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 $\Delta.\nabla = \Delta - \nabla$.

(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

$$f(x_0, x_1, x_2) = f(x_1, x_0, x_2) = f(x_2, x_1, x_0).$$ 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, $h = 0.01$:

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

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

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

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