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**63(FY)SEM-4/MAJ/MATMAJ2044**

**2025**

**MATHEMATICS**

(Major)

Paper : MATMAJ2044

**(Numerical Methods)**

*Full Marks : 50*

*Pass Marks : 20*

Time : Two hours

***The figures in the margin indicate full marks for the questions.***

1. Choose the correct answer from the following : 1×5=5

(a) The condition for convergence of Newton-Raphson's method to a root  $\alpha$  is

(i)  $f'(\alpha) / f''(\alpha) < 1$

(ii)  $f'(\alpha) / f''(\alpha) > 1$

(iii)  $f'(\alpha) / 2f''(\alpha) > 1$

(iv)  $f'(\alpha) / 2 > 1$

(b) In Trapezoidal rule, the function must be

(i) quadratic

(ii) cubic

(iii) biquadratic

(iv) linemar

(c) The value of  $n^{\text{th}}$  differences of a polynomial of degree  $n$  is

(i) zero

(ii) constant

(iii) variable

(iv) less than zero

(d) In LU-decomposition method, the diagonal element in L are all-

(i) 0

(ii) - 1

(iii) 1

(iv) 2

(e) In Simpson's  $\frac{1}{3}^{\text{rd}}$  rule the function  $y = f(x)$  is taken to be

(i) circle

(ii) ellipse

(iii) parabola

(iv) line

2. Answer the following questions : **(any five)**  
2×5=10

(i) Write *any two* limitations of Newton-Raphson's method for finding roots.

(ii) Define Lagrange's forward interpolation.

(iii) Write the formula of Runge-kutta method of order three and four.

(iv) If  $f(x) = \frac{x}{x+1}$ , then find  $\Delta^3 f(x)$ .

(v) If 1.414 is used as an approximation to  $\sqrt{2}$  find the absolute and relative error.

(vi) Calculate the value of the integral

$$\int_4^{5.2} \log x dx$$

by Trapezoidal rule.

(vii) Prove that  $(1+\Delta)(1-\nabla)=1$ .

3. Answer the following questions : **(any five)**  
5×5=25

(a) Find the positive root of  $\cos x - xe^x = 0$  in four steps, using Bisection method.

(b) Given

$x$	1	2	3	4	5	6	7	8
$f(x)$	1	8	27	64	125	216	343	512

find  $f(7.5)$ .

(c) Solve :

$$2x + 3y + z = 9$$

$$x + 2y + 3z = 6$$

$$3x + y + 2z = 8$$

by LU decomposition method.

(d) Let  $\frac{dy}{dx} = \frac{y-x}{x+y}$ , with boundary conditions  $y=1$  when  $x=0$ , find approximately  $y$  for  $x=0.1$ , by Euler's modified method in five steps.

(e) If  $\frac{dy}{dx} = y - x$  with  $y(0) = 2$ , find  $y(0.1)$  and  $y(0.2)$  correct to four decimal places by Runge-kutta fourth order method.

(f) Estimate the error in Simpson's  $\frac{3}{8}$ th rule.

(g) Find a root of the equation  $x - e^{-x} = 0$  correct to three decimal places by the secant method.

(h) Solve the following equations by Gauss-Seidal method.

$$27x + 6y - z = 85$$

$$6x + 15y + 2z = 72$$

$$x + y + 54z = 110$$

4. Answer the following questions : **(any one)**  
10×1=10

(a) Show that Bisection method is always convergent.

(b) Derive Newton-Gregory forward interpolation formula and remainder form.

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