

## Step-1

Consider a pure exponential equation:

$$u = xe^{\lambda t}$$

Substitute this equation in the following equation and find a quadratic Eigen value problem for  $\lambda$ .

$$u'' + Fu' - Au = 0$$

Here,  $F$  is a friction matrix.

## Step-2

Do the following calculations:

$$u = xe^{\lambda t}$$

$$u' = \lambda xe^{\lambda t}$$

$$u'' = \lambda^2 xe^{\lambda t}$$

Substitute these values in the following equation and solve:

$$u'' + Fu' - Au = 0$$

$$\lambda^2 xe^{\lambda t} + F \lambda xe^{\lambda t} - A xe^{\lambda t} = 0$$

$$\lambda^2 x + F \lambda x - Ax = 0$$

Above equation can be written as follows:

$$Ax = \lambda^2 x + F \lambda x$$

$$Ax = (\lambda^2 I + F \lambda) x$$

$$(A - (\lambda^2 I + F \lambda)) x = 0$$

## Step-3

Therefore, quadratic Eigen value problem is:

$$\boxed{Ax = (\lambda^2 I + F \lambda) x}$$