Contents

Preface *page* vii

1 Getting Started 1

1.1 Introduction 1

1.2 Existence, Uniqueness, and Well-Posedness 6

1.3 Standard Form 19

1.4 Control of the Error 27

1.5 Qualitative Properties 34

2 Initial Value Problems 39

2.1 Introduction 39

2.2 Numerical Methods for IVPs 40

2.2.1 One-Step Methods 41

2.2.2 Methods with Memory 57

2.3 Solving IVPs in MATLAB 81

2.3.1 Event Location 92

2.3.2 ODEs Involving a Mass Matrix 105

2.3.3 Large Systems and the Method of Lines 114

2.3.4 Singularities 127

3 Boundary Value Problems 133

3.1 Introduction 133

3.2 Boundary Value Problems 135

3.3 Boundary Conditions 138

3.3.1 Boundary Conditions at Singular Points 139

3.3.2 Boundary Conditions at Infinity 146

3.4 Numerical Methods for BVPs 156
3.5 Solving BVPs in MATLAB 168
4 Delay Differential Equations 213
4.1 Introduction 213
4.2 Delay Differential Equations 214
4.3 Numerical Methods for DDEs 217
4.4 Solving DDEs in MATLAB 221
4.5 Other Kinds of DDEs and Software 247
Bibliography 251
Index 257