$m = \pm 2$

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

P.I $\quad y = Ce^{3x}$

$\frac{dy}{dx} = 3Ce^{3x}$

$\frac{d^2y}{dx^2} = 9Ce^{3x} = 9Ce^{3x} + 6(3Ce^{3x}) - 4(Ce^{3x}) = 10e^{3x}$

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

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

$C = 2, \quad y = 2e^{3x}$

C.S $= C.F + P.I$

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

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

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

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

$m(m+1) + 1(m+1) = 0, \quad m = -1$ (three)

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

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

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

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

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

$C = 1$

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$y = e^{-2x}$.

GS = CF + PI

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

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

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

$m^2 + 25 = 0$

$m^2 + 0 + 25 = 0$, $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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

$\frac{-0 \pm \sqrt{11} \cdot \sqrt{4} \cdot \sqrt{25}}{2}$, $m = \pm\sqrt{25}$ $m = \pm 5$

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

PI $= y = cx^2 + dx + e$, $\frac{dy}{dx} = 2cx + d$

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

$2c + 0(2cx + d) + 25(cx^2 + dx + e) = 5x^2 + x$

$2c + 25(cx^2 + dx + e) = 5x^2 + x$

$2c + 25cx^2 + 25dx + 25e = 5x^2 + x$

Comparing co-efficient.

$2c + 25e = 0$ ... (1)

$25cx^2 = 5x^2$ ... (2)

$c = \frac{5}{25}$, $c = 1/5$ ... (3)

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$25A = 1$ ⇒ $A = 1/25$ ... (iii)

Sub eqn (iii) in (i)

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

$\frac{2}{5} + 25\varepsilon = 0$

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

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

$PI = \frac{5}{25}x^2 + \frac{1}{25x} - \frac{2}{125}$

$\frac{1}{25} \cdot [25x^2 + 5x - 2]$

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

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

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

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

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

$m(m-1) - 1(m-1)$

$m - 1 = 0, \quad m - 1 = 0$

$m = 1$ (twice)

C.F $y = e^{2x}[A + Bx]$

P.I $= (\cos 2x + A\sin x) = y$

$\frac{dy}{dx} = (\sin x + 1)\cos x$

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

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

$= 4\sin x$

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

$= 4\sin x$

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

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

Comparing co-efficients

$-2D = 0$

$-D = 0$

$2C = 4$

$C = 2$

$y_p = 2\cos x + 0(\sin x)$

$y_p = 2\cos x$

Gen. sol $= y = e^{-x}(A + Bx) + 2\cos x$

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

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

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

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

$m = \frac{-4 \pm \sqrt{4^2 - 4(1)(5)}}{2(1)}$, $m = \frac{-4 \pm \sqrt{16 - 20}}{2}$

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

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

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

$$m = -2 \pm j$$

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

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

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

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

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

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

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

$$c = 2$$

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

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

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

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

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

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

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

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

$C = 2$

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

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

at $x = 0$, $y = 1$

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

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

$1 = A + 2$

$A = -2 + 1$

$A = -1$

$\therefore$ at $x = 0$ $dy/dx = -2$

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

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

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

$-2 = -2B - 2$

$-2B = -2 + 2$

$B = 0/-2$

$B = 0$

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

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

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

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

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

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

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

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

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

$3m + 1 = 0$

$3m = -1$

$m_1 = -1/3, \quad m - 1 = 0, \quad m_2 = 1$

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

P.I, $y = cx + d$

$\frac{dy}{dx} = c, \quad \frac{d^2y}{dx^2} = 0$

$3(0) + -2(c) - (cx + d) = 2x - 3$

$0 - 2c - cx - d = 2x - 3$

$-2c - d - cx = 2x - 3$

comparing co-efficients

$-2c - d = -3 \cdot (1)$

$-cx = 2x \cdot (2)$

from eqn (2)

$-cx - 2x$

$c = -2$

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

$16Cxe^{4x} + 4Ce^{4x} + 4Ce^{4x} - 24Cxe^{4x} - 6Ce^{4x} + 8Cxe^{4x} = 8e^{4x}$

$16Cxe^{4x} - 24Cxe^{4x} + 8Cxe^{4x} + 4Ce^{4x} + 4Ce^{4x} - 6Ce^{4x} = 8e^{4x}$

$8Ce^{4x} - 6Ce^{4x} = 8e^{4x}$

$2Ce^{4x} = 8e^{4x}$

$2C = 8$

$C = 8/2$

$C = 4$

$PI = y = 4xe^{4x}$

$GS = CF + PI$

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

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from eqn (i)

$-2C - \Delta = -3$

$-2(2) - \Delta = -3$

$-4 - \Delta = -3$

$-\Delta = -3 + 4$

$-\Delta = -7$

$C = -2, \Delta = -7$

$y = Cx + \Delta$

$PI = y = -2x + 7$

$C.S = y = Ae^{x} + Be^{(-1/3)x} - 2x + 7$

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

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

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

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

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

$m_1 = 2, m_2 = 4$

$PI = y = Ce^{4x}$

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

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

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

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

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

$m^2 - m - 2 = 0$

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

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

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

$m = 2, m - 1$, C.F $y = Ae^{2x} + Be^{-x}$

$PI = y = c$

$\frac{dy}{dx} = 0, \frac{d^2y}{dx} = 0, 0 - 0 - 2C = 8$

$-2C = 8, C = -4$, G.S = CF + PI

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

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

$d^2y/dx^2 - 4y = 0$

$m^2 - 4 = 0$

$\sqrt{m^2} = \pm\sqrt{4}$

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