

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

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

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate Main and Auxiliary Machinery and Associated Control Systems	Fluid Flow and Characteristics of Fuel Oil and Cooling System	Fundamentals of Chemistry <ul style="list-style-type: none"> - Defines an atom - Describes a molecule - Defines: <ul style="list-style-type: none"> - chemical elements - chemical compounds - Explains the difference between compounds and mixtures and names of: <ul style="list-style-type: none"> - elements - compounds - mixtures - Defines a chemical reaction - Defines an oxide - Uses as necessary the convention denoting elements, compounds and mixtures by letters and numbers; for example, carbon dioxide represented by CO_2 - Explains what is meant by: <ul style="list-style-type: none"> - solution - solubility - saturated solution - suspension - precipitation 	6 hrs
Operate Main and Auxiliary Machinery and Associated Control Systems (cont.)	Fluid Flow and Characteristics of Fuel Oil and Cooling System (cont.)	Acidity/Alkalinity <ul style="list-style-type: none"> - Defines the composition of an atom - Explains the result of an atom gaining or losing electrons - Defines a hydrogen ion - Defines a hydroxyl ion - Given pH values, demonstrates whether a solution is alkaline, neutral or acidic, indicating its strength or weakness - Uses an indicator such as litmus paper to determine whether a solution is acid or alkaline 	3 hrs
		Corrosion <ul style="list-style-type: none"> - Defines how metallic hydroxide is formed when an iron is immersed in an acidic solution - Defines the effect of dissolved oxygen and high acidity on polarization 	12 hrs

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
		<ul style="list-style-type: none"> - States that boiler water should be alkaline and contain little or no dissolved oxygen - Explains the fundamental process of corrosion - Names common engineering materials which produce passive oxide films - States the main cause of corrosion - Names the components of a galvanic cell and applies these to the corrosion of a metal - Defines that seawater is an electrolyte - Defines an anode - From a list of common metals, selects relative anodes - Defines metals as being noble or base relative to each other - Defines the use of sacrificial anodes - Recognizes the problems if graphite grease is used when seawater is present - Defines practical means of reducing galvanic action in the choice of metal and exposed surface area 	
Operate Main and Auxiliary Machinery and Associated Control Systems (cont.)	Fluid Flow and Characteristics of Fuel Oil and Cooling System (cont.)	<p>Water testing and treatment</p> <ul style="list-style-type: none"> - Defines pitting corrosion - Recognizes the process of graphitization of cast iron - Defines the reasons why corrosion increases when seawater velocity increases - Defines the terms and what is meant by stress corrosion and names the metals in which it commonly occurs - Explains what is meant by dezincification and dealuminification - Defines how the process in the above objective can be prevented - Explains what is meant by fretting corrosion - Defines the factors which increase the rate of fretting - Defines what is meant by corrosion fatigue - Identifies the major factors affecting the corrosion process as: <ul style="list-style-type: none"> - differential temperatures - stresses within the metal structure - variation in crystal structure of the metal - distribution/concentration of impurities in the metal crystals - flow of oxygen to the cathode - flow of carbon dioxide to the anode and cathode - hydroxyl ion concentration of the aqueous solution 	12 hrs

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate Main and Auxiliary Machinery and Associated Control Systems (cont.)	Fluid Flow and Characteristics of Fuel Oil and Cooling System (cont.)	<ul style="list-style-type: none"> - Recognizes that some films and coatings on metal surfaces can provide protection so long as they remain intact - Recognizes that surface preparation prior to the application of protective coatings is very important - Identifies the important methods of surface protection as: <ul style="list-style-type: none"> - paints - chemical films - metallic coatings - anodizing - Recognizes the importance of controlling the pH value of aqueous solutions within the minimum corrosive range - Identifies the chemical additives that can be used to obtain the condition required in the above objective - Knows the importance of maintaining a gas – free condition in the water used to "feed" a steam boiler or to circulate in an engine cooling system - Identifies the methods in common use for conditioning the water content of marine Power plant, e.g. trisodium phosphate, hydrazine - Explains that natural water supplies contain metallic salts in solution - Demonstrates the standard method of measuring metallic salt content, i.e. state the actual quantity of metallic salt present in a specified quality of water - Knows the standard measurement given in the above objective as in units of "parts per million" (ppm) or less accurately in '32's' (seawater density measurement) - Lists the main metallic salts found in: <ul style="list-style-type: none"> - fresh water - average seawater - Defines: <ul style="list-style-type: none"> - permanent hardness - temporary hardness - Defines briefly how scale and sludge are produced in a steam boiler - Explains the different effects of using seawater, fresh water and distilled water as boiler feedwater - Defines the principal objects of treatment of boiler feedwater 	

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate Main and Auxiliary Machinery and Associated Control Systems (cont.)	Fluid Flow and Characteristics of Fuel Oil and Cooling System (cont.)	<p>Introduction to Fuels and Lubricants</p> <ul style="list-style-type: none"> - Identifies the average carbon, hydrogen, sulphur and ash content of the following fuels: <ul style="list-style-type: none"> - petrol - kerosene - marine diesel fuel - boiler fuel oil - Defines flashpoint and explains its importance for marine fuels and lubricants - Knows flashpoint temperature for the following hydrocarbons: <ul style="list-style-type: none"> - petrol - kerosene - marine diesel fuel - boiler fuel oil - lubricating oil - Identifies the minimum closed flashpoint of marine fuels - States the maximum temperature to which fuel oil may be raised - Describes precautions taken on board ship to prevent accidental ignition of the oils listed in the above objective - Defines viscosity in terms of resistance to flow - Demonstrates why it is necessary to raise the temperature of some fuel oils - Carries out tests on fuels and lubricants for: <ul style="list-style-type: none"> - flashpoint - viscosity - Explains the reason why values of flashpoint or of viscosity need to be known for the following: <ul style="list-style-type: none"> - fuels and lubricants in storage - transfer of fuels and lubricants - Carries out tests on fuels and lubricants for water content 	12 hours
Plan and schedule operation at the Management Level (ML)	Physical and Chemical properties of fuels and lubricants	<p>Shore Side and Shipboard Sampling and Testing</p> <ul style="list-style-type: none"> - Appraise the importance and implications of continual monitoring of quality of fuels and lubricants in efficient operation of machinery - Explain the procedures available for testing fuels and lubricants, including viscosity, water in oil, density, pour point, total base number (TBN), microbiological contamination and other contamination 	1 hour

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Plan and schedule operation at the Management Level (ML) (cont.)	Physical and Chemical properties of fuels and lubricants (cont.)	<p>Interpretation of Test Results</p> <ul style="list-style-type: none"> - Describe the facilities available for laboratory testing of fuels and lubricants, the properties that can be determined, and how the results can be interpreted and utilized in maintenance programme 	1 hour
		<p>Contaminants including microbiological infection</p> <ul style="list-style-type: none"> - Outline procedures for dealing with contamination of oils by water, fuel in lubricating oil, solid debris or other contaminants, including recognition of unacceptable levels and possible consequences - Examine the causes, symptoms, effects and methods of treatment of oils that have been infected with microbiological organisms 	2 hours
		<p>Treatment of fuels and lubricants including storage, centrifuging, blending, pretreatment and handling</p> <ul style="list-style-type: none"> - Detail bunkering procedures and arrangements, explaining the importance of following correct procedures - Evaluate the operation of centrifugal separators and analyse the factors that affect optimum separation <p>Explain the function and operation of a shipboard fuel blender and alternative fuel treatments</p>	4 hours
Operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery	Engine lubrication	<ul style="list-style-type: none"> • Identify diesel engine lubricant types, properties, and applications. • Outline principles of diesel engine lubrication. • In relation to contamination and deterioration of diesel engine lubricants: <ul style="list-style-type: none"> ○ Discuss the sources, types, and effects of contamination ○ Discuss the causes, types, and effects of deterioration ○ Describe typical testing and treatment methods, and ○ Interpret typical results of testing, giving appropriate actions which should be undertaken 	8 hours

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
		<ul style="list-style-type: none"> ○ Describe, using diagrams, the distribution of lubricating oil to diesel engines, in particular the: ○ Guides and crosshead bearings of slow speed diesel engines ○ Top end bearings of medium speed engines ○ Bottom end bearing ○ Main bearings ○ Camshaft drives, showing direction of flow, typical clearances, and stating normal operating parameters. 	
Operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery (cont.)	Boiler water testing	<ul style="list-style-type: none"> ● Define pH and explain how it is measured and controlled ● Evaluate the tests used in the control of boiler and feed water treatment ● Interpret the water implications of out of limit readings from water treatment tests and state the corrective procedures which should be undertaken. 	8 hours
	Boiler water treatment	<ul style="list-style-type: none"> ● Evaluate common methods of boiler, feed and make up water treatment ● Show how oxygen is eliminated in boilers ● Enumerate the normal and maximum operating limits for boiler, feed, and make up water and explain the effect of these contaminations on the reserves of treatment chemicals ● Compare the procedures which may be used to counter contamination of boiler, feed, and make up water 	12 hours
		Total No. of Hours	81 Hours

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