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COLLEGE - ENGINEERING
DEPARTMENT - MECHANICAL
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Answer.

$y = e^{x+x}$

$y' = (2x+1)e^{x^2+x}$

$y'' = 2e^{x^2+x} + (2x+1)(2x+1)e^{x^2+x}$

$y'' = 2e^{x^2+x} + (2x+1)^2 e^{x^2+x}$

$\therefore y'(2x+1) + 2y$

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

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

but $y'' = 2e^{x^2+x} + (2x+1)^2 e^{x^2+x}$

$\therefore y'' = y'(2x+1) + 2y$ //

From the above equation.

Part A.

$A = y''$ $A' = y'''$ $A^n = y^{2+n}$.

Part B.

$B = y'(2x+1)$

$u = y'$ $u^n = y^{n+1}$

$v = 2x+1$

$v' = 2$.

$v^{2+n} = 0$.

$\therefore B_n = (y^{n+1})(2x+1) + n(y^n)(2) + 0$

$B_n = (2x+1)y^{n+1} + 2ny^n$

Part C.

$C = 2y$.

$C^n = 2y^n$.

$\therefore A^n = B^n + C^n$

$y^{n+2} = (2x+1)y^{n+1} + 2ny^n + 2y^n$

$y^{n+2} = (2x+1)y^{n+1} + 2y^n(n+1)$

$\therefore y^{n+2} = (2x+1)y^{n+1} + 2(n+1)y^n$

2 $y = x^3 e^{4x}$ determine $y^{(5)}$

Let $u = e^{4x}$ $u' = 4e^{4x}$ $u'' = 16e^{4x}$ $u^n = 4^n e^{4x}$.

$v = x^3$ $v' = 3x^2$ $v'' = 6x$ $v''' = 6$ $v^{iv} = 0$.

By leibniz theorem

$y^n = 4^n e^{4x} \cdot x^3 + n \cdot 4^{n-1} e^{4x} \cdot 3x^2 + \frac{n(n-1)}{2!} \cdot 4^{n-2} e^{4x} \cdot 6x + \frac{n(n-1)}{3!}$

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$(n-2).4^n e^{4x}$

$y^n = 4^n e^{4x} x^3 + 3x^2 n.4^{n-1} e^{4x} + 3n(n-1).4^{n-2} e^{4x} x + n(n-1)(n-2).4^{n-3} e^{4x}$

$\therefore y^5 = 4^5 e^{4x}.x^3 + 3x^2(5).4^4 e^{4x} + 3(5)(4).4^3 e^{4x} x + (5)(4)(3).4^2 e^{4x}$

$y^5 = 1024e^{4x}.x^3 + 3840e^{4x}.x^2 + 3840e^{4x}.x + 960e^{4x}$

$y^5 = 64e^{4x}(16x^3 + 60x^2 + 60x + 15)$

ii $x^2 \frac{d^2y}{dx^2} + x\, dy/dx + y = 0$. Show that $x^2 y^{(n+2)} + (2n+1)x y^{(n+1)} + (n^2+1)y^n = 0$

For part A.

$A = x^2 y''$

$u = y''$ $\quad u^n = y^{n+2}$

$v = x^2$ $\quad v' = 2x$ $\quad v'' = 2$ $\quad v''' = 0$

$A^n = (y^{n+2})x^2 + n(y^{n+1}).2x + \frac{n(n-1)}{2!}.y^n.2 + 0$

$A^n = x^2 y^{(n+2)} + 2xny^{(n+1)} + n(n-1)y^n$

For Part B.

$B = xy'$

$u = y'$ $\quad u^n = y^{n+1}$

$v = x$ $\quad v' = 1$ $\quad v'' = 0$.

$B^n = (y^{n+1}).x + n(y^n).1 + 0$

$= xy^{(n+1)} + ny^n$

For part C.

$C = y$

$C^n = y^n$

$A^n + B^n + C^n = 0$

$x^2 y^{(n+2)} + 2xny^{(n+1)} + (n^2-n)y^n + xy^{(n+1)} + ny^n + y^n = 0$

$= x^2 y^{(n+2)} + xy^{(n+1)}(2n+1) + y^n(n^2 - n + n + 1) = 0$

$= x^2 y^{(n+2)} + (2n+1)xy^{(n+1)} + (n^2+1)y^n = 0$

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