

ORUMWENSE OSASUYI ERNEST

16/EN GO6/061

Mechanical Eng

300L ENG 381

$$i) \frac{d^2x}{dt^2} + 5 \frac{dx}{dt} + 6x = \text{Cost}$$

$$m^2 + 5m + 6 = 0$$

$$m^2 + 2m + 3m + 6 = 0$$

$$(m^2 + 2m) + (3m + 6) = 0$$

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

$$\therefore m = -2; -3$$

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

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

$$\text{For P.I. ; } x = C\text{Cost} + D\text{Sint}$$

$$\frac{dx}{dt} = -C\text{Sint} + D\text{Cost}$$

$$\frac{d^2x}{dt^2} = -C\text{Cost} - D\text{Sint}$$

$$(-C\text{Cost} - D\text{Sint}) + 5(-C\text{Sint} + D\text{Cost})$$

$$+ 6(C\text{Cost} + D\text{Sint}) = \text{Cost}$$

$$-C\text{Cost} - D\text{Sint} - 5C\text{Sint} + 5D\text{Cost} + 6C\text{Cost}$$

$$+ 6D\text{Sint} = \text{Cost}$$

$$(-C + 5D + 6C)\text{Cost} (-D - 5C + 6D)\text{Sint} = \text{Cost}$$

$$-C + 5D + 6C = 1; -D - 5C + 6D = 0$$

$$5C + 5D = 1; 5D - 5C = 0$$

$$5C + 5D = 1$$

$$-5C + 5D = 0$$

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

$$5(\frac{1}{10}) + 5D = 1$$

$$\frac{5}{10} - 1 = -5D$$

$$\therefore D = \frac{1}{10} \therefore x = \frac{1}{10} \text{Cost} - \frac{1}{10} \text{Sint}$$

$$x = \frac{1}{10} (\text{Cost} + \text{Sint})$$

$$\therefore x = Ae^{-2t} + Be^{-3t} + \frac{1}{10} (\text{Cost} + \text{Sint}) \dots \text{eqn ①}$$

$$\therefore \frac{dx}{dt} = -2Ae^{-2t} - 3Be^{-3t} + \frac{1}{10} (-\text{Sint} + \text{Cost})$$

from eqn ①

$$\text{given } t=0, x=0.1 \quad \frac{dx}{dt} = 0$$

$$0.1 = A + B + 0.1(1)$$

$$\therefore A + B = 0 \dots \text{eqn ③}$$

from eqn ②

$$-2A - 3B + 0.1(1) = 0$$

$$-2A - 3B = 0.1 \dots \text{eqn ④}$$

$$(1) - (2) \text{ gives } A = -B$$

$$-2(-B) - 3B = 0.1$$

$$+2B - 3B = 0.1 \quad \therefore B = -0.1$$

$$A = 0.1$$

$$\therefore x = 0.1 \times e^{-2t} - 0.1 \times e^{-3t}$$

$$+ 0.1 (\text{Cost} + \text{Sint})$$

$$x = 0.1 (e^{-2t} - e^{-3t} + \text{Cost} + \text{Sint})$$

$$\therefore x = \frac{1}{10} (e^{-2t} - e^{-3t} + \text{Cost} + \text{Sint})$$



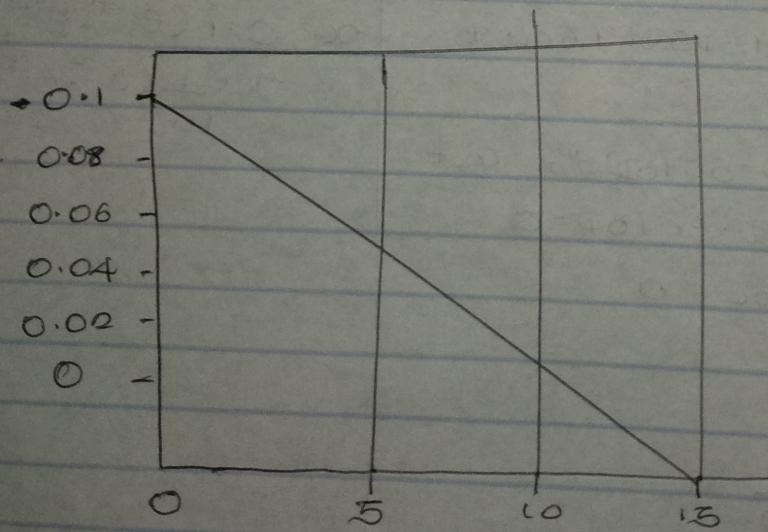
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(ii) MATLAB program to plot the relationship between α and t for $0 \leq t \leq 15$ with a step size of 0.01 and

Soln

- Command window
- clear
- clc
- close all
- symst
- $\alpha = 0.1 * (\exp(-3\pi t) - \exp(-2\pi t)) + (\cos t) + 5\sin t$
- $t_n = [0; 0.01; 15]$
- $\alpha_n = \text{subs}(\alpha, t_n)$
- figure (1)
- plot (t_n, α_n)
- grid on
- grid minor
- ~~gca~~ tight
- x label (' t')
- y label (' α')

Figure 1



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