PREFACE

Mechanisms have fascinated mankind throughout recorded history. Search is still on to list all different mechanisms that can be generated or assimilated. Newer designs are bound to develop and the most promising can be selected in the light of requirements and constraints. Of course, the design concept is a skeleton. Compatibility with interfacing system is essential i.e. we must fill in the blanks with concrete parameters with the use of a systematic design method guided by intuition. Even the simplest physical system or component is usually too complex for direct analysis. A model amenable to analytic, or empirical evaluation must represent it.

Since linkages make simple mechanisms and can be designed to perform complex tasks such as non-linear motion and force transmission. Therefore over the past several years much work has been reported in the literature on the structural synthesis and analysis of mechanisms, so that some unknown mechanisms may be identified. Kinematic synthesis of mechanisms is often stated as having three divisions. First: "type synthesis", i.e. what do we need - gears, cams, linkages or what combination of them? Second:"number synthesis" – i.e., how many links and joints and in what schematic pattern? Third: "dimensional synthesis" – i.e., what must be the essential dimensions of the entire mechanism if it is to perform the desired function? Kinematic analysis ranges from the orderly classification system, to studies of mechanism mobility. The complexity of analysis appears to increase exponentially with number of links, and by specialization of proportions it yields countless mechanisms.

The scan on literature on the method of synthesis and analysis points out following objectives,

- Must generate all chains of a given category
- Ratio of total number of chains generated to the number of distinct chains must be low
- Should aid in elimination of degenerate chains and structures
- Should facilitate synthesis of a chain with different types of joints

- Should aid the process of structural analysis of chains
- Sketching of the chain should be simple
- Should be able to predict performance of kinematic chain in terms of structural error
- Should be completely implemented on computer
- Must derive all possible mechanisms and driving mechanisms

A unified methodology for structural synthesis and analysis is presented to overcome the shortcomings cited in the literature. To make the work more meaningful a scheme is developed for rating of chains in terms of structural error performance without carrying out the dimensional synthesis Further, for authenticity, the results obtained are verified by direct analytic dimensional synthesis. The subject matter is presented in six chapters.

In Chapter2, a methodology for computerized structural synthesis based on Hamming number technique [26] is formulated and illustrated stepwise taking simple examples. The procedure is implemented to generate catalogue of simple jointed kinematic chains up to 13 links 1-d.o.f.

In chapters 3 & 4 formulation of methodology for computerized structural analysis based on "Further application of Hamming number technique [35] is presented. It is implemented on simple jointed kinematic chain synthesized in chapter-2. Analysis up to 12link, 2-d.o.f is listed.

To make the work in chapters 2, 3 and 4 more meaningful a computerized methodology is formulated in chapter 5 so that performance of the synthesized chain can be predicted in terms of structural error without carrying out the dimensional synthesis and with the same generated data. The scheme formulated is based on topology of chain and uniformity of link deployment (symmetry).

In chapter-6, the optimal dimensions of two six-bar chain (Watt-II and Stephenson-III) for same function and range is obtained. By using synthesized link dimensions for a given function, angle constant and precision point angles the error is calculated i.e., structural error of two chains are evaluated based on dimensional synthesis and their performance is predicted. The one having less structural error is superior chain. This justifies

the order of rating obtained using concept of symmetry where symmetry is linked to uniform deployment of links. The uniformity of link deployment can be decided by squaring and summing up of the primary Hamming elements, lower the sum greater is the symmetry and better is the performance of the chain.