PREFACE

Following the format of previous editions, the fifth edition of *Introduction to Environmental Engineering* is designed for use in an introductory sophomore-level environmental engineering course with sufficient depth to allow its use in more advanced courses. We assume that the book will be used in one of the first environmental engineering courses encountered by the student. As such, it provides the fundamental science and engineering principles that instructors in more advanced courses may assume are common knowledge for an advanced undergraduate.

The fifth edition has been reorganized. New chapters on risk assessment, water chemistry, and sustainability and green engineering are included. The risk assessment chapter includes material that was formerly in the chapter on hazardous waste management. It now includes introductory material on probability and risk that is used both in this chapter and in the chapters on water resources engineering and sustainability.

The water chemistry material that was formerly included with water treatment is now presented as a separate chapter. More environmental chemistry concepts are introduced at the beginning of the chapters in which they are relevant. This format integrates the chemistry fundamentals with their application to the subject matter of the chapter. It provides the student with the tools to analyze and understand the environmental engineering issues described in the chapter as well as providing an immediate feedback of the relevance of the basic chemistry. There are over 100 end-of-chapter chemistry-related problems spread throughout the text.

A new chapter on sustainability and green engineering focuses on water resources and energy. Population growth and climate change implications are discussed. This chapter uses water resource engineering concepts presented in Chapter 4 to discuss floods and droughts. Energy conservation measures in building design, water, and wastewater treatment are highlighted.

The Fundamentals of Engineering (FE) examination for civil and environmental engineering has been highlighted as a focal point in this edition. Seventy percent of the topics included in the environmental engineering specific Fundamentals of Engineering (FE) examination are covered in *Introduction to Environmental Engineering*. These include the following subject areas: ethics in Chapter 1; mass balance in Chapter 2; hydrology and watershed processes in Chapter 4; water and wastewater engineering in Chapters 6, 7, and 8; air quality engineering in Chapter 9; the noise pollution aspects of occupational and health safety in Chapter 10; solid and hazardous waste engineering in Chapters 11 and 12; radiological health, safety, and waste management in Chapter 13. We have identified equations in *Introduction to Environmental Engineering* that also appear in the *Fundamentals of Engineering Supplied-Reference Handbook*; these are identified with the FE flag icon. A website has been developed to assist the students in locating similar equations in the *Handbook*. In addition, at the end of each chapter we have supplied typical FE exam formatted problems for the students to work.

Because the FE exam uses both SI units and U.S. Customary System (USCS) units, USCS units are introduced in Chapter 1 and then utilized in numerous example problems as well as the FE exam formatted problems. A conversion factor table is presented in Appendix C.

The concept of materials and energy balance as a tool for understanding environmental processes and solving environmental engineering problems is carried through the text. This concept is introduced in a stand-alone chapter and then applied for conservative systems in hydrology (hydrologic cycle, development of the rational formula, and reservoir design). This theme is expanded to include sludge mass balance in water treatment (Chapter 6), and the DO sag curve in Chapter 7. The design equations for a completely mixed activated sludge system and a more elaborate sludge mass balance are developed in Chapter 8. Mass balance is used to account for the production of sulfur dioxide from the combustion of coal and in the development of absorber design equations in Chapter 9. In Chapter 12, a mass balance approach is used for waste audit. There are over 100 materials and energy balance end-of-chapter problems spread throughout the text.

Each chapter concludes with a list of review items, the traditional end-of-chapter problems, and, perhaps less traditional, discussion questions and FE formatted problems. The review items have been written in the "objective" format of the Accreditation Board for Engineering and Technology (ABET). Instructors will find this particularly helpful for directing student review for exams, for assessing continuous quality improvement for ABET, and for preparing documentation for ABET curriculum review. We have found the discussion questions useful as a "minute check" or spot quiz item to see if the students understand concepts as well as number crunching.

The fifth edition has been thoroughly revised and updated. With the addition of 58 new end-of-chapter problems, there are now a total of over 720 problems. Sixty-six of the problems have been set up for spreadsheet solutions. Two *Solver*® example problems are demonstrated in Chapter 8.

When the senior author was teaching, the course bearing the title of this book provided the foundation for four follow-on senior-level environmental engineering courses. The initial portions of selected chapters (materials and energy balances, water resource engineering, water treatment, water pollution, wastewater treatment, air pollution, noise pollution, and solid waste) were included in the introductory course. Advanced material, including most of the design concepts, were covered in the upper-level courses (water resources engineering, water and wastewater treatment plant design, solid and hazardous waste management). Some of the material is left for the students to pursue on their own (environmental legislation, ionizing radiation). This book provides an ideal foundation for the senior author's book on *Water and Wastewater Engineering: Design Principles and Practice*.

An instructor's manual and set of PowerPoint® slides are available online for qualified instructors. Please inquire with your McGraw-Hill representative for the necessary access password. The instructor's manual includes sample course outlines, solved example exams, and detailed solutions to the end-of-chapter problems. In addition, there are suggestions for using the pedagogic aids in the text.

Numerous Michigan State University alumni have indicated that *Introduction to Environmental Engineering* is an excellent text for review and preparation for the

Professional Engineers examination. It is both readable for self-study as well as a good source of sufficient example problems and data for practical application in the exam. Many have taken it to the exam as one of their reference resources. And they have used it!

As always, we appreciate any comments, suggestions, corrections, and contributions for future revisions.

Mackenzie L. Davis
David A. Cornwell

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