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MAT NO: 15/ENG07/005

1) $y'' + 4y' + 5y = 6\sin t$
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ENG 381 ASSIGNMENT 2

$y'' + 4y' + 5y = 6\sin t$
 $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 5y = 6\sin t$

Soln

$y'' + 4y' + 5y = 6\sin t$
 $k^2 + 4k + 5 = 0$
 $k^2 + 4k = -5$
 $k^2 + 4k + (2)^2 = -5 + (2)^2$
 $(k+2)^2 = -1$
 $k+2 = \pm\sqrt{-1}$
 $k+2 = \pm i$
 $k_1 = -2+i, k_2 = -2-i$
 $y_h = C_1 e^{(-2+i)t} + C_2 e^{(-2-i)t}$
 $y_h = C_1 e^{-2t+i t} + C_2 e^{-2t-i t}$
 $y_h = e^{-2t} (C_1 e^{it} + C_2 e^{-it})$
 $y_h = e^{-2t} [A \cos t + B \sin t]$
 $y_p = A \cos t + B \sin t$
 $y_p' = -A \sin t + B \cos t$
 $y_p'' = -A \cos t - B \sin t$
 $-A \cos t - B \sin t + 4(-A \sin t + B \cos t) + 5(A \cos t + B \sin t) = 6 \sin t$
 $-A \cos t - B \sin t - 4A \sin t + 4B \cos t + 5A \cos t + 5B \sin t = 6 \sin t$
 $4A \cos t + 4B \sin t - 4A \sin t + 4B \cos t = 6 \sin t$
 $(-4A + 4B) \sin t + (4A + 4B) \cos t = 6 \sin t$
 $-4A + 4B = 6$
 $4A + 4B = 0$
 $8B = 6, B = 6/8 = 3/4$

$4A = -4B$
 $A = -B$
 $A = -3/4$

$y_p = -3/4 \cos t + 3/4 \sin t$
 $y = y_h + y_p$
 $y = e^{-2t} [A \cos t + B \sin t] + 3/4 \sin t = 3/4 \cos t$

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Steady state equation
 $y_p = 0$
 $y_p' = \frac{3}{4} \cos t + \frac{3}{4} \sin t = 0$
 $\frac{3}{4} \cos t + \frac{3}{4} \sin t = 0$
 $\frac{3}{4} \cos t = -\frac{3}{4} \sin t$
 $\cos t = -\sin t$
 $\sin t = -\frac{\cos t}{1}$
 $\tan t = -1$

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

$E I m^2 = 0$
 $m^2 = 0$
 $m = \pm \sqrt{0}$
 $m = \pm 0$

$y = e^{mx} [A + Bx]$
 $y = A + Bx$
 $y_p = y = Fx^2 + Gx^3 + Hx^4$
 $\frac{dy}{dx} = 2Fx + 3Gx^2 + 4Hx^3$
 $\frac{d^2 y}{dx^2} = 2F + 6Gx + 12Hx^2$

$E I [2F + 6Gx + 12Hx^2] = \frac{w}{L} (L-x)^2$
 $2FEI + 6GEIx + 12HEIx^2 = \frac{w}{L} (L-x)^2$
 $4FEI + 12FEIx + 24FEIx^2 = w(L^2 - 2Lx + x^2)$
 $24HEI = w$
 $H = \frac{w}{24EI}$ — (1)

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

4FEI = w
F = $\frac{wL}{4EI}$

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

G.E = y =
at y = 0,
0 = A + B
A = -B
 $\frac{dy}{dx} = B +$
0 = B +
B = 0
y_p =
y_p = $\frac{wL^2}{24EI}$
y_p = $\frac{wL^2}{24EI}$
When
y_p =
∴ y = $\frac{wL^2}{24EI}$

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

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

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

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

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

$$\text{at } y = 0, x = 0 \text{ as } x \rightarrow \infty$$

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

$$A = 0$$

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

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

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

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

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

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

$$\therefore y = \frac{w L^4}{8EI}$$