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300L
Mechanical Engineering
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ENG 382

Assignment 2

1.1 If the maximum percentage absolute error is desired to be 1E-9 Using the Newton-Raphson Iteration method and Initial guess of 0.5, find the root of the function in the given equation (1.1)

i) Manually (ii) With the aid of MATLAB $f(x) = e^{-0.5x}(4-x)-2$

Solution

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

$f'(x) =$, let $u = e^{-0.5x}$; $v = (4-x)$

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

$f'(x) = udv + vdu$

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

$x_0 = 0.5$ (Initial guess)

General Newton-Raphson's formular

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

$f(x_0) = f(0.5) = 0.7258027407$

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

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)} = 0.8388906061 \text{ (Root 1)}$$

$f(x_1) = 0.0781499779$

$f'(x_1) = -1.696486032$

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)} = 0.8849560003 \text{ (Root 2)}$$

$f(x_2) = 1.236575203 \times 10^{-3}$

$f'(x_2) = -1.643060762$

$$x_3 = x_2 - \frac{f(x_2)}{f'(x_2)} = 0.885708605 \text{ (Root 3)}$$

$f(x_3) = 3.23583557 \times 10^{-3}$

$f'(x_3) = -1.642200929$

$$x_4 = x_3 - \frac{f(x_3)}{f'(x_3)} = 0.885708802 \text{ (Root 4)}$$

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

$f'(x_4) = -1.642200904$

$$x_5 = x_4 - \frac{f(x_4)}{f'(x_4)} = 0.885708802 \text{ (Root 5)}$$

$\therefore$ 0.885708802 is the root of the equation

MATLAB CODE

```
function [x1, err, relerr] = assign2 (x0, max1, tol, iter, f, fprime)
x0 = 0.5 ;
max1 = 100;
tol = 0.000000001
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 max1
x1 = x0 feval (f, x0/feval (fprime, x0)';
err = abs(x1-x0), relerr = abs(x1-x0)/x1;
fprint (%2 of %10.10F %10.10F%10.10F%10.10f\n", iter, x0 x1,
err, relerr)
x0 = x1; iter = 1+ iter;
if err <= tol, break, end
end
```