



**DIRECTORATE OF MERCHANT SHIPPING
GOVERNMENT OF SRI LANKA
CERTIFICATE OF COMPETENCY EXAMINATION**

GRADE : CHIEF MATE ON SHIPS OF 500 GT OR MORE (UNLIMITED)
SUBJECT : SHIP BOARD OPERATIONS
DATE : 25.08.2023

Time allowed THREE hours

Total marks : 180

ANSWER ALL QUESTIONS

Pass marks : 60%

Formulae and all intermediate steps taken in reaching your answer should be clearly shown. You may draw sketches wherever required. Electronic devices capable of storing and retrieving are **not** allowed.

1)

- a) Monitoring of reefer compartment and refrigeration machinery for correct functionality there are several sensors and transducers are fitted to the refrigeration system. List and explain the basic sensors and transducers fitted to the refrigeration system of the vessel including importance of each item listed. (15marks)
- b) During the carriage of cargo, preservation of cargo achieved by various means. Temperature control is one of the main methods used to preserve certain cargoes. Explain with suitable examples main reasons for temperature control. (15 marks)

2)

- a) Inclination of a vessel may occur due to various factors such as external and internal. Explain in detail with suitable sketches how a vessel will incline due to these internal and external factors. (10 Marks)
- b) Loading instrument either analog or digital helps ships officers to assess the vessels stability at any given situation. List main inputs and outputs of stability instrument. (10 Marks)
- c) Stability booklet provided to the vessel is the main guidance to the ships officers in judging vessels stability. List main contents of the stability booklet. (10marks)

3) There are various measures are in place to monitor merchant vessels condition, Dry docking and regular survey arrangement are one of the key measures in monitoring merchant vessels condition.

- a) List and indicate survey pattern for all the certificate categorized under Harmonized System of Survey and Certification (HSSC). (10 Marks)
- b) Briefly explain Marpol Annex 1 Survey items. (10 Marks)

- c) In relation to Dry docking repair list briefly describe Standard maintenance items, Repair items and Modification items.

(10 marks)

4) With reference to tanker operations;

- a) Explain how cavitation and gassing up can occur?
b) Explain in detail inert gas system on board a Tanker.
c) Give reasons for choosing such a gas for use and how the risks associated are eliminated / minimized?

(10 marks each)

5)

- a) Merchant ships are protected from environmental deterioration by various means. Painting of vessels are not only enhance the cosmetic appearance of the vessels it also to protect the vessels from various processes. Explain in detail main protections offered by marine paints.

(15 Marks)

- b) A vessel having flat bottom area of 6120m² required to be painted with two coats of primer and one coat of antifouling paint. Calculate the total requirement of paint and thinner if each primer coating requires 100 Microns of DFT and antifouling paint with 175 Microns of DFT.

Specification of paint as follows.

	AF Paint	Primer
VS	52%	45%
Thinning	5%	10%

(15 Marks)

- 6) Few years ago, some grain vessels were lost at sea and inquiries indicated it was due to dangerous list associated with bulk grain shift. Subsequently, Grain code was introduced and made it mandatory to follow its provisions.

If you are chief officer;

- a) state the minimum criterion to comply for a vessel to set out to sea with a consignment of grain.

(10 marks)

- b) how the heeling arm due to grain shift is derived and what are the parameters for the vessel to remain seaworthy?

(10 marks)

- c) what action you could take to improve the situation if the vessel is found not complying with the requirements?

(10 marks)

Answers

Q1)

- a) Answer should explain temperature and pressure monitoring system incorporated with the system.
- b) Answer should explain chilled, frozen and air cooled cargo with examples.

Q2)

- a) Answer should explain with suitable diagrams List, Heel and Angle of Loll.
- b) Answer should explain input of dynamic data of the vessel and cargo. Output data to be expressed as static condition of the vessel and stability data.
- c) Answer should contain about main particulars of the vessel, tanks and holds, stability conditions, guidance information etc.

Q3)

- a) Answer should List and indicate seven survey pattern for all the certificate categorized under HSSC.
- b) Answer should briefly explain Survey items relating to IOPP certification.
- c) Answer should briefly explain Standard maintenance items, Repair items and Modification items.

Question 4

ANSWER 1

a) Cavitations could occur when an impeller in the centrifugal pump rotates without actually transferring a liquid through it. This happens when cargo is very low in the tank and a large flow rate cannot be given by the pump.

Gassing up occurs when a pump runs too fast. Whirlpool effect may be produced around the tank suction which permits vapor to be drawn in to the pump.

b) Inert gas diagram and explanation to be done:

Inert gas is a mixture of gases which contains insufficient content of O₂ to support combustion. The gas is produced by the boilers in engine room.

- The plant consist of three sections; Flue gas scrubber, blower and distributing unit.
- **Flu gas valve uptake** - Flu gas produced by the boiler is sucked through them
- **Isolating valve** – When the gas is not required, it isolates the gas plant and send the gas to atmosphere
- **Scrubber** – Cleaning and cooling of the gas take place in this section. First the gas passes through a water seal and then a sand-witch like layers where the impurities are removed and finally passes through the de-mister pads where the water droplets are removed.

- **Gas pressure regulating valve** – This valve re-route the gas to the scrubber system when the gas is not required.
- **Deck water seal** – This unit prevent the back flow of inert gas. If the pressure in the tank exceed, the water in the seal is forced up through the pipe and stop back flow.
- **Deck non-return valve** – This is a mechanical valve which also prevents back flow of the gas and cargo flowing towards the deck seal if the cargo tanks are over filled.
- **Deck isolating valve** – This valve isolates the deck main from the rest of the system when the plant has been shut down. Therefore, it helps to carry out maintenance on the side of the non-return valve.
- **Pressure Vacuum breaker** – They are liquid filled breakers that control the pressure in the tank. (Function is just like shock absorbers.)

c) Reason for using such a gas:

- To prevent explosion
 - It can be used as a fixed fire extinguishing agent
 - It increases discharging rate due to its positive pressure
 - Prevent loss of cargo due to evaporation
 - Helps to carry cargo which reacts with O₂
 - Compulsory requirement for crude oil washing
 - It reduces tank corrosion
 - Maintain O₂ percentage is less than 8%
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- Risks are minimized by

Reducing O₂ content to less than 8% and also the hydrocarbon percentage to less than LFL. Thereby it eliminates main two explosive factors.

Question 5

- Answer should explain cathodic protection,
- Primer – 2720l, AF-2060l, Thinner-720l

Question 6

a)

1) The angle of heel, due to the shift of grain shall not be greater than 12 degrees or the angle at which the deck edge is immersed, whichever is lesser.

- 2) In the statical stability diagram, the net or residual area between the heeling arm curve and the righting arm curve up to the angle of heel 40 or deck edge submerge, whichever is less shall be not less than 0.075 meter radians at all conditions of loading.
- 3) The initial meta-centric height, after correcting for the free surface effects of liquids in tanks, shall be not less than 0.30m.
- 4) After completion of loading, vessel shall sail in upright condition.
- 5) Vessel must have a DOA or otherwise shall meet the conditions required for a vessel without DOA
- 6) Master must demonstrate that the vessel can comply with the requirement at all stage of the voyage.

b)

- 1 Find** or calculate pre-planned displacement of the vessel
- 2 From** the grain heeling/Stability information book obtain volumetric heeling moment for each hold
- 3 Multiple** VHM of each hold by 1.06 for a filled compartment to compensate for vertical shift of cargo and by 1.12 for a partly filled compartment.
- 4 Total** up corrected VHM and divide by SF of cargo to obtain Weight heeling moment
- 5 Compare** the WHM with the maximum permissible WHM for the loaded displacement
- 6 If** permitted proceed ahead
- 7 Draw** statical stability curve for the loaded displacement
- 8 Draw** heeling arm curve after finding λ_0 and λ_{40}
- 9 To find** λ_0 : Total WHM/Displacement and mark as A
- 10 To find** $\lambda_{40} = \lambda_0 \times \cos 40$ and mark as B
- 11 Join** AB and AB indicate heeling arm curve

c) Actions required when not complying with the requirements.

1 If the load line permit, increase displacement by adding some ballast into DB tanks. By doing so, λ_0 can be reduced.

2 If load line does not permit transfer oil and water to lower tank to increase KG. By doing so, initial GM and area under the righting arm curve can be increased.

3 If above two not possible or not sufficient, consider to change loading procedure by reducing partly loaded compartment.

4 If all above fails consider more expensive systems like securing partly filled compartments and filled compartments. (Describe at least one securing method for partly filled and filled compartment)