Department of Computer Science & Engineering
University of Barishal
B.Sc. 3rd Year 1st Semester Final Examination-2024
Course Code: CSE-3107, Course Title: Numerical Methods
Admission Session: 2021-22
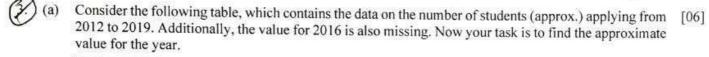
Full Marks: 60   **Time: 03 hour**

Answer any five(5) of the following eight(8) questions. Figures in the right-hand margin indicate full marks.

1. (a) Discuss the importance of studying numerical methods in computer science and how do they address challenges posed by mathematical functions that lack analytical solutions. [04]
   (b) Briefly describe different types of iteration methods and the limitations of each one of these. [06]
   (c) What is the convergence condition of Iteration method. [02]

2. (a) Explain the Newton-Raphson's iterative formula? What are the necessities of using Newton-Raphson method in numerical analysis? Explain all the steps to find out the roots of a function using this method. Mention some of its drawbacks and how to solve them? [08]
   (b) Find the real root of the equation $x^3 - 2x^2 - 4 = 0$ by using False position methods with initial values 2 and 3. [04]

3. (a) Consider the following table, which contains the data on the number of students (approx.) applying from 2012 to 2019. Additionally, the value for 2016 is also missing. Now your task is to find the approximate value for the year. [06]

x	2012	2013	2014	2015	2016	2017
f(x)	17.5	13	14	9.9	-----	12.5

   (b) Find the missing term in the following table: [06]

x	10	15	20	25	30	35
f(x)	43	-----	29	32	-----	77

4. (a) What do you mean by operator? Mention 3 operators and their meaning. [06]
   (b) Establish the relation between the following different operators [06]
   i. $(1 + \Delta)(1 - \nabla) \equiv 1$
   ii. $\Delta \equiv E - 1$

5. (a) Briefly describe and derive Newton's forward interpolation formula for equal intervals. [06]
   (b) For the following table, find the value of f(29) along with the name of interpolation formula with justification. [06]

x	20	22	24	26	28	30
f(x)	165	166	168	169	170	171

6. (a) Describe Lagrange's interpolation formula for unequal intervals. Show its comparison with cubic spline interpolation. [06]
   (b) Suppose you are training a machine learning model that uses sensor reading over time as input. However, on the 22nd second the reading is missing, and you need to estimate it using Linear Spline Interpolation. The data are given below: [06]

Time(x)	0	10	20	25	27	30
Sensor reading f(x)	10	100	150	250	300	400

7. (a) Why do we need to learn numerical differentiation. Write short notes on forward, backward and central differences with proper examples. [06]
   (b) Write short notes on Gauss-Jordan method to solve the systems of linear equations. Solve the following system of linear equations with Gauss-Jordan method. [06]
   $x + y + z = 5$, $2x + 3y + 5z = 8$, $4x + 5z = 2$

8. (a) Explain the concept of numerical integration. Compare and contrast the trapezoidal rule with Simpson's rule. Provide an example scenario where numerical integration is necessary in CSE. [06]
   (b) Using Euler method, find an approximate value of y corresponding to x=2, given that $\frac{dy}{dx} = x + 2y$ and $y(1) = 1$ [06]