

## Chapter 1

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# BASIC PRINCIPLES FOR ELECTRIC MACHINE ANALYSIS

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### 1.1 INTRODUCTION

There are several basic concepts that must be established before the analysis of electric machines can begin. The principle of electromechanical energy conversion is perhaps the cornerstone of machine analysis. This theory allows us to establish an expression of electromagnetic torque in terms of machine variables, generally the currents and the displacement of the mechanical system. Other principles that must be established are (1) the derivation of equivalent circuit representations of magnetically coupled circuits, (2) the concept of a sinusoidally distributed winding, (3) the concept of a rotating air-gap magnetomotive force (MMF), and (4) the derivation of winding inductances. The above-mentioned basic principles are presented in this chapter, concluding with the voltage equations of a 3-phase synchronous machine and a 3-phase induction machine. It is shown that the equations, which describe the behavior of alternating-current (ac) machines, contain time-varying coefficients due to the fact that some of the machine inductances are functions of the rotor displacement. This establishes an awareness of the complexity of these voltage equations and sets the stage for the change of variables (Chapter 3), which reduces the complexity of the voltage equations by eliminating the time-dependent inductances.

### 1.2 MAGNETICALLY COUPLED CIRCUITS

# Basic Principles For Electric Machine Analysis

**JA Banks**



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## **Table of Contents Basic Principles For Electric Machine Analysis**

1. Understanding the eBook Basic Principles For Electric Machine Analysis
  - The Rise of Digital Reading Basic Principles For Electric Machine Analysis
  - Advantages of eBooks Over Traditional Books
2. Identifying Basic Principles For Electric Machine Analysis
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Basic Principles For Electric Machine Analysis
  - User-Friendly Interface
4. Exploring eBook Recommendations from Basic Principles For Electric Machine Analysis
  - Personalized Recommendations
  - Basic Principles For Electric Machine Analysis User Reviews and Ratings
  - Basic Principles For Electric Machine Analysis and Bestseller Lists

5. Accessing Basic Principles For Electric Machine Analysis Free and Paid eBooks
  - Basic Principles For Electric Machine Analysis Public Domain eBooks
  - Basic Principles For Electric Machine Analysis eBook Subscription Services
  - Basic Principles For Electric Machine Analysis Budget-Friendly Options
6. Navigating Basic Principles For Electric Machine Analysis eBook Formats
  - ePub, PDF, MOBI, and More
  - Basic Principles For Electric Machine Analysis Compatibility with Devices
  - Basic Principles For Electric Machine Analysis Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Basic Principles For Electric Machine Analysis
  - Highlighting and Note-Taking Basic Principles For Electric Machine Analysis
  - Interactive Elements Basic Principles For Electric Machine Analysis
8. Staying Engaged with Basic Principles For Electric Machine Analysis
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Basic Principles For Electric Machine Analysis
9. Balancing eBooks and Physical Books Basic Principles For Electric Machine Analysis
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Basic Principles For Electric Machine Analysis
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Basic Principles For Electric Machine Analysis
  - Setting Reading Goals Basic Principles For Electric Machine Analysis
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Basic Principles For Electric Machine Analysis
  - Fact-Checking eBook Content of Basic Principles For Electric Machine Analysis
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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