

Exploring Engineering—An Introduction to Engineering and Design, 4th Edition

by Philip Kosky, Robert Balmer, William Keat, and George Wise
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Reviewed by

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The *Exploring Engineering An Introduction to Engineering and Design* text has been substantially expanded and revised from the previous three editions. The text is written for freshman engineering students with the intent of introducing them to basic engineering methods used by all engineering disciplines, to apply these principles and methods to the specialized chapters of a comprehensive range of engineering disciplines, and finally to present the engineering design process and design challenges.

The latest edition of the text is divided into three parts—**Part 1: Lead-On** presents fundamental principles that all branches of engineering utilize; **Part 2: Minds-On** covers introductory material explicit to 10 engineering fields with an additional three emerging fields; and finally **Part 3: Hands-On** provides content on the engineering design process and design challenges for the design component of an introductory engineering course.

In **Part 1: Lead-On** the authors present five chapters covering: What Engineers Do; Elements of Engineering Analysis; Force and Motion; Energy; and Engineering Economics. It is the intent of the authors that all five of these chapters be covered in depth as they are fundamental to all branches of engineering. They cover how to organize and solve engineering problems and also introduce the use of spreadsheets (but not programming). These skills are used and reinforced in subsequent chapters. Each chapter includes several example problems and has 15-30 exercises at the end. The answers to some of these problems are provided to the students and solutions are available for instructors at the publisher's website. Students are introduced to the "Need – Know – How – Solve" technique and continue this practice throughout the text. The authors also emphasize the importance of units (including American Engineering Units) and dimensions, and a tabular method for multifaceted problems. In addition, they demonstrate how students can approach engineering ethics problems using a matrix approach.

Part 2: Minds-On presents introductory material specifically

for the following engineering disciplines: aeronautical engineering, chemical engineering, civil engineering, computer engineering, electrical engineering, industrial engineering, manufacturing engineering, materials engineering, mechanical engineering, and nuclear engineering. The authors present appropriate overlap of the material in some of these disciplines, which is indicative to some of these disciplines—for example, computer engineering and electrical engineering. In addition, there are three more chapters devoted to emerging engineering fields: bioengineering, electrochemical engineering, and "green" energy engineering. The intent of each of these chapters is to provide students interested in these disciplines information and practice for them to become familiar with the types of problems and solutions the students might face in subsequent courses and study. It is expected that the instructor would "cherry pick" chapters appropriate for the majors offered at their institutions, when covering Part 2 of the textbook.

Specifically for chemical engineering the authors present an overview of our field and present the three primary physical laws underling chemical engineering design as (1) conservation of mass, (2) conservation of momentum, and (3) conservation of energy. Chemical energy conversion is introduced and concepts of atoms, molecules, and chemical reactions are covered. Stoichiometry is also presented with a combustion example. This is followed up by a discussion and example problems on air-to-fuel ratios, heating values, and chemical fuels. To illustrate process engineering, distillation is described. The end-of-chapter exercises focus on stoichiometry and global warming and conclude with five chemical engineering ethics problems. I believe the authors present an adequate description of our profession in limited space, and do provide some insight into the breadth in the modern chemical engineering section and in the end-of-chapter exercises.

Part 3: Hands-On presents content to facilitate a hands-on component of a freshman engineering design course. Chapters include Introduction to Engineering Design, Design Teams, each of the steps of the Design Process (from Defining the Problem to the Report), and Examples of Design Competitions. Many of the chapters include short design challenges that utilize common materials that are appropriate for completion during a discussion/recitation session. For some of the design challenges, evaluation criteria are also provided.

I believe this textbook is appropriate for a minimal credit (one or two credit) introduction to engineering design course. The Lead-On chapters provide a brief introduction to material covered by most engineering disciplines. The instructor could then select chapters from the Minds-On section that correspond to disciplines offered at their institution. And finally, design challenges from the Hands-On section and the design process chapters could be used as just-in-time discussion in the design studio component of the course, and one of the projects could be used for the semester project. □