

# Electrical Machines Lab Syllabus

Spring 2025

## Instructors.

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**Course Goal.** The purpose of the Electrical Machine Lab is to increase your understanding of the theory, design, construction, operation, and maintenance of electrical machinery commonly found aboard ship and in industrial facilities.

You will develop practical electrical skills such as using electrical measuring equipment, reading schematic diagrams, wiring circuits, troubleshooting faulty circuits, and following safe working practices. Additionally you will verify electrical theory by making measurements of electrical machinery in operation.

The material covered in the laboratory supplements the material studied in EN-3111 Electrical Machines and it is assumed that anyone taking the laboratory has either passed this course or is taking it concurrently with the lab. Three STCW skills will be demonstrated during the lab.

**Learning Objectives.** At the completion of this course, the student should be able to:

- Wire electrical circuits from schematic diagrams.
- Measure voltage, amperage, and resistance with a DMM
- Measure amplitude, frequency, period and phase shifts of sine waves using an oscilloscope
- Measure wattage, vars,  $va$ , and power factor using a power meter
- Lock-out and tag out electrical circuits
- Wire a three-way lighting circuit
- Connect three phase transformers in delta and wye configurations, and describe the resulting voltage and current relationships
- Demonstrate the operating characteristics of three phase induction motors
- Demonstrate the operating characteristics of single phase motors
- Demonstrate the operation of unloaded and loaded synchronous generators
- Parallel an AC Generator with the bus or another generator
- Demonstrate the operating principles of two-wire and three-wire control circuits
- Demonstrate the operating principles jogging and breaking circuits
- Demonstrate the operating principles reduced voltage and soft starters
- Wire single- and three-phase motors to UVR and UVP motor controllers

- Describe the operation of and troubleshoot a magnetic motor controller
- Describe the purpose a thermal overload relay
- Describe what is meant by sustained overload protection and interrupting capacity
- Describe safety requirements for working with high voltage equipment
- Describe configuration and operation of 5 kV circuit breaker in the laboratory
- Describe configuration and operation of a Variable Frequency Drive
- Demonstrate proficiency in the following STCW elements:
  1. OICEW-3-1A Plan and use test equipment
  2. OICEW-3-1B Troubleshoot electrical motor control system
  3. OICEW-7-1E Parallel generators

**Schedule.** This course meets for two hours every week and consists of twelve lab exercises. Six are conducted in the upstairs laboratory and six are conducted in the downstairs lab. At each class meeting students will complete one upstairs or one downstairs lab. The laboratory schedule is shown on page 4.

**Technology.** Blackboard will be used to communicate with the class and to collect homework assignments.

**Homework Assignments.** There are two mandatory homework assignments required as part of the course. Specific details about the assignments and due dates are found on Blackboard. All assignments are due by midnight of the date due.

HW Description	Deliverables	Due Date
Troubleshooting Simulator	No upload required	Complete training by 3/30/25 Earn 3 Stars by 4/14/25
Multimeter Video	Upload video to Blackboard	Upload video by 4/28/25

Videos will be collected via Blackboard only, and *will not* be accepted via email. Late assignments receive an automatic extension, but will incur a 1% grade penalty for each day past the deadline. Late assignments must be finished/submitted before midnight June 9, 2025, or you will have to repeat the lab.

**STCW Assessment.** This lab addresses the STCW Function: *Electrical, electronic and control engineering at the operational level*. All students are required to satisfy the STCW assessments of the course. These assessments will be satisfied as follows:

- **OICEW-3-1A** Create and submit the Metering Video and demonstrate competence in the upstairs lab.
- **OICEW-3-1B** Complete the troubleshooting assignment, and demonstrate competence by troubleshooting a motor controller in the upstairs lab.
- **OICEW-7-1E** Demonstrate competence paralleling generators in Lab 6 downstairs using a simulator.

Students must demonstrate competence in all of these areas or they will fail the course and will need to retake it.

**Quizzes and Final.** Quizzes will be given at the end of each lab. Quizzes will not be returned. The final exam will be scheduled during exam week and will have questions covering things that you saw or did in the twelve labs.

**Attendance.** Students are expected to attend all twelve labs.

It is critical that you make every effort to come to your scheduled lab since all sections are usually filled to capacity. If you must miss a lab due to unavoidable circumstances, contact your instructor as early as possible beforehand to see if you can be fit in elsewhere. Make-up labs may be offered at the end of the semester if time permits.

You will be penalized as follows for absences:

- Miss 1 lab – Course Grade reduced by 1 Letter Grade
- Miss 2 labs – Course Grade reduced by 2 Letter Grades
- Miss 3 or more – Automatic course failure

**Grades.** Your final grade will be determined using the following weights

Component	Weight	Notes
Upstairs Lab Quizzes	20%	
Downstairs Lab Quizzes	20%	
Troubleshooting HW and Demo	20%	Grade penalties for missing deadlines.
Meter Safety Video	20%	Grade penalties for missing deadlines.
Lab Final Exam	20%	
Attendance		Grade reduction for missed labs.

**Textbook.** You will receive a lab manual during the first class meeting. This manual will be used in every lab, so always bring it with you. Review each lab before you come to the lab.

The Electrical Machines course textbook, *Operating, Testing, and Preventive Maintenance of Electrical Power Apparatus*, by Charles I. Hubert, and *Electrical Machines, Drives, and Power Systems*, by Theodore Wildi are also recommended.

**Downstairs Labs.**

- **Lab 1** Alternating Current
- **Lab 2** Power Factor
- **Lab 3** Three Phase Transformers
- **Lab 4** Induction Motors
- **Lab 5** AC Synchronous Generators
- **Lab 6** Generator Paralleling Satisfies: STCW 7–1E (Parallel generators)

**Upstairs Labs.**

- **Lab 1** Residential Wiring; Lock-out/Tag-out Procedures; Use of DMM, Clamp-on Ammeter, Wiggy
- **Lab 2** Basic Motor Control
- **Lab 3** Reversing Motor Control. Troubleshooting
- **Lab 4** Reduced Voltage Starters
- **Lab 5** Timing Relays. High Voltage Switchgear
- **Lab 6** Variable Frequency Drives

**Lab Rules.**

- Safety First.
- No food or drink in the lab.

**Spring 2025**

	3	4	5	6	7
	<i>Academic Orientation</i>	<i>Commence Classes</i>			
<b>March</b>	10 <b>H1</b>	11 <b>H1</b> <i>Last day to add</i>	12 <b>H1</b>	13 <b>H1</b>	14 <b>H1</b>
	17 <b>L1</b>	18 <b>L1</b>	19 <b>L1</b>	20 <b>L1</b>	21 <b>L1</b>
	24 <b>H2</b> <i>Last day to drop</i>	25 <b>H2</b>	26 <b>H2</b>	27 <b>H2</b>	28 <b>H2</b>
	31 <b>L2</b>	1 <b>L2</b>	2 <b>L2</b>	3 <b>L2</b>	4 <b>L2</b>
<b>April</b>	7 <b>H3</b>	8 <b>H3</b>	9 <b>H3</b>	10 <b>H3</b>	11 <b>H3</b>
	14 <b>L3</b>	15 <b>L3</b>	16 <b>L3</b>	17 <b>L3</b>	18 <i>No Classes</i>
	21 <i>Patriots' Day</i>	22 <b>H4</b>	23 <b>H4</b> <i>Deficiencies due</i>	24 <b>H4</b>	25 <b>L3</b>
	28 <b>H4</b>	29 <b>L4</b>	30 <b>L4</b>	1 <b>L4</b>	2 <b>H4</b>
<b>May</b>	5 <b>L4</b>	6 <b>H5</b>	7 <b>H5</b>	8 <b>H5</b>	9 <b>L4</b>
	12 <b>H5</b>	13 <b>L5</b>	14 <b>L5</b>	15 <b>L5</b>	16 <b>H5</b>
	<i>← Last day to withdraw — USCG Exam Class of 2025 — →</i>				
	19 <b>L5</b>	20 <b>H6</b>	21 <b>H6</b> <i>Change of Command</i>	22 <b>H6</b>	23 <b>L5</b>
	26 <i>Memorial Day</i>	27 <b>H6</b> <i>Monday Schedule</i>	28 <b>L6</b>	29 <b>L6</b>	30 <b>H6</b>
<b>June</b>	2 <b>L6</b>	3 <b>L6</b>	4 <b>MU</b>	5 <b>MU</b>	6 <b>L6</b>
	9 <b>MU</b>	10 <i>Begin Finals</i>			13