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 λ.

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

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:

$$\begin{aligned} u'' + Fu' - Au &= 0 \\ \lambda^2 xe^{\lambda t} + F\lambda xe^{\lambda t} - Axe^{\lambda t} &= 0 \\ \lambda^2 x + F\lambda x - Ax &= 0 \end{aligned}$$

Above equation can be written as follows:

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

Step-3

Therefore, quadratic Eigen value problem is:

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