



'সমানো মন্ত্র: সমিতি: সমানী'

**UNIVERSITY OF NORTH BENGAL**  
B.Sc. Honours 5th Semester Examination, 2021

**CC12-MATHEMATICS**  
**NUMERICAL METHODS**

Time Allotted: 2 Hours

Full Marks: 40

*The figures in the margin indicate full marks.  
All symbols are of usual significance.*

**GROUP-A**

1. Answer any **five** questions from the following: 1×5 = 5
- (a) Prove that  $\Delta \log f(x) = \log \left\{ 1 + \frac{\Delta f(x)}{f(x)} \right\}$ .
- (b)  $\nabla$  and  $E$  are backward and shift operator respectively. Prove that  $E = \frac{1}{1-\nabla}$ .
- (c) Give the geometrical interpretation of Newton-Raphson method.
- (d) How many digits are to be taken in computing  $\sqrt{20}$  so that the error does not exceed 0.0001%?
- (e) Find the number of significant figures in the approximate number 0.4785 gives its relative error as  $0.1 \times 10^{-2}$ .
- (f) Prove that  $\nabla^n y_k = \Delta^n y_{k-n}$ .
- (g) If  $\pi$  is approximated by 3.14, find the relative error.
- (h) Why polynomials are used for approximating in interpolation.

**GROUP-B**

**Answer any three questions from the following** 5×3 = 15

2. Explain Gauss-Seidel iterative method for solving a system of linear equations. State sufficient conditions for the convergence of the process.
3. If  $\Delta^m$  denotes the  $m$ -th order finite forward difference operator, show that

$$\Delta^m \left( \frac{1}{x} \right) = \frac{(-1)^m m! h^m}{x(x+h)(x+2h) \dots (x+mh)}$$

where  $h$  is the step length.

4. (a) Solve  $\sin x = 5x - 2$  by the Fixed-Point iteration method. 3  
(b) What are the advantages and disadvantages for Regula-Falsi method? 2

5. Evaluate  $\int_0^1 \cos x \, dx$ , correct upto three significant figure, considering ten equal intervals by composite Simpson's  $\frac{1}{3}$  rule.
6. Use Runge-Kutta method of order four to approximate  $y$  when  $x = 1.1$ . Given that  $\frac{dy}{dx} = 3x + y^2$ ,  $y(1) = 1.2$

**GROUP-C**

Answer any two questions from the following

10×2 = 20

7. (a) Use Power method to determine the dominant eigenvalue and corresponding eigenvector of the matrix 5

$$A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

- (b) Deduce the iterative procedure 5

$$x_{n+1} = \frac{1}{2} \left( x_n + \frac{a}{x_n} \right)$$

for evaluating  $\sqrt{a}$  using Newton-Raphson method.

8. (a) Find the number of multiplications and divisions for solving a system of  $n$  linear equations having  $n$  unknowns using Gauss-elimination method. 5
- (b) Establish general quadrature formula from Newton's forward difference interpolating polynomial. Hence deduce Trapezoidal rule. 5

9. (a) Find the least degree polynomial which takes the values 5

$x$	0	2	3	4	7
$f(x)$	4	26	58	112	466

Hence find  $f(5)$ .

- (b) Deduce normal equation for fitting a straight line using least square approximation method. 5

10. What are the partial pivoting and complete pivoting in Gauss-elimination method? Discuss Gauss-elimination method with complete pivoting for solving a system of  $n$  linear equations with  $n$  unknowns. State the condition of convergence of Gauss-Seidel iterative method. 2+6+2

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