Australian Government

MARL014 Apply intermediate principles of marine electrotechnology

Release: 1

MARL014 Apply intermediate principles of marine electrotechnology

Modification History

Release 1. New unit of competency.

Application

This unit involves the skills and knowledge required to apply intermediate marine electrotechnology principles and perform intermediate electrical calculations.

This unit applies to the work of a Marine Engineer Class 2 on commercial vessels greater than 3000 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Class 2 issued by the Australian Maritime Safety Authority (AMSA).

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Not applicable.

Competency Field

L – Marine Engineering

Unit Sector

Not applicable.

Elements and Performance Criteria

Elements describe the essential outcomes.	Performance criteria describe the performance needed to demonstrate achievement of the element.
1 Apply concepts of resistivity, resistance and capacitance to series and parallel AC and DC circuits	1.1 Calculations are performed to solve problems related to resistance, voltage drop, current and power in series and parallel circuits
	1.2 Calculations are performed to solve problems related to temperature coefficient of resistance and change of resistance of a conductor with a change of temperature
	1.3 Basic relationships that give total equivalent capacitance for capacitors arranged in series and parallel combinations are derived

		1.4	Relationships that give total equivalent capacitance to solve numeric problems involving alternating current (AC) and direct current (DC) circuits are applied
2	**Explain how principles of electrolytic action apply to electrical cells and batteries**	2.1	Kirchhoff's circuit laws are explained
		2.2	Calculations to solve problems involving currents, voltage drop and terminal potential difference for cells connected to form batteries in series and in parallel are performed
		2.3	Calculations to solve secondary cell charging and discharging problems are performed
		2.4	Calculations to solve problems related to the efficiency of cells are performed
3	**Analyse a magnetic circuit**	3.1	Key parameters of magnetic circuits are identified
		3.2	Formula for calculating the amount of flux generated by a multi turn solenoid coil carrying a current to give the B/H relationship is applied
		3.3	Significance of the varying slopes in the B/H curves for a solenoid coil with air, cast iron, cast steel and mild steel cores is explained
		3.4	How a magnetic circuit may be created by using a toroidal core within the solenoid coil is demonstrated
		3.5	Calculations to solve problems relating to magnetic circuits using different materials in different parts of their cores, including air gaps, are performed
		3.6	Effect on flux density of applying an alternating magnetising force to an iron core is shown diagrammatically
4	**Interpret electromagnetic consequences of a conductor moving relative to a magnetic field**	4.1	Faraday's and Lenz's Laws are applied to solve problems relating to the electromagnetic induction of EMF and current
		4.2	Generation of EMF is illustrated by a simple, single loop conductor rotating in a uniform magnetic field and how this EMF may be tapped to an external circuit as either AC or DC is explained
		4.3	How alternating electrical quantities may be represented by rotating phasors is illustrated and explained
		4.4	Relationships between instantaneous, maximum, average and RMS values of sinusoidally alternating electrical quantities is

			derived
		4.5	Mathematical problems are solved by applying relationships between instantaneous, maximum, average and RMS values of sinusoidally alternating electrical quantities
5	**Analyse circuits that incorporate combinations of resistive, inductive, and capacitive elements**	5.1	Time constant for different circuit combinations subjected to DC EMF's is defined
		5.2	Calculations are performed to solve problems involving time constants in DC circuits with changing rates of current in resistive/inductive elements and changing voltages through resistive/capacitive circuit elements
		5.3	Differentiation is made between inductive reactance, capacitive reactance and impedance as applied to AC circuits
		5.4	Effects of inductive and capacitive reactance upon phasor relationships between applied AC voltage and current are shown
		5.5	Concept of total impedance is applied to solution of problems involving single phase AC quantities in the presence of both resistive/inductive and resistive/capacitive circuit elements, arranged in either series or parallel
		5.6	Power factor is defined and concepts of real and reactive power usage are applied to solution of problems involving RL and RC elements
6	**Analyse operation of polyphase AC circuits**	6.1	How three phase AC may be developed out of simple single phase AC is explained
		6.2	Voltage and current relationships between line and phase in both Star and Delta 3 phase connections are derived
		6.3	Standard Star to Delta and Delta to Star conversion relationships for current and voltage are derived
		6.4	Numeric problems involving both balanced and unbalanced circuit loads are solved
		6.5	Relationships between kW, kVA and kVAr for 3 phase AC circuits is derived
		6.6	Calculations are performed using the relationship between kW, kVA and kVAr to solve problems in 3 phase AC circuits
7	**Describe basic operating principles**	7.1	Schematic circuits are prepared for separately excited, series, shunt and compound connected generators and motors to

	of shipboard DC machinery		illustrate wiring arrangements used with DC machines
		7.2	EMF equation for a DC generator to solve shipboard problems is applied
		7.3	Torque equation for a DC motor to solve shipboard problems is applied
		7.4	Expression linking back EMF parameters for a DC motor is derived and used to solve shipboard problems
		7.5	Various losses that can occur in DC motors and generators are calculated
8	**Perform calculations related to operation of AC generators**	8.1	Construction features of the AC synchronous generator are explained
		8.2	EMF equation for an AC generator is derived, taking into account distribution and pitch factors
		8.3	Expression for the magnitude and speed of the rotating flux generated by a three-phase supply is derived
		8.4	Voltage regulation for synchronous generator is defined
		8.5	Effect of power factor on load characteristic of an AC generator is illustrated
9	**Perform calculations related to operation of three-phase AC induction motors**	9.1	Construction features of the AC induction motor are explained
		9.2	Expression for slip of an induction motor rotor is derived and applied to frequency of its rotor EMF and current
		9.3	Expression for magnitude of rotor EMF and current is derived, taking into account distribution and pitch factors
		9.4	Relationships between rotor torque, rotor losses and slip indicating factors that affect torque are outlined
		9.5	Significance of torque/slip curves for an induction motor is explained
		9.6	Relationship between starting torque and applied voltage is established and consequences of this upon starting methods are outlined
10	**Explain operating principles of basic electrical**	10.1	Schematic circuit diagrams are prepared that illustrate the main features and applications of moving coil and moving iron voltmeters and ammeters

instrumentation	10.2	Schematic circuit diagrams are prepared that illustrate the main features and applications of air and iron cored dynamometer type wattmeters
	10.3	Dangers associated with current and voltage transformers on high current and voltage systems are identified

Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Key parameters of magnetic circuit include one or more of the following:	• current • flux • flux density • magnetising force • magneto motive force
Circuit combinations must include:	• resistive/capacitive • resistive/inductive
Losses include one or more of the following:	• copper losses • iron losses or magnetic losses • mechanical losses

Unit Mapping Information

This unit replaces and is equivalent to MARL6001A Apply intermediate principles of marine electrotechnology.

Links

Companion Volume implementation guides are found in VETNet - https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2