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Civil Engineering

Question 1]

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

For $y'' \Rightarrow y^{(n+2)} + ny^{(n+1)}0$

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

For $\cancel{y'} \Rightarrow \cancel{y}\ y'(2x+1)$

$u \quad v$

$$y'(2x+1) \Rightarrow y^{(n+1)}(2x+1) + ny^{n}(2)$$

For $2y \Rightarrow 2y^{n}$

adding back together

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

Question 2

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

$v \quad u$

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

$u'''' = 256e^{4x}$, $u^{(5)} = 1016e^{4x}$

$v = x^3$, $v' = 3x^2$, $v'' = 6x$, $v''' = 6$, $v^{(4)} = 0$

$$y^{(5)} = u^{(5)}V + 5u^{(4)}V^{(1)} + 10u^{(3)}V^{(2)} + 10u^{(2)}V^{(3)} + 5u^{(1)}V^{(4)} + uV^{(5)}$$

$$y^{(5)} = 1024e^{4x}.x^3 + [5 * [256e^{4x}.3x^2]] + 10[64e^{4x}.6x] + 10[16e^{4x}.6] + 5[4e^{4x}.0]$$

$$y^{(5)} = 1024e^{4x}.x^3 + 3840e^{4x}.x^2 + 3840e^{4x}x + 960e^{4x}$$

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

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

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

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

Using leibnitz theorem

~~#~~ from x^2y'', $u = y''$ & $x^2 = V$

$$x^2y'' = {}^nC_0u^{(n)}V + {}^nC_1u^{(n-1)}V^{(1)} + {}^nC_2u^{(n-2)}V^{(2)}$$

$$\Rightarrow y^{(n+2)}x^2 + ny^{(n+1)}.2x + \frac{n(n-1)}{2!}y^{(n)}.2$$

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

xy'; $u = y'$ & $V = x$

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

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

bringing all together

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

$$y^{(n+2)} x^2 + x y^{(n+1)} [2n+1] + y^{(n)} \left(n[n-1][n+1]\right)$$

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

$$\Rightarrow x^2 y^{(n+2)} + x y^{(n+1)} [2n+1] + y^{(n)} [n^3 - n]$$

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