Seat No. : _____

MB-113

March-2025

B.Sc., Sem.-V

MAT-301 : Mathematics
(Numerical Methods)

Time : 2:30 Hours] **[Max. Marks : 70**

Instructions : (1) Each question is compulsory.

(2) **All** questions carry equal marks.

1. (A) Define : Absolute error, Relative error, Percentage error.

Find the relative percentage error in $f(x) = 4 \sin x - 3x$ for $x = 0$, if the error in $x = 0.005$. **7**

1. (B) Express a polynomial $f(x)$ of degree n in factorial notation. Also find a function whose first difference is $9x^2 + 11x + 5$. **7**

OR

1. (A) Explain the method of false position to obtain a real root of an equation $f(x) = 0$. **7**

1. (B) Obtain iterative formula for the reciprocal of a non-zero number N by Newton-Raphson formula. Also find the reciprocal of 6. **7**

2. (A) State and prove Newton's forward interpolation formula for equal intervals. **7**

2. (B) In usual notation prove that **7**

(i) $\mu^2 = 1 + \frac{1}{4}\delta^2$

(ii) $\nabla^3 y_3 = \delta^3 y_0$

OR

2. (A) State and prove Gauss's Forward interpolation formula for equal intervals. **7**

2. (B) Find the missing entries of the following table : **7**

x	5	6	7	8	9
$f(x)$	1	3	–	31	81

3. (A) State and prove Newton's divided difference interpolation formula for unequal intervals. **7**

3. (B) Find f'(4) using appropriate interpolation formula. **7**

x	1	2	4	8	10
$f(x)$	0	1	5	21	27

OR

3. (A) Derive :

$$\left(\frac{d^2y}{dx^2}\right)_{x=x_n} = \frac{1}{\hbar^2}\left[\nabla^2 + \nabla^3 + \frac{11}{12}\nabla^4 + \frac{5}{6}\nabla^5 + \ldots.\right] y_n$$

in usual notation. **7**

3. (B) State (only) Lagrange's interpolation formula for unequal intervals. Also find f(7) for given data as follows : **7**

x	5	6	9
$f(x)$	15	13	14

4. (A) Discuss Picard's method to solve first order differential equation $\frac{dy}{dx} = f(x, y)$ with boundary condition $y = y_0$ when $x = x_0$. **7**

4. (B) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by using Simpson's 1/3 rule. Hence obtain the approximate value of π. **7**

OR

4. (A) State and prove Gauss-Legendre Quadrature formula. **7**

4. (B) Solve $\frac{dy}{dx} = y^2 + 1$ with initial condition $y = 0$ at $x = 0$ in the range $0 \leq x \leq 1$ by using the Taylor's series method. **7**

5. Attempt any **seven** in short : **14**

(1) Following numbers are to be rounded off correct up to four significant figures :

(i) 24.564986

(ii) 27.487466

(2) Find the number of significant figures in $V_A = 11.2461$ given its absolute error as 0.25×10^{-2}.

(3) Give an example of algebraic and transcendental equation.

(4) Define forward and backward finite difference.

(5) Define Central difference δ.

(6) In usual Notation prove that $\delta = E^{-\frac{1}{2}}\Delta$.

(7) Define Newton's divided difference $f(x_0, x_1)$.

(8) Using Inverse interpolation, find x when $y = 12$ with following data :

x	1754	2648	3564
y	10	15	20

(9) Find Second Newton's divided difference f(3, 4, 5).

(10) What is the formula for Newton Raphson's iteration method for finding solution of f(x) = 0.

(11) If the root of equation $x^3 - 8x - 4 = 0$ which lies between 3 and 4. Then find the first approximation root by using bisection method.

(12) Write down the Trapezoidal rule for numerical integration.