BANGLADESH UNIVERSITY OF PROFESSIONALS
Military Institute of Science and Technology
B.Sc. in Environmental, Water Resources, and Coastal Engineering, Term Final (Spring) Examination 2024: Oct 2024 - Nov 2024

Student Group: 36<Earned Credit Hours ≤ 72

Subject: EWCE 205, Numerical Methods

Time: 3.00 hours **Full Marks: 120**

INSTRUCTIONS:

a. Use **SEPARATE** answer scripts for each section.
b. **Question-1** in **Section-A** and **Question-5** in **Section-B** are compulsory.
c. Answer any other **TWO** out of the remaining **THREE** questions from each section.
d. Figures in the margin indicate full **marks**.
e. Assume reasonable data if necessary.
f. **Symbols** and **abbreviations** used have their usual meanings.

SECTION-A

Question 1 (Compulsory)

a. Solve the following system using Cramer's rule: **08**

$$x + y + z = 11$$
$$2x - y + z = 5$$
$$3x + 2y + 4 = 24$$

b. Use the classical Runge-Kutta formula of fourth order to find the numerical solution at x = 0.8 for $\frac{dy}{dx} = \sqrt{x+y}$, $y(0.4) = 0.41$. Assume the step length h = 0.2. **12**

Question 2

a. Solve the equations by the Jacobi method **12**

$$27x + 6y - z = 85$$
$$x + y + 54z = 110$$
$$6x + 15y + 2z = 72$$

Do maximum 5 iterations and correct to three decimal places.

b. Consider the initial value problem $y' = x(y + x) - 2$, $y(0) = 2$. Use Euler's method with step sizes h = 0.15 and h = 0.3 to compute approximations to $y(0.6)$. **08**

Question 3

a. (i) Derive the 5-point difference formula. **04+06**
(ii) Use 5-point forward difference formula to find $f'(1.10)$ from the following table **=10**

x	1.10	1.15	1.20	1.25	1.30
f(x)	1.04881	1.07238	1.09545	1.11803	1.14038

b. The following data gives corresponding values of pressure and specific volume of a superheated system: **10**

V	2	4	6	8	10
P	105	42.7	25.3	16	13

Find the rate of change of pressure with respect to volume, when V=2.

Question 4

a. Evaluate $\int_0^{0.6} e^{-x^2}\,dx$, using Simpson's $\frac{1}{3}$ rule by dividing into six equal parts. **06**

b. Use Romberg's method to compute $\int_0^1 \frac{dx}{1+x^2}$ correct to four decimal places. Take h=0.5, 0.25 and 0.125 successively. **14**

SECTION-B

Question 5 (Compulsory)

a. Determine a root of an equation $f(x) = x^3 + 2x^2 + x - 1$ using Bisection method with a desired accuracy of 0.001. **16**

b. State the difference between interpolation and curve fitting. **04**

Question 6

a. Explain the use of interpolation. Also, briefly describe the differences among Newton's forward difference, Newton's backward difference and Newton's divided difference techniques. **06**

b. Determine a root of an equation $f(x) = 2x^3 - 2x - 5$ using False Position method (regula falsi method) with a desired accuracy of 0.001. **14**

Question 7

a. Determine a root of an equation $f(x) = 3x - \cos x - 1$ using Newton-Raphson method correct up to 3 decimal places. **10**

b. Find the cubic polynomial which takes the following values using Newton's Forward Difference formula. **10**

x	0	1	2	3
f(x)	1	2	1	10

Also find $f(4)$ and $f'(4)$.

Question 8

a. Determine a root of an equation $f(x) = x^3 - x - 1$ using Secant method with a desired accuracy of 0.001. **10**

b. Find a solution using Newton's Backward Difference formula for x=3.75. **10**

x	f(x)
2	7
2.5	14.125
3	25
3.5	40.375
4	61