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DPP-8 Maths - IV

Topic - Homogeneous Linear Partial Differential Equation with Constant coefficient (CF)

Q-1: Solve $\frac{\delta^2 z}{\delta x^2} - \frac{\delta^2 z}{\delta x \delta y} - 6\frac{\delta^2 z}{\delta y^2} = 0$

Sol: $\frac{\delta^2 z}{\delta x^2} - \frac{\delta^2 z}{\delta x \delta y} - 6\frac{\delta^2 z}{\delta y^2} = 0$

$(D^2 - DD' - 6D'^2)z = 0$

Put $D = m$, $D' = 1$

$(m^2 - m - 6)z = 0$

Aux Equation -

$m^2 - m - 6 = 0$

$m^2 - 3m + 2m - 6 = 0$

$m(m-3) + 2(m-3) = 0$

$(m+2)(m-3) = 0$

$m = -2, 3$

$CF = f_1(y-2x) + f_2(y+3x)$

$PI = 0$

Complete solution $z = CF + PI$

$z = f_1(y-2x) + f_2(y+3x)$

Ans

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Q-2 : Solve $\frac{\delta^3 z}{\delta x^3} - 3\frac{\delta^3 z}{\delta x^2 \delta y} + 2\frac{\delta^3 z}{\delta x \delta y^2} = 0$

$(D^3 - 3D^2D' + 2DD'^2)z = 0$

$D(D^2 - 3DD' + 2D'^2)z = 0$

Aux Equation :

$D(D^2 - 3DD' + 2D'^2) = 0$

$D = 0$

$CF = f_1(y)$

$D^2 - 3DD' + 2D'^2 = 0$

Put $D = m$, $D' = 1$

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

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

$m = 1, 2$

$CF = f_2(y+x) + f_3(y+2x)$

$PI = 0$

Complete solution $z = CF + PI$

$z = f_1(y) + f_2(y+x) + f_3(y+2x)$ Ans

Q-3 : Solve - $4r - 12s + 9t = 0$

$4\frac{\delta^2 z}{\delta x^2} - 12\frac{\delta^2 z}{\delta x \delta y} + 9\frac{\delta^2 z}{\delta y^2} = 0$

$(4D^2 - 12DD' + 9D'^2)z = 0$

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Auxiliary Equation :- $4m^2 - 12m + 9 = 0$

$(2m-3)^2 = 0$

$m = \frac{3}{2}, \frac{3}{2}$

$C.F. = f_1\left(y + \frac{3}{2}x\right) + x f_2\left(y + \frac{3}{2}x\right)$

$PI = 0$

Complete solution ⇒ $z = CF + PI$

$z = f_1\left(y + \frac{3}{2}x\right) + x f_2\left(y + \frac{3}{2}x\right)$ Ans

Q-4:- $(D^3D' - 4D^2D'^2 + 4DD'^3)z = 0$

$DD'(D^2 - 4DD' + 4D'^2)z = 0$

Auxiliary Equation:-

$DD'(D^2 - 4DD' + 4D'^2) = 0$

$D = 0$ $\quad D' = 0$ $\quad (D^2 - 4DD' + 4D'^2) = 0$

Put $D = m$, $D' = 1$

$C.F. = f_1(y)$ $\quad C.F. = f_2(x)$ $\quad m^2 - 4m + 4 = 0$

$(m-2)^2 = 0$

$m = 2, 2$

$C.F. = f_3(y+2x) + x f_4(y+2x)$

$PI = 0$

Complete solution ⇒ $z = CF + PI$

$z = f_1(y) + f_2(x) + f_3(y+2x) + x f_4(y+2x)$ Ans

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