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17/ENG03/001
CIVIL ENGINEERING

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

$y = Ae^{kt}$

$dy/dt = Ake^{kt}$

$d^2y/dt^2 = Ak^2e^{kt}$

$Ak^2e^{kx} + 5(Ake^{kt} + 6Ae^{kx}$

$Ae^{kx}(k^2 + 5k + 6)$

$K_1 = -2 \quad K_2 = -3$

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

$y = \cos t + \sin t$

$\frac{dy}{dt} = -\sin t + \cos t$

$\frac{d^2y}{dt^2} = -\cos t - \sin t$

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

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

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

$= 5C\cos t - 5D\cos t = \cos t \times 1$

$5D\sin t - 5C\sin t = \sin t \times 1$

$\cos t\,(5C + 5D) = \cos t \times 1$

$\sin t\,(5D - 5C) = \sin t \times 0$

$5C + 5D = 1$

$5D - 5C = 0$

$5D - 5C = 0$

$5D = 5C$

$D = C$

where $5C + 5C = 1$

$10C = 1$

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

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

G.T = $1/10 \cos t + 1/10 \sin t$

$A e^{-2t} + B e^{-3t}$

P.S

$G.T = A e^{-3t} + B e^{-2t} + 1/10 \cos t + 1/10 \sin t$

$G.S = 1/10 e^{-3t} - 1/10 e^{-2t} + 1/10 \cos t + 1/10 \sin t$

$G.S = 1/10 e^{-3t} - 1/10 e^{-2t} + 1/10 (\cos t + \sin t)$

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

2) Command window

clear

cle

close all

Symsx

x = (1/10 * exp(-2*t)) - (1/10 * exp(-3*t)) + (sin(t) + cos(t))

t = 0:0.01:15

xt = subs(x,t)

Plot (t, xt, 'r')

x label ('t')

y label ('x')

Grid on

Grid minor

grid Output

At steady state

$x_p = x = 0.1 \cos t + 0.1 \sin t$

$t \to \infty$ Steady state

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

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

Coefficient of $\cos t = K \sin a$

Co-efficient of $\sin t = K \cos a$

Squaring both side

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

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$K^2(\sin^2\alpha + \cos^2\alpha) = 0.02$

$K^2 = 0.02$

$K = \sqrt{0.02}$

$K = 0.1414 = \sqrt{2}/10$

$\frac{K\sin\alpha}{K\cos\alpha} = \frac{0.1}{0.1} = 1$

Recall that $\sin/\cos = \tan$

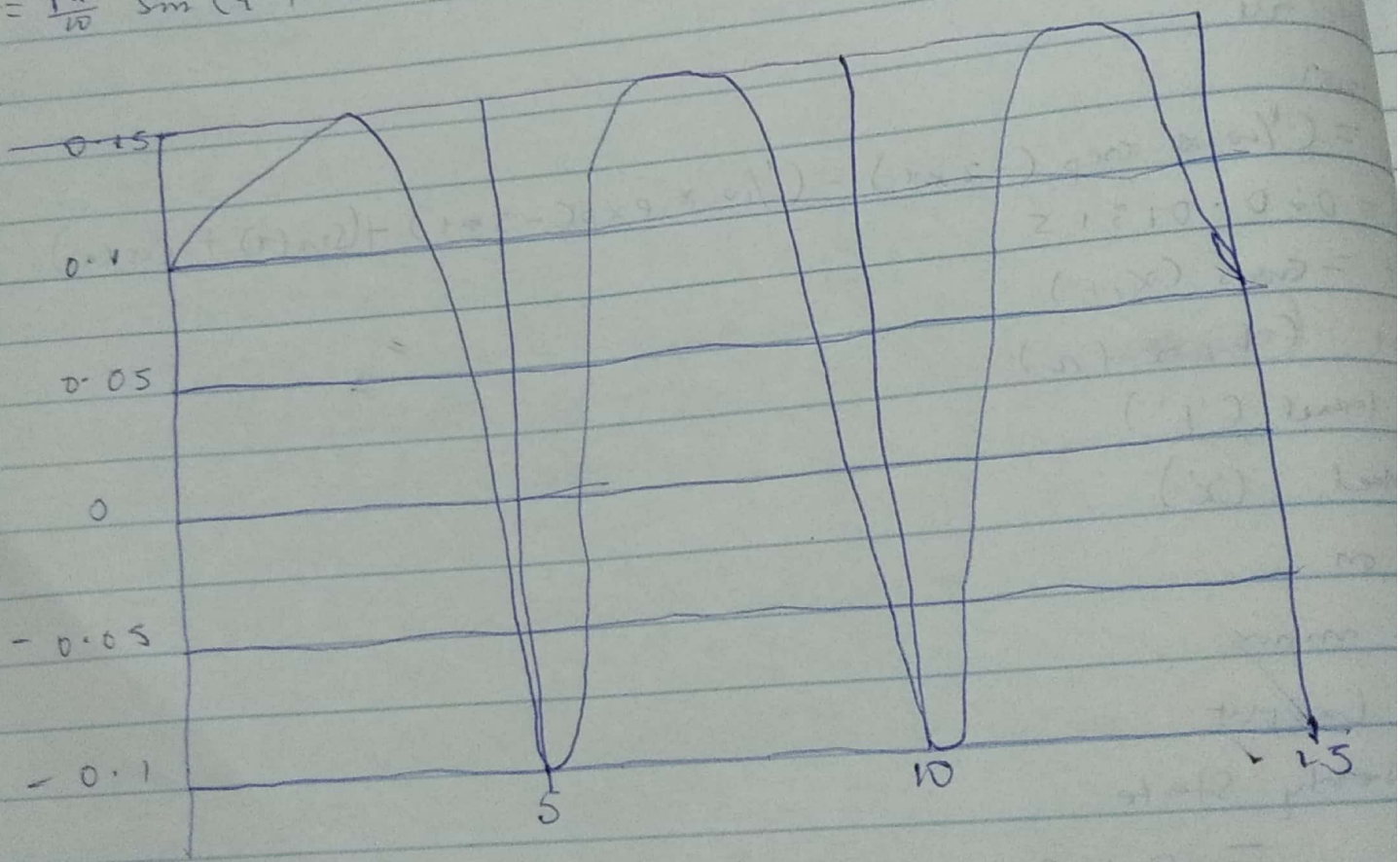
$\tan\alpha = 1$

$\tan^{-1}(1) = 0$

$\alpha = 45^0$ or $\pi/4$ radian

Steady state

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



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