



CINEC CAMPUS(PVT)LTD

Faculty of Marine Engineering

Department of Marine Engineering

**REPARATORY COURSE FOR CHIEF ENGINEER & SECOND ENGINEER OFFICER ON SHIPS OF 3000KW
PROPULSION POWER OR MORE**

ENGINEERING KNOWLEDGE – II (Motor)

WITHDRAWAL EXAMINATION

Time Allowed- Three Hours

Answer Six questions

Marks for each part of the question are shown in the brackets.

12.12.2023

1. With reference to marine engines operated with LNG.

- a) Briefly explain the dual fuel injection technology. (6 Marks)
- b) Sketch a fuel system suitable for above engine stating the safety devices. (4 Marks)
- c) During transportation of LNG, what is "aging" (2 Marks)
- d) What is methane slip. (2 Marks)
- e) What measures are taken to minimize methane slip in dual fuel engines (2 Marks)

2.

- a) Explain the steps needed to enable the operation of a crosshead main propulsion engine in a slow steaming condition. (8 Marks)
- b) Elaborate on the challenges that can occur during an extended period of slow steaming. (4 Marks)
- c) Describe the precautions that should be taken both before and after returning the engine to normal operation following a period of slow steaming. (4 Marks)

3. a) Describe the key benefits of employing a hybrid turbocharger in an internal combustion engine and highlight the situations where it can be most advantageous. (4 marks)

b) Explain the primary components of a variable geometry turbocharger (VGT) and their functions in enhancing engine performance. (4 marks)

c) Illustrate the operation of a two-stage turbocharging system with the help of a sketch. (6 marks)

d) State two actions that can be implemented when a turbocharger undergoes surging. (2 marks)

4. With respect to changing over fuel oil.

- a) Describe in detail the procedures and precautions involved in changing over a marine engine from heavy fuel oil (HFO) to marine gas oil (MGO) while the vessel is underway. (6 marks)
- b) Include specific steps, safety measures, and potential challenges that may arise during the process. (4 marks)
- c) Discuss the importance of proper timing during the changeover process of a marine engine. (4 marks)
- d) Explain how incorrect timing can lead to engine damage and operational issues. (2 marks)

5. a) Explain the main purpose of using VIT (Variable Injection Timing) in slow-speed marine diesel engines and its effect on engine performance. (6 marks)

b) Describe the key components of a typical variable fuel injection system in a slow-speed engine and explain their roles. (4 marks)

c) Discuss the common methods used to control the timing of fuel injection in slow-speed engines. (4 marks)

d) State how variable fuel injection helps reduce harmful emissions such as NO_x and particulate matter in slow-speed engines. (2 marks)

6. Regarding abnormal and excessive cylinder liner wear:

- a) Explain its causes and methods for detection. (6 Marks)
- b) Describe the effects and consequences of excessive cylinder liner wear. (5 Marks)
- c) Explain preventive measures for abnormal cylinder liner wear. (5 Marks)

7. In the context of marine boilers:

a) Explain the importance of water treatment and the difficulties in averting corrosion and scale formation. (6 marks)

b) Outline the essential safety precautions and safeguards integrated into contemporary marine boiler systems to avert accidents like explosions or overheating. (4 marks)

c) Detail the main stages of performing a thorough boiler survey on a ship. Specify the typical areas and components that are inspected. (6 marks)

8. a) Describe an electronically controlled main engine fuel injection system and include a sketch. (8 Marks)

b) Explain how the system from part (a) adjusts fuel injection timing as directed by an engineer at the control terminal. (8 Marks)

9. With reference to WHRS used to generate electrical power.

a) What is the concept of 'WHRs' (2 Marks)

b) Explain a waste heat recovery system that uses main engine exhaust gas in a combined gas/steam turbine system and include a sketch. (8 Marks)

c) Describe how the waste heat recovery system from part (a) operates while the main engine is in operation. (6 Marks)

librmy

00031

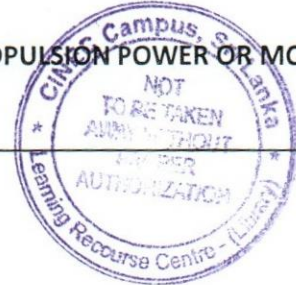


CINEC CAMPUS(PVT)LTD

Faculty of Marine Engineering

Department of Marine Engineering

**CHIEF ENGINEER & SECOND ENGINEER OFFICER ON SHIPS OF 3000KW PROPULSION POWER OR MORE
ENGINEERING KNOWLEDGE – I (GENERAL)**



TIME ALLOWED - THREE HOURS

Attempt TEN questions only as follows:

SIX questions from Section A

TWO questions from Section B

TWO questions from Section C

Marks for each part of the question are shown in the brackets

Pass mark 50 % of total **AND** also need to obtain the minimum of **8** Marks in each Section B and C.

Answers with clear sketches/diagrams, neat handwriting and clear expression will get full marks.

08.12.2023

Section A

1.

With reference to multi-tubular heat exchangers, explain the impact of each of the following factors on achieving satisfactory performance,

- a) The thickness of tube walls (2 marks)
- b) The density of tubes in the tube plate (2 marks)
- c) The selection of tube materials (2 marks)
- d) The rates of coolant flow (2 marks)
- e) The unobstructed passage of coolant at the entry and exit points from the tubes (2 marks)

2. a) With reference to tanks containing hydrocarbon liquids and vapors: define EACH of the following terms:

- i. Explosive limits; (2 Marks)
- ii. Vapor pressure; (2 Marks)
- iii. Flash point. (2 Marks)
- b) Explain the process of calibrating a multi-gas detector. (4 Marks)

3. Regarding Refrigeration systems:

- a) Describe the Relief and Unloading Arrangements Employed in Reciprocating Compressors for Refrigeration. (4 points)
- b) Elaborate on the Significance and Importance of Incorporating Relief and Unloading Arrangements in Reciprocating Compressors for Refrigeration Applications. (4 points)
- c) Generate a Diagram Illustrating a Refrigerated (Reefer) Container and Provide Clear Labels for its Key Components. (2 marks)

4. Sketch each of the following electric arc welding defects stating the cause of each defect:

- a) undercutting; (2 marks)
- b) penetration; (2 marks)
- c) lack of fusion; (2 marks)
- d) slag inclusion. (2 marks)
- e) What precautions should be taken when storing welding rods for an extended period? (2 marks)

5. With respect to centrifugal pumps:

- a) Elaborate on non-invasive methods for assessing pump performance without the necessity of pump dismantling. (3 Marks)
- b) Outline the effects of misalignment between the driving motor and the pump in the context of centrifugal pumps. (2 Marks)
- c) Illustrate, with the assistance of a diagram, the process for checking and adjusting alignment on a newly installed replacement motor in the context of centrifugal pump systems. (5 Marks)

6. In relation to a keyless propeller designed for hydraulic (wet) fit and withdrawal:

- a) Explain the process of fitting the propeller onto the propeller shaft (4 marks)
- b) State how the propeller is extracted from the propeller shaft (2 marks)
- c) Identify two advantages of this keyless hydraulic system in comparison to conventional dry-fit systems (2 marks)
- d) Clarify the mechanism through which thrust is effectively transmitted in this keyless propeller system without utilizing a key and keyway (2 marks)

7. With reference to steam boilers.

- a) Explain the causes of corrosion and erosion in marine steam boilers. (2 marks)
- b) Discuss preventive measures to mitigate corrosion and erosion in boiler components. (2 marks)
- c) Outline a systematic approach for troubleshooting common issues in marine steam boilers. (3 marks)
- d) Provide examples of potential problems and their corresponding corrective actions. (3 marks)

8. a) Explain the significance of sterilizing fresh water for potable use on board ships. (1 mark)
- b) Provide reasons for the necessity of re-mineralizing potable water. (2 marks)
- c) Illustrate, with the aid of a sketch, a method of freshwater purification utilizing silver ions for sterilization. (5 marks)
- d) State one advantage and one disadvantage associated with the use of ultraviolet radiation for the sterilization of fresh water. (2 marks)

Section B

9. With reference to the protection equipment of 03 phase electrical distribution systems on ships:
- a) state the purpose of the fitting protective devices to such systems. (3 Marks)
 - b) list the parameters that are monitored and used to trigger the protective devices. (4 Marks)
 - c) state, with reasons, THREE causes of electrical fires. (3 Marks)

10.

In the context of electrical maintenance and safety aboard a vessel,

- a) Elaborate on the significance of electrical safety within the engine room and state the responsibilities of the Second Engineer in ensuring adherence to safety regulations. (4 marks)
- b) Provide guidelines on the safe handling of electrical equipment in potentially hazardous zones on a ship, such as fuel storage or engine compartments. (4 marks)
- c) State the maintenance practices for shipboard electrical systems and briefly explain the role of the Second Engineer in supervising and coordinating these activities. (4 marks)

11.

With reference to an alkaline battery cell:

- a) Describe a typical cell, stating the materials used; (4 Marks)
- b) Describe the electro-chemical process that takes place during discharge and charge. (2 Marks)
- c) State the effects of overcharge. (2 Marks)
- d) State the advantages of an alkaline cell compared with a lead acid cell. (2 Marks)

Section C

12. a. Briefly describe the necessary procedures and preparations involved in the dry-docking process for vessels. (4 Marks)
- b. What are the important documentation and drawings that must be submitted to the relevant authorities during the dry-docking process. (3 Marks)
- c. State the survey and maintenance tasks undertaken throughout the dry-docking period, (3 Marks)

13

With reference to large container carriers.

- a) Sketch a transverse section of a modern container carrier. (6 Marks)
- b) Explain the function of the following.
- i) bilge keels; (2 Marks)
- ii) passive (uncontrolled) stabilizing tanks. (2 Marks)

14.

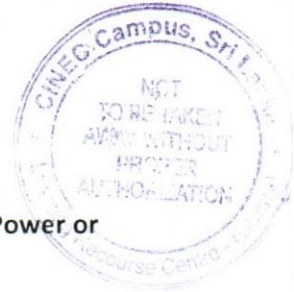
- a) compare the benefits of sacrificial anodes versus impressed current systems in corrosion protection. (2 Marks)
- b) Illustrate, with the help of diagrams, the impressed current system designed for application on a ship. Provide a detailed explanation of the components and their functions. (6 Marks)
- c) State the specific situations or conditions under which an impressed current cathodic protection (ICCP) system is typically deactivated. (2 Marks)



Faculty of Marine Engineering

Department of Marine Engineering

Examination for Officer in Charge of an Engineering Watch on Ships of 750kW Propulsion Power or More



ENGINEERING KNOWLEDGE – II (Motor)

Time Allowed- Three Hours

Answer Six questions

Marks for each part of the question are shown in the brackets

Date: 2023.10.13

Pass marks: 50%

1. With reference to marine turbochargers.

a) Explain the purpose of these components in a turbocharger:

(i) Diffuser (4 marks)

(ii) Damping wire (2 marks)

b) List the benefits of using hybrid turbochargers in modern diesel engines. (4 marks)

c) Why is it important to cool scavenge air after it comes out of the turbocharger before it enters the scavenge air space? (2 marks)

d) Describe two ways to clean a turbocharger while it's in operation. (4 marks)

2. Regarding marine governors.

a) What does a governor do in a marine engine, and how does it work? Include a simple sketch to help explain. (8 marks)

b) Why is speed droop important in a marine engine governor system? (4 marks)

c) What maintenance is necessary to keep a marine engine governor running smoothly? (4 marks)

3. Regarding the Auxiliary Boiler:

a) List its safety features. (4 marks)

b) Name three onboard boiler water tests and explain why each is important. (6 Marks)

c) What's the right temperature for the feedwater tank, (2 Marks)

d) Explain why it's important to maintain the suggested feedwater tank temperature. (2 Marks)

e) State the lowest allowable exhaust gas temperature and why it is important. (2 Marks)

4.

a) How does a fuel oil injector work in a diesel engine? Provide a basic sketch. (6 marks)

b) How is the injection pressure adjusted? (2 marks)

c) What conditions are necessary for proper combustion in diesel engines? (2 marks)

d) What is the recommended viscosity for fuel during injection? (2 marks)

e) State the purpose of using slide type fuel valves in modern diesel engines (4 marks)

5.

With reference to turbochargers explain:

a) Why are air coolers fitted? (2 marks)

b) Why excessive cooling of air should be avoided? (2 marks)

c) How are turbine glands sealed? (2 marks)

d) How are bearings lubricated? (2 marks)

e) Explain the term surging, stating how it occurs, its effect on the turbocharger and how it can be avoided, (6 marks)

f) State two main types of turbocharging used in engines. (2 marks)

6.

With reference to exhaust gas scrubbers

a. Describe with the aid of a sketch Open Loop Sox scrubber system. (8 marks)

b. Explain the added features incorporated in closed loop scrubber system (4 marks)

c. State what systems to be monitored to ensure the scrubber system meets all IMO regulations. (4 marks)

7.

With reference to cylinder liner calibration:

(a) Describe a procedure for cylinder liner calibration, indicating how the readings are recorded to allow for easy recognition of liner wear. (6 marks)

(b) State TWO forms of abnormal cylinder liner wear, (2 marks)

(c) Explain how abnormal cylinder liner wear may be prevented. (4 marks)

(d) State how the cylinder liner defects which could be identified during a scavenge space inspection. (4 marks)

8.

With reference to main starting air compressors:

- a) State the reason for multi-staging. (2 marks)
- b) Explain why compressor lubricating oil consumption should be carefully monitored. (4 marks)
- c) State the factors effecting the volumetric efficiency. (4 marks)
- d) What safety devices are fitted to protect the compressor (2 marks)
- e) What is bumping clearance and explain how it effects the performance (4 marks)

9.

With reference to engine safety.

- a) State the common causes of scavenge fires [4Marks]
- b) List the indications that a scavenge fire is in progress [4 Marks]
- c) State the conditions that may initiate a crankcase explosion [4 Marks]
- d) Explain the condition to cause a secondary crankcase explosion and state the safety devices fitted to obtain an early warning [4 Marks]

Library.



Faculty of Marine Engineering

Department of Marine Engineering



Examination for Officer in Charge of an Engineering Watch on Ships of 750kW Propulsion Power or More

ENGINEERING KNOWLEDGE – I (GENERAL)

TIME ALLOWED - THREE HOURS

Attempt SIX questions only as follows:

FOUR questions from Section A

ONE question from Section B

ONE question from Section C

Marks for each part of the question are shown in the brackets

Pass mark 50 % of total **AND** also need to obtain the minimum of 8 Marks in each Section B and C.

Answers with clear sketches/diagrams, neat handwriting and clear expression will get full marks.

Date: 2023.10.16

1. Give reasons for each of the following conditions in domestic refrigeration unit.

- (a). Excessive high pressure at compressor discharge. (4 marks)
- (b). Excessive vacuum at compressor suction. (4 marks)
- (c). Continual starting and stopping of the compressor. (4 marks)
- (d). Activation of high-pressure cutout. (4 marks)

2. a) Why was the Energy Efficiency Existing Ship Index (EEXI) introduced? (5 marks)

b) Which vessel categories are affected by EEXI regulation? (3 marks)

c) When do the EEXI and CII implementation requirements come into effect? (2 marks)

d) What are four technology options employed in marine engines for EEXI compliance? (4 marks)

e) Which MARPOL Annex is linked to EEXI regulations? (2 marks)

3. With reference to engine room overhead crane.

- a) List the key parts of an engine room overhead crane. (4 marks)
- b) Explain important safety measures for operating an engine room overhead crane. (4 marks)
- c) Describe the necessary maintenance for an engine room overhead crane. (6 marks)
- d) What is SWL in the context of an overhead crane. (2 marks)

4. With reference to Oil Centrifuges explain:

- (a) What is the difference between Purifier and Clarifier? (4 Marks)
- (b) What is the function of purifier gravity disk? (2 Marks)
- (c) What are the methods to select correct size of gravity disk? (4 Marks)
- (d) What is an ALCAP System and list down the benefits of ALCAP System (6 Marks)

5. With reference to on board steering gear.

- a. Sketch a 4-ram hydraulic steering gear system and briefly explain safe operation. (8 Marks)
- b. What is the indication of air in the steering system (2 Marks)
- c. What is the function of a hunting gear in steering gear on a ship (2 Marks)
- d. Explain the procedure of testing the steering gear prior leaving the port. (4 Marks)

6.

With reference to Biological Sewage Treatment Plant Operation:

- (a) Explain the working principle of a biological sewage treatment plant (8 Marks)
- (b) State how anaerobic conditions can develop within a sewage treatment plant (2 marks)
- (c) What are the risks related to toxic gas production (2 Marks)
- (d) State the regulatory requirements related to the sewage treatment plant (4 marks)

7.

- a. State how and why lubricating oil deteriorates in main engine lubrication systems. [4 Marks]
- b. State how deterioration becomes apparent. [3 Marks]
- c. Describe simple shipboard tests to determine the degree of contamination. [3 Marks]
- d. Give a reason in each case, why each of the following conditions of lubricating oil is unacceptable:
 - i. High acidity, [2 Marks]
 - ii. Significant fuel contamination, [2 Marks]
 - iii. Significant freshwater contamination. [2 Marks]

SECTION B

8. About Electrical Equipment Insulation Testing:

- a) Describe the reasons for and the importance of regular insulation testing on electrical equipment. (4 marks)
- b) Provide a step-by-step guide with key considerations for measuring insulation on an electric motor. (6 marks)
- c) List safety measures necessary when conducting insulation tests on an AC generator. (2 marks)
- d) Specify the minimum safe insulation resistance level for motor operation and name two ways to improve motor insulation resistance. (4 marks)

9. With reference to an alkaline battery cell:

- a) Describe a typical cell, stating the materials used; (6 Marks)
- b) Describe the electro-chemical process that takes place during discharge and charge. (4 Marks)
- c) State the effects of overcharge. (2 Marks)
- d) State the advantages of an alkaline cell compared with a lead acid cell. (4 Marks)

SECTION C

10. a. Compare the advantage between the sacrificial anodes and impressed current system

[6 Marks]

b. Describe with aid of sketch(s), the impressed current system suitable to be used in a ship with the aid of a diagrammed

[8 Marks]

c. What are the circumstances that a ICCP system is kept switched off

[2 Marks]

11. With reference to ship construction and operations:

a) Draw a well-labeled diagram illustrating a cross-section of a contemporary container carrier.

(6 marks)

b) Provide concise explanations for the following concepts:

i) Drydocking stresses

(2 marks)

ii) Hogging

(2 marks)

iii) Sagging

(2 marks)

c) Describe why doubled hull design is used in tankers

(4 marks)



MINISTRY OF PORTS AND SHIPPING
MERCHANT SHIPPING SECRETARIAT - SRI LANKA

CERTIFICATE OF COMPETENCY
OFFICER IN CHARGE OF AN ENGINEERING WATCH

ENGINEERING KNOWLEDGE – I (GENERAL)

TIME ALLOWED - THREE HOURS

Attempt only SIX questions as follows:

FOUR questions from PART A

ONE question from PART B

ONE question from PART C

Marks for each part of the question are shown in the brackets

Pass Mark 50% of the total marks **INCLUDING** minimum of 8 Marks for each PART B and C.

Answers with clear sketches/diagrams, neat handwriting and clear expression will get full marks.

PART-A

1. With respect to SOLAS chapter XI-1 Regulation 7- "Atmosphere testing instrument for enclosed spaces" which requires ships to carry an appropriate portable atmosphere testing instrument(s);
 - (a) State what are the concentrations which the instrument should be capable of measuring and displaying; (8 Marks)
 - (b) Briefly explain the procedure(s) of testing the functionality of above portable atmosphere testing instrument prior to use. (8 Marks)

2. With reference to a steam heating coil in a fuel storage tank developing a leak:
 - (a) state how the leak would be detected; (4 Marks)
 - (b) state the immediate action to be taken when the leak is detected; (6 Marks)
 - (c) explain how the leak may be traced. (6 Marks)



3. With reference to a refrigeration system;

- (a) State the preparation and precautions should be taken prior starting a refrigerator plant; (6 Marks)
- (b) State how the operating condition is identified in a good working order; (4 Marks)
- (c) Describe how to charge refrigerant gas into a system. (6 Marks)

4. With reference to static oily water separators;

- (a) State reasons why, in the separation of oil and water, static means are used for bilge water, and dynamic means used for fuel and lubricating oils; (4 Marks)
- (b) Describe with the aid of a single line sketch, the operation of an automatic three stage oily water separator; (6 Marks)
- (c) List the information that should be entered in the Oil Record Book after completion of pumping out the bilges which accumulated in the machinery space. (6 Marks)

5. (a) Describe, with the aid of a sketch(s), a method of remotely indicating the water level of a main water-tube boiler; (8 Marks)

- (b) Explain the action to be taken should the water level recorded on this remote device be;
 - (i) excessively low; (4 Marks)
 - (ii) excessively high. (4 Marks)

6. With reference to automatic control explain the meaning of following control engineering terms;

- (a) Closed loop; (3 Marks)
- (b) Reference input signal; (3 Marks)
- (c) Dead band; (3 Marks)
- (d) Deviation; (3 Marks)
- (e) Gate; (2 Marks)
- (f) Address. (2 Marks)

7.

- (a) Explain why a centrifugal pump is not self-priming; (4 Marks)
- (b) State FOUR methods that will assist the priming of a centrifugal pump; (4 Marks)
- (c) Sketch the impeller and casing of a water ring type priming pump, describing how it operates. (8 Marks)

PART B

8. (a) with reference synchronizing of two generators;

- (I) Describe with aid of sketch(s) the synchronizing sequence to bring a generator into service in parallel with a running generator, using both a synchroscope and lamps; (8 Marks)
- (II) Describe how to carry-out the load sharing of two generators running in parallel; (2 Marks)

(b) Briefly describe the functionality of safety and interlock devices fitted on a main switchboard. (6 Marks)

9. Explain the following Characteristics of semiconductors including their application(s);

- (a) Photoelectric effect; (4 Marks)
- (b) Thermoelectric effect; (4 Marks)
- (c) Communication action; (4 Marks)
- (d) Hall effect. (4 Marks)

→ transfer electrons

PART C

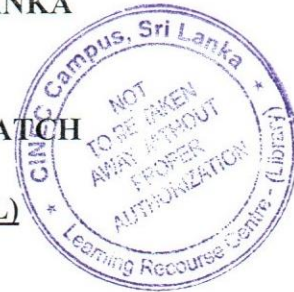
- ✓ 10. (a) Compare the advantages and disadvantages of sacrificial anodes and an impressed current system; **(8 Marks)**
- (b) Describe with the aid sketch(s), how sacrificial anodes are fitted on to a ship's hull; **(4 Marks)**
- (c) Briefly describe how do you decide to discard a sacrificial anode. **(4 Marks)**
- ✓ 11. Briefly describe followings of a propeller;
- (a) Boss; **(2 Marks)**
- (b) Rake; **(2 Marks)**
- (c) Skew; **(2 Marks)**
- (d) Face; **(2 Marks)**
- (e) Back; **(2 Marks)**
- (f) Tip; **(2 Marks)**
- (g) Radius; **(2 Marks)**
- (h) Pitch. **(2 Marks)**



MINISTRY OF PORTS AND SHIPPING
MERCHANT SHIPPING SECRETARIAT - SRI LANKA

CERTIFICATE OF COMPETENCY
OFFICER IN CHARGE OF AN ENGINEERING WATCH

ENGINEERING KNOWLEDGE – I (GENERAL)



TIME ALLOWED - THREE HOURS

Attempt only SIX questions as follows:

FOUR questions from PART A

ONE question from PART B

ONE question from PART C

Marks for each part of the question are shown in the brackets

Pass Mark 50% of the total marks **INCLUDING** minimum of 8 Marks for each PART B and C.

Answers with clear sketches/diagrams, neat handwriting and clear expression will get full marks.

PART-A

1. With respect to SOLAS chapter XI-1 Regulation 7- "Atmosphere testing instrument for enclosed spaces" which requires ships to carry an appropriate portable atmosphere testing instrument(s);
 - (a) State what are the concentrations which the instrument should be capable of measuring and displaying; **(8 Marks)**
 - (b) Briefly explain the procedure(s) of testing the functionality of above portable atmosphere testing instrument prior to use. **(8 Marks)**

2. With reference to a steam heating coil in a fuel storage tank developing a leak:
 - (a) state how the leak would be detected; **(4 Marks)**
 - (b) state the immediate action to be taken when the leak is detected; **(6 Marks)**
 - (c) explain how the leak may be traced. **(6 Marks)**

3. With reference to a refrigeration system;

(a) State the preparation and precautions should be taken prior starting a refrigerator plant;

(6 Marks)

(b) State how the operating condition is identified in a good working order; (4 Marks)

(c) Describe how to charge refrigerant gas into a system. (6 Marks)

4. With reference to static oily water separators;

(a) State reasons why, in the separation of oil and water, static means are used for bilge water, and dynamic means used for fuel and lubricating oils; (4 Marks)

(b) Describe with the aid of a single line sketch, the operation of an automatic three stage oily water separator; (6 Marks)

(c) List the information that should be entered in the Oil Record Book after completion of pumping out the bilges which accumulated in the machinery space. (6 Marks)

5. (a) Describe, with the aid of a sketch(s), a method of remotely indicating the water level of a main water-tube boiler; (8 Marks)

(b) Explain the action to be taken should the water level recorded on this remote device be;

(i) excessively low; (4 Marks)

(ii) excessively high. (4 Marks)

6. With reference to automatic control explain the meaning of following control engineering terms;

(a) Closed loop; (3 Marks)

(b) Reference input signal; (3 Marks)

(c) Dead band; (3 Marks)

(d) Deviation; (3 Marks)

(e) Gate; (2 Marks)

(f) Address. (2 Marks)

7.

- (a) Explain why a centrifugal pump is not self-priming; (4 Marks)
- (b) State FOUR methods that will assist the priming of a centrifugal pump; (4 Marks)
- (c) Sketch the impeller and casing of a water ring type priming pump, describing how it operates. (8 Marks)

PART B

8. (a) with reference synchronizing of two generators;

(I) Describe with aid of sketch(s) the synchronizing sequence to bring a generator into service in parallel with a running generator, using both a synchroscope and lamps; (8 Marks)

(II) Describe how to carry-out the load sharing of two generators running in parallel; (2 Marks)

(b) Briefly describe the functionality of safety and interlock devices fitted on a main switchboard. (6 Marks)

9. Explain the following Characteristics of semiconductors including their application(s);

- (a) Photoelectric effect; (4 Marks)
- (b) Thermoelectric effect; (4 Marks)
- (c) Communication action; → transfer electrons (4 Marks)
- (d) Hall effect. (4 Marks)

PART C

- ✓ 10. (a) Compare the advantages and disadvantages of sacrificial anodes and an impressed current system; **(8 Marks)**
- (b) Describe with the aid sketch(s), how sacrificial anodes are fitted on to a ship's hull; **(4 Marks)**
- (c) Briefly describe how do you decide to discard a sacrificial anode. **(4 Marks)**
- ✓ 11. Briefly describe followings of a propeller;
- | | |
|-------------|------------------|
| (a) Boss; | (2 Marks) |
| (b) Rake; | (2 Marks) |
| (c) Skew; | (2 Marks) |
| (d) Face; | (2 Marks) |
| (e) Back; | (2 Marks) |
| (f) Tip; | (2 Marks) |
| (g) Radius; | (2 Marks) |
| (h) Pitch. | (2 Marks) |



MINISTRY OF PORTS & SHIPPING AND SOUTHERN DEVELOPMENT

MERCHANT SHIPPING SECRETARIAT - SRI LANKA

EXAMINATION FOR CERTIFICATE OF COMPETENCY
OFFICER IN CHARGE OF AN ENGINEERING WATCH-FEBRUARY 2019

ENGINEERING KNOWLEDGE – II (MOTOR)

TIME ALLOWED - THREE HOURS

Attempt SIX questions only

Marks for each part of the question are shown in the brackets

Candidates are required to obtain 50% of the total marks allocated to this paper to gain a pass.

Answers with clear sketches, diagrams, neat handwriting and clear expression will get full marks.

01. With reference to reciprocating engine operations and working principles
- a) Explains the meaning of “*single and double acting*” [3 Marks]
 - b) Sketch and describe the timing diagram for a *Two-Stroke* engine with notifying suitable working temperature and pressure at each changing points [6 Marks]
 - c) Sketch a connecting rod assembly used in a medium speed engine, illustrating the *special features in designing and indicating the maximum allowable limits* for safe operation of the engine [4 Marks]
 - d) List the suitable materials used for constructing the connecting rod and its assemblies sketched in Q.01 (c) [3 Marks]
- 02.
- a) Sketch and explain typical fuel valve which can be used in a large bore cross head type Two stroke engine [4 Marks]
 - b) Describe what are the important areas to be inspected on the above fuel valve during overhaul and explain valid reasons for it [5 Marks]
 - c) Explain how this type of fuel valves comply with *NO_x* emission [4 Marks]
 - d) Describe correct pressure testing procedure for fuel valve mentioned in Q.02.(a) [3 Marks]
03. With reference to cylinder liner defects
- a) State the possible defects which can be found in a cylinder liner [2 Marks]
 - b) Explain the reasons for the defects mentioned in Q.03.(a) and how it can be minimized [8 Marks]
 - c) Explain the correct procedure for calibrating cylinder liner diameter and how it will be decided to replace [6 Marks]
04. With reference to air start system of Medium speed engine
- a) Draw and explain suitable air starting system for a generator engine [5 Marks]
 - b) State the safeties fitted on above system Q.04.(a) [3 Marks]
 - c) Sketch a Main starting air reservoir with its mountings [5 Marks]
 - d) Explain the design features/standards of main air reservoir(s) for starting main propulsion engine [3 Marks]

05. Modern electronically controlled engines are operated without camshafts.
- Describe the operation of fuel injection and exhaust valve operations for large bore slow speed engine without a camshaft. [6 Marks]
 - Explain how the engine describe in **Q.05.(a)** may be operated for very low loads [4 Marks]
 - List out safety devises which are fitted on above mention fuel injection and valve operating systems [6 Marks]
06. With reference to steam boiler fuel atomization and combustion
- Describe the furnace conditions which indicates good combustion [4 Marks]
 - State the theoretical **air/fuel** ratio for a typical boiler fuel [1 Mark]
 - Describe with a single line diagram for a combustion air register including followings [6 Marks]
 - Swirl vanes
 - The flame stabilizer
 - Air-flow control valve
 - The burner
 - Draw a suitable fuel oil system for an Auxiliary boiler and explain the switching over procedures of HFO and LSGO/LSDO [5 Marks]
07. Steam turbines are mainly used as Main propulsion, Power generation and Cargo pumping operations onboard the ships
- State the type of turbines which are commonly used onboard [2 Marks]
 - Describe with aid of sketch(es) the construction of an above mentioned in **Q.07.(a)** [4 Marks]
 - Describe the procedure for starting steam turbine stating precautions to be observed before starts. [6 Marks]
 - State the safety devices fitted on steam turbine and their functions [4 Marks]
08. With reference to crank shaft for the medium speed engines
- State the different kind of crank shaft constructions and what will be suitable for medium speed engines [4 Marks]
 - Discussed validity of the statement as "***the stress concentrate in change of section have been minimized in crank shaft from the construction itself***" [3 Marks]
 - Discussed the correct procedure for taking crank shaft deflection [6 Marks]
 - How do you ensure the accuracy of your readings and action can be taken to avoid or minimize such errors [3 Marks]
09. Various type of sealant and packing are utilized for machinery overhauling and fitting works
- Explain what are the meaning of sealant, gasket and jointing packing [3 Marks]
 - Explain the different between jointing packing and gasket [2 Marks]
 - Describe various onboard applications for each mentioned in **Q.09.(a)** [6 Marks]
 - Discussed with an example, the important of correct thickness of gaskets for optimum operation of a machinery [5 Marks]



MINISTRY OF PORTS AND SHIPPING

MERCHANT SHIPPING SECRETARIAT - SRI LANKA

**EXAMINATION FOR CERTIFICATE OF COMPETENCY
OFFICER IN CHARGE OF AN ENGINEERING WATCH 750 kW OR MORE**

ENGINEERING KNOWLEDGE – II (MOTOR)

TIME ALLOWED - THREE HOURS

Attempt SIX questions only

Marks for each part of the question are shown in the brackets

Candidates are required to obtain 50% of the total marks allocated to this paper to gain a pass.

Answers with clear sketches, diagrams, neat handwriting and clear expression will get full marks.

1. With Regard to the Marine Boilers;
 - a. State why, that the excess air must be kept to a minimum for maintaining good combustion. **[2 Marks]**
 - b. Briefly describe the instruments that are available to indicate and record the percentage of CO₂ and O₂ in the exhaust gas. **[4 Marks]**
 - c. Describe with aid of sketches how pressure-jet and rotary cup burners atomize fuel and promote adequate air/fuel mix ratio. **[5 Marks]**
 - d. Describe the routine inspections and maintenances are to be made on one of burner mentioned in above (c) **[5 Marks]**

2. With reference to the bottom end bearing of a four stroke medium speed main engine which has been opened for inspection:
 - a. List, with reasons, the checks which should be made during the inspection; **[6 Marks]**
 - b. List, with reasons, the checks which should be made while reassembling the bearing; **[6 Marks]**
 - c. State the checks which must be made after reassembly and before the engine is returned to full service. **[4 Marks]**

3. With reference to large slow speed 2-stroke engines:
- Sketch an oil cooled piston and rod assembly, labeling the main components, indicating coolant flow and normal running piston crown temperatures; **[8 Marks]**
 - State, with reasons, the materials used for the piston crown, skirt and rod. **[4 Marks]**
 - Describe the inspection and testing of the assembly sketched in Q3(a). **[4 Marks]**
- 4.
- Explain, with the aid of sketches, how that the use of multiple air inlet and exhaust valves improve efficiency and performance of a diesel engine. **[5 Marks]**
 - Explain why valve rotation is sometimes used for exhaust valves. **[5 Marks]**
 - Describe how the frictional connection between the valve and the cylinder head is removed in order to allow for valve rotation by the use of a spinner. **[6 Marks]**
5. With reference to jerk type, scroll fuel pumps state:
- What determines the actual stroke of the pump **[4 Marks]**
 - How the effective stroke of the pump is controlled **[6 Marks]**
 - Give two reasons why the actual stroke of the pump may be greater than the effective stroke **[6 Marks]**
- 6.
- Explain why electrically driven scavenge air blowers are fitted to 2 stroke large bore cross head diesel engines. **[4 Marks]**
 - Explain why scavenge air is cooled after leaving the turbocharger prior to enters the scavenge air space. **[4 Marks]**
 - Explain how a water separator, fitted in the scavenge air system of a turbocharged engine, functions to remove water droplets from the air **[4 Marks]**
 - State, with reasons, the possible consequences to the engine if water droplets are not removed from the scavenge air before it enters the cylinders. **[4 Marks]**
7. With reference to residual fuels used on board ship:
- Explain the correct procedure for obtaining a representative fuel sample while bunkering; **[4 Marks]**
 - Describe FOUR fuel testing procedures; **[8 Marks]**
 - Explain the importance of the test for flash point. **[4 Marks]**



19th Jan 2021

MINISTRY OF PORTS AND SHIPPING

MERCHANT SHIPPING SECRETARIAT - SRI LANKA

EXAMINATION FOR CERTIFICATE OF COMPETENCY
OFFICER IN CHARGE OF AN ENGINEERING WATCH 750 kW OR MORE

ENGINEERING KNOWLEDGE – II (MOTOR)

TIME ALLOWED - THREE HOURS

Attempt SIX questions only

Marks for each part of the question are shown in the brackets

Candidates are required to obtain 50% of the total marks allocated to this paper to gain a pass.

Answers with clear sketches, diagrams, neat handwriting and clear expression will get full marks.

1. ✓

- a. State, with reasons, the precautions which must be observed when taking crankcase deflections to ensure safety of personnel and accuracy of results. [5 Marks]
- b. Describe the procedure for taking crankshaft deflections on a large crosshead diesel engine. [5 Marks] + 1
- c. Explain why crankshaft deflection readings are taken, indicating the possible consequences of excessive crankshaft deflection readings. [5 Marks]

2. ✓

- a. Sketch a starting air system which may be used for starting a generator engine, explaining how the system operates. [8 Marks]
- b. Explain how a generator engine is set up so that it may be started automatically by the power management system, stating the precautions which must be observed at an engine selected for automatic standby. [8 Marks]

3. ✓

- a. Explain the possible consequences of running an engine with cylinder powers excessively out of balance. [4 Marks]
- b. Explain why perfect power balance between cylinders is not possible. [4 Marks]
- c. Describe how cylinder power and performance can be assessed for a medium speed engine. [4 Marks]
- d. Describe the adjustments which must be made to restore reasonable cylinder power balance to a medium speed engine. [4 Marks]

4. ✓

- Describe the routine maintenance necessary on the following components in order to obtain optimum performance from a main engine turbocharger-
- a. Lubricating oil for ball bearings [4 Marks]
 - b. Air intake silencer/filter [4 Marks]
 - c. Turbine blades [4 Marks]
 - d. Diffuser ring [4 Marks]

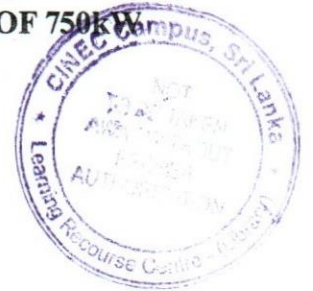
5. With reference to boiler and associated auxiliaries
- a. Explain what is meant by "boiler blow back" and how it can be avoided
[3 Marks]
 - b. Describe the procedure for igniting the burner manually and automatically
[4 Marks]
 - c. Explain why the temperature of boiler exhaust gases should be maintained above a minimum value
[3 Marks]
 - d. State the function of safety valve and describe how it can be blown
[6 Marks]
6. With reference to large slow speed engine suggest with reasons which one or combination of the following conditions is likely to contribute most to breakage of piston rings.
- a. Engine overload [4 Marks]
 - b. Jacket cooling water pump stalled [4 Marks]
 - c. Worn cylinder liner [4 Marks]
 - d. Inadequate cylinder lubrication [4 Marks]
- 7.
- a. State why inhibitors are employed with engine cooling water even though distilled water is used for that purpose [4 Marks]
 - b. State the merits and demerits of the following inhibitors used in engine cooling water systems [9 Marks]
 - i. Chromate
 - ii. Nitrite-borate
 - iii. Soluble oil
 - c. Briefly explain how each inhibitor mentioned in Q7.b functions [3 Marks]
- 8.
- a. Describe how main engine control is changed to the local (engine side) control and maneuvered from that location. [8 Marks]
 - b. Describe how the emergency generator is prepared for automatic operation. [4 Marks]
 - c. Describe how the emergency generator is started manually and run on test. [4 Marks]
- 9.
- a. State why high pressure fuel injector and hydraulic exhaust valve actuating pipes to be sheathed [3 Marks]
 - b. Explain how the failure of sheathed high -pressure pipes is brought to the notice of engineers [3 Marks]
 - i. Describe the replacement of a sheathed high pressure pipe explaining the precautions to be taken [6 Marks]
 - ii. State the checks to be made to ensure that leakage from the high pressure pipe will be detected [4 Marks]



MINISTRY OF PORTS, SHIPPING
MERCHANT SHIPPING SECRETARIAT - SRI LANKA

EXAMINATION FOR CERTIFICATE OF COMPETENCY
OFFICER IN CHARGE OF ENGINEERING WATCH ON SHIPS OF 750KW
PROPULSION POWER OR MORE

ENGINEERING KNOWLEDGE - I (GENERAL)



TIME ALLOWED - THREE HOURS

Attempt to SIX questions only, as indicated below:

FOUR questions from Section A

ONE question from Section B

ONE question from Section C

Marks for each part of the question are shown in the brackets

Pass mark 50 % of total AND also need to obtain a minimum of 8 Marks in each of the Sections "B" and "C".

Answers with clear sketches/diagrams, neat handwriting, and clear expression will get full marks.

SECTION A

1.

- a) State the specific MARPOL Annex associated with regulations relating to EEXI. (2 marks)
- b) Explain the objectives behind introducing the Energy Efficiency Existing Ship Index EEXI. (5 marks)
- c) Identify the vessel categories subject to EEXI regulation. (3 marks)
- d) Specify the timeframe within which the requirements for implementing EEXI and CII must take effect. (2 marks)
- e) Enumerate four technological options utilized in marine engines to meet the requirements of the Energy Efficiency Existing Ship Index (EEXI) standards. (4 marks)

2. Regarding the heat exchangers used onboard ships,

- a) Draw a labeled sectional view of a plate-type heat exchanger illustrating the fluid flow within the plates. (05 marks)
- b) Outline with a suitable sketch the design measures intended to prevent fluid mixing in the cooler, along with the incorporated features designed to provide an early alert regarding the potential risk of such mixing. (04 marks)
- c) Explain the standard cleaning procedure for a plate-type cooler, specifying the areas that demand special attention during the process. (05 marks)
- d) List FOUR advantages of plate coolers over shell and tube types. (02 marks)

3.

- a) Sketch a simple cross-section through a single-stage centrifugal pump with a single-entry impeller; name the components of the pump and indicate the direction of fluid flow. (06 marks)
- b) Define the term "NPSH" regarding the pumping systems. (02 marks)
- c) State causes for the following troubles with the centrifugal pumps,
 - i. No delivery or insufficient delivery (02 marks)
 - ii. Discharge pressure insufficient (02 marks)
 - iii. Lack of prime (02 marks)
 - iv. Vibration of the pump (02 marks)

4. With reference to Biological Sewage Treatment Plant Operation:

- a) Explain the working principle of a biological sewage treatment plant. (08 Marks)
- b) State how anaerobic conditions can develop within a sewage treatment plant installed on ships. (02 marks)
- c) state the risks related to toxic gas production (02 Marks)
- d) State the regulatory requirements related to the sewage treatment plant (04 marks)

5. With reference to the ship's engine room overhead crane.

- a) Identify the essential parts of an engine room overhead crane. (03 marks)
- b) Outline the safety precautions essential during the operation of an engine room overhead crane. (04 marks)
- c) Describe the essential preventive maintenance required for the engine room overhead crane. (06 marks)
- d) State the practical steps that could be taken to prevent overloading an overhead crane when pulling out of a seized main engine piston from the cylinder liner. (03 marks)

6. With reference to the onboard refrigeration plants.

- a) Name four essential characteristics of an ideal refrigerant. (02 marks)
- b) Explain the indications of air in a vapor compression refrigeration system and describe the process of removing air from the system. (06 marks)
- c) Identify the signs associated with an undercharged vapor compression refrigeration system. (02 marks)
- d) Explain the correct procedure for charging refrigerant to a vapor compression refrigeration system. (06 marks)

7. With reference to the steering gear system of a ship,

- a) Sketch a signal line diagram of a 4-ram hydraulic steering gear system and briefly explain its operation. (08 Marks)
- b) Point out the sign that indicates the presence of air within the hydraulic system. (02 Marks)
- c) State the purpose of incorporating hunting gear into the above system. (02 Marks)
- d) State the process of testing the ship's steering gear and its related equipment in the correct sequential order prior to departure. (04 marks)

SECTION B

8. With reference to the alkaline batteries.

- a) Describe a prototype cell, stating the materials used. (06 Marks)
- b) Describe the electrochemical process that takes place during charging and discharging. (04 Marks)
- c) State the consequence of overcharging of alkaline batteries. (02 Marks)
- d) State the advantages of an alkaline cell compared with a lead acid cell. (04 Marks)

9. With reference to Insulation Testing of Electrical Equipment and Systems onboard ships,

- a) Explain the purpose of regular testing and recording insulation resistance on electrical equipment. (04 marks)
- b) Explain the procedure in steps including the safety precautions for performing an insulation test on an electric motor coupled to a bow-thruster. (08 marks)
- c) State the minimum safe insulation resistance for operating when a motor is connected to a low-voltage and a high-voltage system. (4 marks)
- d) State methods that could be used to enhance the insulation resistance of a motor onboard a ship while at sea. (4 marks)

SECTION C

10. With reference to the construction of ships and operations,

- a) Sketch a cross-section of a modern container carrier labeling the important structural members. (8 marks)
- b) State the structural members incorporated in the above structure to withstand the stresses on the hull girder at the following conditions, when
 - i. The ship is resting on docking blocks. (2 marks)
 - ii. The hull is subjected to Hogging or Sagging. (2 marks)
 - iii. The containers are loaded into the cargo hold. (2 marks)
 - iv. The ship is rolling heavily at the sea passage. (2 marks)

11. Explain how the following conditions may influence the stability of the ship
- a. Slack tanks or retention of water on deck (4 marks)
 - b. Formation of ice on the superstructure (4marks)
 - c. Lifting a heavy weight inside the cargo hold using the ship's crane. (4marks)
 - d. Bulk cargo of powder type loaded in the cargo hold. (4 marks)