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15/ENG01/008
CHEMICAL ENGINEERING
ENG381

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

C.F: $d^2y/d\theta^2 + 4\,dy/d\theta + 5y = 0$

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

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

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

$\frac{-4 \pm \sqrt{16 - 4(5)}}{2} = \frac{-4 \pm \sqrt{16 - 20}}{2}$

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

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

$m = -2 \pm j$

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

For P.I: $f(x) = 6\sin\theta$

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

$dy/d\theta = -A\sin\theta + B\cos\theta$

$d^2y/d\theta^2 = -A\cos\theta - B\sin\theta$

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

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

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

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

$4A + 4B = 0 \quad - - \quad (i)$

$-4A + 4B = 6 \quad - - \quad (ii)$

~~Substitution~~ solving the equations using elimination method. 2.

~~4~~ From eqn (i)

$4A = -4B$

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

$A = -B$

~~From~~ Substituting ~~eqn~~ $A = -B$ in eqn (ii) we have

$-4(-B) + 4B = 6$

$4B + 4B = 6$

$8B = 6$

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

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

Since $A = -B$

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

P.I; $y = -\frac{3}{4}\cos\theta + \frac{3}{4}\sin\theta$

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

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

P.I = 0

iii P.I; $y = -\frac{3}{4}\cos\theta + \frac{3}{4}\sin\theta$

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

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

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

Dividing both sides by $-\cos\theta$

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

$\tan\theta = 1$

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

$\theta = 45^\circ$

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

$EI \cdot m^2 = 0$

$m^2 = 0$

$m = \pm\sqrt{0}$

$m = \pm 0$

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

C.F : $y = A + Bx$

P.I : $\cancel{y = Mx^2 + Nx^3 + 0}$

$y = Ex^2 + Fx^3 + Gx^4$

$\frac{dy}{dx} = 2Ex + 3Fx^2 + 4Gx^3$

$\frac{d^2y}{dx^2} = 2E + 6Fx + 12Gx^2$

$EI[2E + 6Fx + 12Gx^2] = \frac{W}{2}(L-x)^2$

$2EEI + 6EFIx + 12GEIx^2 = \frac{W}{2}(L^2 - 2Lx + x^2)$

$4EEI + 12EFIx + 24GEIx^2 = W(L^2 - 2Lx + x^2)$

$24GEI = W$

$G = \frac{W}{24EI}$ --- (1)

$12EFI = -2WL$

$F = \frac{-2WL}{12EI} = \frac{-WL}{6EI}$ -- (2)

$4EEI = WL^2$

$P = \frac{WL^2}{4EI}$

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

$$= \frac{WL^2x^2}{4EI} - \frac{WLx^3}{6EI} + \frac{Wx^4}{24EI}$$

$$= \frac{6WL^2x^2 - 4WLx^2 + Wx^4}{24EI}$$

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

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

at $y = 0$, $x = 0$ $\quad dy/dx = 0$

$$0 = A + B(0) + W/24EI\left[6L^2(0) - 4L(0) + 0\right]$$

$$A = 0$$

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

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

$$B = 0$$

Particular solution

$$y = W/24EI\left[6L^2x^2 - 4Lx^3 + x^4\right]$$

$$y = Wx^2/24EI\left[6L^2 - 4Lx + x^2\right]$$

$$y = Wx^2/24EI\left[x^2 - 4Lx + 6L^2\right]$$

when $x = L$

$$y = \frac{WL^2}{24EI}\left(L^2 - 4L^2 + 6L^2\right)$$

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