Basic Technical Mathematics with Calculus

SI Version

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TENTH EDITION

Basic Technical Mathematics with Calculus

SI Version

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PEARSON

Toronto

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PEARSON

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To Douglas, Julia and Andrea ~Michelle Boué

In memory of my loving wife, Millie ~Allyn J. Washington

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Preface

Scope of the Book

Basic Technical Mathematics with Calculus, SI Version, tenth edition, is intended primarily for students in technical and pre-engineering technology programs or other programs for which coverage of basic mathematics is required. Chapters 1 through 20 provide the necessary background for further study, with an integrated treatment of algebra and trigonometry. Chapter 21 covers the basic topics of analytic geometry, and Chapter 22 gives an introduction to statistics. Fundamental topics of calculus are covered in Chapters 23 through 31. In the examples and exercises, numerous applications from many fields of technology are included, primarily to indicate where and how mathematical techniques are used. However, it is not necessary that the student have a specific knowledge of the technical area from which any given problem is taken.

Most students using this text will have a background that includes some algebra and geometry. However, the material is presented in adequate detail for those who may need more study in these areas. The material presented here is sufficient for three to four semesters.

One of the principal reasons for the arrangement of topics in this text is to present material in an order that allows a student to take courses concurrently in allied technical areas, such as physics and electricity. These allied courses normally require a student to know certain mathematical topics by certain definite times; yet the traditional order of topics in mathematics courses makes it difficult to attain this coverage without loss of continuity. However, the material in this book can be rearranged to fit any appropriate sequence of topics. Another feature of this text is that certain topics traditionally included for mathematical completeness have been covered only briefly or have been omitted. The approach used in this text is not unduly rigorous mathematically, although all appropriate terms and concepts are introduced as needed and given an intuitive or algebraic foundation. The aim is to help the student develop an understanding of mathematical methods without simply providing a collection of formulas. The text material has been developed with the recognition that it is essential for the student to have a sound background in algebra and trigonometry in order to understand and succeed in any subsequent work in mathematics.

New Features

In this tenth edition of *Basic Technical Mathematics with Calculus, SI Version*, we have retained all the basic features of successful previous editions and have also introduced a number of improvements, described here.

NEW AND REVISED COVERAGE

The topics of units and measurement covered in an appendix in the ninth edition have been expanded and integrated into Chapter 1, together with new discussions on rounding and on engineering notation. Interval notation is introduced in Chapter 3 and is used in several sections throughout the text. Chapter 31 includes a new subsection on solving nonhomogeneous differential equations using Fourier series.

Chapter 22 has been revised and expanded; a new section on summarizing data covers measures of central tendency, measures of spread, and new material on Chebychev's theorem; the section on normal distributions now includes a subsection on sampling distributions. In addition, the chapter now includes a completely new section on confidence intervals.

EXPANDED PEDAGOGY

- NEW "Common Error" boxes appear throughout the text. A fresh design emphasizes valuable warnings against common mistakes or areas where students frequently have difficulty. These boxes replace the notes flagged by a "Caution" indicator in the previous edition.

- NEW "Learning Tip" boxes appear in the margin throughout the text. These colourful boxes highlight the underlying rationale of using specific mathematical functions and encourage students to think strategically about how and why specific mathematical concepts are needed and applied. They also focus attention on material that is of particular importance in understanding the topic under discussion. These boxes replace the notes flagged by a "Notes" indicator in the previous edition.
- NEW "Procedure" boxes include step-by-step instructions on how to perform select calculations.

FEWER CALCULATOR SCREENS

Many figures involving screens from a graphic calculator have been either removed from the text or replaced by regular graphs. The calculator displays that remain are, for the most part, related to topics that require the use of technology (such as the graphical solution of systems of equations) or topics where technology can greatly simplify a process (such as obtaining the inverse of a large matrix). The appendix on graphing calculators from the previous edition dedicated to the graphing calculator will be available in Chapter 34 of the Study Plan in both MyMathLab and MathXL versions of this course. Students will also have easy access to it through the eText in MyMathLab.

FUNCTIONAL USE OF COLOUR

The new full-colour design of this edition uses colour effectively for didactical purposes. Many figures and graphs have been enhanced with colour. Moreover, colour is used to identify and focus attention on the text's new pedagogical features. Colour is also used to highlight the question numbers of writing exercises so that students and instructors can identify them easily.

NOTATION

Symbols used in accordance with professional Canadian standards are applied consistently throughout the text.

INCREASED BREADTH OF APPLICATIONS

New examples and exercises have been added in order to increase the range of applications covered by the text. New material can be found involving statics, fluid mechanics, optics, acoustics, cryptography, forestry, reliability, and quality control, to name but a few.

INTERNATIONAL CANADIAN CONTENT

New Canadian content appears either in the form of examples within the text (some of which are linked to chapter openers, so they are accompanied by a full colour image), or as exercises at the end of a section or chapter. All material of global interest has been retained or updated, and some new exercises were also added.

LEARNING OUTCOMES

A list of Learning Outcomes appears on the introductory page of each chapter, replacing the list of key topics for each section in the previous edition. This new learning tool reflects the current emphasis on learning outcomes and gives the student and instructor a quick way of checking that they have covered key contents of the chapter.

Continuing Features

EXAMPLE DESCRIPTIONS

A brief descriptive title is given with each example number. This gives an easy reference for the example, which is particularly helpful when a student is reviewing the contents of the section.

PRACTICE EXERCISES

Throughout the text, there are *practice exercises* in the margin. Most sections have at least one (and up to as many as four) of these basic exercises. They are included so that a student is more actively involved in the learning process and can check his or her understanding of the material to that point in the section. They can also be used for classroom exercises. The answers to these exercises are given at the end of the exercise set for the section.

NEW EXERCISES

More than 300 exercises are new or have been updated. This tenth edition contains a total of about 12 500 exercises.

CHAPTER INTRODUCTIONS

Each chapter introduction illustrates specific examples of how the development of technology has been related to the development of mathematics. These introductions show that past discoveries in technology led to some of the methods in mathematics, whereas in other cases mathematical topics already known were later very useful in bringing about advances in technology.

SPECIAL EXPLANATORY COMMENTS

Throughout the book, special explanatory comments in colour have been used in the examples to emphasize and clarify certain important points. Arrows are often used to indicate clearly the part of the example to which reference is made.

IMPORTANT FORMULAS

Throughout the book, important formulas are set off and displayed so that they can be easily referenced.

SUBHEADS AND KEY TERMS

Many sections include subheads to indicate where the discussion of a new topic starts within the section. Key terms are noted in the margin for emphasis and easy reference.

EXERCISES DIRECTLY REFERENCED TO TEXT EXAMPLES

The first few exercises in most of the text sections are referenced directly to a specific example of the section. These exercises are worded so that it is necessary for the student to refer to the example in order to complete the required solution. In this way, the student should be able to review and understand the text material better before attempting to solve the exercises that follow.

WRITING EXERCISES

One specific writing exercise is included at the end of each chapter. These exercises give the students practice in explaining their solutions. Also, there are more than 400 additional exercises throughout the book (at least 8 in each chapter) that require at least a sentence or two of explanation as part of the answer. The question numbers of writing exercises are highlighted in colour. A special "Index of Writing Exercises" is included at the back of the book.

WORD PROBLEMS

There are more than 120 examples throughout the text that show the complete solutions of word problems. There are also more than 850 exercises in which word problems are to be solved.

CHAPTER EQUATIONS, REVIEW EXERCISES, AND PRACTICE TESTS

At the end of each chapter, all important equations are listed together for easy reference. Each chapter is also followed by a set of review exercises that covers all the material in the chapter. Following the chapter equations and review exercises is a chapter practice

test that students can use to check their understanding of the material. Solutions to all practice test problems are given in the back of the book.

APPLICATIONS

Examples and exercises illustrate the application of mathematics in all fields of technology. Many relate to modern technology such as computer design, electronics, solar energy, lasers, fibre optics, the environment, and space technology. A special "Index of Applications" is included near the end of the book.

EXAMPLES

There are more than 1400 worked examples in this text. Of these, more than 300 illustrate technical applications.

FIGURES

There are more than 1300 figures in the text. Approximately 20% of the figures are new or have been modified for this edition.

MARGIN NOTES

Throughout the text, some margin notes briefly point out relevant historical events in mathematics and technology. Other margin notes are used to make specific comments related to the text material. Also, where appropriate, equations from earlier material are shown for reference in the margin.

ANSWERS TO EXERCISES

The answers to all odd-numbered exercises (except the end-of-chapter writing exercises) are given at the back of the book. The *Student's Solution Manual* contains revised solutions for every other odd-numbered exercise and can be accessed via MyMathLab as well as PCL. The *Instructor's Solution Manual* contains solutions for all section exercises.

FLEXIBILITY OF MATERIAL COVERAGE

The order of material coverage can be changed in many places, and certain sections may be omitted without loss of continuity of coverage. Users of earlier editions have indicated the successful use of numerous variations in coverage. Any changes will depend on the type of course and completeness required.

Supplements

SUPPLEMENTS FOR THE INSTRUCTOR

Instructor's resources include the following supplements.

Instructor's Solutions Manual
The *Instructor's Solution Manual* contains detailed solutions to every section exercise, including review exercises.

Animated PowerPoint Presentations
More than 150 animated slides are available for download from a protected location on Pearson Education's online catalogue, at www.pearsoned.ca.

Each slide offers a step-by-step mini lesson on an individual section, or key concept, formula, or equation from the first 28 chapters of the book. For instance, 15 steps for using the "General Power Formula for Integration" are beautifully illustrated in the animated slide for Chapter 28. There are two sets of slides for "Operations with Complex Numbers" for section 2 of Chapter 12; the 9 steps to perform addition are shown on one slide, and the 13 steps to perform subtraction appear on the second slide.

These animated slides offer bite-sized chunks of key information for students to review and process prior to going to the homework questions for practice. Please note that not every section in every chapter is accompanied by an animated slide as some topics lend themselves to this approach more than others.

TestGen with Algorithmically Generated Questions
Instructors can easily create tests from textbook section objectives. Algorithmically generated questions allow unlimited versions. Instructors can edit problems or create their own by using the built-in question editor to generate graphs; import graphics; and insert math notation, variable numbers, or text. Tests can be printed or administered online via the Web or other network.

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- **Expert tutoring:** Although many students describe the whole of MyMathLab as "like having your own personal tutor," students using MyMathLab do have access to live tutoring from Pearson, from qualified mathematics and statistics instructors who provide tutoring sessions for students via MyMathLab.

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