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DEPT: MECHATRONICS ENGINEERING
MATRIC NO: 17/ENG05/1012

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

Assuming $\frac{d^2x}{dt^2} + 5\frac{dx}{dt} + 6x = 0$

$\frac{d^2x}{dt^2} + 5\frac{dx}{dt} + 6x = k^2 + 5k + 6 = 0$

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

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

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

$k+3 = 0, \quad k+2 = 0$

$k_1 = -3$ or $k = -2$

$C.F = Ae^{-3x} + Be^{-2x}$

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

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

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

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

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

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

$5D + 5C = 1 \quad --- (1)$

$5D - 5C = 0 \quad --- (2)$

Solving Simultaneously $10D = 1 \; ; \; D = 1/10$

$5(1/10) + 5C = 1 \quad \therefore 1/2 + 5C = 1$

$5C = 1 - 1/2 = 1/2$

$5C = 1/2$

$C = 1/10$

$P.I = x = 1/10\cos t + 1/10\sin t$

Therefore GS = P.I + CF

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

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

When $t = 0$, $x = 0.1$ & $dx/dt = 0$

Substituting these values into equation

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

$0.1 = A + B + 0.1$

$A + B = 0.1 - 0.1$

$A + B = 0 \quad - - - (1)$

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

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

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

$A + B = 0$

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

$2A + 2B = 0$

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

$-A = -0.1 \rightsquigarrow \frac{1}{10}$

$A = 0.1$

To Find B we sus A into equ(1)

$0.1 + B = 0$

$B = 0.1$

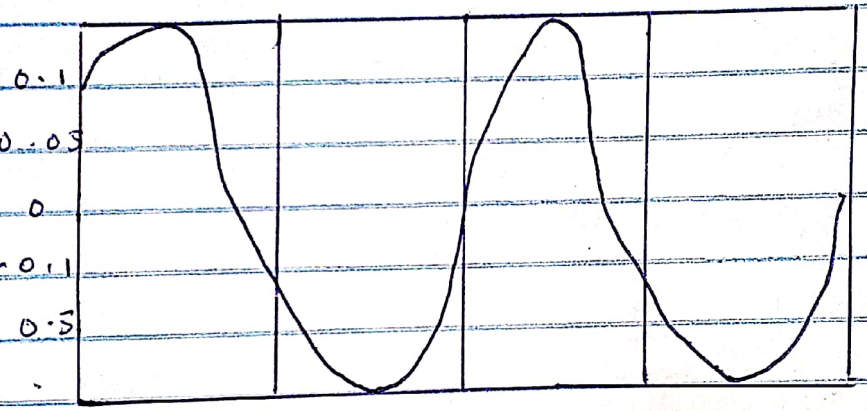
$GS = 0.1e^{-2t} - 0.1e^{-2t} + \frac{1}{10}(\sin t + \cos t)$

$= 0.1(e^{-3t} - e^{-2t} + \sin t + \cos t)$

MATLAB

Command window

```
clear
clc
close all
syms t
t = 0:0.01:15
x = 0.1 * [exp(-3*t) - exp(-2*t) + (cos(t) + sin(t))]
xn = subs(x
plot (t, xn)
axis tight
grid on
grid minor
```



$x = k \sin(t, 1.0)$

knowing that $x = 0.1$, at $t = 0$ $dx/dt = 0$

$dx/dt = k\cos(1t + a)$

$0 = k\cos(0 + a)$

$\therefore k\cos(a) = 0$

$0.1 = k\sin(0 + a)$

$k\sin(a) = 0.1 \quad \ldots (1)$

$\cos a = 0$

$a = \cos^{-1} 0$

$= 90°$

Substituting a into (1)

$0.1 < K \sin(90)$

$K = \frac{0.1}{\sin(90)} = 0.1$

$x = 0.1 [\sin(1+90)]$

Command Window

Close all

Clear

Clc

Syms t, x

t = [0 : 0.01 : 15]

x = 0.1 (sin(1+90))

plot (t, x