

**Assignment 04**

Second Year BS (Honors) 2023-2024

Course Title: Math Lab II, Course Code: AMTH 250

Department of Applied Mathematics, University of Dhaka

**Name:****Roll No:****Group:**

Write a FORTRAN program to solve each of the following problems. Always use **files** named according to the assignment no. and problem no. to take input and show output unless **specified otherwise**, e.g., for problem no. **Y** of assignment no. **X**, input and output file names should be 'in\_a**X**q**Y**.txt' and 'ot\_a**X**q**Y**.txt' respectively.

**No.****Problem**

1. In an RC-series circuit, the charge  $q(t)$  on the capacitor is given by

$$q(t) = 60 - 60e^{-t/5}.$$

Generate necessary values to approximate the current  $i(t) = q'(t)$  in the circuit at  $t = 5s$  using

- i) Three-point mid point formula with  $h = -0.25$
- ii) Three-point end point formula with  $h = 0.25$
- iii) Five-point mid point formula with  $h = 0.50$
- iv) Five-point end point formula with  $h = 0.50$

Show the result in a table with a suitable title and appropriate headings.

2. Let  $f(x) = xe^x$ . Find  $f'(2.0)$  with  $A_5$  using Richardson extrapolation method.

3. A slider in a machine moves along a fixed straight rod. It's distance  $x$  cm along the rod is given below for various values of time  $t$ .

$x$ (cm)	0	0.1	0.2	0.3	0.4	0.5	0.6
$t$ (s)	30.13	31.62	32.87	33.64	33.95	33.81	33.24

Find the velocity and acceleration of the slider when  $t = 0.0 s$  and  $t = 0.6 s$ .

4. Evaluate the integral

$$\int_{-0.4}^{0.6} -\frac{1}{(x-1)(2+\sqrt{2}-2x)} dx$$

using (i) Trapezoidal rule (ii) Simpsons' 1/3 rule, (iii) Simpson's 3/8 rule, and (iv) Weddle's rule with 30 subintervals.

The exact value of the integral is given by

$$\left[ -\frac{1}{\sqrt{2}} \ln \left| \frac{x-1}{\sqrt{2}-2(x-1)} \right| \right]_{-0.4}^{0.6}$$

Construct a table containing the following columns:

'Exact Value', 'Approximate Value', 'Absolute Error', 'Relative Error'.

5. Evaluate the definite integral  $I = \int \frac{1}{1+x^2} dx$

using Romberg integration correct up to 5 decimal places. If possible, compare your results with exact values.