Chima-Boms. Chimbuenyim
16/ENG06/020
Mechanical Engineering
ENG 382

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

a) manually and

b) with the aid of MATLAB

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

NB.: for the manual solution, use all the values given by the calculator

Soln

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

$f'(x) =$

let $u = e^{-0.5x}$ & $v = (4-x)$

$du = -0.5e^{-0.5x}$ ; $dv = -1$

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

$x_0 = 0.5$ · [Initial guess]

General Newton - Raphson's formular

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

$f(x_0) = f(0.5) = 0.725827407$

$f'(x_0) = f'(0.5) = -2.141702153$

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = 0.838890606,$$

$f(x_1) = 0.078146429779$

$f'(x_1) = -1.642200929$

$$x_4 = x_3 - \frac{f(x_3)}{f'(x_3)} = 0.885708802,,$$

$f(x_4) = 7.845 \times 10^{-12}$

$f'(x_4) = -1.642200704$

$$x_5 = x_4 - \frac{f(x_4)}{f'(x_4)} = 0.885708802,,$$

∴ 0.88708602 is the root of eqn (1.1)

MATLAB (Assignment II)

```
function [x1, Err, valeur] = assign2 (x0, max1, tol, iter, f
fprime)
x0 = 0.5;
    max 1 = 100;
    tol = 0.0000000001;
    iter = 1;
    f = @(x) [(exp(-0.5 * x)] * (4 - x)] - 2;
fprime = @(x) [-exp(-0.5 * x)] + [(0.5 * exp(-0.5 * x)] *
    [4 - x);
for i = 1 ; max 1
    x1 = x0 - feval (f, x0) / feval (fprime, x0);
    Err = abs (x1 - x0); valeur = abs (x1 - x0) / x1;
fprintf ('%2 of %10.10f %10.10f %10.10f %10.10f %
    10.10f \n, iter, x0, x1, err, valeur')
x0 = x1, iter = 1 + iter;
if err <= tol, break, end
end
```