**QUESTION 1 [20 MARKS]**

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 Equation (1.1)

(a) manually, and

(b) with the aid of MATLAB.

f(x) = x (4-x) -2 ……………………………………Equation (1.1)

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

**Solution**

**(a) Manual solution**

f(x) = \*(4-x) -2

f’(x) = (-1)-(4-x) \* 0.5 X\*= - \*(1+0.5 \*(4-x))

f’(x) = - \* (3-0.5x)

Applying the Newton-Raphson iteration method,

xi+1 = xi – (F(xi)/F’(xi))

using an initial guess of x =0.5,

xi+1 = 0.5 – (\* (4-(0.5)) -2)/ (- \* (3-0.5(0.5)))) = 0.838890606

xi+1= 0.838890606–( \*(4-(0.838890606))-2)/(\*(3-0.5(0.838890606)))) = 0.8849560003

xi+1=0.8849560003–( \*(4-(0.8849560003))-2)/(- \*(3-0.5(0.8849560003)))) = 0.885708605

xi+1=0.885708605–( (\*(4-(0.885708605))-2)/(- \*(3-0.5(0.885708605)))) = 0.885708802

xi+1=0.885708802–( \*(4-(0.885708802))-2)/(- \*(3-0.5(0.885708802)))) = 0.885708802

The absolute error is given as:

Ea =│(xi+1 - xi ) / xi+1│\* 100

Ea = │(0.838890606 - 0.5 ) / 0.838890606│X 100 = 40.39747299

Ea = │(0.8849560003- 0.838890606) / 0.8849560003│X 100 = 5.205388097

Ea = │(0.885708605- 0.8849560003) / 0.885708605│X 100 = 0.08497204337

Ea = │(0.885708802- 0.885708605) / 0.885708802│X 100 = 2.224207319 \*10-5

Ea = │(0.885708802- 0.885708802) / 0.885708802│X 100 = 0

|  |  |  |
| --- | --- | --- |
| In tabular form the results are:    i | Xi+1 | Ea |
| 0 | 0.5 | - |
| 1 | 0.838890606 | 40.39747299 |
| 2 | 0.8849560003 | 5.205388097 |
| 3 | 0.885708605 | 0.08497204337 |
| 4 | 0.885708802 | 2.224207319 \*10-5 |
| 5 | 0.885708802 | 0 |

