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15/ENG02/033
COMPUTER ENGR

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

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

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

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

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

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

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

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

$\underset{w_1}{y^2} - 2x+1\underset{w_2}{(y^{(1)})} - 2\underset{w_3}{(y^{(0)})} = 0$

$w_1^{(n)} = y^{(n+2)}$

$w_2^{(n)} = y^{(n+1)}(2x+1) + ny^{n}(-2)$

$w_3 = y^{(n)}$

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

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

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

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

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

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

let $u = e^{4x}$ $V = x^3$

[Leibnitz theorem

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

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

$u = e^{4x}$ | $v = x^3$

$u' = 4e^{4x}$ | $v' = 3x^2$

$u'' = 16e^{4x}$ | $v'' = 6x$

$u''' = 64e^{4x}$ | $v''' = 6$

$u^{iv} = 256e^{4x}$ | $v^4 = 0$

$u^v = 1024e^{4x}$ | $v^5 = 0$

$$y^{(5)} = 1024e^{4x}x^3 + 5.256e^{4x}.3x^2 + \cdots \frac{5(4)64e^{4x}6x}{2!}$$

$$+ \frac{5(4)(3)\cancel{(2)}16e^{4x}6}{3!} + \cdots + \frac{5(4)(3)(2)4e^{4x}(0)}{4!} +$$

$$\frac{5(4)(3)(2)(1)e^{4x}.0}{5!}$$

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

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

$\underset{w_1}{x^2y^{(2)}} + \underset{w_2}{x\frac{dy}{dx}} + \underset{w_3}{y} = 0$

$\cancel{w_1}^{(n)} y^n = x^2y^{(n+2)} + ny^{(n+1)}2x + \frac{n(n-1)}{2!}y^{(n)}.2 + 0$

$w_2^{(n)} = x(y^{(n+1)}) + ny^{(n)} + 0$

$$w_3^{(n)} = y^{(n)}$$

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

$$+ y^{(n)} = 0$$

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

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

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

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