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

Question Paper Code:U4M23

B.E./B.Tech. DEGREE EXAMINATION, APRIL 2024

Fourth Semester

Civil Engineering

21UMA423 - NUMERICAL METHODS

(Regulations 2021)

Duration: Three hours | Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Order of convergence of Newton's method is _____ CO1- U

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

2. Gauss Seidel method converges faster than _____ CO1- U

(a) Gauss Elimination (b) Gauss Jacobi (c) Gauss Jordan (d) Newton's

3. Lagrange's interpolation formula can be used for ____ interval CO2- U

(a) equal (b) unequal (c) equal and unequal (d) none of these

4. In Cubic Spline, $M_0=M_n=$ _____ CO2- U

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

5. Truncation error in Trapezoidal rule is of the order ___. CO3- U

(a) h^3 (b)h^2 (c)h^4 (d) 0

6. Gaussian three point quadrature formula is exact for polynomials up to degree _____ CO3- U

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

7. The Fourth order Runge-Kutta methods are used widely in _____ solution to differential equations CO4- U

(a) abstract (b) graphical (c) numerical (d) None of these

8. Taylor Series method will be very useful to give some _____ values for RK, Milne's and Adam's methods CO4- U

(a) initial (b)final (c) intermediate (d) two

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

(a) parabolic (b) elliptic (c) hyperbolic (d) Non homogeneous

10. Bender-Schmidt recurrence scheme is used to solve _____ equation CO5- U

(a) one dimensional heat (b) one dimensional wave

(c) two dimensional heat (d) None of these

PART – B (5 x 2= 10 Marks)

11. Using Power method find the dominant Eigen value of CO1- App

$$\begin{pmatrix} 1 & 2 \\ 4 & 3 \end{pmatrix}$$

12. State Lagranges interpolation formula for three set of values (X_0,Y_0) , (X_1,Y_1) and (X_2,Y_2) are given CO2-U

13. Evaluate $\int_1^2 \frac{dx}{1+x^2}$ with 2 equal intervals using trapezoidal rule CO3-App

14. Using Euler's method find y(0.1) given $\frac{dy}{dx} = 1+ y^2$, y(0) =0 CO4-App

15. Write down the Diagonal Five Point formula to find the numerical solution of Laplace equation $u_{xx} + u_{yy} = 0$ CO5-U

PART – C (5 x 16= 80 Marks)

16. (a) (i) Using Power method find numerically largest Eigen value and the corresponding Eigen vector of the matrix CO1 -App (8)

$$\begin{pmatrix} 9 & 1 & 8 \\ 7 & 4 & 1 \\ 1 & 7 & 9 \end{pmatrix}$$

(ii) Solve 20x+y-2z = 17: 3x+20y-z = -18 ; 2x-3y+20z = 25 using Gauss Seidal method . CO1 -App (8)

Or

(b) (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)

17. (a) (i) Using Lagrange's interpolation formula calculate f(3) for the following data CO2- App (8)

X	0	1	2	5
Y	2	3	12	147

(ii) Using Newton's divided difference formula calculate f(8) for the data CO2- App (8)

X	4	5	7	10	11	13
Y	48	100	294	900	1210	2028

Or

(b) (i) Using cubic spline function calculate f(1.5) for the following data CO2- App (8)

x	1	2	3
y	-8	-1	18

(ii)Using Newton's backward interpolation formula calculate f(4) from the following data : CO2- App (8)

x	0	1	2	3
y	-1	1	1	2

18. (a) (i) Compute the first and second derivatives of y at x = 1 from CO3- App (8)

x	1	2	3	4
y	1	8	27	64

(ii) Evaluate $\int_0^6 \frac{1}{1+x^2}dx$ with 6 equal intervals by CO3- App (8)

(a) Trapezoidal rule

(b) Simpson's $\frac{1}{3}$ rule.

Or

(b) (i) Evaluate $\int_0^1 \frac{1}{1+x^2}dx$ using Romberg's method correct to 4 decimal places. CO3- App (8)

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

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

(ii) Given $\frac{dy}{dx} = x^3 + y$, $y(0) = 2$, $y(0.2) = 2.443$, $y(0.4) = 2.99$, $y(0.6) = 3.68$. Find $y(0.8)$ by Milne's Predictor & Corrector method. CO4- App (8)

Or

(b) (i) Using R-K method of fourth order, find $y(0.1)$ for the initial value problem $\frac{dy}{dx} = x + y^2$ with $y(0) = 1$ CO4- App (8)

(ii) Using Adam's Bash forth Predictor-Corrector method, find y(4.4) given that $5xy' + y^2 = 2$, $y(4) = 1$, $y(4.1) = 1.0049$, $y(4.2) = 1.0097$ and $y(4.3) = 1.0143$ 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) Solve $\nabla^2 u = -10(x^2 + y^2 + 10)$ over the square mesh with sides $x = 0, x = 3, y = 0, y = 3$ with u=0 on the boundary and mesh length 1 unit. CO5- App (16)