MANIPAL UNIVERSITY JAIPUR

(University under Section 2(f) of the UGC Act)

B.TECH FIRST YEAR

ACADEMIC YEAR: 2020-2021

COURSE NAME: BASIC MECHANICAL ENGINEERING

COURSE CODE : MA 2101

LECTURE SERIES NO : 22 (TWENTY TWO)

CREDITS : 03

MODE OF DELIVERY : ONLINE (POWER POINT PRESENTATION)

FACULTY : DR. ANAMIKA JAIN

EMAIL-ID : anamika.jain@Jaipur.manipal.edu

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MANIPAL UNIVERSITY JAIPUR

VISION

Global Leadership in Higher Education and Human Development

MISSION

- Be the most preferred University for innovative and interdisciplinary learning
- Foster academic, research and professional excellence in all domains
- Transform young minds into competent professionals with good human values

VALUES

Integrity, Transparency, Quality,
Team Work, Execution with Passion, Humane Touch

SESSION OUTCOME

"UNDERSTAND THE FUNDAMENTAL CONCEPTS OF PERMUTATION AND COMBINATION"

ASSIGNMENT

QUIZ

MID TERM EXAMINATION –I, II

END TERM EXAMINATION

ASSESSMENT CRITERIA'S

PROGRAM OUTCOMES MAPPING WITH CO4

ENGINEERING KNOWLEDGE: APPLY THE KNOWLEDGE OF MATHEMATICS, SCIENCE, ENGINEERING FUNDAMENTALS, AND AN ENGINEERING SPECIALIZATION TO THE SOLUTION OF COMPLEX ENGINEERING PROBLEMS.

REVIEW ON PERMUTATIONS AND COMBINATIONS

Permutation of a set of objects

A permutation of a set of objects is any arrangement of those objects in a definite order. (order is important).

For example, if $A = \{a, b, c, d\}$, then

ab ~ two-element permutation of A,

acd ~ three-element permutation of A,

adcb ~ four-element permutation of A.

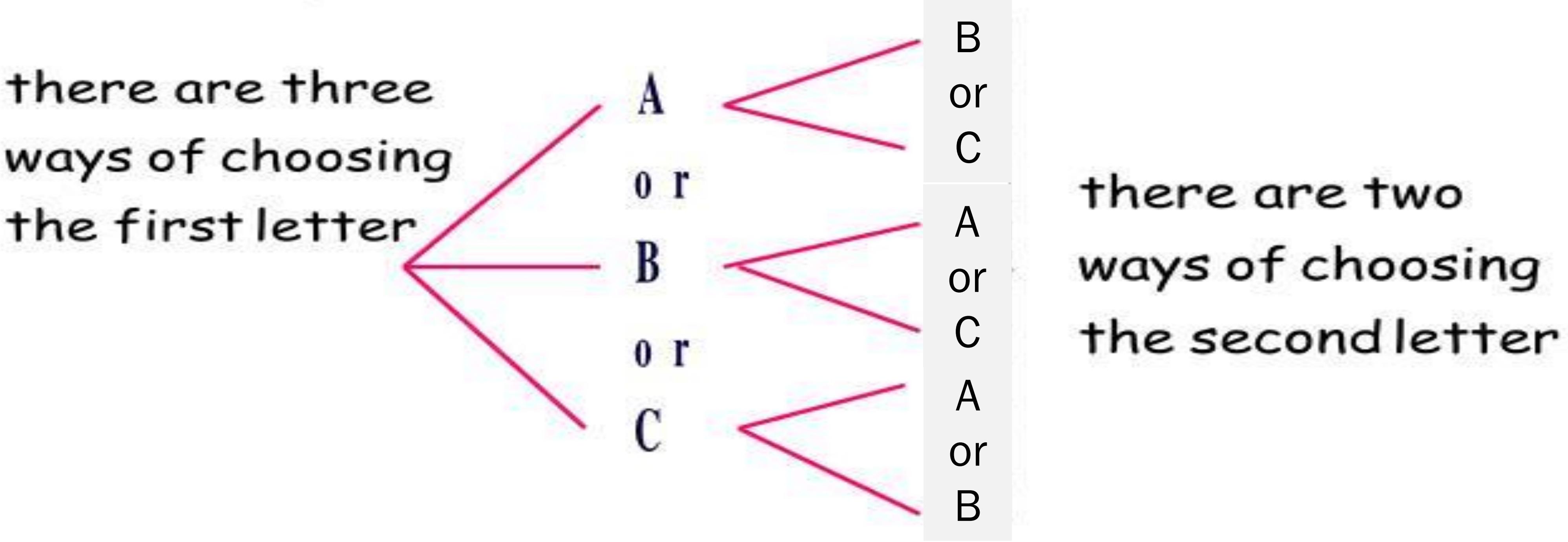
The order in which objects are arranged is important

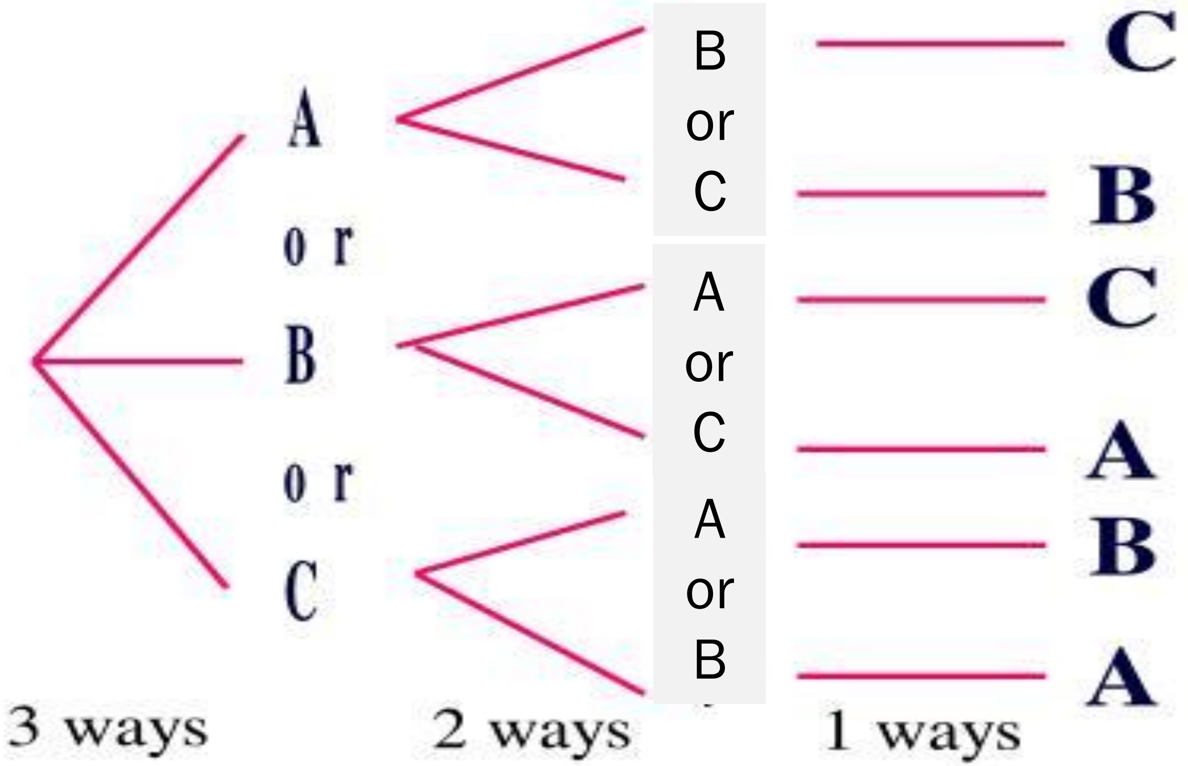
For example ,

- ab and ba are considered 2 different two - element permutations.
- abc and cba are 2 distinct three - element permutations
- abcd and cbad are 2 different four - element permutations.
- There are six different arrangements of ABC ; ABC, ACB, BAC, BCA, CAB & CBA

Permutation of n different objects

We will now consider the method for finding a number of permutations on the letters A, B and C using the multiplication principle. How many arrangements of the letters A, B and C are there?





Having chosen the first two letters,

there is only 1 choice for the third letter.

so, there are $3 \times 2 \times 1 =$ 6 ways of arranging A, B and C.

Any arrangement of n distinct objects taken r at a time $r \leq n$ is called r-permutation. The number of permutations of n distinct objects taken r at a time is given by

For example, there 12 permutations for the letters A, B, C and D taken 2 at a time.

There are ; AB BA CA DA

AC BC CB DB

AD BD CD DC

The number of permutations of r objects chosen from a set of n different objects is denoted by,

$$\boxed{{}^{n}P_{r} = \frac{n!}{(n-r)!}}$$

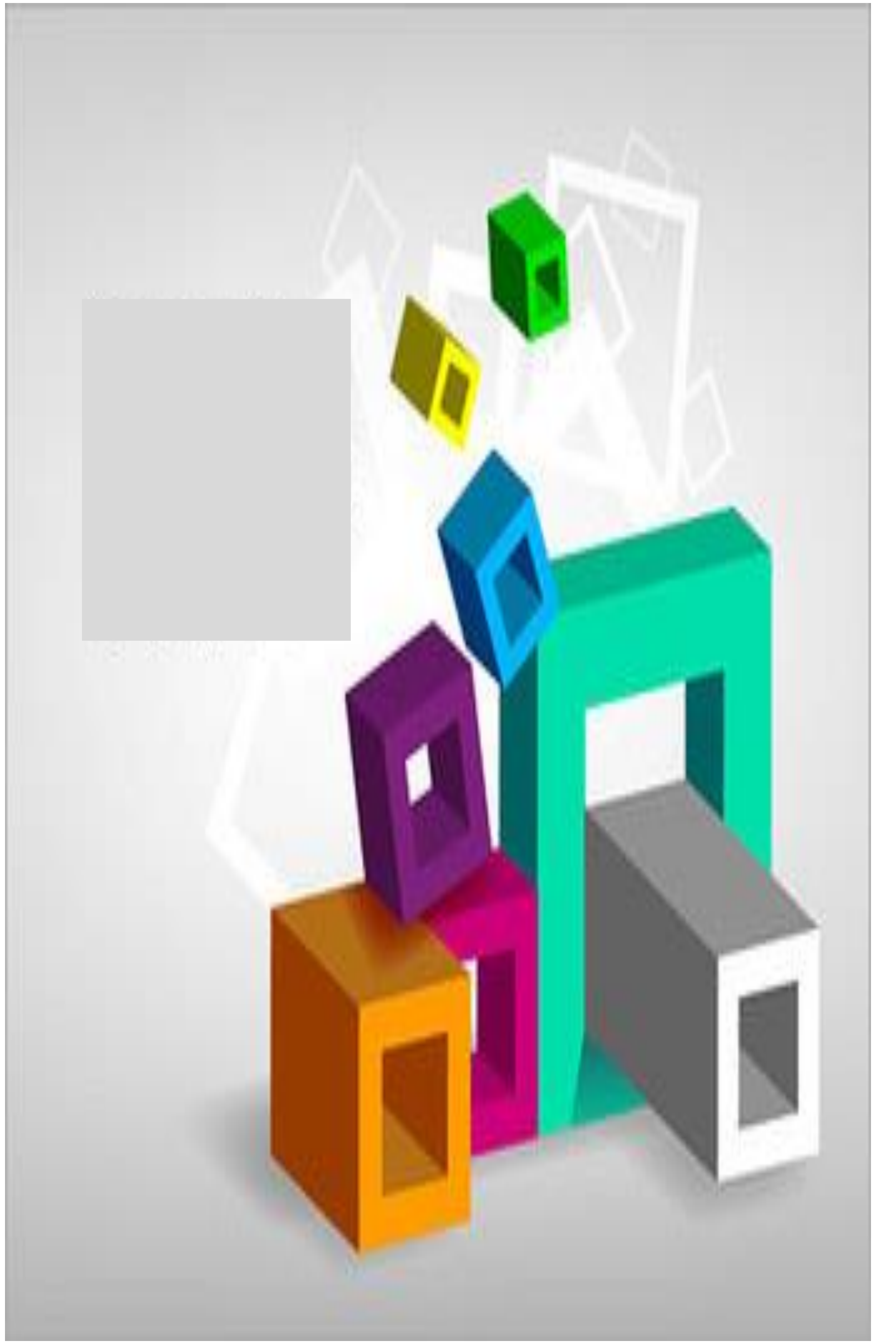
The no of permutations of 4 objects taken two at a time

$n = 4 \quad r = 2$

$$\therefore {}^{n}P_{r} = {}^{4}P_{2} = \frac{4!}{(4-2)!} = \frac{4!}{2!} = \frac{4\times3\times\cancel{2\times1}}{\cancel{2\times1}} = 12$$

OR $\boxed{4 \times 3}$

$$\therefore 4\times3=12$$



Permutation with Repetitions: If out of n objects in a set, p objects are exactly alike of one kind, q objects exactly alike of second kind and r objects exactly alike of third kind and the remaining objects are all different then the number of permutations of n objects taken all at a time is

$$\frac{n!}{p!\,q!\,r!}$$

Example

Find number of permutations of word ALLAHABAD.

Here total number of word **(n) = 9**
Number of repeated A's **(p_1)= 4**
Number of repeated L's **(p_2)= 2**
Rest all letters are different.

Thus applying theorem 3, we have:

$$\boxed{\frac{n!}{p_1!p_2!} = \frac{9!}{4!2!} = 7560\ ways}$$

Example

In how many ways can 4 red, 3 yellow and 2 green discs be arranged in a row if the discs of the same color are indistinguishable ?

Sol: Total number of discs are 4 + 3 + 2 = 9. Out of 9 discs, 4 are of the first kind (red), 3 are of the second kind (yellow) and 2 are of the third kind (green).
Thus number of permutation is:

$$\boxed{\frac{9!}{4!3!2!} = 1260}$$

Example

Find the number of arrangements of the letters of the word INDEPENDENCE. In how many of these arrangements,

(i) do the words start with P

(ii) do all the vowels always occur together

(iii) do the vowels never occur together

(iv) do the words begin with I and end in P?

(v) Repeat part (iv) with I and P interchangeable.

Solution

There are 12 letters, of which N appears 3 times, E appears 4 times and D appears 2 times and the rest are all different. Therefore The required number of arrangements:

$$\frac{12!}{4!3!2!} = 1663200$$

(i) Let us fix P at the extreme left position, we, then, count the arrangements of the

remaining 11 letters. Therefore, the required number of words starting with P are

$$\frac{11!}{4!3!2!} = 138600$$

(ii)

There are 5 vowels in the given word, which are 4 Es and 1 I. Since, they have to always occur together, we treat them as a single object EEEEI for the time being. This single object together with 7 remaining objects will account for 8 objects. These 8 objects, in which there are 3Ns and 2 Ds, can be rearranged in

$$\frac{8!}{3!2!} \text{ ways}$$

Corresponding to each of these arrangements, the 5 vowels E, E, E, E and I can be rearranged in

$$\frac{5!}{4!}$$

ways. Therefore, by multiplication principle the required number of arrangements

$$\frac{8!}{3!2!} \times \frac{5!}{4!} = 16800$$

(iii) The required number of arrangements = the total number of arrangements (without any restriction) – the number of arrangements where all the vowels occur together.

$$= 1663200 - 16800 = 1646400$$

(iv) Let us fix I and P at the extreme ends (I at the left end and P at the right end). We are left with 10 letters. Hence, the required number of arrangements

$$\frac{10!}{4!3!2!} = 12600$$

(v) Repeat same parts as part (iv)
As I and P are interchangable they can furthur be arranged in 2! ways.

Thus 12600 X 2! = 25200 ways


thank you!