AKUMA SUNNY. U.
17/ENG04/009
ELECT/ELECT

Solution

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

Part a

$$x(x-1)y'', \quad u = y'', \quad u^n = y^{n+2}$$

$$v = x^2 - x, \quad v' = 2x - 1, \quad v'' = 2$$

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

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

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

Part b

$$(3x-1)y', \quad u = y', \quad u^n = y^{n+1}$$

$$V = 3x - 1, \quad V' = 3$$

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

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

Part c

part c

$y, u = y, u^n = y^n$

∴ part A + part B + part C = 0

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

∴

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

when $x = 0$

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

$\Rightarrow (n+1)y^{n+1} = -[(n+1)(n+1)]y^n = 0$

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

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

when $n = 0$

$y'_0 = y_0$

when $n = 1$

$y''_0 = 2y'_0, \; 2(y_0)$

when $n = 2$

$y'''_0 = 3y''_0, \; 3(2y_0) = 6y_0$

when $n = 3$

$y^{iv}_0 = 4y'''_0 \; 4(6y_0) = 24y_0$

when $n = 4$

$y^{v}_0 = 5y^{iv}_0 \; 5(24y_0) = 120y_0$

when $n=5$

$y_0^6 = 6y_0^v \quad 6(120y_0) = 720y_0$

when $n=6$

$y_0^7 = 7y_0^{vi} \quad 7(720y_0) = 5040y_0$

when $n=7$

From Mclaurin series

$$y = \frac{x^0 y_0}{0!} + \frac{x^1 y_0^1}{1!} + \frac{x^2 y_0^2}{2!} + \frac{x^3 y_0^{iii}}{3!} + \frac{x^4 y_0^{iv}}{4!} + \frac{x^5 y_0^v}{5!} +$$

$$\frac{x^6 y_0^{vi}}{6!} + \frac{x^7 y_0^{vii}}{7!} =$$

$$y = y_0 + x y_0 + \frac{x^2 2y_0}{2!} + \frac{x^3 6y_0}{3!} + \frac{x^4 24y_0}{4!} + \frac{x^5 120y_0}{5!} + \frac{x^6 720y_0}{6!}$$

$$+ \frac{x^7 5040y_0}{7!}$$

where $y_0 = 0.00005$ & $y_0^1 = 0.00005$

where $y_0 = y_0^1$

5.) when $x = 5m$

$y = 0.00005(1+5+25+125+625+3125+15625+78125)$

$y = 0.00005[97656]$

$y = 48.828$

when $x = 8$

$y = 0.0005[1 + 8 + 64 + 512 + 4096 + 52768 + 262144 + 2,097,152]$

$y = 0.0005[2,396,745]$

$y = 1198.3725$

.

when $x = 10$

$y = 0.0005[1 + 10 + 100 + 1000 + 10000 + 100000 + 1000000 + 10000000]$

$y = [11,111,111]\,0.0005$

$y = 5,555.555$

c) Command window

```
clear
clc
syms x
syms y
x = [0:10];
y = 0.0005*(1 + x + (x.^2) + (x.^3) + (x.^4) + (x.^5)
    + (x.^6) + (x.^7));
plot(x,y)
grid on
grid minor
xlabel('x')
ylabel('Structural Deformation')
```