TU/HW -7 [redacted]

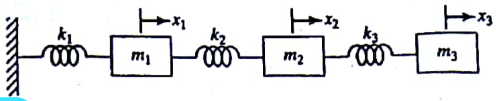


FIGURE 6.6 (a)

6.46 Find the natural frequencies and mode shapes of the system shown in Fig. 6.6(a) when $k_1 = k$, $k_2 = 2k$, $k_3 = 3k$, $m_1 = m$, $m_2 = 2m$, and $m_3 = 3m$. Plot the mode shapes.

6.47 Set up the matrix equation of motion and determine the three principal modes of vibration for the system shown in Fig. 6.6(a) with $k_1 = 3k$, $k_2 = k_3 = k$, $m_1 = 3m$, and $m_2 = m_3 = m$. Check the orthogonality of the modes found.

6.43 Use Lagrange's equations to derive the equations of motion of each of the systems shown in Figs. 6.17 to 6.21.

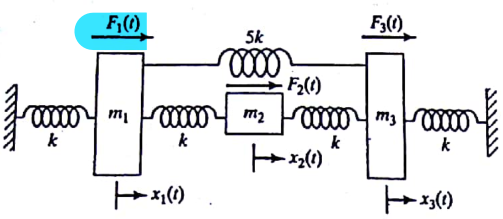


FIGURE 6.17

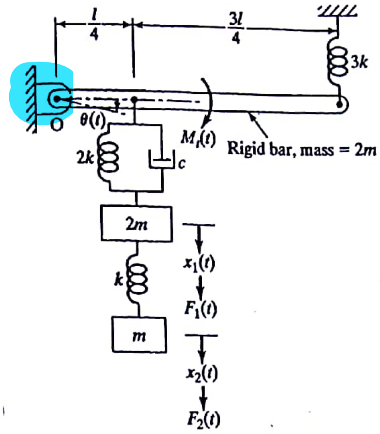


FIGURE 6.18

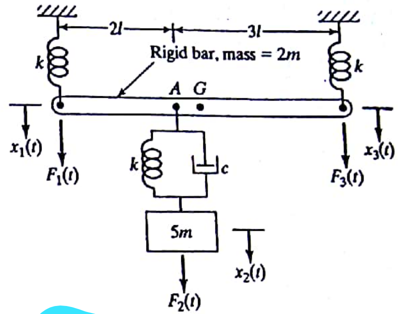


FIGURE 6.19

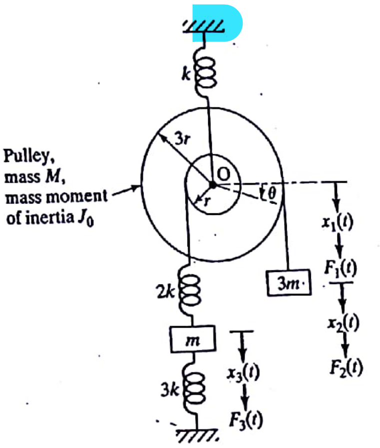
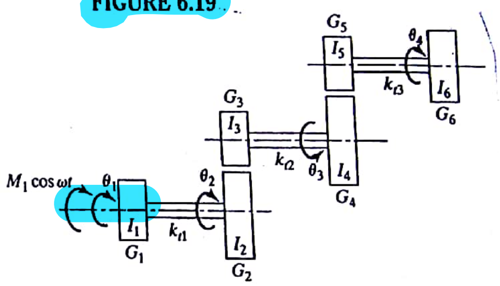


FIGURE 6.20



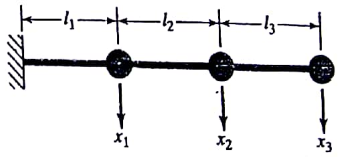
Number of teeth on gear $G_i = n_i$ ($i = 1$ to 6)
Mass moment of inertia of gear $G_i = I_i$ ($i = 1$ to 6)

FIGURE 6.21

6.58 The mass matrix $[m]$ and the stiffness matrix $[k]$ of a uniform bar are

$$[m] = \frac{\rho A l}{4}\begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad \text{and} \quad [k] = \frac{2AE}{l}\begin{bmatrix} 1 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 1 \end{bmatrix}$$

where ρ is the density, A is the cross-sectional area, E is Young's modulus, and l is the length of the bar. Find the natural frequencies of the system by finding the roots of the characteristic equation. Also find the principal modes.



(b)

6.2 airplane wing, Fig. 6.25(a), is modeled as a three degree of freedom lumped mass system, as shown in Fig. 6.25(b). Derive the flexibility matrix and the equations of motion of the wing by assuming that all $A_i = A$, $(EI)_i = EI$, $l_i = l$ and that the root is fixed.

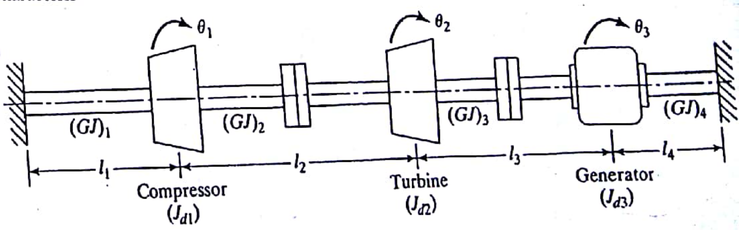
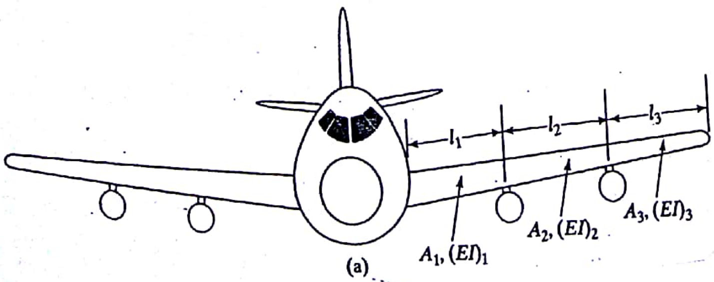


FIGURE 6.23



(a)

19 Find the flexibility and stiffness influence coefficients of the system shown in Fig. 6.24. Also, derive the equations of motion of the system.

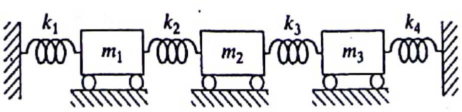


FIGURE 6.24

6.18 Find the flexibility and stiffness influence coefficients of the torsional system shown in Fig. 6.23. Also write the equations of motion of the system.

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