

## 48550 Electrical Energy Technology

### Chapter 6.

## Synchronous Machines

#### Topics to cover:

- 1) *Introduction*
- 2) *Synchronous machine structures*
- 3) *Rotating magnetic field*
- 4) *Equivalent circuit model*
- 5) *Performance as a generator*
- 6) *Performance as a motor*

#### Introduction

A synchronous machine is an ac rotating machine whose speed under steady state condition is proportional to the frequency of the current in its armature. The magnetic field created by the armature currents rotates at the same speed as that created by the field current on the rotor, which is rotating at the synchronous speed, and a steady torque results.

Synchronous machines are commonly used as generators especially for large power systems, such as turbine generators and hydroelectric generators in the grid power supply. Because the rotor speed is proportional to the frequency of excitation, synchronous motors can be used in situations where constant speed drive is required. Since the reactive power generated by a synchronous machine can be adjusted by controlling the magnitude of the rotor field current, unloaded synchronous machines are also often installed in power systems solely for power factor correction or for control of reactive kVA flow. Such machines, known as *synchronous condensers*, may be more economical in the large sizes than static capacitors.

With power electronic variable voltage variable frequency (VVVF) power supplies, synchronous motors, especially those with permanent magnet rotors, are widely used for variable speed drives. If the stator excitation of a permanent magnet motor is controlled by its rotor position such that the stator field is always  $90^\circ$  (electrical) ahead of the rotor, the motor performance can be very close to the conventional brushed dc motors, which is very much favored for variable speed drives. The rotor position can be either detected by using rotor position sensors or deduced from the induced *emf* in the stator windings. Since this type of motors do not need brushes, they are known as brushless dc motors.

# Chapter 6 Synchronous Machines Uts

**Julia Schneider**



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## **Table of Contents Chapter 6 Synchronous Machines Uts**

1. Understanding the eBook Chapter 6 Synchronous Machines Uts
  - The Rise of Digital Reading Chapter 6 Synchronous Machines Uts
  - Advantages of eBooks Over Traditional Books
2. Identifying Chapter 6 Synchronous Machines Uts
  - 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 Chapter 6 Synchronous Machines Uts
  - User-Friendly Interface
4. Exploring eBook Recommendations from Chapter 6 Synchronous Machines Uts
  - Personalized Recommendations
  - Chapter 6 Synchronous Machines Uts User Reviews and Ratings
  - Chapter 6 Synchronous Machines Uts and Bestseller Lists
5. Accessing Chapter 6 Synchronous Machines Uts Free and Paid eBooks
  - Chapter 6 Synchronous Machines Uts Public Domain eBooks
  - Chapter 6 Synchronous Machines Uts eBook Subscription Services

- Chapter 6 Synchronous Machines Uts Budget-Friendly Options
- 6. Navigating Chapter 6 Synchronous Machines Uts eBook Formats
  - ePub, PDF, MOBI, and More
  - Chapter 6 Synchronous Machines Uts Compatibility with Devices
  - Chapter 6 Synchronous Machines Uts Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Chapter 6 Synchronous Machines Uts
  - Highlighting and Note-Taking Chapter 6 Synchronous Machines Uts
  - Interactive Elements Chapter 6 Synchronous Machines Uts
- 8. Staying Engaged with Chapter 6 Synchronous Machines Uts
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Chapter 6 Synchronous Machines Uts
- 9. Balancing eBooks and Physical Books Chapter 6 Synchronous Machines Uts
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Chapter 6 Synchronous Machines Uts
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Chapter 6 Synchronous Machines Uts
  - Setting Reading Goals Chapter 6 Synchronous Machines Uts
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Chapter 6 Synchronous Machines Uts
  - Fact-Checking eBook Content of Chapter 6 Synchronous Machines Uts
  - 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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