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Eng 381
Mathematics Assignment
141/Eng04/077

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

$y' \Rightarrow (2x+1) \cdot e^{x^2+x} \Rightarrow (2x+1).e^{x^2+x}$

$y'' \Rightarrow$ using product rule

$$\frac{dy'}{dx} \Rightarrow (2x+1)\frac{d(e^{x^2+x})}{dx} + e^{x^2+x}\frac{d(2x+1)}{dx}$$

$$\Rightarrow (2x+1)^2 e^{x^2+x} + 2e^{x^2+x}$$

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

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

But differentiating $y'' \Rightarrow y'''$

$$y''' \Rightarrow (2x+1)^3 e^{x^2+x} + (8x+4)e^{x^2+x} + 2(2x+1)e^{x^2+x}$$

$$y''' \Rightarrow (2x+1)\{(2x+1)^2 e^{x^2+x^2} + 2e^{x^2+x}\} + 4(2x+1)e^{x^2+x}$$

but $\quad y'' \Rightarrow (2x+1)^2 e^{x^2+2} + 2e^{x^2+x}$

$\quad y' : (2x+1)e^{x^2+x}$

$\therefore y''' \Rightarrow (2x+1)y'' + 4y'$

likewise $y'' \Rightarrow (2x+1)y' + 2y$.

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

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

let $v = x^3$, $u = e^{4x}$

$v^0 = x^3$, $v' = 3x^2$, $v'' = 6x$, $v''' = 6$

$u^0 = e^{4x}$, $u' = 4e^{4x}$, $u'' = 16e^{4x}$, $v''' = 64e^{4x}$

$y^n = {}^nC_0 u^n v^0 + {}^nC_1 u^{n-1} v' + {}^nC_2 u^{n-2} v'' + \dots + {}^nC_n u v^n$

But the last differential of

$y = v'''$, and $u^n = 4^n e^{4x}$

$\therefore y^{(5)}$

$\Rightarrow {}^5C_0 4^5 e^{4x} \cdot x^3 + {}^5C_1 4^4 e^{4x} \cdot 3x^2 + {}^5C_2 4^3 e^{4x} \cdot 6x$
$+ {}^5C_3 4^2 e^{4x} \cdot 6$

$\Rightarrow 1024e^{4x}x^3 + 3840e^{4x}x^2 + 3840e^{4x}x + 960e^{4x}$

4) $x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$

$\Rightarrow x^2 y'' + xy' + y = 0$

$W_1 = x^2 y''$

$W_1^n \Rightarrow$ let $v = x^2$ $u = y''$

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

$u^0 = y''$, $u' = y'''$, $u'' = y^{iv}$ $\Rightarrow u^n = y^{(n+2)}$

$W_1^n \Rightarrow y^{n+2}x^2 + 2xny^{n+1} + n(n-1)y^n$

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$W_2' \Rightarrow V = x \quad u = y'$

$V^0 = x \quad , V' = 1$

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

$W_2^{(n)} \Rightarrow xy^{n+1} + ny^n$

$W_3' \Rightarrow y$

$V = 1 \quad u = y$

$V^0 = 1 \quad u^{(n)} = y^n$

$W_3^{(n)} \Rightarrow y^n$

$W_1^{(n)} + W_2^{(n)} + W_3^{(n)} = 0$

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

$\Rightarrow x^2 y^{n+2} + \{2xn + x\}y^{n+1} + \{n(n-1) + n + 1\}y^n$

$x^2 y^{n+2} + \{2n+1\}xy^{n+1} + \{n^2 \cancel{-n} \cancel{+n} + 1\}y^n$

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

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