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COMPUTER ENGINEERING
ENG 381 ASSIGNMENT

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

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

$m^2 - m - 2 = 0$

$(m^2 + m) - (2m - 2) = 0$

$m(m+1) - 2(m+1) = 0$

$(m-2)(m+1) = 0$

$m_1 = 2, \; m_2 = -1$

C.F: $y = Ae^{2x} + Be^{-x}$

P.I $= y = C$

$\frac{dy}{dx} = 0$

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

$0 - 0 - 2C = 8$

$-2C = 8$

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

$C = -4$

G.S: $Ae^{2x} + Be^{-x} - 4$

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

$\frac{d^2y}{dx^2} - 4y = 0$

$m^2 - 4 = 0$

$m^2 = 4$

$m = \sqrt{4}$

$m = \pm 2$

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

$$\frac{dy}{dx}$$

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

$$9Ce^{3x} + 0(3Ce^{3x}) - 4(Ce^{3x}) = 10e^{3x}$$

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

$$5Ce^{3x} = 10e^{3x}$$

$$C = \frac{10e^{3x}}{5e^{3x}}$$

$$C = 2$$

$$y = 2e^{3x}$$

$$G.S: A\cosh 2x + B\sinh 2x + 2e^{3x}$$

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

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

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

$$m(m+1) + 1(m+1) = 0$$

$$(m+1)(m+1) = 0$$

$m = -1$ (twice)

$C.F: y = e^{-x}(A + Bx)$

P.I $y = Ce^{-2x}$

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

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

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

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

$$0 + Ce^{-2x} = e^{-2x}$$

$Ce^{-2x} = e^{-2x}$

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

$C = 1$

$P.I = 1e^{-2x}$

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

$G.S = e^{-x}(A+Bx) + e^{-2x}$

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

$\frac{d^2y}{dx^2} + 25y = 0$

$m^2 + 25 = 0$

$m^2 = 25$

$m = \sqrt{25}$

$m = \pm 5$

C.F:

$y = A\cosh 5x + B\sinh 5x$

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

$\frac{d^2y}{dx^2} + 25y = 0$

$m^2 + 0 + 25 = 0$

$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$\frac{-0 \pm \sqrt{0^2 - 4(1)(25)}}{2(1)}$

$\frac{-0 \pm \sqrt{-25 \times 4}}{2}$

$\frac{-0 \pm \sqrt{1} \cdot \sqrt{4} \cdot \sqrt{25}}{2}$

$m = \frac{\pm j2\sqrt{25}}{2}$

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

$m = \pm j5$

CF;

$y = A\cos 5x + B\sin 5x$

P.I; $y = Cx^2 + Dx + E$

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

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

$2C + 0(2Cx + D) + 25(Cx^2 + Dx + E) = 5x^2 +$

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

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

$2C + 25E = 0 \quad -(1)$

$25C = 5 \quad -(2)$

$25D = 1 \quad -(3)$

From eq 1

$2C + 25E = 0$

From eq 2

$25C = 5$

$C = \frac{5}{25}$

$C = \frac{1}{5}$

From Eq 3

$25D = 1$

$D = \frac{1}{25}$

Substituting $C = 1/5$ into eq 1

$2C + 25E = 0$

$2\left(\frac{1}{5}\right) + 25E = 0$

$25E = -\frac{2}{5}$

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

$E = \frac{-2}{125}$

P.I: $y = \frac{1}{5}x^2 + \frac{1}{25}x - \frac{2}{125}$

G.S;

$y = A\cos 5x + B\sin 5x + \frac{1}{5}x^2 + \frac{1}{25}x - \frac{2}{125}$

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

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

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

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

$m(m-1) - m(m-1) = 0$

$(m-1) = 0$ twice

$m = 1$ twice

$y = e^x(A + Bx)$

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

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

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

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

$= 4\sin x$

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

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

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

Comparing coefficients

$-2D = 0$ — (1)

$2C = 4$ — (2)

$C = \frac{4}{2}$

$C = 2$

$-2D = 0$

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

$D = 0$

$P.I = y = 2\cos x + 0\sin x$

$y = 2\cos x$

G.S : $y = e^x[A + Bx] + 2\cos x$

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

given that @ $x = 0$, $y = 1$ and $\frac{dy}{dx} = -2$

$\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 5y = 0$

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

$m = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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

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

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

$4\sin x$

$= -2$

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

$m = \frac{-4 \pm \sqrt{-4}}{2}$

$m = \frac{-4}{2} + j\frac{2}{2}$

$m = -2 \pm j$

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

P.I; $y = Ce^{-2x}$

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

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

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

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

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

$Ce^{-2x} = 2e^{-2x}$

$C = 2$

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

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

at $x = 0 \quad y = 1$

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

$1 = 1(A + 0) + 2$

$1 = A + 2$

$A = -2 + 1$

$A = 1 - 1$

$\therefore x = 0 \quad \frac{dy}{dx} = -2$

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

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

$-2 = -2(0 + B) - 2$

$-2 = -2B - 2$

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

$B = 0$

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

$y = -e^{-2x}\cos x + 2e^{-x}$

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

$3\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - y = 0$

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

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

$3m(m-1) + 1(m-1) = 0$

$(3m+1)(m+1) = 0$

$3m + 1 = 0$

$3m = -1$

$m_1 = \frac{-1}{3}$

$m - 1 = 0$

$m_2 = 1$

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

8 P.I; $y = Cx + D$

$\frac{dy}{dx} = C$

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

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

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

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

Comparing coefficients

$-2C-D=-3$

$-C=2$

$\therefore C=-2$

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

$4-D=-3$

$-D=-3-4$

$-D=-7$

$D=7$

P.I; $y=-2x+7$

G.S: $y=Ae^{-1/3x}+Be^{x}-2x+7$

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

$\frac{d^2y}{dx^2}-6\frac{dy}{dx}+8y=0$

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

$m^2-2m-4m+8=0$

$m(m-2)-4(m-2)=0$

$m-4=0, \quad m-2=0$

$m_1=4, \quad m_2=4$

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

P.I; $y=Ce^{4x}$

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

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

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

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

$Ce^{4x}(0)=8e^{4x}$

$C=\frac{8e^{4x}}{e^{4x}(0)}$

$y=0e^{4x}$

$y=0$