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FIRST SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025

(CUFYUGP)

B. Sc. Mathematics Honours

MAT1MN105-MATRIX THEORY

2024 Admission onwards

Maximum Time :2 Hours	**Maximum Marks :70**

Section A

All Question can be answered. Each Question carries 3 marks (Ceiling : 24 Marks)

1	Solve $$x + 2y = 3$$ $$3x + y = 1$$
2	Find all values of k for which the augmented matrix $\begin{bmatrix} 1 & k & -1 \\ 4 & 8 & -4 \end{bmatrix}$ corresponds to a consistent linear system
3	Let $A = \begin{bmatrix} 2 & 3 & 4 \\ 6 & 6 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 1 & 5 \\ 2 & 7 & 1 \\ 8 & 3 & 9 \end{bmatrix}$. Show that $tr(A + B) = tr(A) + tr(B)$
4	Let $A = \begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix}$ and$B = \begin{bmatrix} 2 & 1 \\ 4 & 6 \end{bmatrix}$. Show that $(AB)^{-1} = B^{-1}A^{-1}$
5	Compute $p(A)$ for the matrix $A = \begin{bmatrix} 2 & 3 \\ 2 & 3 \end{bmatrix}$ and the polynomial $x^2 + 3x - 2$.
6	Use the arrow technique to evaluate the determinant $\begin{vmatrix} 2 & 6 & 5 \\ 9 & 6 & 10 \\ 11 & 2 & 1 \end{vmatrix}$
7	Find the determinant of $\begin{bmatrix} 0 & 0 & 100 & 1002 \\ 4 & 5 & 1000 & 2000 \\ 0 & 0 & 0 & 10 \\ 0 & 3 & 25 & 300 \end{bmatrix}$
8	Let P be the point (1, 7, -3) and Q the point (4, -7, 3). Find the point on the line segment connecting the points P and Q that is $\frac{3}{4}$ of the way from P to Q.
9	Let $\mathbf{v} = (1, -2, 3, 4)$ and $\mathbf{u} = (-7, -2, 4, 5)$. Check whether $\mathbf{u} \bullet \mathbf{v} = \mathbf{v} \bullet \mathbf{u}$
10	Find the distance D between the point $(-1, 7, -3)$ and the plane $2x + 6y + 3z = 5$.

Section B

All Question can be answered. Each Question carries 6 marks (Ceiling : 36 Marks))

11	Change the matrix $\begin{bmatrix} 1 & 8 & 10 \\ 3 & 4 & 5 \\ 9 & 1 & 0 \\ 2 & 3 & 4 \end{bmatrix}$ to reduced row echelon form
12	Let **0** denote a 2×2 matrix, each of whose entries is zero. 1. Is there a 2×2 matrix A such that $A \neq \mathbf{0}$ and $AA = \mathbf{0}$? Justify your answer. 2. Is there a 2×2 matrix A such that $A \neq \mathbf{0}$ and $AA = A$? Justify your answer.
13	Using Row Operations to find A^{-1}, $$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 3 \\ 1 & 0 & 8 \end{bmatrix}$$
14	Determine whether the homogeneous system has nontrivial solutions $$x_1 + 2x_2 + 3x_3 = 0$$ $$2x_1 + 5x_2 + 3x_3 = 0$$ $$x_1 + 8x_3 = 0$$
15	Show that $det(A) = \begin{vmatrix} tr(A) & 1 \\ tr(A^2) & tr(A) \end{vmatrix}$, for every 2×2 matrix
16	Using Cramer's rule solve: $$x + y + 2z = 4$$ $$2x - y + 3z = 9$$ $$3x - y - z = 2$$
17	Find vector and parametric equations of the plane in $\mathbb{R}^4$ that passes through the point $x_0 = (2, -1, 0, 3)$ and is parallel to both $v_1 = (1, 5, 2, -4)$ and $v_2 = (0, 7, -8, 6)$.
18	Show that $\mathbf{u} = (-2, 3, 1, 4)$ and $\mathbf{v} = (1, 2, 0, -1)$ are orthogonal. Verify the Theorem of Pythagoras for these vectors

Section C

Answer any ONE. Each Question carries 10 marks (1x10=10 Marks))

19	Test for consistency and solve $$5x+3y+3z=48$$ $$2x+6y-3z=18$$ $$8x-3y+2z=21$$
20	Without evaluating the determinants directly, show that $$\begin{vmatrix} a_1 & b_1+ta_1 & c_1+rb_1+sa_1 \\ a_2 & b_2+ta_2 & c_2+rb_2+sa_2 \\ a_3 & b_3+ta_3 & c_3+rb_3+sa_3 \end{vmatrix} = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$$