

Robotics

A User-Friendly Introduction

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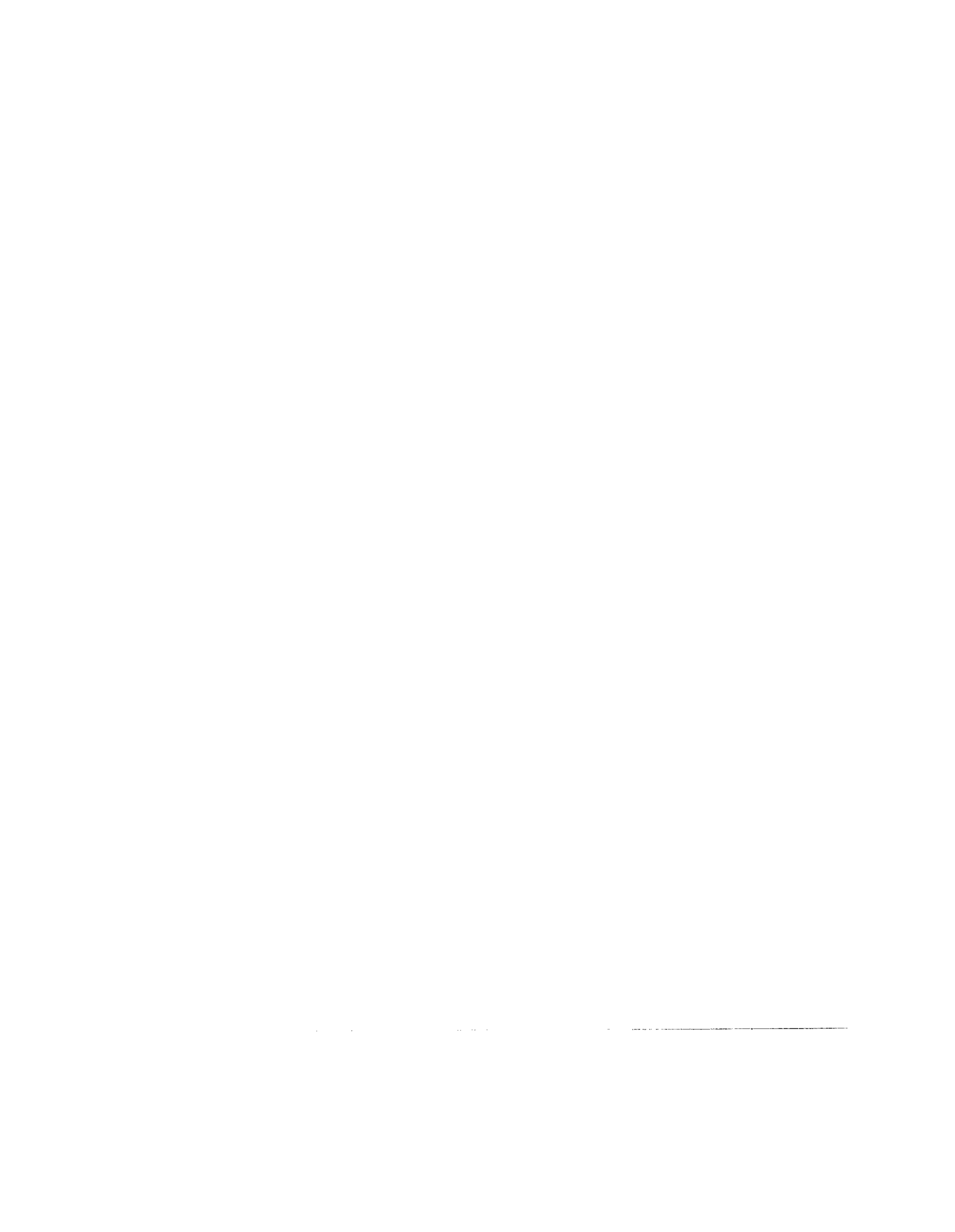
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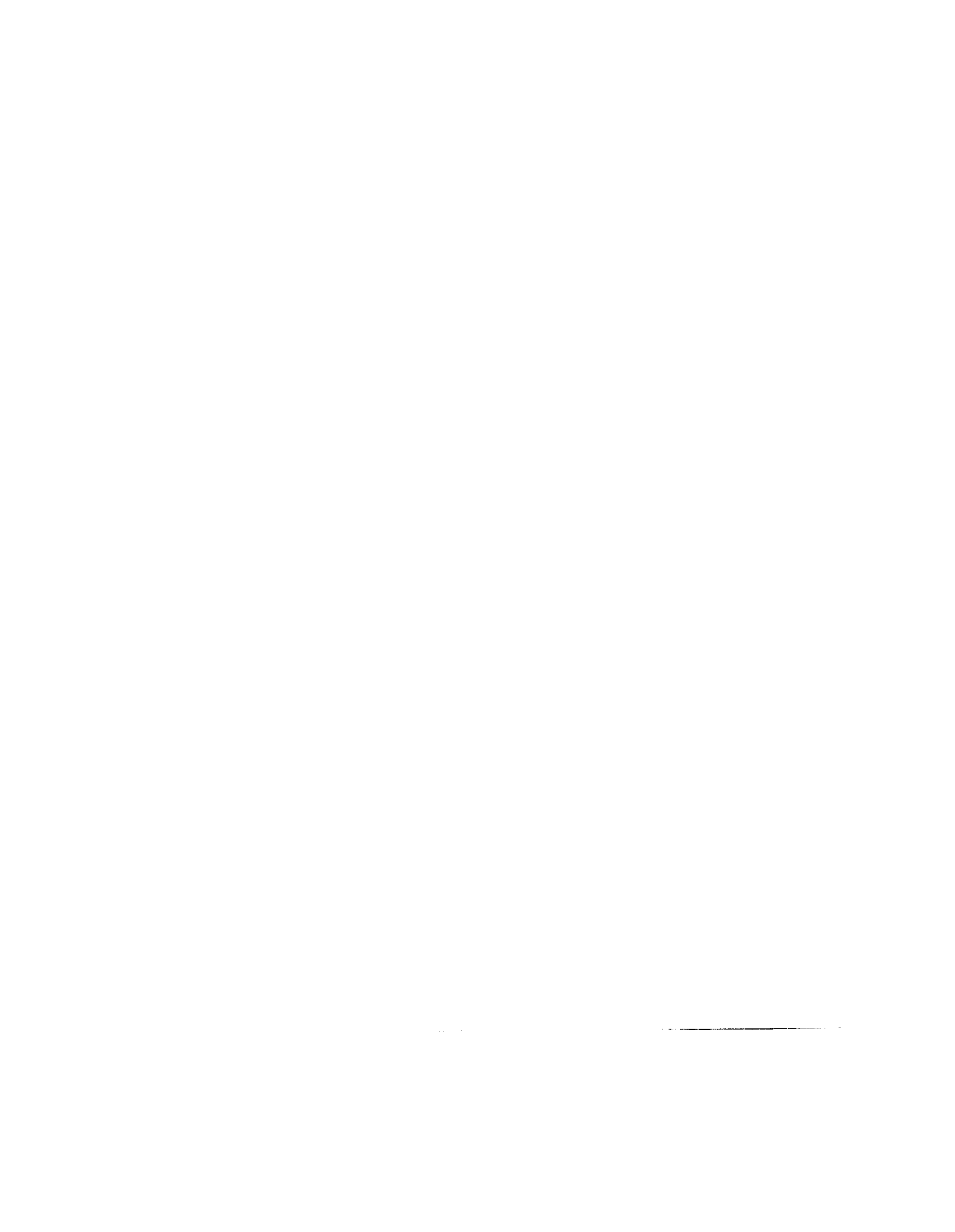
For our students



Introduction

Robotics: A User-Friendly Introduction is an introductory text designed for undergraduate robotics courses. Written in a style that is a careful mixture of the vernacular and pedagogy, the book is both readable and informative. A complete coverage of the emerging field of robotics is presented, including a description of the components and operation of industrial robots, intelligent robot programming, sensors for intelligent robots, industrial robot applications, and future robot considerations. A chapter on the history of robotics is also included to provide a means of discovering the origins of this fascinating machine. Economic considerations and methods for the justification of an industrial robot purchase are also presented. The social and political implications and impacts of robots are also presented in two thought-provoking chapters.

Although the overall book is introductory, some previous computer-programming experience is helpful for portions of the material. The text is recommended for a first course in industrial robotics.



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Preface

The purpose of this book is to provide a user-friendly introduction to the important and exciting field of robotics. Robots will certainly affect our lives in important ways in coming years—economically, socially, and politically. They are already changing the way we do much of our work in factories and promise to change the way we work in our home and offices in the future. They are beginning to have an impact on the productivity of our industries and on the competitiveness of our products in the world market.

Robots are assuming many of the dangerous and difficult tasks that humans now do; this is one of the greatest benefits offered by robots. As robots assume tasks in hazardous environments, perhaps all industrial diseases that now afflict human workers can be eliminated. Another benefit brought about by the use of robots concerns what sort of work we deem fit for humans to perform. Robots are able to do simple, monotonous, repetitive work much better than humans because they do not get bored or tired. Humans were surely never intended for such work, or we would not have been equipped with the wonderful assortment of sensory, intellectual, and perceptual capabilities that goes into our makeup. Robots, on the other hand, are designed and intended for these jobs, freeing humans for more challenging and satisfying kinds of work.

This book is directed toward those readers who are willing to face the challenges of robotics, who are concerned about the impacts of modern automation on society, and who may someday live in a world with millions of robots. Through explanations, examples, drawings, and photographs, the authors hope to give readers a general idea of what robots are, how they work, what they can and cannot do, how people react to them, how they affect us now, and how they might affect us in the future. Although a good deal of attention is given to the industrial robot (because it is the most numerous and well-known type used today), we are also concerned with the use and impact of intelligent robots. These wonderful combinations of machine and computer powers have the potential and capability to make our best dreams of science fiction come true.

At present, most of the educational literature on robotics has been written in the highly precise and technical language of engineering mathematics. This would be fine if no one but engineers needed to know about robots. However, the impact of these universal machines has created a need for an interdisciplinary, general introduction to robotics. It is this need that has motivated the writing of this book.

We gratefully acknowledge the assistance and encouragement provided us by our friends at the University of Cincinnati, the University of Tennessee, Cincinnati Milacron, the Oak Ridge National Laboratory, and the other robotics educational and research facilities who assisted us in the collection of information for this book.

Our special thanks go to Professors Ivan Morse, Ronald Huston, and Richard Shell, and to Dean Lewis Laushy at the University of Cincinnati for providing their encouragement and support of this work. We also deeply appreciate the assistance of James Geier, Richard Messinger, James Gavin, Alfred Scheide, Dick Carrico, Mertin Corwin, and Richard Hohn of Cincinnati Milacron for sharing their robotics expertise. Our warmest thanks and sincere appreciation go to Ronald Tarvin of Cincinnati Milacron, who freely shared his robotics course notes, provided suggestions, and reviewed the manuscript. Finally, we would like to thank Professors June Adamson and Michael Keene of the University of Tennessee for their inspiration and high standards of clear communication, without whose encouragement this book would never have been attempted.

We would also like to thank our reviewers, whose keen observations and practical criticisms helped us immensely in seeing the book through others' eyes. They caught several errors and noted missing details; any faults of the book that remain are the sole responsibility of the authors.

We would also like to note that our editor, Mr. John Beck, has been a constant guide and source of inspiration to us throughout the preparation of this work, and to him we extend our sincere appreciation.

Ernest L. Hall
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To the Instructor

This book has been designed for use in an introductory robotics course for a general audience. The material has been developed from a series of robotics courses taught at the University of Cincinnati and the University of Tennessee. As you will note, a careful mixture of vernacular and pedagogic material is used for clarity and ease of understanding. Also, a fair sprinkling of opinion and conjecture is included to convey to students an understanding of some of the paradox, conflict, and problems that need to be thought about but are rarely mentioned in standard robotics texts.

As an introductory technology course at the freshman or sophomore level, you may wish to concentrate on Chapters 1, 2, 4, and 5. Chapter 2 provides an opportunity to discuss the history and evolution of robots and can lead to an understanding of the sophistication of the modern, industrial robot. The book assumes some knowledge of programming, especially in Chapter 4.

For an introductory awareness course at this level, the entire text may be assigned for reading and special topics selected for class discussion from either the material or problems.

As an engineering text for juniors, seniors, and graduate engineering and computer science students for a one-quarter course, the material in Chapters 1, 2, 3, 6, and 7 can be covered thoroughly in about 30 hours of lecture. A second quarter could be based on Chapters 4, 5, 8, 9, and 10, with an emphasis on the use of intelligent robots and the intelligent use of robots. The material could also be used in a three-quarter course, especially if projects were assigned each quarter. For example, in the first quarter, a project on the economic justification of a robot, such as that given in Chapter 7, could be assigned. In the second, a project involving robots and sensor systems could be used as the basis of an intelligent robot project. For the third quarter, a robot design or major application project could be assigned or studied.

For a two-semester course, Chapters 1, 2, 3, 4, and 7 could be covered in the first semester. A project on the economic justification of an industrial robot would be appropriate. During the second semester, Chapters 5, 6, 8, 9, and 10 could be covered, with emphasis on intelligent robots. Robot programming and simulation could also be emphasized.

Supplementary materials, such as videotapes, are available from Robotics International, through either the local chapter or from headquarters which is located at 1 SME Drive, Dearborn, Michigan. We have found most manufacturers very willing to assist with plant tours of local facilities. A well-equipped robotics laboratory is very helpful. A set of slides of the illustrations in this book is available from the authors.