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17/ENG02/063

COMPUTER ENGINEERING.

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

$$1. \quad (x^2 - x)y'' \quad w_1 = uv$$

using Leibnitz theorem,

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

$$2. \quad (3x-1)y' \quad w_2 = uv$$

using Leibnitz theorem,

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

$$3 \quad y^{(1)} \quad w_3 = uv$$

using Leibnitz theorem,

$$w_3^{(n)} = y^{(n)}(1)$$

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

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

at  $x=0$ ,

$$(-n-1)(y^{(n+1)})_0 + (n(n-1) + 3n + 1)(y^{(n)})_0 = 0$$

$$(y^{(n+1)})_0 = \frac{-(n(n-1) + 3n + 1)(y^{(n)})_0}{-(n+1)}$$

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

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

when  $n = 1$ ,

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

when  $n = 2$ ,

$$(y^{(3)})_0 = 3(y^{(2)})_0 = 3(2(y^{(1)})_0)$$

when  $n = 3$ ,

$$(y^{(4)})_0 = 4(y^{(3)})_0 = 4 \cdot 3 \cdot 2 (y^{(1)})_0$$

when  $n = 4$ ,

$$(y^{(5)})_0 = 5(y^{(4)})_0 = 5 \cdot 4 \cdot 3 \cdot 2 (y^{(1)})_0$$

when  $n = 5$ ,

$$(y^{(6)})_0 = 6(y^{(5)})_0 = 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 (y^{(1)})_0$$

when  $n = 6$ ,

$$(y^{(7)})_0 = 7(y^{(6)})_0 = 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 (y^{(1)})_0$$

Using Maclaurin series, substitute into it;

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



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

$y(0) = 0.0005 \text{ m}$  and  $y'(0) = 0.0005$

$$y = 0.0005 + 0.0005 \{x + x^2 + x^3 + x^4 + x^5 + x^6 + x^7\}$$

b) when  $x = 5 \text{ m}$

$$y = 0.0005 + 0.0005 \{5 + 5^2 + 5^3 + 5^4 + 5^5 + 5^6 + 5^7\}$$

$$y = 48.828 \approx 49$$

when  $x = 8 \text{ m}$ ,

$$y = 0.0005 + 0.0005 \{8 + 8^2 + 8^3 + 8^4 + 8^5 + 8^6 + 8^7\}$$

$$y = 1,983,372.05 \approx 1,984,198$$

when  $x = 10 \text{ m}$ ,

$$y = 0.0005 + 0.0005 \{10 + 10^2 + 10^3 + 10^4 + 10^5 + 10^6 + 10^7\}$$

$$y = 5555.55 \approx 5,556$$

C. Command Window

clear

clc

close all

$x = 0 : 1 : 10 ;$

$Y = 0.0005 + (0.0005 * (x + x.^2 + x.^3$

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+ x.^4 + x.^5 + x.^6 + x.^7) );  
plot (x, Y, 'k')  
xlabel ('Length')  
ylabel ('Deformation')  
title ('Length - Deformation Graph')  
grid on  
grid minor  
axis tight
```



### Length-Deformation Graph

