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17/ENG05/002
Mechatronics

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

$w_1 + w_2 + w_3 = 0$.

w_1

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

$u = y''$ $u' = y'''$ $u'' = y''''$ $u''' = y^{v}$, $u^n = y^{n+2}$

using Leibnitz 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 . . . $(3x-1)$

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

$u = y'$ $u' = y''$ $u'' = y'''$, 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 . . . (y).

$v = x$ $v' = 0$

$u = y$ $u' = y'$, Hence $u^n = y^n$.

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

$$w_3 = y^n$$

$w_3 + w_2 + w_3 = 0$.

$\therefore$ ~~$y^{n+2} x^{3n+1}$~~

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

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

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

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

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

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

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

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

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

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

when y at $n = 0$.

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

$-y' = y$

$y'(0) = y_0$.

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

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

$y' = 1$.

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

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

$0 = 2y'' - 4y'$ $\quad \therefore y'' = 2$.

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

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

$0 = 3y''' - 9y_0''$

$9y_0'' = 3y_0'''$

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

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

when $x=0$ $n=3$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Using the Leibnitz maclaurins formula

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

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

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

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

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

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

$=$

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

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

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

but $y_0' = y_0$

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

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

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

$y_5 = 0.0005(97,656)$.

$y_5 = 48.828$

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

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

$= 1198.8725$.

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

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

$= 5555.5555$

1.) Commands window

2.) Clear

3.) Clc

4.) Syms x, y.

5.) x = (0 : 10);

6.) $y_0 = 0.0005$

Comand window

Clear

clc.

$y_0 = 0.0005$

$x = (0:10)$

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

$y_n = Sub(x, y)$.

Plot (x, y_n).

grid on

grid minor

xLabel ('x')

yLabel ('Structural element').

SKETCH/////

GRAPH OF STRUCTURAL ELEMENT AGAINST x.