

Contents

Introduction	3
1 Scattering by Stripe Grating	5
1.1 The Physical Problem	6
1.2 Relation to the Time-dependent Problem	6
1.3 Form of Solutions for $ z > d$	8
1.4 Form of Solutions Inside the Slab	8
1.5 Boundary Matching of Solutions	10
1.6 Remarks and References	10
1.7 Mathematical Issues	11
1.8 Partial Solution to Problem (3)	13
2 Packing Problems in Data Communications	14
2.1 Motivation and Problem Statement	14
2.2 $p = q = \infty$	16
2.3 The Case $p = q = 2$	17
2.4 Solution to the Spread Problem	18
2.5 References	19
3 Unresolved Mathematical Issues in Coating Flow Mechanics	20
3.1 Curtain Coating	20
3.2 Known Mathematical Results	24
3.3 Simplified Models	26
3.4 Future Directions	28
3.5 References	29
4 Conservation Laws in Crystal Precipitation	32
4.1 Particles in Photographic Emulsions	32
4.2 A Simple Model of Tavaré	34
4.3 A More Realistic Model	35
4.4 Solution to Problems (1), (2)	37
5 A Close Encounter Problem of Random Walk in Polymer Physics	40

6 Mathematical Models for Manufacturable Josephson Junction Circuitry	46
7 Image Reconstruction in Oil Refinery	52
7.1 The Problem	52
7.2 Suggested Method	55
8 Asymptotic Methods in Semiconductor Device Modeling	57
8.1 The MOSFET	57
8.2 The PNPN Problem	61
8.3 Solution of Problem 1.	62
8.4 References	65
9 Some Fluid Mechanics Problems in U.K. Industry	66
9.1 Interior Flows in Cooled Turbine Blades	66
9.2 Fiber Optic Tapering	70
9.3 Ship Slamming	72
9.4 References	74
10 High Resolution Sonar Waveform Synthesis	76
10.1 References	79
11 Synergy in Parallel Algorithms	80
11.1 General framework	80
11.2 Gauss-Seidel	82
11.3 The Heat Equation	83
11.4 Open Questions	85
11.5 References	85
12 A Conservation Law Model for Ion Etching for Semiconductor Fabrication	86
12.1 Etching of a Material Surface	86
12.2 Etching in Semiconductor Device Fabrication	89
12.3 Open Problems	93
12.4 References	95
13 Phase Change Problems with Void	97
13.1 The Problem	97
13.2 The Void Problem in 1-Dimension	99
13.3 A Scheme to Solve the Void Problem	101
13.4 References	103
14 Combinatorial Problems Arising in Network Optimization	105
14.1 General Concepts	105
14.2 Diameter Estimation	107
14.3 Reducing the Diameter	108

14.4 Expander Graphs	109
14.5 Reliability	112
14.6 References	112
15 Dynamic Inversion and Control of Nonlinear Systems	114
15.1 Linear Systems	114
15.2 Nonlinear Systems	116
15.3 References	120
16 The Stability of Rapid Stretching Plastic Jets	121
16.1 Introduction	121
16.2 The Free Boundary Problem	122
16.3 Stability Analysis	125
16.4 Open Problems	126
16.5 References	127
17 A Selection of Applied Mathematics Problems	128
17.1 Path Generation for Robot Cart	128
17.2 Semiconductor Problems	131
17.3 Queuing Networks	135
17.4 References	137
18 The Mathematical Treatment of Cavitation in Elastohydrodynamic Lubrication	139
18.1 The Model	139
18.2 Roller Bearing	141
18.3 Open Problems	142
18.4 Partial Solutions	143
18.5 References	143
19 Some Problems Associated with Secure Information Flows in Computer Systems	145
19.1 Threats and Methods of Response	145
19.2 More General Policies	150
19.3 References	151
20 The Smallest Scale for Incompressible Navier-Stokes Equations	153
20.1 References	157
21 Fundamental Limits to Digital Syncronization	159
21.1 The Barker Code	159
21.2 Complex Barker Sequences	162
21.3 References	163

x CONTENTS

22 Applications and Modeling of Diffractive Optics	164
22.1 Introduction to Diffractive Optics	164
22.2 Practical Applications	167
22.3 Mathematical Modeling	168
22.4 References	171
Index	173