MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

M(CS)-301

NUMERICAL METHODS

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. 10×1 = 10

(i) Lagrange's interpolation can be used for

(A) only equi-spaced nodes
(B) only unequi-spaced nodes
(C) for both cases of (a) and (b)
(D) none of these

(ii) The inherent error for Trapezoidal rule of integration is as (the notations have their usual meanings)

(A) $-\frac{nh^5}{140}f^v(x_0)$ (B) $-\frac{nh^5}{140}f^{iv}(x_0)$

(C) $-\frac{nh^3}{12}f^v(x_0)$ (D) none of these

(iii) The total number of significant digits in 500000 is

(A) 2 (B) 1
(C) 0 (D) none of these

(iv) $(\Delta - \nabla)x^2$ is equal to (the notations have their usual meanings)

(A) h^2 (B) $2h^2$
(C) $-2h^2$ (D) none of these

(v) Newton's Divided difference interpolation formula is used for

(A) equispaced arguments only
(B) unequispaced only
(C) both equispaced and unequispaced arguments
(D) none of these

(vi) The rate of convergence of bisection method is

(A) linear (B) quadratic
(C) cubic (D) none of these

(vii) The error in the Simpson's $1/3^{rd}$ rule is of order

(A) h (B) h^2
(C) h^3 (D) h^4

(viii) In the Newton's Forward Interpolation formula, the value of $u=\frac{x-x_0}{h}$ lies between

(A) 0 and 1 (B) –1 and 0
(C) –1 and 1 (D) 5 and 0

(ix) In Trapezoidal rule, the portion of curve is replaced by

(A) straight line
(B) circular path
(C) parabolic path
(D) none of these

(x) Which relations are true?

(A) $E = 1 + \Delta$, $\Delta\nabla = \Delta - \nabla$
(B) $E = 1 - \Delta$, $\Delta\nabla = \Delta + \nabla$
(C) $E = 1 - \Delta$, $\Delta\nabla = \Delta - \nabla$
(D) $E = 1 + \Delta$, $\Delta\nabla = \Delta + \nabla$

(xi) Regula-Falsi method is used to

(A) solve the differential equation of boundary value problem
(B) solve transcendental equation numerically
(C) solve a system of equation numerically
(D) none of these

(xii) If 'A' be the actual value and 'T' be its estimated value, the formula for relative error is

(A) A/T (B) (A-T)/T
(C) $|A - T|/A$ (D) $|A - T|/T$

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. What is the difference between interpolation and extrapolation? Give suitable examples.

3. Compute the value of π from the formula $\frac{\pi}{4} = \int_0^1 \frac{dx}{1+x^2}$ using Simpson's 1/3 rule with 10 sub-intervals.

4. Prove the following operator relation:
$\mu^2 = 1 + \frac{1}{4}\delta^2$, where the notations have their usual meanings.

5. Evaluate $\sqrt{12}$ to three places of decimals by Newton-Raphson Method.

6. Evaluate the missing terms in the following table:

x:	0	1	2	3	4	5
$f(x)$:	0	-	8	15	-	35

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) Computer $f(0.23)$ and $f(0.29)$ using suitable formula from the table below: 7+5+3

x:	0.20	0.22	0.24	0.26	0.28	0.30
$f(x)$:	1.6596	1.6698	1.6804	1.6912	1.7024	1.7139

(b) Describe Geometric Significance of Simpson's 1/3 Rule.

(c) Determine the absolute error E_A of the following approximate number given their relative error, $x_A = 67.84$, $E_R = 1\%$.

8. (a) Using Gauss-Seidel method find the solution of the following system of linear equations correct up to two decimal places: 6+5+4
$3x + y + 5z = 13$, $5x - 2y + z = 4$, $x + 6y - 2z = -1$.

(b) Solve the equation $\frac{dy}{dx} = \frac{1}{x+y}$, $y(0) = 1$, for $y(0.1)$ and $y(0.2)$, using Runge-Kutta method of the fourth order.

(c) Show that $(1 + \Delta)(1 - \nabla) \equiv 1$.

9. (a) Find the root of the equation $x \tan x = 1.28$, that lies in the interval (0, 1), correct to 4 decimal places, using Bisection method. 7+8

(b) Given $\frac{dy}{dx} + \frac{y}{x} = \frac{1}{x^2}$, $y(1) = 1$. Evaluate $y(1.2)$ by modified Euler's method correct up to 4 decimal places.

10.(a) Find the polynomial $f(x)$ and hence calculate $f(5.5)$ for the given data: 6+3+6

x:	0	2	3	5	7
$f(x)$	1	47	97	251	477

(b) What is the order of operation needs for L-U decomposition method?

(c) Solve the following system of equation by L-U decomposition method:
$x + y - z = 2$, $2x + 3y + 5z = -3$, $3x + 2y - 3z = 6$.

11.(a) Find a real root of the equation $x^3 = 2$ within (1, 2) by Regula Falsi method, correct up to 4 place of decimals. 5

(b) Solve by method of finite difference for $h = 0.25$ 5

$$\frac{d^2y}{dx^2} + y = 0, \quad y(0) = 0, \quad y(1) = 1.$$

(c) Using the Divided difference formula find $f(0.72)$ from the following table: 5

x	0.62	0.68	0.70	0.73	0.75
$f(x)$	0.6604918	0.73363074	0.7585837	0.7965858	0.8223167