



Basic Electrical and Electronics Engineering

Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism. This field first became an identifiable occupation in the later half of the 19th century after commercialization of the electric telegraph, the telephone, and electric power distribution and use. Subsequently, broadcasting and recording media made electronics part of daily life. The invention of the transistor, and later the integrated circuit, brought down the cost of electronics to the point they can be used in almost any household object. The subject of electronic engineering is often treated as its own subfield but it intersects with all the other subfields, including the power electronics of power engineering. Electrical and electronics engineers are involved in a wide variety of technology ranging from huge global positioning systems which can pinpoint the location of a moving vehicle to gigantic electrical power generators. These engineers are responsible for designing, developing, testing as well supervising the production of electrical and electronic equipment and machinery. Broadcast and telecommunication systems, electric motors, controls of machinery, lights and wiring in building complexes, vehicles, aircraft, radar and navigation systems, power generation, control and transmission devices which are used by electric utilities are all examples of equipment built by these engineers.

Key features:

- Provides a coverage of the full spectrum of fundamental topics in each of the several major areas of electrical and electronics.
- Topics are logically arranged according to the course outline of the subject.
- The use of simple language to facilitate a better understanding of each chapter.
- Illustrative examples of varying difficulties, wherever needed, are presented to enhance the interest of students.
- The provision of knowledge check test for each chapter is given at the end of chapter to strengthen the learning process of students.
- Case Study, Role Model, Keywords, and Examples are also provided to enrich the knowledge of students.

The Book comes with a companion DVD for rich learning experience, which includes:

1. E-Book with further reading and learning links
2. Interactive E-lecture of each chapter. E-lectures are expressive, informational, entertaining and persuasive, it uses the tool of self-exploration, which makes it easy to learn and understand each topic in detail. It is very informative as concrete details are provided and also entertaining, as graphics and other visuals are provided to make the learning process more interactive..
3. Video Lecture of each chapter, which explains each topic in detail with examples, animations, images and text and makes it easy to understand the topics in easier, simpler and better way.
4. Huge Database of Interactive Assessments for each chapter, which is also printable
5. Further reading and learning links for each topic
6. Glossary and Notes for each chapter to understand each chapter with to the point information
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8. Review Questions for each chapter are also given in the DVD, which are also printable

The DVD is also a useful tool for teachers to teach with digital resources in classroom and do a great job of illustrating skills and techniques that are otherwise difficult to explain.



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BASIC ELECTRICAL AND ELECTRONICS ENGINEERING



3G E-LEARNING

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Authored and Edited by 3G E-learning LLC, USA

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PREFACE

Electrical engineering is a field of engineering that generally deals with the study and application of electricity, electronics, and electromagnetism. This field first became an identifiable occupation in the later half of the 19th century after commercialization of the electric telegraph, the telephone, and electric power distribution and use. Subsequently, broadcasting and recording media made electronics part of daily life. The invention of the transistor, and later the integrated circuit, brought down the cost of electronics to the point they can be used in almost any household object. The subject of electronic engineering is often treated as its own subfield but it intersects with all the other subfields, including the power electronics of power engineering. Electrical and electronics engineers are involved in a wide variety of technology ranging from huge global positioning systems which can pinpoint the location of a moving vehicle to gigantic electrical power generators. These engineers are responsible for designing, developing, testing as well supervising the production of electrical and electronic equipment and machinery. Broadcast and telecommunication systems, electric motors, controls of machinery, lights and wiring in building complexes, vehicles, aircraft, radar and navigation systems, power generation, control and transmission devices which are used by electric utilities are all examples of equipment built by these engineers.

Content Coverage

Chapter One provides an overview of electrical circuits and measurements. An electric circuit is a path which electrons from a voltage or current source flow. Electric current flows in a closed path called an electric circuit. *Chapter Two* emphasizes on electrical machines such as concept, merits and demerits. *Chapter Three* describes the semiconductor devices and their applications. *Chapter Four* presents an emphasis on digital electronics such as decimal number system and binary number system. *Chapter Five* focuses on signals and systems and its representation. *Chapters Six* and *Chapter Seven* reveal on the techniques for analog and digital signal processing.

The following are the salient features of the book:

- Provides a coverage of the full spectrum of fundamental topics in each of the several major areas of electrical and electronics.

- Topics are logically arranged according to the course outline of the subject.
- The use of simple language to facilitate a better understanding of each chapter.
- Illustrative examples of varying difficulties, wherever needed, are presented to enhance the interest of students.
- The provision of knowledge check test for each chapter is given at the end of chapter to strengthen the learning process of students.
- Case Study, Role Model, Keywords, and Examples are also provided to enrich the knowledge of students.

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ELECTRICAL CIRCUITS AND MEASUREMENTS

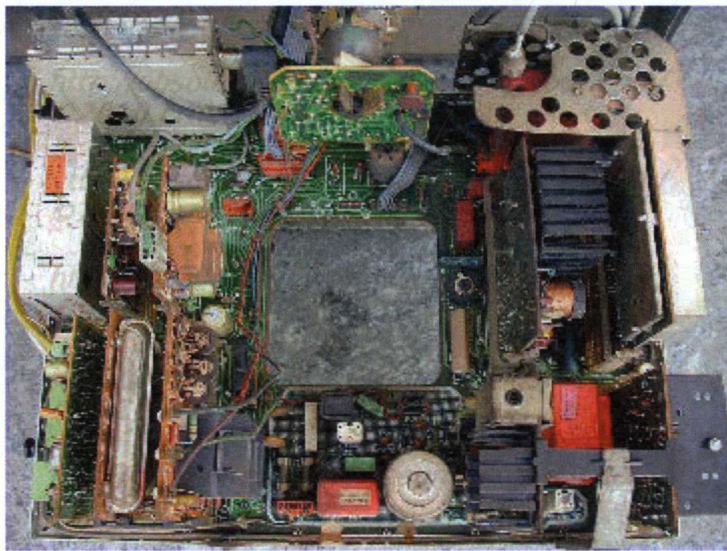
LEARNING OBJECTIVES

After studying this chapter, you will be able to:

1. Describe the methods of analysis
2. Focus on sinusoidal steady-state analysis
3. Explain the maximum power transfer theorem

INTRODUCTION

An electric circuit is a path which electrons from a voltage or current source flow. Electric current flows in a closed path called an electric circuit. The point where those electrons enter an electrical circuit is called the “source” of electrons. Electric field is defined as the electric force per unit charge. The direction of the field is taken to be the direction of the force it would exert on a positive test charge. The electric field is radially outward from a positive charge and radially in toward a negative point charge.



The interconnection of various electric elements in a prescribed manner comprises as an electric circuit in order to perform a desired function. The electric elements include controlled and uncontrolled source of energy, resistors, capacitors, inductors, etc. Analysis of electric circuits refers to computations required to determine the unknown quantities such as voltage, current and power associated with one or more elements in the circuit. To contribute to the solution of engineering problems one must acquire the basic knowledge of electric circuit analysis and laws. Many other systems, like mechanical, hydraulic, thermal, magnetic and power system are easy to analyze and model by a circuit.

1.1 METHODS OF ANALYSIS

Having understood the fundamental laws of circuit theory (Ohm's law and Kirchhoff's laws), we are now prepared to apply these laws to develop two powerful techniques for circuit analysis: nodal analysis, which is based on a systematic application of Kirchhoff's current law (KCL), and mesh analysis, which is based on a systematic application of Kirchhoff's voltage law (KVL).

Analyze almost any circuit by obtaining a set of simultaneous equations that are then solved to obtain the required values of current or voltage. One method of solving simultaneous equations involves **Cramer's rule**, which allows us to calculate circuit variables as a quotient of determinants.

1.1.1 Kirchhoff's Current Law (KCL)

In an electrical circuit, the current flows rationally as electrical quantity. As the flow

