PERMUTATIONS AND COMBINATIONS

INTRODUCTION & FUNDAMENTAL PRINCIPLE OF COUNTING

Introduction

The most fundamental application of mathematics is counting. There are many natural methods used for counting This chapter is dealing with various known techniques those are much faster than the usual counting methods. We mainly focus, our methods, on counting the number of arrangements (Permutations) and the number of selections (combinations), even although we may use these techniques for counting in some other situations also.

Fundamental principle of counting (counting without actual counting)

If an event A can occur in 'm' different ways and another event B can occur in 'n' different ways, then the total number of different ways of-

(a) Simultaneous occurrence of both events in a definite order is m× n. This can be extended to any number of events (known as multiplication principle).

(b) Happening exactly one of the events is m + n (known as addition principle).

Ex. There are 15 IITs in India and let each IIT has 10 branches, then the IITJEE topper can select the IIT and branch in $15 \times 10 = 150$ number of ways.

Ex. There are 15 IITs & 20 NITs in India, then a student who cleared both IITJEE & AIEEE exams can select an institute in $(15 + 20) = 35$ number of ways.

Ex. There are 8 buses running from Udaipur to Jaipur and 10 buses running from Jaipur to Delhi. In how many ways a person can travel from Udaipur to Delhi via Jaipur by bus?

Sol. Let E_1 be the event of travelling from Udaipur to Jaipur & E_2 be the event of travelling from Jaipur to Delhi by the person.

E_1 can happen in 8 ways and E_2 can happen in 10 ways.

Since both the events E_1 and E_2 are to be happened in order, simultaneously,

the number of ways $= 8 \times 10 = 80$

Ex. A college offers 6 courses in the morning and 4 in the evening. The number of ways a student can select exactly one course, either in the morning or in the evening-

Sol. The student has 6 choices from the morning courses out of which he can select one course in 6 ways.

For the evening course, he has 4 choices out of which he can select one in 4 ways.

Hence the total number of ways $6 + 4 = 10$.