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COMPUTER ENGINEERING
17/ENG02/066
ASSIGNMENT III

① $x(x-1)y'' + (3x-1)y' + y = 0$

Taking $x(x-1)y'' = w_1$
$(3x-1)y' = w_2$
$y = w_3$

Considering w_1

$u = y''$ $\quad V = x(x-1)$
$u^n = y^{(n+2)}$ $\quad V' = 2x-1$
$u^{n-1} = y^{(n+1)}$ $\quad V'' = 2$
$u^{n-2} = y^2$ $\quad V''' = 0$

w_2

$u = y'$ $\quad V = (3x-1)$
$u^n = y^{(n+1)}$ $\quad V' = 3$
$u^{n-1} = y$ $\quad V'' = 0$

w_3

$u = y$ $\quad V = 1$
$u^n = y^n$ $\quad V = 0$

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

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

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

$w_3^n = y^n \cdot 1 + 0$

$w_1 + w_2 + w_3$

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

$n y^n + 3 + y^n = 0$

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

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

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

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

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

when $x = 0$

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

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

$$-(n+1)\,(y^{n+1})_0 + (n^2+2n+1)\,(y^n)_0 = 0$$

$$(y^{(n+1)})_0 = +\frac{(n^2+2n+1)(y^n)_0}{+(n+1)}$$

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

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

when $n = 0$

$$(y^{0+1})_0 = (0+1)\,(y^0)_0$$

$$(y')_0 = 1\,(y^{(0)})_0$$

when $n = 1$

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

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

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When $n=2$

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

$$[y^{(3)}]_0 = 3(y^{(3)}]_0 = 3(2)[y^{(2)}]_0$$

$$[y^{(3)}]_0 = 6[y^{(2)}]_0$$

When $n=3$

$$(y^{(4)}]_0 = 3+1)[y^{(3)}]_0$$

$$(y^{(4)}]_0 = 4[y^{(3)}]_0 = 4[6][y^{(1)})_0$$

$$(y^{(4)})_0 = 24[y^{(1)}]_0$$

When $n=4$

$$[y^{(5)}]_0 = (4+1)[y^{(4)}]_0$$

$$[y^{5)}]_0 = 5[y^{(4)}]_0 = 5(24)[y^{(1)}]_0$$

$$(y^{(5)})_0 = 120[y^{(1)}]_0$$

When $n=5$

$$(y^{(6)}]_0 = [5+1(y^{(5)}]_0$$

$$(y^{(6)}]_0 = 6[y^{(5)}]_0 = 6[120](y^{(1)})_0$$

$$(y^{(6)})_0 = 720[y^{(1)}]_0$$

When $n=6$

$$(y^{(n)})_0 = (6+1)[y^{(6)}]_0$$

$$= 7[y^{(6)}]_0 = 7(720)(y^{(1)})_0$$

$$(y^{\circ}]_0 = 5040(y^{(1)}]_0$$

$$y = [y^{(1)}]_0 + x[y^{(1)}]_0 + \frac{x^2}{2!}(y^{(2)})_0 + \frac{x^3}{3!}[y^{(3)}]_0 + \frac{x^4}{4!}(y^4)_0$$

$$+ \frac{x^3}{5!}(y^5)_0 + \frac{x^6}{6!}(y^{(6)}] + \frac{x^7}{7!}(y^{(7)}]_0$$

$$y = (y^{(0)})_0 + x[y^{(1)}]_0 + \frac{x^2}{2!}\cdot 2[y^{(2)}]_0 + \frac{x^3}{3!}\cdot 6(y^{(1)}]_0 +$$

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$$\frac{x^4}{4!} \cdot 24(y^{(4)})_0 + \frac{x^5}{5!} \cdot 120[y^{(5)}]_0 + \frac{x^6}{6!} = 720[y^{(6)}]_0 + \frac{x^7}{7!} 5040(y^{(7)})_0$$

(a) (i) $y(1+x)(y^{(0)})_0 + (x^2+x^3+x^4+x^5+x^6+x^7)(y^{(1)})_0$

$y_{(0)} = 0.0005m, y'(0) = 0.0005$

$y = (1+x)(0.0005m) + (x^2+x^3+x^4+x^5+x^6+x^7)(0.0005)$

when $x = 5m$, $8m$ and $10m$

$y = (1+5)(0.0005m) + (5^2+5^3+5^4+5^5+5^6+5^7)(0.0005)$

$y = 3\times10^{-3}m + 97650m(0.0005)$

$y = 3\times10^{-3}m + 48.825m$

$y = 48.828m$

when $x = 8m$

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

$y = 4.5\times10^{-3} + 2396736(0.0005)$

$y = 4.5\times10^{-3} + 1198$

$y = 1198m$

when $x = 10$

$y = (1+10)(0.0005) + (10^2+10^3+10^4+10^5+10^6+10^7)(0.0005)$

$y = 5.5\times10^{-3} + 11111100(0.0005)$

$y = 5555.5555m$

$\approx 5556m.$

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Mat lab

(1) Command Window.

(2) Clear

(3) CLC

(4) Close all

(5) Syms x

```
x = ((1+x)*(0.0005)+((x^2+x^3+x^4+x^5+x^6+x^7)*
    (0.0005))
t = 0:0.01:10
xt = subs(x,t)
xtn = double(xt)
plot(t, xtn)
xlabel('t')
ylabel('x')
grid on
grid minor
axis tight
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