

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

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

$$m = -2 \pm j$$

$$\alpha = -2 \quad \beta = 1$$

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

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

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

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

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

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

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

$$4D + 4C = 0$$

$$4D - 4C = 6$$

$$C = -\frac{3}{4}, \quad D = \frac{3}{4}$$

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

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

$$iii) \frac{dy}{dx} = \frac{3}{4} \sin \theta + \frac{3}{4} \cos \theta$$

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

$$\frac{\sin \theta}{\cos \theta} = -\frac{\cos \theta}{\cos \theta}, \quad \tan \theta = -1$$

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

$$\theta \text{ at steady state} = -45^\circ$$

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

$$EI m^2 = 0$$

$$m = 0$$

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

$$y = A + Bx$$

$$PI: y = Cx^2 + Dx^3 + Ex^4$$

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

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

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

$$2EI(2C + 6Dx + 12Ex^2) = w(L^2 - 2Lx + x^2)$$

$$4EIC + 12DEIx + 24(EI)Ex^2 = wL^2 - 2wLx + wx^2$$

$$24EI(E) = w$$

$$E = \frac{w}{24EI}$$

$$12DEI = -2wL$$

$$D = \frac{-2wL}{12EI}$$

$$4CEI = wL^2$$

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

$$\text{PI: } y = \left(\frac{WL^2}{4EI}\right)x^2 + \left(\frac{-WL}{6EI}\right)x^3 + \left(\frac{W}{24EI}\right)x^4$$

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

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

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

$$\text{G.S: } y = A + Bx + \frac{W}{24EI} (6L^2x^2 - 4Lx^3 + x^4)$$

$$\text{at } y = 0 ; x = 0, \frac{dy}{dx} = 0$$

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

$$A = 0$$

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

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

$$B = 0$$

P.S

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

$$x = L$$

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

$$y = \frac{w}{24EI} (3L^4)$$

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