

**ANNEX B OF CMO NO. 20, SERIES OF 2015
BACHELOR OF SCIENCE IN MARINE ENGINEERING
COURSE SPECIFICATIONS**

Course Code	:	Electro 3
Course Descriptive Title	:	Marine Electronics and Electrical Maintenance
Course Credits	:	5 units
Lecture Contact Hours per Week	:	4 hours
Laboratory Contact Hours per Week	:	3 hours
○ Prerequisite	:	Electro 2
Reference/s	:	<ul style="list-style-type: none"> ○ Table A-III/1 and Table III/2 Function: Electrical, Electronic and Control Engineering ○ IMO Model Courses 7.02 and 7.04 ○ STCW'78 as amended ○ Annex A of CMO No. 20, Series of 2015 (Curriculum Mapping for BSMarE)

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate electrical, electronic and control systems	Electronic equipment	<p>1. Electron Theory</p> <ul style="list-style-type: none"> - Explains standards/regulations for watchkeeping in a national law if any - Explains what is meant by: <ul style="list-style-type: none"> -an atom -an element -a compound -a molecule - Explains the composition of an atom in terms of electrons, protons and neutrons and the balance of electrons and protons - States that electrons orbit the nucleus, their increasing energy level being proportional to their distance from it - Describes the effect of applying energy to an atom - Describes the flow of current in a conductor subjected to a potential difference, referring to: <ul style="list-style-type: none"> -electron flow -conventional flow - Explains the significance of the number of electrons in the outer shell, with reference to: <ul style="list-style-type: none"> -inert elements -positive ions -negative ions -ionization 	5 Hours
Operate electrical, electronic and control systems (cont)	Electronic equipment (cont)	<p>2. Basic Electronic Circuit Elements</p> <p>1) Semiconductor</p> <ul style="list-style-type: none"> - Defines the semiconductor - Describes how semiconductors are utilized - Explains the current and the free electrons in the semiconductor - Explains what types of intrinsic/extrinsic semiconductor are - Explains the following characteristics of semiconductors <ul style="list-style-type: none"> - photoelectric effect - thermoelectric effect - communicating action - hall effect - Explains the following with regard to semiconductors: 	20 Hours

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
		<ul style="list-style-type: none"> - P-N junction and its properties - semiconductor diode rectification - structure of diode - function principle - transistor amplification effect 	
Operate electrical, electronic and control systems (cont)	Electronic equipment (cont)	<p>2) Thyristor</p> <ul style="list-style-type: none"> - Defines the thyristors - Lists various types of thyristors and describes their actions and characteristics - Describes how thyristors are utilized, taking some applications as examples - States advantages and disadvantages when using thyristors <p>3) IC and LSI</p> <ul style="list-style-type: none"> - Defines Integrated Circuit (IC) and Large Scale Integrated Circuit (LSI) as circuit elements - Describes the structures of IC - Describes briefly the functions of the following types of IC <ul style="list-style-type: none"> -Transistor Transistor Logic (TTL) -Emitter-Coupled Logic (ECL) -Complementary Metal-Oxide Semiconductor (CMOS) -Erasable Programmable Read-Only Memory (EP-ROM) - Random Access Memory (RAM) - Central Processing Unit (CPU) 	
Maintenance and repair of electrical and electronic equipment	The interpretation of electrical and simple electronic diagrams	<ul style="list-style-type: none"> - Explains major electrical and electronic symbols used in their circuit diagrams - Describes the function of circuit elements presented by the symbols in their circuit diagram - Explains briefly the flow of electrical/electronic current and functions of their circuit diagrams taking simple circuits containing major electrical/electronic symbols as examples - Explains the basic differences between the following electrical diagrams: <ul style="list-style-type: none"> - block diagram - system diagram - circuit diagram - wiring diagram - Using a given simple wiring diagram, sketches a circuit diagram - From given simple circuit or wiring diagrams, sketches schematic or system diagrams, using correct letter and circuit symbols 	5 Hours

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
		<ul style="list-style-type: none"> - Uses the diagrams named in the above objective 	
	Maintenance and repair of electrical system equipment, switchboards, electric motors, generator and DC electrical systems and equipment	<p>3. Principles of Maintenance</p> <ul style="list-style-type: none"> - Explains the need for maintenance - Describes briefly what is meant by: <ul style="list-style-type: none"> -breakdown maintenance -planned maintenance -condition monitoring - 	5 Hours
Maintenance and repair of electrical and electronic equipment	Maintenance and repair of electrical system equipment, (cont)	<p>4. Generator</p> <ul style="list-style-type: none"> - States the safety and isolation precautions necessary before commencing work - Lists the parts to be inspected, their common faults and the necessary remedial action - Tests and records values of insulation resistance - Performs routine maintenance and testing of a generator 	5 Hours
		<p>5. Switchboard</p> <ul style="list-style-type: none"> - Describes or carries out a maintenance routine on main circuit breakers - Describes the care to be taken when handling circuit breakers - Detects and corrects faults implanted in circuit breakers 	5 Hours
		<p>6. Electrical Motors</p> <ul style="list-style-type: none"> - Lists the principle maintenance equipment for motors - Carries out the maintenance necessary for a cage electric motor, paying particular attention of: <ul style="list-style-type: none"> -damp, condensation and air flow -dust and oil -external and internal surfaces -frequency of maintenance -deterioration of insulation -cleaning, inspection, renewal and lubrication of bearings -describes the most common causes of failure of insulation -checks the insulation resistance of a three-phase induction motor 	5 Hours
		<p>7. Starters</p> <ul style="list-style-type: none"> - Carries out the maintenance necessary, and completes reports on, starters and controllers, with specific reference of: <ul style="list-style-type: none"> -casings, corrosion and bonding 	5 Hours

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Maintenance and repair of electrical and electronic equipment (cont)	Maintenance and repair of electrical system equipment, (cont)	<ul style="list-style-type: none"> -contactors, magnet faces, pitting, overheating, spring force, lubrication -connections, cables and leads -correct operation when in use - Detects and rectifies faults implanted in motors, starters and protection equipment 	
Maintenance and repair of electrical and electronic equipment (cont)	Maintenance and repair of electrical system equipment, (cont)	<p>8. Distribution System (Transformer)</p> <ul style="list-style-type: none"> - Describes the maintenance checks required by a transformer (Distribution) - Explains what is meant by the following faults: <ul style="list-style-type: none"> -open-circuit -earth -short-circuit - Estimates the current flowing during given fault conditions - Explains how earth faults occur and the potential danger - Explains the effects of an earth fault with an insulated distribution system - Given a diagram showing earth-fault lamps, describe the appearance of the lamps when an earth fault occurs - Explains the principle of using earth-fault instruments - On a given distribution circuit, carries out a logical procedure to detect the location of an earth, using earth-fault lamps and an insulation-testing instrument - Explains why the circuit must be switched off when replacing a lamp - Describes the deterioration common in both lamp holders and their wire connections - Explains the care necessary when working on fluorescent lamp circuits - Describes how failed lamps are disposed of - Describes the care necessary when maintaining: <ul style="list-style-type: none"> - exposed watertight fittings - portable hand lamps - Carries out routine testing and maintenance of lighting circuits and fittings - Detects and rectifies implanted faults likely to be encountered at sea (High voltage) - States that high-voltage systems are normally earthed via a resistor - Explains how the presence of earth faults is indicated in a high-voltage system with an earthed neutral - States routine maintenances and inspection/testings to be needed 	20 Hours

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Maintenance and repair of electrical and electronic equipment (cont)	Maintenance and repair of electrical system equipment, (cont)	<p>(Cables)</p> <ul style="list-style-type: none"> - Fits cables through glands into a terminal box, earthing the armoring as appropriate - Solders and crimps terminal sockets to conductors - Measures resistance of cables - Explains the limitation of temporary repairs to insulation - Carries out temporary repairs to insulation 	
Maintenance and repair of electrical and electronic equipment (cont)	Maintenance and repair of electrical system equipment, (cont)	<p>9. D.C Electrical Systems and Equipment (Battery system)</p> <ul style="list-style-type: none"> - States that emergency lights and back-up power supply lines for the ship's propulsion machinery must be tested at frequent intervals - Demonstrates or describes the maintenance of batteries, taking all necessary precautions - Names the gases given off when recharging a lead-acid battery, explaining the effect on the electrolyte and how it is remedied - Checks the specific gravity of the electrolyte of a lead-acid battery and of an alkaline battery and explains its significance 	5 Hours
Maintenance and repair of electrical and electronic equipment (cont)	Maintenance and repair of electrical and electronic equipment (cont)	<p>(Remote/Automatic Control Equipment)</p> <ul style="list-style-type: none"> - States that the presence of back-up power for remote/automatic control equipment should be continuously monitored and must be checked at frequent intervals - States how back up power for monitoring systems can be tested and its built-in battery must be renewed at a certain intervals - States that back-up power for safety/protective devices is supplied from emergency D.C. line and it must be tested carefully at a certain intervals - States that the power for safety/protective devices is isolated from control systems and other power sources 	
Maintenance and repair of electrical and electronic equipment (cont)	Detection of electric malfunction, location of faults and measures to prevent damage	<p>10. Fault Protection</p> <ul style="list-style-type: none"> - Explains why fault protection is essential - Names the component parts of fault-protection equipment - Explains why fault currents can be extremely high - Names the three types of over current-protection relay and describes the principles of operation of each - Explains the advantages and disadvantage of high-rupturing-capacity fuses - Names the protection provided against: 	15 Hours

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Maintenance and repair of electrical and electronic equipment (cont)	Detection of electric malfunction, location of faults and measures to prevent damage (cont)	<ul style="list-style-type: none"> -short circuits -small overloads - Describes the procedure when replacing a blown fuse - Explains in simple terms, preferential tripping when overload occurs - Explains the purpose of under voltage protection of generators and of motors - Explains the purpose of reverse power protection - Sketches the layout of a typical main switchboard, indicating the function of the main parts - Explains the danger associated with the spaces in the vicinity of busbar - Explains the use of transformers for switchboard instruments, stating the voltages and current produced - Describes the earthing of instruments - Explains the potential danger of instrument voltage/current transformer circuits and the safe procedure for working on such circuits - Explains how status indicator lamps are usually supplied with power - Describes the procedure if a fault develops with a miniature circuit breaker - Adjusts, maintains and tests the types of fault protection normally encountered 	
Manage operation of electrical and electronic control equipment (ML)	Design features and system configurations of operational control equipment for electrical motors	<p>11. Fault Location</p> <ul style="list-style-type: none"> - Describes the essential requirements for the automatic operation of marine machinery - Uses control and instrumentation terminology in its correct context - Compares pneumatic, hydraulic and electronic-electrical control systems - Describes a simple control loop - Names analogue and digital devices - Locates faults in simple control systems - On locating fault takes actions to best prevent damage - States what is necessary to prevent damage from electrical malfunctions such as burned circuit elements, poor contacts, breaking and faulty limit/micro switches 	5 Hours
		<p>12. Effect of varying frequency and voltage of A.C. Motors</p> <ul style="list-style-type: none"> - Locates faults in simple control systems - Speed - Temperature - Torque - Power output - Starting time, current - 	4 Hours

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Manage operation of electrical and electronic control equipment (ML)	Design features and system configurations of operational control equipment for electrical motors	13. Insulated Gate Bipolar Transistor (IGBT) motor speed control <ul style="list-style-type: none"> - Gate driving characteristics with high current - High frequency, high current switch - Advantages of IGBT in varying motor speed control 	4 Hours
		14. Motor speed control by Thyristors <ul style="list-style-type: none"> - Application of thyristors in motor speed control 	2 Hours
		15. Three Phase Generators <ul style="list-style-type: none"> - Construction. Salient and cylindrical rotor types - Shaft generators - Excitation methods - Automatic voltage regulation - Synchronisation - Parallel operation - Generator trouble shooting 	7 Hours
		15. Three Phase Transformers <ul style="list-style-type: none"> - Construction Polarity - Configurations in Star and Delta combinations - Open delta configuration 	3 hours
		Total No. of Hours	120 Hours

* the discrepancy between course specifications and course map total number of hours is intended for assessment