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

Solution

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

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

$= \frac{-4 \pm \sqrt{4^2 - 20}}{2 \times 1}$

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

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

$= \frac{-4 \pm j2}{2} = -2 \pm j$

C.F $= y = e^{-2\theta}[C\cos\theta + D\sin\theta]$

P.I $= y = A\cos\theta + B\sin\theta$

$\frac{dy}{d\theta} = -A\sin\theta + B\cos\theta$

$\frac{d^2y}{d\theta^2} = A\cos\theta - B\sin\theta$

$-A\cos\theta - B\sin\theta - 4\sin\theta + 4B\cos\theta + 5A\cos\theta + 5B\sin\theta = 6\sin\theta$

$\cos\theta(-A + 4B + 5A) + \sin\theta(-B - 4A + 5B) = 6\sin\theta$

$4A + 4B = 0$ —— ①

$4B - 4A = 6$ —— ②

adding ① and ②

$4A + 4B = 0$

$+ \quad -4A + 4B = 6$

$8B = 6$

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

$4A + 4(3/4) = 0$

$4A + 3 = 0$

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$A = -3/4$

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

$GE = y = e^{\alpha}((c\cos\theta + D\sin\theta) - \frac{3}{4}\cos\theta + \frac{3}{4}\sin\theta$

at $\theta = \omega$ and $dy/d\theta = 0$

$dy/d\theta = e^{\alpha\omega}[-C\sin\theta + D\cos\theta] + [\cos\theta + D\sin\theta] - 2e^{\omega} + 3/4\sin\theta + 3/4\cos\theta$

$\theta = 3/4\sin\theta + 3/4\cos\theta$

$-3/4\cos\theta = 3/4\sin\theta$

$-\cos\theta = \sin\theta$

$-1 = \tan\theta$

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

$= -45^{\circ}$

2) $EI\frac{d^2y}{dx^2} = \frac{\omega}{2}(L-x)^2$

Solution

$EIm^2 = 0$

$m^2 = 0$

$m = +\sqrt{0}$

$m = \pm 0$

$y = e^{\alpha x}(A + Bx)$

$y = A + Bx$

$PI = y = Fx^2 + Gx^3 + Hx^4$

$\frac{dy}{dx} = 2Fx + 3Gx^2 + Hx^3$

$\frac{d^2y}{dx^2} = 2F + 6Gx + 12Hx^2$

$EI[2F + 6Gx + 12Hx^2] = \frac{\omega}{2}(L-x)^2$

~~$2FEI + 6GEI = +$~~

$2FEI + 6GEIx + 12HEIx^2 = \frac{\omega}{2}(L-x)^2$

$4FEI + 12GEIx + 24HEIx^2 = \omega(L^2 - 2Lx + x^2)$

$24HEI = \omega$

$H = \frac{\omega}{24EI}$ — (2)

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$12EI = 2wL$

$C_4 = \frac{-2wL}{12EI} = -\frac{w}{6EI}$ ---- ②

$48EI = wL^2$

$I = \frac{wL^2}{48E}$

$y = \left[\frac{wL^2}{48EI}\right]x^2 - \left[\frac{wL}{6EI}\right]x^3 + \left[\frac{w}{24EI}\right]$

$= \frac{wL^2x^2}{48EI} - \frac{wLx^3}{6EI} + \frac{wx^4}{24EI}$

$= 6wL^2x^2 - 4wLx^3 + wx^4$
$24EI$

$EI\frac{d^2y}{dx^2} = A + Bx + \frac{w}{24EI}[6L^2x^2 - 4Lx^3 + x^4]$

At $y = 0,\ x = 0,\ dy/dx = 0$

$0 = A + B(0) + \frac{w}{24EI}[6L^2(0) - 4L(0) + 0]$

$A = 0$

$\frac{dy}{dx} = B + \frac{w}{24EI}[12L^2x - 12Lx^2 + 4x^3]$

$0 = B + \frac{w}{24EI}[12(0) - 12(0) + 4(0)]$

$B = 0$

Particular Solution

$y = \frac{w}{24EI}[6L^2x^2 - 4Lx^3 + x^4]$

$y = \frac{wx^2}{24EI}[6L^2 - 4Lx + x^2]$

$y = \frac{wx^2}{24EI}[x^2 - 4Lx + 6L^2]$

when $x = L$

$y = \frac{wL^2}{24EI}[L^2 - 4L^2 + 6L^2]$

$y = \frac{wL^4}{8EI}$

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