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**Question Paper Code: 54022**

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2022

Fourth Semester

Civil Engineering

15UMA422 - NUMERICAL METHODS

(Common to EEE, EIE and Chemical Engineering)

(Regulation 2015)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. What is the order of convergence of Newton-Raphson method CO1-R  
(a) 0 (b) 1 (c) 2 (d) 3
2. If the eigen values of A are -4, 3, 1 then the dominant eigen value of A is CO1-R  
(a) -4 (b) 3 (c) 1 (d) 0
3. Newton's forward interpolation formula used only for \_\_\_\_\_ intervals CO2-R  
(a) unequal (b) equal (c) both (d) None
4. The parabola which passes through the points (0, 0), (1, 1), and (2, 20) CO2-R  
(a)  $8x^2-9x$  (b)  $9x^2-8x$  (c)  $3x^2-2x$  (d)  $2x^2-3x$
5. What is the restriction on the number of intervals for Simpson's 1/3 rule? CO3-R  
(a) Odd number (b) Even number (c) multiple of 3 (d) any
6. Gaussian three point formula is exact for polynomials upto degree CO3-R  
(a) 1 (b) 3 (c) 5 (d) 6
7. From the following which one is single step method CO4-R  
(a) Milne's (b) Taylor (c) Adam Bashforth (d) None
8. How many prior values are required to predict the next value in Adam's method CO4-R  
(a) 2 (b) 3 (c) 4 (d) 5

9. A partial differential equation is classified as a Parabolic if  $B^2 - 4AC$  CO5-R  
 (a)  $< 0$  (b)  $= 0$  (c)  $> 0$  (d) None
10. What type of equations can be solved by Crank-Nicolson's difference formula. CO5-R  
 (a) Parabolic (b) Elliptic (c) Hyperbolic (d) None

PART – B (5 x 2= 10Marks)

11. Find the iterative formula to find  $\sqrt{N}$  where N is a positive number. CO1-R
12. Form the Newton's divided difference table for the following data CO2-R

x	5	15	22
y	7	36	160

13. Apply two point formula to evaluate  $\int_{-1}^1 \frac{dx}{1+x^2}$ . CO3-R
14. Using Euler's method compute y for  $x = 0.2$  from  $y' = y - \frac{2x}{y}$ ,  $y(0) = 1$ . CO4-R
15. Write the difference scheme for solving the Laplace equation. CO5-R

PART – C (5 x 16= 80Marks)

16. (a) (i) By Newton- Raphson method find a non zero root of  $x^2 + 4\sin x = 0$ . CO1-Ana (8)  
 (ii) Solve the system of equations by Gauss elimination method CO1-Ana (8)  
 $x + 2y + z = 3$ ;  $2x + 3y + 3z = 10$ ;  $3x - y + 2z = 13$
- Or
- (b) (i) Using Gauss-Seidel method, solve the following system. CO1-App (8)  
 $x + 3y + 5z = 173.61$ ;  $x - 27y + 2z = 71.31$ ;  $41x - 2y + 3z = 65.46$   
 Start with  $x = 1, y = -2, z = 3$ .
- (ii) Determine the largest eigen value and the corresponding eigen CO1-Ana (8)  
 vector of the Matrix  $\begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{bmatrix}$  by power method
17. (a) (i) Using Newtons divided difference formula find  $u(3)$  given CO2-App (8)  
 $u(1) = -26, u(2) = 12, u(4) = 256$  and  $u(6) = 844$ .

- (ii) From the following table find the value of  $\tan 45^\circ 15'$  by CO2-Ana (8)  
Newton's forward Interpolation formula.

$x^\circ$	45	46	47	48	49	50
$\tan x^\circ$	1	1.03553	1.07237	1.11061	1.15037	1.19175

Or

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

x	-1	0	1	2
y	-1	1	3	35

18. (a) (i) Compute  $f'(0)$  and  $f''(4)$  from the data. CO3-Ana (8)

x	0	1	2	3	4
y	1	2.718	7.381	20.086	54.598

- (ii) Find  $\int_{1.6}^{2.8} f(x) dx$  by Simpsons  $(1/3)^{rd}$  rule from the CO3-App (8)  
following table.

x	1.6	1.8	2.0	2.2	2.4	2.6	2.8
f(x)	4.95	6.05	7.39	9.02	11.02	13.46	16.44

Or

- (b) (i) Evaluate  $\int_0^2 \frac{x^2 + 2x + 1}{1 + (x + 1)^4} dx$  by Gaussian three point formula CO3-Ana (8)

- (ii) Evaluate  $\int_0^1 \int_0^1 e^{x+y} dx dy$  using trapezoidal rule and Simpson's CO3-U (8)  
rule.

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

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

- (ii) Using Modified Euler's methods find CO4-App (8)

y(0.2) if  $\frac{dy}{dx} = y - x^2 + 1, y(0) = 0.5$

Or

- (b) Apply Runge-Kutta method of fourth order to find approximate values of  $y$  for  $x = 0.2, 0.4$  and  $0.6$  if  $\frac{dy}{dx} = x^3 + y, y(0) = 2$ . Hence find  $y(0.8)$  by Milne's predictor-corrector method. CO4-Ana (16)

20. (a) Solve CO5-App (16)

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0, \text{ subject to}$$

(i)  $u(0,y) = 0, 0 \leq y \leq 4$

(ii)  $u(4,y) = 12 + y, 0 \leq y \leq 4$

(iii)  $u(x,0) = 3x, 0 \leq x \leq 4$

(iv)  $u(x,4) = x^2, 0 \leq x \leq 4$  by dividing the square into 16 square meshes of side 1.

Or

- (b) Solve the Poisson equation  $\nabla^2 u = -10(x^2 + y^2 + 10)$ ,  $0 \leq x \leq 3; 0 \leq y \leq 3; u = 0$  on the boundary. CO5-U (16)