Reg. No.																

Question Paper Code	14184

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Third Semester

Electronics and Communication Engineering

(Common to Electrical and Electronics Engineering & Electronics and Instrumentation Engineering)

20BSMA301 - LINEAR ALGEBRA, PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS

Regulations - 2020

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

No.	Question	Marks	K – Level	CO
1.	If S = $\{v_1, v_2, v_3 \dots . v_N\}$ is a set of vectors in a finite dimensional vector space V, then S is called a basis for V if (a) S spans V (b) S is linearly independent (c) either A or B (d) both A and B	1	K1	CO1
2.	Does the vectors $v_1 = (-3,7)$ and $v_2 = (5, 5)$ form a basis for R^2 ? (a) Data not complete (b) No (c) Yes (d) Not in R^2	1	K2	CO1
3.	Let $T(x,y,z) = (x,0,y)$ be a linear map. What is the null space of T? (a) Generated by (0,1,0) (b) Generated by (0,0,1) (c) Generated by (1,1,0) (d) none of these.	1	K2	CO2
4.	Let $T: V \to W$ be a mapping and if $N(T) = \{0\}$, then T is (a) linear (b) one-one (c) onto (d) none of the above	1	K1	CO2
5.	The Lagrange's multipliers for solving the partial differential equation are $px(y-z) + qy(z-x) = z(x-y)$ (a) x, y, z (b) 1,1,1 (c) $y, z, 1$ (d) $x, y, 1$	1	K2	CO3
6.	The partial differential equation corresponding to $z = ax + by + ab$ by eliminating the arbitrary constants, where $\frac{\partial z}{\partial x} = p$, $\frac{\partial z}{\partial y} = q$ is (a) $z = px+qy+pq$ (b) $z = qx+py+pq$ (c) $z = px-qy$ (d) $z = px+qy$	1	K2	CO3
7.	$cosx$ is a periodic function of period (a) π (b) 2π (c) $\frac{\pi}{2}$ (d) $\frac{3\pi}{2}$	1	K1	CO4
8.	If F(s) is the Fourier Transform of f(x), then F[f(x-a)] is (a) e^{as} F(s) (b) e^{-as} F(s) (c) e^{ias} F(s) (d) e^{-ias} F(s)	1	K1	CO4
9.	$Z[c]$ is (a) $\frac{z}{z-1}$ (b) $\frac{cz}{z-1}$ (c) $\frac{cz}{1-z}$ (d) $\frac{cz}{1-cz}$	1	K1	CO5
10.	The Z-transform of a unit impulse function is (a) 1 (b) z (c) $\frac{1}{z}$ (d) Z^n	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

No.	Question	Marks	K – Level	CO
11.	Define vector space.	2	K1	CO1
12.	Is (2,-5,4) a linear combination of (1,-3,2) and (2,-1,1) in $R^3(R)$.	2	K2	CO1
13.	Define Range space.	2	K1	CO2
14.	Is $T: R^3 \to R^3$ defined by $T(x, y, z) = (x, 0,0)$ is a linear transformation?	2	K2	CO2
15.	Form the partial differential equation of all spheres whose centre lie on the Z-axis.	2	K2	CO3
16.	Solve : $\left(D^3 - 3DD'^2 + 2D'^3\right) z = 0$.	2	K3	CO3
17.	Define Fourier Transform pair.	2	K1	CO4
18.	Find the Fourier Cosine transform of $\frac{1}{a^2 + x^2}$.	2	K2	CO4

19.	State and prove initial value theorem of Z Transform.	2	K1	CO5
20.	Form the difference equation from the relation $y_n = a + b.3^n$.	2	K2	CO5
21.	State modulation theorem in Fourier Transform.	2	K1	CO4
22.	Show that the vectors $(1,2,3)$, $(3,-2,1)$, $(1,-6,-5)$ $in\ R^3$ are linearly dependent over R.	2	K3	CO1

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	Let V be the set of all polynomials of degree $\leq n$, including the zero polynomial in F[x]. Then Prove that V is a vector space over F.	11	K3	CO1
		OR			
	b)	Find the basis for the subspace $W_1 = \{(a_1, a_2, a_3, a_4, a_5) \in F^5 / a_1 - a_3 - a_4 = 0.\}$ $W_2 = \{(a_1, a_2, a_3, a_4, a_5) \in F^5 / a_2 = a_3 = a_4\ and\ a_1 + a_5 = 0$ of F and dimensions of W_1 and W_2.	11	K3	CO1
24.	a)	Let $T: R^2 \to R^3$ be defined by $T(x, y) = (x + 3y, 0, 2x - 4y)$. Compute the matrix of the transformation with respect to the standard bases of $R^2\ and\ R^3$. Find N(T) and R(T).	11	K3	CO2
		OR			
	b)	Find an orthonormal basis of the inner product space $R^3(R)$ with standard inner product, given the basis $B = \{(1,0,1), (1,0,-1), (0,3,4)\}$ using Gram-Schmidt orthogonalization process.	11	K3	CO2
25.	a)	Find the singular integral of $z = px + qy + pq$.	11	K3	CO3
		OR			
	b)	Solve : $\left(D^3 + D^2D' - DD'^2 - D'^3\right) z = e^{2x+y} + \cos(x+2y)$.	11	K3	CO3
26.	a)	Find the Fourier transform f(x) given by $f(x) = \begin{cases} a - \lvert x \rvert, & \text{for} \lvert x \rvert < a \\ 0 & \text{for} \lvert x \rvert > a > 0 \end{cases}$. Hence show that $\int_0^{\infty} \left(\frac{\sin t}{t}\right)^2 dt = \frac{\pi}{2}$.	11	K3	CO4
		OR			
	b)	Evaluate $\int_0^{\infty} \frac{dx}{(x^2 + a^2)(x^2 + b^2)}$ using Fourier Cosine Transform.	11	K3	CO4
27.	a)	Find $Z^{-1}\left[\frac{z(z^2 - z + 2)}{(z+1)(z-1)^2}\right]$ using the method of partial fraction.	11	K3	CO5
		OR			
	b)	Solve the difference equation $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ given that $y_0 = 0,\ y_1 = 0$.	11	K3	CO5
28.	a) (i)	Find the basis for the subspace $W_2 = \{(a_1, a_2, a_3, a_4, a_5) \in F^5 / a_2 = a_3 = a_4\ and\ a_1 + a_5 = 0\}$ of F and hence find dimension of W_2.	6	K3	CO1

(ii) If $T: R^2 \to R^3$ is a linear transformation such that $T(1,1) = (1,0,2)$, $T(2,3) = (1,-1,4)$ 5 K3 CO2

(a) Determine T.

(b) Find $T(2,5)$, $T(8,11)$.

OR

b) (i) Determine if the set $\{x^3 + 2x^2, -x^2 + 3x + 1, x^3 - x^2 + 2x - 1\}$ is linearly dependent or linearly independent in $R^3(R)$. 6 K3 CO1

(ii) Let $V = P(R)$, the vector space of polynomials over R with inner product defined by $\langle f, g \rangle = \int_0^1 f(t)\, g(t)\, dt$, where $f(t) = t + 2$, $g(t) = t^2 - 2t - 3$. Find $\|f\|$ and $\|g\|$. 5 K3 CO2