MINISTRY OF PORTS AND SHIPPING

MERCHANT SHIPPING SECRETARIAT - SRI LANKA

EXAMINATION FOR CERTIFICATE OF COMPETENCY
SECOND ENGINEER OFFICER

Engineering Knowledge -II (Motor) June 2023

- **TIME ALLOWED - THREE HOURS**
- **Answer any SIX (6) questions**
- **Marks for each part of the question are shown in the brackets**
- **Pass marks - 50%**

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

1. With regards to exhaust gas scrubbers:

   a) Illustrate an Open Loop SOx Scrubber System using a diagram. (6 Marks)
   b) Elaborate on the additional features integrated into a Closed Loop Scrubber System. (4 Marks)
   c) State the systems that need to be monitored to ensure compliance with all IMO regulations regarding scrubber systems. (3 Marks)
   d) Specify the requirements for wash water discharge. (3 Marks)

2. Regarding marine turbochargers:

   a) Define the concept of surging, including its causes and the impact it has on the turbocharger. (6 Marks)
   b) Discuss methods for minimizing the occurrence of surge. (4 Marks)
   c) Outline the necessary steps to be taken in the event of surging, emphasizing the importance of prompt action. (3 Marks)
   d) Describe the process of evaluating the operational performance of a turbocharger. (3 Marks)

3. Regarding electronically controlled marine slow-speed engines:

   a) Illustrate with a suitable sketch a starting air system with a slow turning function. (8 Marks)
   b) Elaborate on the significance of slow turning in the operation of such engines. (4 Marks)
   c) Identify and describe the safety devices incorporated within the system. (4 Marks)

4. Regarding dual-fuel two-stroke engines used in LNG carriers:

a) Enumerate the advantages associated with these engines. (2 Marks)
b) Illustrate the operation of a gas injection system using a suitable diagram. (9 Marks)
c) Explain the safety features integrated into the gas piping system. (3 Marks)
d) Define the term "aging" of LNG during transportation. (2 Marks)

5. Regarding crankshaft deflection of a large bore two-stroke engine:

a) Explain the procedure for obtaining crankshaft deflection readings, highlighting the purpose of this process. (10 Marks)
b) Elaborate the measures taken to ensure the accuracy of the readings obtained. (3 Marks)
c) State the reasons the readings obtained are deviating from the manufacturer's recommended values. (3 Marks)

6. Regarding Lubricating oil used on board ships:

a) State the necessary properties of a crankcase oil and provide reasoning behind each requirement. (6 Marks)
b) Specify an appropriate mesh size for the crankcase lubricating oil filter elements and justify the choice. (2 Marks)
c) Explain the procedure for identifying defects and determining the cause when white metal particles are detected in the main lubricating oil filters. (6 Marks)
d) What are the additional properties that required in cylinder lubricating oil compared to Crank case lubricating oil. (2 marks)

7. Regarding scavenge fires and crankcase explosions:

a) Identify the common causes of scavenge fires and provide a brief explanation for each cause. (4 Marks)
b) List the indications that suggest a scavenge fire is occurring. (4 Marks)
c) State the conditions that have the potential to initiate a crankcase explosion. (4 Marks)
d) Explain the circumstances that can lead to a secondary crankcase explosion. (4 Marks)

8. Regarding chocking and holding down arrangements for a main engine bed plate:

a) Illustrate the chocking and holding down arrangement for a large bore two-stroke slow speed main engine with the aid of suitable diagrams. (6 Marks)
b) Explain the process of checking the tightness of the holding down and chocking system, emphasizing the importance of maintaining in proper condition. (6 Marks)
c) Elaborate on the purpose of engine side and end braces, and describe how they are inspected and the condition are evaluated. (4 Marks)

9. As the Second Engineer on board responsible for obtaining indicator cards from an old large bore slow-speed diesel engine which is not fitted with electronic indicator device:

a) Outline the initial checks and preparations you would undertake. (6 Marks)

b) State the additional information required with the indicator cards in order of importance. (4 Marks)
c) Describe your procedure for analyzing the indicator cards and determining the cylinder powers. (3 Marks)
d) State the reasons that could lead to erroneous indicator diagrams. (3 Marks)

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EXAMINATION FOR
CERTIFICATE OF COMPETENCY- SECOND ENGINEER
ENGINEERING KNOWLEDGE-I (GENERAL)

TIME ALLOWED-THREE HOURS
Attempt total of 10 questions as follows
SIX questions from PART A
TWO questions from PART B
TWO questions from PART C
Pass mark 50% of total marks and also need to obtain the minimum of 10 marks for each PART B & C
Answers with Clear sketchers/diagram, Neat hand writing and clear expression will get full marks.

PART A

1. Write the Short Notes on followings with respect to Energy Efficiency of Existing ship Index (EEXI)

   a) Required EEXI **(4 Marks)**
   b) Attained EEXI **(4 Marks)**
   c) Shaft/Engine Power Limitation **(4 Marks)**
   d) EEXI Technical File **(4 Marks)**

2. The steering gear operation of a vessel that recently experienced a heavy storm during the sea passage is found to be abnormal and sluggish.

   a) State FIVE reasons for possible malfunction of the gear. **(5 Marks)**
   b) State the corrective actions that may be carried out at sea, that will allow the vessel to continue to the nearest port. **(5 Marks)**

3. With reference to refrigeration systems:

   a) explain why under-cooling of the refrigerant at the condenser outlet is desirable; **(3 Marks)**
   b) describe, with the aid of a sketch, how a heat exchanger could be incorporated in the circuit to enhance under cooling; **(5 Marks)**
   c) explain the possible consequences of the refrigerant having a dryness fraction below 1 (one) at the compressor suction. **(2 Marks)**

4. With respect to a biological sewage treatment plant.

a) Describe the principle of operation **(4 Marks)**

b) Explain how anaerobic conditions can occur within a sewage treatment plant, stating hazards that may be encountered. **(4 Marks)**

c) Explain the meaning and significance of the term biological oxygen demand **(2 Marks)**

5.

a) Discuss the merits of a condition monitoring system compared to other maintenance regimes. **(5 Marks)**

b) Describe how the data is gathered, stored and evaluated on a computer-based vibration analysis system. **(5 Marks)**

6. With reference to radial lip seals for propulsion shafting:

a) describe, with the aid of a sketch, an outboard seal arrangement as fitted to an oil lubricated stern tube; **(6 Marks)**

b) explain, with reasons, the possible actions should be taken in the event that loss of oil is observed in the stern tube seal header tank. **(4 Marks)**

7. With reference to steam boilers:

a) list six (06) alarms/essential safety shutdowns that are fitted on a boiler, describing how EACH would be tested; **(6 Marks)**

b) state the important steps to be followed when safety valves are set after an overhaul carried out on the valves. **(4 Marks)**

8. Describe the procedure could be used to verify the operation of a machinery space CO_2 total flooding system. **(10 Marks)**

PART 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. With the aid of suitable sketch describe a frequency converter used to control the frequency of AC electrical power generated by a shaft generator driven by direct coupled variable speed main engine.

(10 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)**

PART C

12. With reference to double hulled oil tankers:
   a) sketch a midship section identifying important structural members. **(6 Marks)**
   b) state the advantages of this type of design. **(2 Marks)**
   c) state disadvantages of this type of design. **(2 Marks)**

13. With reference to roll reduction systems, explain the principles of operation of EACH of the following, stating the advantages and disadvantages of EACH:
   a) bilge keels; **(5 Marks)**
   b) passive (uncontrolled) stabilizing tanks. **(5 Marks)**

14. Describe, with the aid of sketches, how main propulsion efficiency can be improved by the addition of EACH of the following:

   a) Ducted propeller (Kort nozzle); **(5 Marks)**
   b) Vane or Grim wheel aft of the propeller. **(5 Marks)**