Assignment 2

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16/ENG04/016

Electrical / Electronics

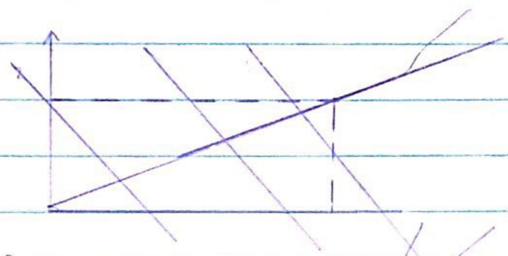
Question

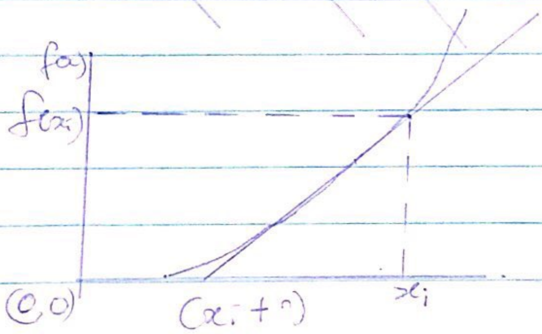
If the maximum percentage absolute error ~~chef~~ desired is to be 1% using Newton-Raphsons iteration method; and initial guess value of 0.5, find the root of the function, given in equation

(a) manually

(b) with ~~Math~~ MATLAB

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





$$f'(x) = \frac{f(x_i) - 0}{x_i - (x_{i+1})}$$

$$f'(x)\left(x_i - (x_{(i+1)})\right) = f(x_i)$$

$$f'(x) * (x) - f(x)\left(x_{(i+1)}\right) = f(x)$$

$$x_{(i+1)} = \frac{f(x_i) * x_{(i)} - f(x)}{f'(x)}$$

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

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

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

$$f'(x) = 0.5 \times 4(e^{-0.5x}) - (x * (-0.5e^{-0.5x}) + e^{-0.5x} - 1) = 0$$

$= -2e^{-0.5x} + x0.5e^{-0.5x} - e^{-0.5x}$

therefore if $x_0 = 0.5$ as given

$$x(i+1) = x_i - \frac{f(x_i)}{f'(x_i)}$$

when $i=0$

$$x(0+1) = x_0 - \frac{f(x_0)}{f'(x_0)}$$

$x_0 = 0.5$

$$x_1 = 0.5 - \left(\frac{\cancel{e}\,5e^{-0.5(0.5)}(4.05)-2}{(-2e^{-(0.5*0.5)} + 0.5(0.5e^{-0.5*0.5})}\right)$$

$$x_1 = 0.5 - \left(\frac{0.725803}{2.1417022}\right)$$

$$x_1 = 0.5 - (-0.338890)$$

$$x_1 = 0.83889$$

error =

$$e_a = \frac{x(i+1) - x(i)}{x(i+1)}$$

when $i=0$

$$e_a = \frac{x_1 - x_0}{x_1}$$

$$e_a = \frac{0.83889 - 0.5}{0.83889}$$

$= 0.40397 \times 100 = 40.397\%$

when $i = 1$

$$x_2 = x_1 - \frac{f(x)}{f'(x_1)}$$

$$x_2 = 0.83889 - \left(\frac{e^{-(0.83889 \times 0.5)}(4-(0.83889))}{-2e^{-(0.5 * 0.838897} + (0.83889 * 0.5 * (0.5) - e^{-(0.5 * 0.83889)}}\right)$$

$$x_2 = 0.83889 - \left(\frac{0.078150}{-1.6640}\right)$$

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$0.83889 - (0.\cancel{0460}\,046965)$

$= 0.8858$

when $i = 1$

$$\text{error} = \frac{x_2 - x_1}{x_2}$$

$$= \frac{0.8858 - 0.83889}{0.8858}$$

$= 0.0529 \times 100$

$= -5.295\%$

when $i = 2$

$$x_3 = x_2 - \frac{f(x_2)}{f'(x_2)}$$

$$x_3 = 0.8858 - \frac{(e^{-0.8858 \times 0.5}(4 - 0.8858) - 2)}{-2e - (0.5 * 0.8858) + (0.8859 \times 0.5 \times e^{-0.5 \times 0.885})}$$

$$x_3 = 0.8858 - \left(\frac{-0.0001496}{-1.6426}\right)$$

$0.8858 + 0.000091075$

$= 0.885891075$

$$\text{error} = \frac{x_3 - x_2}{x_3}$$

$$= \frac{0.88589 - 0.8858}{0.88589}$$

$= 0.0001015 \simeq 1 \times 015 \times 10^{-4}$

$= 0.01\%$

when $i = 3$

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

$$x_4 = 0.88589 - \frac{(e^{-0.8859 \times 0.5} \times (4 - 0.88589) - 2)}{-2e^{-(-0.5 * 0.88589)} + (0.8889 \times 0.5 \times e^{-0.5 \times 0.8859}) - e^{-(0.5 \times 0.8859)}}$$

$x_4 = 0.88559$

$$error = \frac{0.88559 - 0.88559}{0.88559}$$

$= 0\%$