

CHEMICAL ENGINEERING

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

let $6\sin\theta = 0$

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

$$a = 1 \quad b = 4 \quad c = 5$$

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

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

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

$$m = -2 \pm j$$

$$m = \alpha \pm j\beta$$

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

$$f(\theta) = 6\sin\theta$$

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

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

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

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

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

$$+ 5 \cos\theta + 5 \sin\theta = 6 \sin\theta$$

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

$$+ 5 \cos\theta + 5D \sin\theta = 6 \sin\theta$$

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

$$= 6 \sin\theta$$

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

$$= 6 \sin\theta$$

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

$$4C + 4D = 0 \quad \dots \dots (i)$$

$$-4C + 4D = 6 \quad \dots \dots (ii)$$

$$8D = 6$$

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

from eqn (i)

$$4C + 4\left(\frac{3}{4}\right) = 0$$

$$4C + 3 = 0$$

$$C = -3/4$$

$$P.I \therefore y = \frac{-3 \cos\theta + 5 \sin\theta}{4}$$

$$G.S = C.F + P.I$$

$$y = e^{-2\theta} (A \cos\theta + B \sin\theta) + \frac{3}{4} \cos\theta + \frac{5}{4} \sin\theta$$

Steady state equation

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

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

$$\tan\theta = -1$$

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

$$\theta = -45^\circ$$

$$EI \frac{d^4 y}{dx^4} = w(1-x)^2$$

$$EI m^4 = 0$$

$$m^4 = 0$$

$$m = \pm \sqrt[4]{0}$$

$$m = \pm 0$$

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

$$C.I = y = A + Bx$$

$$P.I = y = Fx^2 + Gx^3 + Hx^4$$

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

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

$$EI (2F + 6Gx + 12Hx^2) = \frac{w}{2} (1-x)^2$$

$$2FEI + 6Gx EI + 12HEI x^2 = \frac{w}{2} (1-x)^2$$

$$4FEI + 12Gx EI + 24HEI x^2 = w(1^2 - 2x + x^2)$$

$$24HEI = w$$

$$H = \frac{w}{24EI} \quad \text{Comparing both eqn}$$

$$12GEI = 2wL$$

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

$$4FEI = wL^2$$

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

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

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

$$y = \frac{6wL^2 x^2 - 4wL x^3 - w x^4}{24EI}$$

$$G.S = y = A + Bx + \frac{w}{24EI} [6L^2 x^2 - 4L x^3 + x^4]$$

$$\text{at } y=0 \text{ and } \frac{dy}{dx} = 0$$

$$0 = A + B(0) + \frac{w}{24EI} [6L^2(0)^2 - 4(L)(0)^3 + (0)^4]$$

$$A = 0$$

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

$$0 = B + \frac{w}{24EI} [12L^2(0) - 12L^2 + 4(0)^3]$$

$$B = 0$$

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

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

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

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

$$\text{when } x = L$$

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

$$y = \frac{wL^2}{24EI} (3L^2)$$

$$y = \frac{3wL^4}{24EI}$$

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