

EX/SC/MATH/UG/CORE/TH/07/2025(OLD)

B. SC. MATHEMATICS EXAMINATION, 2025 (OLD)

(2nd Year, 1st Semester)

(Numerical Methods)

PAPER : CORE-07

Time : 1 Hour 15 minute

Full Marks : 24

Use separate answer scripts for each part.

Notations and Symbols have their usual meanings.

PART—I

(12 Marks)

Answer *any two* questions :

6×2=12

1. (i) Using a proper numerical scheme, find the equation of a catenary of the form $y = c \cosh \frac{(x-a)}{c}$ passing through the points (1, 1) and (2, 3), correct to 4 decimal places.
(ii) Explain the concept of relative error briefly, supported by a suitable example. 4+2=6
2. (i) Consider the following two methods for finding $7^{1/5}$. Arrange them in order based on their apparent speed of convergence, starting with $x_0 = 1$:

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[Turn Over]

(2)

(a) $x_k = x_{k-1} - \frac{x_{k-1}^5 - 7}{5x_{k-1}^4}, k = 1, 2, 3, \dots$

(b) $x_k = x_{k-1} - \frac{x_{k-1}^5 - 7}{12}, k = 1, 2, 3, \dots$

- (ii) Determine the maximum percentage error in the time period $T = 2\pi\sqrt{l/g}$, given that the length l has a measurement error of 1% and the acceleration due to gravity g has an error of 2%. 4+2=6

3. (i) Show that for a system of linear equation $Ax = b$ where A is an $n \times n$ matrix, the Jacobi iteration scheme converges for any initial starting vector if A is strictly diagonally dominant.
- (ii) Show that the bisection method exhibits a linear rate of convergence. 3+3=6

PART—II

(12 Marks)

Answer any **two** questions from the following : 6×2=12

1. Establish Lagrange's polynomial interpolation formula for a function $f(x)$ corresponding to the distinct points $x_0, x_1, x_2, \dots, x_n$. Discuss the remainder term. 4+2=6
2. Evaluate $\int_0^1 \sqrt{1-x^3}$ by Simpson's one-third rule taking 10 intervals correct up to four decimal places. Obtain the error term. 5+1=6

(3)

3. (i) Determine the weights and abscissas in the Gauss Quadrature formula $\int_{-1}^1 \phi(u) du = \sum_{n=1}^3 \phi(u_n)$.
- (ii) Evaluate $\int_0^1 \frac{dx}{1+x}$ using above formula. 4+2=6

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