Recitation 9

ASEN 3112 – Spring 2020

Problem: Forced Spring-Mass System

The 2-DOF spring-mass system of Figure 2 has the following matrix equation of motion

$$m\begin{bmatrix}4 & 0\\ 0 & 2\end{bmatrix}\begin{bmatrix}\ddot{u}_1\\ \ddot{u}_2\end{bmatrix} + k\begin{bmatrix}6 & -2\\ -2 & 2\end{bmatrix}\begin{bmatrix}u_1\\ u_2\end{bmatrix} = \begin{bmatrix}F_0\cos\Omega t\\ 0\end{bmatrix}.$$

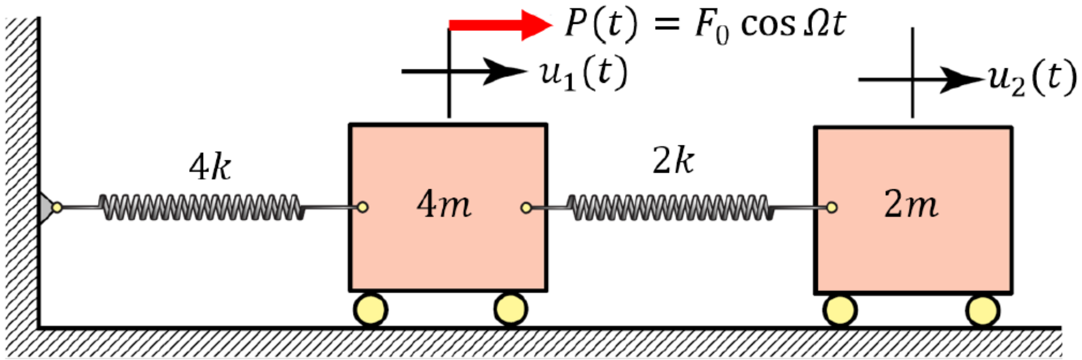

Figure 3: Two-DOF spring-mass system for Problem 2.

a. Solve for the *natural frequencies* and *mode shapes*. Scale each mode so that its largest component is 1.

b. Normalize the mode shape vectors (eigen vectors) with respect to the mass matrix. Verify that this normalization produces a mass normalized modal matrix by checking the generalized mass and stiffness matrices.

c. The system is forced by a function $P(t)$. Use the mass normalized modal matrix to perform modal analysis and determine the total (homogeneous and steady-state) response of the system. Assume the system is at complete rest at $t = 0$.