

Question 2

(1) Matrix M

$$M = \begin{bmatrix} 0 & 0 & 10000 \\ 0 & 10000 & 10000 \\ 10000 & 10000 & 10000 \end{bmatrix}$$

(2) Modal mass M_j

$$M_j = \phi_j^T M \phi_j$$

$$M_j = \begin{bmatrix} 0.2486 & -0.585 & 0.0 \\ 0.4258 & -6.674 & -0.1903 \\ \phi & 1 & -0.5868 \end{bmatrix} \begin{bmatrix} 0 & 0 & 10000 \\ 0 & 10000 & 10000 \\ 10000 & 10000 & 10000 \end{bmatrix}$$

$$M_j = \begin{bmatrix} -8868, \end{bmatrix}$$

$$M_j = \begin{bmatrix} -8868 & 3296 & 18097 \end{bmatrix}$$

(3) ω_n

$$\omega_n = \sqrt{\frac{k}{m}} = \sqrt{\frac{24 \times 10^6}{10000}} = 48.99 \text{ rad/s}^{-1}$$

(4)