

BMET - Intermediate

Description of Unit

This syllabus covers the underpinning knowledge of marine electrical systems and marine instrumentation. It leads from a revision of dc & ac theory into its application to electrical equipment. It includes the basic sensors and control systems with drawings used on a typical marine installation. Students understanding of these concepts will be applied to the understanding of electrical power sources, distribution and utilisation. It therefore provides a platform for safe, effective electrical/electronic installation and maintenance, basic faultfinding and the operation of navigational aids equipment.

Summary of outcomes

To achieve this unit a student must:

- Evaluate dc and ac single-phase circuits.
- Identify and apply circuit diagrams and conventions used on electrical power and instrumentation systems.
- Choice and operation of test equipment.
- Investigate operation of generators, motors and power supplies
- Investigate distribution systems
- Undertake selection and maintenance of batteries
- Undertake routine electrical installation, maintenance and fault finding procedures
- Undertake routine electronic installation, maintenance and fault finding procedures
- Understand basic principles and operation of :
 - Radar
 - Radio
 - Navigational aids

1. Evaluate dc and single phase circuits

d.c. circuits: circuit analysis using Ohm's law, series and parallel circuits, power calculations.

Single phase: peak & rms values, periodic time and frequency, polarity indicators.

2. Identify and apply circuit diagrams and conventions

Conventions: awareness of relevant regulations (ISO 10133) for installation of low voltage dc equipment on vessels up to 24 metres LOA.

Symbols: recognise electrical and electronic symbols to ISO standards. Relates circuit diagrams to equipment components and wiring. Utilise circuit diagrams for faultfinding procedures.

Instrument Drawings: Recognise electrical, electronic and instrumentation drawings

3. Choice and operation of electrical test & measurement equipment.

Awareness of the safe, competent application and the limitations of various equipment types.

Safety test equipment: Live line testers, insulation resistance testers

Measurement equipment: Multimeters - analogue and digital, clamp on ammeters,

4. Investigate operation of generators, motors and power supplies

Generators: Control of voltage and frequency

Generator instrumentation: Voltage/Current monitoring

a.c. motors: various types, maintenance and basic fault finding.

d.c. motors: various types, maintenance and basic fault finding.

Motor protection: short - circuit, overcurrent, thermistor protection.

Power supplies: basic linear, rectification, smoothing

5 Investigate Distribution Systems

AC and DC Systems, ring and radial/ systems, transformers, earth leakage monitoring, insulated and earthed dc systems, shore Supplies, circuit protection systems, cable requirements.

6 Undertake selection and maintenance of batteries

Basic technology : primary, secondary, different battery types and requirements

Basic maintenance : storage, routine procedures, protection

7. Undertake routine electrical installation, maintenance and fault finding procedures

Safety: electrical safety and electric shock levels.

Maintenance: need for routine maintenance

Faultfinding: recognition of faults, faultfinding procedures

8 Undertake routine electronic installation, maintenance and fault finding procedures.

Safety: isolation, toxic substances, handling of hazardous components

Maintenance: need for routine maintenance

Faultfinding: Basic fault finding related to connection of power supplies, correct polarity, earthing, filtering and screening, inter-unit connections.

Test Equipment: oscilloscope, signal generator, power and VSWR meter, modulation meter.

9 Understands the operational controls and principles of operation of radio, radar and navigational aids.

Operational controls: radar, logs , echosounders , autopilots, electronic charts, ssb radio, vhf, digital selective calling, navtex and weatherfax, television

Basic principles of operation of the range of communication and navigational aids

Outcome and assessment criteria

Outcomes	Assessment criteria
	To achieve each outcome a student must demonstrate the ability to:
1. Evaluate dc and single phase circuits	<ul style="list-style-type: none"> • Analyse d.c circuits in terms of voltage, current, resistance and power • Calculate RMS, peak values, periodic times / frequency.
2. Identify and apply circuit diagrams and conventions	<ul style="list-style-type: none"> • Identify correct circuit polarity • Read and, where appropriate modify, circuit diagrams for a basic electrical system • Read installation drawings for radio and electronic navigation equipment. • Read and, where appropriate, modify, instrumentation drawings.
3. Choice and operation of electrical test & measurement equipment.	<ul style="list-style-type: none"> • Demonstrate proper isolation and subsequent testing procedures. • Demonstrate the safe use of a Multimeter, clamp on ammeter Insulation resistance tester and live line tester. • Demonstrate the use of a range of test equipment for electronics and instrumentation.
4. Investigate the operation of generators and motors	<ul style="list-style-type: none"> • Understand the operation of generators and alternators. • Identify voltage and current measuring equipment. • Understand the operation of different motor types. • Recognise the causes of failure and the purpose of protection systems • Identify analogue and a digital control signals. • Investigate linear and switch mode power supplies.
5. Investigate distribution systems	<ul style="list-style-type: none"> • Recognise ac ring and radial systems and dc insulated and non insulated systems • Demonstrate an understanding of transformers • Demonstrate safe connection of shore supplies • Undertake earth fault monitoring. • Understands cable requirements and circuit protection systems.
6. Undertake care and maintenance of batteries	<ul style="list-style-type: none"> • Understand battery types and associated equipment • Demonstrates an understanding of battery maintenance and associated safety issues

<p>7. Undertake Routine electrical maintenance and fault finding procedures</p>	<ul style="list-style-type: none"> • Demonstrate safety procedures • Undertake routine and preventative maintenance • Recognise a range of basic faults on electrical and instrumentation systems.
<p>8. Undertake routine electronic installation, maintenance and fault finding procedures</p>	<ul style="list-style-type: none"> • Safe isolation of circuits. Handling components with toxic substances. Safe handling of cathode ray tubes • Carry out routine maintenance • Carry out basic fault finding on connection of power supplies, inter connection of units • Correctly site and fit antennas or transducers or repeaters for logs, autopilots, GPS, echosounders, wind instrumentation and electronic compasses
<p>9. Understand operational controls and principles of operation of radio and navigational aids</p>	<ul style="list-style-type: none"> • Conduct a performance operational test on all radio and navigation equipment to ensure it is operating as per manufacturer's specification. • Understand basic principles of operation of radio and navigational aids equipment. • Understand basic principals of navigation. (bearings, variation, waypoints, routes, tidal vector)

Guidance

Generating evidence

Evidence of outcome must be demonstrated in written and practical assessments. Assignments, written tests/examinations or workshop activities may be used to demonstrate competency.

Links

Students should realize the relationship, which exists between the power generation equipment and distribution systems.

Resources

On the job training.

Delivery

Reading List

Practical Marine Electrical Knowledge by Dennis T Hall. Witherby Press
BMEA Code of Practice
ISO Codes