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15/ENG04/025
ELECTRICAL/ELECTRONICS ENG.

Solution to Assignment 3.

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

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

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

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

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

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

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

$2y = 2 \cdot e^{x^2+x}$

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

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

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

$w = y''$

$w^n = y^{n+2}$

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

$v = 2x+1 \qquad u = y'$

$v' = 2 \qquad u^n = y^{n+1}$

$v'' = 0 \qquad u^{n-1} = y^n$

$p^n = y^{n+1} \cdot 2x+1 + n \cdot y^n \cdot 2$

$s = 2y$

$s^n = 2y^n$

$w^n = p^n + s^n$

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

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

(2) Using the Leibnitz theorem, given that

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

$v = x^3$ $\quad\quad$ $u = e^{4x}$

$v^{(1)} = 3x^2$ $\quad\quad$ $u^{(1)} = 4e^{4x}$

$v^{(2)} = 6x$ $\quad\quad$ $u^{(2)} = 4 \cdot 4 e^{4x}$

$v^{(3)} = 6$ $\quad\quad$ $u^{(3)} = 4 \cdot 4 \cdot 4 e^{4x}$

$v^{(4)} = 0$ $\quad\quad$ $u^n = 4^n e^{4x}$

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

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

$$\Rightarrow y^3 = 4^3 e^{4x} x^3 + 4e^{4x} 3x^2 + 5 \cdot 4 \cdot 4^3 e^{4x} 3x + 5 \cdot 4 \cdot 3 \cdot 4^2 e^{4x}$$

(ii) $x^2 y^{(2)} + x y^{(1)} + y = 0$ show that

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

let $w = x^2 y^{(2)}$

$v = x^2$ $\quad\quad$ $u = y^{(2)}$

$v^{(1)} = 2x$ $\quad\quad$ $u^{(1)} = y^{(3)}$

$v^{(2)} = 2$ $\quad\quad$ $u^{(2)} = y^{(4)}$

$v^{(3)} = 0$ $\quad\quad$ $u^{(n)} = y^{n+2}$

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

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

let $P = xy'$

$v = x$ $\quad\quad$ $u = y'$

$v^{(1)} = 1$ $\quad\quad$ $u^{(1)} = y^{(2)}$

$v^{(2)} = 0$ $\quad\quad$ $u^n = y^{n+1}$

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$p^n = y^{n+1} \cdot x + n \cdot y^n \cdot 1$

$p^n = x y^{n+1} + n y^n$

$s = y$

$s^n = y^n$

(1)

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

$\Rightarrow y^{n+2} x^2 + (2xn\, y^{n+1} + x y^{n+1}) + [n(n-1) y^n + n y^n + y^n] = 0$

$\Rightarrow x^2 y^{n+2} + (2n+1) x\, y^{n+1} + [n(n-1) + 1 + n] y^n = 0$

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