Reg. No.															

Question Paper Code	13166

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Third Semester

Civil Engineering

(Common to Electronics and Communication Engineering, Electrical and Electronics Engineering, Electronics and Instrumentation Engineering & Instrumentation and Control Engineering)

20BSMA301 - LINEAR ALGEBRA, PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS

Regulations - 2020

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

Marks K – Level CO

1. The set of vectors $S = \{(1,2),(2,3),(1,-1)\}$ are *1 K2 CO1*
   (a) Linearly independent (b) Linearly dependent
   (c) Basis (d) Both (a) & (b)
2. The singleton non zero element is *1 K2 CO1*
   (a) Linearly independent (b) Linearly dependent
   (c) Neither Linearly independent nor Linearly dependent (d) Generating set.
3. The dimension of set of all 2×4 matrices over real is *1 K2 CO1*
   (a) 10 (b) 8 (c) 9 (d) 11
4. Which of the following is not a subspace? *1 K2 CO1*
   (a) W=$\{(a,0): a \in R\}$ (b) W_1=$\{(0,a): a \in R\}$
   (c) W=$\{(a_1,a_2):2a_1+3a_2=0;a_1,a_2\in R\}$ (d) W=$\{(a_1,a_2):2a_1+3a_2=4;a_1,a_2\in R\}$
5. Let $T: V \to W$ be a mapping and if $N(T) = \{0\}$, then T is *1 K1 CO2*
   (a) linear (b) one-one (c) onto (d) none of the above
6. Let $T: V \to W$ be a linear transformation, $dim\, V = 3$ and $rank\ (T) = 1$. Then $nullity(\,T) =$ *1 K2 CO2*
   (a) 4 (b)2 (c) 3 (d) 1
7. Let x=(1+i,4) and y=(2-3i,4+5i) then <x, y>= *1 K2 CO2*
   (a) 15-15i (b) 15+15i (c) 11-11i (d) 1+i
8. Cauchy-Schwartz inequality is *1 K1 CO2*
   (a) $|\langle u,v\rangle| \geq \|u\|\|v\|$ (b) $|\langle u,v\rangle| = \|u\|\|v\|$
   (c) $|\langle u,v\rangle| \leq \|u\|\|v\|$ (d) $|\langle u,v\rangle| \neq \|u\|\|v\|$
9. The partial differential equation by eliminating arbitrary constant from $z = (x^2 + a)(y^2 + b)$ is *1 K2 CO3*
   (a) $pq = 4xyz$ (b) $p = 4xyz$ (c) $q = 4xyz$ (d) $px + qy$
10. The particular integral of $(D^2 + 3DD' - 4D'^2)z = \sin y$ is *1 K2 CO3*
    (a) $\frac{1^{siny}}{4}$ (b) $\frac{1^{sinx}}{4}$ (c) $\frac{1^{cosx}}{4}$ (d) $\frac{1^{cosy}}{4}$
11. What are the Lagrange's multipliers while solving the PDE $px(y-z) + qy(z-x) = z(x-y)$? *1 K2 CO3*
    (a) x, y, z (b) 1,1,1 (c) $y, z, 1$ (d) $x, y, 1$
12. The complete integral of $p^2 + q^2 = 1$ is *1 K2 CO3*
    (a) $z = ax \pm \sqrt{1-a^2}y + c$ (b) $z = ay \pm \sqrt{1-a^2}x + c$
    (c) $z = x \pm \sqrt{1-a^2}y + c$ (d) $z = y \pm \sqrt{1-a^2}x + c$
13. If $F[f(x)] = F(s)$, then $F\left[e^{iax}f(x)\right] =$ *1 K1 CO4*
    (a) $F(s-a)$ (b) $F(s \pm a)$ (c) $F(s+a)$ (d) None of the above

14.	The Fourier Sine Transform of $f(x) = e^{-x}$ is (a) $\sqrt{\frac{2}{\pi}}\frac{1}{1+s^2}$ (b) $\sqrt{\frac{2}{\pi}}\frac{s}{1+s^2}$ (c) $\sqrt{\frac{1}{2\pi}}\frac{s}{1+s^2}$ (d) $\sqrt{\frac{1}{2\pi}}\frac{1}{1+s^2}$	1	K2	CO4
15.	The convolution of two functions $f(x)$ and $g(x)$ is defined as (a) $(f*g)(x) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(t)g(x-t)dt.$ (b) $(f*g)(x) = \frac{1}{\sqrt{2}}\int_{-\infty}^{\infty} f(t)g(x-t)dt.$ (c) $(f*g)(x) = \frac{1}{\sqrt{2}}\int_{-\infty}^{\infty} f(t)g(x-t)dt.$ (d) $(f*g)(x) = \frac{\sqrt{2}}{\sqrt{\pi}}\int_{-\infty}^{\infty} f(t)g(x-t)dt.$	1	K1	CO4
16.	Choose the self-reciprocal function under Fourier Transform (a) $F[e^{-x}] = e^{-s}$ (b) $F\left[e^{-\frac{x^2}{2}}\right] = e^{-\frac{s^2}{2}}$ (c) $F\left[e^{-\frac{x}{2}}\right] = e^{-\frac{s}{2}}$ (d) $F\left[e^{-\frac{x^2}{4}}\right] = e^{-\frac{s^2}{4}}$	1	K1	CO4
17.	$Z[1]$ is (a) $\frac{z}{z-1}$ (b) $\frac{-z}{z-1}$ (c) $\frac{z}{1-z}$ (d) $\frac{z}{z+1}$	1	K2	CO5
18.	The Z transform of the function $4(2^n)$is (a) $4\frac{z}{z-2}$ (b) $2\frac{z}{z-2}$ (c) $\frac{z}{z-2}$ (d) $\frac{z}{z-4}$	1	K2	CO5
19.	If $Z[f(n)] = F(z)$, then $Z[a^n f(n)] =$ (a)$F(az)$ (b) $F\left(\frac{z}{a}\right)$ (c) $F\left(\frac{a}{z}\right)$ (d) $F(a)$	1	K1	CO5
20.	The difference equation by eliminating arbitrary constant from $u_n = a\,2^{n+1}$ is (a) $2u_{n+1} - u_n = 0$ (b) $u_{n+1} + 2u_n = 0$ (c) $u_{n+1} - 2u_n = 0$ (d) $u_{n+1} - u_n = 0$	1	K2	CO5

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21.	Define single criterion condition for subspace.	2	K1	CO1
22.	Show that the vectors (1,2,3),(3,-2,1),(1,-6,-5) in R^3 are linearly dependent over R.	2	K2	CO1
23.	If $T: R^2 \to R^2$ is defined by $T(a_1, a_2) = (2a_1 + a_2, a_1)$. Verify whether T is a linear transformation.	2	K2	CO2
24.	Define Orthogonal vectors.	2	K1	CO2
25.	Find the partial differential equation by eliminating arbitrary function 'f' from the relation $z = f(x^2 + y^2)$.	2	K2	CO3
26.	Find the complete integral of $p + q = pq$.	2	K2	CO3
27.	Define Fourier Transform pair.	2	K1	CO4
28.	Find the Fourier cosine transform of e^{-x}.	2	K2	CO4
29.	State linearity property of Z-transform.	2	K1	CO5
30.	Find Z$\left[\frac{a^n}{n!}\right]$.	2	K2	CO5

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31.	a)	Let V be the set of all polynomials of degree $\leq n$,including the zero polynomial in $F[x]$.Prove that V is a vector space over F.	10	K3	CO1
		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 $R^3(R)$.	5	K3	CO1
	ii)	Check if (2,6,8) can be expressed as a linear combination of $(1,2,1), (-2,-4,-2), (0,2,3), (2,0,-3), (-3,8,16)$.	5	K3	CO1

32.	a)	In the inner product space $R^3(R)$ with the standard inner product, $B=\{(1,0,1),(1,0,-1),(0,3,4)\}$ is a basis. By Gram-Schmidt orthogonalization process find an orthogonal basis. Hence find an orthonormal basis.	*10*	*K3*	*CO2*
		OR			
	b)	Let $T: R^3 \to R^2$ be defined by $T(x,y,z) = (2x-y, 3z)$. Verify whether T is linear or not. Find $N(T)$, $R(T)$ and hence verify the dimension theorem.	*10*	*K3*	*CO2*
33.	a)	Solve $(D^2 + DD' - 6D'^2)z = x^2y + e^{3x+y}$.	*10*	*K3*	*CO3*
		OR			
	b)	Solve $(3z-4y)p + (4x-2z)q = 2y-3x$.	*10*	*K3*	*CO3*
34.	a)	Find the Fourier transform of $f(x) = \begin{cases} 1-\lvert x\rvert, & \lvert x\rvert < 1 \\ 0, & \lvert x\rvert \geq 1 \end{cases}$ and hence deduce that $(i)\ \int_0^\infty \frac{sin^2 t}{t^2}dt$ $(ii)\ \int_0^\infty \frac{sin^4 t}{t^4}dt$	*10*	*K3*	*CO4*
		OR			
	b)	Evaluate $\int_0^\infty \frac{x^2}{(x^2+a^2)(x^2+b^2)}dx$ using Fourier Sine Transform.	*10*	*K3*	*CO4*
35.	a)	Using convolution theorem, find inverse Z – transform of $\frac{z^2}{(z-a)(z-b)}$.	*10*	*K3*	*CO5*
		OR			
	b)	Using Z-transform, solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ given that $y_0 = 0, y_1 = 0$.	*10*	*K3*	*CO5*
36.	a) i)	Determine $\{1+2x+x^2, 3+x^2, x+x^2\}$ is a basis for $P_2(R)$.	*5*	*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, $\lVert f\rVert$ and $\lVert f+g\rVert$.	*5*	*K3*	*CO2*
		OR			
	b) i)	Show that the matrices $\begin{pmatrix}1&0\\0&0\end{pmatrix}, \begin{pmatrix}0&1\\0&0\end{pmatrix}, \begin{pmatrix}0&0\\1&0\end{pmatrix} and \begin{pmatrix}0&0\\0&1\end{pmatrix}$ generate $M_{2\times 2}(F)$.	*5*	*K3*	*CO1*
	ii)	If $T: R^2 \to R^3$ is a linear transformation such that $T(1,1)=(1,0,2)$, $T(2,3)=(1,-1,4)$. Determine T. $T(2,5), T(8,11)$.	*5*	*K3*	*CO2*