

# Contents

<b>1. Computational Methods in Classical Physics</b>	
By J.G. Zabolitzky .....	1
1.1 Preface .....	1
1.2 Motion of a Classical Point-Like Particle .....	1
1.3 Short Course in FORTRAN Programming Methodology ..	9
1.4 Methods of Higher Accuracy (and Efficiency) .....	12
1.5 Finding Extremal Points of Motion .....	29
1.6 Statics and Dynamics of Strings .....	43
1.7 Dynamics of Strings .....	49
1.8 Literature .....	53
<b>2. Monte Carlo Simulations in Statistical Physics</b>	
By D. Stauffer .....	55
2.1 Introduction .....	55
2.2 Random Numbers .....	57
2.3 Ising Model .....	60
2.4 Cellular Automata (Q2R and Crcutz) .....	64
2.5 Diffusion and Percolation .....	68
2.6 Eden Clusters .....	71
2.7 Kauffman Model .....	74
2.8 Summary .....	77
2.9 Appendix: Principles of Vector Computing .....	78
2.10 References .....	81
Notes Added to the Second Edition .....	81
<b>3. Reduce for Beginners. Six Lectures on the Application of Computer-Algebra (CA). By V. Winkelmann and F.W. Hehl</b>	83
Introduction .....	83
Lecture 1 .....	85
1.1 A first interactive Reduce session .....	85
1.2 What can CA do for you? .....	88
1.3 The Reduce character set .....	90
1.4 Integers, rational and real numbers .....	91

1.5 Variables named by identifiers .....	91
1.6 A Reduce program, a follow-up of commands .....	92
1.7 Assign a temporary result to a variable .....	93
1.8 Homework .....	94
 Lecture 2 .....	95
2.1 Built-in operators .....	95
2.2 Manipulating Reduce expressions amounts to manipulating formulae .....	97
2.3 The process of evaluation in Reduce .....	98
2.4 Repeatedly doing something: Loops .....	100
2.5 Loops and lists .....	102
2.6 Multidimensional objects: Arrays .....	103
2.7 Homework .....	104
 Lecture 3 .....	105
3.1 The conditional statement .....	105
3.2 Combining several statements I: The group statement .....	106
3.3 Combining several statements II: The compound statement .....	107
3.4 Some elementary mathematical functions .....	109
3.5 Differentiation with DF .....	109
3.6 Integration with INT .....	111
3.7 Substitution with SUB .....	112
3.8 Homework .....	112
 Lecture 4 .....	114
4.1 Operators that act on lists .....	114
4.2 Right and left-hand-side of an equation .....	115
4.3 Solving (non-)linear equations .....	115
4.4 Retrieving parts of polynomials and rational functions .....	116
4.5 To make decisions with boolean operators .....	118
4.6 Writing messages .....	118
4.7 How to define your own operators .....	119
4.8 LET rules .....	120
4.9 Homework .....	122
 Lecture 5 .....	124
5.1 Extended LET rules .....	124
5.2 Examples: Factorials and binomial coefficients .....	125
5.3 Clearing LET rules .....	127
5.4 Creating non-commutative algebras, symmetric and antisymmetric operators .....	128
5.5 Procedures for repeated use of commands .....	130

5.6 A procedure for l'Hospital's rule and a caveat .....	131
5.7 Homework .....	133
Lecture 6 .....	135
6.1 Linear algebra package: Matrices .....	135
6.2 Calculus of exterior differential forms in EXCALC .....	138
6.3 Turning switches on and off .....	142
6.4 Reordering expressions .....	144
6.5 On Reduce input and output .....	145
6.6 Generating Fortran programs .....	146
6.7 Concluding remarks .....	147
6.8 Homework .....	147
References .....	149
Appendix .....	150
A.1 Where can you buy Reduce? .....	150
A.2 Some additional exercises (preliminary) .....	151
<b>4. Appendix: A Short Introduction to FORTRAN</b> By D. Stauffer .....	153