

U.G. 5th Semester Examination - 2025

MATHEMATICS

[MAJOR-VII]

Course Code : MATH-M-T-7

[Numerical Analysis (Theory)]

[NEP-2020]

Full Marks : 40

Time : $2\frac{1}{2}$ Hours*The figures in the right-hand margin indicate marks.**The notations and symbols have their usual meanings.*

1. Answer any **five** questions: 2×5=10
- Find the absolute error and relative error in taking $\pi = 3.141593$ as $\frac{22}{7}$.
 - Show that $\Delta \log f(x) = \log \left\{ 1 + \frac{\Delta f(x)}{f(x)} \right\}$.
 - State fundamental theorem of finite difference calculus.
 - What do you mean by the degree of precision of a quadrature formula?
 - Is it possible to find numerically least eigen value for a matrix A by power method? Discuss.
 - State the advantage of Lagrange's interpolation.
 - What do you mean by the diagonally dominant for system of linear equations?

[Turn over]

h) State the basic principle of Newton-Raphson method.

2. Answer any **two** questions: $5 \times 2 = 10$

a) Establish Newton's Backward interpolation formula when is this formula used.

b) By integrating Newton's forward interpolation formula, obtain the basic form of Simpson's one-third rule for numerical integration, taking the error term.

c) State the Newton-Raphson formula for solving a transcendental equation and explain the limitation of using Newton-Raphson formula.

d) To solve the non-linear equation $e^{-x} - \cos x = 0$ by fixed-point iteration method, the following fixed-point formulation may be considered.

i) $x = -\ln(\cos x)$

ii) $x = \cos^{-1}(e^{-x})$

3. Answer any **two** questions: $10 \times 2 = 20$

a) Establish Gauss-Seidel iteration method for numerical solution of a system of n linear equations with n unknowns. Deduced the condition of convergence for this method.

$$6+4=10$$

b) Describe Newton's divided difference formula for interpolation formula with remainder. Hence deduce Newton's forward difference interpolation formula from this method.

$$7+3=10$$

c) i) Describe power method for finding numerically largest eigen value of a square matrix. State the condition of convergence. 6

ii) Deduce the iterative formula for Picard's method for solving initial value problem. 4

d) Established Lagrange's polynomial interpolation formula. If x_1, x_2, \dots, x_n be the interpolating points and $l_i(x) (i=0, 1, 2, \dots, n)$ be the Lagrangian functions then show that $\sum_{i=0}^n l_i(x) = 1$. 10
