

**SYSTEM DYNAMICS AND CONTROL LAB - ME 443**

**Fall 2020-21**

**Report # 1 (20 Marks)**

**Due Date: 15 October 2020**

**Problem 1:**

Consider the system,

$$\ddot{y} + 8\dot{y} + 5y = 5\sin(t)$$

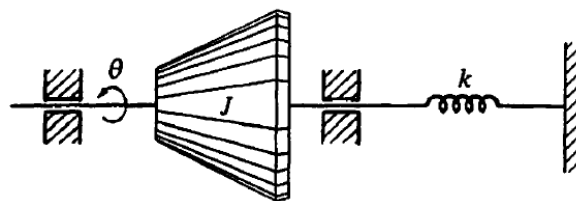
subjected to the initial condition

$$y(0) = 0 \quad , \quad \dot{y}(0) = 1 \quad , \quad \ddot{y}(0) = 1$$

Write a **MATLAB** code to solve the previous equation numerically (use `ode45`). Plot  $y(t)$  versus  $t$ ,  $\dot{y}(t)$  versus  $t$ , and  $\ddot{y}(t)$  versus  $t$  over the time interval  $0 \leq t < 20$ .

**Problem 2:**

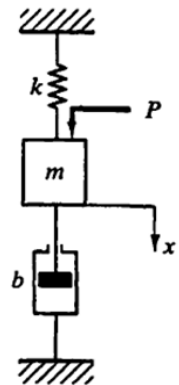
Consider the experimental determination of moments of inertia  $J$  of a rigid body. The process is as follows: a rigid body is mounted in frictionless bearings so that it can rotate freely about the axis of rotation around which the moment of inertia is to be determined. Next, a torsional spring with known spring constant  $k$  is attached to the rigid body. The spring is then twisted slightly and released, and the period of the resulting simple harmonic motion  $T$  is measured.



1. Write the equation of motion for the system.
2. Determine the moments of inertia  $J$  of the rigid body, if  $k = 300 \text{ N.m/rad}$  and  $T = 0.8 \text{ sec}$ .
3. Determine the natural frequency of the system.

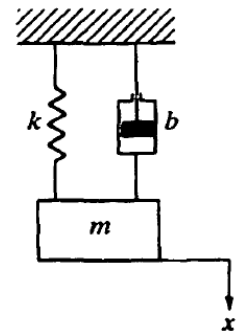
**Problem 3:**

Consider the mechanical system shown in the figure. The system is initially at rest, and the displacement  $x$  is measured from the equilibrium position. Assume that  $m = 5$  kg,  $b = 40$  N-s/m, and  $k = 100$  N/m. Use MATLAB to obtain the response curve of the system when 20 N of force (a step input) is applied to the mass  $m$ .



**Problem 4:**

Consider the mechanical system shown in the figure, where  $m = 3$  kg,  $b = 10$  N-s/m, and  $k = 20$  N/m. Assume that the displacement  $x$  of mass  $m$  is measured from the equilibrium position and that at  $t = 0$  the mass  $m$  is pulled downward such that  $x(0) = 0.05$  m and  $\dot{x}(0) = 0.1$  m/s. Use MATLAB to obtain the motion of the mass subjected to the initial condition. (Assume no external forcing function.)



**Report Instructions:**

- A group of 4-5 students should work in a team to do the report
- Create MS-Word file includes MATLAB codes and figures
- Report should have a cover page
- Report should be submitted on the due date
- Upload the report on the blackboard in (pdf) format