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MECHANICAL ENGR
ENG381

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

$U = x^2 + z$

$dy/dx = 2x + 1$

$y = e^u$

$dy/dx = e^u$

$dy/dx = dy/dx \times du/dx$

$= e^u \times 2x + 1$

$2x + 1e^u \quad u = x^2 + x$

$dy/dx = 2x + 1e^{x^2} + x$

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

$d^2y/dx^2 = 2e^{x2} + x + 4x^2 + 4x + 1 + e^{x2} + x$

$y'' = d^2y/dx^2 \quad y' \neq dy/dx \quad y = e^{x^2} + z$

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

$y'' = 2e^{x2} + x + 4x^2 + 4x + 1e^{x2} + x$

$y' = (2x+1) = (2x+1)(2x+1)\, e^{x2+x}$

$= 4x^2 + 4x + 1e^{x2+x}$

$2y = 2e^{x2+x}$

$y'(2x+1) + 2y = 2e^{x2+x} + 4x^2 + 4x + 1e^{x^2} + x$

$= 2e^{x^2} + x + 4x^2 + \cancel{4}x + 1e^{x^2} + x$

$$\underbrace{y''}_{w_1} = \underbrace{y'(2x+1)}_{w_2} + \underbrace{2y}_{w_3}$$

w_1

$v = y''$ $\qquad v = 1$

$v^n = y^{n+2}$ $\qquad v = 0$

$= y^{n+2}{}_{-1} + v$

w_2

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

$v^n = y^{n+1}$ $\qquad v = 0$

$(2\,[y^n{}_{-1}] + v]$

$w_1 = w_2 + w_2$

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

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

2a) using the theihoitz theorem

$y = x^2 e^{4x} \qquad y^{(5)}$

Solution

$y^{(5)} = v^{(5)}v + 5v^4v' + 10v^3v'' + 10w^2v^3 + 5v'v^4$

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

$= 1024e^{4x}x^3 + 1280e^{4x}3x^2 + 640e^{4x} \cdot 6x + 80e^{4x} \cdot 6$

$= 1024e^{4x}x^3 + 3840e^{4}x^2 + 3840e^{4x}x + 480e^{4x}$

$x^2 dy/dx^2 + x\,dy/dx + y = 0$

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

For w_1

$v = y'' \qquad V = 8x^2$

$v^n = y^{n+2} \qquad V' = 2x$

$v^{n-1} = y^{n+1} \qquad V'' = 2$

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

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

for w_2

$w = y_1 \qquad V = x$

$u^n = y^{n+1} \qquad V = 1$

$V^{n-1} = y^n \qquad V'' = 0$

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

For w_2

$v = y \qquad v = 1$

$v^n = y_n \qquad v' = 0$

$= y_n$

$w_1 + w_2 + w_3 = 0$

$x^2 y_{n+2} + 2nx y_{n+1} + (n^2 - n) y_n + x y_{n+1} + n y_n + y_n$

$x y_{n+2} + 2nx y_{n+1} + x y_{n+1} + n^2 y_n - \cancel{n y_n} + \cancel{n y_n}$

$x^2 y_{n+2} + (2n+1)(x y_{n+1}) + (n^2+1) y_n$