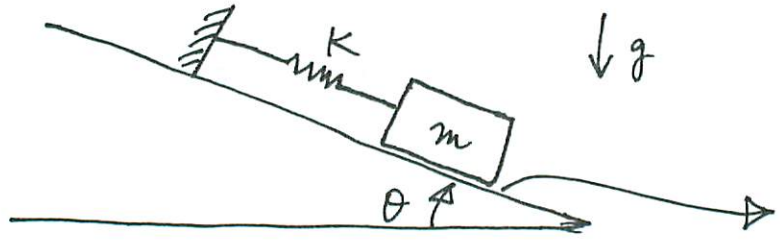
HW #2

Advanced Engineering Vibration 511
due March 17th 2009

1.

$X(0) = X_0$
$\dot{X}(0) = 0$



Coulomb damping:
Kinetic coefficient of friction

Compute the equation of motion for the system

2. Given

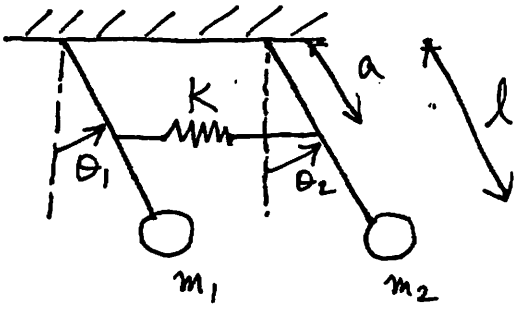
$$\begin{bmatrix} 1 & 0 \\ 0 & 4 \end{bmatrix} \ddot{X} + \begin{bmatrix} 3 & -1 \\ -1 & 1 \end{bmatrix} X = 0$$

m : Kg
K : N/m

Use modal analysis to calculate the solution of this given $X(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ mm , $\dot{X}(0) = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$ mm/sec

Also calculate the eigenvalues of the system.
And calculate the eigenvectors and normalize.

3.



ℓ = length of pendulum

$K = 20\ N/m$ $\quad \ell = 0.5\ m$

$m_1 = m_2 = 10\ kg$ $\quad a = 0.1\ m$ along the pendulum

Determine the natural frequencies and mode shapes.

4. $$\begin{bmatrix} 9 & 0 \\ 0 & 1 \end{bmatrix} \ddot{X} + \begin{bmatrix} 27 & -3 \\ -3 & 3 \end{bmatrix} X = 0$$

Calculate the response of the system to IC

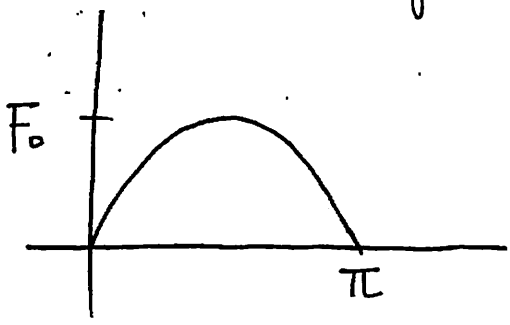
$$X_0 = \frac{1}{\sqrt{2}} \begin{bmatrix} \frac{1}{3} \\ 1 \end{bmatrix} \qquad \dot{X}_0 = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

5 Calculate the response of the system

$$3\ddot{X}(t) + 6\dot{X}(t) + 12X(t) = 3\delta(t) - \delta(t-1)$$

Subject to IC $\quad X(0) = 0.01\ m \quad V(0) = 1\ m/sec$

6 Calculate the response of an underdamped system to the excitation given below



$f(t) = F_0 \sin t$