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15/ENG04/053

①

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

$m^2 - m - 2 = 0$

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

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

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

$m_1 = -1$

$m_2 = 2$

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

$P.I \Rightarrow y = C$

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

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

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

$C = 4$

$G.S \Rightarrow Ae^{-x} + Be^{-2x} + (-4)$

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

②

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

$m^2 - 4 = 0$

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

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

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

$m_1 = 2, \quad m_2 = -2, \quad m = \pm 2$

$C.F \Rightarrow y = A\cosh 2x + B\sinh 2x$

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

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

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

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

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

$C = 10/5$

$C = 2$

$A\cosh 2x + B\cos 2x + 2e^{3x}$

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

(3)

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

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

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

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

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

$m = -1$ twice

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

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

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

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

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

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

$C = 1$

$G.S = e^{-x}(A + Bx) + 1e^{-2x}$

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

(4)

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

$m^2 + 25 = 0$

$m^2 = -25$

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

$m = \pm 5j$

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

P.I $y = Ex^2 + Fx + G$

$\frac{dy}{dx} = 2Ex + F$

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

$2E + 25[Ex^2 + Fx + G] = 5x^2 + x$

$2E + 25Ex^2 + 25Fx + 25G = 5x^2 + x$

$25Ex^2 = 5x^2$

$25E = 5$

$E = 1/5$

$25Fx = x$

$25F = 1$

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

$2E + 25G = 0$

$2(1/5) + 25G = 0$

$2/5 + 25G = 0$

$25G = -2/5$

$G = -2/125$

G.S $= C\cos 5x + D\sin 5x + 1/5x^2 + 1/25x - 2/125$

(5)

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

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

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

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

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

$m = 1$ twice

$y = Ae^x + Bxe^x$

$y = ex(A + Bx)$

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P.I $y = C\sin x + D\cos x$

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

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

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

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

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

$-2C = 0$

$C = 0$

$2D = 4$

$D = 2$

G.S $= e^x(A + Bx) + 0\sin x + 2\cos x$

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

(6)

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

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

$m^2 + 4m + 5$

$a = 1, b = 4, c = 5$

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

$= \frac{-4 \pm \sqrt{4^2 - 4 \times 5}}{2} = \frac{-4 \pm \sqrt{16 - 20}}{2}$

$= \frac{-4 \pm \sqrt{-4}}{2} \quad 2 \quad -4 \pm 2j$

$= -2 \pm j$

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

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

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

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

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

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

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

$9Ce^{-2x} - 8Ce^{-2x} = 2e^{-2x}$

$C = 2$

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

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

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

$1 = A + 2$

$A = -1$

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

$-4e^{-2x}$

at $x = 0$

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

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

$-2 = B + 2(-1) - 4$

$-2 = B + 2 - 4$

$B = -2 + 2$

$B = 0$

$G.S: e^{-2x}(-1\cos x + 0\sin x) + 2e^{2x}$

$G.S = 1\ e^{-2x}\{-\cos x\} + 2e^{-2x}$

$G.S = 1\ -e^{-2x}\cos x + 2e^{-2x}$

$2e^{-2x} - \cos x\, e^{-2x}$

$G.S = e^{-2x}\{2 - \cos x\}$

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(7)

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

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

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

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

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

$m = -1/3, \; m = 1$

$y = Ae^{-1/3x} + Be^{x}$

$P.I = Cx + D$

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

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

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

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

$-Cx = 2x$

$C = -2$

$-2C - D = -3$

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

$4 - D = -3$

$-D = -4 - 3$

$D = 7$

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

(8)

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

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

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

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

$m = 2, \; m = 4$

$C.F \Rightarrow y = Ae^{2x} + Be^{4x}$

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

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

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

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

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

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

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

$C = 0$

$\therefore$ P.I $= y = Cxe^{4x}$

$= 4Cxe^{4x}$

$\frac{dy}{dx} = 16Cxe^{4x}$

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

$16Cxe^{4x} =$

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

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

$\frac{d^2y}{dx^2} = 8Ce^{4x} + 16Cxe^{4x}$

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

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

$2Ce^{4x} + 0 = 8e^{4x}$

$2C = 8$

$C = 4$ $\therefore y = 4xe^{4x}\{Cxe^{4x}\}$

GS $\Rightarrow y = Ae^{2x} + Be^{4x} + 4xe^{4x}$

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