Name _____

EM406
Examination II
October 9, 2000

Problem	Score
1	/20
2	/15
2	/20
3	/45
Total	/100

This is an closed book/closed note exam with the following conditions.

1. You are allowed a maximum of 2 hours to take the exam
2. The exam must by completed at one sitting
3. You may only use your crib sheet, existing Maple worksheets and Matlab simulink models.
4. You are not to discuss the exam with ANYONE!

Show all work for credit
AND
Turn in your signed help sheet

Honor Statement: I pledge my honor that I neither gave nor received help on this exam, and I only worked on the test during the time allotted.

Signed _____

Start time _____ End _____

Name _____ 20 pts

EM406 Examination II **Problem 1** October 9, 2000

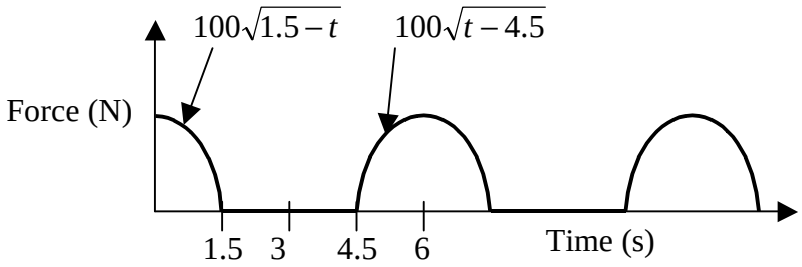
A computer disk drive is to be isolated from a panel that vibrates at frequencies ranging from 50 to 100 Hz. The force transmitted is not as crucial as the displacement in this case. It is estimated that at least 75% vibration isolation must be achieved for the disk drive to operate properly. Assume the disk drive weighs 1 lb and the damping ratio for the isolator is 3%. Determine:

a) the stiffness of the isolator
b) the force transmissibility for your design.

Name _____ 15 pts

EM406 Examination II **Problem 2** October 9, 2000

A second order system (m = 0.25 kg, k = 1000 N/m, c = 0.3 N-s/m) is forced with a periodic force as shown below (only the portion of the force for t>0 is shown and the equations are only valid for the cycle between 0<t<6). The force is zero between 1.5 and 4.5 s.



Determine

a) the Fourier series for the input force (write down the first 3 non-zero terms below)

b) the steady state response of the system (write down the first 3 non-zero terms below).

c) about how many terms do you need in your steady state solution to have a good approximation?

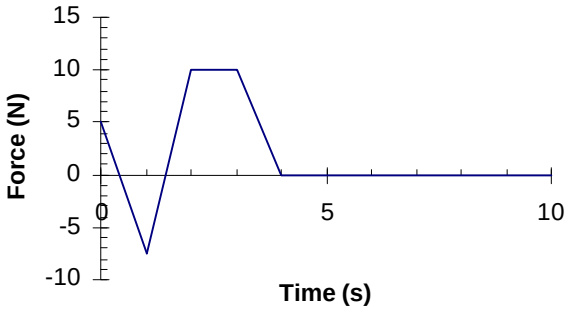
Clearly show below what you need to put in your Maple worksheet and include a printout of your Maple worksheet.

Name _____ 20 pts

EM406 Examination II **Problem 3** October 9, 2000

A second order system is forced with the excitation shown below. After t = 4 the force is zero.

a) Using Simulink apply this force to a second order system (m = 1 kg, k = 800 N/m, and c = 0.7 N-s/m) and determine the response of the system. Include a printout of your simulink model, the forcing function, and the time response for $0 < t < 10$ s.
b) Describe in words how you would determine a response spectrum for this forcing.



Name _____ 45 pts

EM406 Examination II **Problem 4** October 9, 2000

An airfoil of mass m is suspended by a linear spring of stiffness k and torsional spring of stiffness k_t. The center of gravity, G, is located a distance e from point O as shown below. The mass moment of inertia of the airfoil about an axis passing through O is J_O. Use the coordinates x = the vertical displacement of point O (positive is down, measured from SEP) and θ = the angle of the airfoil with respect to the horizontal (positive is clockwise)

a) Find the equations of motion for the airfoil. (20 points – be sure to show all your work!)

If numbers are substituted into the equations found in part a) the following differential equations are obtained:

$$\ddot{x} + 0.5\ddot{\theta} + x = 0$$

$$2\ddot{\theta} + 0.5\ddot{x} + \theta = 0$$

b) What are the natural frequencies of this system? (10 pts)

c) What are the natural modes of this system. Sketch the modes assuming e = 0.3. Be sure to label the relative displacements clearly. (15 pts)