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15/ENG01/020
ENG 381
CHEMICAL ENGINEERING

a $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 5y = 6\sin\theta$

$m^2 + 4m + 5 = 0$

$m = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$= \frac{-4 \pm \sqrt{4^2 - 4 \times 1 \times 5}}{2 \times 1}$

$= \frac{-4 \pm \sqrt{16 - 20}}{2}$

$\frac{-4 \pm \sqrt{-4}}{2}$

$m = -2 \pm j$

$y = e^{-2}(A\cos\theta + B\sin\theta)$

P.I $y = C\cos\theta + D\sin\theta$

$\frac{dy}{dx} = -C\sin\theta + D\cos\theta$

$\frac{d^2y}{dx^2} = -C\cos\theta - D\sin\theta$

$= -C\cos\theta - D\sin\theta + 4(-C\sin\theta + D\cos\theta) + 5(C\cos\theta + D\sin\theta)$

$= 6\sin\theta$

$= -C\cos\theta - D\sin\theta - 4C\sin\theta + 4D\cos\theta + 5C\cos\theta + 5D\sin\theta$

$= 6\sin\theta$

$\cos\theta(C - C + 4D + 5C) + \sin\theta(-D - 4C + 5D) = 6\sin\theta$

$4D + 4C = 0 \quad -①$

$4D - 4C = 6 \quad -②$

$8C = -6$

$C = \frac{-6}{8} \quad \frac{3}{4}$

$C = -\frac{3}{4}$

Sub in eqn ②

$4D - 4(-\frac{3}{4}) = 6$

$4D + 3 = 6$

$4D = 6 - 3$

$4D = 3$

$D = \frac{3}{4}$

G.S $= y = e^{-2}(A\cos\theta + B\cos\theta) + \frac{3}{4}\cos\theta + \frac{3}{4}\sin\theta$

b Neglecting the C.F

Where the model

$= y = \frac{3}{4}(-\cos\theta + \sin\theta) = -\frac{3}{4}(\cos\theta - \sin\theta)$

From $0°$ to $270°$

c It is steady flow value

(2) $EL\frac{d^2y}{dx^2} = \frac{W}{2}(L-x)^2$ ---(1)

$+m^2 = 0$

$m^2 = 0$

$m = \pm 0$ twice

$y = e^x(A+Bx)$

P.I $y = Cx^2 + Dx^3 + Ex^4$

$\frac{dy}{dx} = 2Cx + 3Dx^2 + 4Ex^3$

$\frac{d^2y}{dx^2} = 2C + 6Dx + 12Ex^2$

Sub into equ (1)

$EL(2C + 6Dx + 12Ex^2) = \frac{W}{2}(L-x)^2$

$EL(2C + 6Dx + 12Ex^2] = \frac{W}{2}(L^2 - 2Lx + x^2)$

$EL2C = \frac{WL^2}{2}$

$C = \frac{WL^2}{2} \div EL2$

$C = \frac{WL^2}{4EL}$

$EI\frac{d}{} = -2L\omega/2$

$d = -2L\omega/2EL6$

$= \frac{\omega L}{6EL}$

$EL+2e = \frac{\omega}{2}$

$e = \frac{\omega}{24EL}$

$y = \left[\left(\frac{\omega L^2}{4eL}\right)x^2 + \left(\frac{-\omega L}{6EL}\right)x^3 + \left(\frac{\omega}{24EL}\right)x^4\right]$

$y = \omega L^2 x^2 \cdot 6 - 4\omega L x^3 + \omega x^4$
$24EL$

when $y = 0$ & $x = 0$

$0 = A + B(0) + \frac{\omega}{24EL(0)}$

$= A = 0$

$\frac{dy}{dx} = B + \frac{\omega}{24EL}(12L^2x - 12Lx^2 + 4x^3)$

when $\frac{dy}{dx} = 0$ & $x = 0$

$0 = B + \frac{\omega}{24EL}(0)$

$B = 0$

Sub $y = 0 + 0 + \frac{\omega}{24EL}(6L^2x^2 - 4Lx^3 + x^4)$

$y = \frac{\omega}{24EL}(6L^2x^2 - 4Lx^3 + x^4)$

when $x = L$

$y = \frac{\omega}{24EL}(6L^2(L)^2 - 4L(L)^3 + (L)^4)$

$y = \frac{\omega}{24EL}(6L^4 - 4L^4 + L^4)$

$y = \frac{\omega}{24EL} \cdot 3L^4$

$y = \frac{3\omega L^4}{24EL}$ i. $y = \frac{\omega L^4}{8EL}$ (1)