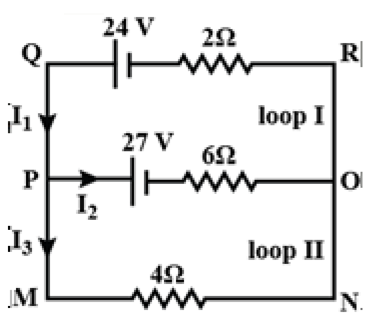
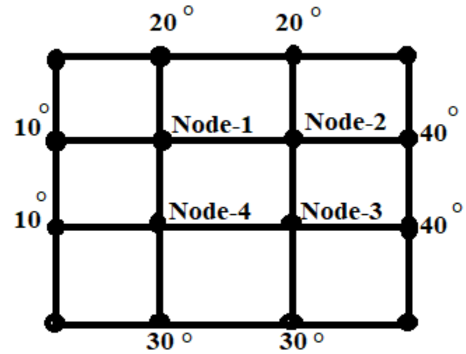
Parul University

Faculty of Engineering & Technology
Department of Applied Sciences and Humanities
1st Year B. Tech Programme- Semester-1 (All Branches)
Mathematics– 1 (303191101) 2023-24
Unit – 3 MATRICES (Tutorial-1)

Q-1 A	Identify which of the following matrices are symmetric, skew symmetric. (a) $\begin{bmatrix} -1 & 2 & 2 \\ 2 & 3 & 4 \\ 2 & 4 & -2 \end{bmatrix}$ (b) $\begin{bmatrix} 0 & 2 & -3 \\ -2 & 0 & 1 \\ 3 & -1 & 0 \end{bmatrix}$
B	Check whether the matrix $\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$ is orthogonal or not.
Q-2	Which of the following matrices are in row-echelon form, reduced-row echelon form or both? Justify your answer. $(a)\begin{bmatrix} 1 & 0 & 0 & 5 \\ 0 & 0 & 1 & 2 \\ 0 & 1 & 0 & 7 \end{bmatrix}$ $(b)\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$ $(c)\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$ $(d)\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$ $(e)\begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$
Q-3	In the circuit shown below, find the currents I_1, I_2 and I_3 in the loops. [Hint: Apply Kirchoff's Laws for junction and path.] 
Q-4	Determine the steady-state temperature distribution of a thin plate representing a cross - section of a beam as shown in the following figure. Assuming negligible heat flow in the direction perpendicular to the plane. [Hint: The temperature at a node is approximately equal to the average of the four nearest nodes.]

	
Q-5	Solve the following systems of equations using Gauss elimination method. (a) $x - 2y + 2z = 3$, $2x + y + 2z = 4$, $6x + 2y - 2z = 4$ (b) $2x_1 - x_2 + x_3 = 3$, $3x_1 - x_2 + 2x_3 = 6$, $-5x_1 + 8x_2 - 4x_3 = 2$
Q-6	Solve the following systems of linear equations, by Gauss-Jordan Method. (a) $x + 2y + z = 0$, $-x - y + z = 2$, $y + 3z = 3$ (b) $x + 2y + z = 5$, $-2x - 2y + z = 2$, $-x + 2z = 1$
Q-7	Solve the following using any method and find the value of λ so that the equations have (a) a nontrivial solution (b) a trivial solution. $2x + y + 2z = 0$ $x + y + 3z = 0$ $4x + 3y + \lambda z = 0$
Q-8	a) Find the value of x so that the rank of matrix A is (i) equal to 3 and (ii) less than 3. $A = \begin{bmatrix} 3-x & 2 & 2 \\ 1 & 4-x & 0 \\ -2 & -4 & 1-x \end{bmatrix}$ b) Find a and b such that the rank of the matrix $\begin{bmatrix} 1 & -2 & 3 & 1 \\ 2 & 1 & -1 & 2 \\ 6 & -2 & a & b \end{bmatrix}$ is 2. b) Find the ranks of the below stated matrices: i. $\begin{bmatrix} 1 & 2 & 2 & -1 \\ 1 & 4 & 0 & 2 \\ -1 & 0 & -4 & 4 \end{bmatrix}$ ii. $\begin{bmatrix} 1 & -3 & 1 & 2 \\ 0 & 1 & 2 & 3 \\ 3 & 4 & 1 & -2 \end{bmatrix}$
Q-9	Find eigen values and eigen vectors for the following matrices. Also determine algebraic multiplicity and geometric multiplicity of the matrices wherever possible. a) $\begin{bmatrix} 2 & 3 \\ 4 & 1 \end{bmatrix}$, b) $\begin{bmatrix} 3 & 0 & 0 \\ 8 & 4 & 0 \\ 6 & 2 & 5 \end{bmatrix}$ c) $\begin{bmatrix} 2 & 1 & 1 \\ 2 & 3 & 2 \\ 3 & 3 & 4 \end{bmatrix}$ d) $\begin{bmatrix} 2 & 2 & -1 \\ 5 & -1 & 3 \\ 0 & 0 & 1 \end{bmatrix}$

Q-10	Find a matrix that diagonalizes A, and determine $P^{-1}AP$ where, $A = \begin{bmatrix} 2 & 2 & -1 \\ 5 & -1 & 3 \\ 0 & 0 & 1 \end{bmatrix}$
Q-11	Find Characteristic polynomials and the inverse using Cayley-Hamilton theorem, $a)$ $\begin{bmatrix} 1 & 2 \\ 1 & 3 \end{bmatrix}$ b) $\begin{bmatrix} 0 & 0 & -2 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix}$ c) $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$
Q-12	Reduce the quadratic form $3x_1^2 + 5x_2^2 + 3x_3^2 - 2x_2x_3 + 2x_3x_1 - 2x_1x_2$ into canonical form.