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Math.

Department: Mechanical

$$k \frac{d^2 x}{dt^2} + 5 \frac{dx}{dt} + 6x = \cos(t)$$

Given that $t=0$, $x = 0.1$, $\frac{dx}{dt} = 0$.

$$C.F = m^2 + 5m + 6 = 0$$

$$(m+3)(m+2) = 0$$

$$m_1 = -3, m_2 = -2$$

$$x = Ae^{-3t} + Be^{-2t}$$

$$f(t) = \cos t$$

P.I.

$$x = C \cos t + D \sin t$$

$$\frac{dx}{dt} = -C \sin t + D \cos t$$

$$\frac{d^2 x}{dt^2} = -C \cos t - D \sin t$$

$$\therefore = -C \cos t - D \sin t + 5(-C \sin t + D \cos t) + 6(C \cos t + D \sin t) = \cos t$$

$$= \cos t (-C + 5D + 6C) + \sin t (-D - 5C + 6D) = \cos t$$

$$= \cos t (5D + 5C) + \sin t (-5C + 5D) = \cos t$$

$$= 5D + 5C = 1$$

$$\rightarrow 5D - 5C = 0$$

$$10D = 1$$

$$D = \frac{1}{10}$$

to find C.

$$5 \left(\frac{1}{10} \right) + 5C = 1$$

$$\frac{1}{2} + 5C = 1$$

$$C = \frac{1}{10}$$

$$\therefore \cos t x = Ae^{-3t} + Be^{-2t} + \frac{1}{10} \cos t + \frac{1}{10} \sin t$$

Sub: $(x = 0.1), t = 0$

$$0.1 = Ae^{-0} + Be^{-0} + \frac{1}{10} \cos 0 + \frac{1}{10} \sin 0$$

$$0.1 = A + B + 0.1$$

$$A + B = 0 \quad \text{--- (i)}$$

$$\frac{dx}{dt} = -3Ae^{-3t} - 2Be^{-2t} - \frac{1}{10} \sin t + \frac{1}{10} \cos t$$

$$0 = -3A + 2B + \frac{1}{10}$$

$$3A + 2B = \frac{1}{10} \quad \text{--- (ii)}$$

$$A + B = 0$$

x 2

$$3A + 2B = 0.1$$

x 1

$$2A + 2B = 0$$

$$3A + 2B = 0.1$$

$$-A = -0.1$$

$$A = 0.1$$

To get B:

$$0.1 + B = 0$$

$$B = \frac{-1}{10} = -0.1$$

$$= -\frac{1}{10} e^{-3t} + \frac{1}{10} e^{-2t} + \frac{1}{10} \cos t + \frac{1}{10} \sin t$$

$$= \frac{1}{10} e^{-2t} - \frac{1}{10} e^{-3t} + \frac{1}{10} \cos t + \frac{1}{10} \sin t$$

$$= \frac{1}{10} (e^{-2t} - e^{-3t} + \cos t + \sin t)$$

MATLAB mfile.

× Command window

× clear

× clc

× close all

× syms t

× t = 0:0.01:15

* x = 0.1 * [exp(-2*t) - exp(-3*t) + cos(t) + sin(t)].

* Xn = subs(x)

* plot(t, Xn)

* axis tight

* Grid on

* Grid minor