

COURSE PACKAGE

Part A: Course Specifications

Course Code	: IChem				
Course Descriptive Title	: Industrial Chemistry& Tribology				
Prerequisite	: None	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	: 2 hours
Course Description	: Industrial Chemistry and Tribology (IChem) is designed to enable Bachelor of Science in Marine Engineering students become competent marine engineers, executing their onboard functions in monitoring, assessing performance and maintaining safety of propulsion plant and auxiliary machinery through their understanding of the Chemistry involved in the use of boiler water, engine cooling water, lubricating oil, and fuel oil. This also includes descriptions and usage of various chemicals on board.				
STCW Reference	STCW Table	Function	Competence	Knowledge, Understanding and Proficiency	
	: <i>Specific underpinning knowledge and understanding under Table III/2 of the STCW Code are incorporated to Course.</i>				
	A-III/2	Marine Engineering at the Management level	Plan and Schedule operations	Physical and chemical properties of fuels and lubricants	
Course Outcome	: PO-B.1 PO-C.2 PO-E.1, PO-E.3-4 PO-E.8-9	: <i>At the end of the course, the student must be able to:</i> CO1. Explain the usage of other various chemicals on board. CO2. Identify risks in handling chemicals on board and the mitigation procedures in accordance with manual and/or best industry practices CO3. Explain the physical and chemical characteristics of the following: a. water b. fuel oil c. lube oil			

		<p>CO4. Conduct actual tests and analyse a given sample of boiler water, cooling water, and potable water in accordance with manual and/or best industry practices</p> <p>CO5. Recommend appropriate treatment based on test results of the boiler system, cooling water system, and potable Water to achieve the specifications</p>
<p>Course Intake Limitations</p>	<p>:</p>	<p>The number of students that can be accommodated shall not exceed 40 per for lecture and 20 for laboratory.</p>
<p>Faculty Requirement</p>	<p>:</p>	<p>Instructor The faculty that will be assigned to handle the course must possess the following qualifications:</p> <ul style="list-style-type: none"> ● 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); <p>OR</p> <ul style="list-style-type: none"> ● Registered professional holding a bachelor's degree in Chemical Engineering or Chemistry with Master's degree in the same discipline; ● with at least one (1) year industrial and/or teaching experience; ● completed Approved Training Course for Instructors (IMO Model Course 6.09); ● completed Approved Training Course on Assessment, Examination and Certification of Seafarers (IMO Model Course 3.12) <p>OR</p> <ul style="list-style-type: none"> ● Registered professional holding a bachelor's degree in Chemical Engineering or Chemistry; ● completed Approved Training Course for Instructors (IMO Model Course 6.09); ● completed Approved Training Course on Assessment, Examination and Certification of Seafarers (IMO Model Course 3.12) <p>Assessor The assessor assigned shall have the same qualifications listed above.</p> <p><i>Note:</i></p> <ol style="list-style-type: none"> 1. <i>The instructor shall conduct the formative assessment.</i> 2. <i>Summative assessment shall be conducted by an Assessor not teaching the students (assessee).</i>
<p>Teaching Facilities and Equipment</p>	<p>:</p>	<p>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:</p> <ul style="list-style-type: none"> ● Tables and chairs or armed chairs ● Whiteboards or chalkboards ● Multimedia equipment ● Scientific Calculator (<i>shall be provided by the student</i>) <p style="text-align: center;">EQUIPMENT FOR PRACTICAL WORK</p>



		Facilities and Equipment	Equipment to Student Ratio
		<i>(The following shall be provided by the MHEI)</i>	
		1. Boiler Water Test Kit	1:4
		2. Fresh Water Cooling Test Kit	1:4
		3. Potable (drinking) Water Test Kit	1:4
		4. Sample MSDS	1:1
		5. Viscotool (Viscosity comparator)	1:4
		6. Water contamination test kit	1:5
		7. Crackle Test	1:5
		8. Insoluble test kits	1:1
<i>Note: The MHEIs can use additional teaching facilities and equipment as deemed necessary to meet the learning outcomes of this course.</i>			
Teaching Aids	:	TA1 Fundamentals of Chemistry TA2 Acidity/Alkalinity TA3 Corrosion TA4 The Chemistry of water TA5 Boiler Water Testing and Treatment TA6 Cooling Water Testing and Treatment TA7 Properties of Fuels and Lube Oil TA8 Chemical Handling	
	<i>Note: The MHEIs can use alternate and/or additional teaching aids as deemed necessary to meet the learning outcomes of this course.</i>		



References/ Bibliographies	<p>R1 Officer in Charge of an Engineering watch (IMO Model Course 7.04) R2 Manufacturer's Manual of Fuel and Lubricating Oil Test Kit R3 Jackson, L. and Morton, T.D., General Engineering Knowledge for Marine Engineers, 5th edition. London, Thomas Reed Publications Ltd. 1990 (ISBN – 09 – 47 – 63776 – 1) R4 Chandler K. A. Marine and Offshore Corrosion, Butterworth and Co, 1995 R5 Silberberg M. Amateis P. Chemistry: The Molecular Nature of Matter and Change 9th Edition R6 Polymerization; https://www.britannica.com/science/polymerization R7 Rizvi, S.Q.A (2014); A Comprehensive Review of Lubricant Chemistry, Technology, Selection and Design; ASTM International R8 Singh, Ranvijay Pratap; Lecture notes on Fuel; Faculty of Engineering and Technology, University of Lucknow; https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004132159500424ranvijay_engg_Fuels.pdf R9 Material Safety Data Sheet R10 Manual for Boiler Water Test Kit, Cooling Water Test Kit, and Potable Water Test Kit R11 Manual for Viscotool, Water contamination test kit, Crackle test kit, Insoluble test kit</p> <p><i>Note: The MHEIs can use alternate and/or additional references/bibliographies as deemed necessary to meet the learning outcomes of this course.</i></p>
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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
<p><i>Note: MHEIs shall determine the number of periods for terms the semester is divided based on their school calendar activities</i></p>	1 – 5	1. Fundamentals of Chemistry 1.1 Matter 1.2 Elements, Compounds, Mixtures 1.3 Atomic structure 1.4 Stoichiometry 1.5 Polymerization	15	-
	6 – 7	2. Chemicals used on board 2.1 Classifications of Chemicals on board 2.2 Refrigerants 2.3 Risks in handling chemicals 2.4 Material Safety Data Sheet 2.5 Mitigation Procedures	6	-
	8 – 12	3. Water, Fuel Oil, and Lube Oil 3.1 Properties of water 3.2 Acid and bases 3.3 pH Scale 3.4 Fresh water and Sea Water 3.6 Corrosion 3.5 Fuel Technology 3.6 Fuel Distillation 3.6 Testing of Fuel and Oil 3.7 Fuel Characteristics 3.8 Fuel Combustion 3.9 Lubrication 3.10 Types of Lubricants 3.11 Selection and Classification of Lubricants 3.12 Test of Lube Oil	21	-



Term	Week	Topic	Time Allotment (in hours)	
			Theoretical	Demonstration / Practical Work
	13 – 14	4. Water Analysis, Boiler Water Treatment, and Engine Cooling Water 4.1 Boiler feed water 4.2 Boiler Water Test 4.3 Engine Cooling Water Test and Treatment 4.4 Potable (drinking) Water Test	9	-
	15 - 17	5. Practical Work 5.1 Lube Oil Viscosity comparator 5.2 Lube Oil Water Contamination Test 5.3 Lube Oil Crackle Test 5.4 Lube Oil Insoluble Test 5.5 Boiler Water Test 5.6 Engine Cooling Water Test 5.7 Potable (drinking) Water Test	-	34
Sub-total (Contact Hours)			51	34
Total Contact Hours			85	
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
CO1 CO2	<p>1. Fundamentals of Chemistry</p> <p>1.1 Explain the basic principles and properties of matter</p> <p>1.2 Identify the important basic units used in chemistry</p> <p>1.3 Differentiate elements, compounds and mixtures</p> <p>1.4 Explain the principles of law of mass conservation, definite composition, and multiple proportions</p> <p>1.5 Calculate mass fraction in a given compound</p> <p>1.6 Explain the principles of atom and its structure</p> <p>1.7 Explain the difference of atomic number and mass number</p> <p>1.8 Explain the difference of metals, non-metals and metalloids in terms of properties</p> <p>1.9 Explain the difference between ionic and covalent compounds</p> <p>1.10 Explain the ways in representing molecules in terms of formulas and models</p> <p>1.11 Calculate the molecular/formula mass in a chemical formula</p> <p>1.12 Explain the difference between heterogeneous and homogeneous mixture</p> <p>1.13 Explain the principles of stoichiometry of chemical formula and equations</p> <p>1.14 Explain the relationship of mass of a substance to the number of chemical entities such as atoms, ions, molecules and formula units</p> <p>1.15 Calculate mole, molar mass, and number of molecules in a chemical formula</p> <p>1.16 Explain the steps for balancing a chemical equation</p> <p>1.17 Write a balance equation for a given chemical reaction</p> <p>1.18 Explain the characteristics of a polymer</p> <p>1.19 Explain the relationship of polymer mass with the degree of polymerization</p>	R1, R3	TA1
	<p>2. Chemicals used on board</p> <p>2.1 Identify the chemicals used on board based on their general classifications</p> <p>2.2 Identify the chemicals used on board according to degree of polymerization</p> <p>2.3 Explain the risks of the various chemicals used on board</p> <p>2.4 Explain the risks of handling refrigerants</p> <p>2.5 Explain the safety procedures in handling refrigerants</p> <p>2.6 Explain safety procedures in handling chemicals as per material safety data sheet (MSDS) and/or best industry</p>	R6, R9	TA8

CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
	<p>practices 2.7 Explain the mitigation procedures in handling chemicals as per MSDS and/or best industry practices</p>		
CO3	<p>3. Water, Fuel Oil, and Lube Oil 3.1 Explain the properties of water 3.2 Explain the principles of acid and bases in water 3.3 Explain the principles of pH scale 3.4 Explain the difference of fresh water and sea water in terms of properties 3.5 Explain the principles of corrosion 3.6 Explain the factors and causes of corrosion in boilers 3.7 Identify and explain the three classifications of crude petroleum 3.8 Explain the chemical composition of petroleum 3.9 Explain the principle of fuel and its purpose 3.10 Explain the classification of fuel 3.11 Explain the characteristics of good fuel 3.12 Explain the distillation process of fuel 3.13 Explain the parameters in testing liquid fuel and oil 3.14 Explain the principles of fuel combustion 3.15 Explain the purpose of analysis of fuel gases 3.16 Explain the purpose of lubrication 3.17 Explain the relationship of friction and wear in lubrication 3.18 Explain the composition of a lubricant 3.19 Explain the different of types of lubricants 3.20 Explain the criteria to be considered in selecting lubricants 3.21 Explain the different classification of lubricant 3.22 Explain the difference in system oil use in 2 stroke, 4 stroke and turbines. 3.23 Explain the purpose of testing lube oil on board 3.24 Conduct lube oil test in the following testing methodologies in accordance with manual and/or best industry practices: a. Viscosity b. Water contamination c. Crackle test d. Insolubles test</p>	R1, R2, R5, R7, R8, R11	TA1, TA2, TA3, TA4, TA7



CO	Topics Learning Outcomes	References/ Bibliographies	Teaching Aids
CO4 CO5	<p>4. Water Analysis: Boiler Water Treatment, Engine Cooling Water and Potable Water Test</p> <p>4.1 Explain the effects of sea and fresh water to boiler</p> <p>4.2 Explain the principles in the analysis of sea and fresh water</p> <p>4.3 Explain the purpose of boiler feed water treatment</p> <p>4.4 Explain the different kinds treatment for boiler feed water</p> <p>4.5 Explain the difference in feed water requirements for Low and High Pressure boilers</p> <p>4.6 Explain the purpose of boiler water test</p> <p>4.7 Explain the parameters and procedures including safety in conducting boiler water test</p> <p>4.8 Conduct boiler water test, evaluate the result and recommend/apply the necessary treatment</p> <p>4.9 Calculate blow-down requirements with respect to boiler water conductivity (microsiemens)</p> <p>4.10 Record the result of the test and the treatment applied in the boiler water treatment log sheet</p> <p>4.11 Explain the detrimental effects of cooling water to engine</p> <p>4.12 Explain the parameters and procedures including safety in conducting cooling water test and treatment</p> <p>4.13 Conduct cooling water test, evaluate the result and recommend/apply the necessary treatment.</p> <p>4.14 Record the result of test and the treatment applied in the cooling water treatment log sheet</p> <p>4.15 Explain the parameters and procedures including safety in conducting potable water test</p> <p>4.16 Conduct potable water test, evaluate the result and recommend/apply the necessary treatment</p> <p>4.17 Record the result of the potable water rest in log sheet</p>	R5, R10	TA5, TA6

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.

