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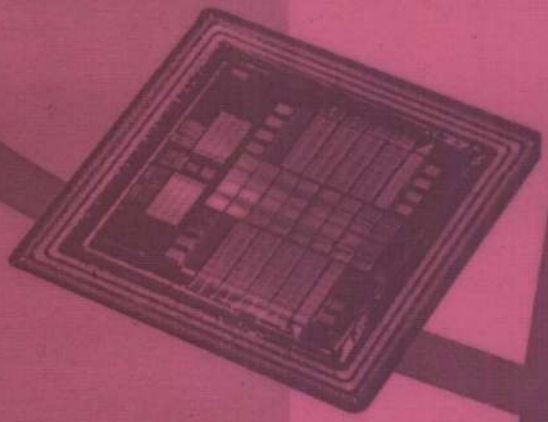

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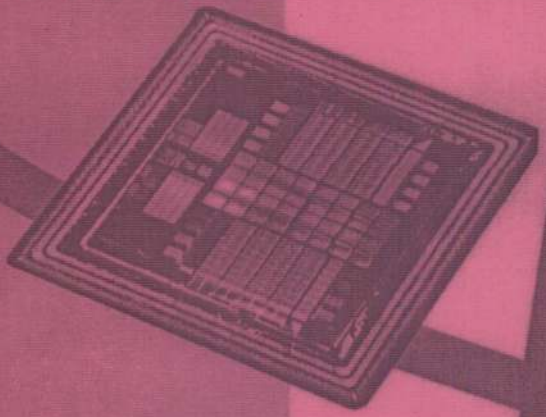

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We feel that the contents of the book may also be of some value to practising designers in systematizing the practices which they may already be following.

We wish to express our sincerest appreciation to Dr. Santosh Gupta who contributed in innumerable ways to the development of this text; to Dr. J.K. Ghelawat and Dr. M. Von Oppen for contributions to Chapters 9 and 13 respectively; to many students and teachers of the course 'Introduction to Design'; and to the Curriculum Development Centre, Quality Improvement Programme, at the Indian Institute of Technology, Kanpur, for providing financial assistance for the preparation of the manuscript.

VIJAY GUPTA
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...upon the restructuring of commerce and management ...my Universities and autonomous colleges, many new ...st areas have recently been introduced. One such broad ...NCIAL SECTOR which comprises of financial markets, ...ions and financial services.

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We are greatly indebted to all our well-wishers for their constant encouragement and valuable suggestions. Our publishers deserve special thanks for their wholehearted support and co-operation in bringing out this edition elegantly and in time.

Critical comments and constructive suggestions for the improvement of this book are most welcome and will be greatly appreciated.

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S. W. Yuan

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θ	Dimensionless parameter
ξ	Average depth of penetration
ΔH_f	Enthalpy of formation
ΔH_R	Enthalpy of combustion
ΔU_R	Internal energy of reaction

Superscript * refers to standard state

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by

Sharma & Chandra Mohan

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మా కన్నతల్లికి మంగళారతులు

Applied Mathematics
by
S. S. Rao

SINGIRESU S. RAO
University of Miami
Coral Gables, FL

1 Introduction to Numerical Methods

1.1 Importance of Numerical Methods in Engineering

CHAPTER CONTENTS

Most engineering analysis problems involve (1) the development of a mathematical model to represent all the important characteristics of the physical system; (2) the derivation of the governing equations of the model by applying physical laws, such as equilibrium equation, Newton's laws of motion, conservation of mass and conservation of energy; (3) solution of the governing equations; and (4) interpretation of the solution. Depending on the system being analyzed and the mathematical model used, the governing equations may be a set of linear or nonlinear algebraic equations, a set of transcendental equations, a set of ordinary or partial differential equations, a set of homogeneous equations leading to an eigenvalue problem, or an equation involving integrals or derivatives. We may or may not be able to find the solution of a governing equation analytically. If the solution can be

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SINGIRESU S. RAO
University of Miami
Coral Gables, FL

Applied Mathematics
M Tech (Thermal power Engg)

1 Introduction to Numerical Methods

1.1 Importance of Numerical Methods in Engineering

CHAPTER CONTENTS

1.1 Importance of Numerical Methods in Engineering
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1.4 Data Representation
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1.6 Errors
1.7 Numerical Methods Considered
1.8 Software for Numerical Analysis
1.9 Use of Software Packages
1.10 Computer Programs

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Thermal Power Engineering
by
Aswatha Narayana P.A. & Seetharama K.N.

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The preparation of this textbook has been possible with support from various quarters. Authors thank the Centre for Continuing Education of Indian Institute of Technology Madras for providing the necessary support and encouragement and also the Educational Technology Cell to have the initial material in the form of video lectures. Dr.B.S.V.Patnaik our former research scholar and presently at NUS, Singapore attended all the video lectures and encouraged us to bring the material in the form of a textbook. We are thankful to him. We thank Prof.R.Natarajan, Chairman, All India Council for Technical Education and formerly Director of Indian Institute of Technology, Madras for providing the Foreword and also the encouragement rendered at IIT Madras. The authors would like to express their gratitude to Mr.N.K.Mehra and Mrs. Anupama Jauhry for their interest in publishing this book. Five chapters have been added to the original draft after the first author joined the School of Mechanical Engineering, University of Science Malaysia (USM). The authors thank Dr. Zainal Alimuddin, the previous Dean and Dr.Zaidi Mohd. Ripin, the Dean of the School of Mechanical Engineering for their encouragement. Authors are thankful to Mr.Vidya Acharyulu who was working with the first author as a Project Assistant at IIT Madras for coordinating the whole work from IIT Madras and USM Engineering Campus. Authors would like to place on record the services of Mrs. Lalitha and Mrs. Godhamani for their help in typing the material, Mr.Jeevanandham of IIT Madras in making the necessary drawings, and Mr. Ooi Chun Keat of USM for his help. Authors are indebted to Mr. Tan Chun Wai and Miss Norasmah Wahab for their enthusiastic help in tying the lose ends in the final stages and also for making the final print out possible at USM.

Suggestions and critical comments are welcome from the readers.

USM Engineering Campus
Nibong Tebal, Penang
Malaysia

P. A. Aswatha Narayana
(paa_iitm@hotmail.com)

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P. A. Aswatha Narayana
(paa_iitm@hotmail.com)

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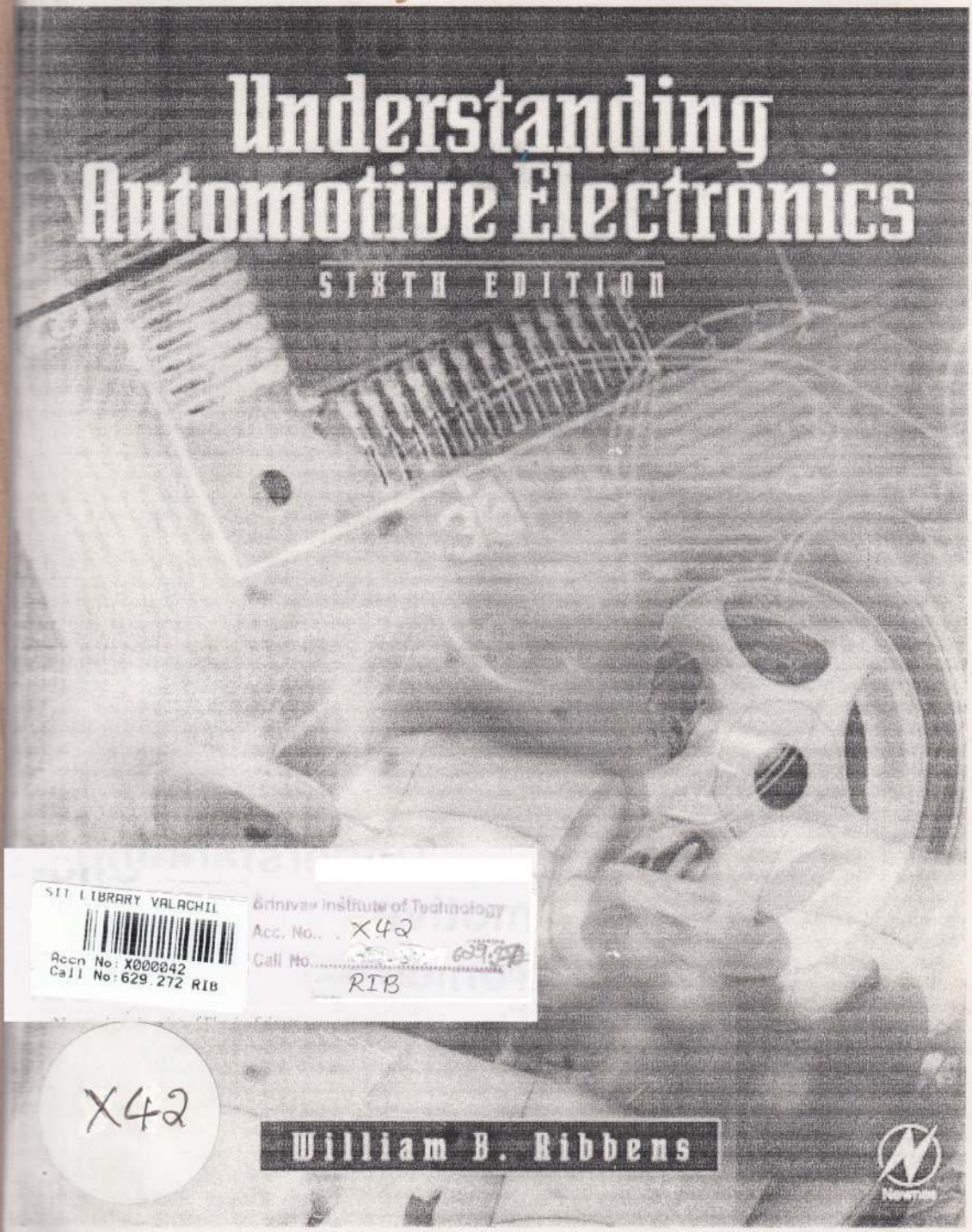

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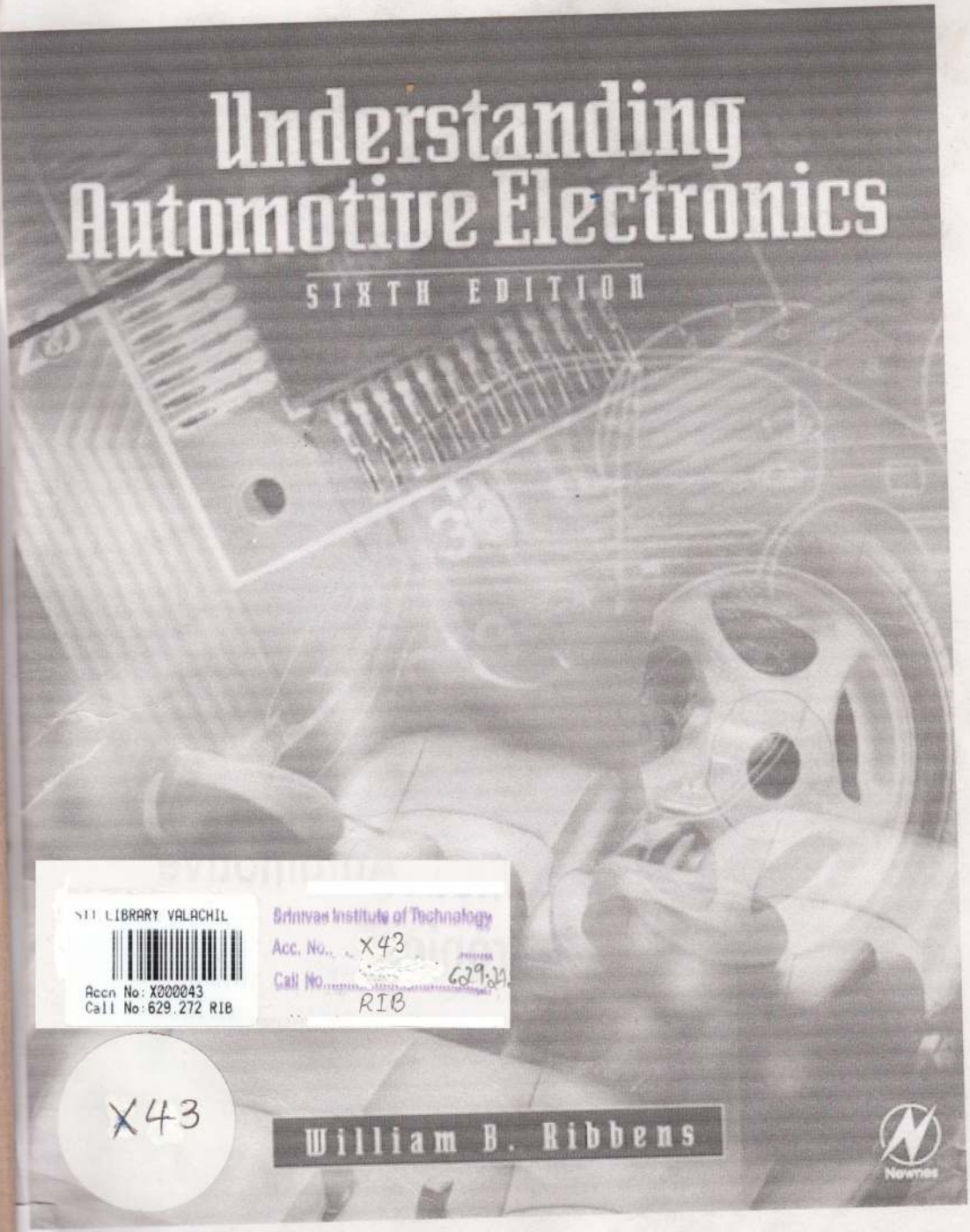

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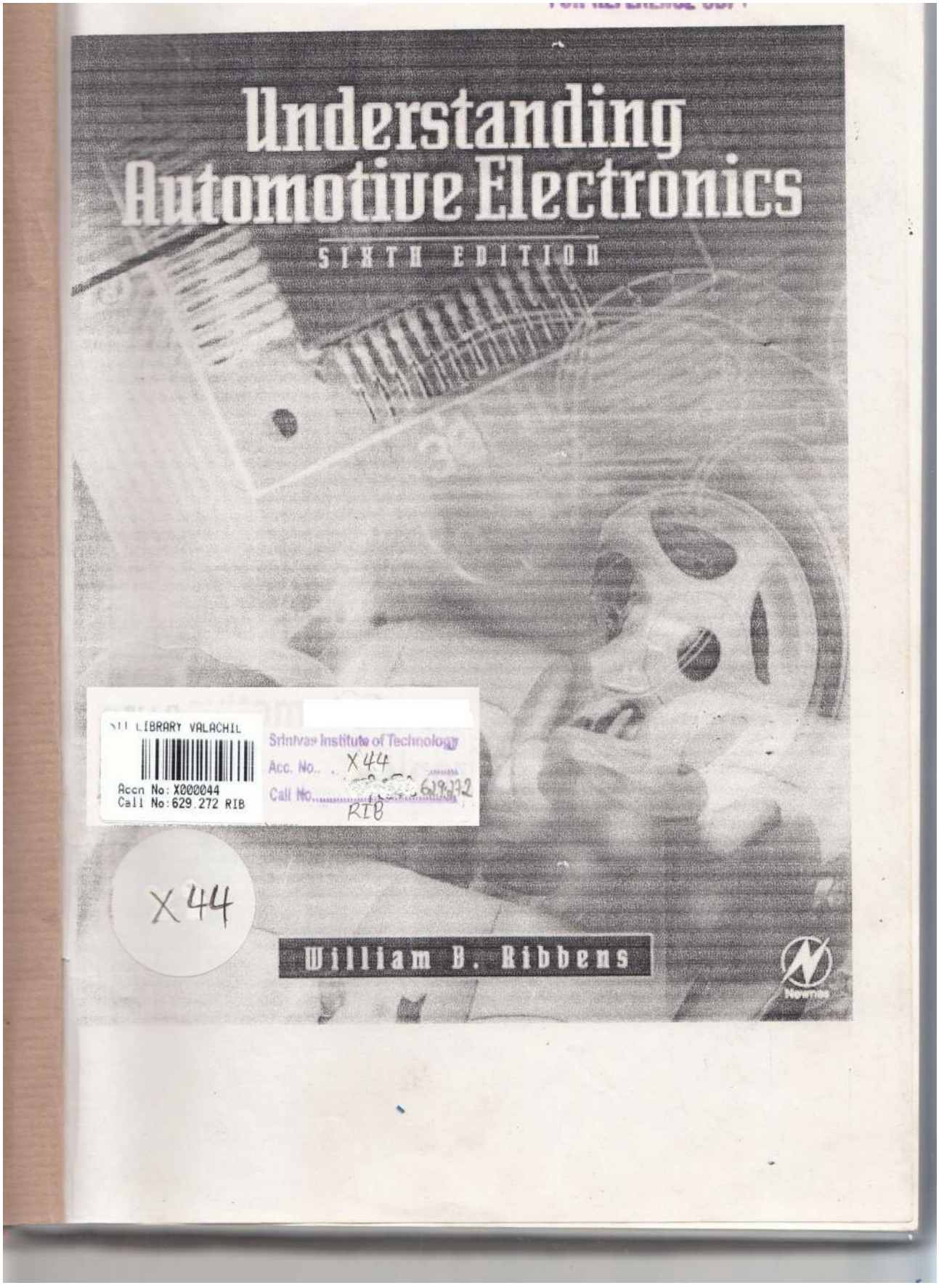

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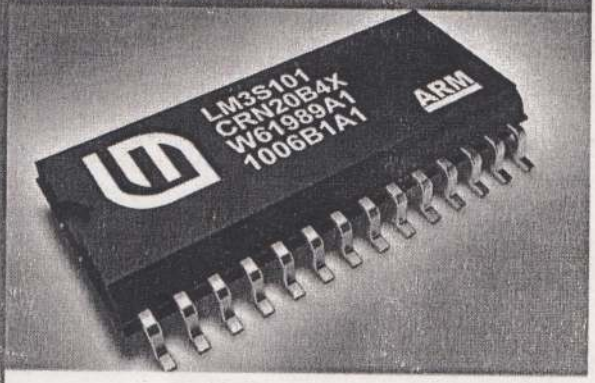

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Heat Transfer
A BASIC APPROACH

M. Necati ÖZIŞIK

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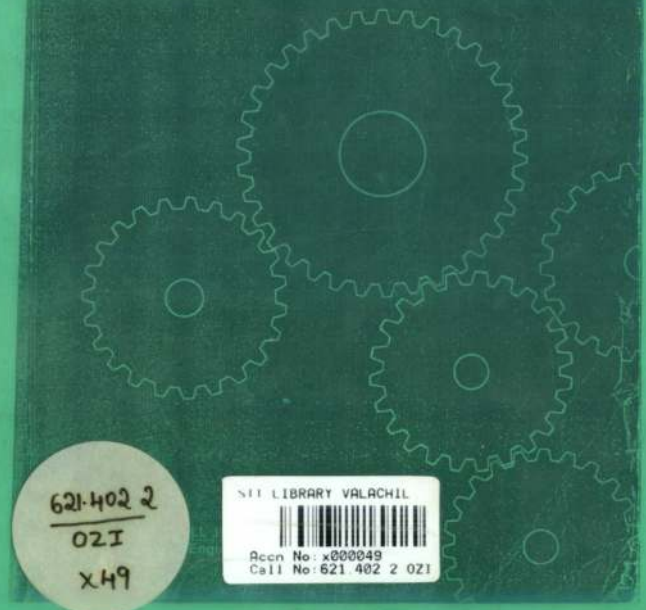

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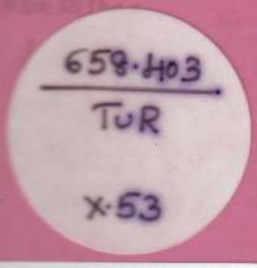

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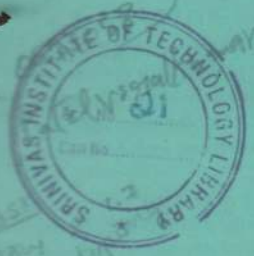

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- The major technologies used are data mining (business intelligence//business analytics) systems to identify profitable customer classes (analysis) and a customer-relationship management (CRM) system to market promotions, monitor sales, and identify problems and new opportunities. The data-mining methods may include regression analysis, neural networks, cluster analysis, and optimization approaches.
- The DSS is used in making a variety of marketing decisions, ranging from determining which customers are most profitable to how to promote the properties to all customers. Promotions can be made on a day-to-day basis.
- Decision support is based on a vast amount of internal and external data.
- The DSS analysis software applications are separate from the transaction processing system (TPS), yet they use much of the TPS data.
- Statistical and other quantitative models are used in the CRM.
- The managers are ultimately responsible for all decisions.

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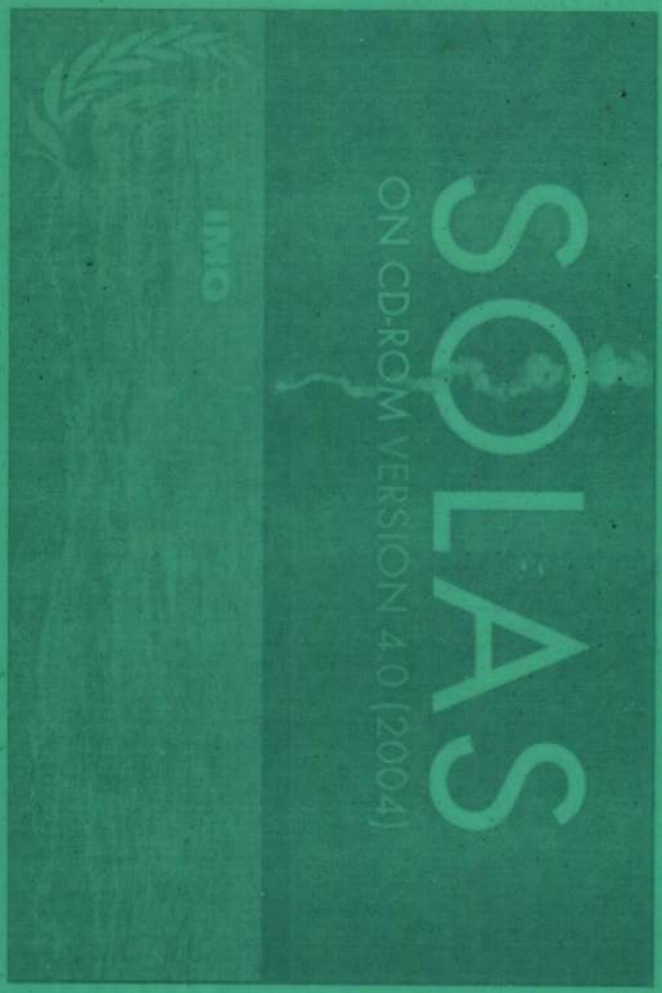

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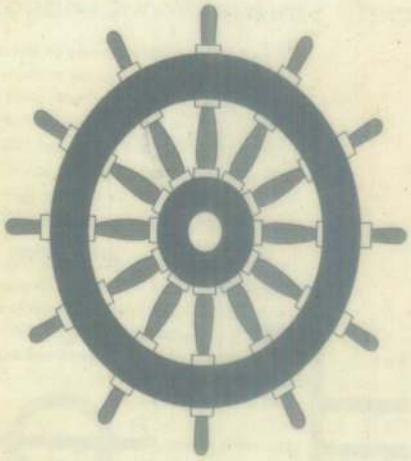

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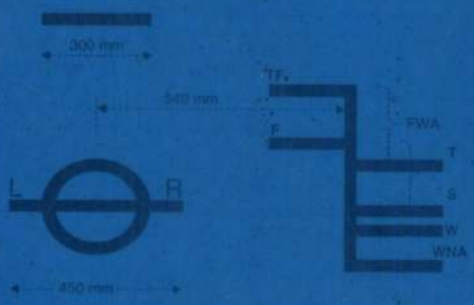

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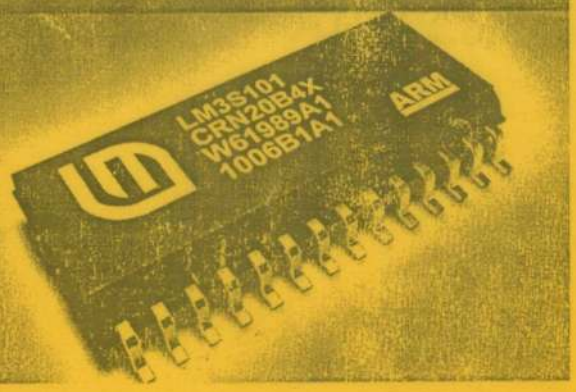

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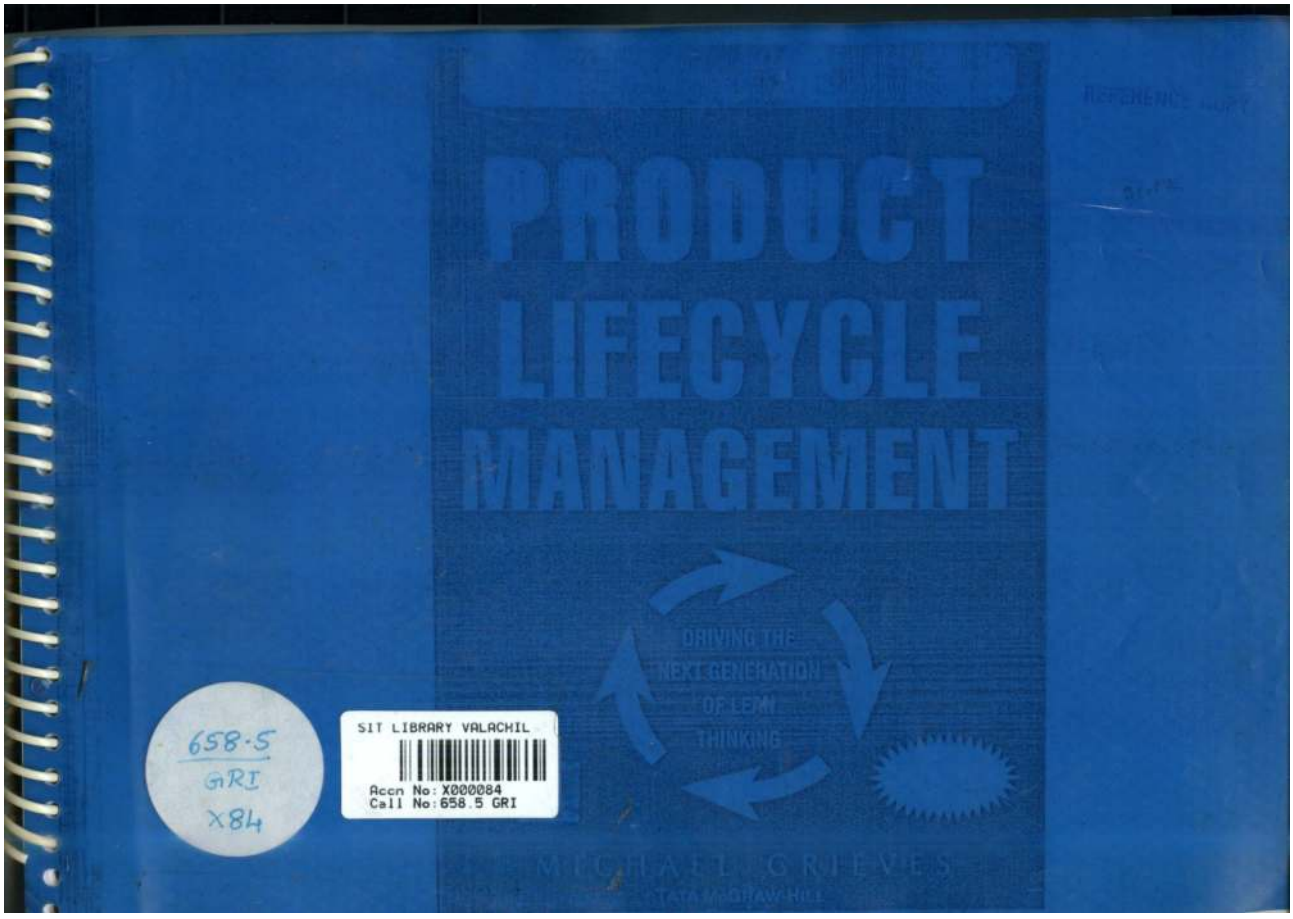

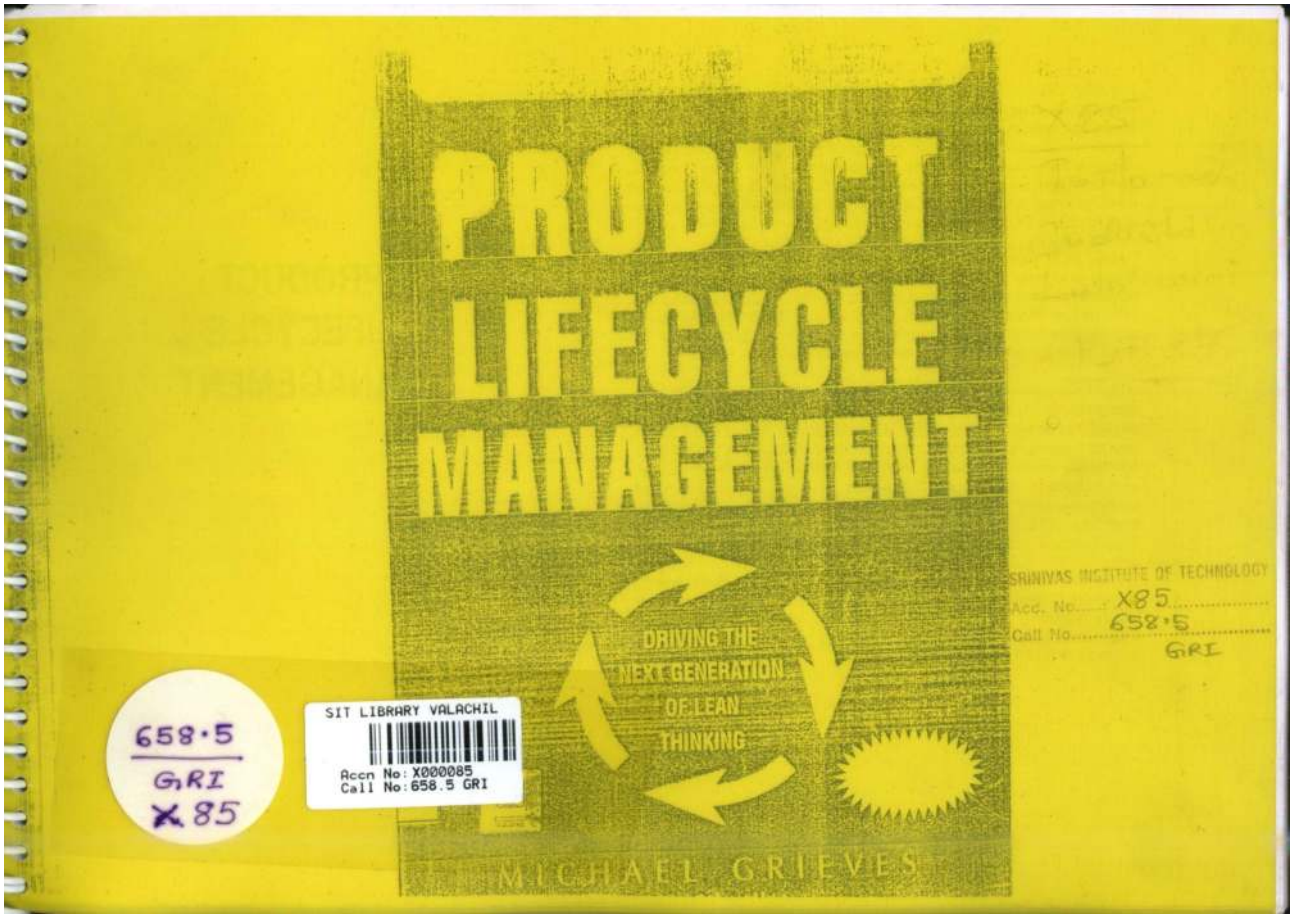

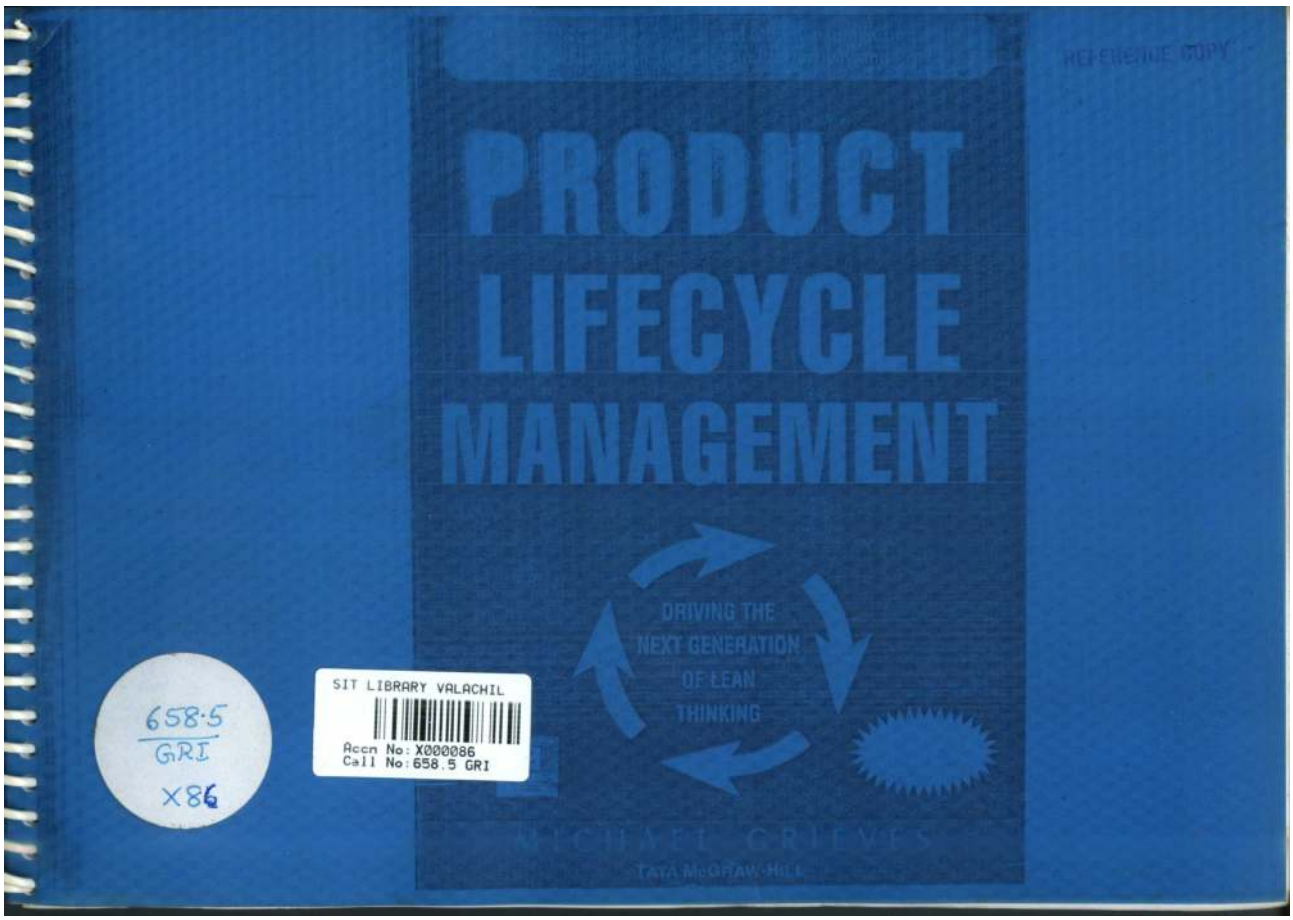

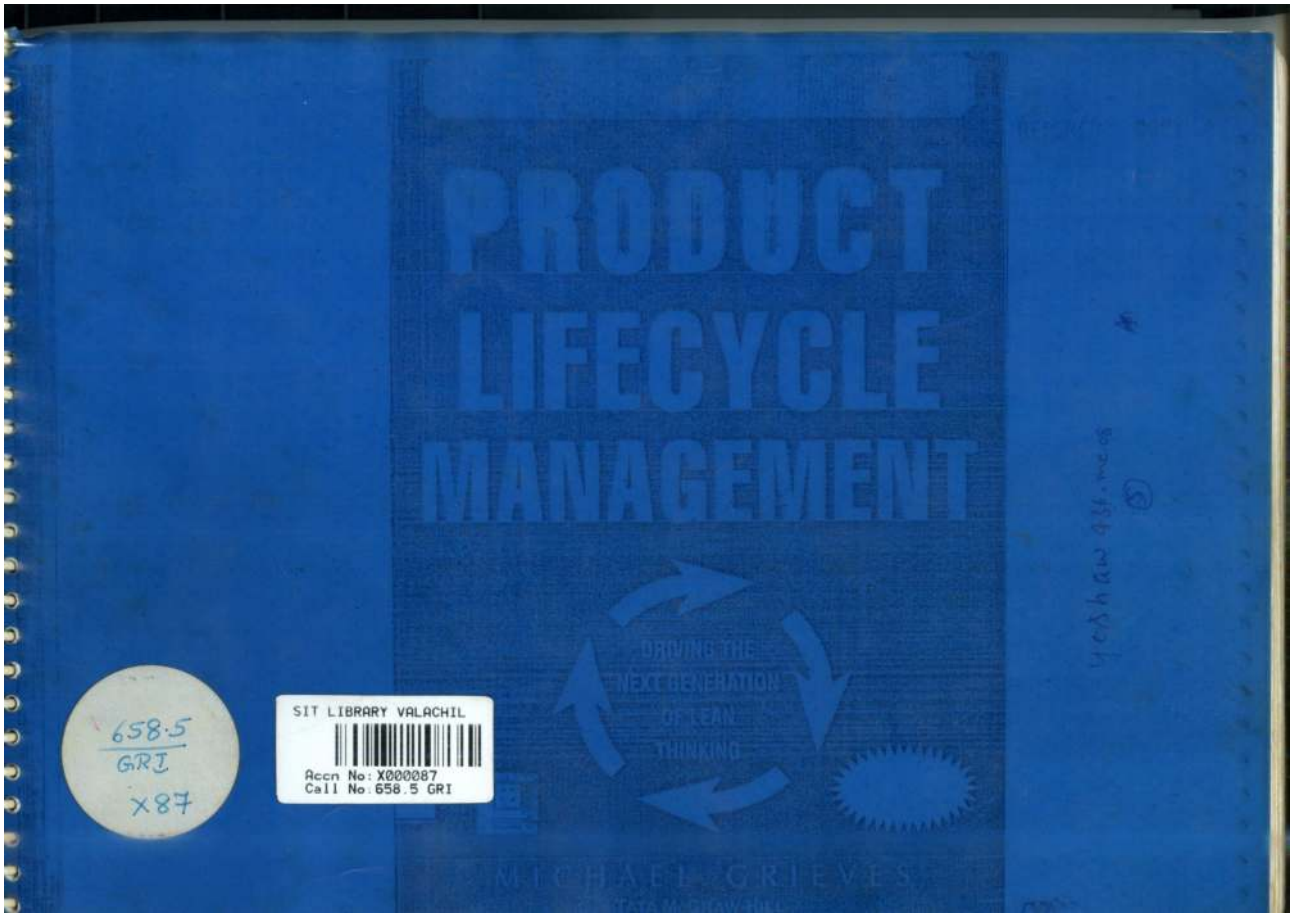

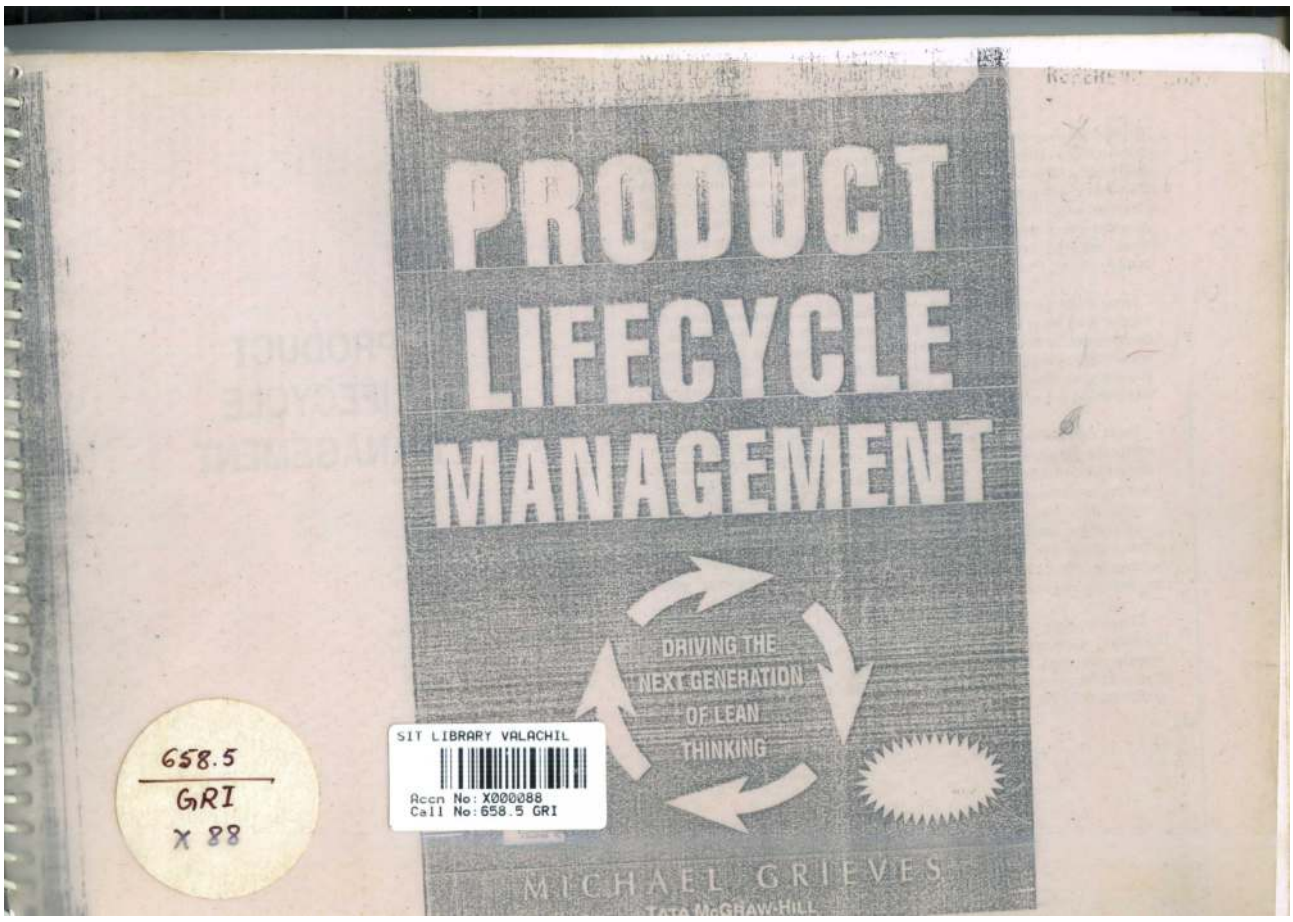

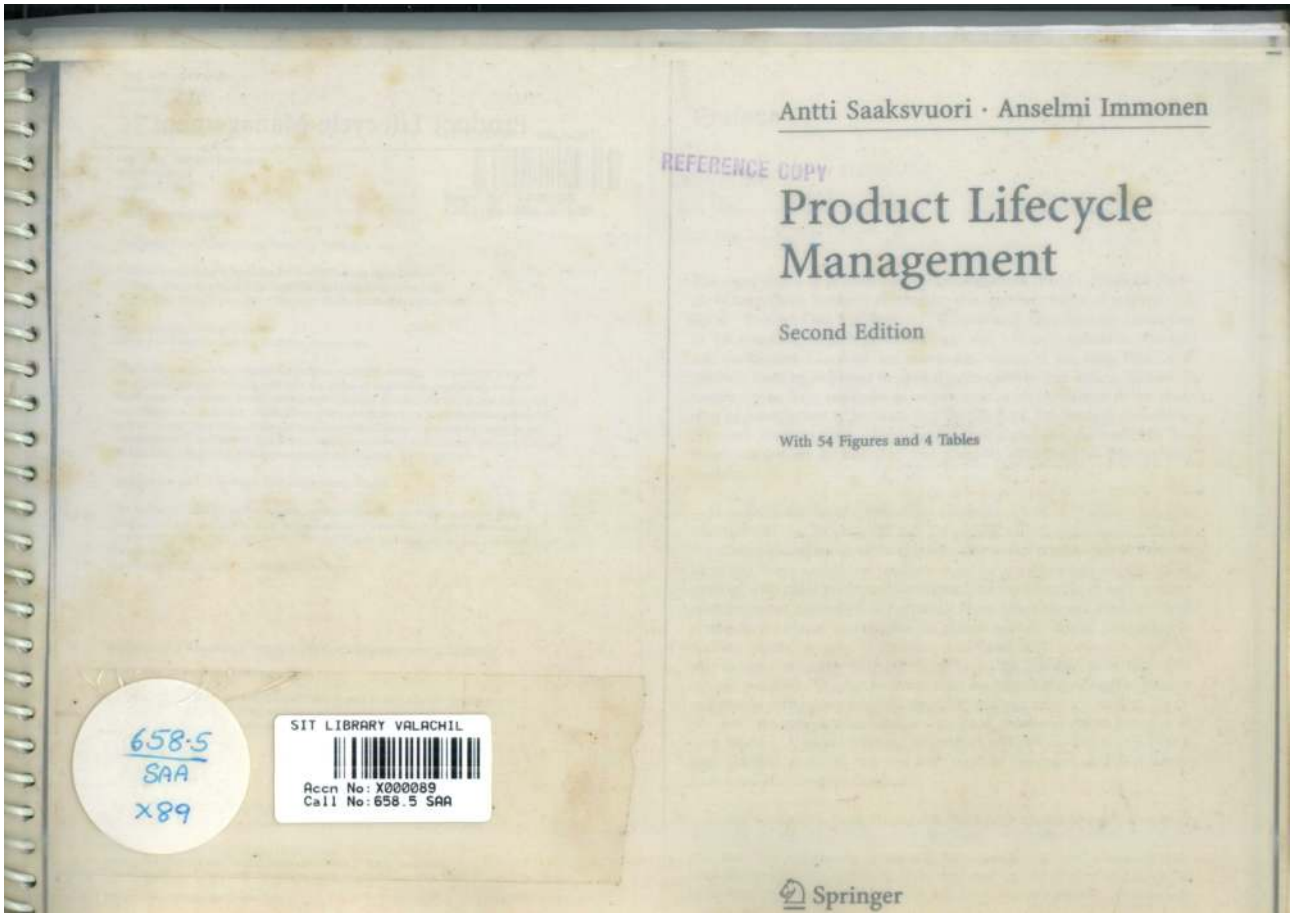

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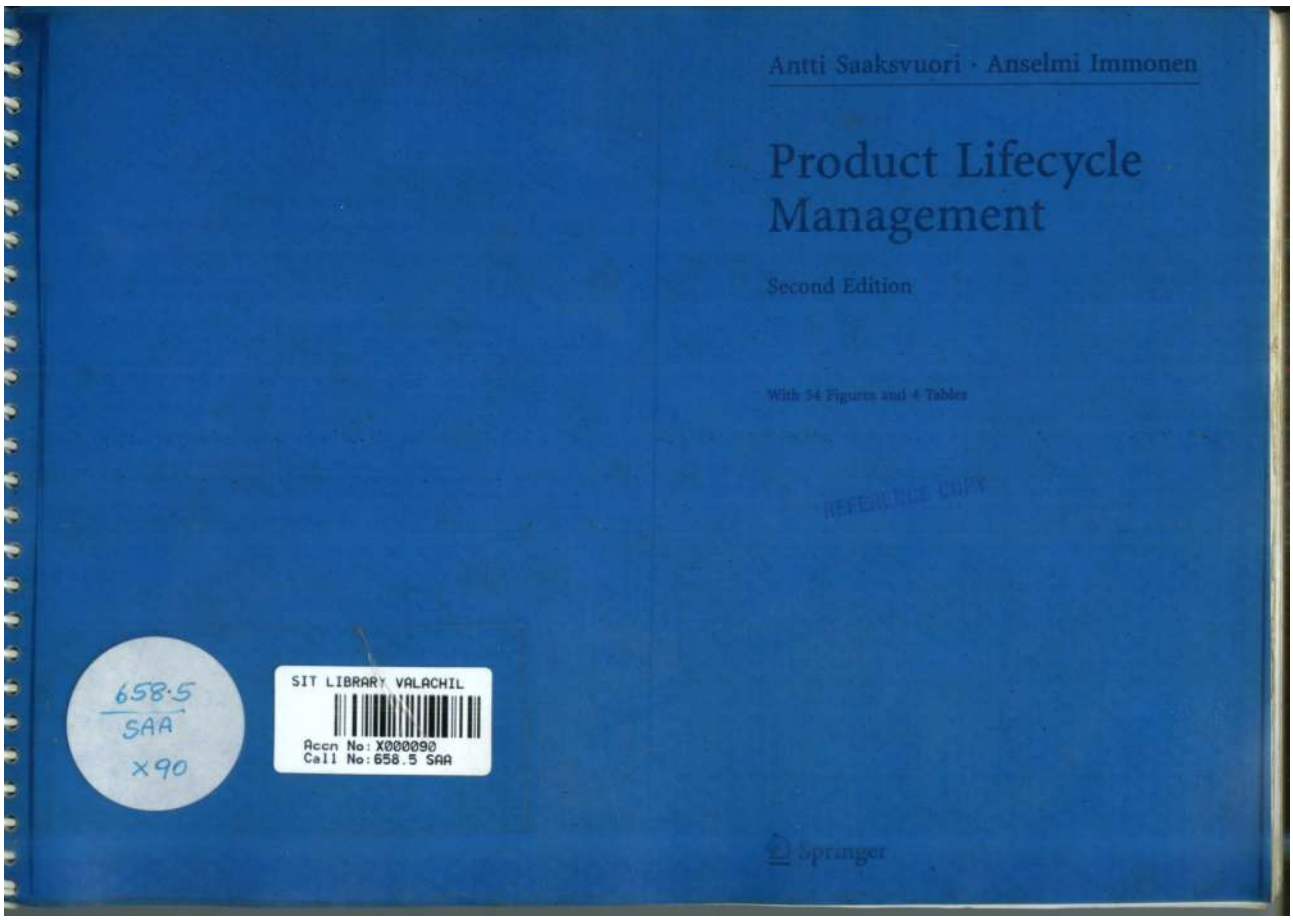
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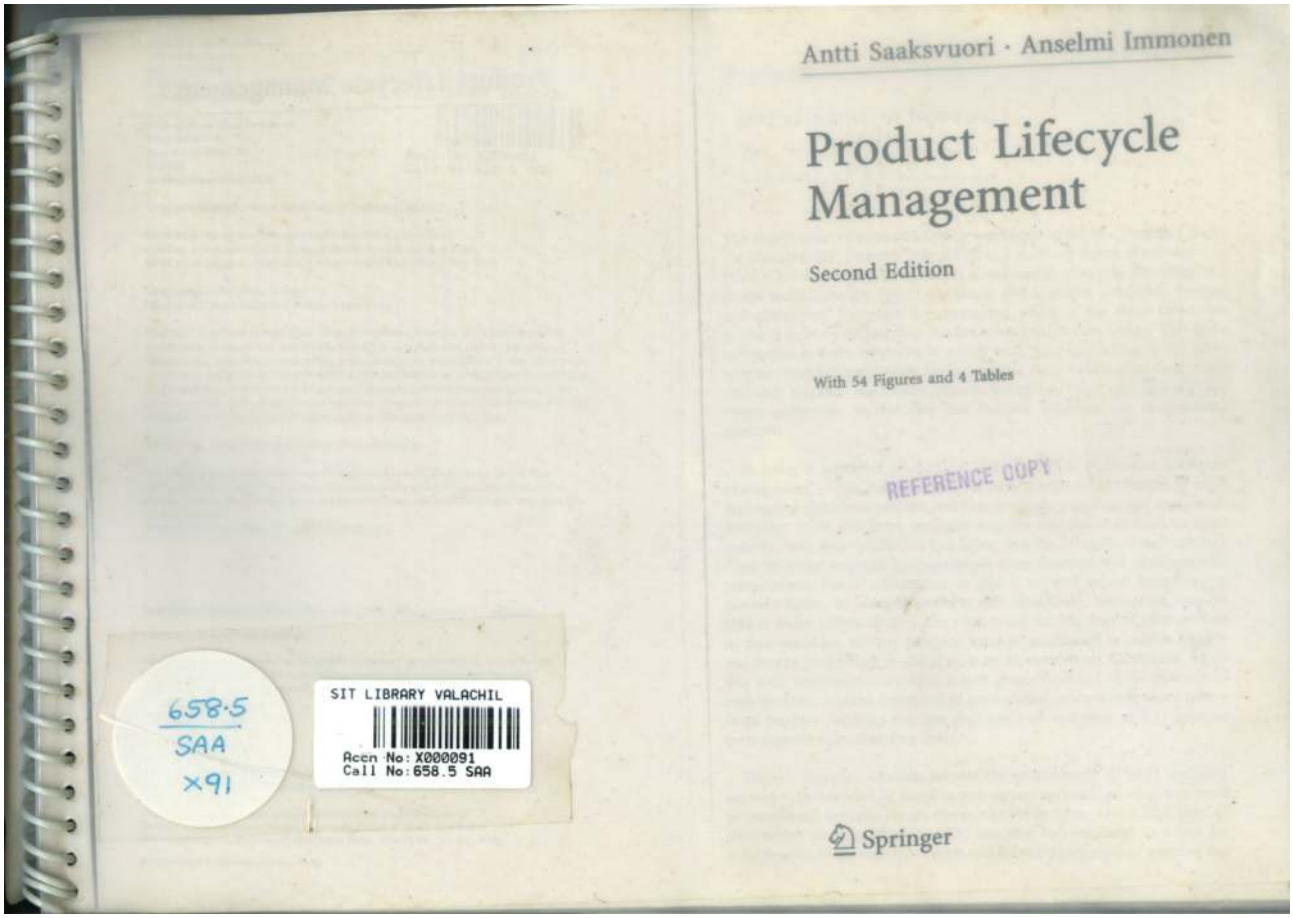
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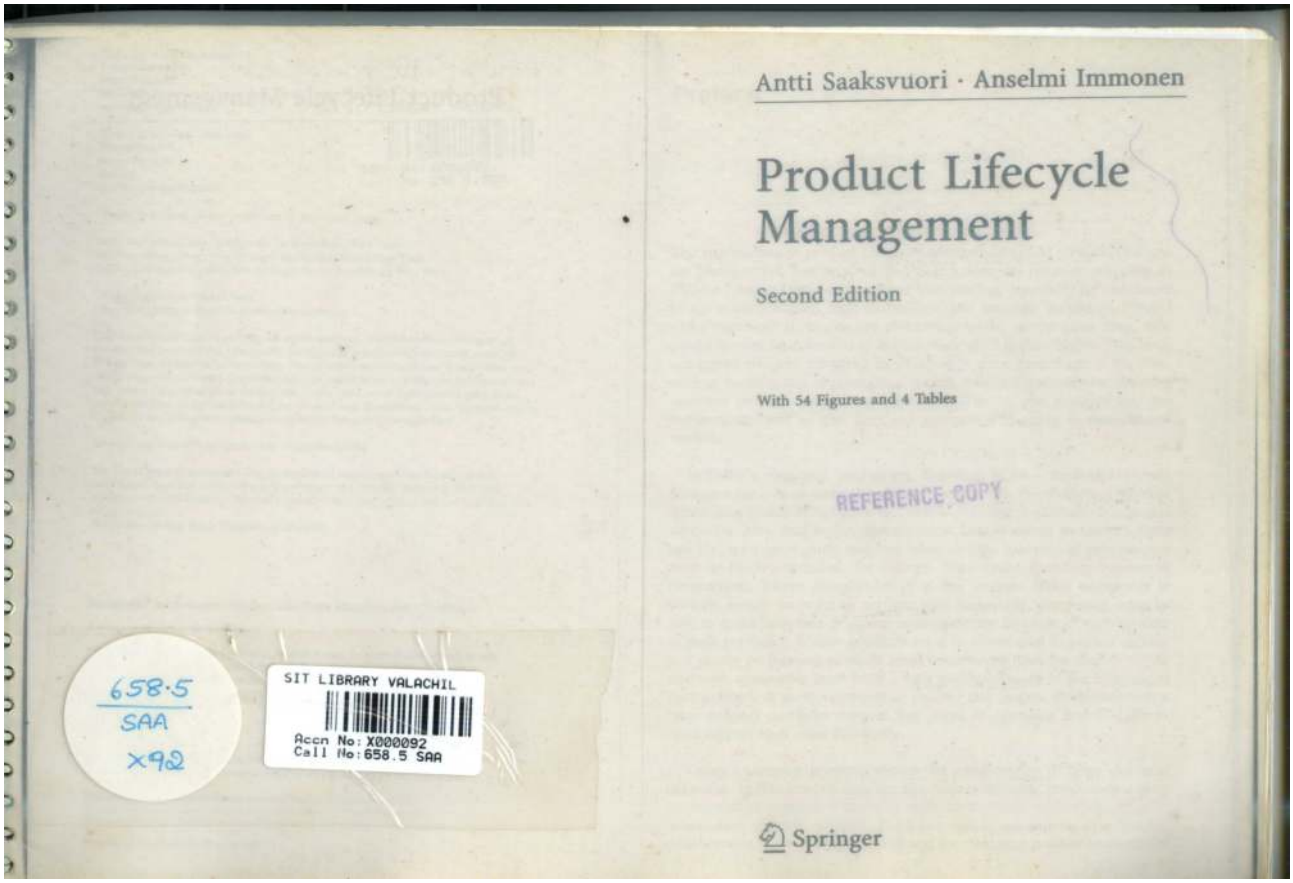

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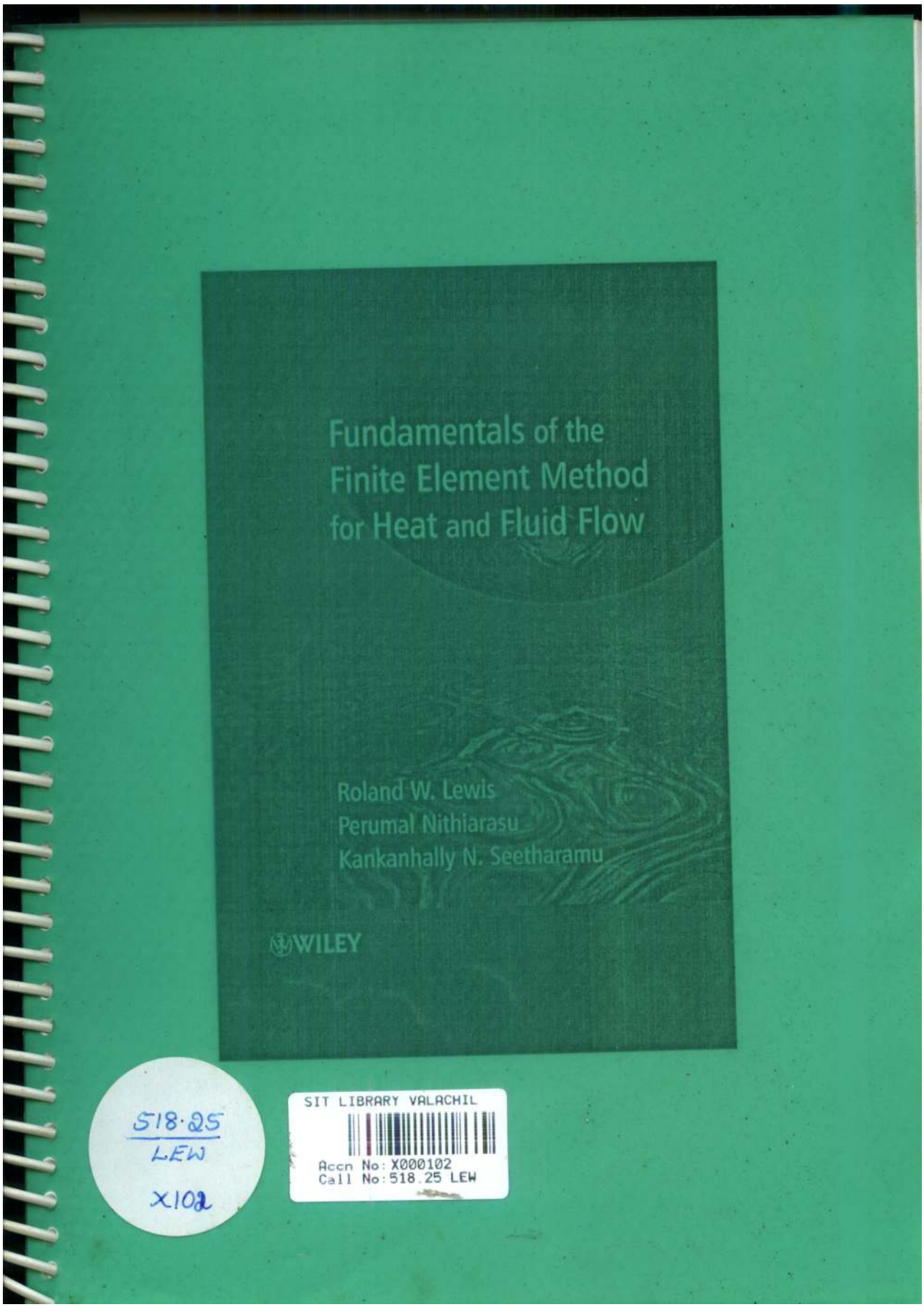

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24.21 Using Formula (24.5.5), show that $p(n) < 2.2/k$, if $n \geq 2$, so that the expected number of basic operations performed by *RepeatPrimeTest* is linear in the input size n.

24.22 Suppose that we are given an NC algorithm for evaluating a multivariate polynomial $P(x_1, \ldots, x_m)$ of degree n over the real numbers. For example, $P(x_1, x_2, \ldots, x_m)$ might be a determinant of matrix A whose entries involve the variables $x_1, x_2, \ldots, x_m$. Design and analyze an RNC algorithm (a parallel Monte Carlo algorithm having logarithmic complexity in n and m which uses a polynomial number of processors in n and m) for determining whether or not P is identically zero. Use the following lemma.

Lemma

For any set of k real numbers $S = \{r_1, \ldots, r_k\}$, the number of zeros in S^m of a multivariate polynomial $P(x_1, x_2, \ldots, x_m)$ of degree n is at most kn^{k-1}. ∎

CHAPTER 25

LOWER-BOUND THEORY

Given a problem and a specific algorithm for solving the problem, it is important to determine how close the algorithm comes to exhibiting optimal worst-case or average complexity for the problem itself. But how do we determine what optimal behavior is for the problem? Of course, the complexity of any algorithm that correctly solves the problem gives us *upper bounds* for the complexities of the problem. The object of this chapter is to discuss various techniques for determining good *lower-bound* estimates for the worst-case and average complexities of problems such as comparison-based searching and sorting.

25.1 BASIC TERMINOLOGY AND TECHNIQUES

In Chapter 3, we found *sharp* lower-bound formulas for the worst-case complexity of the problem of adjacent-key comparison-based sorting and for the best-case, worst-case, and average complexities of the problem of finding the maximum value in a list. In other words, we found algorithms solving these problems that performed no more than the absolute minimum number of basic operations required to solve the given problems by *any* algorithm. There are relatively few problems for which sharp lower-bound formulas have been established. It is more realistic to search for lower-bound formulas for the order of complexity of a problem. An algorithm whose complexity has the same order as a lower bound for the problem is called *order optimal*. Even establishing order optimality is rare and usually can only be done in the context of suitably restricting the problem or type of algorithm allowed.

We discuss six basic techniques for determining lower bounds: simple counting arguments (based on a principle of minimal work), enumeration arguments, decision (comparison) tree arguments, adversary arguments, information theoretic arguments, and graph theoretic arguments.

25.1.1 SIMPLE COUNTING ARGUMENTS

Simple counting arguments for establishing lower bounds are based on showing that any algorithm for solving a given problem must do a certain amount of minimal work to correctly output the

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The algorithms that we have considered so far (with the exception of the Karp-Rabin string matcher) are *deterministic*; that is, they leave nothing to chance. Running a deterministic algorithm time after time with the same input produces identical results each time. On the other hand, a *probabilistic* algorithm contains steps that make random choices by invoking a random (or pseudorandom) number generator. Thus, they are subject to the laws of chance. In particular, a probabilistic algorithm can perform differently for two runs with the same input.

Probabilistic algorithms fall into four main design categories: randomizations of deterministic algorithms, Monte Carlo algorithms, Las Vegas algorithms, and numerical probabilistic algorithms. A randomization of a deterministic algorithm occurs when certain steps that made canonical choices are replaced by steps that make these choices in a random fashion. Randomization is done to break the connection between a particular input and worst-case behavior and thereby homogenize the expected behavior of inputs to the algorithm.

The expected behavior of a randomized algorithm over all inputs is no better than the average behavior of its associated deterministic algorithm and is usually a little worse due to the overhead of calls to a random number generator, among other factors. Monte Carlo algorithms often produce solutions very quickly but only guarantee correctness with high probability. A Las Vegas algorithm never outputs an incorrect solution but has some probability of reporting a failure to produce a solution. In practice, obtaining solutions with high probability is almost as satisfactory as the foolproof guarantee provided by a deterministic algorithm. For many important problems, such as prime testing, the most efficient algorithms currently known for their solutions are probabilistic.

Numerical probabilistic algorithms were among the first examples of introducing randomness into the design of algorithms. A classical example is the estimation of π obtained by throwing darts at a square and recording how many darts landed inside a circle inscribed in the square.

23.24 Find a sequence of admissible moves for the two-level heuristic search illustrated in Figure 23.16 that leads to a loss for player A in 3 × 3 tic-tac-toe.

23.25 Show that by assigning the values 9, 0, and −9 to terminal nodes that are wins, ties, or losses, respectively, for player A, the two-level search illustrated in Figure 23.16 never leads to a loss for player A.

23.26 Because there are no tie positions in the 3 × 3 × 3 tic-tac-toe game, the first player has a winning strategy. Find a winning strategy for the first player.

23.27 Design a recursive function *DABNodeValue*(*X*, *NumLevels*, *ParentValue*, *NodeValueLowBnd*) for deep alpha-beta pruning. The initial invocation of *DABNodeValue* should have *ParentValue* = ∞ and *NodeValueLowBnd* = −∞.

23.28 Redo Exercise 23.22 for deep alpha-beta pruning. Indicate any pruned nodes that were not pruned by alpha-beta pruning.

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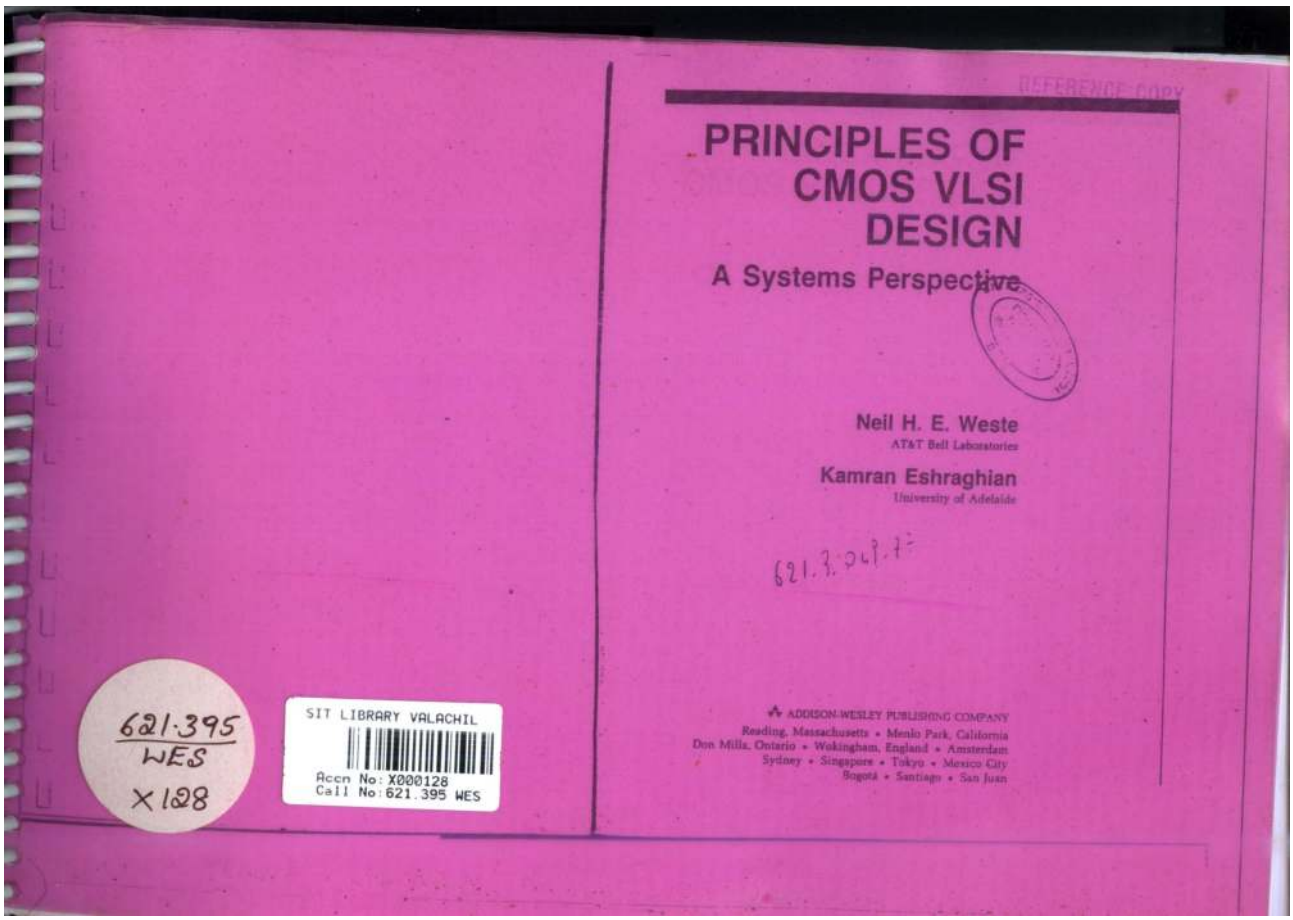
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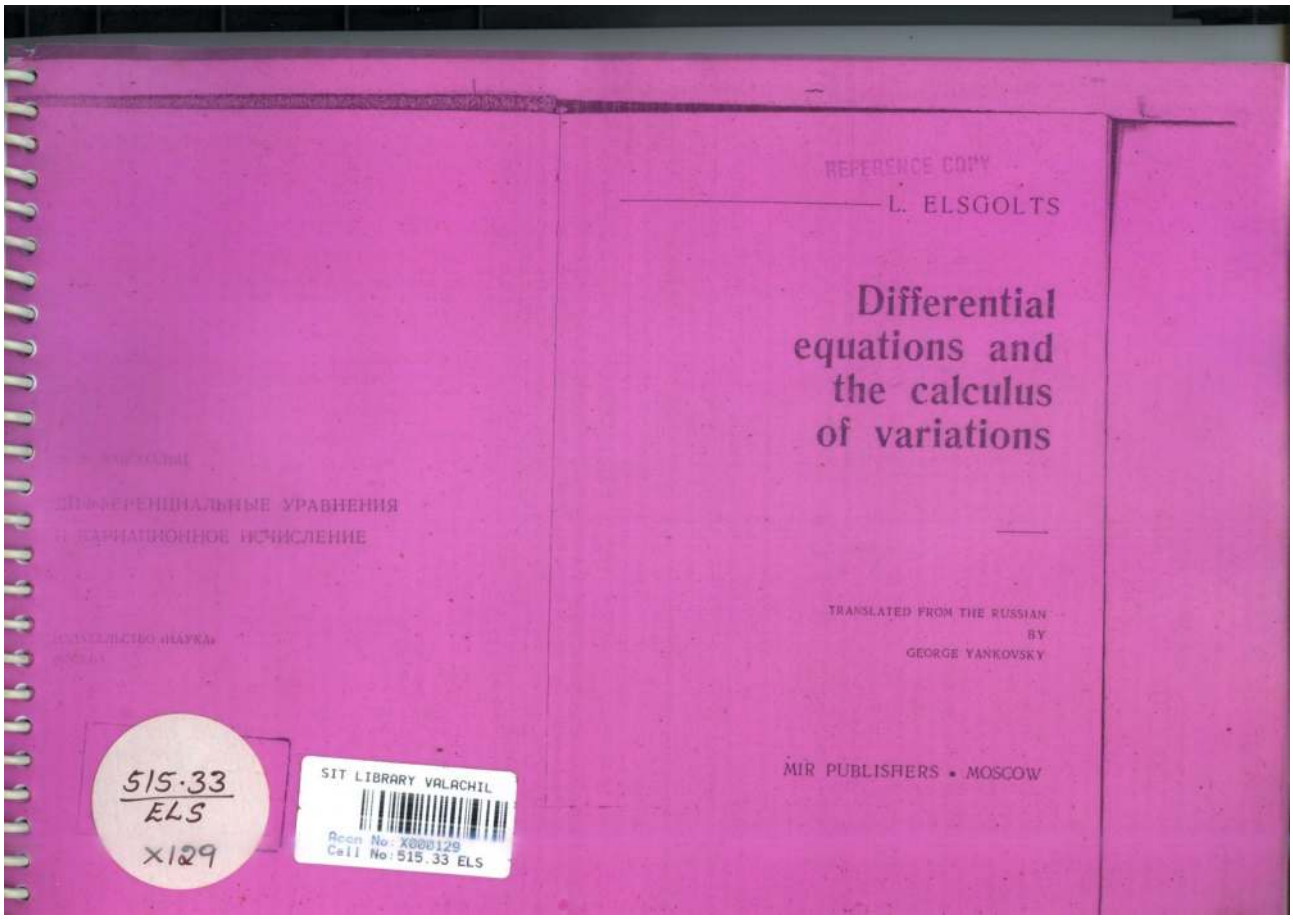
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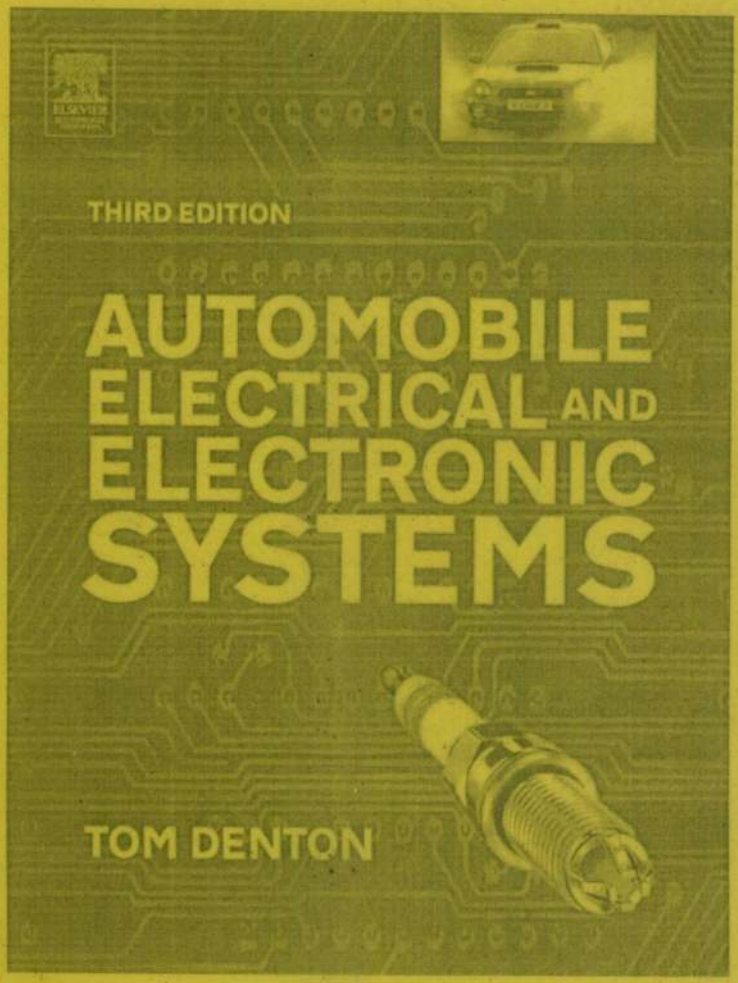

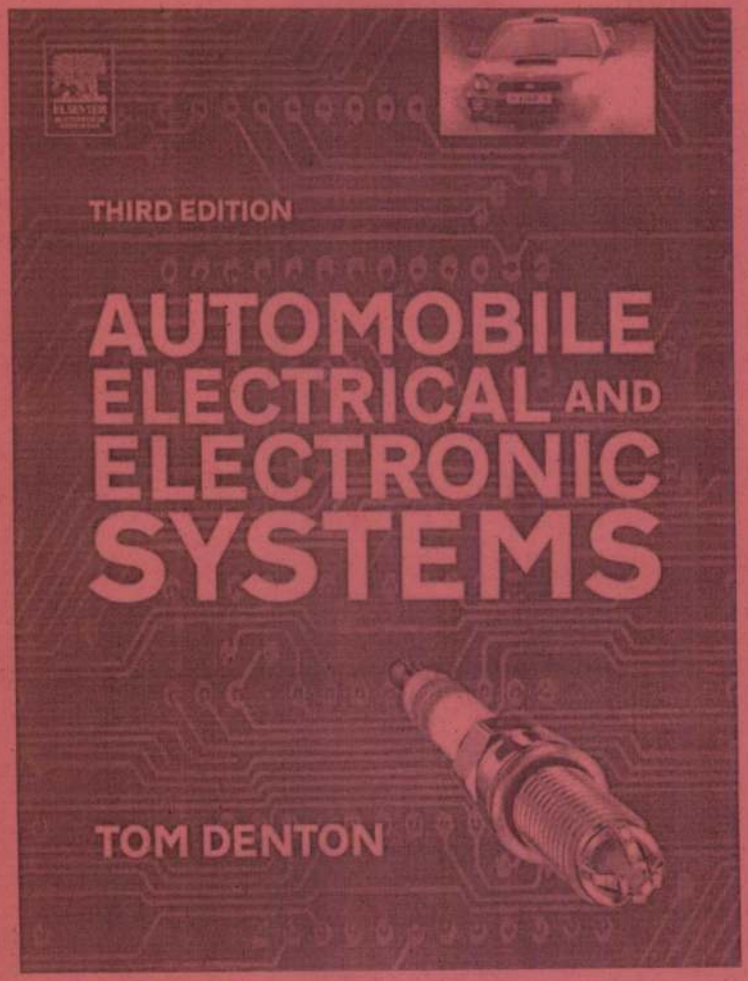

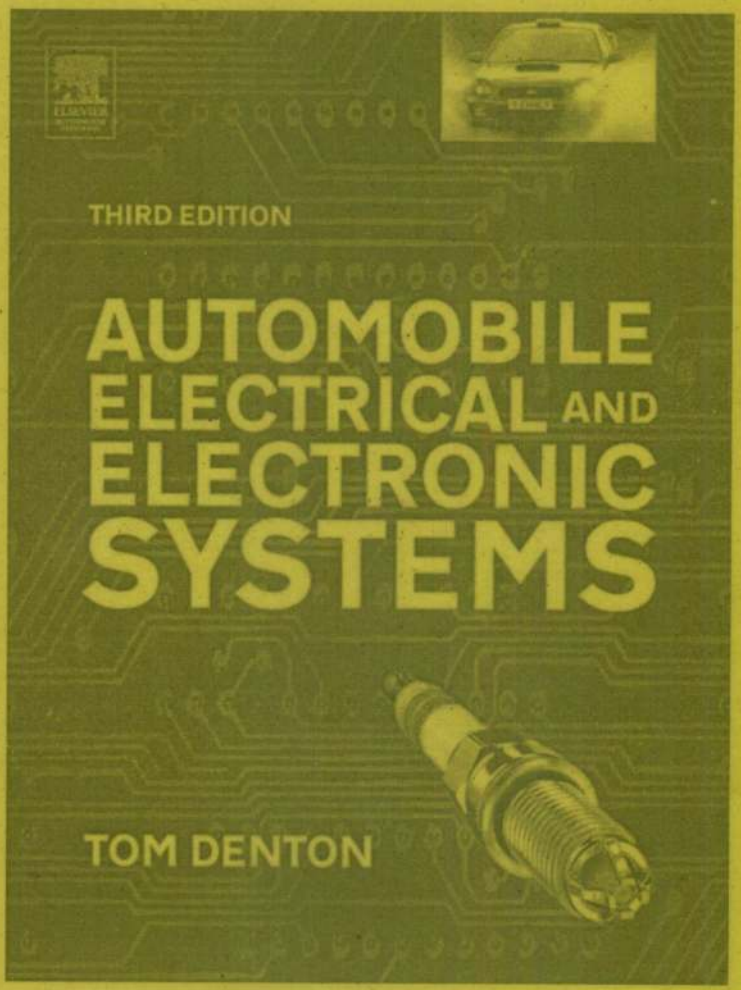

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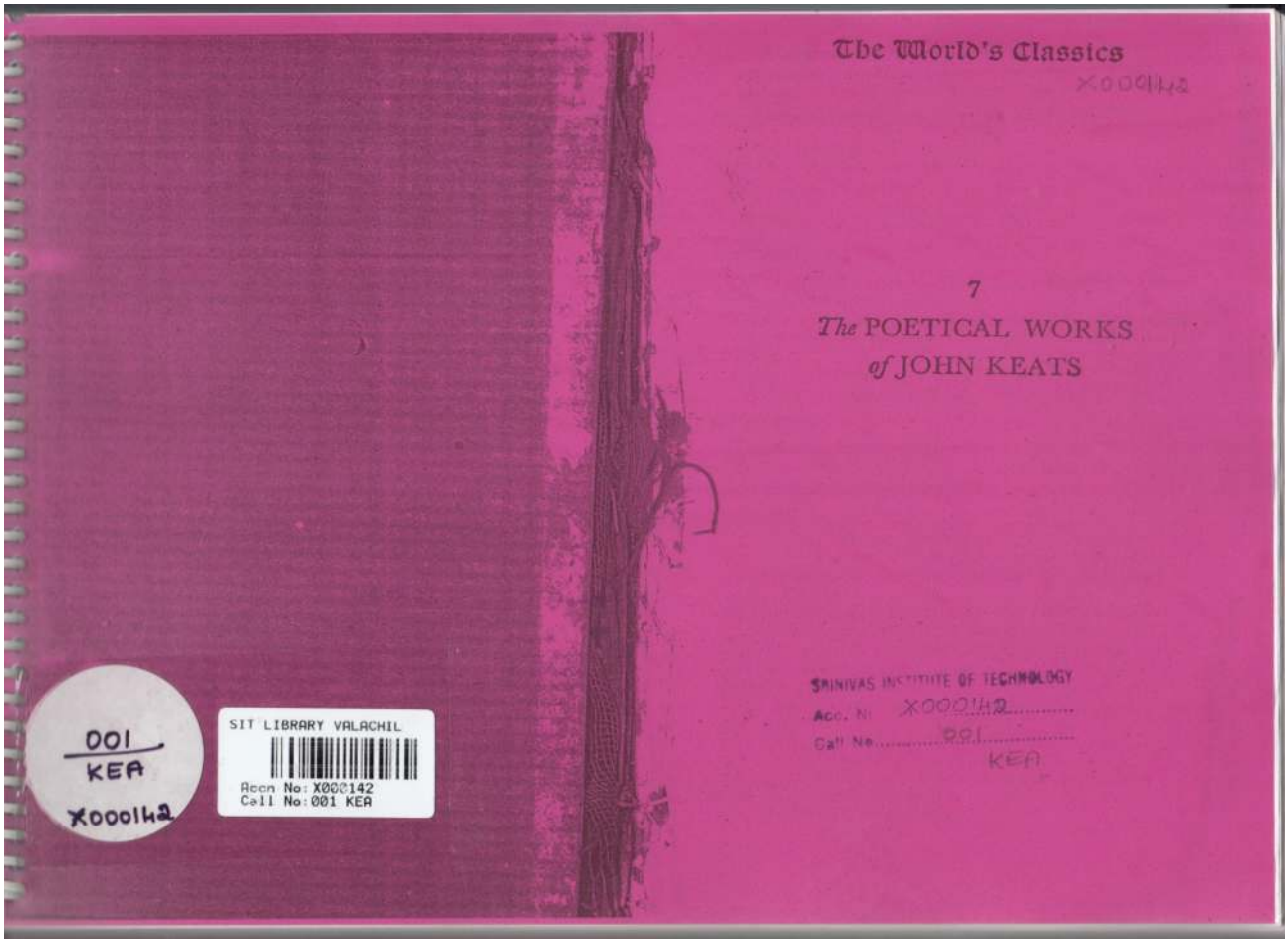

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