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15/ENG02/024
Computer Engineering
ENG382

Assignment

i) $f(x) = e^{-0.5x}(4-x) - 2$

$f'(x) = -0.5e^{-0.5x}(4-x) - e^{-0.5x}$

Recall: $x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$ $\Rightarrow x_i - \left(\frac{e^{-0.5x}(4-x)-2}{-0.5e^{-0.5x}(4-x) - e^{-0.5x}}\right)$

For $i = 0$, $x = 0.5$

$$x_{i+1} = 0.5 - \left(\frac{e^{-0.5(0.5)}(4-0.5)-2}{-0.5e^{-0.5(0.5)}(4-0.5) - e^{-0.5(0.5)}}\right)$$

$$= 0.8389$$

For $i = 1$, $x = 0.8389$

$$x_{i+1} = 0.8389 - \left(\frac{e^{-0.5(0.8389)}(4-0.8389)-2}{-0.5e^{-0.5(0.8389)}(4-0.8389) - e^{-0.5(0.8389)}}\right)$$

$$= 0.8850$$

For $i = 2$, $x = 0.8850$

$$x_{i+1} = 0.8850 - \left(\frac{e^{-0.5(0.8850)}(4-0.8850)-2}{-0.5e^{-0.5(0.8850)}(4-0.8850) - e^{-0.5(0.8850)}}\right)$$

$$= 0.8857$$

For $i = 3$, $x = 0.8857$

$$x_{i+1} = 0.8857 - \left(\frac{e^{-0.5(0.8857)}(4-0.8857)-2}{-0.5e^{-0.5(0.8857)}(4-0.8857) - e^{-0.5(0.8857)}}\right)$$

$$= 0.8857.$$

For $i = 4$, $x = 0.8857$

For $i = 5$, $x = 0.8857$.

$$\% \text{ error tolerance} = \left| \frac{x_{i+1} - x_i}{x_{i+1}} \right| \times 100$$

For $i = 0$, $x = 0.5$, $\%\ \text{Er} = 100\%$

For $i = 1$, $x = 0.8389$

$$= \left| \frac{0.8389 - 0.5}{0.8389} \right| \times 100$$

$$= 40.39\%$$

For $i = 2$, $x = 0.8850$

$$= \left| \frac{0.8850 - 0.8389}{0.8850} \right| \times 100$$

$$= 5.28\%$$

For $i = 3$, $x = 0.8857$

$$= \left| \frac{0.8857 - 0.8850}{0.8857} \right| \times 100$$

$$= 0.079\%$$

For $i = 4$, $x = 0.8857$

$$= \left| \frac{0.8857 - 0.8857}{0.8857} \right| \times 100$$

$$= 0\%$$

For $i = 5$, $x = 0.8857$

$$= \left| \frac{0.8857 - 0.8857}{0.8857} \right| \times 100$$

$$= 0\%$$

i	x_i	% Error
0	0.5	100
1	0.8389	40.39
2	0.8850	5.28
3	0.8857	0.079
4	0.8857	0
5	0.8857	0

2) $F_D = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v$

$F_D = mg$

$m = 3.5\ kg$

$g = 9.8\ m/s$

$F_D = 9.8 \times 3.5 \Rightarrow F_D = 34.3$

equating both equations

$$34.3 = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v$$

$$0 = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v - 34.3$$

$$F(v) = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v - 34.3$$

$F'(v) =$,

$\frac{0.3v^2}{500 + (\ln v)^3}$ → u

v

using quotient rule ; $\frac{u'v - v'u}{v^2}$

$u = 0.3v^2$

$u' = 0.6v$

$v = 500 + (\ln v)^3$

$v' = \frac{3(\ln v)^2}{v}$

$$= \frac{0.6v\left(500 + (\ln v)^3\right) - 0.3v^2\left(3\left(\frac{\ln v}{v}\right)^2\right)}{\left(500 + (\ln v)^3\right)^2}$$

$$= \frac{300v + (\ln v)^3 0.6v - 0.9v(\ln v)^2}{500^2 + \ln v^6}$$

$$F'(v) = \frac{300v + \ln v^3 (0.6v) - 0.9v(\ln v)^2}{500^2 + \ln v^6} - 0.02$$

$v_{i+1} = v_i - \frac{F(v)}{F'(v)}$

$$= v_i - \frac{\frac{0.3v^2}{500 + (\ln v)^3} - 0.02v - 34.3}{\frac{300v + \ln v^3 (0.6v) - 0.9v(\ln v)^2}{500^2 + \ln v^6} - 0.02}$$