Contents

Preface to the Instructor ..... **xiii**

Technical Support for Instructors ..... **xiv**
Other Information Sources for Instructors and Students ..... **xiv**
MATLAB-Based Books ..... **xv**
Acknowledgments ..... **xv**

Part One: Introduction ..... **xvii**

To the Student ..... **xvii**
About the Cover ..... **xviii**
The Student Edition of MATLAB vs. Professional MATLAB ..... **xix**
How to Upgrade to Professional MATLAB ..... **xix**
Support, Registration, and Warranty ..... **xx**
Student Support Policy xx
Student User Registration xx
Defective CD Replacement xxi
Limited Warranty xxi
Toolboxes ..... **xxi**

Installation ..... **xxiii**

MATLAB for Microsoft Windows ..... **xxiii**
System Requirements xxiii
The MATLAB Notebook for Windows ..... **xxiv**

PC Installation Procedure ..... **xxiv**
MATLAB for Macintosh ..... **xxv**
System Requirements xxv
Macintosh Installation Procedure xxv

A Quick Overview xxvii

Help Desk and Online Documentation ..... **xxvii**
What's New in MATLAB 5? ..... **xxix**
About *The Student Edition of MATLAB 5* ..... **xxxi**
Upgrading from MATLAB 4 to MATLAB 5 ..... **xxxii**
New Platform-Specific Features ..... **xxxiii**
MS Windows xxxiii
Macintosh xxxvi

1 Introduction 1

1.1 Simple Math **4**
1.2 The MATLAB Workspace **6**
1.3 About Variables **6**
1.4 Comments and Punctuation **9**
1.5 Complex Numbers **10**

2 Scientific Features 13

2.1 Common Mathematical Functions **14**

3 Command Window Features 23

3.1 Managing the MATLAB Workspace **24**
3.2 Saving and Retrieving Data **26**
3.3 Number Display Formats **26**

4 Script M-files 29

5 File Management 35

5.1 MATLAB at Startup 40

6 Array Operations 41

6.1 Simple Arrays 42
6.2 Array Addressing 43
6.3 Array Construction 44
6.4 Array Orientation 47
6.5 Arrays of Ones or Zeros 54
6.6 Array Manipulation 54
6.7 Subarray Searching 61
6.8 Array Comparisons 62
6.9 Array Size 66
6.10 Multidimensional Arrays 68

7 Matrix Operations 75

7.1 Sets of Linear Equations 76
7.2 Matrix Functions 79
7.3 Special Matrices 82

8 Relational and Logical Operations 87

8.1 Relational Operators 88
8.2 Logical Operators 90
8.3 Relational and Logical Functions 90

9 Text 93

9.1 Character Strings 94
9.2 String Conversions 97
9.3 String Functions 98
9.4 Cell Arrays of Strings 99

10 Time 103

10.1 Current Time and Date 104
10.2 Format Conversions 104
10.3 Date Functions 106
10.4 Timing Functions 107
10.5 Plot Labels 108

11 Control Flow 113

11.1 `for` Loops 114
11.2 `while` Loops 116
11.3 `if-else-end` Constructions 117
11.4 `switch-case` Constructions 119

12 Function M-files 125

12.1 Rules and Properties 127

13 Data Analysis 135

13.1 Data Analysis Functions 142

14 Polynomials 145

14.1 Roots 146
14.2 Multiplication 146
14.3 Addition 147
14.4 Division 148
14.5 Derivatives 148
14.6 Evaluation 148
14.7 Rational Polynomials 149

15 Curve Fitting and Interpolation 153

15.1 Curve Fitting 154
15.2 One-Dimensional Interpolation 157
15.3 Two-Dimensional Interpolation 162

16 Numerical Analysis 167

16.1 Plotting 168
16.2 Minimization 170
16.3 Zero Finding 172
16.4 Integration 173
16.5 Differentiation 176
16.6 Differential Equations 179

17 Two-Dimensional Graphics 183

17.1 Using the Plot Command 184
17.2 Line Styles, Markers, and Colors 187
17.3 Plotting Styles 188
17.4 Plot Grids, Axes Box, Labels, and Legends 189

17.5 Customizing Plot Axes 192
17.6 Printing Figures 197
17.7 Manipulating Plots 197
17.8 Other Two-Dimensional Plotting Features 201
17.9 Summary 211

18 Three-Dimensional Graphics 213

18.1 Line Plots 214
18.2 Mesh and Surface Plots 215
18.3 Manipulating Plots 219
18.4 Other Three-Dimensional Plotting Features 223
18.5 Understanding Colormaps 226
18.6 Using Colormaps 228
18.7 Using Color to Add Information 229
18.8 Displaying Colormaps 230
18.9 Creating and Altering Colormaps 232
18.10 Summary 236

19 Cell Arrays and Structures 239

19.1 Cell Arrays 240
19.2 Creating and Displaying Cell Arrays 240
19.3 Combining and Reshaping Cell Arrays 242
19.4 Accessing Cell Array Contents 243
19.5 Cell Arrays of Character Strings 245
19.6 Structures 245
19.7 Building Structures 245
19.8 Accessing Structure Fields 247
19.9 Conversion and Test Functions 249
19.10 Summary 249

Symbolic Math Toolbox 251

20

20.1 Symbolic Objects and Expressions 254
20.2 Creating and using Symbolic Objects 255
20.3 MATLAB Representation of Symbolic Expressions 257
20.4 Symbolic Variables 261
20.5 Things to Try on Your Own 262
20.6 Summary 263
20.7 Operations on Symbolic Expressions 263
20.8 Extracting Numerators and Denominators 264
20.9 Standard Algebraic Operations 266
20.10 Advanced Operations 267
20.11 Conversion Functions 269
20.12 Variable Substitution 270
20.13 Summary 272
20.14 Differentiation 273
20.15 Integration 274
20.16 Summary 279
20.17 Plotting Symbolic Expressions 280
20.18 Formatting and Simplifying Expressions 282
20.19 Summary and Other Features 285
20.20 Variable Precision Arithmetic 286
20.21 Things to Try on Your Own 288
20.22 Summary 288
20.23 Solving Equations 289
20.24 Solving a Single Algebraic Equation 289
20.25 Several Algebraic Equations 291
20.26 Single Differential Equation 294
20.27 Several Differential Equations 296
20.28 Summary and Other Features 297
20.29 Linear Algebra and Matrices 308
20.30 Linear Algebra Operations 302
20.31 Other Features 303
20.32 Summary 305
20.33 Transforms 306
20.34 Step and Impulse Functions 306

20.35 The Laplace Transform 307
20.36 The Fourier Transform 308
20.37 Things to Try on Your Own 309
20.38 The *Z*-Transform 310
20.39 Summary 311
20.40 Interactive Symbolic Tools 311
20.41 Function Calculator 313
20.42 Symbolic Math Toolbox Function List 315

21 Control System Toolbox 319

21.1 System Representations 320
21.2 LTI Objects 322
21.3 Data Retrieval 324
21.4 LTI Object Conversion 325
21.5 LTI Object Arithmetic 326
21.6 System Analysis 326
21.7 Control System Toolbox Function Listing 329

22 Signal Processing Toolbox 335

22.1 Signal Analysis 336
22.2 Filter Design 339
22.3 GUI Signal Analysis and Filter Design 340
22.4 Signal Processing Toolbox Function Listing 342

23 Help! 349

23.1 *Command* Window Help 350
23.1.1 The `help` Command 350
23.1.2 The `lookfor` Command 352
23.1.3 The `whatsnew` and `info` Commands 352

23.2 The *Help* Window **353**
23.3 Browsing for Help **354**
23.4 Internet Resources **356**
23.4.1 MATLAB Automated Electronic Mail Response System 358
23.4.2 The MathWorks MATLAB Digest 358
23.4.3 The MATLAB Newsletter 358

M-File List of Student Edition **361**

HELP Topics **363**
Preferences **364**
General Purpose Commands **365**
Operators and Special Characters **368**
Programming Language Constructs **372**
Elementary Matrices and Matrix Manipulation **374**
Elementary Math Functions **377**
Specialized Math Functions **379**
Matrix Functions and Numerical Linear Algebra **381**
Data Analysis and Fourier Transforms **383**
Interpolation and Polynominals **385**
Function Functions and ODE Solvers **386**
Sparse Matrices **388**
Two-dimensional Graphs **391**
Three-dimensional Graphs **392**
Specialized Graphs **395**
Handle Graphics **398**
Graphical User Interface Tools **400**
Character Strings **403**
File Input/Output **404**
Time and Dates **407**
Data Types and Structures **408**
Dynamic Data Exchange (DDE) **411**
Examples and Demonstrations **411**

Index **417**