ω_n) of the system.

[25 marks]

Time constant (τ)

Rise time (T_r)

Settling time (T_s)

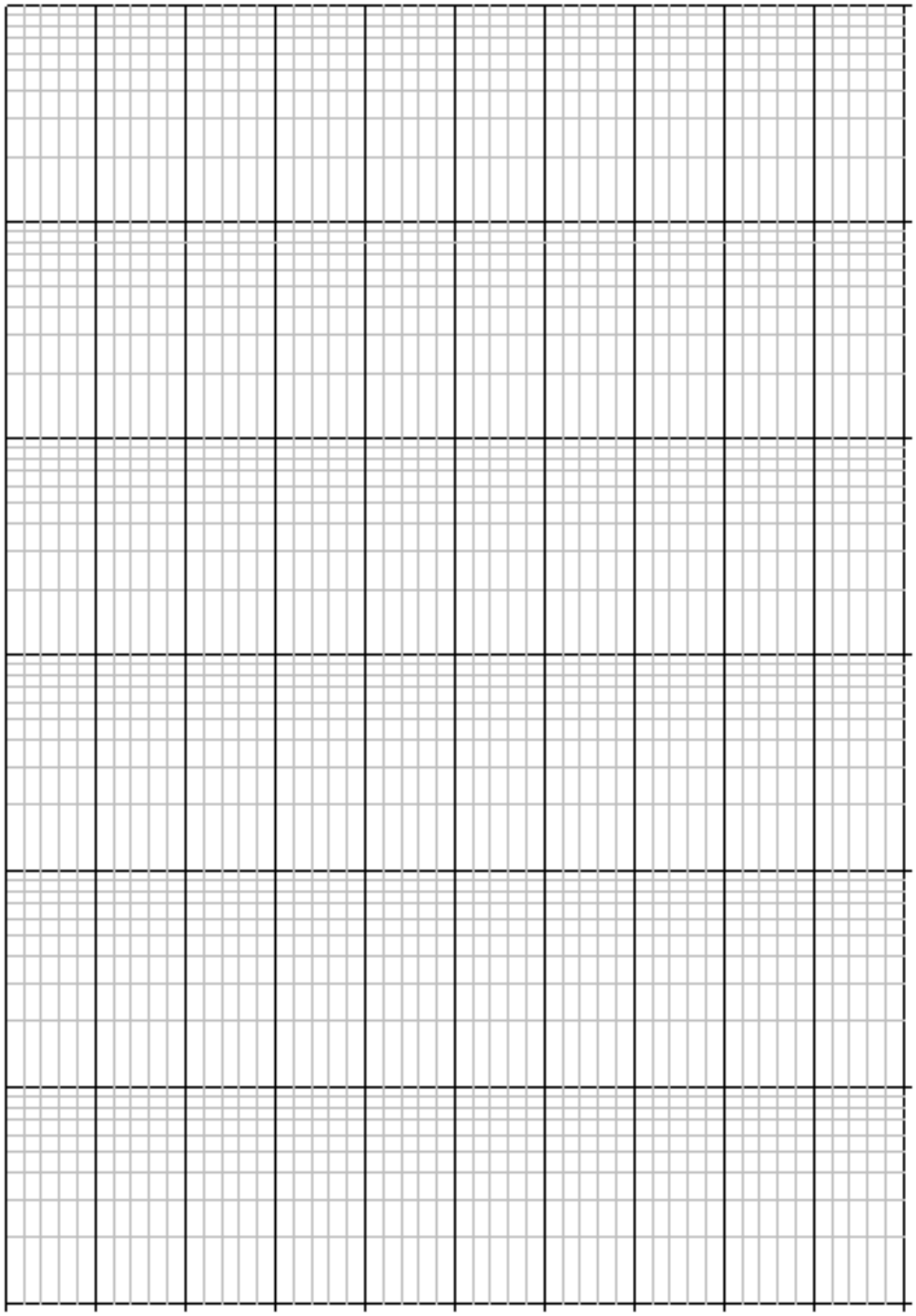
Time to peak (T_p)

Percentage overshoot ($\%OS$

Damping ratio (ζ)

Natural frequency (ω_n)

c. Plot the frequency response of the system (both magnitude and phase). [10 marks]



d. Describe of frequency response characteristics of the system as in part (c). [5 marks]

Note: Include all of your Matlab m files in your submission.

Appendix – Matlab m. Files