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17/ENG03/009
CIVIL ENGINEERING

ASSIGNMENT

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

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

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

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

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

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

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

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

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

from the above equation

Part A

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

Part B

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

$x = y'$; $x'' = y^{x+1}$

$x = 2x+1$

$v' = 2$

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

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

Part C

$C = 2y$

$C'' = 2y^n$

$\therefore A' = B'' + C''$

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

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

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

20 $y = x^3 e^{4x}$, $y^{(5)}$

let $u = e^{4x}$, $u' = 4e^{4x}$, $u'' = 16e^{4x}$, $u^n = 4^n e^{4x}$
let $v = x^3$, $v' = 3x^2$, $v'' = 6x$, $v''' = 6$, $v'''' = 0$

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

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

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

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

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

For Part A

$A = x^2 y''$

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

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

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

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

For part B

$B = xy'$

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

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

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

For part C

$C = y$

$C^n = y^n$

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

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

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

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