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ENG381 LMS Assignment 1.

① (i) $y'(2x+1)+2y$

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

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

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

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

From the above equation.

* Part A,

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

* Part B,

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

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

$v = 2x+1$

$v' = 2$

$v'' = 0$

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

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

* Part C,

$c = 2y$

$c^n = 2y^n$

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

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

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

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

② (i) $y = x^3 e^{4x}$ determine y^3

let $u = e^{4x}, u' = 4e^{4x}, u'' = 16e^{4x}$ $u^{n} = 4^n e^{4x}$

let $V = x^3 = V' = 3x^2; V'' = 6x, V''' = 6, V^{iv} = 0$

By Leibnitz theorem

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

$4^{n-3}.e^{4x}.6 + c$

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

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

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

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

(5) $x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$ Show that

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

* For part A

$A = x^2 y^n$

$u = y^n, u^n = y^{n+2}$

$v = x^2, v' = 2x, v'' = 2, v''' = 0$

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

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

* Part B

$B = xy^n$

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

$v = x, v' = 1, v'' = 0$

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

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

* For part C

$C = y$

$C^n = y^n$

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

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

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

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