

> with(LinearAlgebra) :

> M := m*L^2/3*Matrix(1..3, 1..3, [[1, 0, 0], [0, 1, 0], [0, 0, 1]]);

$$M := \begin{bmatrix} \frac{1}{3} mL^2 & 0 & 0 \\ 0 & \frac{1}{3} mL^2 & 0 \\ 0 & 0 & \frac{1}{3} mL^2 \end{bmatrix}$$

(1)

> K := Matrix(1..3, 1..3, [[k*L^2 + m*g*L/2, -k*L^2, 0], [-k*L^2, 2*k*L^2 + m*g*L/2, m*g*L/2], [0, -k*L^2, k*L^2 + m*g*L/2]]);

$$K := \begin{bmatrix} kL^2 + \frac{1}{2} mgL & -kL^2 & 0 \\ -kL^2 & 2kL^2 + \frac{1}{2} mgL & -kL^2 \\ 0 & -kL^2 & kL^2 + \frac{1}{2} mgL \end{bmatrix}$$

(2)

> Sm := (-M*x + K);

$$Sm := \left[\left[-\frac{1}{3} x mL^2 + kL^2 + \frac{1}{2} mgL, -kL^2, 0 \right], \right.$$

(3)

$$\left[-kL^2, -\frac{1}{3} x mL^2 + 2kL^2 + \frac{1}{2} mgL, -kL^2 \right],$$

$$\left[0, -kL^2, -\frac{1}{3} x mL^2 + kL^2 + \frac{1}{2} mgL \right] \right]$$

> S := Determinant(Sm);

$$S := -\frac{1}{27} x^3 m^3 L^6 + \frac{4}{9} x^2 m^2 L^6 k + \frac{1}{6} x^2 m^3 L^5 g - x mL^6 k^2 - \frac{4}{3} x m^2 L^5 k g - \frac{1}{4} x m^3 L^4 g^2 + \frac{3}{2} k^2 L^5 m g + k L^4 m^2 g^2 + \frac{1}{8} m^3 g^3 L^3$$

(4)

> S := factor(S);

$$S := -\frac{1}{216} mL^3 (2Lx - 3g) (3mg + 6kL - 2mxL) (3mg + 18kL - 2mxL)$$

(5)

> omeg2 := solve(S=0, x);

$$omeg2 := \frac{3}{2} \frac{g}{L}, \frac{3}{2} \frac{mg + 2kL}{mL}, \frac{3}{2} \frac{mg + 6kL}{mL}$$

(6)

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