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BIOMEDICAL ENGINEERING.
17/ENG08/004
ENG 381 ASSIGNMENT

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

$x = C_F + P.I$

$x = C_F$

$d^2x/dt^2 + 5dx/dt + 6x = 0$

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

$6m^2$ $\quad 2m, 3m$

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

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

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

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

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

$x = P.I$

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

$dx/dt = -C\sin t + D\cos t$

$d^2x/dt^2 = -C\cos t - D\sin t$

Substitute in General equation.

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

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

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

Collect the like coefficient

$\cos t(5C + 5D) = \cos t$ —— (i)

$\sin t(5D - 5C) = 0$ —— (ii)

Divide both equation by cost & sint respectively.

$5C + 5D = 1$ —— (i)

$5D - 5C = 0$ —— (ii)

Re-write eqn (ii)

$5D = 5C$

$D = C$

put $D = C$ in eqn (i)

$5C + 5C = 1$

$10C = 1$

$C = 1/10$

$\therefore D = 1/10$

$x = 1/10\cos t + 1/10\sin t$

$x = 1/10(\cos t + \sin t)$

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

at $t = 0$; $x = 0.1$.

$0.1 = Ae^{-3(0)} + Be^{-2(0)} + 1/10(\cos 0 + \sin 0)$

$0.1 = A + B + 1/10.$

$A+B = 0.1 - 1/10$

$A+B = 0$ ——— (I).

When $t = 0$ $dx/dt = 0$. ; differentiating x we have

$dx/dt = -3Ae^{-3t} - 2Be^{-2t} - 1/20 \sin t + 1/10 \cos t$.

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

$0 = -3A - 2B + 1/10$

$3A + 2B = 1/10$ ——— (II).

We write eqn (I).

$A = -B$.

Put $A = -B$ in eqn (II)

$3(-B) + 2B = 1/10$

$-3B + 2B = 1/10$

$-B = 1/10$

$B = -1/10$

$A = 1/10$

$\therefore x = 1/10\, e^{-3t} - 1/10 e^{-2t} + 1/10 (\cos t + \sin t)$

$x = 1/10 [e^{-3t} - e^{-2t} + \cos t + \sin t)$.

b. Command window.

```
clear
clc.
Close all
SymT
x = 1/10 * (exp(-3*t) - exp(2*t) + cos(t) + sin(t))
t = 0:0.01:15
xt = subs(x,T)
xtn = double(xt)
Plot(t, xtn)
xlabel('t')
ylabel('x')
grid on
grid minor
axis tight
```