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MENG470 MECHANICAL VIBRATIONS
Fall 2005

Assignment 7 Due: Sunday 2/11/1426 H.

Follow MODAL ANALYSIS procedure used in class for solving the following problem:

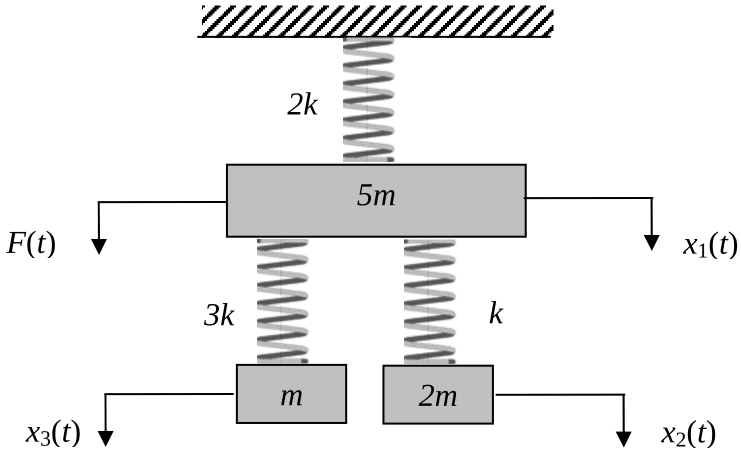

Figure (1)

Part A:
In the vibratory system shown in the figure above, a harmonic force: $F(t)=F_0 \cos(\omega t)$ is applied to the top mass where m=2 kg, k=1200 N/m, F_o=10 N, ω=15 rad/sec.

(a) Obtain equations of motion.
(b) Determine the natural frequencies. Check your answers using MA TLAB.
(c) Determine the mode shapes (or modal vectors). Check your answers using MATLAB.
(d) Normalize the mode shapes with respect to the mass matrix and obtain the orthonormal modal vectors.
(e) Use the orthonormal modes to formulate the orthonormal modal matrix $\tilde{P}$.
(f) Use the orthonormal modal matrix $\tilde{P}$ decouple the equation of motion and obtain the steady state responses for $x_1(t)$, $x_2(t)$, $x_3(t)$. Check all the matrix multiplications using MATLAB.

Part B:
Repeat step (f) above for predicting response when the system is subjected to the following initial Conditions when $F(t)$ = 0 (ie free vibration). $x_1(0)$=0.0l m; $x_2(0)$=0; $x_3(0)$=0 ;

Assume a modal damping ratio ζ of 2% for all modes. (ie. you can incorporate this damping in your final step when dealing with the uncoupled equations)

Hint: use the orthonormal matrix to convert the given initial conditions to appropriate initial conditions in the normal co-ordinates