

# Indian Institute of Information Technology Senapati, Manipur

Assessment-1, December 2022

Course Title: **Mathematics-1**

Semester: I

Date of Examination: 19.12.2022

Course Code: **MA1011**

Maximum Marks: 25

Time: 1 hour

## Part A (5×2 =10 marks)

1. Show that the vectors  $(1,2,1), (2,1,0), (1, -1,2)$  form a basis of  $\mathbb{R}^3$ .

$$\begin{bmatrix} 1 & 0 & 3 & 3 \\ 2 & 0 & 6 & 6 \\ 1 & 1 & 3 & 3 \end{bmatrix}$$

2. Find the row reduced echelon form of the matrix  $\begin{bmatrix} 1 & 0 & 3 & 3 \\ 2 & 0 & 6 & 6 \\ 1 & 1 & 3 & 3 \end{bmatrix}$ .
3. Show whether the set of non-singular  $2 \times 2$  matrices is a vector space or not. Show also whether the set of singular  $2 \times 2$  matrices is a vector space or not.
4. If  $A$  is  $4 \times 4$  invertible matrix, what is the nullspace of the  $4 \times 8$  matrix  $B = (A \ A)$ ?
5. Explain why each of the three elementary row operations does not affect the solution set of a linear system.

## Part B (3×5 =15 marks)

6. Determine 'b' such that the system of homogenous equations

$$2x + y + 2z = 0, \quad x + y + 3z = 0, \quad 4x + 3y + bz = 0$$

has (i) Trivial Solution                      (ii) Non-Trivial solution

Find the Non-Trivial solution using matrix method.

7. (a) If  $Ax = b$  has at least one solution for every  $b$ , where  $A$  be an  $m$  times  $n$  matrix, what is the rank of  $A$ ? Further describe all vectors in the null space of  $A^T$ . Explain your reasoning for both the part in details mentioning any relevant theorems used.

**OR**

- (b) Find the general solution of the system of equations by Gauss elimination methods

$$3x + 2z + 2w = 0, \quad -x + 7y + 4z + 9w = 0, \quad 7x - 7y - 5w = 0$$

8. (a) Let  $A$  be a  $3 \times 3$  matrix where the third row is the sum of the first two rows. Let  $b = (1 \ 0 \ 0)^T$ , does the system  $Ax = b$  have a solution? Which vector  $b = (b_1 \ b_2 \ b_3)^T$  will allow solutions of  $A$  (give your answer in terms of the relations between the  $b_i$ 's)? Is  $A$  invertible? Explain your reasoning for all parts in details mentioning any relevant theorems used.

**OR**

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(b) If  $R$  be the field of real numbers. Which of the following are subspace of  $\mathfrak{R}^3$ ? Explain your reasoning.

i.  $\{(x, 2y, 3z) : x, y, z \in R\}$  .

ii.  $\{(x, y, z) : x, y, z \text{ are rational numbers}\}$  .