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DEPARTMENT: CHEMICAL ENGINEERING

COURSE CODE: ENG 381

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

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

$m = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ where $a = 1, b = 4, c = 5$

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

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

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

$= -2 \pm j$

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

For particular integration; $y = C\cos\theta + D\sin\theta$

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

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

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

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

$4C + 4D = 0$

$4C = -4D$

$C = -D$

$4D - 4C = 6$

Substitute $C = -D$ in the above equation

$4D - 4(-D) = 6$

$4D + 4D = 6$

$8D = 6$

$D = 3/4$

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

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

iii) At steady state, $\frac{dx}{d\theta} = 0$ and $\theta = \infty$

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

$0 = e^{-2\infty}(-A\sin\infty + B\cos\infty) - 2e^{-2\infty}(A\cos\infty + B\sin\infty) + \frac{3}{4}\sin\infty + \frac{3}{4}\cos\infty$

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

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

$\frac{4}{3} \times \frac{3}{4}\tan\theta = -\frac{3}{4} \times \frac{4}{3}$

$\tan\theta = -1$

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

$\theta = -45^\circ$

$\theta = 180^\circ - 45^\circ$

$\theta = 135^\circ$

2 $EI\frac{d^2y}{dx^2} = \frac{w}{2}(L - x^2)$ $EI\frac{d^2y}{dx^2} + 0y = \frac{w}{2}(L - x^2)$

$EI\frac{d^2y}{dx^2} = 0$

$\frac{EIm^2}{EI} = \frac{0}{EI}$

$m^2 = 0$

$m = \pm\sqrt{0}$

$m = \pm 0$

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

~~$y = A$~~ $y = A$

~~for particular integration~~ for particular integration; $y = Cx^2 + Dx + E$

$\frac{dy}{dx} = 2Cx + D$

$\frac{d^2y}{dx^2} = 2C$

$EI(2C) = \frac{w}{2}(L - x^2)$

$2CEI = \frac{wL}{2} - \frac{wx^2}{2}$ $\frac{w}{2}(L^2 - x^2)$

$2CEI = \frac{w}{2}(L - x)^2$

$2CEI = \frac{w}{2}(L - x)(L - x)$

$2CEI = \frac{w}{2}(l - \pi l x - \pi l x + x^2)$

$2CEI = \frac{w}{2}(l - 2\pi l x + x^2)$

$2CEI = \frac{1}{2}(wl - 2x\pi l + x^2)$

$CEI = wl - 2x\pi l + x^2$

$\frac{CEI}{EI} = \frac{wl}{EI}$

$C = \frac{wl}{EI}$, $E = \frac{wl}{GI}$

$0 = -2x\pi l$

$x = 0$

$y = \left(\frac{wl}{EI}\right)x^2$ ~~$+ \frac{wl}{GI}$~~

G.S; $y = A + \left(\frac{wl}{EI}\right)x^2 + \frac{wl}{GI}$

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

$0 = A$

$A = 0$

$\frac{dy}{dx} = 1 + 2\left(\frac{wl}{EI}\right)x$

$0 = 1 + 0$

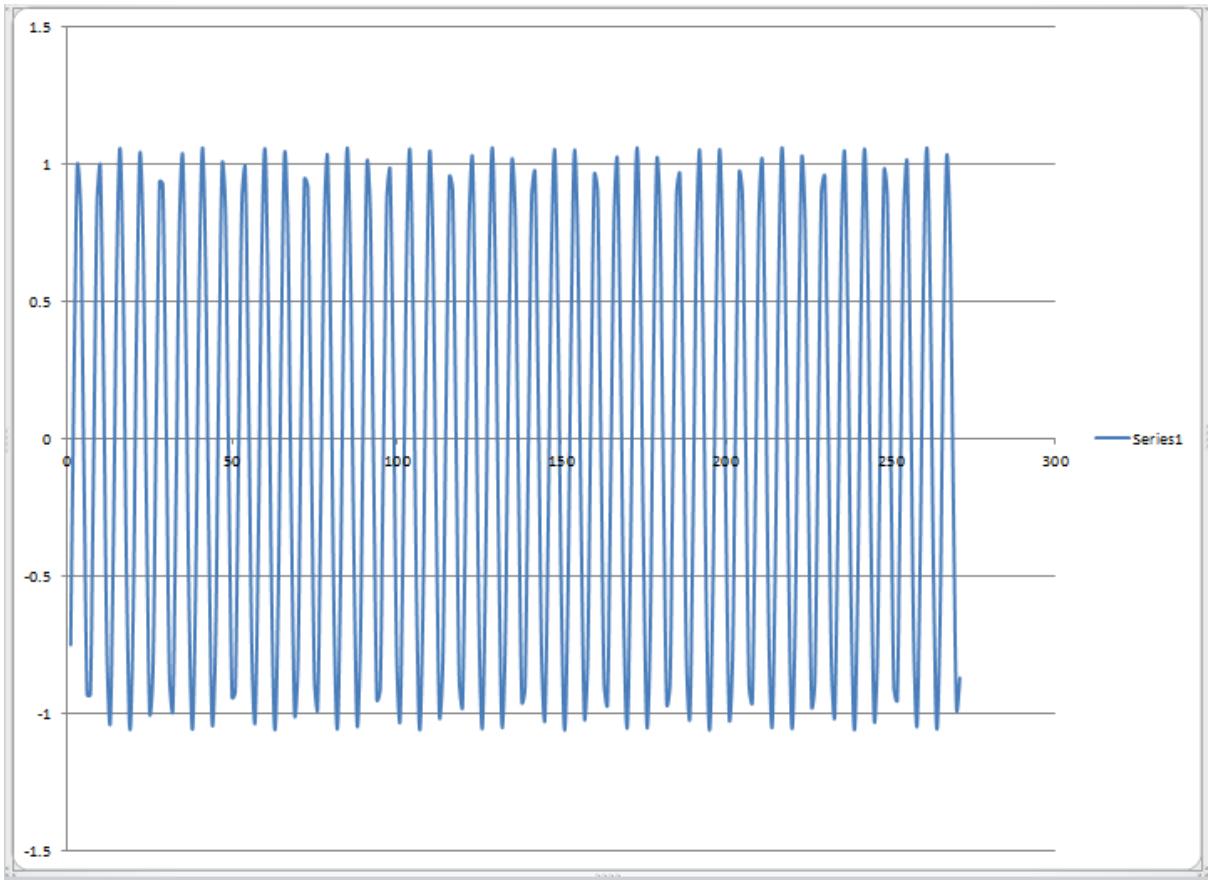
$0 = 1$

P.S; $y = \left(\frac{wl}{EI}\right)x^2$

when $x = l$

$y = \left(\frac{wl}{EI}\right)l^2$

$y = \frac{wl^3}{EI}$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