

# Unit

## 1

# MATRICES AND EIGEN VALUE PROBLEMS

### ◆ § 1.1. INTRODUCTION

The word 'Matrix' was used first of all by J. J. Sylvester in 1850. Then Arthur Cayley developed the principles of matrices in 1858.

### ◆ § 1.1. (A) MATRIX (SOME ELEMENTARY CONCEPTS)

**Definition.** A system of  $mn$  numbers (real or complex) arranged in a rectangular array of  $m$  rows and  $n$  columns is called a matrix of order  $m \times n$ . It is also called  $m \times n$  matrix.

Matrices are usually denoted by capital letters  $A, B, C, X, Y, Z, \dots$ . If  $A$  is a  $m \times n$  matrix, then it is represented in square brackets as follows :

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}_{m \times n}$$

**Order of a matrix.** If there are  $m$  rows and  $n$  columns in a matrix, then it is called a matrix of order  $m \times n$ ; first factor i.e.,  $m$  denotes the number of rows and second factor i.e.,  $n$  denotes the number of columns.

It should be noted that it is not necessary that the number of rows be equal to number of columns, in the matrix, e.g.,

$$\begin{bmatrix} 3 & 5 & 7 \\ 9 & 10 & 11 \end{bmatrix}, [7 \ 8 \ 9], \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

are matrices of order  $2 \times 3$ ,  $1 \times 3$ ,  $2 \times 1$  respectively.

**Elements of a matrix.**  $a_{11}, a_{12}, \dots, a_{mn}$  are called the elements of the matrix,  $a_{ij}$  is called the general element of the matrix and it is situated in  $i^{\text{th}}$  row and  $j^{\text{th}}$  column. First lower suffix  $i$  in  $a_{ij}$  always represents row and second lower suffix  $j$  represents column e.g.,

$$\text{In } \begin{bmatrix} 3 & -2 & 5 \\ 4 & 7 & 9 \end{bmatrix}, a_{11} = 3, a_{12} = -2, a_{23} = 9 \text{ etc.}$$

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