ELECTRICAL MACHINES | EN-3111

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Electrical Machines is an STCW required course. For all students a minimum grade of C- (70%) is required for STCW credit and to pass the course. Engineering Physics II is a prerequisite for the class.

LEARNING OBJECTIVE

To provide the student with an operational understanding of power systems, motors, and generators including single and three phase AC systems, DC systems, and storage batteries. While not an exclusive list, nor a complete list, at the conclusion of the course, the student must be able to:

- Distinguish between single and three phase systems
- Provide an electrical load analysis of an AC system
- Mathematically correct the power factor of an AC system
- Define the differences in various types of transformers and compute electrical loads on them
- Describe the design and operation of electric motors, including single and three phase AC motors and DC motors.
- Describe the design and operation of electric generators, including single & three phase AC generators and DC generators.
- Describe the methodology for correctly paralleling two AC generators and balancing the electrical loads on each.
- Describe the construction, maintenance, and operation of DC battery systems.

STCW Learning Objectives:

- OICEW-B1.1 Basic configuration and operation principles of electrical generators
- OICEW-B1.1 Basic configuration and operation principles of electrical distribution systems
- OICEW-B1.1 Preparing, starting, paralleling and changing over generators
- OICEW-B1.1 Basic configuration and operation principles of electrical motors
- OICEW-B1.1 Electrical motor starting methodologies
- OICEW-B1.1 Basic configuration and operation principles of high-voltage installations
- OICEW-B2.1 Safety requirements for working on shipboard electrical systems
- OICEW-B2.1 Safe isolation of electrical equipment required before personnel are permitted to work on such equipment
- OICEW-B2.2 Maintenance and repair of electrical system equipment
- OICEW-B2.2 Maintenance and repair of electrical switchboards
- OICEW-B2.2 Maintenance and repair of electric motors and generators
- OICEW-B2.2 Maintenance and repair of DC electrical systems and equipment
- OICEW-B2.3 Detection of electric malfunctions
- OICEW-B2.3 Location of faults causing electrical malfunctions
- OICEW-B2.3 Measures to prevent damage caused by electrical malfunctions
- OICEW-B2.4 Construction of electrical testing and measuring equipment
- OICEW-B2.4 Operation of electrical testing and measuring equipment

TEXT

"Operating, Testing, and Preventive Maintenance of Electrical Power Apparatus", Charles I. Hubert, PE, Prentice Hall.

GRADING

Exams: 60% | Final Exam: 40%

There will be approximately eight exams and each will be announced in advance. Make-up exams will only be considered for extraordinary circumstances. Attendance is mandatory; each absence may result in a three-point deduction from the final course grade. At any time any exam may include USCG questions.

SCHEDULE

SESSION 1 **Current, Voltage, Resistance, Insulation and Conductors, DC Circuits, Magnetic Fields and Magnetic Forces**
- READING: Chapters 1, 2, & 3
- HOMEWORK: Chapter 1: Problems 1, 5, 9, 13, 17, 21, 25
  Chapter 2: Problems 1, 5, 9, 13, 17, 21, 25, 29, 33, 37
  Chapter 3: Problems 1, 2, 3, 4

SESSION 2 **Magnetic Circuits and Inductance, Capacitors**
- IN CLASS: **EXAM 1 – CHAPTERS 1, 2, & 3**
- READING: Chapters 4, 5
- HOMEWORK: Chapter 4: Odd Problems
  Chapter 5: Odd Problems

SESSION 3 **Current, Voltage and Impedance in Single-Phase Systems**
- IN CLASS: **EXAM 2 – CHAPTERS 4 & 5**
- READING: Chapter 6
- HOMEWORK: Chapter 6: Odd Problems

SESSION 4 **Resonance, Harmonics and their Harmful Effects**
- IN CLASS: **EXAM 3 – CHAPTER 6**
- READING: Chapter 7
- HOMEWORK: Chapter 7: All Problems

SESSION 5 **Active, Reactive and Apparent Power in the Single-Phase System**
- IN CLASS: **EXAM 4 – CHAPTER 7**
- READING: Chapter 8
- HOMEWORK: Chapter 8: Odd Problems

SESSION 6 **Current, Voltage, and Power in the Three-Phase System**
- IN CLASS: **EXAM 5 – CHAPTER 8**
- READING: Chapter 9
- HOMEWORK: Chapter 9: Odd Problems

SESSION 7 **Transformers**
- IN CLASS: **EXAM 6 – CHAPTER 9**
- READING: Chapter 10
- HOMEWORK: Chapter 10: Problems 1 – 15, Odd

SESSION 8 **Three-Phase Induction Motors & Synchronous Motors**
- IN CLASS: **EXAM 7 – CHAPTER 10**
- READING: Chapter 11 & Chapter 12
- HOMEWORK: Chapter 11: All Problems
  Chapter 12: Review Questions 1 – 11

SESSION 9 **Operational Problems of Three-Phase Motors**
- IN CLASS: **EXAM 8 – CHAPTERS 11 & 12**
- READING: Chapter 13
- HOMEWORK: Chapter 13: Odd Problems

SESSION 10 **Synchronous Generators: Principles and Operational Problems**
- IN CLASS: **EXAM 9 – CHAPTER 13**
- READING: Chapter 14
- HOMEWORK: Chapter 14: Odd Problems

SESSION 11 **Single-Phase Induction Motors & Direct Current Generators: Principles and Operational Problems**
- IN CLASS: **EXAM 10 – CHAPTER 14**
- READING: Chapters 16 & 17
- HOMEWORK: Chapter 16: Review Questions 1 – 13, Problems 1 & 2
  Chapter 17: Problems 1 – 8

SESSION 12 **Direct Current Motors: Principles and Operational Problems**

In Class	**Exam 11 – Chapters 16 & 17**
Reading	Chapter 18
Homework	Chapter 18: All Problems

Session 13 **Bonding, Grounding, Earthing and Ground Fault Protection**

In Class	**Exam 12 – Chapter 18**
Reading	Chapter 28
Homework	Chapter 28: All Review Questions

Session 14

In Class	**FINAL EXAM**

Notes:

1. Students are responsible for all review questions in each chapter.

2. The syllabus is a working document and depending on the speed of the class we may do slightly more chapters or slightly less.

3. A session is defined as material covered in a 3-hour class week.

4. Office hours are M-W-F from 9-10am