REV-01
MSM/15/20

2025/12

SET A

M.SC. MATHEMATICS
FIRST SEMESTER
NUMERICAL ANALYSIS
MSM – 104

[USE OMR FOR OBJECTIVE PART]

Duration: 1:30 hrs. **Full Marks: 35**

Objective

Time: 15 mins. **Marks: 10**

Choose the correct answer from the following: ***1×10=10***

1. The forward difference operator (Δ) is defined as
   a. $\Delta f(x) = f(x+h) - f(x)$ b. $\Delta f(x) = f(x) - f(x-h)$
   c. $\Delta f(x) = f(x+h) + f(x)$ d. $\Delta f(x) = f(x) - f(x+h)$

2. The backward difference operator (∇) is defined as:
   a. $\nabla f(x) = f(x+h) - f(x)$ b. $\nabla f(x) = f(x) - f(x-h)$
   c. $\nabla f(x) = f(x) - f(x+h)$ d. $\nabla f(x) = f(x-h) - f(x)$

3. The central difference operator (δ) is defined as:
   a. $\delta f(x) = f(x+h) - f(x-h)$ b. $\delta f(x) = f(x+h) + f(x-h)$
   c. $\delta f(x) = f(x) - f(x-h)$ d. $\delta f(x) = f(x+h) - 2f(x) + f(x-h))$

4. The relationship between Δ and the shift operator E is
   a. $. \Delta = E + 1$ b. $. \Delta = E - 1$
   c. $. \Delta = 1 - E$ d. $. \Delta = E^2 - 1$

5. The second forward difference of a function **f(x)f(x)f(x)** is:
   a. $\Delta^2 f(x) = f(x+2h) - f(x)$ b. $\Delta^2 f(x) = f(x+2h) - 2f(x+h) + f(x)$
   c. $\Delta^2 f(x) = f(x+2h) + f(x)$ d. $\Delta^2 f(x) = f(x+2h) - 2f(x)) + f(x+h)$

6. The Newton forward interpolation formula is based on
   a. Forward differences b. Backward differences
   c. Central differences d. Divided differences

7. The Newton backward interpolation formula is most suitable when
   a. The value to be interpolated is near the beginning of the table b. The value to be interpolated is near the middle of the table
   c. The value to be interpolated is near the end of the table d. None of the above

8 The order of the finite difference approximation of the first derivative $f'(x)$ using central difference is:
   a. first order b. second order
   c. Third order d. Fourth order

9. The error term in the first-order forward difference approximation of **f'(x)f'(x)f'(x)** is proportional to:

a. h b. h^2

c. $\frac{1}{h}$ d. h^3

10. If $f(x) = x^3$ and $h = 1$, what is the first forward difference $\Delta f(x)$ at $x = 2$?

a. 15 b. 17

c. 18 d. 19

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Descriptive

Time : 1 hr. 15 mins. Marks : 25

[Answer question no.1 & any two (2) from the rest]

1. Establish the relation $\Delta \log\{f(x)\} = \log\{1 + \frac{\Delta f(x)}{f(x)}\}$ 5

2. 5+5=10

a. Prove that $\left(E^{\frac{1}{2}} + E^{\frac{-1}{2}}\right)(1 + \Delta)^{\frac{1}{2}} = 2 + \Delta$

b. Show that $\Delta = \frac{1}{2}\delta^2 + \delta\sqrt{1 + \frac{\delta^2}{4}}$

3. 5+5=10

a. State Newton Gregory's forward interpolation formula and calculate the population of the city in the decimal census, as given below Year

Year	1961	1971	1981	1991	2001
Population (Thousands)	46	66	81	93	101

Estimate the population for the year 1975

b. Show that the $\sqrt[k]{N}$ iterative formula is

$$x_{n+1} = \frac{1}{k}[(k-1)x_n + {}^{N}/_{x_n{}^{k-1}}$$

4. State the definition of the Divided difference and find the third divided difference with the arguments $2, 4, 9, 10$ of the function $f(x^2 - 2x)$ **3+7=10**

5. Solve by factorization method of the equations **10**

$$3x + 2y + 7z = 4$$

$$2x + 3y + z = 5$$

$$3x + 4y + z = 7$$

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