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15/ENG06/002

Mechanical

~~Maths~~

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

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

$m = -1 \pm j$

$y = C\cos\theta + D\sin\theta$

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

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

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

$\frac{dy}{dx} = -2e^{-2x}(-A\sin x + B\cos x) - 4e^{-2x}$

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

$-2 = -2(B) - 4$

$-2 = -2B - 4$

$-2 + 4 = -2B$

$\frac{2}{-2} = \frac{-2B}{-2}$ $B = 0$

$y = e^{-2x}(-C\cos x + -\cos\sin 0)$

$\therefore y = e^{-2x}(-\cos x)$

2) $3\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - y = 2x - 3$

$\frac{dy}{dx} = C$ $y = (x + 1)$

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

$3(0) - 2(C) - (x + D) = 2x - 3$

$= 0 - 2C - (x + 1) = 2x - 3$

$-2C - (x + 1) = 2x - 3$

$-x = 2x$ $-2(1) = -3$

$\frac{-C}{-} = \frac{2}{-}$ $-2(-2) + D = -3$

$C = -2$ $4 + D = -3$

$D = -7$

5.) $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 4\sin\sin x$

$y = C\cos x + D\sin x$

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

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

$(\cos x - 1)\sin x - 2(-C\sin x + D\cos x) + C\cos x + 1)\sin x = 4\sin x$

$(\cos x - 1)\sin x + 2C\sin x - 2D\cos x + C\cos x + D\sin x = 4\sin x$

$C\cos x + C\cos x - D\sin x + D\sin\sin x + 2C\sin x - 2C\cos x = 4\sin x$

$2C\sin x - 2D\cos x = 4\sin x$

$2C = 4 \qquad -2D = 0$

$2C = C \qquad -2D = 0$

$C = \frac{4}{2} = 2 \qquad D = 0$

$P_2 = 2\cos x$

$m^2 - 2m + 1 = 0 \quad \therefore m = 1$

$\therefore y = e^x(A + Bx) + 2\cos x$

6.) $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 5y = 2e^{-2x}$

$\frac{dy}{dx} = -2Ce^{-2x} \qquad \frac{d^2y}{dx^2} = 4Ce^{-2x}$

$4Ce^{-2x} + 4(-2Ce^{-2x}) + 5(Ce^{-2x}) = 2e^{-2x}$

$4Ce^{-2x} - 8Ce^{-2x} + 5Ce^{-2x} = 2e^{-2x}$

$e^{-2x}(4C - 8C + 5C) = 2e^{-2x}$

$\frac{1}{1}e = \frac{2}{1}$

$C = 2$

$P.I = 2e^{-2x}$

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

$m = \alpha \pm i\beta$

$m = -2 \pm i$

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

$x = 0 \quad dy/dx = -2$

$1 = e^{-2(0)}\cdot(A\cos(0) + B\sin(0)) + 2e^{-2(0)}$

$1 = 1\cdot A + 2$

$1 - 2 = 1A \quad -1/1 = 1A/1 \quad A = -1$

3) $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 1e^{-2x}$

$y = Ce^{-2x}$

$\frac{dy}{dx} = -2Ce^{-2x}$

$\frac{d^2y}{dx^2} = 4Ce^{-2x}$

$4Ce^{-2x} + 2(-2Ce^{-2x}) + Ce^{-2x} = 1e^{-2x}$

$4Ce^{-2x} - 4Ce^{-2x} + Ce^{-2x} = 1e^{-2x}$

$e^{-2x}(4C - 4C + 1C) = 1e^{-2x}$

$4C - 4C + 1C = 1$

$\frac{1C}{1} = \frac{1}{1}$ $\quad PI = 1e^{-2x}$

C.F

$m^2 + 2m + 1 = 0$

$m = -1$

$y = e^{-x}(A + Bx) + 1e^{-2x}$

4) $\frac{d^2y}{dx^2} + 25y = 5x^2 + x$

$m^2 + 25 = 0$

$m^2 = -25$

$m = \pm\sqrt{-25}$

~~$m = \pm\sqrt{25}$~~

$m = \pm 5j$

C.F : $y = A\cos 5x + B\sin 5x$

$F(x) = 5x^2 + x$ $\quad y = Cx^2 + Dx + E$

$dy/dx = 2(x+1)$ $\quad d^2y/dx = 2C$

$2C + 25(Cx^2 + Dx + E) = 5x^2 + x$

$2C + 25Cx^2 + 25Dx + 25E = 5x^2 + x$

$25Cx = 5x^2$ $\quad 25Dx = 1$ $\quad 2C + 25E = 0$

$C = \frac{1}{25}$ $\quad D = \frac{1}{25}$ $\quad 2(\frac{1}{5}) + 25E = 0$

$E = -\frac{2}{5} \times \frac{1}{25} = \frac{-2}{125}$

$\therefore P.I = \left(\frac{x^2}{5} + \frac{x}{25} - \frac{2}{125}\right)$

G.S : $y = A\cos 5x + B\sin 5x + \left(\frac{x^2}{5} + \frac{x}{25} - \frac{2}{125}\right)$

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151ENG06100 2
Mechanical Engr

1) $\frac{d^2y}{dx^2} - \frac{dy}{dx} - 2y = 8$

$m^2 - m - 2 = 0$

$m_1 = -1 \quad m_2 = 2$

$y = Ae^{-x} + Be^{2x}$

$y = c$

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

$= (0 - 0) - 2(0) = 8$

$-\frac{2c}{-2} = \frac{8}{2} = -4$

$c = -4$

$\therefore y = Ae^{-x} + Be^{2x} - 4$

2) $\frac{d^2y}{dx^2} - 4y = 10e^{3x}$

$m^2 - 4 = 0$

$m^2 = 4$

$m = \pm\sqrt{4}$

$m = \pm 2$

$y = A\cosh 2x + B\sinh 2x$

$= ce^{3x}$

y

$dy/dx = 3ce^{3x} \qquad \frac{d^2y}{dx^2} = 9ce^{3x}$

$9ce^{3x} - 4(ce^{3x}) = 10e^{3x}$

$9(e^{3x} - 4ce^{3x} = 10e^{3x}$

$e^{3x}(9c - 4c) = 10e^{3x}$

$\frac{5c}{5} = \frac{10}{5}$

$c = 2 \quad \therefore PI = 2e^{3x}$

$y = A\cosh 2x + B\sinh 2x + 2e^{3x}$