CERTIFICATE

This is to certify that the dissertation entitled **"Development of a probabilistic damage accumulation model for reliability prediction"** being submitted by Gaurav Kumar (2013PIE5108) is a bonafied work carried out by him under my supervision and guidance, and hence approved for submission to the **Department of Mechanical Engineering, Malaviya National Institute of Technology Jaipur** in fulfillment of the requirements for the award of the degree of **Master of Technology (M.Tech.)** in **Industrial Engineering**. The matter embodied in this dissertation report has not been submitted anywhere else for award of any other degree or diploma.

Prof. Rakesh Jain
Professor,
Department of Mechanical Engineering,
MNIT Jaipur
Place: Jaipur
Dated: June 2015

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
JAIPUR – 302017 (RAJASTHAN), INDIA

CANDIDATE'S DECLARATION

I hereby declare that the work which is being presented in this dissertation entitled **"Development of a probabilistic damage accumulation model for reliability prediction"** in partial fulfilment of the requirements for the award of the degree of **Master of Technology (M.Tech.)** in **Industrial Engineering**, and submitted to the **Department of Mechanical Engineering, Malaviya National Institute of Technology Jaipur** is an authentic record of my own work carried out by me during a period of one year from July 2014 to June 2015 under the guidance and supervision of **Prof. Rakesh Jain** of the Department of Mechanical Engineering, Malaviya National Institute of Technology Jaipur.

The matter presented in this dissertation embodies the results of my own work and has not been submitted anywhere else for award of any other degree or diploma.

Gaurav Kumar
(2013PIE5108)

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Prof. Rakesh Jain
Supervisor

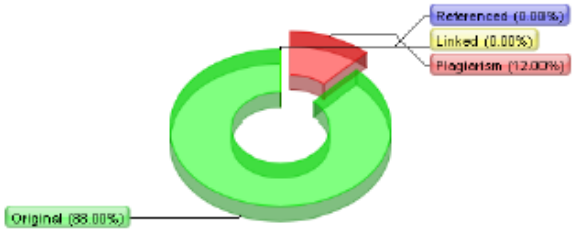
Place: Jaipur
Dated: June 2014

PLAGIARISM REPORT

Originality report details:	
Generation Time and Date:	6/13/2015 8:35:34 PM
Document Name:	my project report.docx
Document Location:	C:\Users\sonu\Desktop\my project report.docx
Document Words Count:	16744

Important Hint: to understand what exactly is meant by any report value - you can click "Help Image" . It will navigate you to the most detailed explanation at our web site.

Plagiarism Detection Chart:



Referenced 0% / Linked 0%

Original - 88% / 12% - Plagiarism

ACKNOWLEDGEMENTS

With great delight, I acknowledge my indebted thanks to my guide and mentor **Prof. Rakesh Jain** who has always been a source of inspiration and encouragement for me. His stimulated guidance and unwavering support always motivated me to reach out for, and achieve higher levels of excellence. This dissertation could not have attained its present form, both in content and presentation without his active interest, direction and help. I am grateful to him for keeping trust in me in all circumstances. I thank him for being big-hearted with any amateurish mistakes of mine.

I express my sincere gratitude to **Prof. A.P.S Rathore, Prof. Gopal Agrawal, Prof. G.S. Dangayach, Prof. Awadhesh Bhardwaj, Dr. M.L. Mittal** and **Dr. M.L. Meena and Dr. Gunjan Soni** for their support and guidance throughout the course of study at MNIT Jaipur.

I highly acknowledge and duly appreciate the support extended by my seniors, colleagues-friends and juniors at various industries for assistance with the collection of data for my research work..

I am thankful to my senior research scholars at MNIT Jaipur for their support and guidance. I extend my heartiest thanks to my colleagues-friends for their help & support in accomplishment of this work during my stay at MNIT Jaipur.

Final thanks go to almighty God, my parents **Sh. Virendra Kumar** and **Smt. Usha Devi**, for their continuous support, encouragement and blessings.

- Gaurav Kumar

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

In today's world scenario, systems are too complex having a number of components. Due to this complexity increases, so new failure mode of any system, subsystem, component increasing, fastly. The increasing of high reliability of any system is become a challenge. Reliability assessment using degradation data has become a significant approach to evaluate the reliability and safety of critical systems. Different method for reliability prediction has been emerged with the passage of time.

Physics of failure define the different models for capturing the reliability of any component. Damage accumulation is widely acceptable model throughout the world for prediction of reliability. Different factors have been involved in it with the time. This thesis considered a very important factor like load sequencing and load interaction for capturing the fatigue life of any component subjected to variable loading condition.

Many structures are subjected to variable amplitude loading in engineering practice. The foundation of fatigue life prediction under variable amplitude loading is how to deal with the fatigue damage accumulation.

Combining a nonlinear damage accumulation model (Using Weibull distribution model), a probabilistic *S-N* curve and one-to-one probability density functions transformation technique, a general probabilistic methodology for modeling damage accumulation is developed to analyze the fatigue reliability in this thesis. The damage accumulation is characterized as a distribution in a general degradation path, which captures a nonlinear damage accumulation phenomenon under the single and multi-level loading conditions, its mean and variability change with the time. Here damage accumulation is considered with the load sequencing and load interaction effects Experimental data of 45 steels used in the railway vehicle are then used to validate the proposed methodology. The fatigue reliability is analyzed and demonstrated using probabilistic model of cumulative fatigue damage**.**

Proposed model in the present thesis is the generalized model for all other distribution and can be widely used in many situations for fatigue life prediction.