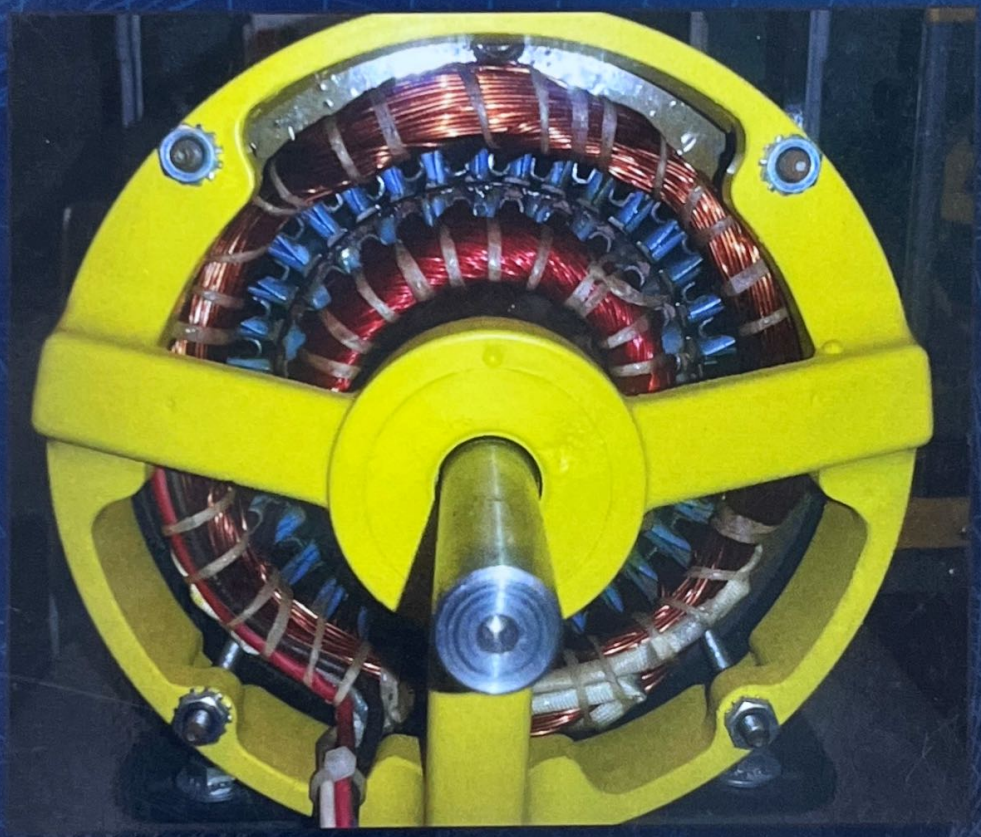
FUNDAMENTALS OF ELECTRIC MACHINES

A Primer with MATLAB®



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Preface

An electric machine is a device that converts mechanical energy into electrical energy or vice versa. It can take the form of an electric generator, electric motor, or transformer. Electric generators produce virtually all electric power we use all over the world.

Electric machine blends the three major areas of electrical engineering: power, control, and power electronics. This book presents the relation of power quantities for the machine as the current, voltage power flow, power losses, and efficiency. The control condition presents the methods of speed control and electrical drive. Power electronics is important to machine control and drive.

The purpose of this book is to provide a good understanding of the machine behavior and its drive. The book begins with the study of salient features of electrical DC and AC machines. Then it presents their applications in the different types of configurations in lucid detail. This book is intended for college students, both in community colleges and universities.

This book organized into 11 chapters. With a short review of the basic concept of magnetism in Chapter 1, it starts with a discussion of magnetism and electricity, history of magnetism, types of magnets, and magnetic materials. It also discusses the lines of magnetic forces and force generated in the field. Chapter 2 presents magnetic circuits and quantities. The description of electrical circuit elements, its connection in series and parallel, and its phasor diagram are discussed in Chapter 3 under the title of Alternating Current Power.

Chapter 4 deals with an electric transformer, installation of the transformer, core shape, principle of operation, and the operation of the transformer under no load and full load conditions. Chapter 5 deals with the transformer design techniques. It includes the conventional design of core and shell type for single- and three-phase transformers. It illustrates all the calculation that is required to design a transformer. The description details of all types of DC machine and related voltage, current, power, and efficiency are covered in Chapter 6. All types of AC machines are also covered in Chapter 7. The chapter also elaborates the related voltage, current, power, and efficiency.

In Chapter 8, the principles of conversion from AC to DC involving single-phase as well as three-phase are presented. DC choppers and the study of several applications of power electronics are also mentioned. Chapter 9 discusses electric drives in general and concept of DC drive in particular. Chapter 10 describes the basic principles of speed control techniques employed in three-phase induction motors using power electronics converters.

Chapter 11 introduces some machines that have special applications. The examples explained in this chapter include stepper motors, brushless DC motor, switched reluctance motor, servomotors, synchro motors, and resolvers.

Several problems are provided at the end of each chapter. The answers to odd-number problems appear in Appendix D.

It is not necessary that the reader has previous knowledge of MATLAB®. The material of this text can be learned without MATLAB. However, the authors highly recommend that the reader studies this material in conjunction with the MATLAB Student Version. Appendix C of this text provides a practical introduction to MATLAB.