
Contents

Preface to the Student	ix
Introduction	xi
CHAPTER 1. Crystal Precipitation	1
1.1 The road ahead—Some helpful hints to the student	1
1.2 Background	2
1.3 The model	5
1.4 Some facts about differential equations (BASIC)	7
1.5 Picard's method of successive approximations (BASIC)	10
1.6 Nonrectangular regions (BASIC)	11
1.7 The Euler method (or method of polygons) (BASIC)	12
1.8 Crystals of single size	14
1.9 Remarks on Theorems 1.8.3–1.8.5	16
1.10 Reminder on Newton's method	16
1.11 The Runge–Kutta method (BASIC)	18
1.12 Discussion and motivation (BASIC)	20
1.13 Crystals of several sizes	22
1.14 Summary	25
CHAPTER 2. Air Quality Modeling	27
2.1 Background	27
2.2 The model	29
2.3 The advection equation	30
2.4 Numerical methods	32
2.5 The general advection equation	35
2.6 Enters diffusion	36
2.7 The von Neumann stability criterion	37

2.8	Stability, consistency, and convergence	40
2.9	Summary	45
CHAPTER 3. Electron Beam Lithography		47
3.1	Background	47
3.2	The mathematical model	48
3.3	The heat equation	50
3.4	The proximity effect	53
3.5	The use of Fourier series	54
3.6	The inclusion of backward scattering	58
3.7	Computational experiments	59
3.8	Summability of Fourier series	59
3.9	Summary	61
3.10	Appendix: Proof of Féjer's theorem	63
CHAPTER 4. Development of Color Film Negative		69
4.1	The process	69
4.2	The mathematical model	71
4.3	The bulk reaction problem	73
4.4	Analysis of the solution	74
4.5	Late development of film	77
4.6	Implicit methods for solving system (4.12)–(4.16) numerically	78
4.7	Summary	83
4.8	Appendix: Proof of the strong maximum principle	83
CHAPTER 5. How Does a Catalytic Converter Function?		87
5.1	Background	87
5.2	The model	88
5.3	The control problem	90
5.4	A simplified model	91
5.5	The calculus of variations	92
5.6	The Euler-Lagrange equation	93
5.7	The simplified control problem	95
5.8	Determining the optimal control	99
5.9	Summary	102
CHAPTER 6. The Photocopy Machine		105
6.1	Background	105
6.2	The photocopy machine	105
6.3	The electric image	107
6.4	Modeling the electric image	108

6.5	Solving Poisson's equations numerically	111
6.6	Transmission conditions	115
6.7	Computing the electric image	117
6.8	A simple method for solving (6.18), (6.17)	119
6.9	Summary	122
CHAPTER 7. The Photocopy Machine (Continued)		123
7.1	The visible image	123
7.2	Impossibility of a precise image	128
7.3	Summary	132
Index		135