

$$(2^2 - 2) y^{(n+2)} + (2\alpha - 1) n y^{(n+1)} + (3\alpha - 1) y^{(n+1)} + n(n-1) y^n + 3ny^n + y^n = 0$$

$$(2^2 - 2) y^{(n+2)} + (2\alpha n - n) y^{(n+1)} + (3\alpha - 1) y^{(n+1)} + (n^2 - 2) y^n + 3ny^n + y^n = 0$$

$$(2^2 - 2) y^{(n+2)} + (2\alpha n + 3\alpha - n - 1) y^{(n+1)} + (n^2 - n + 3n + 1) y^n = 0$$

$$(2^2 - 2) y^{(n+2)} + (2\alpha n + 3\alpha - n - 1) y^{(n+1)} + (n^2 + 2n + 1) y^n = 0$$

$$(2 - 2) y^{(n+2)} + (2\alpha n + 3\alpha - n - 1) y^{(n+1)} + (n^2 + 2n + 1) y^n = 0$$

when $\alpha = 0$

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

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

$$-(n+1) (y^{(n+1)})_0 + (n^2 + 2n + 1) (y^n)_0 = 0$$

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

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

$$(y^{(n+1)})_0 = (n+1) (y^n)_0$$

when $n = 0$

$$(y^{(0+1)})_0 = (0+1) (y^0)_0$$

$$(y^1)_0 = 1 (y^0)_0$$

when $n = 1$

$$(y^{(0+1)})_0 = (1+1) (y^{(1)})_0$$

$$(y^{(2)})_0 = 2 (y^{(1)})_0$$

When $n=2$
 $(y^{(2)})_0 = [2+1] [y^{(2)}]_0$

$$[y^{(3)}]_0 = 3(y^{(3)})_0 = 3(2) [y^{(2)}]_0$$

$$[y^{(3)}]_0 = 6 [y^{(2)}]_0$$

When $n=3$
 $(y^{(4)})_0 = 3+1) [y^{(3)}]_0$

$$(y^{(4)})_0 = 4 [y^{(3)}]_0 = 4 [6] [y^{(1)}]_0$$

$$(y^{(4)})_0 = 24 [y^{(1)}]_0$$

When $n=4$

$$[y^{(5)}]_0 = (4+1) [y^{(4)}]_0$$

$$[y^{(5)}]_0 = 5 [y^{(4)}]_0 = 5(24) [y^{(1)}]_0$$

$$(y^{(5)})_0 = 120 [y^{(1)}]_0$$

When $n=5$

$$(y^{(6)})_0 = [5+1] (y^{(5)})_0$$

$$(y^{(6)})_0 = 6 [y^{(5)}]_0 = 6 [120] (y^{(1)})_0$$

$$(y^{(6)})_0 = 720 [y^{(1)}]_0$$

When $n=6$

$$(y^{(7)})_0 = (6+1) [y^{(6)}]_0$$

$$= 7 [y^{(6)}]_0 = 7 [720] (y^{(1)})_0$$

$$(y^{(7)})_0 = 5040 (y^{(1)})_0$$

$$\textcircled{*} y = [y^{(0)}]_0 + x [y^{(1)}]_0 + \frac{x^2}{2!} (y^{(2)})_0 + \frac{x^3}{3!} [y^{(3)}]_0 + \frac{x^4}{4!} (y^{(4)})_0$$

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

$$y = (y^{(0)})_0 + x [y^{(1)}]_0 + \frac{x^2}{2!} \cdot 2 [y^{(2)}]_0 + \frac{x^3}{3!} \cdot 6 [y^{(3)}]_0 +$$

$$\frac{x^4}{4!} \cdot 24 (y^{(4)})_0 + \frac{x^5}{5!} \cdot 120 [y^{(5)}]_0 + \frac{x^6}{6!} = 720 [y^{(6)}]_0 + \frac{x^7}{7!} 5040 (y^{(7)})_0$$

a) $y(1+x)(y^{(0)})_0 + (x^2 + x^3 + x^4 + x^5 + x^6 + x^7) (y^{(1)})_0$
 $y(0) = 0.0005 \text{ m}, y'(0) = 0.0005$

$$y = (1+x)(0.0005 \text{ m}) + (x^2 + x^3 + x^4 + x^5 + x^6 + x^7) (0.0005)$$

when $x = 5 \text{ m}, 8 \text{ m}$ and 10 m

$$y = (1+5)(0.0005 \text{ m}) + (5^2 + 5^3 + 5^4 + 5^5 + 5^6 + 5^7) (0.0005)$$

$$y = 4 \times 3 \times 10^{-3} \text{ m} + 97650 \text{ m} (0.0005)$$

$$y = 3 \times 10^{-3} \text{ m} + 48.825 \text{ m}$$

$$y = 48.828 \text{ m}$$

when $x = 8 \text{ m}$

$$y = (1+8)(0.0005) + (8^2 + 8^3 + 8^4 + 8^5 + 8^6 + 8^7) (0.0005)$$

$$y = 4.5 \times 10^{-3} + 2396736 (0.0005)$$

$$y = 4.5 \times 10^{-3} + 1198$$

$$y = 1198 \text{ m}$$

when $x = 10$

$$y = (1+10)(0.0005) + (10^2 + 10^3 + 10^4 + 10^5 + 10^6 + 10^7) (0.0005)$$

$$y = 5.5 \times 10^{-3} + 11111100 (0.0005)$$

$$y = 5555.5555 \text{ m}$$

$$= 5556 \text{ m.}$$

Matlab

Command Window.

Clear

clc

close all

syms x

$$x = ((i+x) * (0.0005) + (x^2 + x^3 + x^4 + x^5 + x^6 + x^7) * (0.0005))$$

$$t = 0:0.01:10$$

xt = subs(x,t)

xtn = double(xt)

plot(t, xtn)

xlabel('t')

ylabel('x')

grid on

grid minor

axis tight

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 171 ENG 05 1033
 MECHATRONICS
 ENG 881 :

$$① x(x-1)y'' + (3x-1)y' + y = 0$$

$$\text{Taking } x(x-1)y'' = w_1$$

$$(3x-1)y' = w_2$$

$$y = w_3$$

Considering w_1 ,

$$u = y''$$

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

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

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

$$V = x(x-1)$$

$$V' = 2x-1$$

$$V'' = 2$$

$$V''' = 0$$

w_2

$$u = y'$$

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

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

$$V = (3x-1)$$

$$V' = 3$$

$$V'' = 0$$

w_3

$$u = y$$

$$u^n = y^n$$

$$V = 1$$

$$V = 0$$

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

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

$$w_2^n = y^{(n+1)} \cdot (3x-1) + n y^n \cdot 3 + 0$$

$$w_3^n = y^n \cdot 1 + 0$$

$$w_1 + w_2 + w_3$$

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

$$n y^n = 3 + y^n = 0$$

$$2(x-1)y'' + (3x-1)y' + y = 0$$

let

$$W_1 = 2(x-1)y''$$

$$W_2 = (3x-1)y'$$

$$W_3 = y$$

$$F = W_1$$

$$u = y^2$$

$$V = xC$$

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

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

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

for W_3

$$u = y$$

$$y^n = y^n$$

Recall