Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 40877

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fourth/Fifth/Sixth Semester

MA 8491 — NUMERICAL METHODS

(Common to : Aeronautical Engineering/Aerospace Engineering/Agriculture Engineering/Civil Engineering/Electrical and Electronics Engineering/Electronics and Instrumentation Engineering/Instrumentation and Control Engineering/Manufacturing Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/Biotechnology and Biochemical Engineering/Chemical Engineering/Chemical and Electrochemical Engineering/Plastic Technology/Polymer Technology/Textile Technology)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Which method among Gauss-Jacobi and Gauss-Seidel has faster convergence? Why?

2. What is the order of convergence of Newton-Raphson method?

3. Express $\Delta^2 y_0$ and $\Delta^3 y_0$ in terms of the values of the function y.

4. What are cubic splines?

5. Write down the formula upto the fourth order differnces for finding $\frac{d^2y}{dx^2}$ at any point using Newton's backward interpolation formula.

6. How will you evaluate $I = \int_{-1}^{1} f(x)dx$ using two-point Gaussian quadrature formula?

7. Compare single-step and multi-step methods of solving initial value problems.

8. State Milne's predictor corrector formulae for solving first order differential equation.

9. State Crank-Nicolson formula for solving one dimensional heat equation.

10. State the diagonal five-point formula for solving Poisson equation.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find a real root of $x^3 + x^2 - 1 = 0$ correct to 3 decimal places using fixed point iteration method. (8)

(ii) Find the inverse of $A = \begin{pmatrix} 1 & 1 & 2 \\ 2 & 0 & 1 \\ 3 & 1 & 1 \end{pmatrix}$ using Gauss Jordan method. (8)

Or

(b) (i) Using Gauss-Seidel method, solve the following system of equations, correct to 2 decimal places accuracy. (8)

$$x - 2y + 5z = 12;\; 5x + 2y - z = 6;\; 2x + 6y - 3z = 5$$

(ii) Using Jacobi's method, find all the eigen values and the corresponding eigenvectors of the matrix $A = \begin{pmatrix} 2 & 0 & -1 \\ 0 & 2 & 0 \\ -1 & 0 & 2 \end{pmatrix}$. (8)

12. (a) (i) Find the Lagrange's interpolation polynomial fitting the following data and hence find $y(5)$. (8)

x	1	3	4	6
y	–3	0	30	132

(ii) The sales in a particular department store is given in the following table. Estimate the sales for the year 1979 using Newton's backward difference interpolation formula. (8)

Year	1974	1976	1978	1980	1982
Sales (in lakhs)	40	43	48	52	57

Or

(b) Fit a natural cubic spline for the following data. (16)

x	0	1	2	3
y	1	4	0	–2

13. (a) (i) Find the first and second derivatives of $f(x)$ at $x = 1.5$ from the following data : (8)

x	1.5	2.0	2.5	3.0	3.5	4.0
$f(x)$	3.375	7.000	13.625	24.000	38.387	59.000

(ii) Evaluate $I = \int_0^6 \frac{dx}{1+x^2}$ using Simpson's 1/3rd rule. (8)

Or

(b) Compute $I = \int_0^1 \frac{dx}{1+x^2}$ using Trapezoidal rule with $h = 0.5$, 0.25 and 0.125 and then apply Romberg's method. Hence deduce and approximate value of π. (16)

14. (a) (i) Solve $\frac{dy}{dx} = xy + y^2$, $y(0) = 1$ to find the values of y at $x = 0.1$ and $x = 0.2$ using Runge-Kutta fourth method. (10)

(ii) Using Taylor's series upto third order, find $y(1.1)$ given $\frac{dy}{dx} = xy^{1/3}$, $y(1) = 1$. (6)

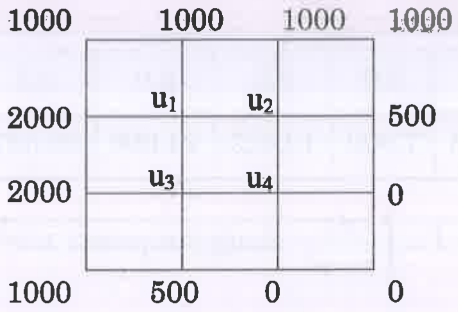
Or

(b) (i) Using Adams-Bashforth predictor-corrector method, find $y(0.3)$ given $\frac{dy}{dx} = (x+y)e^{-x}$, $y(-0.1) = 0.9053$, $y(0) = 1$ $y(0.1) = 1.1046$ and $y(0.2) = 1.2173$. (10)

(ii) Using Euler method, find $y(4.1)$ and $y(4.2)$, with $h = 0.1$ given $5x\frac{dy}{dx} + y^2 - 2 = 0$, $y(4) = 1$. (6)

15. (a) (i) Using finite difference method, find $y(0.25)$, $y(0.5)$ and $y(0.75)$ satisfying the differential equation $y'' + y = x$ with boundary conditions $y(0) = 0$, $y(1) = 2$. (8)

(ii) Using Leibmann's method with Gauss-Seidel iterations, solve $u_{xx} + u_{yy} = 0$ for the following square mesh. (8)



Or

(b) (i) Solve the boundary value problem given by $u_t = u_{xx}$, $0 \le x \le 1$, $t \ge 0$ subject to $u(x, 0) = \sin \pi x$, $0 < x < 1$, $u(0, t) = u(1, t) = 0, t > 0$ using Bendre-Schmidt method. Take $\Delta x = 0.2$ and $\alpha = 1/2$. (8)

(ii) Solve $y_{tt} = y_{xx}$ taking $\Delta x = 0.1$ upto $t = 0.5$. The boundary conditions are $y(0,t) = y(1, t) = 0$, $y_t(x, 0) = 0$ and $y(x, 0) = 10 + x(1 - x)$. (8)

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