



RV College of Engineering

M. J. Road, RV Vidyankur Post,
Bengaluru - 560099, Karnataka, India

DEPARTMENT OF MATHEMATICS

Course: Fundamentals of Linear Algebra, Calculus and Statistics	CIE-2 First semester 2024-2025	Maximum marks: 10+50
Course code: MA211TC	Chemistry Cycle Branch: CI, BT, CD, CS, CY, IS	Time: 2.00 PM – 4.00 PM Date: 11/12/2024

Q. No	Answer all questions	M	BT	CO
PART A				
1.1	The Cartesian form of the polar curve $r = 2(\sin \theta - \cos \theta)$ is _____.	2	1	1
1.2	The radius of curvature at (x, y) of the curve $y = \frac{c}{2}(e^{x/c} + e^{-x/c})$ is _____.	2	2	2
1.3	The coefficient of $(x - \frac{\pi}{2})^2$ in the Taylor's series expansion of $\cos x$ about the point $x = \frac{\pi}{2}$ is _____.	2	1	2
1.4	If $z = x^2y$ where $x = at$, $y = 2at$ then $\frac{dz}{dt} =$ _____.	2	1	1
1.5	Given that $\cos^y x = \sin^x y$, then $\frac{dy}{dx} =$ _____.	2	1	1
PART B				
1	Determine the angle of intersection of the pair of curves $r = \frac{a\theta}{1+\theta}$ and $r = \frac{a}{1+\theta^2}$.	10	2	2
2	Show that the circle of curvature at the origin of the curve $x + y = ax^2 + by^2 + cx^3$ is $(a + b)(x^2 + y^2) = 2(x + y)$.	10	3	3
3a	Obtain the angle between the radius vector and tangent for the curve $r \cos^2(\frac{\theta}{2}) = a^2$ at $\theta = \frac{2\pi}{3}$.	4	2	1
3b	If $u = f(\frac{y-x}{xy}, \frac{z-x}{xz})$, then show that $x^2u_x + y^2u_y + z^2u_z = 0$.	6	2	2
4	Use Maclaurin series up to fourth degree term to evaluate the approximate value of the integral $\int_0^1 e^{x \sin x} dx$.	10	3	3
5a	If $f(x, y) = x e^{xy}$, then verify that $f_{xy} = f_{yx}$.	5	2	2
5b	The temperature function for a bird in flight is given by $T(x, y, z) = 0.09x^2 + 1.4xy + 95z^2$. Use differential dT to approximate change in temperature when head wind x increases from 1 meter per second to 2 meters per second, bird heart rate y increases from 50 beats per minute to 55 beats per minute and flapping rate z increases from 3 flaps per second to 4 flaps per second.	5	4	4

BT-Blooms Taxonomy, CO-Course Outcomes, M-Marks

Marks Distribution	Particulars		CO1	CO2	CO3	CO4	L1	L2	L3	L4	L5	L6
	Test	Max Marks	4	21	20	5	0	25	20	5	-	-
	Quiz	Max Marks	6	4			8	2				



Course: Fundamentals of Linear Algebra, Calculus and Statistics	CIE-1 First semester 2024-2025	Maximum marks: 50+10
Course code: MA211TC	Chemistry Cycle Branch: CI, BT, CD, CS, CY, IS	Time: 2.00PM - 4.00PM Date: 04/11/2024

Q.No	Answer all questions	M	BT	CO
PART A				
1.1	If the matrix $B = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 6 & 9 \\ 0 & 2 & 4 \end{bmatrix}$, then the rank of its transpose is _____.	2	1	1
1.2	Rank of a matrix of order 6×7 whose all minors of order 6 are zero is _____.	1	1	1
1.3	By Gauss Jordan method the augmented matrix $\begin{bmatrix} 1 & 1 & 3 \\ 2 & 3 & 2 \end{bmatrix}$ reduces to _____.	2	1	2
1.4	If A is an invertible matrix of order 5×5 and X is matrix of unknowns of order 5×1 , then the system $AX = 0$ has _____ solution.	1	1	1
1.5	The solution of the given system of equations $x + y + z = 0, y - z = 0, x + 2y = 0$ is _____.	2	2	2
1.6	If $\begin{bmatrix} 4 \\ 3 \\ 1 \end{bmatrix}$ is the eigenvector of $\begin{bmatrix} 2 & 4 \\ 3 & 1 \end{bmatrix}$. The associated eigenvalue is _____.	2	2	2
PART B				
1a)	Find the values of b such that the rank of the matrix $A = \begin{bmatrix} 1 & 5 & 4 \\ 0 & 3 & 2 \\ b & 13 & 10 \end{bmatrix}$ is 2.	4	2	1
1b)	Investigate for what values of λ and μ the system of simultaneous equations $x + y + z = 6, 2x + 4y + 6z = 20, 3x + 6y + \lambda z = \mu$ has (i) no solution (ii) unique solution (iii) infinite number of solutions.	6	3	3
2	Solve the following system of linear equations by Gauss-Elimination method $4x_1 - x_2 + 2x_3 - x_4 = 2, x_1 - 2x_2 - 3x_3 + x_4 = 4, x_1 + 4x_2 - x_3 + x_4 = 2, x_2 - 4x_4 = 0.$	10	2	2
3	Apply Gauss Jordan method to find the inverse of the matrix $= \begin{bmatrix} 3 & 0 & 1 \\ -2 & 1 & 0 \\ -1 & 2 & 4 \end{bmatrix}$. Hence solve the system of equation $AX = B$ where $B = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$.	10	3	3
4(a)	The current in the branches of an electrical network follows the system of linear equations of the form $5i_1 + 2i_2 + 12i_3 = 36, 10i_1 - 3i_2 + 2i_3 = 10, 3i_1 + 11i_2 - i_3 = -23$. Find an approximate solution for the above system of equations using Gauss-Seidel method. Perform 3 iterations (consider four decimal places).	5	3	4
4(b)	Find the eigenvalues and the corresponding eigenvectors of the Matrix $B = \begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}$.	5	1	2
5	In analysing connectivity between pages, Google's PageRank algorithm uses eigenvalues and eigenvectors to determine the importance of pages. For a simplified network analysis, identify the dominant eigenvalue and corresponding eigenvector of the matrix $A = \begin{bmatrix} 3 & 1 & 0 \\ 1 & 2 & 1 \\ 0 & 1 & 3 \end{bmatrix}$ by Rayleigh's power method with the initial approximation $[1 \ 0 \ 0]^T$. Perform 5 iterations.	10	2	4

*****ALL THE BEST*****

BT-Blooms Taxonomy, CO-Course Outcomes, M-Marks

Marks Distribution	Particulars		CO1	CO2	CO3	CO4	L1	L2	L3	L4	L5	L6
	Test	Max Marks	4	15	16	15	6	23	21	-	-	-
	Quiz	Max Marks	4	6			6	4				



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Department of Mathematics
Academic Year 2024-2025 (Odd Semester 2024)

Date	02/01/2025	Time	2:00 PM to 4 PM
Test	Improvement CIE (Quiz & Test)	Maximum Marks	10+50=60
Course Title	Fundamentals of linear Algebra, Calculus and Statistics	Course Code	MA211TC
Semester	I	Programs	B.E. (AIML, BT, CD, CS, CY, IS)

PART - A

S.No.	Questions	M	BT	CO
1	Let $x = r \cos \theta$ and $y = r \sin \theta$. Then Jacobian of x, y with respect to r, θ is _____.	2	1	1
2	Given the data points (1, 2), (3, 5) and (7, 11). The slope of the line $y = mx$ that fits the data is _____.	2	1	1
3	The following data regarding the heights (y) and the weights (x) of twelve college students are given $\sigma_x = 16.8, \sigma_y = 10.8, \sum(x - \bar{x})(y - \bar{y}) = 2020$. For the given data the regression coefficient of x on y is _____.	2	2	2
4	Given $f(x, y) = x^3 + y^3 - 63(x + y) + 12xy, f_{xx} = 6x, f_{yy} = 6y$ and $f_{xy} = 12$. Which of the critical points $(-7, -7)$ and $(-1, 5)$ are saddle points?	2	1	1
5	In a partially destroyed laboratory record of an analysis of a correlation data, the following results were noted: variance of $x = 9$, equations of lines of regression of y on x is $4x - 5y + 33 = 0$ and x on y is $20x - 9y = 107$. For the given data the value of correlation coefficient is _____ and the standard deviation of y is _____.	2	2	2

PART - B

Sl.No.	Questions	M	BT	CO														
1a	Calculate $\frac{\partial(x,y,z)}{\partial(u,v,w)}$ if $u = \frac{2yz}{x}$, $v = \frac{3zx}{y}$ and $w = \frac{4xy}{z}$.	5	2	2														
1b	Using the concept of Jacobians, determine whether the following functions are functionally dependent or not. If functionally dependent, find the functional relation between them. $u = x_1 + x_2 - x_3$, $v = x_1 - x_2 + x_3$, $w = x_1^2 + x_2^2 + x_3^2 - 2x_2x_3$.	5	2	2														
2	For the given function, $f(x,y) = x^2 + y^2 - 4x - 4y$. Determine the following: i) The extreme values of $f(x,y)$. ii) The extreme values of $f(x,y)$ on the circle $x^2 + y^2 = 9$. iii) The extreme values of $f(x,y)$ on the open disk $x^2 + y^2 < 9$.	10	2	3														
3a	A rectangular box without a lid is to be made from $12m^2$ of cardboard. Find the maximum volume of such a box using Lagrange's multiplier method.	6	3	4														
3b	Use the method of least squares to fit the data points, (1, 1.8), (2, 5.1), (3, 8.9) and (4, 14.1) to a straight line of the form $y = mx + c$.	4	1	1														
4	The following pair of observations was noted in an experimental work on cosmic rays. Find by the method of least squares the best values of a and b for the equation $y = ax^b$ which fits the following data. Also extrapolate the value of y when $x = 7$. <table border="1"><tr><td>x</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>y</td><td>8.3</td><td>15.4</td><td>33.1</td><td>65.2</td><td>127.4</td></tr></table>	x	2	3	4	5	6	y	8.3	15.4	33.1	65.2	127.4	10	3	3		
x	2	3	4	5	6													
y	8.3	15.4	33.1	65.2	127.4													
5	Marks obtained by 6 students in mathematics papers are given below: <table border="1"><tr><td>Paper I</td><td>60</td><td>65</td><td>68</td><td>70</td><td>75</td><td>85</td></tr><tr><td>Paper II</td><td>62</td><td>64</td><td>65</td><td>70</td><td>74</td><td>88</td></tr></table> i) Determine the equations of lines of regressions and hence the coefficient of correlation for the given data. ii) Obtain the angle between the lines of regression.	Paper I	60	65	68	70	75	85	Paper II	62	64	65	70	74	88	10	2	2
Paper I	60	65	68	70	75	85												
Paper II	62	64	65	70	74	88												

BT-Blooms Taxonomy, CO-Course Outcomes, M-Marks

Marks Distribution	Particulars		CO1	CO2	CO3	CO4	L1	L2	L3	L4	L5	L6
	Test	Max Marks	4	20	20	6	4	30	16	-	-	-
	Quiz	Max Marks	6	4	-	-	6	4	-	-	-	-