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DEPARTMENT : CHEMICAL ENGINEERING

COURSE CODE : ENG 381

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

SOLN

$y' = \frac{dy}{dx} = 2x+1\,(e^{x^2+x})$

$y'' = \frac{d^2y}{dx^2} = e^{x^2+x}.(2) + (2x+1)\,(2x+1\,(e^{x^2+x}))$

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

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

$w_1 \quad w_2 \quad w_3$

For w_1

$u = y^2 \qquad v = 1$

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

For w_2

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

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

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

For w_3

$u = 2y \qquad v = 2$

$u^n = y^n$

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

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

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

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

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

SOLN

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

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

$u^{n-1} = 4^{(n-1)} e^{4x}$ $\quad v'' = 6x$

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

$u^{n-3} = 4^{(n-3)} e^{4x}$

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

$$y^5 = 4^5 e^{4x} \cdot x^3 + 5\left(4^{(5-1)} e^{4x}\right) \cdot 3x^2 + \frac{5(5-1)}{2!}\left(4^{(5-2)} e^{4x}\right) \cdot 6x + \frac{5(5-1)(5-2)}{3!} \left(4^{(5-3)} e^{4x}\right) \cdot 6$$

$$y^5 = 1024 e^{4x} \cdot x^3 + 3840 x^2 e^{4x} + 3840 x e^{4x} + 960 e^{4x}$$

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

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

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

SOLN

$$\underbrace{x^2 y^2}_{w_1} + \underbrace{x y'}_{w_2} + \underbrace{y^0}_{w_3} = 0$$

For w_1

$u = y^2$ $\quad v = x^2$

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

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

$u^{(n-2)} = y^n$

For w_2

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

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

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

For w_3

$u = y$ $\quad v = 1$

$u^n = y^n$

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

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

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

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

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

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

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