ME 4189 Spring 2016
Homework assignment #2
Due on Thursday 02/04/2016

Learning objectives

Please study your class notes and the corresponding sections of the textbook before completing the assignment. After completing this assignment, you should be able to:

- Apply formulae for the frequency of undamped and damped vibrations to determine parameters of a 1 DOF system
- Determine the parameters of a damped 1 DOF system from the free vibration response
- Determine the steady-state response of 1DOF system and plot the response using Matlab
- Find the steady state and total response of 1DOF systems using a set of initial conditions

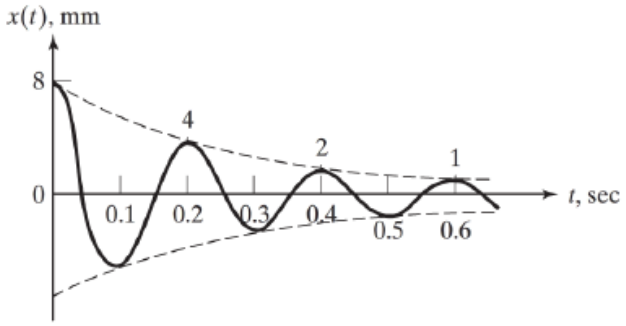
Solve the following problems of the textbook:

- 2.97
- 2.102
- 3.24. (the mass moment of inertia of the uniform rod of length l and mass m around the hinge O is $\frac{1}{3}ml^2$; the mass moment of inertia of the mass M around the hinge O is Ml^2)
- 3.27. Plot on a single graph the transient response, the steady-state response and the total response as a function of time.

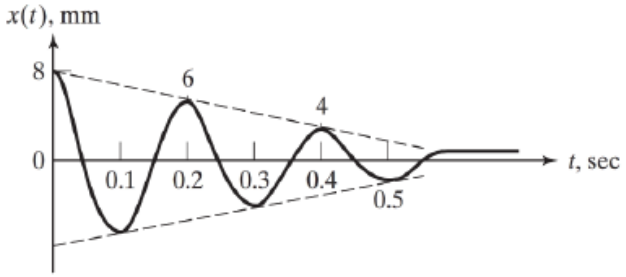
For each problem, you need to show your work and circle your final answer. Please staple your homework.

2.97 A simple pendulum is found to vibrate at a frequency of 0.5 Hz in a vacuum and 0.45 Hz in a viscous fluid medium. Find the damping constant, assuming the mass of the bob of the pendulum is 1 kg.

2.102 The free-vibration responses of an electric motor of weight 500 N mounted on different types of foundations are shown in Figs. 2.107(a) and (b). Identify the following in each case: (i) the nature of damping provided by the foundation, (ii) the spring constant and damping coefficient of the foundation, and (iii) the undamped and damped natural frequencies of the electric motor.



(a)



(b)

Problem 3.24. Derive the equation of motion and find the steady-state response of the system shown in Fig. 3.44 for rotational motion about the hinge O for the following data: k1=k2=5000 N/m, a=0.25m, b=0.5m, l=m, M=50kg, m=10 kg, F0=500N, ω=1000rpm

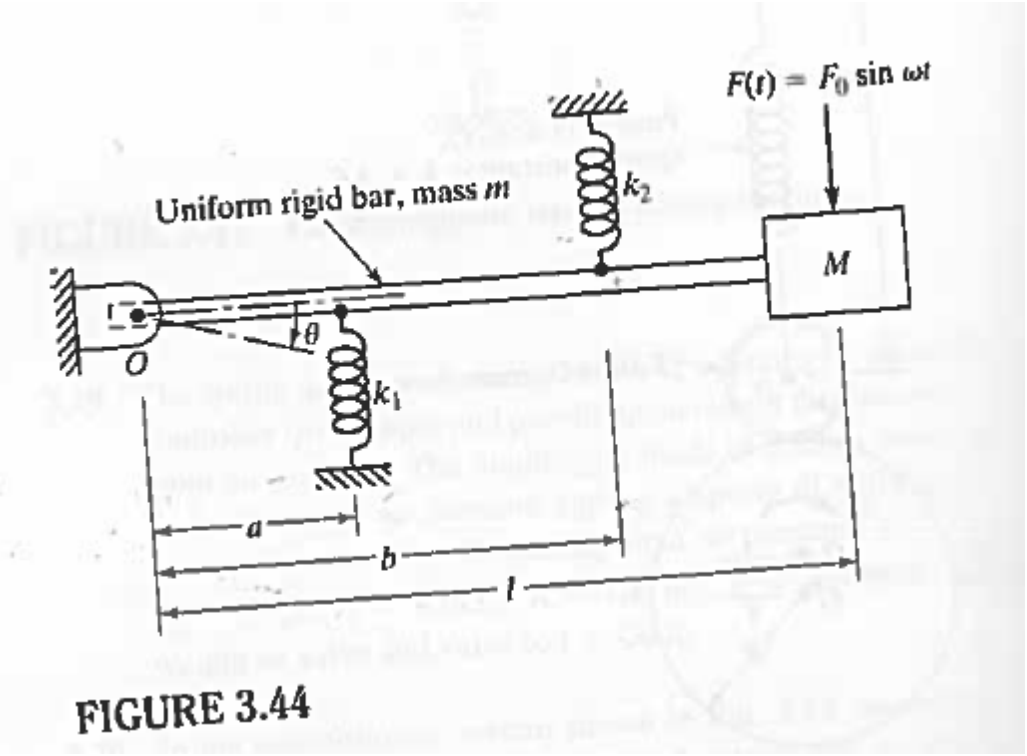


FIGURE 3.44

3.27 Consider a spring-mass-damper system with $k = 4000$ N/m, $m = 10$ kg, and $c = 40$ N-s/m. Find the steady-state and total responses of the system under the harmonic force $F(t) = 200 \cos 10t$ N and the initial conditions $x_0 = 0$ and $\dot{x}_0 = 10$ m/s.