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

SOLN

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

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

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

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

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

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

$= -2 \pm i$

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

PI : $y = A\cos\theta + B\sin\theta$

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

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

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

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

$4A + 4B = 0$ ——— (1)

$4B - 4A = 6$ ——— (2)

$4A + 4B = 0$

$-4A + 4B = 6$

$8B = 6$

$B = \frac{6}{8}$

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

$4A + 4(\frac{3}{4}) = 0$

$4A + 3 = 0$

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

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

GS : $y = e^{-x\theta}(a\cos\theta + b\sin\theta) - \frac{3}{4}\cos\theta + \frac{3}{4}\sin\theta$

at $\theta = \infty$ and $\frac{dy}{d\theta} = 0$

$\frac{dy}{d\theta} = e^{-x\theta}[-a\sin\theta + b\cos\theta] + [a\cos\theta + b\sin\theta] - 2e^{2\theta} +$

$\frac{3}{4}\sin\theta + \frac{3}{4}\cos\theta$

$0 = \frac{3}{4}\sin\theta + \frac{3}{4}\cos\theta$

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

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

$-1 = \frac{\sin\theta}{\cos\theta}$

$-1 = \tan\theta$

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

$= -45°$

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

SOLN

$EIm^2 = 0$

$m^2 = 0$

$m = \pm\sqrt{0}$

$y = e^{0(x)}(A+Bx)$

$y = A+Bx$

PI : $y = Lx^2 + Mx^3 + Nx^4$

$\frac{dy}{dx} = 2Lx + 3Mx^2 + 4Nx^3$

$\frac{d^2y}{dx^2} = 2L + 6Mx + 12Nx^2$

$EI[2L + 6Mx + 12Nx^2] = \frac{w}{2}(L-x)^2$

$2LEI + 6MEIx + 12NEIx^2 = \frac{w}{2}(L-x)^2$

$4LEI + 12MEIx + 24NEIx^2 = w(L^2 - 2Lx + x^2)$

$24NEI = w$

$N = \frac{w}{24EI}$ ——— (1)

$12MEI = -2wL$

$M = \frac{-2wL}{12EI} = -\frac{wL}{6EI}$ ——— (2)

$$AEI = wL^2$$

$$L = \frac{wL^2}{4EI}$$

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

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

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

$$24EI$$

GE $y = A + Bx + \frac{w}{24EI}\left[6L^2x^2 - 4Lx^2 + x^4\right]$

At $y = 0$, $x = 0$, $\frac{dy}{dx} = 0$

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

$$A = 0$$

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

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

$$B = 0$$

Particular solution

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

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

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

when $x = L$

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

$$y = \frac{wL^2}{24EI}\left[3L^2\right]$$

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