A **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code: R4M23

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Fourth Semester

Civil Engineering

R21UMA423- NUMERICAL METHODS

(Regulations R2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Order of convergence of iteration method is CO6- U

   (a) 1 (b) 2 (c) 3 (d) 0

2. When Gauss Elimination method is used to solve AX=B, A is transferred in a _____ matrix CO6- U

   (a) lower triangular (b) upper triangular (c) square (d) zero

3. The n^{th} divided difference of n^{th} degree polynomial is CO6- U

   (a) constant (b) variable (c) equal (d) unequal

4. In Cubic Spline, $M_0 = M_n =$ _____ CO6- U

   (a) 1 (b) n (c) 3 (d) 0

5. In Simpson's 3/8 rule the number of subintervals should be_____ CO6- U

   (a) multiple of 1 (b) multiple of 2 (c) multiple of 3 (d) All of these

6. Gaussian two point quadrature formula is exact for polynomials up to degree _____ CO6- U

   (a) 1 (b) 2 (c) 3 (d) 5

7. The Fourth order Runge – Kutta methods are used widely in _____ solution to differential equations CO6- U

   (a) Abstract (b) Graphical (c) Numerical (d) None of these

8. _____ prior values are required to predict the next value in Milne's method CO6- U

(a) 1 (b) 2 (c) 3 (d) 4

9. PDE of second order, if $B^2 - 4AC = 0$ then CO6- U

(a) parabolic (b) elliptic (c) hyperbolic (d) None of these

10. Crank Nicholson's difference equation is _____ method CO6- U

(a) Explicit (b) Implicit (c) single step (d) multi step

PART – B (5 x 2= 10 Marks)

11. Write the condition of convergence of Newton's method CO1- U

12. Form the divided difference table for the following data CO2- App

x	2	5	10
y	5	29	109

13. Using two –point Gaussian quadrature formula find CO3- App

$$\int_{-1}^{1} \frac{1}{1+x^2}\,dx$$

14. Using Euler's method find y(0.2) given $\frac{dy}{dx} = y + e^x$, y(0) =0. CO4- App

15. Classify: $U_{xx} - 2U_{xy} + U_{yy} = 0$. CO6- U

PART – C (5 x 16= 80 Marks)

16. (a) (i) Using Newton's Raphson method find the real positive root of $x^4 - x - 10 = 0$. CO1- App (8)

(ii) Solve: x + 3y +3z = 16, x + 4y +3z = 18, x + 3y + 4z =19 using Gauss Jordan method. CO1- App (8)

Or

(b) (i) Solve: 27x + 6y – z = 85, 6x + 15y +2z = 72, x + y + 54z =110 using Gauss Seidel method. CO1- App (8)

(ii) Using Power method find numerically largest Eigen value and the corresponding Eigen vector of the matrix $\begin{pmatrix} 9 & 1 & 8 \\ 7 & 4 & 1 \\ 1 & 7 & 9 \end{pmatrix}$. CO1- App (8)

17. (a) (i) Using Lagrange's interpolation formula calculate $f(10)$ for the following data: CO2- App (8)

X	5	6	9	11
Y	12	13	14	16

(ii) Using Newton's divided difference formula calculate $f(3)$ satisfying the following data: CO2- App (8)

x	0	1	2	5
y	2	3	12	147

Or

(b) (i) Using Newton's forward interpolation formula calculate $f(5)$ for the following data: CO2- App (8)

X	4	6	8	10
Y	1	3	8	10

(ii) Using cubic spline function calculate $f(1.5)$ for the following data: CO2- App (8)

x	1	2	3
f(x)	-8	-1	18

18. (a) (i) Compute the first and second derivatives of y at x = 1.5 CO3-App (8)

x	1.5	2.0	2.5	3.0	3.5	4.0
y	3.375	7.000	13.625	24.000	38.875	59.000

(ii) Using Trapezoidal rule, evaluate $\int_{-1}^{1} \frac{1}{1+x^2} dx$ by taking 8 intervals. CO3-App (8)

Or

(b) (i) Evaluate: $\int_{-1}^{1} \frac{x^2}{1+x^4} dx$ using three point Gaussian quadrature formula. CO3-App (8)

(ii) Evaluate: $\int_0^1 \int_0^1 \frac{1}{1+x+y} dx.dy$ by using Simpson's rule by taking h=k=0.5 CO3-App (8)

19. (a) (i) Using Taylor's series method find y(1.1)given y' = x + y with y(1) = 0. CO4-App (8)

(ii) Given $\frac{dy}{dx} = 1 + y^2$, y(0) = 0, y(0.2) = 0.2027, y(0.4) = 0.4228, y(0.6) = 0.684 evaluate y(0.8) by Milne's Method. CO4-App (8)

Or

(b) (i) Using R.K Method of 4th order, solve $\frac{dy}{dx} = y + x^2$ with y(0) = 1 at x = 0.2. CO4-App (8)

(ii) Given $\frac{dy}{dx} = x^2 + y^2$, y(0) =0, y(0.2) = 0.2027, y(0.4)=0.4228, y(0.6) = 0.6841 evaluate y(0.8) by Adams – Bash forth Method. CO4-App (8)

20. (a) Solve the Poisson equation $u_{xx} + u_{yy} = -81xy$, $0 < x < 1$, $0 < y < 1$, u(0, y) = 0, u(x, 0) = 0, u(1, y) = 100, u(x, 1) = 100 and h = 1/3. CO5-App (16)

Or

(b) (i) Solve: $\frac{\partial^2 u}{\partial x^2} = 2\frac{\partial u}{\partial t}$, u(0, t) = 0, u(4,t) = 0, u(x,0) = x(4 - x). Take h = 1 and find the values of u up to t = 5 using Bender-Schmidt's difference equation. CO5-App (8)

(ii) Using Crank-Nicholson's difference equation to solve $\frac{\partial^2 u}{\partial x^2} = 16\frac{\partial u}{\partial t}$, u(0,t) = 0, u(1,t) = 100t, u(x,0) = 0 compute u for one time step function with h=0.25. CO5-App (8)