Step-1

Consider a pure exponential equation:

$$u = xe^{i\omega t}$$

Substitute this equation in the following equation and find a generalised Eigen value problem for the frequency ω.

$$Mu'' + Ku = 0$$

Here, M is a mass matrix.

Step-2

Do the following calculations:

$$u = xe^{i\omega t}$$
$$u' = i\omega xe^{i\omega t}$$
$$u'' = -\omega^2 xe^{i\omega t}$$

Substitute these values in the following equation and solve:

$$\begin{aligned} Mu'' + Ku &= 0 \\ -\omega^2 xe^{i\omega t} M + Kxe^{i\omega t} &= 0 \\ -\omega^2 xM + Kx &= 0 \\ \omega^2 x &= KM^{-1}x \end{aligned}$$

Step-3

Assume the following:

$$KM^{-1} = A$$

Above equation can be written as follows:

$$\begin{aligned} Ax &= \omega^2 x \\ \left(A - \omega^2 I\right)x &= 0 \end{aligned}$$

Step-4

Therefore, generalised Eigen value problem that must be solved for the frequency ω and the vector x is:

$$\boxed{Ax = \omega^2 x}$$