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

$w_1 + w_2 + w_3 = 0.$

w_1

$v = x(x-1) \quad v' = 2x-1 \quad v'' = 2 \quad v''' = 0.$

$u = y'' \quad u' = y''' \quad u'' = y'''' \quad u''' = y^{v}, \; u^n = y^{n+2}.$

using Leibniz theorem

w_1

$w_1 = y^{n+2}(x(x-1)) + n y^{n+1}(2x-1) + \frac{n(n-1)}{2!} y^n(2) + \frac{n(n-1)(n-2)}{3!}(y^{n-1})(0).$

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

$w_2 \ldots (3x-1)$

$v = 3x-1 \quad v' = 3 \quad v'' = 0$

$u = y' \quad u' = y'' \quad u'' = y''', \text{ Hence } u^n = y^{n+1}.$

$w_2 = y^{n+1}(3x-1) + n y^n(3) + \frac{n(n-1)}{2!}(0) y^{n-1}$

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

$w_3 \ldots (1)$

$v = x \quad v' = 0$

$u = y \quad u' = y', \text{ Hence } u^n = y^n.$

$w_3 = y^n(1) + n y^{n-1}(0). + \ldots$

$w_3 = y^n$

$w_3 + w_2 + w_3 = 0$.

$\therefore$

$$y^{n+2}(n(n-1)) + ny^{n+1}(2n-1) + n(n-1)y^n + y^{n+1}(3n-1) + 5ny^n + y^n = 0.$$

$$y^{n+2}(n(n-1)) + ny^{n+1}(2n-1) + y^{n+1}(3n-1) + n(n-1)y^n + 5ny^n + y^n = 0.$$

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

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

$$y^{n+2}(n(n-1)) = -y^n(y(n(2n-1) + 5n - 1) - (n^2 + 2n + 1)) = 0.$$

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

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

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

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

$$y^{n+2}(n^2 - n) = -y^{n+1}(n(2n-1) + 3n - 1) - y^n(n+1)^2. \Rightarrow \text{Recurring equation.}$$

when y at $n = 0$.

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

$$-y' = y$$

$$y'(1) = y_0.$$

when $n = 0$, $n = 0$.

$$y^2(0) = -y'(-1) - y^0(1)^2$$

$$y' = 1.$$

when $n = 0$ $n = 1$.

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

$$0 = 2y'' - 4y'$$

$$y'' = 2y' \quad y' = 1 \quad \therefore y'' = 2.$$

when $x=0$, $n=2$.

$y^4(0) = -y^3(2(-1)-1) - 9y_0^2$

$0 = 3y_0^m - 9y_0^{ii}$

$9y_0^{ii} = 3y_0^m$

$y_0^m = 8y_0^{ii} = 8(2y_0')$

$y^{iii} = 3!(y_0')$.

when $x=0$ $n=5$.

$y^5(0) = -y_0^4(-3-1) - 16y_0^3$

$0 = +4y_0^{iv} - 16y_0^{iii}$

$16y_0^m = 4y_0^{iv}$

$4y_0^{iii} = y_0^{iv}$

$y_0^{iv} = 4y_0^{iii}$.

$y_0^{iv} = (4(3(2(y_0'))$

$y_0^{iv} = 4!(y_0')$

when $x=0$ $n=4$.

$y^6(0) = -y_0^5(-4+1) - 25y^{iv}$.

$0 = 5y^v - 25y^{iv}$

$25y^{iv} = 5y^v$

$y^v = 5y^{iv}$

$y_0^v = 5(4(3(2(y_0'))$

$y_0^v = 5!(y_0')$.

when $x=0$ $n=5$.

$y^7(0) = -y_0^{vi}(-5-1) - y_0^v(36)$

$0 = +6y_0^{vi} - 36y^v$

$6y_0^{vi} = 36y^v$.

$y_0^{vi} = 6y_0^v$.

$y_0^{vi} = 6(5\times4\times3\times2\times y_0')$.

$y_0^{vi} = 6!(y_0')$

when $x=0$ $n=6$.

$y^{viii}(0) = -y_0^7(-6-1) - y^{vi}(49)$

$0 = -y_0^{viii}(-7) - 49y^{vi}$

$49y^{viii} = 7y_0^{vii}$

$y_0^{vii} = 7y^{vi}$

$y_0^{vii} = 7y_0^{vi} = 7(6!y_0')$.

using the Leibnitz maclaurins formula.

$y_0 + x(y_0') + \frac{x^2}{2!}(y_0^{ii}) + \frac{x^3}{3!}(y_0^{iii})$

$+ \frac{x^4}{4!}y_0^4 + \frac{x^5}{5!}y_0^5 + \frac{x^6}{6!}y_0^6$

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

$y_0 + xy_0' + \frac{x^2}{2!}(2y_0') + \frac{x^3}{3!}(3!y_0)$

$+ \frac{x^4}{4!}(4!y_0') + \frac{x^5}{5!}(5!y_0') + \frac{x^6}{6!}(6!y$

$+ \frac{x^7}{7!}(7!y_0')$.

$=$

$y_0 + xy_0' + x^2y_0' + x^3(y_0') + x^4$

$+ x^5(y_0') + x^6(y_0') + x^7(y_0') + \dots$

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

but $y_0' = y_0$

$y = y_0(1 + x + x^2 + x^3 + x^4 + x^5 + x^6 + x^7)$

i.e when $x = 5$ and when $y_0' = y_0 = 0.0005$.

b.)i) $y_5 = 0.0005(1 + 5 + 5^2 + 5^3 + 5^4 + 5^5 + 5^6 + 5^7)$.

$y_5 = 0.0005(97656)$.

$y_5 = 48.828$

ii) $y_8 = 0.0005(1 + 8 + 8^2 + 8^3 + 8^4 + 8^5 + 8^6 + 8^7)$.

$y_8 = 0.0005(2,396,745)$

$= 1198.8725$.

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

$= 0.0005(11\,111\,111)$

$= 5555.5555$

Command window

Clear

clc

```
y0 = 0.0005
x = (0 : 10)
y = y0 * (1 + x + x^2 + x^3 + x^4 + x^5 + x^6 + x^7).
yn = Sub(x, y)
Plot (x, yn).
grid on
grid minor
xLabel ('x')
yLabel ('Structural element').
```

SKETCH//////

GRAPH OF STRUCTURAL ELEMENT AGAINST X.