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

Question Paper Code: 54022

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2018

Fourth Semester

Civil Engineering

15UMA422 - NUMERICAL METHODS

(Common to EEE, EIE and Chemical Engineering)

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. In what form is the coefficient matrix transformed into when, AX=B is solved by Gauss elimination method CO1-R

   (a) diagonal matrix (b) Upper triangular (c) Null matrix (d) None

2. What is the condition for convergence of iteration method CO1-R

   (a) $|\varphi'(x)| > 1$ (b) $|\varphi'(x)| < 1$ (c) $|\varphi'(x)| = 1$ (d) $|\varphi'(x)| = 0$

3. Newton's forward interpolation formula is used only for CO2-R

   (a) equal intervals (b) unequal intervals (c) continuous interval (d) none

4. The parabola of the form $y = ax^2 + bx + c$, which passing through the points (0,0), (1,1) and (2,20) is CO2-Ana

   (a) $9x^2 + 8x$ (b) $9x^2 - 8x$ (c) $8x^2 + 9x$ (d) 0

5. Error in the Trapezoidal rule is of order CO3-R

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

6. Two point Gaussian Quadrature formula is exact for polynomial upto degree CO3-R

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

7. From the following, which one is multi step method CO4-R

(a) Taylor (b) Euler (c) Runge-Kutta (d) Milne's

8. Using Euler's method find $y(0.2)$ given $y' = x + y, y(0) = 1$ CO4-App

(a) 1.2 (b) 1.1 (c) 0 (d) 2.2

9. Classify the equation $u_{xx} + 2\,u_{xy} + 4\,u_{yy} = 0$ CO5-App

(a) Hyperbolic (b) Parabolic (c) Elliptic (d) None

10. If u is harmonic, will it satisfy $\nabla^2 u = 0$? CO5-R

(a) No (b) Yes (c) both a and b (d) None

PART – B (5 x 2= 10Marks)

11. What is the condition for convergence of Newton-Raphson method and order of convergence? CO1-R

12. State Lagrange's interpolation formula. CO2-R

13. Apply two point formula to evaluate CO3-App

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

14. Write the Euler's algorithm for first order differential equation. CO4-R

15. Write Crank-Nicolson formula for one dimensional heat equation. CO5-R

PART – C (5 x 16= 80Marks)

16. (a) (i) Solve the equation $x^3 + x^2 - 1 = 0$ for the positive root by iteration method. CO1-App (8)

(ii) Write down Newton-Raphson formula for finding $\sqrt{N}$ where N is a positive number and hence find $\sqrt{5}$ CO1-U (8)

Or

(b) (i) Using Gauss-elimination method, find the inverse of CO1-App (8)

$$A = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 2 & 0 \\ 3 & -1 & -4 \end{bmatrix}$$

(ii) Using Gauss-seidel method, solve the following system. Start with $x = 1, y = -2, z = 3$. CO1-App (8)

$x + 3y + 52z = 173.61;\ x - 27y + 2z = 71.31;\ 41x - 2y + 3z = 65.46$

17. (a) (i) For the given values, evaluate f(9) using Lagrange's formula CO2-App (8)

x	5	**6**	9	11
f(x)	12	13	14	16

(ii) From the following data estimate the number of persons earning weekly wages Between 60-70 rupees CO2-App (8)

Wages in rupees	Below 40	40-60	60-80	80-100	100-120
No. of persons	250	120	100	70	50

Or

(b) Obtain the cubic Spline approximation for the function $y = f(x)$ from the following data given that $y_0'' = y_3'' = 0$. CO2-Ana (16)

X	-1	0	1	2
Y	-1	1	3	35

18. (a) (i) The velocity v of a particle at a distance S from a point on its path is given by the table below. Estimate the time taken to travel 60 meters by using Simpson's one- third rule. Compare your answer with Simpson's three-eight rules.` CO3-U (8)

S (in metre)	0	10	20	30	40	50	60
V m/sec	47	58	64	65	61	52	38

(ii) By dividing range into ten equal parts evaluate CO3-U (8)

$\int_0^{\pi} \sin x\,dx$ by trapezoidal rule and Simpson's rule. Verify your answer with actual integration.

Or

(b) (i) Evaluate CO3-E (8)

$\int_1^2 \int_1^2 \frac{xy}{x+y}\,dxdy$ with h= k = 0.25, using trapezoidal rule and Simpson's rule.

(ii) Evaluate CO3-E (8)

$\int_0^2 \frac{x^2 + 2x + 1}{1 + (x+1)^4}dx$ by Gaussian three point formula.

19. (a) (i) Find by Taylor's series method, the values of y at x = 0.1 and CO4-App (8)

x = 0.2 to four decimal places from $\frac{dy}{dx} = x^2 y - 1, y(0) = 1$

(ii) Using Runge-Kutta method of fourth order, find y(0.8) correct to CO4-App (8)

4 decimal places$y' = y - x^2,\ y(0.6) = 1.7379.$

Or

(b) Find $y(0.1), y(0.2), y(0.3)$ from $\frac{dy}{dx} = xy + y^2,\ y(0) = 1$ by using CO4-E (16)

Runge-Kutta method and hence obtain $y(0.4)$ using Adam's method.

20. (a) Approximate the solution to the wave equation CO5-App (16)

$\frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$, $0 < x < 1, t > 0$ given

$u(x,0) = u_t(x,0) = u(0,t) = 0$ and $u(1,t) = 100 sin \pi t$.

Compute u for 4 time steps with $h = 0.25$.

Or

(b) Solve $u_{xx} + u_{yy} = -81xy,\ 0 < x < 1,\ 0 < y < 1$ given that CO5-U (16)

$u(0,y) = u(x,0) = 0,\ \ u(1,y) = u(x,1) = 100$ and $h = 1/3$.