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LE/ENCo4/009

Electrical Electronics ~~Engineering~~ Engineering

Assignment II

If the maximum percentage associate error is desired to be $1E-4$, 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

(B) with the aid of matlab

$$f(x) = e^{-0.5x} \times (4-x) - 2 \quad \text{------ equation (1.1)}$$

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

(A) manually

Solution

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

$$f'(x) = e^{-0.5x}(-1) - (4-x) \times 0.5 \times e^{-0.5x}$$

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

$$f'(x) = -e^{-0.5x} \times (3 - 0.5x)$$

Applying Newton-Raphson iteration method

using initial guess of $x = 0.5$,

$$x_{i+1} = x_i - (f(x_i) / f'(x_i))$$

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

$$= 0.838890606$$

$$x_{i+1} = 0.838890606 - \left[\frac{e^{-0.5(0.838890606)} \times (4 - 0.838890606) - 2}{e^{-0.5(0.838890606} \times (3 - 0.5(0.838890606}\right]$$

$$= 0.884956003$$

$$x_{i+1} = 0.884956003 - \left[\frac{e^{0.5(0.884956003)} \times (4 - 0.884956003) - 2}{e^{-0.5(0.884956003)} \times (3 - 0.5(0.884956003}\right]$$

$$= 0.885708605$$

$$x_{i+1} = 0.88570\,80605 - \left[\frac{e^{-0.5(0.88570\,80605)} \times (4 - 0.88570\,80605) - 2}{e^{-0.5(0.88570\,80605)} \times 3 - 0.5(0.88570\,80605)}\right]$$

$$= 0.88570\,8802$$

$$x_{i+1} = 0.88570\,8802 - \left[\frac{e^{-0.5(0.88570\,8802)} \times (4 - 0.88570\,8802) - 2}{e^{-0.5(0.88570\,8802)} \times (3 - 0.5(0.88570\,8802))}\right]$$

Absolute error is given as,

$$E_a = \left|\frac{x_{i+1} - x_i}{x_{i+1}}\right| \times 100$$

$$E_{a2} = \left|\frac{0.83890606 - 0.5}{0.83890606}\right| \times 100 = 40.39747299$$

$$E_a = \left|\frac{0.88495603 - 0.83890606}{0.83890606}\right| \times 100 = 5.20538809\,7$$

$$E_a = \left|\frac{0.88570\,8605 - 0.88495603}{0.88570\,8605}\right| \times 100 = 0.08497204337$$

$$E_a = \left|\frac{0.88570\,8802 - 0.88570\,8605}{0.88570\,8802}\right| \times 100 = 2.224207319 \times 10^{-5}$$

$$E_a = \left|\frac{0.88570\,8802 - 0.88570\,8802}{0.88570\,8802}\right| \times 100 = 0$$

i	x_{i+1}	Ea
0	0.5	—
1	0.838890606	40.39742299
2	0.884956003	5.205388097
3	0.885708605	0.084972043 37
4	0.885708802	$2.224207349 \times 10^{-5}$
5	0.885708802	0