

Introductory

TECHNICAL MATHEMATICS

5th Edition



Robert Smith & John C. Peterson

INTRODUCTORY TECHNICAL MATHEMATICS

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FIFTH EDITION

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Robert D. Smith
John C. Peterson



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Introductory Technical Mathematics, 5th Edition

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Contents

Preface xvii

SECTION I ■

Fundamentals of General Mathematics

I

UNIT 1 Whole Numbers

2

1-1	Place Value	2
1-2	Expanding Whole Numbers	3
1-3	Estimating (Approximating)	4
1-4	Addition of Whole Numbers	5
1-5	Subtraction of Whole Numbers	7
1-6	Problem Solving—Word Problem Practical Applications	8
1-7	Adding and Subtracting Whole Numbers in Practical Applications	9
1-8	Multiplication of Whole Numbers	11
1-9	Division of Whole Numbers	15
1-10	Multiplying and Dividing Whole Numbers in Practical Applications	18
1-11	Combined Operations of Whole Numbers	20
1-12	Combined Operations of Whole Numbers in Practical Applications	22
UNIT EXERCISE AND PROBLEM REVIEW		25
1-13	Computing with a Calculator: Whole Numbers	29

UNIT 2 Common Fractions

33

2-1	Definitions	33
2-2	Fractional Parts	34
2-3	A Fraction as an Indicated Division	35
2-4	Equivalent Fractions	35
2-5	Expressing Fractions in Lowest Terms	36
2-6	Expressing Mixed Numbers as Improper Fractions	36
2-7	Expressing Improper Fractions as Mixed Numbers	37
2-8	Division of Whole Numbers; Quotients as Mixed Numbers	38
2-9	Use of Common Fractions in Practical Applications	38
2-10	Addition of Common Fractions	40
2-11	Subtraction of Common Fractions	45
2-12	Adding and Subtracting Common Fractions in Practical Applications	48
2-13	Multiplication of Common Fractions	52

2-14	Multiplying Common Fractions in Practical Applications	56
2-15	Division of Common Fractions	59
2-16	Dividing Common Fractions in Practical Applications	62
2-17	Combined Operations with Common Fractions	65
2-18	Combined Operations of Common Fractions in Practical Applications	67
	UNIT EXERCISE AND PROBLEM REVIEW	69
2-19	Computing with a Calculator: Fractions and Mixed Numbers	74

UNIT 3 Decimal Fractions **81**

3-1	Meaning of Fractional Parts	82
3-2	Reading Decimal Fractions	82
3-3	Simplified Method of Reading Decimal Fractions	83
3-4	Writing Decimal Fractions	83
3-5	Rounding Decimal Fractions	84
3-6	Expressing Common Fractions as Decimal Fractions	84
3-7	Expressing Decimal Fractions as Common Fractions	85
3-8	Expressing Decimal Fractions in Practical Applications	86
3-9	Adding Decimal Fractions	88
3-10	Subtracting Decimal Fractions	88
3-11	Adding and Subtracting Decimal Fractions in Practical Applications	89
3-12	Multiplying Decimal Fractions	92
3-13	Multiplying Decimal Fractions in Practical Applications	95
3-14	Dividing Decimal Fractions	97
3-15	Dividing Decimal Fractions in Practical Applications	100
3-16	Powers and Roots of Decimal Fractions	103
3-17	Decimal Fraction Powers and Roots in Practical Applications	106
3-18	Table of Decimal Equivalents	109
3-19	Combined Operations of Decimal Fractions	112
3-20	Combined Operations of Decimal Fractions in Practical Applications	114
	UNIT EXERCISE AND PROBLEM REVIEW	118
3-21	Computing with a Calculator: Decimals	125

UNIT 4 Ratio and Proportion **131**

4-1	Description of Ratios	131
4-2	Order of Terms of Ratios	132
4-3	Description of Proportions	134
4-4	Direct Proportions	137
4-5	Inverse Proportions	139
	UNIT EXERCISE AND PROBLEM REVIEW	142

UNIT 5 Percents **146**

5-1	Definition of Percent	146
5-2	Expressing Decimal Fractions as Percents	147
5-3	Expressing Common Fractions and Mixed Numbers as Percents	147

5-4	Expressing Percents as Decimal Fractions	148
5-5	Expressing Percents as Common Fractions	149
5-6	Types of Simple Percent Problems	149
5-7	Finding Percentage in Practical Applications	152
5-8	Finding Percent (Rate) in Practical Applications	154
5-9	Finding the Base in Practical Applications	156
5-10	More Complex Percentage Practical Applications	157
	UNIT EXERCISE AND PROBLEM REVIEW	160

UNIT 6 Signed Numbers **164**

6-1	Meaning of Signed Numbers	164
6-2	The Number Line	166
6-3	Operations Using Signed Numbers	167
6-4	Absolute Value	167
6-5	Addition of Signed Numbers	168
6-6	Subtraction of Signed Numbers	171
6-7	Multiplication of Signed Numbers	172
6-8	Division of Signed Numbers	174
6-9	Powers of Signed Numbers	175
6-10	Roots of Signed Numbers	177
6-11	Combined Operations of Signed Numbers	180
6-12	Scientific Notation	182
6-13	Engineering Notation	188
	UNIT EXERCISE AND PROBLEM REVIEW	191

SECTION II

Measurement **197**

UNIT 7 Precision, Accuracy, and Tolerance **198**

7-1	Exact and Approximate (Measurement) Numbers	198
7-2	Degree of Precision of Measuring Instruments	199
7-3	Common Linear Measuring Instruments	199
7-4	Degree of Precision of a Measurement Number	200
7-5	Degrees of Precision in Adding and Subtracting Measurement Numbers	201
7-6	Significant Digits	202
7-7	Accuracy	203
7-8	Accuracy in Multiplying and Dividing Measurement Numbers	204
7-9	Absolute and Relative Error	204
7-10	Tolerance (Linear)	205
7-11	Unilateral and Bilateral Tolerance with Clearance and Interference Fits	207
	UNIT EXERCISE AND PROBLEM REVIEW	209

UNIT 8 Customary Measurement Units **214**

8-1	Customary Linear Units	214
8-2	Expressing Equivalent Units of Measure	215
8-3	Arithmetic Operations with Compound Numbers	218

8-4	Customary Linear Measure Practical Applications	222
8-5	Customary Units of Surface Measure (Area)	225
8-6	Customary Area Measure Practical Applications	227
8-7	Customary Units of Volume (Cubic Measure)	228
8-8	Customary Volume Practical Applications	229
8-9	Customary Units of Capacity	230
8-10	Customary Capacity Practical Applications	231
8-11	Customary Units of Weight (Mass)	232
8-12	Customary Weight Practical Applications	233
8-13	Compound Units	233
8-14	Compound Units Practical Applications	235
	UNIT EXERCISE AND PROBLEM REVIEW	237

UNIT 9 Metric Measurement Units **240**

9-1	Metric Units of Linear Measure	240
9-2	Expressing Equivalent Units within the Metric System	242
9-3	Arithmetic Operations with Metric Lengths	244
9-4	Metric Linear Measure Practical Applications	244
9-5	Metric Units of Surface Measure (Area)	246
9-6	Arithmetic Operations with Metric Area Units	247
9-7	Metric Area Measure Practical Applications	248
9-8	Metric Units of Volume (Cubic Measure)	248
9-9	Arithmetic Operations with Metric Volume Units	250
9-10	Metric Volume Practical Applications	250
9-11	Metric Units of Capacity	251
9-12	Metric Capacity Practical Applications	252
9-13	Metric Units of Weight (Mass)	253
9-14	Metric Weight Practical Applications	254
9-15	Compound Units	254
9-16	Compound Units Practical Applications	256
9-17	Metric Prefixes Applied to Very Large and Very Small Numbers	257
9-18	Conversion Between Metric and Customary Systems	261
	UNIT EXERCISE AND PROBLEM REVIEW	264

UNIT 10 Steel Rules and Vernier Calipers **268**

10-1	Types of Steel Rules	268
10-2	Reading Fractional Measurements	268
10-3	Measurements that Do Not Fall on Rule Graduations	270
10-4	Reading Decimal-Inch Measurements	271
10-5	Reading Metric Measurements	272
10-6	Vernier Calipers: Types and Description	273
10-7	Reading Measurements on a Customary Vernier Caliper	275
10-8	Reading Measurements on a Metric Vernier Caliper	277
	UNIT EXERCISE AND PROBLEM REVIEW	279

UNIT 11	Micrometers	281
11-1	Description of a Customary Outside Micrometer	281
11-2	Reading a Customary Micrometer	282
11-3	The Customary Vernier Micrometer	283
11-4	Reading a Customary Vernier Micrometer	284
11-5	Description of a Metric Micrometer	286
11-6	Reading a Metric Micrometer	286
11-7	The Metric Vernier Micrometer	287
11-8	Reading a Metric Vernier Micrometer	288
	UNIT EXERCISE AND PROBLEM REVIEW	290
SECTION III	Fundamentals of Algebra	293
UNIT 12	Introduction to Algebra	294
12-1	Symbolism	294
12-2	Algebraic Expressions	294
12-3	Evaluation of Algebraic Expressions	297
	UNIT EXERCISE AND PROBLEM REVIEW	302
UNIT 13	Basic Algebraic Operations	305
13-1	Definitions	305
13-2	Addition	306
13-3	Subtraction	308
13-4	Multiplication	311
13-5	Division	314
13-6	Powers	318
13-7	Roots	321
13-8	Removal of Parentheses	324
13-9	Combined Operations	325
13-10	Basic Structure of the Binary Numeration System	326
	UNIT EXERCISE AND PROBLEM REVIEW	330
UNIT 14	Simple Equations	336
14-1	Expression of Equality	336
14-2	Writing Equations from Word Statements	337
14-3	Checking the Equation	339
14-4	Principles of Equality	341
14-5	Solution of Equations by the Subtraction Principle of Equality	341
14-6	Solution of Equations by the Addition Principle of Equality	344
14-7	Solution of Equations by the Division Principle of Equality	347
14-8	Solution of Equations by the Multiplication Principle of Equality	349
14-9	Solution of Equations by the Root Principle of Equality	352
14-10	Solution of Equations by the Power Principle of Equality	354
	UNIT EXERCISE AND PROBLEM REVIEW	356

UNIT 15	Complex Equations	359
15-1	Equations Consisting of Combined Operations	359
15-2	Solving for the Unknown in Formulas	363
15-3	Substituting Values Directly in Given Formulas	363
15-4	Rearranging Formulas	366
	UNIT EXERCISE AND PROBLEM REVIEW	370
UNIT 16	The Cartesian Coordinate System and Graphs of Linear Equations	373
16-1	Description of the Cartesian (Rectangular) Coordinate System	373
16-2	Graphing a Linear Equation	374
16-3	Slope of a Linear Equation	377
16-4	Slope Intercept Equation of a Straight Line	378
16-5	Point-Slope Equation of a Straight Line	378
16-6	Determining an Equation, Given Two Points	379
16-7	Describing a Straight Line	380
	UNIT EXERCISE AND PROBLEM REVIEW	383
UNIT 17	Systems of Equations	385
17-1	Graphical Method of Solving Systems of Equations	385
17-2	Substitution Method of Solving Systems of Equations	387
17-3	Addition or Subtraction Method of Solving Systems of Equations	388
17-4	Types of Systems of Equations	392
17-5	Determinants	393
17-6	Cramer's Rule	394
17-7	Writing and Solving Systems of Equations from Word Statements, Number Problems, and Practical Applications	395
	UNIT EXERCISE AND PROBLEM REVIEW	401
UNIT 18	Quadratic Equations	403
18-1	General or Standard Form of Quadratic Equations	403
18-2	Incomplete Quadratic Equations ($ax^2 = c$)	404
18-3	Complete Quadratic Equations	408
18-4	Practical Applications of Complete Quadratic Equations. Equations Given.	411
18-5	Word Problems Involving Complete Quadratic Equations. Equations Not Given.	417
	UNIT EXERCISE AND PROBLEM REVIEW	421
SECTION IV	Fundamentals of Plane Geometry	423
UNIT 19	Introduction to Plane Geometry	424
19-1	Plane Geometry	424
19-2	Axioms and Postulates	425
19-3	Points and Lines	428
	UNIT EXERCISE AND PROBLEM REVIEW	429

UNIT 20	Angular Measure	430
20-1	Units of Angular Measure	430
20-2	Units of Angular Measure in Degrees, Minutes, and Seconds	431
20-3	Expressing Degrees, Minutes, and Seconds as Decimal Degrees	432
20-4	Expressing Decimal Degrees as Degrees, Minutes, and Seconds	432
20-5	Arithmetic Operations on Angular Measure in Degrees, Minutes, and Seconds	435
20-6	Simple Semicircular Protractor	441
20-7	Complements and Supplements of Scale Readings	445
	UNIT EXERCISE AND PROBLEM REVIEW	445
UNIT 21	Angular Geometric Principles	448
21-1	Naming Angles	448
21-2	Types of Angles	448
21-3	Angles Formed by a Transversal	449
21-4	Theorems and Corollaries	451
	UNIT EXERCISE AND PROBLEM REVIEW	458
UNIT 22	Triangles	461
22-1	Types of Triangles	462
22-2	Angles of a Triangle	464
22-3	Isosceles and Equilateral Triangles	468
22-4	Isosceles Triangle Practical Applications	468
22-5	Equilateral Triangle Practical Applications	469
22-6	The Pythagorean Theorem	470
22-7	Pythagorean Theorem Practical Applications	470
	UNIT EXERCISE AND PROBLEM REVIEW	473
UNIT 23	Congruent and Similar Figures	477
23-1	Congruent Figures	477
23-2	Similar Figures	479
23-3	Practical Applications of Similar Triangles	482
	UNIT EXERCISE AND PROBLEM REVIEW	488
UNIT 24	Polygons	491
24-1	Types of Polygons	491
24-2	Types of Quadrilaterals	493
24-3	Polygon Interior and Exterior Angles	495
24-4	Practical Applications of Polygon Interior and Exterior Angles	495
24-5	Practical Applications of Trapezoid Median	500
	UNIT EXERCISE AND PROBLEM REVIEW	502
UNIT 25	Circles	505
25-1	Definitions	505
25-2	Circumference Formula	507

25-3	Arc Length Formula	508
25-4	Radian Measure	510
25-5	Circle Postulates	512
25-6	Chords, Arcs, and Central Angles	513
25-7	Practical Applications of Circle Chord Bisector	515
25-8	Circle Tangents and Chord Segments	518
25-9	Practical Applications of Circle Tangent	518
25-10	Practical Applications of Tangents from a Common Point	519
25-11	Angles Formed Inside and on a Circle	522
25-12	Practical Applications of Inscribed Angles	523
25-13	Practical Applications of Tangent and Chord	524
25-14	Angles Outside a Circle	526
25-15	Internally and Externally Tangent Circles	528
25-16	Practical Applications of Internally Tangent Circles	529
25-17	Practical Applications of Externally Tangent Circles	530
	UNIT EXERCISE AND PROBLEM REVIEW	534

SECTION V **Geometric Figures: Areas and Volumes** **541****UNIT 26 Areas of Common Polygons** **542**

26-1	Areas of Rectangles	542
26-2	Areas of Parallelograms	546
26-3	Areas of Trapezoids	550
26-4	Areas of Triangles Given the Base and Height	553
26-5	Areas of Triangles Given Three Sides	555
	UNIT EXERCISE AND PROBLEM REVIEW	559

UNIT 27 Areas of Circles, Sectors, Segments, and Ellipses **564**

27-1	Areas of Circles	564
27-2	Ratio of Two Circles	565
27-3	Areas of Sectors	568
27-4	Areas of Segments	570
27-5	Areas of Ellipses	572
	UNIT EXERCISE AND PROBLEM REVIEW	574

UNIT 28 Prisms and Cylinders: Volumes, Surface Areas, and Weights **578**

28-1	Prisms	578
28-2	Volumes of Prisms	578
28-3	Cylinders	582
28-4	Volumes of Cylinders	582
28-5	Computing Heights and Bases of Prisms and Cylinders	584
28-6	Lateral Areas and Surface Areas of Right Prisms and Cylinders	586
	UNIT EXERCISE AND PROBLEM REVIEW	589

UNIT 29	Pyramids and Cones: Volumes, Surface Areas, and Weights	591
29-1	Pyramids	591
29-2	Cones	592
29-3	Volumes of Regular Pyramids and Right Circular Cones	592
29-4	Computing Heights and Bases of Regular Pyramids and Right Circular Cones	594
29-5	Lateral Areas and Surface Areas of Regular Pyramids and Right Circular Cones	595
29-6	Frustums of Pyramids and Cones	598
29-7	Volumes of Frustums of Regular Pyramids and Right Circular Cones	599
29-8	Lateral Areas and Surface Areas of Frustums of Regular Pyramids and Right Circular Cones	601
	UNIT EXERCISE AND PROBLEM REVIEW	605
UNIT 30	Spheres and Composite Figures: Volumes, Surface Areas, and Weights	607
30-1	Spheres	607
30-2	Surface Area of a Sphere	608
30-3	Volume of a Sphere	608
30-4	Volumes and Surface Areas of Composite Solid Figures	610
	UNIT EXERCISE AND PROBLEM REVIEW	615
SECTION VI	Basic Statistics	617
	UNIT 31	Graphs: Bar, Circle, and Line
		618
31-1	Types and Structure of Graphs	618
31-2	Reading Bar Graphs	619
31-3	Drawing Bar Graphs	624
31-4	Drawing Bar Graphs with a Spreadsheet	626
31-5	Circle Graphs	631
31-6	Drawing Circle Graphs with a Spreadsheet	635
31-7	Line Graphs	637
31-8	Reading Line Graphs	638
31-9	Reading Combined-Data Line Graphs	640
31-10	Drawing Line Graphs	644
31-11	Drawing Broken-Line Graphs	644
31-12	Drawing Broken-Line Graphs with a Spreadsheet	646
31-13	Drawing Straight-Line Graphs	648
31-14	Drawing Curved-Line Graphs	649
	UNIT EXERCISE AND PROBLEM REVIEW	653
UNIT 32	Statistics	657
32-1	Probability	657
32-2	Independent Events	659

32-3	Mean Measurement	661
32-4	Other Average Measurements	663
32-5	Quartiles and Percentiles	664
32-6	Grouped Data	667
32-7	Variance and Standard Deviation	672
32-8	Statistical Process Control: <i>X</i> -Bar Charts	677
32-9	Statistical Process Control: <i>R</i> -Charts	681
	UNIT EXERCISE AND PROBLEM REVIEW	685

SECTION VII ■■■**Fundamentals of Trigonometry** **687****UNIT 33 Introduction to Trigonometric Functions** **688**

33-1	Ratio of Right Triangle Sides	688
33-2	Identifying Right Triangle Sides by Name	689
33-3	Trigonometric Functions: Ratio Method	690
33-4	Customary and Metric Units of Angular Measure	692
33-5	Determining Functions of Given Angles and Determining Angles of Given Functions	692
	UNIT EXERCISE AND PROBLEM REVIEW	696

UNIT 34 Trigonometric Functions with Right Triangles **699**

34-1	Variation of Functions	699
34-2	Functions of Complementary Angles	701
34-3	Determining an Unknown Angle When Two Sides of a Right Triangle Are Known	703
34-4	Determining an Unknown Angle When an Acute Angle and One Side of a Right Triangle Are Known	705
	UNIT EXERCISE AND PROBLEM REVIEW	709

UNIT 35 Practical Applications with Right Triangles **711**

35-1	Solving Problems Stated in Word Form	711
35-2	Solving Problems Given in Picture Form that Require Auxiliary Lines	716
35-3	Solving Complex Problems that Require Auxiliary Lines	725
	UNIT EXERCISE AND PROBLEM REVIEW	734

UNIT 36 Functions of Any Angle, Oblique Triangles **739**

36-1	Cartesian (Rectangular) Coordinate System	739
36-2	Determining Functions of Angles in Any Quadrant	740
36-3	Alternating Current Applications	743
36-4	Determining Functions of Angles Greater Than 360°	746
36-5	Instantaneous Voltage Related to Time Application	747
36-6	Solving Oblique Triangles	748
36-7	Law of Sines	748
36-8	Solving Problems Given Two Angles and a Side, Using the Law of Sines	749

36–9	Solving Problems Given Two Sides and an Angle Opposite One of the Given Sides, Using the Law of Sines	751
36–10	Law of Cosines (Given Two Sides and the Included Angle)	755
36–11	Solving Problems Given Two Sides and the Included Angle, Using the Law of Cosines	755
36–12	Law of Cosines (Given Three Sides)	758
36–13	Solving Problems Given Three Sides, Using the Law of Cosines	759
36–14	Practical Applications of Oblique Triangles	762
	UNIT EXERCISE AND PROBLEM REVIEW	769

UNIT 37 **Vectors**

774

37–1	Scalar and Vector Quantities	774
37–2	Description and Naming Vectors	774
37–3	Vector Ordered Pair Notation	775
37–4	Vector Length and Angle Notation	776
37–5	Adding Vectors	776
37–6	Graphic Addition of Vectors	778
37–7	Addition of Vectors Using Trigonometry	782
37–8	General (Component Vector) Procedure for Vectors Using Trigonometry	788
	UNIT EXERCISE AND PROBLEM REVIEW	793
	APPENDIX A United States Customary and Metric Units of Measure	796
	APPENDIX B Formulas for Areas (A) of Plane Figures	798
	APPENDIX C Formulas for Volumes and Areas of Solid Figures	799
	APPENDIX D Answers to Odd-Numbered Exercises	800
	INDEX	845

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Preface

Introductory Technical Mathematics is written to provide practical vocational and technical applications of mathematical concepts. Presentation of concepts is followed by applied examples and problems that have been drawn from diverse occupational fields.

Both content and method have been used by the authors in teaching related technical mathematics on both the secondary and postsecondary levels. Each unit is developed as a learning experience based on preceding units. The applied examples and problems progress from simple to those whose solutions are relatively complex. Many problems require the student to work with illustrations such as are found in trade and technical manuals, handbooks, and drawings.

The book was written from material developed for classroom use and it is designed for classroom purposes. However, the text is also very appropriate for self-instruction use. Great care has been taken in presenting explanations clearly and in giving easy-to-follow procedural steps in solving examples. One or more examples are given for each mathematical concept presented. Throughout the book, practical application examples from various occupations are shown to illustrate the actual on-the-job uses of the mathematical concept. Students often ask, “Why do we have to learn this material and of what practical value is it?” This question was constantly kept in mind in writing the book and every effort was made to continuously provide an answer.

An understanding of mathematical concepts is emphasized in all topics. Much effort was made to avoid the mechanical *plug-in* approach often found in mathematics textbooks. A practical rather than an academic approach to mathematics is taken. Derivations and formal proofs are not presented; instead, understanding of concepts followed by the application of concepts in real situations is stressed.

Student exercises and applied problems immediately follow the presentation of concept and examples. Exercises and occupationally related problems are included at the end of each unit. The book contains a sufficient number of exercises and problems to permit the instructor to selectively plan assignments.

Illustrations, examples, exercises, and practical problems expressed in metric units of measure are a basic part of the content of the entire text. Emphasis is placed on the ability of the student to think and to work with equal ease with both the customary and the metric systems.

An analytical approach to problem solving is emphasized in the geometry and trigonometry sections. The approach is that which is used in actual on-the-job trade and technical occupation applications. Integration of algebraic and geometric principles with trigonometry by careful sequencing and treatment of material also helps the student in solving occupationally-related problems.

The majority of instructors state that their students are required to perform basic arithmetic operations on whole numbers, fractions, and decimals prior to calculator usage. Thereafter, the students use the calculator almost exclusively in problem-solving computations. The structuring of calculator instructions and examples in this text reflect the instructors’ preferences. The scientific calculator is introduced at the end of this Preface. Extensive calculator instruction and examples are given directly following each of the units on whole numbers, fractions and mixed numbers, and decimals. Further calculator instruction and examples are given throughout the text wherever calculator applications are appropriate to the material presented. Often there are

differences in the methods of computation among various makes and models of calculators. Where there are two basic ways of performing calculations, both ways are shown.

An extensive survey of instructors using the fourth edition was conducted. Based on instructor comments and suggestions, significant changes were made. The result is an updated and improved fifth edition, which includes the following revisions:

- Throughout the book content has been reviewed and revised to clarify and update wherever relevant.
- Section VI, Basic Statistics, is a new section. This includes a new unit on statistics and a unit that consolidates all of the statistical graphing techniques of bar, line, and circle graphs.
- The metric and the customary systems of measure have been placed in separate units.
- New material on conversion between the metric and the customary systems of measure has been added to the unit on the metric system and to Appendix A.
- The use of spreadsheets for graphing has been included. Most students learn the basics of working with spreadsheets outside of the mathematics classroom. This material builds on that experience.

The following supplementary materials are available to instructors:

- Instructor's Guide consisting of solutions and answers to all problems.
- Student Solutions Manual for solutions to all odd-numbered exercises and problems.
- An e.resource containing:
 - Computerized Test Bank
 - PowerPoint Presentation Slides
 - Image Library

About the Authors

Robert D. Smith was Associate Professor Emeritus of Industrial Technology at Central Connecticut State University, New Britain, Connecticut. Mr. Smith has had experience in the manufacturing industry as tool designer, quality control engineer, and chief manufacturing engineer. He has also been active in teaching applied mathematics, physics, and industrial materials and processes on the secondary school level and in apprenticeship programs. He is the author of Thomson Delmar Learning's *Mathematics for Machine Technology*.

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Introduction to the Scientific Calculator

A scientific calculator is to be used in conjunction with the material presented in this textbook. Complex mathematical calculations can be made quickly, accurately, and easily with a scientific calculator.

Although most functions are performed in the same way, there are some differences among different makes and models of scientific calculators. In this book, generally, where there are two basic ways of performing a function, both ways are shown. However, not all of the differences among the various makes and models of calculators can be shown. It is very important that you become familiar with the operation of your scientific calculator. An owner's manual or reference guide is included with the purchase of a scientific calculator, explains the essential features and keys of the specific calculator, as well as providing detailed information on the proper use. *It is essential that the owner's manual be studied and referred to whenever there is a question regarding calculator usage.*

For use with this textbook, the most important feature of the scientific calculator is the Algebraic Operating System (AOS[™]). This system, which uses algebraic logic, permits you to enter numbers and combined operations into the calculator in the same order as the expressions are written. The calculator performs combined operations according to the rules of algebraic logic, which assigns priorities to the various mathematical operations. *It is essential that you know if your calculator uses algebraic logic.*

Most scientific calculators, in addition to the basic arithmetic functions, have algebraic, statistical, conversion, and program or memory functions. Some of the keys with their functions are shown in the above table. Most scientific calculators have functions in addition to those shown in the table.

SOME TYPICAL KEY SYMBOLS AND FUNCTIONS FOR A SCIENTIFIC CALCULATOR	
KEY(s)	FUNCTION(s)
[+], [−], [×], [÷], [=], or [EXE], or [ENTER]	Basic Arithmetic
[+/-] or [(-)]	Change Sign
[π]	Pi
[(),]	Parentheses
[EE] or [EXP]	Scientific Notation
[Eng]	Engineering Notation
[STO], [RCL], [EXC]	Memory or Memories
[x ²], [√x]	Square and Square Root
[$\sqrt[y]{x}$], [\sqrt{y}]	Root
[y ^x] or [x ^y]	Power
[1/x] or [x ⁻¹]	Reciprocal
[%]	Percent
[a ^{b/c}] or [A ^{b/c}]	Fractions and Mixed Numbers
[DRG]	Degrees, Radians, and Graduations
[DMS] or [°'"]	Degrees, Minutes, and Seconds
[sin], [cos], [tan]	Trigonometric Functions

General Information About the Scientific Calculator

Since there is some variation among different makes and models of scientific calculators, your calculator function keys may be different from the descriptions that follow. *To repeat, it is very*

important that you refer to the owner's manual whenever there is a question regarding calculator usage.

- Solutions to combined operations shown in this text are performed on a calculator with algebraic logic (AOS[™]).

Turning the Calculator On and Off

- The method of turning the calculator on with battery-powered calculators depends on the calculator make and model. When a calculator is turned on, 0 and/or other indicators are displayed. Basically, a calculator is turned on and off by one of the following ways.
- With calculators with an on/clear, $\boxed{\text{ON/C}}$, key, press $\boxed{\text{ON/C}}$ to turn on. Press the $\boxed{\text{OFF}}$ key to turn off.
- With calculators with an all clear power on/power off, $\boxed{\text{AC}}$, key, press $\boxed{\text{AC}}$ to turn on. Generally, the $\boxed{\text{AC}}$ key is also pressed to turn off.
- With calculators that have an on-off switch, move the switch either on or off. The switch is usually located on the left side of the calculator.
- NOTE: In order to conserve power, most calculators have an automatic power off feature that automatically switches off the power after approximately five minutes of nonuse.

Clearing the Calculator Display and all Pending Operations

- To clear or erase *all* entries of previous calculations, depending on the calculator, either of the following procedures is used.
- With calculators with an on/clear, $\boxed{\text{ON/C}}$, key, press $\boxed{\text{ON/C}}$ twice.
- With calculators with the all clear, $\boxed{\text{AC}}$, key, press $\boxed{\text{AC}}$.

Erasing (Deleting) the Last Calculator Entry

- A last entry error can be removed and corrected without erasing previously entered data and calculations. Depending on the calculator, either of the following procedures is used.
- With calculators with the on/clear, $\boxed{\text{ON/C}}$, key, press $\boxed{\text{ON/C}}$.
- With calculators with a delete, $\boxed{\text{DEL}}$, key, press $\boxed{\text{DEL}}$. If your calculator has a backarrow, $\boxed{\leftarrow}$, key, use it to move the cursor to the part you want to delete.
- With calculators with a clear, $\boxed{\text{CLEAR}}$, key, press $\boxed{\text{CLEAR}}$.

Alternate–Function Keys

- Most scientific calculator keys can perform more than one function. Depending on the calculator, the $\boxed{2^{\text{nd}}}$ and $\boxed{3^{\text{rd}}}$ keys or $\boxed{\text{SHIFT}}$ key enable you to use alternate functions. The alternate functions are marked above the key and/or on the upper half of the key. Alternate functions are shown and explained in the book where their applications are appropriate to specific content.

Decisions Regarding Calculator Use

The exercises and problems presented throughout the text are well suited for solutions by calculator. However, it is felt decisions regarding calculator usage should be left to the discretion of the course classroom or shop instructor. The instructor best knows the unique learning environment and objectives to be achieved by the students in a course. Judgments should be made by the instructor as to the degree of emphasis to be placed on calculator applications, when and where a calculator is to be used, and the selection of specific problems for solution by calculator. Therefore, exercises and problems in this text are *not* specifically identified as calculator applications.

Calculator instruction and examples of the basic operations of addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals are presented at the ends of each of Units 1, 2, and 3. Further calculator instruction and examples of mathematics operations and functions are given throughout the text wherever calculator applications are appropriate to the material presented.

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SECTION I ■

Fundamentals of General Mathematics

- [*Selected Writings \(Penguin Classics\) here*](#)
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