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15/ENG06/049
MECH. ENG

ENG 381

Assignment 1

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

$m^2 - m - 2 = 0$

$m_1 = -1 \quad m_2 = 2$

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

$y = C$

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

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

$\frac{-2C}{-2} = \frac{8}{-2}$

$C = -4$

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

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

$m^2 - 4 = 0$

$m^2 = 4$

$m = \pm\sqrt{4}$

$m = \pm 2$

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

$y = Ce^{3x}$

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

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

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

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

$C = 2$

$PI = 2e^{3x}$

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

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

$y = Ce^{-2x}$

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

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

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

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

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

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

$4C-4C+C = 1$

$\therefore C = 1$

$PI = 1e^{-2x}$

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

$m = -1$

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

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

$m^2 + 25 = 0$

$m^2 = -25$

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

$m = \pm j5$

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

$f(x) = 5x^2 + x$ $\qquad y = Cx^2 + Dx + E$

$\partial y/\partial x = 2Cx + D$ $\qquad \partial^2 y/\partial x = 2C$

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

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

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

$C = 1/25$ // $\qquad D = 1/25$ // $\qquad 2(1/5) + 25E = 0$

$E = -2/5 \times 1/25 = -2/125$ //

$\therefore P.I = (x^2/5 + x/25 - 2/125)$

$C.F \cdot y = A\cos 5x + B\sin 5x + (x^2/5 + x/25 - 2/125)$

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

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

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

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

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

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

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

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

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

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

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

$= 2$

$P.I. = 2\cos x$

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

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

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

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

$dy/dx = -2Ce^{-2x}$ $\quad d^2y/dx^2 = 4Ce^{-2x}$

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

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

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

$C = 2$

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

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

$m = -4 + jB$

$m = -2 \pm j)$

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

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

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

$1 = 1A + 2$

$1 = 1A + 2$

$1 - 2 = 1A$

$\frac{-1}{1} = \frac{1A}{1}$

$A = -1$

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

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

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

$-2 = -2B - 4$

$-2 + 4 = -2B$

$2 = -2B$

$B = \frac{2}{-2} = 1$

$y = e^{-2x}(-\cos x - (0)\sin 1)$

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

7 $\frac{3d^2y}{dx^2} = \frac{2dy}{dx} - y = 2x - 3$

$\frac{dy}{dx} = C \qquad y = Cx + D$

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

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

$= 0 - 2C - Cx + D = 2x - 3$

$-2C - Cx + D = 2x - 3$

$-Cx = 2x$

$-C = 2$

$\therefore C = -2$

$-2C + D = -3$

$-2(-2) + D = -3$

$4 + D = -3$

$D = -3 - 4 = -7$

P I $\Rightarrow y = -2x - 7$

$3m^2 - 2m - 1 = 0$

$m_2 = 1, \quad m_1 = -\frac{1}{3}$

$C.F = y = Ae^{-\frac{1}{3}x} + Be^{x}$

$C.F = y = Ae^{-\frac{1}{3}x} + Be^{x} - 2x - 7$

8 $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 2y = 8e^{4x}$

$y = Ce^{4x}$

$\frac{dy}{dx} = 4Ce^{4x}$

$\frac{d^2y}{dx^2} = 16Ce^{4x}$

$16Ce^{4x} - 6(4Ce^{4x}) + 8(Ce^{4x}) = 8e^{4x}$

$16Ce^{4x} - 24e^{4x} + 8Ce^{4x} = 8e^{4x}$

$e^{4x}(16C - 24C + 8C) = 8e^{4x}$

$0C = 8$

$C = \frac{8}{0}$ which is undefined

$m^2 - 6m + 8 = 0$

$m_1 = 2; \quad m_2 = 4$

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