

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

Course Code	:	PPS
Course Descriptive Title	:	Power Plant Steam
Course Credits	:	6 units
Lecture Contact Hours per Week	:	5 hour
Laboratory Contact Hours per Week	:	3 hours
Prerequisite	:	Power Plant Diesel
Reference/s	:	1.STCW Table A-III/1, III/2 2.IMO Model Courses 7.02 and 7.04 3.Annex A of CMO 20, series of 2015 (Curriculum Mapping)

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate main and auxiliary machinery and associated control systems (cont.)	<p>Basic construction and operation principles of machinery systems, including:</p> <p>.2 marine steam turbine (cont.)</p>	<p>Basic construction</p> <ul style="list-style-type: none"> - Names the materials used in the manufacture of the listed items, then describe, with the aid of sketches, the assembled construction of these items: <ul style="list-style-type: none"> -high pressure turbine casing -low pressure turbine casing -astern turbine casing -low pressure turbine exhaust casing -high pressure turbine rotor -low pressure turbine rotor -receiver pipe -reduction gear -wheels -pinions -main condenser -gland condenser -gland packing steam reservoir -gland packing steam leak-off reservoir -gland packings -gland steam make-up valve, gland steam spill valve -manoeuvring valve -astern guardian valve -flexible coupling -thrust bearing -labyrinth packings -nozzles -blades (moving blade, stationary blade) -shroud - States the feature of impulse turbine - States the feature of reaction turbine - Sketches types of turbine plant arrangement: <ul style="list-style-type: none"> -bleeder turbine (extraction turbine) -regenerative turbine -reheat turbine 	10 hrs

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate main and auxiliary machinery and associated control systems (cont.)	.2 marine steam turbine (cont.)	<p>Operation principles</p> <ul style="list-style-type: none"> - Explains why main condenser is kept in vacuum - Explains how to keep main condenser in vacuum - Describes the importance of draining inside turbine casing - Describes, with the aids of a sketch/computer aided drawing, function of gland packing steam - Explains the function of manoeuvring valve - Explains the role of extraction steam - Describes that gland steam pressure is controlled by make-up valve and spill valve - Describes how to keep the hotwell level of condenser - Explains spinning operation - Explains the meaning of throttle governing and nozzle governing, which is the way of control of turbine output - Explains meaning of auto-spinning system - States that the main turbines are provided with a satisfactory emergency supply of lubricating oil, which will come into use automatically in case of failure of lubricating oil system 	20 hrs
Operate main and auxiliary machinery and associated control systems (cont.)	.4 marine boiler	<p>Steam boiler fuel atomization and combustion</p> <ul style="list-style-type: none"> - States that the elements carbon and hydrogen combine chemically with oxygen during combustion to form the gaseous products carbon dioxide and water vapour - Explains the part played by nitrogen in the combustion process - States that, to ensure that the combustion process is as complete as possible, excess air is normally supplied - States that the excess of air must be kept to a minimum, consistent with good combustion - States that either the percentage of carbon dioxide or the percentage of oxygen in the exhaust gas should be continuously recorded - States that although excess air is supplied, there may be some incomplete combustion of carbon to carbon monoxide (CO) - States that in practice the products of combustion are normally a gaseous mixture of carbon dioxide, sulphur dioxide, water-vapour, possibly carbon monoxide and an ash, 	12 hrs

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate main and auxiliary machinery and associated control systems (cont.)	.4 marine boiler (cont)	<p>possibly containing sodium and vanadium</p> <ul style="list-style-type: none"> - States that poor combustion creates smoke, which pollutes the atmosphere and wastes fuel and reduces the efficiency of the engine or boiler - States that the production of smoke may lead to prosecution - Explains why the proportion of CO₂ or O₂ in exhaust gases provides an indication of combustion efficiency <p>Describes briefly the instruments available to indicate and record the percentage of CO₂ and O₂ in exhaust gas</p> <ul style="list-style-type: none"> - States the ranges of percentages of CO₂ which indicate: <ul style="list-style-type: none"> -good combustion -poor combustion -bad combustion - Explains the importance of atomization when it is required to mix a liquid fuel with air prior to combustion - Explains why the viscosity of a fuel is important in its atomization - Describes how the viscosity of a liquid fuel can be controlled by varying its temperature - States the theoretical air/fuel ratio for a typical boiler fuel - States the actual air/fuel ratio, allowing for normal excess air, in: <ul style="list-style-type: none"> -the furnace of a steam boiler -the cylinder of a diesel engine - States that if sulphur dioxide contacts a low-temperature surface, sulphuric acid will be produced, which will cause corrosion - Explains how the effect of the above objective can be minimized - Sketches a section through the nozzle assembly of a pressure-jet burner - States that in the above objective atomization is produced by the fuel, at high pressure, passing through a small orifice in the burner nozzle - Describes the attention required by burner atomizer tips - Describes, with a single line diagram, a combustion air register, identifying: <ul style="list-style-type: none"> -swirl vanes -the flame stabilizer -air-flow control valves -the burner - States typical values of the pressure drop and of the velocity of combustion air in the register - Explains why the thorough and rapid mixing of atomized fuel and combustion air is important 	

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate main and auxiliary machinery and associated control systems (cont.)	.4 marine boiler (cont)	<ul style="list-style-type: none"> - Describes furnace conditions which indicate good combustion - Describes, with the aid of sketches, how pressure-jet, steam-jet and rotary-cup burners atomize fuel and promote adequate fuel/air mix rati 	
Operate main and auxiliary machinery and associated control systems (cont.)	.4 marine boiler (cont)	<p>Marine boiler fundamentals</p> <ul style="list-style-type: none"> - Describes, with the aid of diagrams, an auxiliary boiler steam system together with identifying the services supplied by steam - States typical pressures of steam produced in auxiliary boilers and average system supply pressures - States that auxiliary steam boilers range from simple fire-tube boilers to self-contained fully automated package units - Explains simply and briefly, with the aid of diagrams, the principal differences between a fire-tube boiler, a water-tube boiler and a packaged boiler 	8 hrs
Operate main and auxiliary machinery and associated control systems (cont.)	.4 marine boiler (cont.)	<p>Marine boiler construction</p> <ul style="list-style-type: none"> - Describes the material commonly used for construction in a fire-tube boiler - Describes, with the aid of sketches, the general constructional details of a fire-tube boiler, showing how the parts are connected to form a compete structure - States that, for pressure vessels: <ul style="list-style-type: none"> -shells of cylindrical form give a higher strength/weight ratio than other shapes -the cylindrical shell can be sited vertically or horizontally -dished or spherical end-plates give a higher strength than flat end-plates of similar thickness -all flat surfaces must be properly stayed to resist deformation -stays can have the form of solid bars, thick tubes or plate girders -corrugated furnaces provide higher strength and flexibility than plain furnaces of similar thickness - States why boiler is usually installed on board diesel engine ships - Explains and outlines a boiler system listing associated systems including their 	10 Hours

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate main and auxiliary machinery and associated control systems (cont.)	.4 marine boiler (cont.)	components <ul style="list-style-type: none"> - Explains the relationship between a boiler and exhaust gas economizer - Explains ignition system including the function of burner control - Explains feed water system including the function of feed water control - Explains steam temperature control system usually used for main boiler - States what is meant by ABC and ACC - Describes how a tube is expanded into a tube plate - Describes the principles of construction, operation and control of a packaged boiler 	
Operate main and auxiliary machinery and associated control systems (cont.)	.4 marine boiler (cont.)	Marine boiler mountings and steam distribution <ul style="list-style-type: none"> - Identifies the following boiler fittings and position on boiler shell (supply shell diagram for fitting to be married/drawn and identified): <ul style="list-style-type: none"> -main steam outlet (or "stop") valve -auxiliary steam stop valve -safety valves and easing gear -water level gauges -feed inlet valve -blow-down valve -scumming valve -soot blowers -connections for pressure gauges -air release valve -sampling valve - Explains the importance of boiler mounted valves - Identifies the following internal boiler fitting and internal position within boiler shell: <ul style="list-style-type: none"> -feedwater distribution unit -scumming pan -blow-down dip pipe - Explains the purpose of the valves and fittings listed in the above objectives, comparing the differences, where applicable, between water—tube and fire—tube boilers - Explains the purpose of a reducing valve - Describes the operation of a reducing valve, using a single line sketch 	10 hrs

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate main and auxiliary machinery and associated control systems (cont.)	.4 marine boiler (cont.)	<ul style="list-style-type: none"> - Explains how steam pipes are supported - Explains how expansion and contraction are allowed for in steam pipes - Describes the different methods of joining lengths of a steam pipe - Explains the purpose of drains and steam traps - Describes the operation of steam traps - Describes the procedure for warming through a steam line and explains the cause, in simple terms, of water hammer and how water hammer can be avoided - Explains the outline of steam supply system including its components/installations - Describes the means used to minimize the possibility of oil contaminating the boiler feed water 	
Operate main and auxiliary machinery and associated control systems	Other auxiliaries	<p>Thermal fluid heating Systems</p> <ul style="list-style-type: none"> - States the functions of a thermal fluid heating system onboard ship - States the differences between a thermal fluid heating system and an auxiliary steam system - States the properties of thermal fluids used onboard ship - Describes with the aid of diagrams and sketches the components and their functions, fittings and safety devices of a thermal fluid system - Explains the need for a minimum flow of the thermal fluid in the system - Describes the safety precautions and possible dangers when operating a thermal fluid heating system - Describes the operation of a thermal fluid heating system 	5 hrs
Operate main and auxiliary machinery and associated control systems (cont)	Fluid flow and Characteristics of Major System	<ul style="list-style-type: none"> - Describes fluid flows of: <ul style="list-style-type: none"> -main steam -condensate water -feed water -lubricating oil -systems in the steam turbine propulsion plant 	5 hrs
Operate main and auxiliary machinery and associated control systems (cont)	Steam Boilers and associated auxiliaries and steam systems	<p>Boiler and Associated Auxiliaries, and Steam Systems</p> <ul style="list-style-type: none"> - States procedures for igniting the burner manually and automatically - States how to build up the steam pressure and to put boiler into service - Explains precautions and necessary measures to be taken when getting up steam - Explains the benchmark for building up steam pressure 	16 hrs

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
Operate main and auxiliary machinery and associated control systems (cont)	Steam Boilers and associated auxiliaries and steam systems (cont)	<ul style="list-style-type: none"> - States the function of safety valve and how to adjust the setting point to blow - Explains operation methods of boiler and economizer under way - Explains precautions for using exhaust gas economizer - Describes the method used to ensure that all pipes, cocks, valves and other fittings used for indicating water level are clear and in good working order - Explains the treatment of boiler water including examination of properties of boiler water, surface and bottom blowing of boiler water - States what is meant by soot blow including the function of soot blowers - Explains what malfunctions /troubles likely happen to boiler on its operation - States precautions for opening high temperature steam valves - Explains how to keep boiler in cold condition while it is out of service - Describes the correct procedures for operating steaming boilers in parallel on load - Describes the correct procedures for checking the water level in steaming boilers - Describes the danger of oil entering a boiler with the feedwater - Explains what is meant by "blow-back" - Explains how blow-back can be avoided - Explains the need for, and the use of, soot blowers - Explains why the temperature of boiler exhaust gases should be maintained above a minimum value 	
Operate main and auxiliary machinery and associated control systems (cont)	Auxiliary prime movers and associated systems	<p>Steam turbine</p> <ul style="list-style-type: none"> - States precautions before starting a steam turbine such as confirming steam line, gland steam line, lubricating oil line, condensate water line and circulating line - Describes briefly components constructing each associated system for a steam turbine - States preparations and procedures for start of a steam turbine - Describes briefly the control system and its components including their function - States the safety devices and their functions 	2 hrs
Manage the operation of propulsion plant machinery at	Marine Steam Boiler (ML)	<ul style="list-style-type: none"> - Describes with the aid of sketches/computer aided drawing, material selection and design features of marine steam boilers: -Types of main steam boilers -Methods of construction 	10 hrs

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
<p>the Management Level (ML)</p> <p>Manage the operation of propulsion plant machinery at the Management Level (ML) (cont)</p>	<p>Marine Steam Boiler (ML) (cont)</p>	<ul style="list-style-type: none"> -Boiler fittings and drum internals -Water circulation -Gas circulation -Operating parameters -Support and expansion -Super heaters and their temperature control -Soot blowers -Economisers -Air heaters -Steam to steam generation -Chemistry of combustion -Burners and burner registers -Local and remote water level indicators -Safety valves - Describes with the aid of sketches/computer aided drawing, material selection and design features of marine steam boiler feed water systems: -Main feed systems -Condenser types, level control, construction, materials, support, expansion, operating parameters, loss of vacuum and leak testing -Air ejectors -Vacuum pumps -Extraction pumps -Gland condensers -Low pressure heaters -Drain coolers -High pressure heaters -Turbo feed pumps, hydraulic balance -De-aerators 	
<p>Plan and schedule operations at</p>	<p>Marine Steam Boiler</p>	<ul style="list-style-type: none"> - Explains the following with the aid of sketches where applicable: -Rankine cycle -Thermal efficiency of Rankine cycle 	<p>10 hrs</p>

COMPETENCE	KNOWLEDGE, UNDERSTANDING AND PROFICIENCY	PERFORMANCE	APPROX HOURS
the Management Level (ML)		-Heat balance of a marine steam plant -Boiler/turbine performances -Boiler/turbine efficiency	
Operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery at the Management Level (ML)	The efficient operation, surveillance, performance assessment and maintaining safety of propulsion plant and auxiliary machinery: Thermal Fluid System	<ul style="list-style-type: none"> - Examine typical thermal fluid heating systems and explain the advantages and disadvantages of these systems - Explain the locations and functions of all components, fittings, and safety devices used in thermal fluid systems - Analyze the properties of thermal fluids used, effects of contamination, and methods of testing the fluid - Compare thermal fluid plants with conventional steam plants 	3 hrs
		- Total No. of Hours	141 Hours

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