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17/ENG04/071

ELECT/ELECT

Applying Leibnitz method:

$x(x-1)y^n + (3x-1)y' + y = 0$

For $G_1 - x(x-1)y''$

$u = y''$, $v = x^2 - x$

$u' = y'''$ $v' = 2x-1$

$u^n = y^{n+2}$ $v'' = 2$

$v''' = 0$

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

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

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

For $G_2 - (3x-1)y'$

$v = 3x-1$ $u = y'$

$v' = 3$ $u^n = y^{n+1}$

$v'' = 0$

$(y^{n+1})(3x-1) + n(y^n)(3)$

for G_3

$u^n = y^n$, $v = 1$

y^n

Combining

$x^2 - x(y^{n+2}) + n(2x-1)(y^{n+1}) + n(n-1)(y^n) + (3x-1)(y^{n+1}) + 3n(y^n) + y^n$

Solving

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

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

$x^2 - x(y^{n+2}) + (n(2x-1) + (3x-1)] y^{n+1} + (n^2 + 2n + 1) y^n = 0$

at $x = 0$

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

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

$$(y^{n+1})_0 = -\frac{(n^2+2n+1)\cdot y^n}{=n-1}$$

$$= \frac{2 \neq (n^2+2n+1) y^n}{\neq (n+1)}$$

$$(y^{n+1})_0 = \frac{n^2+2n\neq 1}{n+1} (y^n)_0$$

$$y^{n+1} = n+1\ y^n$$

at $n=0$

$y'(0) = 1y_0$

$x=0,\ n=1$

$y^2_0 = 2y^1 = 2$

$n=2$

$y^3 = 3y^2 = 3(2)(y') = 6y'$

$n=3$

$y^4 = 4y^3 = 4(3)(2)(y')_0 = 24y'$

$n=4$

$y^5 = 5y^4 = (2)(3)(4)(5)(y')_0$

$n=5$

$y^6 = 6y^5 = (2)(3)(4)(5)(y')_0 = (2)(3)(4)(5)(6)$

$n=6$

$y^7 = 7y^6 = (2)(3)(4)(5)(6)(y')_0 = (2)(3)(4)(5)(6)(7)$

Maclaurin series:

$$y = y_0 + x(y'_0) + \frac{x^2}{2!}(y^2) + \frac{x^3}{3!}(y^3)_0 + \frac{x^4}{4!}(y^4) + \frac{x^5}{5!}(y^5)_0 +$$

$$\frac{x^6}{6!}(y') + \frac{x^7}{7!}(y^7)_0$$

$$y = (y_0) + x(y'_0) + \frac{x^2}{2!}(2y'_0) + \frac{x^3}{3!}(3!\,y'_0) + \frac{x^4}{4!}(4!\,y'_0) +$$

$$\frac{x^5}{5!}(5!\,y'_0) + \frac{x^6}{6!}(6!\,y'_0) + \frac{x^7}{7!}(7!\,y'_0)$$

$$y = y_0 + y'_0x + y'x^2 + y'_0x^3 + x^4y' + x^5y' + x^6y' + x^7y'$$

$y = y_0 + y'(x + x^2 + x^3 + x^4 + x^5 + x^6 + x^7)$

Recall

$y_1 = y_0$

$y_0[1 + x + x^2 + x^3 + x^4 + x^5 + x^6 + x^7]$

(b) $y'(0) = 0.0005$

when $x = 5$

$y_5 = 0.0005[1 + 5 + 5^2 + 5^3 + 5^4 + 5^5 + 5^6 + 5^7]$

$= 0.0005(97656)$

$= 48.828 = 49$

when $x = 6$, $y_0 = 0.0005$

$y_8 = 0.0005[1 + 8 + 8^2 + 8^3 + 8^4 + 8^5 + 8^6 + 8^7]$

$= 0.0005[2396745)$

$= 1198.3725 = 1198$

$x = 10m$

$y_{10} = 0.0005(1 + 10 + 10^2 + 10^3 + 10^4 + 10^5 + 10^6 + 10^7)$

$= 0.0005(11111111)$

$= 5555.5555$

~~$=$~~ 5556.

(c) Command Window

```
clc
clear all
Close all
Syms x y
x = 0:0.1:10
y = (0.0005)*(1+x+x.^2+x.^3+x.^4+x.^5+x.^6+x.^7)
yn = subs(y)
ynn = double(yn)
plot(x, ynn)
xlabel('x')
ylabel('T')
Grid on
```

Grid minor

Axis right