

Name: ID:

Department of Computer Science and Engineering

CSE 330: Numerical Methods

Quiz 1 FALL 2018

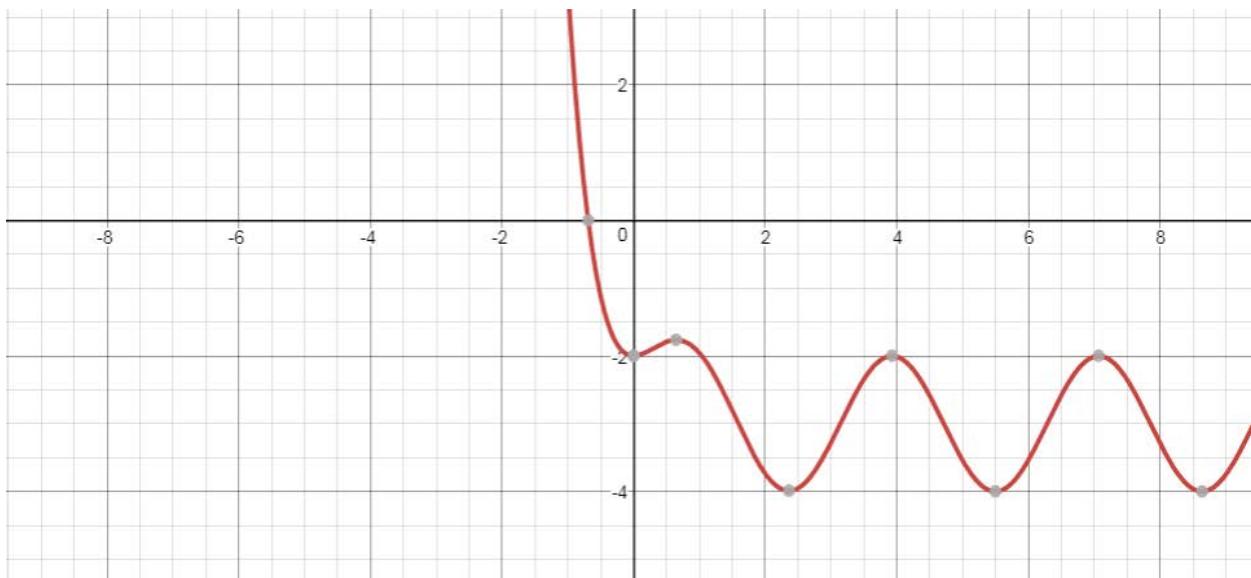
Full Marks: 10

SET B

Solve the following equation using an iterative approach upto **3** iterations. Also find the *absolute relative true error*, $|E_t| \%$ after each iteration. Suppose, you are given an initial guess of $x_0 = 1$.

$$e^{-2x} + \sin(2x) - 3 = 0$$

Graphical representation of the given equation:



$$\text{Bisection Method: } x_m = \frac{x_l + x_u}{2}$$

$$\text{False Position Method: } x_r = \frac{x_u f(x_l) - x_l f(x_u)}{f(x_l) - f(x_u)}$$

$$\text{Newton Raphson's Method: } x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$$

$$f(x) = e^{-2x} + \sin(2x) - 3 = 0$$

$$x_0 = x_1 = 1$$

$$f'(x) = -2e^{-2x} + 2\cos(2x)$$

Iteration 1:

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

$$= 1 - \frac{e^{-2 \times 1} + \sin(2 \times 1) - 3}{-2 \times e^{-2 \times 1} + 2 \cos(2 \times 1)}$$

$$= -0.7728$$

Absolute Relative True Error,

$$|\epsilon_t| = \left| \frac{\text{True Value} - \text{Approximate Value}}{\text{True Value}} \right| \times 100\%$$

Suppose, True value = -0.7 (from graph)

$$|\epsilon_t| = \left| \frac{-0.7 + 0.7728}{-0.7} \right| \times 100\% \\ = 10.4\%$$

Iteration 2:

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

$$= -0.7728 - \frac{e^{-2x(-0.7728)} + \sin(2x - 7728) - 3}{-2e^{-2x(-0.7728)} + 2\cos(2x - 7728)}$$

$$= -0.6987$$

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$$|t+| = \left| \frac{-0.7 + 0.6987}{-0.7} \right| \times 100\%.$$

$$= 0.1857\%$$

Iteration 3:

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

$$= -0.6987 - \frac{e^{-2x(-0.6987)} + \sin(2x - 6987) - 3}{-2e^{-2x(-0.6987)} + 2\cos(2x - 6987)}$$

$$= -0.690995$$

$$|t+| = \left| \frac{-0.7 + 0.690995}{-0.7} \right| \times 100\% = 1.286\%$$