ME 460/660 Final, Spring ‘96

One equation sheet. Front and back. No examples. No derivations. It must be turned in with the exam. Each problem is worth 25 points.

1) Find the spectral matrix, Λ, and eigenvector matrix, P, given the following:

$$M = \begin{bmatrix} 4 & 0 \\ 0 & 36 \end{bmatrix}, K = \begin{bmatrix} 3 & -3 \\ -3 & 27 \end{bmatrix}$$

2) Choose a suspension damping coefficient (c) for a 1000 kg car such that the settling time is less than 3 sec and the displacement transmissibility if less than 0.5 at 3 Hz ($r = 2$).

3) Find the free response of the following two degree of freedom system given the following:

$$M = \begin{bmatrix} 4 & 0 \\ 0 & 4 \end{bmatrix}, K = \begin{bmatrix} 4 & -1 \\ -1 & 4 \end{bmatrix}, \Lambda = \begin{bmatrix} 0.866 & 0 \\ 0 & 1.118 \end{bmatrix}, P = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$$

$$\mathbf{r}_0 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \dot{\mathbf{r}}_0 = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

4) Derive the equations of motion for the following system using Lagrange’s equations with x and θ as the generalized coordinates. The block can only move in the vertical direction. (Hint: Set the datums to be at the unstretched spring length and $\theta = 0$.