ANWANKWO ANTHONY UG/ENG/04/036 Elect/Elect

2. If the maximum percentage absolute error is desired to be 1E-9, using Newton-Raphson iteration method and initial guess of 0.5, find the root of the function given in Equ (1.1)

a) manually

b) with matlab

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

Solve (Newton-Raphson)

$x_{i+1} = x_i - \frac{F(x_i)}{F'(x_i)} =$

$F(x)\ e^{-0.5x}(4-x)-2$

$F'(x) = e^{-0.5x}(-1) + 0.5e^{-0.5x}(4-x)$

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

$= (1+2-0.5x) - e^{-0.5x}$

$= (3-0.5x) - e^{-0.5x}$

$F'(x) = e^{-0.5x}(0.5x-3)$

$\%Error = ((x_{i+1}-x_i)/x_{i+1}) \times 100$

$\therefore x_{i+1} = x_i - \left(\frac{e^{-0.5x}(4-x)-2}{e^{-0.5x}(0.5x-3)}\right)$

i	x	%error
1	0.5	0.403974729
2	0.884956003	0.084972043 37
3	0.885708605	0.000 2224 207
4	0.885708802	0
5	0.885708802	0
6	0.885708802	0
7	0.885708802	0
8	0.885708802	0
9	0.885708802	0

$$x_{i+1} = x_i - \left(\frac{e^{-0.5x_i}(4 - x_i) - 2}{e^{-0.5x_i}(0.5x_i - 3)} \right)$$

$$x_1 = x_0 - \left(\frac{e^{-0.5x_0}(4 - x_0) - 2}{e^{-0.5x_0}(0.5x_0 - 3)} \right)$$

$$x_1 = 0.5 - \left(\frac{e^{-0.5 \times 0.5}(4 - 0.5) - 2}{e^{-0.5 \times 0.5}(0.5 \times 0.5 - 3)} \right)$$

$x_1 = 0.838890606$

$x_2 = 0.884956003$

$x_3 = 0.885708805$

$x_4 = 0.885708802$

$x_5 = 0.885708802$

$x_6 = 0.885708802$

$x_7 = 0.885708802$

$x_8 = 0.885708802$

$x_9 = 0.885708802$

$$\%\,\text{Error} = \frac{x_{i+1} - x_i}{x_{i+1}} \times 100$$

$$= \frac{x_1 - x_0}{x_1} \times 100 = \frac{0.838890606 - 0.5}{0.838890606}$$

$\%\,\text{Error}_1 = 0.403974729$

$= 0.885708605 - 0.884972043$

0.885708605

$\%E_{a_2} = 8.497204337 \times 10^{-4}$

$= 0.000849720433$

$\%E_{a_3} = \frac{0.885708802 - 0.885708605}{0.885708802} \times 100$

$= 2.224207319 \times 10^{-5} \times 100$

$\%E_{a_3} = 0.002224207$

$\%E_{a_4} = 0$

$\%E_{a_5} = 0$

$\%E_{a_5} = 0$

MATLAB

```
x = 0.5
for i = 1:9
Iter(i+1) = i;
x(i+1) = x(i) - [(exp(-0.5*x(i)) * (4 - x(i) - 2)) / (exp(-0.5*x(i)) * (0.5*x(i) - 3))];
Ea(i+1) = [abs[x(i+1) - x(i)] / x(i+1)] * 100;
end
p = [Iter' z' Ea']
```