Department of H&S

B. Tech Mid Question Bank (R22 Regulation)

Academic Year: 2024-2025

Semester : I

Subject Name: Matrices & Calculus

Subject Code: 22MA101BS

Faculty Name: Dr. K. Bhagya Lakshmi

PART-A

Q. No	Questions	Marks	BL	CO	Unit No
1	Define rank of a matrix with example.	2	L1	CO1	I
2	Define Echelon form & Normal form of a matrix.	2	L1	CO1	I
3	Explain about Consistency and Inconsistency for the system of linear equations.	2	L2	CO1	I
4	Find the value of k if the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & k & 7 \\ 3 & 6 & 10 \end{bmatrix}$ is 2.	2	L1	CO1	I
5	Explain Gauss seidel Iteration Method.	2	L2	CO1	I
6	Explain Gauss Elimination method	2	L2	CO1	I
7	Write the Symmetrix matrix of the quadratic form $x_1^2+2x_2^2-7x3^2-4x_1x_2+8x_1x_3$	2	L1	CO2	II
8	Obtain the quadratic form of the Matrix $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 5 & 6 & 7 \\ 3 & 6 & 0 & 1 \\ 4 & 7 & 1 & 2 \end{bmatrix}$	2	L1	CO2	II
9	Define Canonical Form with a suitable example	2	L1	CO2	II
10	Define Eigen Values and Eigen Vectors.	2	L1	CO2	II
11	Find the sum & product of the Eigen values of the matrix A = $\begin{bmatrix} 2 & 5 & 7 \\ 1 & 4 & 6 \\ 2 & -2 & 3 \end{bmatrix}$	2	L1	CO2	II
12	Find the nature, rank, Index of a quadratic form $2x^2+2y^2+2z^2+2yz$	2	L1	CO2	II
13	State Rolle's, theorem.	2	L2	CO3	III

14	State Lagrange's Mean value theorem.	2	L2	CO3	III
15	State Cauchy Mean value theorem.	2	L2	CO3	III
	UPTO MID-1				
16	Prove that $B(m,n) = B(m+1,n) + B(m,n+1)$	2	L5	CO3	III
17	Find $B(2.5, 1.5)$	2	L1	CO3	III
18	Define Beta and Gamma Functions.	2	L1	CO3	III
19	Define homogeneous function.	2	L1	CO4	IV
20	State Euler's theorem.	2	L2	CO4	IV
21	Find first and second order partial derivatives of $x^3 + y^3 - 3axy$.Hence verify $\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial^2 f}{\partial y \partial x}$	2	L1	CO4	IV
22	Define chain rule of partial differentiation.	2	L1	CO4	IV
23	Define Total Differential coefficient.	2	L1	CO4	IV
24	Define functional dependence of Jacobian.	2	L1	CO4	IV
25	Evaluate $\int_1^2 \int_1^3 xy^2 dx\,dy$	2	L5	CO5	V
26	Evaluate $\int_0^5 \int_0^{x^2} x\left(x^2+y^2\right) dx\,dy$	2	L5	CO5	V
27	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dxdy$	2	L5	CO5	V
28	Evaluate $\int_0^1 \int_1^2 \int_2^3 xyz dxdydz$	2	L5	CO5	V
29	Evaluate $\int_0^1 \int_0^{1-x} \int_0^{1-x-y} dxdydz$	2	L5	CO5	V
30	Define double and triple integrals.	2	L1	CO5	V

PART-B

Q .No	Questions	Marks	BL	CO	Unit No
1	Discuss for what value of λ, μ the simultaneous equations x+ y+ z=6, x+2y+3z=10, x+2y+ λ z= μ have i) no solution ii) unique solution iii) an infinite number of solutions.	8	L3	CO1	I
2	Find the rank of the matrix A by reducing to echelon form where A=$\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$	4	L5	CO1	I
3	Solve the following system of equations by Gauss-Seidel method 4x+y+2z=4, 3x+5y+z=7, x+y+3z=3	8	L3	CO1	I
4	By reducing the matrix $\begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$ into normal form ,find its rank.	4	L2	CO1	I
5	Find the inverse of the matrix A=$\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$ using Gauss Jordan method.	4	L3	CO1	I
6	Solve the system of equations 3x+y+2z=3, 2x-3y-z = -3,x+2y+z=4 using Gauss Elimination method.	4	L3	CO1	I
7	Solve x+10y+z=6, 10x+y+z=6, x+y+10z=6 using Gauss Seidel iteration method.	8	L3	CO1	I
8	Solve the system of equations x+3y-2z=0,2x-y+4z=0,x-11y+14z=0	4	L3	CO1	I
9	Show that the system of equations x+2y+z=3,2x+3y+2z=5,3x-5y+5z=2,3x+9y-z=4 are consistent and solve them.	4	L5	CO1	I
10	If A = $\begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$, find the value the matrix $A^8-5A^7+7A^6-3A^5+A^4-5A^3+8A^2-2A+I$	4	L4	CO2	II
11	Prove that the sum of the eigen values of a square matrix is equal to its trace and product of the eigen values is equal to its	4	L5	CO2	II

	determinant.				
12	Find the Eigen values and Eigen vectors of the Matrix A= $\begin{bmatrix}1 & 2 & 3\\2 & 4 & 6\\3 & 6 & 9\end{bmatrix}$	4	L3	CO2	II
13	Find the characteristic roots of the matrix $\begin{bmatrix}6 & -2 & 2\\-2 & 3 & -1\\2 & -1 & 3\end{bmatrix}$ and the corresponding characteristic vectors.	4	L3	CO2	II
14	Verify Cayley-Hamilton theorem and hence find A^{-1} for $\begin{bmatrix}1 & 2 & 3\\2 & -1 & 4\\3 & 1 & -1\end{bmatrix}$	4	L2	CO2	II
15	Find the eigen values and eigen vector of the matrix $A=\begin{bmatrix}1 & 1 & -1\\0 & 2 & 1\\-4 & 4 & 3\end{bmatrix}$	4	L3	CO2	II
16	Reduce the quadratic form $3x^2+2y^2+3z^2-2xy-2yz$ to the normal form by orthogonal transformation . Also write the rank, Index, nature and signature.	8	L1	CO2	II
17	Using Cayley Hamilton Theorm find the inverse and A^4 of the matrix $A=\begin{bmatrix}7 & 2 & -2\\-6 & -1 & 2\\6 & 2 & -1\end{bmatrix}$	8	L2	CO2	II
18	Reduce the Q.form $8x^2+7y^2+3z^2+12xy+4xz+8yz$ to canonical form and find rank, nature, index & signature	8	L5	CO2	II
19	Using Rolle's theorem, show that $g(x) = 8x^3 - 6x^2 - 2x + 1$ has a zero between 0 and 1.	4	L1	CO3	III
20	$Find\ c\ of$ Cauchy mean value theorem for $f(x) =$	4	L1	CO3	III

	$\sqrt{x}$, $g(x) = \frac{1}{\sqrt{x}}$ in $[a, b]$ $0 < a < b$.				
21	Show that $\frac{\sin^{-1}x}{\sqrt{1-x^2}} = x + \frac{4x^3}{3!} + \ldots$ (or) Expand $\frac{\sin^{-1}x}{\sqrt{1-x^2}}$ $in\ powers\ of\ x$	4	L1	CO3	III
22	If a<b, prove that $\frac{b-a}{1+b^2} < \tan^{-1} b - \tan^{-1} a < \frac{b-a}{1+a^2}$ using Lagranges mean value theorem. Deduce the following. (i) $\frac{\pi}{4} + \frac{3}{25} < \tan^{-1}\frac{4}{3} < \frac{\pi}{4} + \frac{1}{6}$ (ii) $\frac{5\pi+4}{20} < \tan^{-1} 2 < \frac{\pi+2}{4}$	4	L3	CO3	III
23	Prove that $\frac{\pi}{6} + \frac{1}{5\sqrt{3}} < \sin^{-1}(\frac{3}{5}) < \frac{\pi}{6} + \frac{1}{8}$	4	L5	CO3	III
	UPTO MID1				
24	Evaluate $\int_0^1 x^3\sqrt{1-x}\,dx$ using β – Γ functions	4	L1	CO3	III
25	Evaluate $\int_0^1 x^4\left(\log\frac{1}{x}\right)^3 dx$	4	L2	CO3	III
26	Prove that $\int_0^{\pi/2} sin^2\theta\, cos^4\theta\ d\theta = \frac{\pi}{32}$	4	L5	CO3	III
27	Evaluate $\int_0^{\infty} \frac{x}{(1+x^6)}\ dx$ using β - Γ functions	4	L5	CO3	III
28	Evaluate $\int_0^{\frac{\pi}{2}} \sqrt{cot\theta} d\theta$	4	L5	CO3	III
29	If $u = \frac{1}{\sqrt{x^2+y^2+z^2}}$, $x^2 + y^2 + z^2 \neq 0$ *then prove that* $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = 0$	8	L5	CO4	IV
30	**If** $\boldsymbol{u(x, y) = \log(\frac{x^4+y^4}{x+y})}$ **, show that** $\boldsymbol{x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 3}$	4	L1	CO4	IV

31	Examine for minimum and maximum values of $\sin x + \sin y + \sin(x+y)$	8	L4	CO4	IV
32	Examine the extrema of $f(x,y) = x^2 + y^2 + xy + \frac{1}{x} + \frac{1}{y}$	8	L4	CO4	IV
33	If $u = x^2 - y^2$, $v = 2xy$ where, $X = r\cos\theta$, $Y = r\sin\theta$ Show that $\frac{\partial(u,v)}{\partial(r,\theta)} = 4r^3$	4	L5	CO4	IV
34	If $x = u(1-v), y = uv$ prove that $JJ^1 = 1$	4	L5	CO4	IV
35	If $U = \frac{x+y}{1-xy}, V = \tan^{-1}x + \tan^{-1}y$ find $\frac{\partial(U,V)}{\partial(x,y)}$ hence prove that U and V are functionally Dependent. Find functional relation between them.	4	L5	CO4	IV
36	Find the maxima & minima of the function $f(x) = 2(x^2 - y^2) - x^4 + y^4$	4	L5	CO4	IV
37	Find the maximum and minimum values of $f(x,y) = x^2 + y^2 + z^2$ given that $xyz = a^3$	4	L5	CO4	1V
38	Evaluate $\iint (x^2 + y^2)\,dx\,dy$ over the area bounded by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	4	L5	CO5	V
39	Evaluate $\int_0^{\pi/4} \int_0^{a\sin\theta} \frac{r\,dr\,d\theta}{\sqrt{a^2 - r^2}}$	4	L5	CO5	V

40	Change the order of integration and evaluate $=\int_0^a \int_{x/a}^{\sqrt{x/a}} \left(x^2+y^2\right) dx\, dy$	4	L5	CO5	V
41	**aluate the integral by changing to polar co-ordinates** $\int_0^{\sqrt{a^2-y^2}} \left(x^2+y^2\right) dx\, dy$	4	L5	CO5	V
42	Change the order of integration in $\int_0^1 \int_{x^2}^{2-x} xydxdy$ and hence evaluate the double integral.	8	L5	CO5	V
43	By using the transformation x+y=u, y=uv Prove that $\int_0^1 \int_0^{1-x} e^{y/(x+y)} dydx = \frac{1}{2}(e-1)$	8	L5	CO5	V
44	Find the area bounded by the parabolas $y^2 = 4ax \; and \; x^2 = 4ay$	4	L3	CO5	V
45	Evaluate $\int_0^{log2} \int_0^x \int_0^{x+logy} e^{x+y+z} dxdydz$	4	L5	CO5	V
46	Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} xyz\, dx\, dy\, dz$	8	L5	CO5	V