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Paper Name: Mathematical Foundation of Computer Science **Paper Code:** B.Sc.-103
Total Marks: 60 **Total Time:** 2.5 hrs.

Attempt all questions from section A, any Four questions from section B and any Two questions from section C.

Abbreviations Used

CO-Course Outcomes:

CO1: Students will become skilled in computations and applications of matrices to solve industrial problems.
CO2: Represent vectors, compute dot and cross products for presentations of lines and planes.
CO3: Determine and understand the concept of gradient, curl, divergence, conic section, and curvature.
CO4: Solve applied problems using differentiation and Partial differentiation.
CO5: Solve problems using mathematics in unfamiliar settings.

|SECTION-A|

All questions are compulsory. True or False & Fill in the blanks. **|20 Marks|**

Q. No.	Questions	Marks	CO	BL
1.	**True/False;** If $A = \begin{bmatrix} a & h & g \\ -h & b & f \\ -g & -f & c \end{bmatrix}$, Then matrix is symmetric matrix.	1	CO2	L1
2.	**True/False;** In a square matrix if any two rows/column are interchanged, then the sign of the determinant's not changed.	1	CO1	L2
3.	**True/False;** The determinant of a Singular matrix is non-zero.	1	CO3	L3
4.	**True/False;** An independent system has infinitely many solutions.	1	CO2	L1
5.	**True/False;** The eigen value λ for matrix A and A^T is same.	1	CO3	L2
6.	**True/False;** The Cayley Hamilton theorem allows A^n to be expressed as a linear combination of the lower matrix powers of A.	1	CO2	L3
7.	**True/False;** The rank of the matrix $A_{m\times n}$ is minimum of m and n.	1	CO4	L2
8.	**True/False;** For the gradient f is a scalar-valued function, while ∇f is a vector-valued function.	1	CO3	L3
9.	**True/False;** For the divergence $\vec{F}$ is a vector-valued function. while $\nabla.\vec{F}$ is a scalar-valued function.	1	CO4	L1
10.	**True/False;** For the curl $\vec{F}$ is a vector-valued function. while $\nabla \times \vec{F}$ is a vector-valued function.	1	CO5	L2
11.	The curvature of a straight line is	1	CO3	L4
12.	The point where the second derivative of the function is zero, called.....	1	CO4	L2
13.	The product of the eigen values of a matrix is equal to the.....of the matrix.	1	CO2	L1
14.	The point is a circle whose diameter is.....	1	CO4	L3
15.	The equation of a straight line is **(a):** linear **(b):** Non-linear **(c):** both **(d):** None.	1	CO5	L4
16.	Two lines are parallel if their slopes are.....	1	CO4	L3
17.	If $m_1 m_2 = -1$ then two lines are said to be.....	1	CO5	L1
18.	The trace of a matrix is the sum of all the elements on its.....	1	CO2	L2
19.	A sphere is .....in all directions. **(a):** asymmetrical **(b):** symmetrical **(c):** both **(d):** None.	1	CO5	L1
20.	If $\Delta \neq 0$, $h = 0$ and $a = b$, then it represents the.....	1	CO4	L3

SECTION-B

Attempt any Four questions. 4 × 05 = 20 Marks

Q. No.	Questions	Marks	CO	BL
1.	(a): If $\begin{vmatrix} x+1 & x-1 \\ x-3 & x+2 \end{vmatrix} = \begin{vmatrix} 4 & -1 \\ 1 & 3 \end{vmatrix}$, then find x. (b): Find x, y, z and w, if, $\begin{bmatrix} 3x & 3y \\ 3z & 3w \end{bmatrix} = \begin{bmatrix} x & 6 \\ -1 & 2w \end{bmatrix} + \begin{bmatrix} 4 & x+y \\ z+w & 3 \end{bmatrix}$.	5	CO1	L4
2.	Reduce the matrix A to a diagonal form if $A = \begin{bmatrix} -1 & 2 & -2 \\ 1 & 2 & 1 \\ -1 & -1 & 2 \end{bmatrix}$ also find the rank of A.	5	CO2	L3
3.	If $y = \left\{ x + \sqrt{x^2 + a^2} \right\}^n$ then prove that $\frac{dy}{dx} = \frac{ny}{\sqrt{x^2+a^2}}$.	5	CO3	L5
4.	Prove that $f(x, y) = x^3 - 2x^2y + 3xy^2 + y^3$ is homogeneous, what is the degree of the function ? Verify Euler's Theorem for f.	5	CO2	L3
5.	Find the radius of curvature for the rectangular hyperbola if $xy = c^2$.	5	CO4	L6
6.	Find the volume of a sphere whose surface area is 154 cm^2. Also find the area of the circle if $9x^2 + 9y^2 = 25$.	5	CO5	L4

SECTION-C

Attempt any Two questions. 2 × 10 = 20 Marks

Q. No.	Questions	Marks	CO	BL
1.	Find the characteristic equation of the matrix $A = \begin{bmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{bmatrix}$, show that the equation is satisfied by A and hence obtain the inverse of the given matrix.	10	CO1	L1,L3
2.	(a): If $\vec{F} = (x + y + 1)\hat{\imath} + \hat{\jmath} - (x + y)\hat{k}$, then show that $\vec{F}$.Curl $\vec{F} = 0$. (b): If $u = x^2y + y^2z + z^2x$, then show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = (x + y + z)^2$.	5 5	CO3	L2,L4
3.	Find all the asymptotes of the curve $y^3 + 4xy^2 + 4x^2y + 5y^2 + 15xy + 10x^2 - 2x + 1 = 0$.	10	CO4	L5
4.	(a): For what value of λ the given equation $\lambda x^2 - 10xy + 12y^2 + 5x - 16y - 3 = 0$ represents a pair of straight lines? (b): Solve the differential equation $(1 + x^2)\frac{dy}{dx} + 2xy - 4x^2 = 0$, subject to the initial condition $y(0) = 0$.	5 5	CO2	L4,L6

BL-Bloom's Taxonomy Levels: (1-Remembering, 2-Understanding, 3-Applying, 4-Analysing, 5-Evaluating, 6-Creating)