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17/ENG04/043 Electrical Electronics
ENG 381 ASSIGNMENT I

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

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

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

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

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

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

$$m+2 = 0 \quad m+3 = 0$$

$$m = -2, \quad m = -3$$

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

P.I; $f(t) = \cos t$; $x = C\cos t + D\sin t$

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

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

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

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

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

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

$$5C + 5D = 1 \quad \text{—(i)}$$

$$-5C + 5D = 0 \quad \text{—(ii)}$$

$$5D = 1 - 5C \quad \text{—(iii)}$$

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

$$1 - 10C = 0$$

$$1 = 10C$$

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

put C in eqn (iii)

$5D = 1 - 8 \times 1/10 \times 2$

$5D = 1 - 1/2$

$5D = 1/2 \quad : \quad D = 1/2 \div 5$

$D = 1/2 \times 1/5 = 1/10$

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

G.S ; C.F + P.I

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

when $t = 0, \quad x = 0.1$

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

$0.1 = A + B + 1/10$

$A + B = 0.1 - 1/10$

$A + B = 0 \quad$ ——— (i)

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

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

when $t = 0 \quad dx/dt = 0$

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

$0 = -2A - 3B - 1/10(0 - 1)$

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

$2A + 3B = 0.1 \quad$ ——— (ii)

from eqn (i)

$A = -B$

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

$-2B + 3B = 0.1$

$B = 0.1 = 1/10$

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

particular solution:

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

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

2) Command Windows

```
Clear
Clc
Close all
Syms x, t
x = 0.1*(exp(-3*t) - exp(-2*t) + cos(t) + sin(t))
t = 0:0.01:15
xn = subs(x)
plot(t, xn)
xlabel('time')
grid on
grid minor
axis tight.
```

Steady Flow

3) $0.1\cos t + 0.1\sin t = K\sin(t+a)$

$0.1\cos t + 0.1\sin t = K\sin t\cos a + K\sin a\cos t$

Comparing Coefficients

Cost ; $0.1 = K\sin a$

Sint ; $0.1 = K\cos a$

Square $K\sin a$ and $K\cos a$ and equate it to the addition

$K^2\sin^2 a + K^2\cos^2 a = 0.1 + 0.1$

$K^2(\sin^2 a + \cos^2 a) = 0.2$ $\quad [\sin^2 a + \cos^2 a = 1]$

$K^2 = 0.2$

$K^2 = \frac{2}{10}$

$K = \frac{\sqrt{2}}{10}$

$\frac{K\sin a}{K\cos a} = \frac{0.1}{0.1}$

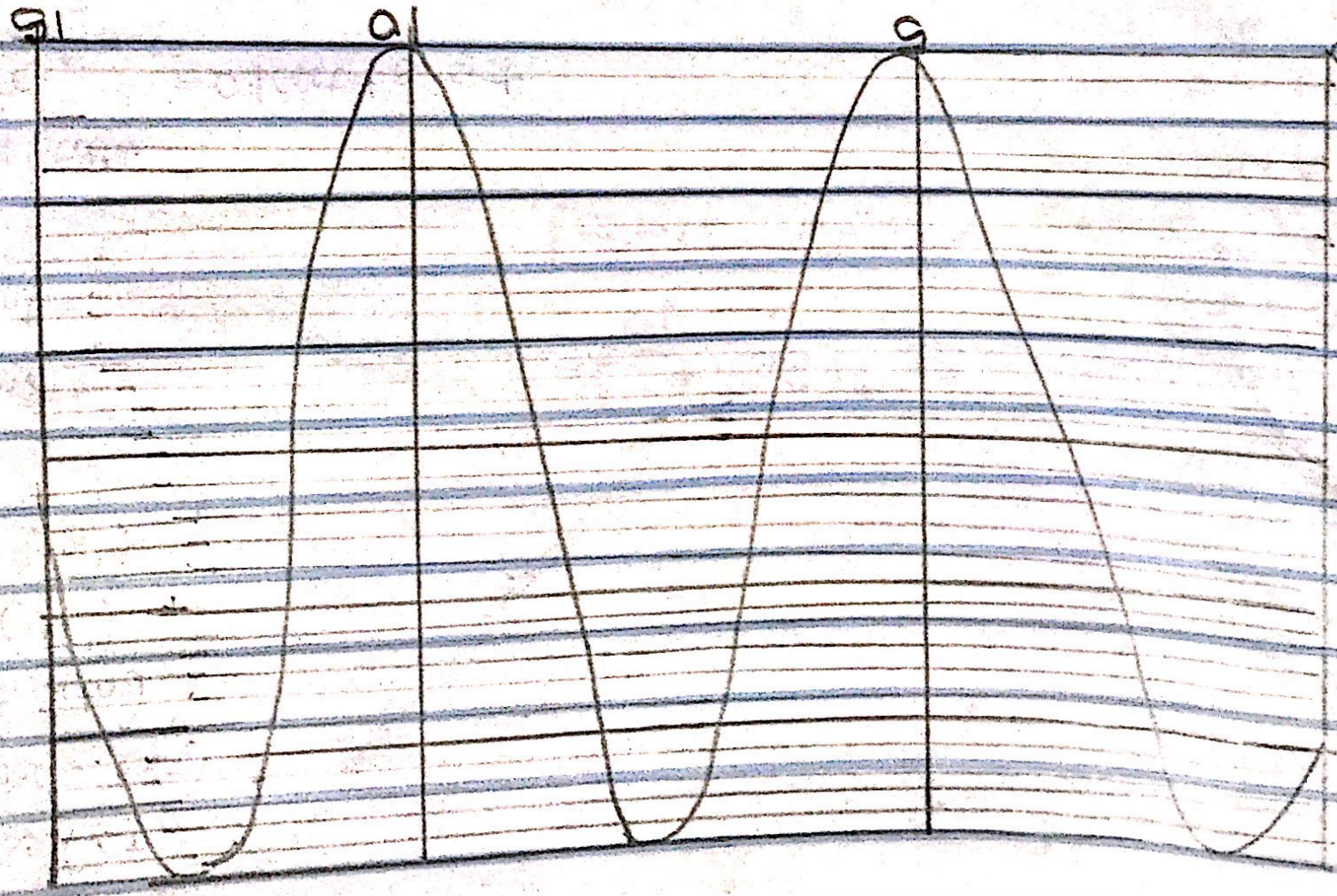
$\tan a = 1$

$a = \tan^{-1} 1$

$a = 45^\circ$ or $\frac{\pi}{4}$

∴ The Steady State ;

$x = \frac{\sqrt{2}}{10}\sin\left(\frac{\pi}{4} + t\right)$.


1.0
50.0
0
50.0
1.0
51.0