

MATLAB[®] for Engineers

Holly Moore

Fourth Edition



About ESource

Your Introductory Engineering Course—Your Way

Welcome to ESource, Prentice Hall's Introductory Engineering series. Over 25 modules in this series cover topics frequently taught in introductory engineering courses. Topics include an introduction to the various fields of engineering, design and problem solving skills, communication and teamwork, computer applications such as MATLAB and Mathcad, an introduction to engineering graphics and visualization, and more. All the books in the ESource series are written by educators specifically for freshman/first-year students. A complete list of all of our ESource authors and their respective backgrounds is available at www.prenhall.com/esource.

Customize

Every book in this series is available separately or packaged together at a discount to students—or, using our electronic customization program—instructors can create their own customized ESource textbook, selecting any combination and sequence of chapters from any of the books in the series. Plus, instructors can add their own material to the book as well (syllabi, course notes, etc.). For more information, visit www.prenhall.com/esource.

ESource Access

Instructors who choose to bundle two or more texts from the ESource series or use a customized ESource textbook can provide their students with an on-line library of selected ESource content—ESource Access. Student access codes are valid for six months after initial registration. Contact your local Prentice Hall sales representative for more information.

Classroom and Instructor Resources

A wealth of resources are available to adopting instructors, including PowerPoints and Instructors Manuals. Visit www.prenhall.com/esource for more information.

MATLAB[®] for Engineers

This page intentionally left blank

MATLAB[®] for Engineers

Fourth Edition

HOLLY MOORE

Salt Lake Community College
Salt Lake City, Utah

PEARSON

Boston • Columbus • Indianapolis • New York
San Francisco • Upper Saddle River • Amsterdam
Cape Town • Dubai • London • Madrid • Milan
Munich • Paris • Montreal • Toronto • Delhi
Mexico City • São Paulo • Sydney • Hong Kong
Seoul • Singapore • Taipei • Tokyo

VP/Editorial Director, Engineering/Computer Science: *Marcia J. Horton*
Executive Editor: *Holly Stark*
Editorial Assistant: *Carlin Heinle*
Senior Marketing Manager: *Tim Galligan*
Senior Managing Editor: *Scott Disanno*
Project Manager: *Priyadharshini Dhanagopal*
Senior Art Director: *Jayne Conte*
Cover Designer: *Bruce Kenselaar*
Full-Service Project Management: *Pavithra Jayapaul, Jouve India*
Composition: *Jouve India*

Credits and acknowledgments borrowed from other sources and reproduced, with permission, in this textbook appear on appropriate page within text.

MATLAB® and Simulink® are registered trademarks of The Mathworks, Inc., 3 Apple Hill Drive, Natick MA 01760-2098.

Copyright © 2015, 2012, 2009, 2007 Pearson Education, Inc., publishing as Prentice Hall, One Lake Street, Upper Saddle River, New Jersey 07458. All rights reserved. Manufactured in the United States of America. This publication is protected by Copyright, and permission should be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or likewise. To obtain permission(s) to use material from this work, please submit a written request to Pearson Education, Inc., Permissions Department, One Lake Street, Upper Saddle River, New Jersey 07458.

Many of the designations by manufacturers and seller to distinguish their products are claimed as trademarks. Where those designations appear in this book, and the publisher was aware of a trademark claim, the designations have been printed in initial caps or all caps.

Library of Congress Cataloging-in-Publication Data

Moore, Holly.

MATLAB for engineers / Holly Moore, Salt Lake Community College, Salt Lake City, Utah. – Fourth edition.

pages cm

ISBN-13: 978-0-13-348597-4

ISBN-10: 0-13-348597-8

1. Engineering mathematics—Data processing. 2. MATLAB. I. Title.

TA345.M585 2013

620.001'51—dc23

2013034649

10 9 8 7 6 5 4 3 2 1

PEARSON

www.pearsonhighered.com

ISBN 10: 0-13-348597-8
ISBN 13: 978-0-13-348597-4

Contents

ABOUT THIS BOOK	XI
DEDICATION AND ACKNOWLEDGMENTS	XV

1 • ABOUT MATLAB®	1
--------------------------	----------

- 1.1 What Is MATLAB®? 1
- 1.2 Student Edition of MATLAB® 2
- 1.3 How Is MATLAB® Used in Industry? 3
- 1.4 Problem Solving in Engineering and Science 5

2 • MATLAB® ENVIRONMENT	9
--------------------------------	----------

- 2.1 Getting Started 9
- 2.2 MATLAB® Windows 11
- 2.3 Solving Problems with MATLAB® 17
- 2.4 Saving Your Work 42
- Summary 52
- MATLAB® Summary 53
- Key Terms 55
- Problems 55

3 • BUILT-IN MATLAB® FUNCTIONS	63
---------------------------------------	-----------

- Introduction 63
- 3.1 Using Built-In Functions 63
- 3.2 Using the Help Feature 65
- 3.3 Elementary Math Functions 68
- 3.4 Trigonometric Functions 76
- 3.5 Data Analysis Functions 80
- 3.6 Random Numbers 100
- 3.7 Complex Numbers 104
- 3.8 Computational Limitations 108
- 3.9 Special Values and Miscellaneous Functions 109
- Summary 111

MATLAB® Summary	112
Key Terms	113
Problems	114

4 • MANIPULATING MATLAB® MATRICES 121

4.1 Manipulating Matrices	121
4.2 Problems with Two Variables	128
4.3 Special Matrices	135
Summary	141
MATLAB® Summary	142
Key Terms	142
Problems	142

5 • PLOTTING 149

Introduction	149
5.1 Two-Dimensional Plots	149
5.2 Subplots	166
5.3 Other Types of Two-Dimensional Plots	168
5.4 Three-Dimensional Plotting	185
5.5 Editing Plots from the Menu Bar	191
5.6 Creating Plots from the Workspace Window	193
5.7 Saving Your Plots	194
Summary	195
MATLAB® Summary	195
Problems	197

6 • USER-DEFINED FUNCTIONS 207

Introduction	207
6.1 Creating Function M-Files	207
6.2 Creating Your Own Toolbox of Functions	226
6.3 Anonymous Functions and Function Handles	228
6.4 Function Functions	229
6.5 Subfunctions	230
Summary	233
MATLAB® Summary	234
Key Terms	235
Problems	235

7 • USER-CONTROLLED INPUT AND OUTPUT 242

Introduction	242
7.1 User-Defined Input	242
7.2 Output Options	246
7.3 Graphical Input	256
7.4 More Cell Mode Features	257

7.5 Reading and Writing Data from Files	259
7.6 Debugging Your Code	261
Summary	265
MATLAB® Summary	266
Key Terms	267
Problems	267

8 • LOGICAL FUNCTIONS AND SELECTION STRUCTURES **271**

Introduction	271
8.1 Relational and Logical Operators	272
8.2 Flowcharts and Pseudocode	274
8.3 Logical Functions	276
8.4 Selection Structures	282
8.5 Debugging	298
Summary	299
MATLAB® Summary	300
Key Terms	300
Problems	300

9 • REPETITION STRUCTURES **311**

Introduction	311
9.1 For Loops	312
9.2 While Loops	320
9.3 Break and Continue	328
9.4 Midpoint Break Loops	329
9.5 Nested Loops	333
9.6 Improving the Efficiency of Loops	334
Summary	337
MATLAB® Summary	338
Key Terms	338
Problems	338

10 • MATRIX ALGEBRA **343**

Introduction	343
10.1 Matrix Operations and Functions	343
10.2 Solutions of Systems of Linear Equations	363
10.3 Special Matrices	377
Summary	380
MATLAB® Summary	382
Key Terms	382
Problems	382

11 • OTHER KINDS OF ARRAYS **390**

Introduction	390
11.1 Data Types	391
11.2 Multidimensional Arrays	400

11.3 Character Arrays	402
11.4 Cell Arrays	407
11.5 Structure Arrays	408
Summary	416
MATLAB® Summary	416
Key Terms	417
Problems	417

12 • SYMBOLIC MATHEMATICS

423

Introduction	423
12.1 Symbolic Algebra	424
12.2 Solving Expressions and Equations	432
12.3 Symbolic Plotting	445
12.4 Calculus	453
12.5 Differential Equations	467
12.6 Converting Symbolic Expressions to Anonymous Functions	470
Summary	471
MATLAB® Summary	473
Problems	474

13 • NUMERICAL TECHNIQUES

483

13.1 Interpolation	483
13.2 Curve Fitting	493
13.3 Using the Interactive Fitting Tools	506
13.4 Differences and Numerical Differentiation	509
13.5 Numerical Integration	518
13.6 Solving Differential Equations Numerically	524
Summary	531
MATLAB® Summary	533
Key Terms	534
Problems	534

14 • ADVANCED GRAPHICS

543

Introduction	543
14.1 Images	543
14.2 Handle Graphics	559
14.3 Animation	563
14.4 Other Visualization Techniques	569
14.5 Introduction to Volume Visualization	571
Summary	574
MATLAB® Summary	575
Key Terms	576
Problems	577

