

2026

MATHEMATICS — HONOURS

Paper : DSCC-15

(Numerical Analysis)

Full Marks : 75

*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.**Symbols have their usual meanings.**Students may use non-programmable scientific calculators.*1. Answer **any five** questions :

3×5

- (a) Prove that $\Delta \cdot \nabla = \Delta - \nabla$.
- (b) If $y = 2 + 7x^2$, find the relative error in y at $x = 0$, if the error in x is 0.001.
- (c) Find a second degree polynomial that passes through (0, 1), (1, 3), (2, 7) and (3, 13).
- (d) What are the basic features of Hermite interpolation formula?
- (e) If for four sub-intervals, the value of the integral $\int_1^9 x^2 dx$ by Trapezoidal rule is $2[41 + \alpha^2 + \beta^2 + 7^2]$, then find the values of α and β .
- (f) Give geometrical interpretation of Newton-Raphson method.
- (g) Discuss the Gauss-Jacobi iteration method for solving a system of linear equations $AX = B$.
- (h) How modified Euler's method is different from Euler's method?

2. Answer **any six** questions :

- (a) If $z = \frac{x^2 y}{2}$ and $\Delta x = 0.01, \Delta y = 0.02$ at $x = 2, y = 1$, compute the maximum absolute and relative errors in evaluating z . 2+3
- (b) (i) Evaluate $\left(\frac{\Delta^2}{E}\right)x^3$.
- (ii) Prove that $\Delta = \mu\delta + \frac{1}{2}\delta^2$. 3+2

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- (c) Derive Newton's forward interpolation formula for $(n+1)$ equispaced tabular data. Write the error term. 4+1
- (d) Show that the sum of the Lagrangian coefficients is unity. 5
- (e) Find the missing term in the following table : 5

x	1	2	3	4	5
$f(x)$	7	?	27	40	55

- (f) Define divided difference $f(x_0, x_1, x_2)$ with three arguments x_0, x_1, x_2 . Show that

$$f(x_0, x_1, x_2) = f(x_1, x_0, x_2) = f(x_2, x_1, x_0). \quad 2+3$$

- (g) Compute $f'(1.1)$ and $f''(1.1)$ from the following table : 5

x	1.1	1.2	1.3	1.4	1.5
$f(x)$	2.0091	2.0333	2.0692	2.1143	2.1667

- (h) If T_1, T_2 denote Trapezoidal rule approximations to $I = \int_a^b f(x)dx$ with 1, 2 sub-intervals

respectively, then show that $(I - T_2) = \frac{1}{3}(T_2 - T_1)$. 5

- (i) Compute the value of the integral $\int_1^{1.6} \frac{dx}{\sqrt{2+x^2}}$ correct to four significant figures by Simpson's one-third rule taking 6 sub-intervals. 5

3. Answer **any six** questions :

- (a) Discuss Bisection method to find a simple root of an equation $f(x) = 0$. Hence prove or disprove 'The bisection method is always convergent'. 3+2
- (b) Using Newton-Raphson method, establish the iterative formula, $x_{n+1} = \frac{1}{3} \left[2x_n + \frac{N}{x_n^2} \right]$ to calculate the cube root of N . 5
- (c) Solve the equation $10^x + x - 4 = 0$ correct to three significant figures by Regula-Falsi method. 5
- (d) Describe Gauss elimination method to solve a system of linear equations $AX = B$. Why pivoting process is necessary? 4+1
- (e) What is the condition of convergence of Gauss-Seidel method? Is it a necessary and sufficient condition? Compare this method with Gauss's Elimination method. 2+1+2

- (f) Discuss how the inverse of a real non-singular matrix can be obtained by Gauss elimination method. 5

- (g) Find the numerically largest eigenvalue and the corresponding eigenvector correct to two decimal

places of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 3 & 4 & 5 \end{bmatrix}$. 5

- (h) Compute the value of $y(0.04)$ for the following initial value problem by modified Euler's method, correct to four significant figures by using step length, $h = 0.01$:

$$\frac{dy}{dx} = x^2 + y, \quad y(0) = 1. \quad 5$$

- (i) By the fourth-order Runge-Kutta method, tabulate the solution of the initial value problem

$$\frac{dy}{dx} = \frac{xy + 1}{10y^2 + 4}, \quad y(0) = 0,$$

in $[0, 0.2]$ with step length 0.1, correct to four significant figures. 5
