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MATRIC 15/ENG06/097
DEPT MECHANICAL

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

odn

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

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

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

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

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

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

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

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

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

$y^5 = (4)^5 e^{4x} \cdot x^3 + 5(4)^4 e^{4x} \cdot 3x^2 + 10(4)^3 e^{4x} \cdot 6x + 10(4)^2 e^{4x} \cdot 6 + 0$

$y^5 = 1024x^3 e^{4x} + 3840x^2 e^{4x} + 3840x e^{4x} + 960e^{4x} + 0$

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

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

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

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

Using leibnitz theorem

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

~~$y^n = x^2y^{(n+2)} + 2xy$~~

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

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

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

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

equate to 0

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