CHAPTER-IV

SUMMARY AND CONCLUSIONS

In the midst of proliferating semiconductor devices the transformer and such other basic devices have long since lost their fascination. The present technology is still based on the successful exploitation of transformer-perhaps the most eloquent application of the induction principle. The fact is that even today no space vehicle can yet be designed without transformers, nor, for that matter, can a radio or telephone.

The high cost of transformer is due to the impracticability of standardization, materials needed, and the processes inherent in their manufacture. The problem associated with the use of transformer can be minimized by the employment of "astute" application practices. Morever as electrical circuits and electronic systems have become more complex, the design of the transformer has necessarily become a more difficult and "subtle" art.

The indispensable component of electronic circuits-the transformer entered the commercial and governmental market areas, whereas the earlier practical transformer went principally to the industrial market area. Apart from the technical considerations, each of these market areas

size, and these requirements affect profoundly the design and development of electronic transformers.

The present work is intended essentially to facilitate and speed-up the transformer design process with the aid of computer. The knowledge of operational theory of transformer is presumed.

The **chapter-I** begins with the mention of names behind the pioneering work in the field of electromagnetism, who laid down the foundation for todays wonderful land of electricity and electronic. It further describes the story that when transformer came into existence, and how it was shaped and framed for the practical use. It also highlights the economic advantages of use of transformer in the power distribution being among the most efficient devices. The need of transformer and the applications have been briefly mentioned. The chapter classifies and subclassifies the various transformers on the basis of different features. It further takes a short account of '**Transformers in Electronic Industry**', and stresses the need for 'miniaturization',demanding for newer technique of transformer designing. In the 'proposed plan of work' a review of the problems that a designer face in the course of design is made. The moderr transformer designer must possess a w ealth of information and powerful mathematical

techniques. For a practical transformer designer there is need to know more about state and limit of art of transformer design. In the world of computers the designing of transformers on computer may not be surprising. However, the formulation of transformer design (System analysis) carried out by someone who is familiar with the technical problems involved is one of the major difficulties. This is where lot of time has been spent, and out of many transformers, few have been undertaken for the design on the computer, which are common in electronic circuits. The software is developed in **BASIC** being easy and widely available with sufficient facilities both in text and graphic.

The next step towards computer aided transformer design is to interpret the system analysis into a form which is suitable for the computer being used. The **chapter II** has been fully devoted to the design algorithm along simple mathematical lines. The common user is not obliged to take part in the mathematical excursion, and what counts for him are the final results. The transformer design has to have certain information before a design can be created. This include the items like primary and secondary voltages, currents, frequency, temperature rise etc. These come under customer's specification. The next are the designer's specification which includes the items like type of winding

design, type and grade of core and winding conductors, flux and current densities, insulation, temperature gradient in the winding etc. The designer employ due steps to decide and select the core size from the standard table. A structure of winding and insulation is then built up by using standard tables and standard insulation clearance depending upon the test voltage conditions. Once this general arrangement has been established, the various inherent characteristics such as copper loss, iron loss, resistance and temperature rise are calculated and compared with desired results. A process of modification by trial and error is then applied, which could change winding proportion or even core size. This trial and error technique is influenced by the designer's experience and intuition to ignore the things which are obviously wrong. The power transformer being the most common type of transformer the design-algorithm for it has been streamlined in detail. In case of other transformers their design procedure have been illustrated in light of typical applications in electronic circuits. The treatment of pulse transformer is given independently. The design of all the transformer goes all around the standard EI-stampings as a 'core', except for the pulse transformer, where standard grade ferrite pot cores have been suggested.

Final stage is to transcribe the design steps into computer language-called programming. This is a "skilled

art" since one must formulate the problem accurately, explicitly and unambiguously. The 'BASIC' being remarkable simple language contains enough power and versatility, is used for coding the design steps for the computer to understand. The **chapter III** describes the software developed. The purpose of software developed is two fold : to study the designing process in general and develop the computer routine in particular with logical approach. Before the computer programmer can start to code the instructions, the complete method of approach has first to be expressed in detail starting with logical sequence to be carried out as done in preceeding chapter. This certainly involves many logical decisions, together with necessary boundary limitations to ensure convergence to the desired results. The flow charts drawn show the method of approach in the pictorial form. The software consists mainly of two modules : 'TITLE' and 'DESIGN'. First module introduces the software package to the user. It displays various 'titles' on graphic background created through line and circle functions. It contains 'Log-In', 'How to use package' instructions, 'The system of units' used, simple 'Subroutines' for 'Sound and Beep', 'To continue' are included. The program at the end load and runs the file containing module : 'Design'. The second module is the 'master-program' supported by various subroutines. The master program is the control program that

governs the whole design process of design and determines how various subroutines are self contained programs intended to perform the specific task. The transformers undertaken for design are displayed in the 'transformer menu'. The user can pick up the transformer of interest and go all along the design process till the satisfactory results are obtained. The database is mainly in the form of sequential data files, besides the tables displayed at appropriate junctures. The 'Design out of Range' message is displayed when the specification go beyond the limiting conditions set inside the program.

CONCLUSIONS

The transformer design involves large number of mathematical equations intertwined with iterative processes. The computer is exceptionally fast and hence economical when solving the mathematical equations, where large iterative process are reduced to a minimum. That is the beauty to use computer for transformer design. This ofcourse involves many logical decisions, together with the necessary boundary conditions to ensure convergence to the desired results.

With the aid of a large computer it would be possible to set a ranges of losses and to let the computer only printout the overall minimum cost design. If the computer is also allowed to print out other computed designs, this would

avoid losing them and would provide additional results that could be useful for further reference.

The advantage of using computer for transformer design are obvious. Several designs can be provided for one inquiry in order to arrive at, the most economical solution. Tables can be made up, which shows the change in cost for variation in loss for a given rated power and voltage. The design can be modified quickly if do not meet the specification. When the several designs are required in short time, the computer is the only method of providing the necessary information accurately. It gives the designer more time to read the specification and to ensure that all the requirements have been taken into account.

However there are limitations in using computer for transformer design. The computer cannot read the specification and therefore dependent upon the designer to input the correct information for the design. The designer decides upon the general configuration of the transformer. A computer does not have intuition and therefore confuse in ambiguous situation. This part of the design is the most difficult to overcome. It all depends upon the programmer's skill to develop the software in this direction.

The number of ways, in which the problem of transformer design can be solved by a computer are virtually unlimited.

The method evolved is dependent upon which parameter of design is considered to be the most important : whether it is the losses, size and weight, cost and the like.

One of the simplest approaches is to store in a sorted order, all the design records of units which have been completed. The computer can use this information as a starting point to meet the requirements for the design in question.

If the approach is to be more fundamental without relying on previous design experience, the empirical relationships between the major parameters must be found, and programmed for a computer to give out the convergent results.

There are numerous ways in which the computer can be employed. The question is to whether a particular routine should be programmed is an economical one. Before the cost of running the program is compared with cost of the hand method, the usage should be evaluated against the cost of writing and testing the program.

In any case, the software-routine developed is going to be a very handy tool and a launching-point towards the better and economical transformer designing, not only to an 'Expert' in the field, but even to the common user who has passing interest without much knowledge of transformer designing.

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