



CINEC CAMPUS(PVT)LTD
Faculty of Marine Engineering

Class 1
Ministry

**REPARATORY COURSE FOR CHIEF ENGINEER OFFICER ON SHIPS OF 3000KW 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

2024.02.13

1.

With reference to marine engines operated with LNG.

- a) Briefly explain the dual fuel operation of large marine engines on lean burn principle and gas injection principle [6 Marks]
- b) Sketch a fuel system suitable for gas injection engine stating the safety devices. [6Marks]
- c) During transportation of LNG, what is “aging” (2 Marks)
- d) What is methane slip. (2 Marks)

2.

- a) Describe the actions and checks required to ensure that a crosshead main propulsion engine may be operated in a Slow Steaming condition. (8 Marks)
- b) Explain the problems which may arise during a prolonged period of slow steaming. (4 Marks)
- c) Explain what actions should be taken before, and after the engine is returned to normal operation after a period of slow steaming. (4 Marks)

3.

You are the Chief Engineer on a merchant vessel, and the vessel has experienced a significant engine failure during its latest voyage. Draft a detailed report to the Superintendent, providing a comprehensive overview of the incident. In your report, address the following key points:

- Incident Overview (2 marks)
- Details of Engine Failure (3 marks)
- Immediate Response (3 marks)
- Root Causes (2 marks)
- Repair and Recovery Plan (3 marks)
- Preventive Measures for Future (3 marks)

4. With reference to modern turbochargers fitted to large slow speed diesel engines.

- 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) Describe the operation of a two-stage turbocharging system with the help of a sketch. (6 marks)
- d) State actions that can be implemented when a turbocharger undergoes surging. (2 marks)

5.

With reference to the electronic engine Multi-Purpose Controller (MPC),

- a) Describe the steps involved in the replacement process when substituting a faulty MPC with a new spare. (6 marks)
- b) Elaborate on the redundancy mechanisms employed in the following sensors:
 - i) Exhaust valve inductive sensor, (3 marks)
 - ii) Fuel quantity sensor. (3 marks)
- c) Explain the purpose of quadrant sensors incorporated in the angle encoder (4 marks)

6.

- a) With reference to abnormal and excessive cylinder liner wear.
- b) explain how it may be caused, stating how it is detected; (6 Marks)
- c) explain the effects and consequences of excessive cylinder liner wear; (5 Marks)
- d) explain how abnormal cylinder liner wear may be prevented. (5 Marks)

7.

With reference to diesel engine NO_x emissions:

- a) explain how No_x is formed during operation of the engine indicating why the aim of high engine efficiency increases the problem; (6 marks)
- b) describe ONE external means by which diesel engine NO_x emissions may be reduced in order to meet current regulations; (10 marks)

8.

With reference to steam turbines.

- Compare the characteristics of impulse and reaction steam turbines (2 marks)
- Describe how gland seals in a steam turbine work to prevent steam leakage and maintain the right pressure, ensuring the turbine operates efficiently and reliably. (6 marks)

With reference to gas turbines.

- a) Explain the main components of a gas turbine. (4 marks)

- b) Explain the role of variable geometry stator vanes and variable inlet guide vanes, in gas turbine performance. (4 marks)

9. With reference to marine boilers.

- a) Differentiate between direct-loaded and pilot-operated safety valves. Highlight the advantages and disadvantages of each type. (4 marks)
- b) Outline the procedure for setting the safety valve pressure on an exhaust gas boiler. (6 marks)
- c) State the regulations governing boiler safety valve settings on ships (4 marks)
- d) Explain the role of classification societies in ensuring compliance with boiler-related regulations. (2 marks)

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CINEC CAMPUS(PVT)LTD

Faculty of Marine Engineering

**REPARATORY COURSE FOR CHIEF 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

"Attain a passing score of at least 50%, ensuring a minimum of 10 marks in both Section B and C."

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

2024.02.04

Section A

1.

Describe the actions to be taken by the Administration or Classification society under the following scenarios related to the handling of an ISM certificate:

(a) In the event of a major non-conformity being identified. (3 marks)

(b) When corrective action has been implemented for non-conformities raised during an external audit within the specified time frame. (3 marks)

(c) Identify the circumstances that may result in the withdrawal of Safety Management Certificate (SMC) or Document of Compliance (DOC). (4 marks)

2.

Regarding cargo space inert gas systems and oxygen analyzers, answer the following:

a) Create a diagram illustrating a cargo space inert gas system that utilizes washed and cooled flue gas from a boiler. (4 marks)

b) Discuss the safety considerations and precautions associated with operating and maintaining ship inert gas systems. (3 marks)

c) Explain the purpose and functioning of a pressure-vacuum valve in an inert gas system. (3 marks)

3.

Examine the duties of the Chief Engineer aboard a vessel in relation to the following scenarios:

(a) Addressing disputes arising from lube oil or fuel oil discrepancies and determining necessary actions in such situations. (4 marks)

(b) Managing oil spillage in the water during bunkering operations. (4 marks)

(c) Briefly explain the term "Custody transfer" in bunkering. (2 Marks)

4.

a) With reference to online monitoring of machinery:

i) State the methodologies employed for monitoring machinery condition. [2Marks]

b) Enumerate the various approaches and instruments utilized in the collection of data for machinery condition monitoring. [4 Mark]

c) Examine the significance of incorporating machinery condition monitoring into approved planned maintenance systems. [4 Marks]

5.

As the Chief Engineer Officer, address the following:

a) List and explain the factors to consider when storing manual metal arc welding electrodes to ensure the production of high-quality welds. (2 marks)

b) Describe the significance of edge preparation before welding and its impact on the quality and integrity of the weld joint. (2 marks)

c) Sketch and label two different methods of edge preparation commonly used in welding processes. (2 marks)

d) A hairline crack is detected in a pipe. As the Chief Engineer Officer, outline the factors that need to be considered when deciding on the method of repair for the crack. (4 marks)

6.

With reference to CO₂ total flooding systems fitted to protect the machinery space.

(a) Outline the safety protocols that the Chief Engineer Officer must adhere to when overseeing maintenance performed by contractors on the system. (4 Marks)

(b) Enumerate the steps involved in the safe release of CO₂ into the machinery space in the event of a fire. (4 Marks)

(c) Detail the factors that warrant consideration before re-entering machinery spaces following the release of CO₂ gas. (2 Marks)

7.

During bunkering operations, a section of the deck bunker line develops a fuel oil leak from a pinhole located in the middle of the pipe.

a) As the Chief Engineer Officer, describe the immediate actions that should be taken to prevent a potential pollution incident. (2 marks)

b) Explain the procedure for making a permanent repair to the damaged section of the deck bunker line, including any precautions to be taken and subsequent inspections that would be necessary. (8 marks)

8.

Describe, with the aid of a sketch, the principle of operation of a radial lip stern tube sealing arrangement for an oil-filled stern tube that incorporates an air space and is designed to prevent pollution. (10 marks)

Section B

9.

With reference to electronic automation systems in the engine room, provide answers to the following:

a) Discuss the advantages and challenges of utilizing electronic automation systems for engine room operations and outline the Chief Engineer's responsibilities in overseeing their maintenance and troubleshooting. (4 marks)

b) Explain the importance of conducting regular inspections and tests on electronic control systems, such as engine monitoring and alarm systems, and describe the Chief Engineer's role in coordinating these activities. (3 marks)

c) Outline the procedures for ensuring the proper functioning and calibration of electronic sensors and instrumentation used in monitoring various parameters in the engine room and explain the Chief Engineer's responsibilities in this regard. (3 marks)

10.

With reference to the electrical equipment to be used in hazardous areas:

a) Describe the meaning of the terms "Intrinsically safe equipment" and "Flame proof enclosure." (4 Marks)

b) Sketch a safety barrier for the power supply of intrinsically safe equipment. (3 Marks)

c) Explain the special consideration to be taken to account during the maintenance of a device fitted with flame proof enclosure. (3 Marks)

11.

a) With reference to of high voltage systems onboard ships:

Why is SF6 gas chosen for high voltage circuit breakers? Explain its unique properties that make it suitable for interrupting electrical currents in such systems. (3 marks)

b) Explain the step-by-step process for conducting an Infrared (IR) test on a high voltage motor used for bow thruster application. Outline necessary precautions, equipment, and test parameters, (5 marks)

c) What is the minimum recommended Insulation Resistance (IR) value for high voltage equipment. (1 mark)

d) State the recommended voltages for IR testing in 6.6 KV and 11 KV rated electrical motors. (1 mark)

Section C

12.

Describe the following emergencies occurred in a vessel

- a) Insufficient reserve buoyancy leading to progressive flooding (3 marks)
- b) Progressive flooding due to excessive List or Trim (2 marks)
- c) Capsizing due to loss of stability (2 Marks)
- d) Structural failure (3 Marks)

13.

With reference to hull repairs of a large vessel.

- a) Detail the process for renewing shipside plating on a large container carrier. Your answer should elaborate an assessment of area identification, progress inspection, (6 marks).
- b) Outline the testing procedure post-completion of the work, (2 marks).
- c) Explain the method employed to document the location of the above plate renewal for future reference, (2 marks)

14.

With reference to modern ship construction.

- a) State how advancements in hull design contribute to improved fuel efficiency in modern ships. (4 Marks)
- b) State how digitalization and smart technologies contribute to fuel efficiency in ship operations. (3 Marks)
- c) What are the potential cybersecurity concerns associated with the integration of digital technologies in modern ship constructions. (3 Marks)

ED class I



MINISTRY OF PORTS & SHIPPING

MERCHANT SHIPPING SECRETARIAT - SRI LANKA

EXAMINATION FOR CERTIFICATE OF COMPETENCY
CHIEF ENGINEER OFFICER

ENGINEERING KNOWLEDGE – I (GENERAL)

Class II
Ministry

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.

Section A

1. As the chief engineer of a vessel which pass through a heavy storm and subsequent the steering gear abnormally' sluggish,
 - a. Describe the inspection you would carry out in order to find the causes of malfunction [4 Marks]
 - b. State the corrective actions that may be carried out at sea, that will allow the vessel to continue to nearest port [4 Marks]
 - c. Explain the tests and inspections that should be carried out till you reach nearest port stated in Q1.b. [2 Marks]

2.
 - a. Describe with the aid of a sketch, a type of outboard seal fitted to an oil lubricated stern tube. [6 Marks]
 - b. State with reasons the materials used for the components of the seal described above Q2.a. [2 Marks]
 - c. Explain how seal design caters for wear and shaft movement. [2 Marks]

3. With regards to auxiliary boiler control system.
 - a. With aid of a sketch describe the basic operation of a burner control system. [6 Marks]
 - b. State how items in the system safely tested for its functionality. [4 Marks]

4. With regards to oily water separators.
- Explain in detail what action you would take as Chief Engineer if oily water separator oil content measuring equipment found defective during routine inspection. **[5 Marks]**
 - Sketch and describe the working principle of an oil content monitoring equipment and its operating system. **[5 Marks]**
5. Explain each of the following metallurgical mechanism
- Creep **[2 Marks]**
 - Fretting **[2 Marks]**
 - Fatigue **[2 Marks]**
 - Brinelling **[2 Marks]**
 - State with reasons where each of the mechanism above may occur in a ship propulsion system **[2 Marks]**
6. Your vessel has been detained due to three major non conformities (NCs) during an ISM audit. Prepare a report in the format of an email, addressing the engineer superintendent with the suggested steps to rectify the NCs. **[10 Marks]**
7. Discuss the influence of the following properties / contents have on fuel characteristics and its economic use
- Viscosity **[2 Marks]**
 - Density **[2 Marks]**
 - Ignition quality **[2 Marks]**
 - Compatibility **[2 Marks]**
 - Vanadium and ash content **[2 Marks]**
- 8.
- Sketch a cargo space inert gas system that uses washed and cooled flue gas from a boiler **[5 Marks]**
 - List 5 (five) safety devices built into the inert gas system, stating the function of EACH. **[5 Marks]**

Section B

9. With reference to a three phase electrical distribution system
- a. Discussed the advantages and disadvantages of an insulated neutral system [4 Marks]
 - b. State how an earthed neutral system is earthed and the measures taken to limit the maximum earth fault current [2 Marks]
 - c. Describe a suitable earth fault monitoring system for ship use 220 v system and explain the procedure for rectifying a single earth fault in this system [4 Marks]
10. With reference to automatic voltage regulators (A.V.R) fitted to electric generators:
- a. Sketch an A.V.R, incorporates with thyristors [2 Marks]
 - b. Draw voltage dip curve and state an acceptable recovery time from initiation of a voltage change, [2 Marks]
 - c. Considering control and automation concepts explain, achieving of following in an A.V.R.
 - i. Stability, [2 Marks]
 - ii. Load change, [2 Marks]
 - iii. Fast response [2 Marks]
11. With reference to large electrical transformers on board ships:
- a. State where transformers may be used [1 Mark]
 - b. State the typical efficiency range for a transformer [1 Mark]
 - c. State the regulations pertaining to transformers [3 Marks]
 - d. State the protective devices that are fitted [2 Marks]
 - e. Briefly describe the maintenance requirements [3 Marks]

Section C

- 12.
- a. Describes the action of anti-fouling paint [3 Marks]
 - b. Describes the use of self-polishing anti-fouling paint [3 Marks]
 - c. Explains the ban on harmful types of antifouling paint [4 Marks]

13. Explain EACH of the following with regards to thickness measurements and acceptance criteria.

- a. Gauged thickness. [2 Marks]
- b. Reserve thickness. [2 Marks]
- c. Renewal thickness. [2 Marks]
- d. Voluntary thickness addition. [2 Marks]
- e. Substantial corrosion. [2 Marks]

14.

- a. Sketch and describe a transverse section of a cargo tank of double hull tanker with the arrangement of web frame and longitudinal in view (half of the view web frame and the other half longitudinal). [6 Marks]
- b. Indicate areas of corrosion in a cargo spaces of above tanker and the reasons for such corrosion. [4 Marks]



Library
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MINISTRY OF PORTS AND SHIPPING
MERCHANT SHIPPING SECRETARIAT - SRI LANKA
EXAMINATION FOR CERTIFICATE OF COMPETENCY
CHIEF ENGINEER OFFICER



Engineering Knowledge -I (General)

*Class D
Ministry*

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 question are shown in brackets

Pass mark 50% of the total along with at least 10 marks for each B & C Sections.

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

SECTION A

1. In relation to a ship's air conditioning plant:

- a) Define the term "comfort zone." (2 Marks)
- b) Explain the primary objective behind maintaining conditioned air within the comfort zone, specifically within the context of a ship's air conditioning plant. (2 Marks)
- c) Enumerate four (04) areas within a ship's air conditioning plant where recirculation of conditioned air should be avoided and justify your answers given for each area. (4 Marks)
- d) State how does an air conditioning system effectively prevent harmful bacterial growth. (2 Marks)

2.

- a) Develop an emergency preparedness plan to handle a significant oil spillage caused during bunkering while the vessel is at a port with the aid of an outline of the plan. (6 Marks)
- b) Explain the main benefits associated with the implementation of the plan outlined in the section "a". (4 Marks)

3. Fatal accidents could arise from the unintentional or premature discharge of CO₂ in machinery spaces.
- a) Elaborate on the safety protocols that the Chief Engineer Officer must adhere to when shoreside contractors are carrying out maintenance on the CO₂ multi-bottle firefighting system. (3 Marks)
 - b) Provide the sequential procedure for the safe release of CO₂ into the machinery space in case of a fire. (3 Marks)
 - c) State as a chief engineer how would you decide the best time to release CO₂ into a space that caught fire onboard the ship. (2 Marks)
 - d) Discuss the factors necessary to consider before re-entering the machinery spaces after the release of CO₂ gas. (2 Marks)
4. Regarding SOLAS Ch.IX ISM code.
- a) State the names of the certificates issued under the ISM code. (1 Mark)
 - b) Clarify the difference between Major Non-Conformity & Non-Conformity. (2 Marks)
 - c) State six (06) defects, and/or deficiencies that are found on board ships, that may lead to raising a Major Non-Conformity during an ISM audit. (3 Marks)
 - d) State the actions that should be taken by the ship's staff when Major Non-Conformity is raised during an ISM audit. (4 Marks)
5. State the indications, and the possible causes to develop the following types of defects on a hydraulic steering gear system and explain the actions that could be taken in such events to maintain the safe steering capability until thorough repairs are carried out.
- a) Twisted rudder stock (4 Marks)
 - b) Sluggish response of rudder to steering command. (3 Marks)
 - c) Irregular response of rudder to steering command. (3 Marks)
6. Alloyed steel plays an extensive role in the shipbuilding industry.
- a) Briefly explain the reasons for the wide use of alloyed steel in the shipbuilding industry. (2 Marks)
 - b) Name the common elements that are used in alloying steel. (2 Marks)
 - c) State the physical properties that could be changed in the steel to meet the applicable requirements in shipbuilding using each of the four (04) elements stated in section "b" as an alloy. (4 Marks)
 - d) Briefly explain the advantages of heat treatment of metallic material. (2 Marks)
7. Regarding main transmission shaft flange coupling arrangements,
- a) Briefly explain the principle of transmitting torque through a flange coupling. (1 Mark)
 - b) State the important factors that must be considered selecting bolts for such couplings. (2 Marks)
 - c) State the possible causes for the failure of coupling bolts. (3 Marks)
 - d) Describe the steps that you would take with reasons as a chief engineer if **one out of ten (10) coupling bolts** of intermediate shaft coupling of the main propulsion system found broken while proceeding in a sea passage and no spare bolts are available on boards. (4 Marks)

8. IMO is aiming at cutting down CO₂ emissions from seaborne transport by at least 40% by 2030.

- a) State the immediate operational steps that could be taken to meet emission reduction targets set for the year 2023 onwards by the ships. (2 Marks)
- b) In this context explain as a chief engineer how you motivate the ship's staff to achieve these targets. (1 Mark)
- c) Discuss the machinery & structural modifications that could be made to meet the CO₂ emission reduction targets. (5 Marks)
- d) State the innovative technologies available at present to improve the energy efficiency of ships. (2 Marks)

SECTION B

9. With reference to the electrical systems generating High Voltage onboard the ship,

- a) state the standing orders that the chief engineer should give to the ship's staff working in association with high-voltage equipment. (4 Marks)
- b) List the essential maintenance requirements that should be included in the planned maintenance system related to HV equipment. (4 Marks)
- c) Explain the reason for using infrared temperature measurement on High Voltage Equipment. (2 Marks)

10. Describe, with the aid of a diagram, the function of a static frequency converter system suitable for a shaft generator coupled to a variable-speed marine engine-driven propeller shaft.

(10 Marks)

11. Explain the characteristics & operation of the following semiconductor devices and their application onboard ships:

- a) Insulated Gate Bipolar Transistor (IGBT): (2 Marks)
- b) Uni-junction Transistor (UJT): (2 Marks)
- c) Ideal and Practical Operational Amplifier (OP-Amp) (4 Marks)
- d) Silicon Controlled Rectifier (SCR): (2 Marks)

SECTION C

12. Regarding the structural strength & integrity of a ship's hull,

- a) Explain the functions of the main structural components incorporated into the aft section of a ship. (5 Marks)
- b) Discuss the various operational conditions of the ship that could lead to damage to the above components. (2 Marks)
- c) State the possible causes for abnormal vibration experience in the aft section of the hull structure during a sea passage, with appropriate preventive measures to mitigate vibration. (3 Marks)

13. Most commercial ship structures are built using steel and are susceptible to corrosion.
- a) State the method used to prevent hull structure from "General Corrosion". (2 Marks)
 - b) Define the term "Corrosion Fatigue". (2 Marks)
 - c) Describe the methods adopted in modern shipbuilding to prevent hull failures due to corrosion fatigue. (6 Marks)
- 14.
- a) State the various reasons for ships taken into dry-dock. (2 Marks)
 - b) As a Chief Engineer, explain the specific areas need to consider in preparation for dry-docking a ship when a damaged structural section of the hull under the main shafting is required to be repaired. (8 Marks)