

# Preface

I am very happy to present you the revised edition of the previous book on Measurements Systems, Special Indian Edition 2007 that was an adaptation carried out by me of the original book written by Doebelin. Students and teachers across India have enthusiastically received this edition, and 14 reprints came out in the span of four years. I am thankful to all of you.

The main reason for undertaking the adaptation in 2007 was to help students by adding examples, exercise problems and more importantly, present all the data in SI units. In addition, the first adaptation removed some material that was not relevant for an undergraduate text. I consider myself an experimentalist and, in addition, I have taught the course on measurements at IIT Bombay for more than ten years. So when I got an offer from the publishers to adapt the original edition by Doebelin, which would be very useful to students in India, I readily accepted so that I could put some of my expertise to use.

After publication of the Special Indian Edition 2007 (earlier version of this book), I prepared an extensive Solution Manual for all the exercise problems of the book. From this experience, I concluded that many of the exercise problems should actually have been in the main text. This is one of the most important changes in this edition—relevant problems from the exercises now appear in the main text. This move aims to enhance the understanding of some of the material within the text. Among these problems, many relate to the design of transducers based on feedback principles. Since this textbook has emphasized the design of transducers based on feedback principles, the additional examples will be definitely useful to students and teachers; 66 exercise problems from the previous edition are now included in the text as example problems. In addition, I have also added a section on feedback systems in Chapter 3. With the 105 new exercise problems, along with the 116 exercise problems of the 2007 edition, the book now has 221 exercise problems.

This book will cater to those interested in studying the dynamic characteristics of transducers and instrumentation used in measurement systems. Undergraduates in any discipline of engineering, science or perhaps even medicine, will find it useful. Anyone with a background in ordinary differential equations, Laplace transforms and circuit theory can use this book. Although the book covers measurement of different physical quantities throughout, the main emphasis is on studying the dynamic characteristics of various transducers and instrumentation that have many common aspects between them. Since dynamic systems—including those related to life sciences—have many similarities, students of many

disciplines can effectively use this book. Many recent developments demand new types of transducers and instrumentation. Therefore, a generic viewpoint emphasized in this book should help anyone to take up the challenge of designing new dynamic systems in future.

The main theme of this book is the measurement of various physical quantities like displacement, velocity, acceleration, force, pressure, sound, flow, temperature, etc. In addition to discussing the fundamental aspect of measuring these quantities, the theory covers many practical systems in use to relate the underlying concepts of their design. It also gives the physical phenomenon underlying the measurement of these physical quantities in great length without sacrificing the rigor. Therefore, this book covers material that not only describes some steps of measurement of a physical quantity, but also gives enough detail for one to design even a new transducer or instrumentation.

The summarized salient features are as follows:

- **Exhaustive coverage** of the course on Measurement Systems
- New chapter on **Data Acquisition Systems**
- **Inclusion** of **vital topics** like **Measurement of Level, Humidity, Viscosity, Density**
- **Augmented coverage** of **Transducers**
- **Value addition** to the text in the form of **Control Systems, AC Bridges, Electrical Instruments**
- **Excellent and enhanced pedagogy with answers provided alongside Practice Problems**
  - Solved Examples: **136**
  - Problems: **272**
  - Figures: **480**

The first chapter begins with the importance of measuring systems. The second chapter discusses generalized configurations and function descriptions of measuring instruments; and the third chapter discusses the generalized performance characteristics. The first three chapters, therefore, form the basis for all the discussion of the later chapters. Chapters 4 through 8, which form the bulk of the textbook, cover the measurement of various physical quantities: motion, force, pressure, flow and temperature. Chapters 9 through 12 cover relevant portions concerning manipulating and transfer of data from instrumentation systems.

Based on the feedback received from various users, I have added many sections to the book. The most important among them are (1) photo transducers, (2) level indicators, (3) AC bridges, (4) signal generators, and (5) sampling and delayed-time oscilloscopes. All example problems now stand numbered, making their reference easy and in addition, the new layout style distinctly separates them from the main text making them easily identifiable. For better understanding and continuity, the text now firmly integrates the example problems. The section numbering of the text has continued and, with better-typeset features of this edition, it has become very easy to search for various sections. An important feature of this edition is that all illustrations now appear closer to the points of reference, which makes for easier reading and comprehension. A detailed Solution Manual and PowerPoint presentations for all the chapters will soon be available to teachers, making it easier for them to use this book. A section at the end of the book carries answers to selected exercise problems.

Using chapters 1 through 8, students can employ this book for a semester course on measurement systems. Those studying a semester course on measurement and controls can also use this book in conjunction with a suitable controls text. If the students have already learnt system dynamics, they may spend less time on Chapter 3. Although students from various disciplines of engineering will use this book, those studying instrumentation courses can also use this as reference. For those who are

not familiar with DC bridge circuits, it will be better to first study some portions of Chapter 9 that will be useful while teaching strain-gage circuits. Chapters 9 through 12 are mainly concerned with conditioning circuits, manipulation and transmission of data. For practicing engineers, there is a lot of discussion on designing and building of transducers.

### Web Supplements

The web supplements are available at <https://www.mhhe.com/doebelin/ms6e> and contain the following articles:

- Solution Manual and PPTs for *Instructors*
- Chapter on Measurement Systems Applied to Micro- and Nanotechnology; and DASLAB Software for *Students*

There is always scope for improvement in every endeavor. I sincerely appreciate the work done by the reviewers of this book who took out time to assess the content. The list, given below, mentions their names. Keeping the student in mind, I would like to simplify the textbook further without losing the essence of the original edition of Doebelin. In addition, I would like to add many more example and exercise problems that would cover most of the transducers and instrumentation discussed in the book. We plan to bring out the next revision before 2015.

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I thank the staff at McGraw-Hill (India) for their excellent cooperation and patience in bringing out this revised edition. I also thank those of you who offered constructive suggestions to improve the book and hope you will continue to give your valuable feedback in the near future. In the meantime, you may please stay in touch with me. Please feel free to contact me at [dnmanik@iitb.ac.in](mailto:dnmanik@iitb.ac.in)

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