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16/ENG04/021
Electrical/Electronics Engineering
EEG 381 Assignment.

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

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

where: $u = 2x+1$, $v = e^{x^2+x}$

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

$y'' = u\frac{dv}{dx} + v\frac{du}{dx}$

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

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

from Leibnitz Theorem

$y'' - y'(2x+1) - 2 = 0$

$w_1 = y''$, $u = 1$, $u^n = y^{n+2}$

$u = y''$; $v' = 0$, $m_1^n = {}^nC_0 u^{n-0} v^x$

$w_2 = y'(2x+1)$, $v = 2x+1 \doteq y^{n+2}$

$u = y'$, $v' = 2$

$u^n = y^{n+1}$, $u_1^n = {}^nC_0 u^{n-0} u^0 + {}^nC_1 u^{n-1} v'$

$v'' = 0$

$= u^n v + n u^{n-1}$

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

$W_3 = 2y$

$u = y$, $V = 2$, $V' = 0$

$u^n = y^n$

$w_3^n = {}^nC_0 u^{n-0} u$

$= 2y^n$

$y^n - y'(2x+1) - 2y = 0$

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

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

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

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

$V^0 = x^3$; $V' = 3x^2$, $V'' = 6x$, $V''' = 6$

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

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

$y^n = {}^nC_0 u^{n-0} v^0 + {}^nC_1 u^{n-1} v' + {}^nC_2 u^{n-2} v'' + {}^nC_3 u^{n-3} v'''$ or

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

$= 4^n e^{4x} \cdot x^3 + n4^{n-1} e^{4x} \cdot 3x^2 + \frac{n(n-1) 4^{n-2} e^{4x} 6x}{2}$

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

$= 4^n e^{4x} \cdot x^3 + n4^{n-1} e^{4x} \cdot 3x^2 + n(n-1) 4^{n-2} e^{4x} \cdot 3x + n(n-1)(n-2)$

$4^{n-3} e^{4x}$

$$= 4^{n-3} e^{4x}[4^3x^3 + n4^2 \cdot 3x^2 + n(n-1)4 \cdot 3x + n(n-1)(n-2)]$$

$$= 4^{n-3} e^{4x}[64x^3 + n48x^2 + 12(n-1) + n(n-1)(n-2)]$$

$$y^3 = 4^{5-3} e^{4x}[64x^3 + (5\times48)x^2 + 12\times5(5-1)x + 5(5-1)(5-2)]$$

$$y^3 = 16e^{4x}[64x^3 + 240x^2 + 240x + 60]$$

ii. $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$

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

$w_1 = x^2y''$

$u^0 = V = y''$

$V' = y'''$, $V'' = y''$

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

$W_2 = xy'$

$V^0 - u = y'$

$V' = y''$, $V'' = y'''$

$V^n = y^{n+1}$

$w_3 = y$

$V = y$

$V = y'$, $V'' = y''$

$V^n = y^n$

$w_1^n = {}^nC_0 u^{n-0} V^0 + {}^nC_1 V^{n-1} V' + {}^nC_2 V^{n-2} V''$

$= V^n y + nV^{n-1}V' + \frac{n(n-1)}{2!} V^{n-2} V''$

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

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

$= y^n(y^2x^2 + ny^3x + n(n-1))$

$u_2^n = {}^nC_0 U^{n-0} V^0 + {}^nC_1 V^{n-1} V' + {}^nC_2 V^{n-2} V'' + {}^nC_3 V^{n-3} V'''$

$= V^n u^0 + nV^{n-1}V' + \frac{(n-1)n}{2!} U^{n-2} \cdot 0$

$= y^{n+1} \cdot x + ny \cdot 1 + 0$

$= y^n(xy + n)$

$W_3^n = {}^nC_0 V^{n-0} V^0 + {}^nC_1 V^{n-1} V'$

$= u^n y^0 + 0$

$= y^n$

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

$w_1 + w_2 + w_3 = 0$

$y^n(y^2x^2 + n2xy + n(n-1)] + y^n(xy+n) + y^n = 0$

At $x = 0$

$y^n n(n-1) + y^n n + y^n = 0$

$n(n-1)+n+1=0$

$y^n \cdots y^n n(n-1)-ny^n$

at $n=1$

$y=\cancel{-0}-y'$

$y=-y'$

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

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

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

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