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16/ENG06/076

ENR 381

$$1. \frac{d^2x}{dt^2} + 5\frac{dx}{dt} + 6x = \cos t$$

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

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

$$m(m+3) + 2(m+3)$$

$$(m+3)(m+2)$$

$$m = -3 \text{ or } m = -2$$

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

$$P.I \quad F(x) = \cos t$$

$$x = A \cos t + B \sin t$$

$$\frac{dx}{dt} = -A \sin t + B \cos t$$

$$\frac{d^2x}{dt^2} = -A \cos t - B \sin t$$

$$(-A \cos t - B \sin t) + 5(-A \sin t + B \cos t) + 6(A \cos t + B \sin t) = \cos t$$
$$\cos t (5B + 5A) + \sin t (6B - 5A)$$

$$5B + 5A = 1$$

$$+5B - 5A = 0$$

$$10B = 1$$

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

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

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

$$5A = 1 - \frac{1}{2}$$

$$A = \frac{1}{2} \div 5$$

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

$$P.I = \frac{1}{10} \cos t + \frac{1}{10} \sin t$$

$$x = C \cdot e + D \cdot T$$

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

When $x = 0$ | $t = 0$

$$0 = Ae^0 + Be^0 + \frac{1}{10}(\cos(0) + \sin(0))$$

$$0 = A + B + \frac{1}{10}(1 + 0)$$

$$0.1 = A + B$$

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

$$A + B = 0$$

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

When $\frac{dx}{dt} = 0$ | $x = 0$ | $t = 0$

$$0 = -3Ae^0 - 2Be^0 + \frac{1}{10}(-\sin(0) + \cos(0))$$

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

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

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

$$\therefore \begin{array}{l} 3A + 2B = \frac{1}{10} \quad \times 1 \\ A + B = 0 \quad \times 2 \end{array}$$

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

$$2A + 2B = 0$$

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

$$3\left(\frac{1}{10}\right) + 2B = \frac{1}{10}$$

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

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

$$B = \frac{2}{10} \div 2$$

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

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x
=
exp(-3*t)/10 - exp(-2*t) + cos(t) +
sin(t)

t
n
=
      0
    0.0100
   15.0000

x
n
=

    1/10 cos(1/100) - exp(-1/50) + exp(-3/100)/10 +
sin(1/100)          cos(15) - exp(-30) + exp(-
                    45)/10 + sin(15)

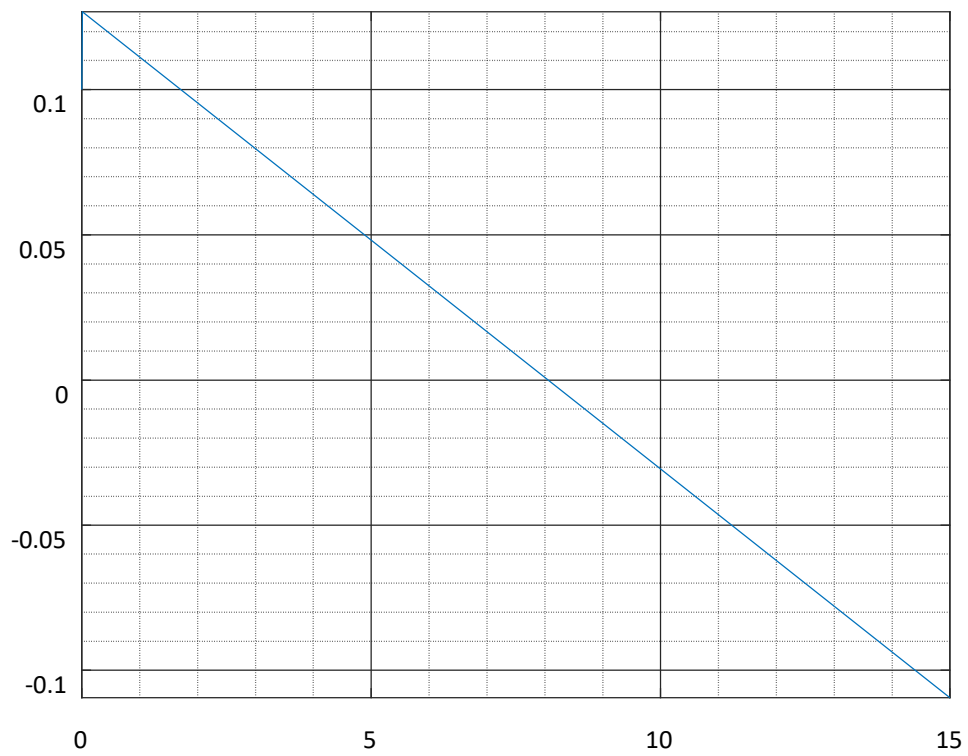
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COPMMANDS
commandwin
dow clear
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all syms t
x = 0.1*(exp(-3*t))-exp(-
2*t)+cos(t)+sin(t) tn = [0;0.01;15] xn =
subs(x,tn) figure (1) plot(tn,xn) grid on
grid minor axis tight xlabel ('t') ylabel
('x')

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3 From the graph A amplitude $B = 0.141$; $A \sin(\omega t + \phi)$

$$T = 14.9 - 8.7 = 6.2 \text{ sec}$$

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{6.2} = 1.0 \text{ rad/sec or } \frac{\pi}{2} \text{ rad}$$

$\phi =$ the value of t for which $\sin t = \cos t$

$$\Rightarrow 45^\circ \text{ or } \frac{\pi}{4} \text{ rad}$$

The steady state solution is given as

$$0.141 \sin(t + 45^\circ)$$

OR

$$\frac{\sqrt{2}}{10} \sin(t + \frac{\pi}{4})$$