PREFACE

Machine failure has direct product-quality implications and may cause loss of throughput resulting into significant financial losses. Therefore to improve productivity and cost effectiveness, it may become necessary to develop intelligent systems that will offer accurate and reliable fault detection, diagnosis and prediction followed by suggestions of preventive actions especially for delicate modern machinery. Fault Detection and Diagnosis (FDD) has its own significance in Engineering Systems, and deserve further attention in view of the rising complexity and enhanced quality performance of modern machinery. For fairly simple systems, simple sensing or observation and one's intuition usually provide sufficient diagnosis of a faulty condition rather quickly.

The appropriate fault diagnosis becomes subtle task with traditional methods. This is because the modern machineries involve with advanced technologies and their hardware and software architectures tend to be very complex. Fuzzy logic provides a method of reducing and explaining system complexity. It deals with system uncertainties and ambiguities in a way that mimics the human reasoning. Fuzzy logic allows the membership of a variable within a group to be estimated with a prescribed degree of uncertainty. In this way, the application of Fuzzy logic to machinery fault diagnosis naturally allow the membership of dynamic signal frequency spectra from an unknown source to be determined with respect to a set of spectra representing particular faults. Using fuzzy membership functions that are similar in shape to the distribution of data within the dynamic signal would be relatively easy to implement. This would electively customize the procedure for use in a wide variety of fault diagnostic approaches and thereby greatly enhance the overall quality maintenance performance of system.

The task of fault diagnosis in Textile Industry can be formulated as ‘combinational multiple objective- multistage process problem’ associated with constraints and heterogeneous data. This gives rise to legion of diagnosis
algorithms leading to no universally accepted optimal solution. In practice, however Fuzzy logic approach is proven to be promising in finding compromised solutions in different applications.

The entire research work has been centered on the exploiting the Fuzzy Logic based modus operandi as a machinery fault diagnostic technique. Its ability to classify and identify machinery faults demonstrated the considerable potential in employing the Fuzzy Logic in Fault Detection followed by its Diagnosis in the Textile Industry. An attempt has been made to comprehend the procedure for arriving at this objective. The optimum limits were found manually in this study, but this process could also be automated easily. Using fuzzy membership functions that are similar in shape to the distribution of data within the dynamic signal would be relatively easy to implement. This has been effectively customized to exploit in a wide variety of applications and thereby greatly enhance the overall performance of system approach and Textile Industrial Field is not an exception.

The entire research work is presented in the thesis in five chapters. **Chapter 1** highlights the introduction to the different types of faults in the industries in general sense and Textile Industry in particular. It also includes the survey of different industries studied according maintenance cost and different categories of faults like mechanical, electrical and electronics hardware faults. It introduces Fuzzy logic as a powerful tool for reducing fault diagnosis system complexity. Literature survey includes the literature on past research on fault and fault detection, machinery fault diagnosis, condition monitoring, reliability, maintenance, artificial intelligence and fuzzy techniques.

**Chapter 2** gives the brief outline of the different machines used in Textile Industry. It describes the basics of manufacturing processes carried out in the weaving and spinning sections. It focuses on the different fault collection and diagnosis models and methodologies along with the machine maintenance methods. The chapter concludes with the description of sensing technologies those can be explored in fault collection process.
The fuzzy inference system and fuzzy modeling of the different fault collection and diagnosis systems are incorporated in **Chapter 3**. It gives the details of the FIS design of the motor fault determination, oil tank determination, machine environment condition determination and emergency fault determination. It includes the design of simulation models useful for the understanding of the system.

**Chapter 4** depicts the details of the hardware design of the fault collection units. It explains the aspects of fault collection subsystems like sensor selection, signal conditioning units, methods useful for machine parameter data collection and the design of central unit. It also specifies the software algorithms to identify the fault condition and to provide the remedial solution. The MATLAB based GUI for ease of an operator is also included in this chapter.

The conclusive **Chapter 5** gives the summery of the entire research work done and the discussions on the simulation results obtained from the designed FIS and fuzzy models. The real time data results are also incorporated in this chapter. The final part of the chapter covers the convincing outcomes of the work done along with the future work that can be carried out in upcoming years.

References made in the form of Books, Research papers and Research articles have been cited at the end followed by the appendix of MATLAB sample coding.