

# Contents

<b>Glossary of Notation</b>	xi
<b>CHAPTER I</b>	
<b>Residue or Modular Arithmetic</b>	1
1. Introduction	1
2. Single-Modulus Residue Arithmetic	3
3. Multiple-Modulus Residue Arithmetic	11
4. Mapping Standard Residue Representations onto Integers	17
5. Single-Modulus Residue Arithmetic with Rational Numbers	23
6. The Forward Mapping and the Inverse Mapping	31
7. Multiple-Modulus Residue Arithmetic with Rational Numbers	49
<b>CHAPTER II</b>	
<b>Finite-Segment <math>p</math>-adic Arithmetic</b>	63
1. Introduction	63
2. The Field of $p$ -adic Numbers	63
3. Arithmetic in $\mathbb{Q}_p$	73
4. A Finite-Segment $p$ -adic Number System	79
5. Arithmetic Operations on Hensel Codes	90
6. Removing a Leading Zero from a Hensel Code	99
7. Mapping a Hensel Code onto a Unique Order- $N$ Farey Fraction	100
<b>CHAPTER III</b>	
<b>Exact Computation of Generalized Inverses</b>	109
1. Introduction	109
2. Properties of $g$ -inverses	110
	ix

3. Applications of $g$ -inverses	116
4. Exact Computation of $A^+$ if $A$ Is a Rational Matrix	118
5. Failures of Residue Arithmetic and Precautionary Measures	131
CHAPTER IV	
<b>Integer Solutions to Linear Equations</b>	134
1. Introduction	134
2. Theoretical Background	135
3. The Matrix Formulation of Chemical Equations	138
4. Solving the Homogeneous System	140
5. Solving a Non-Homogeneous System	148
6. Solving Interval Linear Programming Problems	150
7. The Solution of Systems of Mixed-Integer Linear Equations	155
CHAPTER V	
<b>Iterative Matrix Inversion and the Iterative Solution of Linear Equations</b>	162
1. Introduction	162
2. The Newton–Schultz Method for the Matrix Inverse	163
3. Iterative Solution of a Linear System	169
4. Iterative Computation of $g$ -inverses	174
CHAPTER VI	
<b>The Exact Computation of the Characteristic Polynomial of a Matrix</b>	180
1. Introduction	180
2. The Algorithm Applied to Lower Hessenberg Matrices	181
<b>Bibliography</b>	186
<b>Index</b>	191