Homework #9
EMA 545, Spring 2013

For the following problems, you may have the equations of motion for some of these systems in your past homework assignments or in the solutions to those that were posted online, so you may use those if you wish.

For all of these problems you may use Matlab or some other package to find the natural frequencies and mode vectors and to mass normalize the mode vectors (if needed).

1.) **Problem 4.3** in Ginsberg. Sketch the deformation of the system when it moves in each of the modes. (Notice that you can pull out factors such as *k* and *m* so that only numbers remain in the mass and stiffness matrices. Then it is possible to check your answers using Matlab.)

2.) **Problem 4.7** as given in the text. You may use the following equations of motion:

$$mL^2\begin{bmatrix} 4/3 & 1/2 \\ 1/2 & 1/3 \end{bmatrix}\begin{Bmatrix} \ddot{\theta}_1 \\ \ddot{\theta}_2 \end{Bmatrix} + mgL\begin{bmatrix} 2\beta - 3/2 & -\beta \\ -\beta & \beta - 1/2 \end{bmatrix}\begin{Bmatrix} \theta_1 \\ \theta_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$$

3.) **Problem 4.11** as given in the text. Hint: normal modes = mass normalized modes

4.) **Problem 4.29** as given in the text. Also, plot the motion of the automobile as a function of time. Is the response a pure-sinusoid? Why or why not? Note: The answer provided by the book is incorrect. The correct answer is:

$y_1(t) = 0.16\cos(1.5t') + 0.84\cos(2.0t')$
$y_2(t) = 0.45\cos(1.5t') - 0.45\cos(2.0t')$