COURSE PACKAGE

Part A: Course Specifications

Course Code	:	Electro 2					
Course Descriptive Title	:	Basic Electronics					
Prerequisite	:	Electro 1		**Corequisite**	:	None	
Year Level	:	First Year		**Semester Offered**	:	Second Semester	
Course Credits	:	4 units	**Theoretical Contact Hours Per Week**	:	3 hours	**Demonstration/ Practical Work Contact Hours Per Week**	: 3 hours
Course Description	:	The course is an introductory course which is the second series of the 3 – part course for the competencies of "Operate electrical, electronic and control systems" and "Maintenance and repair of electrical and electronics equipment". This course is designed to provide students with knowledge and skills in semiconductors devices, electronic circuits, digital electronics, and its practical application.					

STCW Reference	:	**STCW Table**	**Function**	**Competence**	**Knowledge, Understanding and Proficiency**
		A-III/1	Electrical, Electronic and Control Engineering at the Operational Level	Operate Electrical, Electronic and Control systems	Basic Configuration and operation principles of the following electrical, electronic and control equipment .2 Electronic Equipment 2a Characteristics of basic electronic circuit elements
				Maintenance and repair of electrical and electronic equipment	Safety requirements for working on shipboard electrical systems, including the safe isolation of electrical equipment required before personnel are permitted to work on such equipment. Detection of electric malfunction, location of faults and measures to prevent damage The interpretation of electrical and simple electronic diagram

Course Outcome	:	*PO-E.1, PO-E.4-.7*	*At the end of the course, the student must be able to:* **CO1.** Apply safety measures in handling electrical and electronic components in accordance with best industry practices **CO2.** Explain the operation principles and applications of various electronic components. **CO3.** Identify the basic configuration and explain the operating principles of electronic equipment **CO4.** Select, use and test electrical measuring instruments, and testing equipment required in handling electronic components. **CO5.** Interpret simple electronic diagrams. **CO6.** Construct a power supply in accordance with design specifications		
Course Intake Limitations	:	The number of students that can be accommodated shall not exceed 40 per for lecture and 20 for laboratory.			
Faculty Requirement	:	***Instructor*** The faculty that will be assigned to handle the course must possess the following qualifications: • Officer in charge of a watch of seagoing ships powered by main propulsion machinery of 750 kW propulsion or more; • graduate of Bachelor of Science in Marine Engineering; • completed Training Course for Instructors (IMO Model Course 6.09) • completed Training Course on Assessment, Examination and Certification of Seafarers (IMO Model Course 3.12); OR • Holder of Certificate of Competency (COC) for Electro-technical Officer (ETO); • completed Training Course for Instructors (IMO Model Course 6.09); • completed Training Course on Assessment, Examination and Certification of Seafarers (IMO Model Course 3.12) OR • Registered professional holding a bachelor's degree in Electronics Engineering or Electrical Engineering with Master's degree in the same discipline with at least one (1) year industrial and/or teaching experience; • completed Training Course for Instructors (IMO Model Course 6.09); • completed Training Course on Assessment, Examination and Certification of Seafarers (IMO Model Course 3.12); OR • Registered professional holding a bachelor's degree in Electronics Engineering or Electrical Engineering; • completed Training Course for Instructors (IMO Model Course 6.09);		

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- completed Training Course on Assessment, Examination and Certification of Seafarers (IMO Model Course 3.12);

Assessor
The assessor assigned shall have the same qualifications above.
Note:
1. *The instructor shall conduct the formative assessment.*
2. *Summative assessment shall be conducted by an Assessor not teaching the students (assessee).*

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<tr><td>Teaching Facilities and Equipment</td><td>:</td><td>

CLASSROOM
The standard classroom size shall be a minimum of 48 square meters, no side shall be less than 6 meters for a class of 40 students. Classroom must be illuminated at 50.76 Lux and well-ventilated. It should contain the following:

- Tables and chairs or armed chairs
- Whiteboards or chalkboards
- Multimedia equipment
- Scientific Calculator *(shall be provided by the student)*

<table>
<tr><th>Facilities and Equipment</th><th>Quantity Required/ Equipment to Student Ratio</th></tr>
<tr><td colspan="2">Test Instruments and Equipment</td></tr>
<tr><td>1. Digital Multimeter</td><td>1:2</td></tr>
<tr><td>2. Analog Multimeter</td><td>1:2</td></tr>
<tr><td>3. Soldering Iron, soldering lead, borax flux or paste flux</td><td>1:2</td></tr>
<tr><td>4. Vacuum Desoldering Tool</td><td>1:2</td></tr>
<tr><td>5. Logic tester</td><td>1:2</td></tr>
<tr><td colspan="2">Electronic Components</td></tr>
<tr><td>1. Various types of diodes</td><td>1:1</td></tr>
<tr><td>2. Various types of transistors</td><td>1:1</td></tr>
<tr><td>3. Various types of resistors</td><td>1:1</td></tr>
<tr><td>4. Various types of thyristors</td><td>1:1</td></tr>
<tr><td>5. Various types of logic gates</td><td>1:1</td></tr>
<tr><td>6. Various types of capacitors</td><td>1:1</td></tr>
<tr><td>7. Laboratory Power Supply (adjustable) with accessories</td><td>1:5</td></tr>
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		EQUIPMENT FOR	**PRACTICAL WORK**

(such as alligator wire)	
Training Modules	
1. Electronic Training Kit Module	1:4

Note: The MHEIs can use additional teaching facilities and equipment as deemed necessary to meet the learning outcomes of this course.

Teaching Aids	:	**TA1**	Semiconductor fundamentals
		TA2	Zener Diodes
		TA3	Bipolar Transistors
		TA4	Field effect Transistors
		TA5	Thyristors
		TA6	Integrated Circuits

		TA7 Optoelectronic Devices **TA8** Power Supplies **TA9** Number Systems **TA10** Basic Logic Gates **TA11** Basic Troubleshooting *Note: The MHEIs can use alternate and/or additional teaching aids as deemed necessary to meet the learning outcomes of this course.*
References/ Bibliographies	:	**References:** **R1** Officer in Charge of an Engineering watch (IMO Model Course 7.04) **R2** Hall, D.T. (1984); Practical Marine Electrical Knowledge. London, Witherby & Co Ltd. **R3** Kraal, E.G.R., (1985) Basic Electrotechnology for Engineers. 3rd ed. London, Thomas Reed Publications Ltd. **R4** Brown, M., Jawahar, R., Dinesh, P., (2005); Practical Troubleshooting of Electrical Equipment and Control Circuits, An imprint of Elsevier **R5** Richards, Steve (2013); Electronics, Navigational Aids and Radio Theory for Electrotechnical Officers; Adlard Coles Nautical; An imprint of Bloomsburry Publishing **R6** Boylestad, R.L & Nashelsky L; Electronic Devices and Circuit Theory, 11th Edition; Pearson Education, Inc *Note: The MHEIs can use alternate and/or additional references/bibliographies as deemed necessary to meet the learning outcomes of this course.*

Part B: Course Outline and Timetable

Note:
Considering that practical work activities could not be performed per weekly basis because of the required underpinning knowledge, the MHEI can deliver the same on the specified weeks provided below:

Term	Week	Topic	Time Allotment (in hours)	
			Theoretical	Demonstration / Practical Work
Note: MHEIs shall determine the number of periods for terms the semester is divided based on their school calendar activities	1-2	**1. Semiconductors PN Junction Diode** 1.1 Construction and operation, characteristics curve 1.2 Datasheet interpretation 1.3 Diode Circuit Analysis 1.4 Light Emitting Diode 1.5 Testing diodes	6	-
	3	**2. Zener Diodes** 2.1 Zener Diode Characteristics 2.2 Zener Diode Ratings and Datasheet interpretation 2.3 Voltage Regulation with Zener Diodes and its application 2.4 Testing Zener Diodes	6	-
	4-5	**3. Bipolar Transistors** 3.1 Transistor Construction 3.2 Transistor Types and Packaging 3.3 Basic Transistor Operation (NPN & PNP) – Transistor as a switch and amplifier 3.4 Transistor Testing 3.5 Transistor Substitution	6	-
	6-7	**4. Field Effect Transistors** 4.1 Junction FETs 4.2 Depletion Insulated Gate FETs (MOSFETs) 4.3 Enhancement Insulated Gate FETs (MOSFETs) - N-MOS and P-MOS 4.4 Insulated gate Bipolar Transistor (IGBT) 4.5 MOSFET Safety Precautions 4.6 Testing FETs	6	-
	8	**5. Thyristors** 5.1 Silicon-Controlled Rectifiers (SCR) 5.2 TRIACs – application in AC circuits 5.3 Bidirectional Trigger Diodes (DIAC)	6	-

Term	Week	Topic	Time Allotment (in hours)	
			Theoretical	**Demonstration / Practical Work**
		5.4 Triggering of Thyristors –application circuits (AC to DC converter) 5.5 Testing Thyristors		
	9	**6. Digital Electronics** 6.1 Number Systems 6.2 Logic Gates	3	-
	10-11	**7. Power Supply and Power Inverter**	9	-
	12-13	**8. Amplifiers**	6	-
	14	**9. Optoelectronic Devices**	3	-
	15 - 17	**10. Practical Work** 10.1 Analysis of electronic components 10.2 Testing of electronic components 10.3 Power supply design	-	51
Sub-total (Contact Hours)			**51**	**51**
Total Contact Hours			**102**	
Examination and Assessment				

Note:

1. *The MHEIs are to develop their respective timetable according to their resources but meets with the minimum time allocation for the contact hours. OR*
2. *The MHEIs shall determine the time allotment for the conduct of summative assessments*

Part C: Course Syllabus

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
CO2	**1. Semiconductor Fundamentals** 2.1 Explain the properties of conductor, insulator and semiconductor in terms of atomic structure. 2.2 Explain the principles and characteristics of semiconductors 2.3 Explain the construction and operating principle of a PN junction diode 2.4 Explain the characteristic curve of a PN junction diode 2.5 Explain the uses of diode in an electronic circuit 2.6 Explain the safety precautions in handling and using diodes 2.7 Analyze diode circuits using diode approximation 2.8 Explain the procedures in testing diode 2.9 Identify the operating limits of a diode according to its data sheet 2.10 Analyze parameters of a circuit that involves diodes	R1, R3, R5, R6	TA1
	2. Zener Diodes 2.1. Explain the construction and operating principle of Zener Diode 2.2. Explain the characteristic curve of a Zener diode 2.3. Explain the uses of Zener diode in an electronic circuit 2.4. Analyze parameters of a circuit with Zener diode 2.5. Explain the safety precautions in handling and using Zener diodes 2.6. Explain the procedure in testing Zener diodes 2.7. Identify the operating limits of a Zener diode according to its data sheet	R3, R5, R6	TA2
	3. Bipolar Junction Transistors (BJTs) 3.1. Explain the construction, configuration and operating principles of a BJT 3.2. Explain the operating regions of a BJT 3.3. Explain the uses of BJT in an electronic circuit 3.4. Analyze parameters of a circuit that involves BJTs 3.5. Explain the safety precautions in handling and using BJTs 3.6. Explain the procedure in testing BJT 3.7. Explain the transistor substitutions 3.8. Identify the types of packaging of transistors	R3, R5, R6	TA3

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
	4. Field Effect Transistors (FETs) 4.1. Explain the construction and operating principles of Junction Field Effect Transistors (JFETs) 4.2. Explain the uses of a JFET in an electronic circuit 4.3. Differentiate Depletion Insulated Gate FETs (IGFETs) and Enhancement Insulated Gate FETs (MOSFETs) - N-MOS and P-MOS 4.4. Explain the operating principle of Insulated gate Bipolar Transistor (IGBT) 4.5. Explain the uses of IGBT in industrial and power electronics 4.6. Explain the safety precautions in handling and using FETs 4.7. Explain the procedure in testing FETs 4.8. Analyze parameters of a circuit that involves FETs	R3, R5, R6	TA4
	5. Thyristors 5.1 Explain the construction and operating principles of thyristor 5.2 Identify the types of thyristors and explain its characteristics 5.3 Explain the applications of Diac, Triac, and SCR in industrial and power electronics based on its operating principle 5.4 Analyze parameters of a circuit that involves thyristors 5.5 Explain the safety procedure in handling and using thyristor 5.6 Explain the procedure in testing thyristors	R3, R5, R6	TA5
	6. Digital Electronics 6.1 Explain the following number systems: a. Binary b. Octal c. Decimal d. Hexadecimal 6.2 Convert a particular number system to another 6.3 Explain the construction and operating principles of the following logic gates: a. AND Gate b. OR Gate c. NOT Gate	R3, R5, R6	TA6

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
	d. NAND Gate e. NOR Gate f. Exclusive OR and NOR Gates g. Buffer 6.4 Explain the safety precautions in handling and using logic gates 6.5 Explain the procedure in testing logic gates		
CO3	**7. Power Supply and Inverters** 7.1 Explain the construction and operating principles of a power supply 7.2 Explain the types of power supply and its functions 7.3 Calculate parameters of a DC power supply 7.4 Explain the construction and operating principle of a power inverter 7.5 Explain the safety procedures in handling power supplies and inverters	R6	TA7
	8. Amplifiers 8.1 Explain the construction and operating principles of an amplifier 8.2 Explain the functions of an amplifier 8.3 Explain the classes of amplifiers 8.4 Explain the safety procedures in handling amplifiers	R6	TA8
	9. Optoelectronic Devices 9.1 Explain the operating principles of the following optoelectronic devices and state its application a. Light-Sensitive Devices b. Light-Emitting Devices c. Optocoupler ICs d. Flame Eye e. Oil Content Monitoring Devices	R3	TA9
CO1 CO4	**10. Testing Electronic Components (practical)** 10.1 Identify the measuring and testing equipment for testing electronic components 10.2 Carry-out function test by using measuring and testing equipment for testing the following: a. Diodes b. Transistors c. Thyristors d. Logic gates 10.3 Explain the procedures in handling and prevention electrostatic discharge	R2, R3, R4, R6	TA10

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
	10.4 Test parameters of a diode, transistor, thyristor and/or logic gate in a circuit. 10.5 Explain the procedure in using soldering iron 10.6 Explain the types, characteristics and conditions of flux 10.7 Explain the types and characteristics of conformal coating 10.8 Solder and de-solder an electronic component using proper techniques		
CO5 **CO6**	**11. Power Supply (practical)** 11.1 Draw a DC power supply diagram based on specification 11.2 Assemble a DC power supply, taking necessary safety precautions, based on specification 11.3 Test the parameters of the components in the assembled DC power supply	R6	TA11

Note: The MHEIs are to develop Part D: Detailed Teaching Syllabus and Instructional Materials (IMs), and Part E: Course Assessment and Assessment Tools (ATs) which satisfactorily meets with the requirements of the course as prescribed in the course outcomes and learning outcomes.