

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

$$A = x(x-1)y''$$

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

$$C = y$$

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

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

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

$$C^n = y^n$$

$$A^n + B^n + C^n = 0$$

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

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

when $x=0$

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

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

$$y^{n+1} = (n+1)y^n \dots \text{Equation (1)}$$

$$n=0$$

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

$$n=2$$

$$(y^3)_0 = 3(y^2)_0$$

Therefore

$$(y^n)_0 = n!(y)_0$$

$$n=1$$

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

$$n=3$$

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

Maclaurin Series

$$Y = (y)_0 + x(y^1)_0 + \frac{x^2}{2!}(y^2)_0 + \frac{x^3}{3!}(y^3)_0 + \frac{x^4}{4!}(y^4)_0 + \frac{x^5}{5!}(y^5)_0 + \frac{x^6}{6!}(y^6)_0 + \frac{x^7}{7!}(y^7)_0$$

$$\therefore Y = (y)_0 + x(y)_0 + \frac{x^2}{2!}(2!(y)_0) + \frac{3!x^3}{3!}(y)_0 + \frac{4!x^4}{4!}(y)_0 + \frac{5!x^5}{5!}(y)_0 + \frac{6!x^6}{6!}(y)_0 + \frac{7!x^7}{7!}(y)_0$$

$$Y = (y)_0 + x(y)_0 + x^2(y)_0 + x^3(y)_0 + x^4(y)_0 + x^5(y)_0 + x^6(y)_0 + x^7(y)_0$$

where $(y)_0 = 0.005$

$$Y = 0.005 [1 + x + x^2 + x^3 + x^4 + x^5 + x^6 + x^7]$$

$$Y = 0.005 [x^0 + x^1 + x^2 + x^3 + x^4 + x^5 + x^6 + x^7]$$

When $x = 5$

$$y = 0.0005 [1 + 5 + 25 + 125 + 625 + 3125 + 15625 + 78125]$$
$$= 0.0005 [97,656]$$
$$\approx 48.828 \text{ m}$$

When $x = 8$

$$y = 0.0005 [1 + 8 + 64 + 512 + 4096 + 32,768 + 262,144 + 2,097,152]$$
$$= 0.0005 [2,396,745]$$
$$\approx 1,198.3725 \text{ m}$$

When $x = 10$

$$y = 0.0005 [1 + 10 + 10^2 + 10^3 + 10^4 + 10^5 + 10^6 + 10^7]$$
$$= 0.0005 [11,111,111]$$
$$\approx 5,555.56 \text{ m}$$

c) Matlab Code

1 - close all;

2 - clc

3 - Syms x y

4 - $x = 0:0.5:10;$

5 - $y = 0.0005 * [1 + (x) + (x.^2) + (x.^3) + (x.^4) + (x.^5) + (x.^6) + (x.^7)]$

6 - plot(x, y)

7 - title('Graph of Response of the Structural element to x');

8 - xlabel('x');

9 - ylabel('y');

The image shows a MATLAB workspace with the following components:

- Code Editor:** Contains the following MATLAB code:

```
1 - close all;
2 - clc;
3 - syms x y
4 - x = 0:0.5:10;
5 - y = 0.0005*(1 + (x) + (x.^2) + (x.^3) + (x.^4) + (x.^5) + (x.^6) + (x.^7) + (x.^8) + (x.^9) + (x.^10));
6 - plot(x,y)
7 - title ('Graph of Response of the Structural element and x ');
8 - xlabel ('X');
9 - ylabel ('y');
10
```
- Figure Window:** Titled "Graph of Response of the Structural element and x", showing a plot of y versus x. The x-axis ranges from 0 to 10, and the y-axis ranges from 0 to 6000. The curve shows an exponential-like growth.
- Command Window:** Shows the output of the code execution, including the value of y for each x.
- Taskbar:** Shows the system clock as 8:43 AM on 27-Oct-19.