INTRODUCTION

TO

COMBINATORICS IN SCHEDULING

COMBINATORICS:

**Combinatorics** is the study of discrete structures broadly speaking. Most notably, combinatorics involves studying the enumeration (counting) of said structures. For example, the number of three-cycles in a given graph is a combinatorial problem, as is the derivation of a non-recursive formula for the Fibonacci numbers, and so too methods of solving the Rubic’s cube. Mathematicians who spend their careers studying combinatorics are known as combinatorialists.

Combinatorial problems often make up a good portion of problems found in mathematics competitions and can be approached by a variety of techniques, such as generating functions or the principle of inclusion-exclusion. Combinatorics also has many applications outside of pure mathematics, notably in theoretical computer sciences, statistics, and various fields of science.

ROLES:

Combinatorics plays a crucial role in scheduling, offering mathematical techniques for arranging and selecting resources, time slots, or events in various ways. Since scheduling often involves managing limited resources (like time, workers, or machines) across competing demands, combinatorial methods provide a framework to explore possible arrangements, optimize resource usage, and make scheduling decisions efficiently.

IMPORTANCE OF SCHEDULING:

**Scheduling** problems arise in almost all areas of human activity. The Viking mission to Mars called for coordinating the activities of more than 20.000 people. Meeting the daily manufacturing quota in an automobile plant can depend on the precise allocation of manpower and tools. Even the preparation of a multicourse dinner can present a nontrivial scheduling problem. It might appear that there are natural algorithms or step-by-step procedures for constructing highly efficient schedules. That, however, is not the case. Apparently logical ways of constructing schedules cannot be counted on to perform equally well in different situations. For example: in some instances, increasing the number of workers on a job can actually increase the time required to meet a schedule. Some of the commonest and most intuitive scheduling procedures can give rise to unexpected and even seemingly paradoxical results.

SCHEDULING MODEL:

A SCHEDULING MODEL isolates the essential elements of real scheduling situations. It can be used to study the behavior of algorithms, or step-by-step procedures, for constructing efficient schedules. The basic scheduling model consists of a set of identical processors and a set of tasks to be performed by the processors according to certain rules. With each task T there is associated an execution timer(T), equal to the amount of time required to execute T.

The processors of the model could be typists working for a company and the tasks could be a set of reports to be typed. Although the company president's report might be at the head of the priority list, his report would probably depend on the results of subordinates' reports, that is, those reports would be predecessors of the president’s. The processors of the model could also represent minicomputers in a multiprocessing computer system that is executing the various sub routines of a complex program. Although the model is rather simple. it does have sufficient structure to exhibit almost the full range of difficulties encountered in general combinatorial scheduling problems.

OPTIMUM SCHEDULING:

A SCHEDULE IS OPTIMUM for a particular set of tasks if its finishing time is the shortest that can be achieved by any rearrangement of the priority list for the tasks.