

TABLE OF CONTENTS

| | |
|--|-----|
| Preface | 7 |
| Notation | 10 |
| 1. Accuracy of computation | 11 |
| 1.1. Propagation of data errors | 11 |
| 1.2. Propagation of rounding errors..... | 22 |
| 1.3. Propagation of data errors and rounding errors | 34 |
| 1.4. Engineering applications..... | 37 |
| 2. Solving linear algebraic equations | 46 |
| 2.1. Matrix factorisation..... | 46 |
| 2.2. Non-iterative algorithms | 52 |
| 2.3. Iterative algorithms | 62 |
| 3. Approximation | 66 |
| 3.1. Interpolation..... | 66 |
| 3.2. Least-squares approximation..... | 73 |
| 3.3. Other types of approximation..... | 87 |
| 3.4. Engineering applications..... | 90 |
| 4. Solving nonlinear algebraic equations | 93 |
| 4.1. Preliminary exercises | 93 |
| 4.2. Single-point iterative algorithms | 95 |
| 4.3. Multiple-point iterative algorithms | 111 |
| 4.4. Accuracy of numerical solutions..... | 115 |
| 4.5. Engineering applications..... | 121 |
| 5. Numerical differentiation | 123 |
| 5.1. Accuracy | 123 |
| 5.2. Design of differentiation formulae..... | 130 |
| 5.3. Optimisation of differentiation step | 135 |
| 5.4. Engineering applications..... | 138 |
| 6. Numerical integration | 140 |
| 6.1. Preliminary exercises | 140 |
| 6.2. Quadrature-based methods..... | 144 |
| 6.3. Monte-Carlo methods..... | 160 |
| 6.4. Engineering applications..... | 163 |
| 7. Solving ordinary differential equations | 165 |
| 7.1. Preliminary exercises | 165 |
| 7.2. Single-step methods | 168 |
| 7.3. Multi-step methods | 186 |
| 7.4. Engineering applications..... | 198 |
| Index of basic concepts of numerical analysis | 204 |
| Index of MATLAB functions | 206 |