

**College of Micronesia – FSM**  
**P.O. Box 159**  
**Kolonia, Pohnpei**

## Course Outline Cover Page

**Electro Technology**  
 Course Title

**ME 224**  
 Department and Number

**Course Description:** This course will provide the student with the knowledge and skills required to safely operate and maintain electrical equipment on board a vessel not exceeding 750 kW propulsion power.

**Prepared by:** Brent Villiers

**State:** FSM-FMI

	Hours per Week	No. Of Weeks	Total Hours	Semester
Credits				
Lecture	3/6/12/24	16/8/4/2	48	3
Laboratory	3/6/12/24	16/8/4/2	48	1
Total Semester Credits:				4

**Purpose of Course**

Degree Requirement	_____XX_____
Degree Elective	_____
Advanced Certificate	_____
Certificate	_____
Remedial	_____
Other (Workshop)	_____

**Prerequisite Course(s):** ME 179 Practical Mathematics, ME 180 Engineering Knowledge

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 Signature, Chairman, Curriculum Committee

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 Date Approved by Committee

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 Signature, President, COM-FSM

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 Date Approved by the President

**General Objective:** On successful completion of this course, the student will be able to safely operate and maintain electrical equipment on board a vessel not exceeding 750 kW propulsion power.

**Learning Outcomes:** On successful completion of this course the student will be able to:

1. Manage the effects of electric current on conductors/insulators and electric circuits.
2. Manage a low voltage DC battery system in accordance with safe and statutory requirements.
3. Operate and manage electrical equipment/circuits affected and utilizing magnetic fields.
4. Operate, manage, and monitor basic AC equipment in accordance with established procedure and safety requirements.
5. Operate and carry out basic maintenance of rotating electric machines in accordance with manufacturer recommendations, established procedure, and safety requirements.
6. Operate and carry out basic maintenance of single and three phase electrical distribution systems on vessels in accordance with manufacturer recommendations, safety and statutory requirements.
7. Operate and interpret switchboard indicating instruments and electrical test equipment in accordance with operating manuals, technical specifications, and safety requirements.
8. Isolate and re-establish circuits, conduct fault tracing, and carrying out basic maintenance of electrical equipment in accordance with technical specifications, established procedure, and safety requirements.

***STUDENTS SHOULD BE MADE AWARE OF OCCUPATIONAL HEALTH AND SAFETY ISSUES IN ALL SITUATIONS AND BE EXPECTED TO DEMONSTRATE SAFE WORKING PRACTICES AT ALL TIMES.***

**Outline of Content:**

This course contains:

1. Safety
  - Electrical shock, prevention, and treatment
  - Isolation procedure and reinstating circuits
  - Tagging and testing
  - Earthing

2. Electrical Circuit
  - Electrons and electric currents
  - Conductors and insulators
  - Basic single and three phase electrical distribution systems
  - Basic operation and maintenance
  - Protection devices
  - Simple fault finding
  - Magnetic and thermal effects
  - Ohm's law and effects of resistance
  - Shore power
3. Cells
  - Primary and secondary cells
  - Electrolytic dissociation
  - Lead acid and alkaline types
  - Low voltage systems
  - Safety and maintenance
4. Magnetism
  - Magnetic fields and materials
  - Magnetism in conductors and coils
  - Faraday's Law of induction
5. Electrical Machines
  - Production of EMF by a coil in a field
  - AC alternators
  - Parallel operation of alternators
  - Induction motors
  - Introduction to motor starters and protection
  - Basic maintenance and safety
6. AC Theory
  - AC. current and AC voltage.
  - Maximum, average and RMS values
  - Power factor
7. Electrical Instruments
  - Switchboard instruments
  - Operation and care
  - Multimeters
  - Insulation resistance and "Megger"
  - Actions for low insulation readings
  - Earth fault lamps

<b>Learning Outcomes:</b>	On completion of this course the learner will be able to:
<b>Learning Outcome 1</b>	<b>Manage the effects of electric current on conductors/insulators and electric circuits.</b>
Assessment criteria	<ol style="list-style-type: none"> <li>1.1 Electric current in terms of electron movement is explained.</li> <li>1.2 Conductors and insulators are described.</li> <li>1.3 Heating and magnetic effects of electric currents are explained.</li> <li>1.4 Common electrical units are identified.</li> <li>1.5 Ohm's law is defined and current, voltage, resistance, and power of simple series and parallel electrical circuits are calculated.</li> <li>1.6 The voltage drop in circuits due to the effects of resistance is calculated.</li> </ol>
Conditions and Method of assessment	<p>As specified in the Assessment Strategy listed at the end of this outline and by a combination of:</p> <ul style="list-style-type: none"> <li>• Written assessment</li> <li>• Calculations</li> <li>• Assignments</li> <li>• Oral assessment</li> <li>• Practical assessment</li> </ul>
<b>Learning Outcome 2</b>	<b>Manage a low voltage DC battery system in accordance with safe and statutory requirements.</b>
Assessment criteria	<ol style="list-style-type: none"> <li>2.1 Primary and secondary cells are identified.</li> <li>2.2 Electrolytic dissociation of substances in solution is explained.</li> <li>2.3 Basic construction of lead acid and alkaline batteries are described</li> <li>2.4 Routine operation and maintenance of batteries, including the use of a hydrometer, in accordance with safe and established practices are described.</li> <li>2.5 The normal battery charging procedures and circuits are explained.</li> <li>2.6 Low voltage distribution systems, including emergency circuits, are described.</li> <li>2.7 Safety precautions and statutory requirements associated with the management of batteries and low voltage systems are described.</li> </ol>

Conditions and Method of assessment	<p>As specified in the Assessment Strategy listed at the end of this outline and by a combination of:</p> <ul style="list-style-type: none"> <li>• Written assessment</li> <li>• Calculations</li> <li>• Assignments</li> <li>• Oral assessment</li> <li>• Practical assessment</li> </ul>
<b>Learning Outcome 3</b>	<b>Operate and manage electrical equipment/circuits effected and utilising magnetic fields.</b>
Assessment criteria	<p>3.1 Common magnetic material and their magnetic fields are described.</p> <p>3.2 Magnetic fields due to electric currents in straight conductors and coils are explained.</p> <p>3.3 Shielding of magnetically sensitive material is described.</p> <p>3.4 Faraday's Law of magnetic induction is identified</p>
Conditions and Method of assessment	<p>As specified in the Assessment Strategy listed at the end of this outline and by a combination of:</p> <ul style="list-style-type: none"> <li>• Written assessment</li> <li>• Calculations</li> <li>• Assignments</li> <li>• Oral assessment</li> <li>• Practical assessment</li> </ul>
<b>Learning Outcome 4</b>	<b>Operate, manage, and monitor basic AC equipment in accordance with established procedure and safety requirements.</b>
Assessment criteria	<p>4.1 The relationship between alternating current and voltage is described.</p> <p>4.2 The terms maximum, average, RMS, power, and power factor in regard to alternate current are defined.</p> <p>4.3 Simple problems involving AC voltage, current, power, and power factor are solved.</p>
Conditions and Method of assessment	<p>As specified in the Assessment Strategy listed at the end of this outline and by a combination of:</p> <ul style="list-style-type: none"> <li>• Written assessment</li> <li>• Calculations</li> <li>• Assignments</li> </ul>

- Oral assessment
- Practical assessment

**Learning Outcome 5**

**Operate and carry out basic maintenance of rotating electric machines in accordance with manufacturer recommendations, established procedure, and safety requirements.**

## Assessment criteria

- 5.1 The production of EMF due to a rotating single loop in a magnetic field is described.
- 5.2 The basic operation of an AC alternator is explained.
- 5.3 Parallel operation of electrical alternators in accordance with established procedures are demonstrated.
- 5.4 The operation of AC motors, including induction motors, is explained.
- 5.5 Basic motor starters and protection devices are explained.
- 5.6 Routine maintenance with electric rotating machines in accordance with manufacturer recommendations and safety requirements are described.

## Conditions and Method of assessment

As specified in the Assessment Strategy listed at the end of this outline and by a combination of:

- Written assessment
- Calculations
- Assignments
- Oral assessment
- Practical assessment

**Learning Outcome 6**

**Operate and carry out basic maintenance of single and three phase electrical distribution systems on vessels in accordance with manufacturer recommendations, safety and statutory requirements.**

## Assessment criteria

- 6.1 Basic single and three phase marine electrical distribution systems are described and their components and functions explained.
- 6.2 The basic operation and maintenance of the above systems in accordance with manufacturer recommendations, safety and statutory requirements are described.
- 6.3 Common electrical faults, their causes, effects, and relevant protection devices are described.

- 6.4 Protection devices, including fuses, circuit breakers, preferential tripping, and earth lamps, are explained.
- 6.5 Dangers associated with electrical distribution systems, relevant protection devices, and safe working practices are described.
- 6.6 The relevant statutory regulations applying to electrical equipment are identified.
- 6.7 Procedure of connecting the vessel to shore power, including docking operations, in accordance with safety and statutory requirements are described.

Conditions and  
Method of assessment

As specified in the Assessment Strategy listed at the end of this outline and by a combination of:

- Written assessment
- Calculations
- Assignments
- Oral assessment
- Practical assessment

**Learning Outcome 7**

**Operate and interpret switchboard indicating Instruments and electrical test equipment in accordance with operating manuals, technical specifications, and safety requirements.**

Assessment criteria

- 7.1 Switchboard indicating instruments are identified and their operating principles explained.
- 7.2 Types of multimeters are identified, and the correct and safe use of each type, including fault tracing, is demonstrated.
- 7.3 The importance of insulation resistance is identified and its measurement, including the use of a “Megger”, in accordance with safety and statutory requirements is described.
- 7.4 Appropriate action on detecting low insulation resistance is described.
- 7.5 The function, and the correct and safe use of a “tong tester”, is described.
- 7.6 The measurement of the resistance of a circuit or component using an ammeter and a voltmeter in accordance with established practices and safety requirements are demonstrated.
- 7.7 The correct and safe use of electrical testing equipment is explained.

Conditions and Method of assessment	As specified in the Assessment Strategy listed at the end of this outline and by a combination of: <ul style="list-style-type: none"> <li>• Written assessment</li> <li>• Calculations</li> <li>• Assignments</li> <li>• Oral assessment</li> <li>• Practical assessment</li> </ul>
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<b>Learning Outcome 8</b>	<b>Isolate and re-establish circuits, conduct fault tracing, and carrying out basic maintenance of electrical equipment in accordance with technical specifications, established procedure, and safety requirements.</b>
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Assessment criteria	<p>8.1 Safety precautions when working with electrical systems are identified.</p> <p>8.2 Maintenance of electrical equipment including: <ul style="list-style-type: none"> <li>• Isolation of electric circuits;</li> <li>• Tagging;</li> <li>• Testing procedures;</li> <li>• Basic fault finding procedure; and</li> <li>• Re-establishing circuits</li> </ul> in accordance with established procedure and safety requirements is described.</p> <p>8.3 Possible causes of electrical shock, prevention, and actions to be taken are identified.</p> <p>8.4 Actions to be taken with electrical fires are identified.</p>
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Conditions and Method of assessment	As specified in the Assessment Strategy listed at the end of this outline and by a combination of: <ul style="list-style-type: none"> <li>• Written assessment</li> <li>• Calculations</li> <li>• Assignments</li> <li>• Oral assessment</li> <li>• Practical assessment</li> </ul>
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<u>Delivery strategy</u>	<p>The module provides for delivery by on-the-job and off-the-job training and assessment.</p> <p>Some areas of content may be common to more than one learning outcome, and therefore integration of training and assessment may be appropriate.</p>
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Methods of instruction includes:

1. Classroom lectures with handouts, course notes, overhead transparencies (or equivalent), slide presentations, video material, and whiteboard notes;
2. Calculation via examples and tutorials; and
3. Practical demonstrations.

Resource requirements

Delivery of the training will require:

- Classroom
- Whiteboard
- Overhead projector (or equivalent)
- Video player
- Access to an appropriate vessels
- Appropriate electrical gear or models
- Electrical testing equipment
- Appropriate tools and safety equipment

Assessment Strategy

Assessment Method

Knowledge based criteria will be satisfied through a combination of calculations, written and oral assessments.  
Skill based criteria will be satisfied through practical exercises.

Condition of Assessment

This module may be assessed on and off the job. Competence may be assessed in the following situations: classroom; laboratories; and appropriate vessels.

Evaluation:

Final Grade for this course will be based on meeting the course requirements at the following percentage rates:

96% - 100%	A – Superior
90% - 95%	B – Above Average
80% - 89%	C – Average
69% - 79%	D – Below Average
0 % - 69%	F – Failure

Attendance:

The COM-FSM attendance policy will apply.