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

Question Paper Code :R3M23

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

Third Semester

Electronics And Communication Engineering

R21UMA323- NUMERICAL ANALYSIS AND LINEAR ALGEBRA

(Regulations R2021)

Duration: Three hours | Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. Trapezoidal rule is so called, because it approximates the integral by the sum of _____trapezoids CO6-U

   (a) n (b) n+1 (c) n-1 (d) 2n

2. 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

3. Taylor Series method will be very useful to give some _____ values for RK, Milne's and Adam's methods CO6-U

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

4. The Runge-Kutta method of second order is nothing but the _____ CO6-U

   (a) Euler's method (b) modified Euler's method

   (c) improved Euler's Method (d) Taylor's series method

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

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

6. The Poisson's equation $\partial^2u/\partial x^2+\partial^2u/\partial y^2=f(x,y)$ is a example of CO6-U

   (a) $\frac{1}{2}$ (b) $\frac{1}{3}$ (c) $\frac{1}{4}$ (d) 1

7. In a vector space V, for every $x, y \in V$ then the property x+y=y+x is known as _____ CO6-U

(a) commutative (b) associative (c) identity (d) inverse

8. In a linear transformation T: V→W the range of T is a subspace of _ CO6-U

(a) V (b) W (c) both V and W (d) none of these

9. $\langle x, x \rangle = 0$ if and only if _____ CO6-U

(a) x = 1 (b) $x \neq 1$ (c) x = 0 (d) $x \neq 0$

10. Let V be an inner product space and u ϵ V is orthogonal to v ϵ V then CO6-U

(a) $\langle u, v \rangle = 1$ (b) $\langle u, v \rangle \neq 0$ (c) $\langle u, v \rangle = 0$ (d) None

PART – B (5 x 2= 10Marks)

11. Apply three –point Gaussian quadrature formula to evaluate $\int_{-1}^{1} \cos x \, dx$ CO1- App

12. Using Taylor's series method find y(0.1) given $y' = 1 + y$with y(0)=1 CO2- App

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

14. Determine whether the vectors $v_1 = (1, -2, 3)$, $v_2 = (5, 6, -1)$ and $v_3 = (3, 2, 1)$ form a linearly dependent or linearly independent set in R^3 CO4-App

15. Verify triangle inequality for the following data
$\|x + y\| = 6, \|x\| = 3 \; and \; \|y\| = 4$ CO5-App

PART – C (5 x 16= 80Marks)

16. (a) (i) Find the first and second derivatives of y at x = 54 from the following data CO1-App (8)

x	50	51	52	53	54	55	□6
y	3.6840	3.7084	3.7325	3.7563	3.7798	3.8030	3.8259

(ii) The velocity v of a particle at a distance S from a point on its path is given by the table below. CO1-App (8)

x	0	10	20	30	40	50	60
y	47	58	64	65	61	52	38

Estimate the time taken to travel 60 metres by using Simpson's one-third rule and Trapezoidal rule.

Or

(b) (i) Evaluate $\int_0^2 \frac{dx}{4+x^2}$ using Romberg's method correct to 4 decimal places. CO1-App (8)

(ii) Evaluate. $\int_1^5 \frac{dx}{x}$ using three point Gaussian quadrature formula. CO1-App (8)

17. (a) (i) Using Taylor's series method find y(0.1)given $y' = x^2 + y^2$ with y(0)=1 CO2-App (8)

(ii) Using R-K method of fourth order, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ CO2-App (8)

with y(0)=1at x=0.2

Or

(b) (i) Given $\frac{dy}{dx}$ =1+ 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. CO2-App (8)

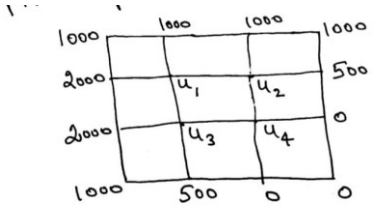
(ii) Given $\frac{dy}{dx} = x^3 + y$,y(0)=2,y(0.2)=2.443,y(0.4)=2.99,y(0.6)=3.68, Find y(0.8) by Milne's Predictor & Corrector method CO2-App (8)

18. (a) (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. CO3-App (8)

(ii) Solve $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$ in $0 \le x \le 5$, $t \ge 0$,u(0,t) = 0 , u(5,t) = 100 , u(x,0) = 20 find the values of u for 1 time step function with h = 1 by Crank-Nicholson's difference method. CO3-App (8)

Or

(b) Obtain a finite difference Scheme to Solve the Laplace equation $U_{xx} + U_{yy} = 0$ at the pivotal points in the square mesh given below CO3-App (16)



19.	(a)	(i) Verify the vectors (2,1,0) , (-3,-3,1) ,(-2,1,-1) in R^3 is a basis of R^3	CO4-App	(8)
		(ii) Find the dimension of the subspace spanned by the vectors (1,0,2), (2,0,1), (1,0,1) in $V_3(R)$	CO4-App	(8)
		Or		
	(b)	(i) If T: $R^2 \rightarrow R^2$ be linear transformation defined by $T(a_1, a_2) = (a_1 + a_2, a_1)$ then find nullity(T), rank(T) ,Is T one-to-one? Is T onto? Also check the rank nullity theorem.	CO4-App	(8)
		(ii) Find the matrix of the linear transformation T: $R^2 \rightarrow R^2$ defined by T(a,b) =(2a-3b,a+b) for the standard basis of R^2	CO4-App	(8)
20.	(a)	(i) Show that the following function defines an inner product on $V_2(R)$where $x = (x_1, x_2)$ and y= (y_1, y_2) and $\langle x, y \rangle = 6\, x_1 y_1 + 7 x_2 y_2$	CO5-App	(8)
		(ii) If $x = (2,1+i,i)$ and $y = (2-i,2,1+2i)$ then verify Schwarz's inequality.	CO5-App	(8)
		Or		
	(b)	Apply Gram-Schmidt process to construct an orthonormal basis for $V_3(R)$ with the standard inner product for the basis $\{v_1, v_2, v_3\}$ where$v_1 = (1,0,1)$,$v_2 = (1,0,-1)$ and $v_3 = (0,3,4)$	CO5-App	(16)