ME 563 **HOMEWORK # 9** **Fall 2008**

PROBLEM 1: (50%)

Given the following set of equations for a vibrating system with translational and rotational degrees of freedom,

$$\begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} \begin{Bmatrix} \ddot{y} \\ \ddot{\theta} \end{Bmatrix} + \begin{bmatrix} 0.4 & -0.2 \\ -0.2 & 0.2 \end{bmatrix} \begin{Bmatrix} \dot{y} \\ \dot{\theta} \end{Bmatrix} + \begin{bmatrix} 4 & -2 \\ -2 & 2 \end{bmatrix} \begin{Bmatrix} y \\ \theta \end{Bmatrix} = \begin{Bmatrix} f(t) \\ \tau(t) \end{Bmatrix}$$

find the analytical expressions for the modal frequency response functions of the system. What combination of forcing functions should be chosen to only excite mode #1? What about for mode #2?

PROBLEM 2: (50%)

Assume you are designing a vibration isolation system for a machine tool. You must select the mounts to position beneath the tool in order to achieve a 90% reduction in the transmitted cutting forces of the tool. If the machine tool weighs 2000 Newtons and spins at 1000 RPM in the steady state, what mount stiffness do you need to choose if the damping ratio of the system is 0.05? If the measured transmitted force is twice the cutting force for this same machine tool and your selected mount design, what must be the lower speed(s) of operation of the machine?