

Introductory

# TECHNICAL MATHEMATICS

5th Edition



Robert Smith & John C. Peterson

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# **INTRODUCTORY TECHNICAL MATHEMATICS**

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FIFTH EDITION

# INTRODUCTORY TECHNICAL MATHEMATICS

**Robert D. Smith**  
**John C. Peterson**



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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<sup>™</sup>). 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 <sup>2</sup> ], [√x]	Square and Square Root
[ $\sqrt[y]{}$ ], [ $\sqrt{}$ ]	Root
[y <sup>x</sup> ] or [x <sup>y</sup> ]	Power
[1/x] or [x <sup>-1</sup> ]	Reciprocal
[%]	Percent
[a <sup>b/c</sup> ] or [A <sup>b/c</sup> ]	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<sup>™</sup>).

### 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



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