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Assignment 2

Matric: 15/01907/028

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

$y'' + y' + 5y = 6\sin t$

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

$k^2 + 4k = -5$

$k^2 + 4k + 4 = -5 + 4$

$(k+2)^2 = -1$

$k+2 = \pm i$

$k_1 = -2+i, k_2 = -2-i$

$y = C_1 e^{(-2+i)t} + C_2 e^{(-2-i)t}$

$y = C_1 e^{-2t+i t} + C_2 e^{-2t-i t}$

$y = C_1 e^{-2t} e^{i t} + C_2 e^{-2t} e^{-i t}$

$y = e^{-2t} (C_1 e^{i t} + C_2 e^{-i t})$

$y = e^{-2t} (A \cos t + B \sin t)$

$y_p = A \cos t + B \sin t$

$y'_p = -A \sin t + B \cos t$

$y''_p = -A \cos t - B \sin t$

$-A \cos t - B \sin t + 4(-A \sin t + B \cos t)$

$+ 5A \cos t + 5B \sin t = 6 \sin t$

$-A \cos t - B \sin t - 4A \sin t + 4B \cos t$

$+ 5A \cos t + 5B \sin t = 6 \sin t$

$(-4A + 4B) \sin t + (4A + 4B) \cos t$

$= 6 \sin t$

$-4A + 4B = 6$

$4A + 4B = 0$

$8B = 6$

$B = \frac{6}{8} = \frac{3}{4}$

$4A = -4B$

$A = -B$

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

$y_p = -\frac{3}{4} \cos t + \frac{3}{4} \sin t$

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

Recall steady state eqn

$y'_p = 0$

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

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

$\cos t = -\sin t$

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

$\tan t = -1$

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

$E I m^2 = 0$

$m^2 = 0$

$m = \pm 0$

$m = \pm 0$

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

$y = A + Bx$

$y_p = y_2 F x^2 + G x^3 + H x^4$

$\frac{dy_p}{dx} = 2F x + 3G x^2 + 4H x^3$

$\frac{d^2y_p}{dx^2} = 2F + 6G x + 12H x^2$

$E I (2F + 6G x + 12H x^2) = \frac{w}{2} (L-x)^2$

$2F E I + 6G E I x + 12H E I x^2 = \frac{w}{2} (L-x)^2$

$4F E I + 2H E I x + 24H E I x^2 =$

$w(L^2 - 2Lx + x^2)$

$24H E I = w$

$H = \frac{w}{24E I}$

$12G E I = -2wL$

$$Q = \frac{-2wl}{12EI} = \frac{-wl}{6EI} \quad (2)$$

$$4FEI = wl^2$$

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

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

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

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

$$G.F = y = A + Bx + \frac{W}{24EI} (6l^2 x^2 - 4lx^3 + x^4)$$

$$at x=0, x=0 \quad \frac{dy}{dx} = 0$$

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

$$A = 0$$

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

$$0 = B + \frac{W}{24EI} (12l(0) - 12l(0) + 4(0))$$

$$B = 0$$

$$y_p = \frac{W}{24EI} (6l^2 x^2 - 4lx^3 + x^4)$$

$$y_p = \frac{W x^2}{24EI} (6l^2 - 4lx + x^2)$$

$$y_p = \frac{W x^2}{24EI} (x^2 - 4lx + 6l^2)$$

$$\text{at } x=l$$

$$y_p = \frac{wl^2}{24EI} (l^2 - 4l^2 + 6l^2)$$

$$y_p = \frac{wl^2}{24EI} (3l^2)$$

$$y_p = \frac{wl^3}{8EI}$$