$w_2 = x y^{(1)}$ $\quad\quad$ $w_3 = y$

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

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

$u^{(n-1)} = y^{(n)}$

Using lebnitz theorem

$$y^{n} = u^{(n)} v + n u^{(n-1)} v^{(1)} + \frac{n(n-1)}{2!} u^{(n-2)} v^{(2)}$$

$$w_1^{(n)} = y^{(2+n)} \cdot x^2 + n(y^{(1+n)} \cdot 2x) + \frac{n(n-1) y^{(n)}}{2!} \cdot 2$$

$$w_1^{(n)} = x^2 y^{(n+2)} + 2xn y^{(1+n)} + n(n-1) y^{(n)}$$

$$w_2^{(n)} = y^{(1+n)} \cdot x + n y^{(n)} \cdot 1$$

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

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

$u^n = 4^n e^{4x}$

$u^{n-1} = 4^{n-1} e^{4x}$ $\quad$ $v^1 = 3x^2$

$u^{n-2} = 4^{n-2} e^{4x}$ $\quad$ $v^2 = 6x$

$u^{n-3} = 4^{n-3} e^{4x}$ $\quad$ $v^3 = 6$

$y^{(n)} = u^{(n)} v + n u^{(n-1)} v^1 + \frac{n(n-1) u^{(n-2)}}{2!} v^2 +$

$\frac{n(n-1)(n-2)}{3!} u^{(n-3)} v^3 + \cdots$

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

$+ \frac{5(4)(3)}{3!} (4^2 e^{4x}) \cdot 6 \; 2$

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OLADIMEJI .O. MAYOWA
15/ENG02/042
Computer Engineering

1. $y = e^{x^2+x}$ —— (i)

$y^n = a^n e^{ax}$

$y' = (2x+1)e^{x^2+x}$ —— (ii)

$u = 2x+1$ $\quad$ $v = e^{x^2+x}$

$\frac{du}{dx} = 2$ $\quad$ $\frac{dv}{dx} = (2x+1)e^{x^2+x}$

using product rule,

$y'' = u\,dv/dx + v\,du/dx$

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

2 a)