To the student

Mother nature is so strict that, to the extent we know her rules, we can make reliable predictions about the behavior of her children, the world of physical objects. In particular, for essentially all practical purposes all objects that engineers study strictly follow the laws of Newtonian mechanics. So, if you learn the laws of mechanics, as this book should help you do, you will be able to make quantitative calculations that predict how things stand, move, and fall. You will also gain intuition about how the physical world works.

How to use this book

Most of you will naturally get help with homework by looking at similar examples and samples in the text or lecture notes, by looking up formulas in the front and back covers, or by asking questions of friends, teaching assistants and professors. What good are books, notes, classmates or teachers if they don't help you do homework problems? All the examples and sample problems in this book, for example, are just for this purpose. But too-much use of these resources while solving problems can lead to self deception. To see if you have learned to do a problem, do it again, justifying each step, *without looking up even one small thing*. If you can't do this, you have a new opportunity to learn at two levels. First, you can learn the missing skill or idea. More deeply, by getting stuck after you have been able to get through a problem with guidance, you can learn things about your learning process. Often the real source of difficulty isn't a key formula or fact, but something more subtle. We have tried to bring out some of these more subtle ideas in the text discussions which we hope you read, sooner or later.

Some of you are science and math school-smart, mechanically inclined, or are especially motivated to learn mechanics. Others of you are reluctantly taking this class to fulfil a requirement. We have written this book with both of you in mind. The sections start with generally accessible introductory material and include simple examples. The early sample problems in each section are also easy. But we also have discussions of the theory and other more advanced asides to challenge more motivated students.

Calculation strategies and skills

In this book we try here to show you a systematic approach to solving problems. But it is not possible to reduce the world of mechanics problem solutions to one clear set of steps to follow. There is an art to solving problems, whether homework problems or engineering design problems. Art and human insight, as opposed to precise algorithm or recipe, is what makes engineering require humans and not just computers. Through discussion and examples, we will try to teach you some of this systematic art. Here are a few general guidelines that apply to many problems.

Understand the question

You may be tempted to start writing equations and quoting principles when you first see a problem. But it is generally worth a few minutes (and sometimes a few hours) to try to get an intuitive sense of a problem before jumping to equations. Before you draw any sketches or write equations, think: does the problem make sense? What information has been given? What are you trying to find? Is what you are trying to find determined by what is given? What physical laws make the problem solvable? What extra information do you think you need? What information have you been given that you don't need? Your general sense of the problem will steer you through the technical details.

Some students find they can read every line of sample problems yet cannot do test problems, or, later on, cannot do applied design work effectively. This failing may come from following details without spending time, thinking, gaining an overall sense of the problems.

Think through your solution strategy

For the problem solutions we present in this book or in class, there was a time when we had to think about the order of our work. You also have to think about the order of your work. You will find some tips in the text and samples. But it is your job to own the material, to learn how to think about it your own way, to become an expert in your own style, and to do the work in the way that makes things most clear to you and your readers.

What's in your toolbox?

In the toolbox of someone who can solve lots of mechanics problems are two well worn tools:

- A vector calculator that always keeps vectors and scalars distinct, and
- A reliable and clear free body diagram drawing tool.

Because many of the terms in mechanics equations are vectors, the ability to do vector calculations is essential. Because the concept of an isolated system is at the core of mechanics, every mechanics practitioner needs the ability to draw a good free body diagram. Would that we could write

> "Click on WWW.MECH.TOOL today and order your own professional vector calculator and expert free body diagram drawing tool!",

but we can't. After we informally introduce mechanics in the first chapter, the second and third chapters help you build your own set of these two most-important tools.

Guarantee: if you learn to do clear correct vector algebra and to draw good free body diagrams you will do well at mechanics.

Think hard

We do mechanics because we like mechanics. We get pleasure from thinking about how things work, and satisfaction from doing calculations that make realistic predictions. Our hope is that you also will enjoy idly thinking about mechanics and that you will be proud of your new modeling and calculation skills. You will get there if you think hard. And you will get there more easily if you learn to enjoy thinking hard. Often the best places to study are away from books, notes, pencil or paper when you are walking, washing or resting.