

(Paper Format)

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX. MARKS: 200

NOTES:

- 1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.**
 - 2. All questions carry equal marks.**
 - 3. Wherever applicable sketches should be drawn in support of the same.**
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Q1. NUMERICAL BASED ON FUEL CONSUMPTION/ INDICATOR DIAGRAM/ POWER OUTPUT/ SLIP

Q2. MARINE ENGINEERING TERMS/ BOILERS

Q3. DISTILLATION AND FRESH-WATER SYSTEMS/ PUMPS AND PUMPING SYSTEMS

Q4. STEERING GEARS/ STABILISERS

Q5. GENERATORS, ALTERNATORS AND ELECTRICAL DISTRIBUTION

Q6. REFRIGERATION, AIR-CONDITIONING AND VENTILATION

Q7. SEWAGE TREATMENT PLANTS/ OILY-WATER SEPARATORS AND OIL FILTERING EQUIPMENT/ INCINERATORS

Q8. DECK MACHINERY/ HYDRAULIC SYSTEMS

Q9. DIESEL ENGINES/ STEAM TURBINE SYSTEMS/ PROPELLER AND PROPELLER SHAFT

Q10. BRIDGE CONTROL/ ENGINE ROOM WATCH KEEPING

Please note that the above format is only an indicative of the examination paper. The candidates are advised to refer to detailed teaching syllabus and the course outline.

GOVERNMENT OF INDIA

PM PAPER

Date: -13th-NOV-2025

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Q.1 The effective power of ship is 1400 kW at 12 knots, the propulsive efficiency 65% and the fuel consumption 0.3 kg/kWh, based on shaft power.

Calculate the fuel required to travel 10,000 nautical miles at 10 knots.

Q.2 a) With basic sketch of water tube boiler, show positions of boiler mountings.

b) Explain briefly why boiler water test is necessary and which tests are carried out.

Q.3 a) Explain any positive displacement pump with the help of a sketch and describe the relief arrangement provided for the system.

b) Discuss advantages and disadvantages of this pump as compared to centrifugal pump.

Q.4 a) Sketch and describe an electro-hydraulic steering gear.

b) How will you steer the ship if there is a loss of telemotor control?

Q.5 a) What are services provided by the emergency switchboard?

b) What precautions and maintenance is required on lead acid batteries on ship?

Q.6 For a ship's domestic fridge system, explain:

a) Compressor b) Condenser c) Expansion valve d) Evaporator

Q.7 a) Explain why it is necessary to treat the sewage generated on board? What treatment is carried out before pumping out sewage overboard?

b) List important regulations as per MARPOL for disposal of sewage from the ship within and outside Special Area.

Q.8 a) Sketch a simple hydraulic system used for anchor windlass.

b) What maintenance is required on the hydraulic system for trouble-free operation?

Q.9 a) What is a scavenge fire and its causes in a 2-stroke engine?

b) How do engineers fight such a fire?

Q.10 a) Explain the procedure in engine room on two-hour notice for arrival port.

b) Explain the procedure in engine room on two-hour notice for departure

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Q.1 a) Define: i) Apparent slip ii) Real slip

b) At 90 rev/min, a propeller of 5 m pitch has an apparent slip of 15% and wake fraction of 0.10.
Calculate the real slip.

Q.2 a) Explain why boiler water tests are necessary and which tests are carried out.

b) Explain procedure to raise the steam in boiler from cold condition.

Q.3 Sketch and label Low Pressure Evaporator for FW (fresh water) generation.

Q.4 With a neat sketch, describe 4-ram steering gears with feedback system.

Q.5 a) With simple sketch, explain how electricity is produced by generator.

b) Explain routine maintenance required on Battery and Battery room.

Q.6 a) What is meant by BOD for biological sewage treatment plant?

b) Sketch and describe Biological sewage treatment plant.

Q.7 a) Write desirable properties of refrigerant gas.

b) Sketch and describe Domestic refrigeration system.

Q.8 a) With a simple sketch explain the basic hydraulic circuit of a winch.

b) Why is it important to maintain cleanliness in hydraulic oil?

c) What are the routine maintenance carried out on deck machineries?

Q.9 a) Write notes on preparation for main engine after receiving 2 hours' notice.

b) Explain for hydraulic system, effects of:

- i) High viscosity
- ii) High temperature

Q.10 a) Explain in detail reasons for scavenge fire, how it is detected and how fire is extinguished.

b) Working principle of centrifugal B/p's and Reciprocating P/p's.

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Q.1 The daily fuel consumption of the ship at a speed of 16 knots is 48 tonnes. She has taken bunker for voyage of 1200 miles at the above speed and extra fuel for five days. She is to be proceeded to a port 1300 miles away at a speed of 15.5 knots. Calculate:

- a) Bunker remaining on board at the end of the voyage.
- b) Time taken in hours to complete the above distance.

Q.2 a) What is the importance of maintaining boiler water to certain standards?

b) How poorly maintained water in the boiler can damage the boiler?

c) Describe any 4 boiler water tests carried out on board ships and indicate typical values for the same.

Q.3 a) What is osmotic pressure and briefly explain why pressure applied in RO system is very high.

b) Sketch and describe a low-pressure evaporator.

Q.4 Sketch and describe an electrohydraulic steering gear system.

In case of failure of controls between bridge to steering gear room, what action is required to be taken?

Q.5 a) With a schematic sketch show arrangement for electrical distribution system onboard ships.

b) What are the safety features normally incorporated in the above system to prevent accidents, total loss of power, fire, & explosion?

Q.6 a) Sketch and describe a vapour compression refrigeration system.

b) What are the important properties of a refrigerant?

c) What are the functions of an expansion valve fitted in the system?

Q.7 Sketch and describe a biological sewage treatment plant.

Q.8 a) Describe the advantages and disadvantages of a hydraulic system used onboard.

b) Explain the effect of air, water, dirt and insufficient cooling on the hydraulic system operation.

Q.9 Explain the following:

a) Why proper lubrication bearings inside the crank case important to prevent crank case explosion?

b) What are the tell-tale signs of an impending crank case explosion?

c) What are the regulatory requirements to prevent crank case explosion related accidents on ships?

Q.10 What is understood by unmanned machinery spaces?

Explain the requirements regarding watch keeping duties in an unmanned machinery space.

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Q.1 The speed of a ship is increased to 20% above normal for 8.0 hours, and then reduced to 10% below normal for 10 hours. The speed is then reduced for the remainder of the day so that the consumption for the day is the normal amount.
Find the percentage difference between the distance travelled in that day and the normal distance travelled per day.

- Q.2 a) Sketch a boiler water level gauge glass suitable for low pressure boiler.
b) Explain the procedure of blowing through of such a gauge glass.

- Q.3 a) What is osmotic pressure & briefly explain why pressure osmosis applied in R.O system is very high?
b) Sketch & describe low pressure evaporator.

- Q.4 Write short notes on the following:
a) SOLAS requirement for steering gear.
b) Navigation light circuit and its requirements as per SOLAS.
c) Routine battery maintenance.

- Q.5 Write short notes on the following:
a) Use of circuit breaker and fuses.
b) Operation of emergency compressor.
c) Services to be supplied from emergency generator.

Q.6 Describe the refrigeration cycle and the refrigerants used for refrigeration on board ships.

Q.7 Sketch & describe sewage treatment plant (Block Diagram).

- Q.8 a) Sketch & describe a Hydraulic Windlass drive system.
b) Describe the purpose of hydraulic accumulator.

- Q.9 a) Name the three types of indicator cards taken for main engine on board a ship.
b) Sketch & describe briefly any two of these cards.

- Q.10 Write notes on the following:
a) Precautions to be taken in engine room for rough weather.
b) Bridge control of main engine

GOVERNMENT OF INDIA

PM PAPER

Date: - 15th-May-2025

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

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Q.1 A ship of 18,000 tonne displacement carries 500 tonnes of fuel. If the fuel coefficient is 47250 when the ship's speed is 12 knots. Calculate:

- a) The range of operation of the ship, and
- b) The percentage difference in the range of the ship's operation if the speed of the ship is increased by 5%.

Q.2 a) Sketch and describe a water tube boiler. Discuss its advantages over a smoke tube boiler.

b) Explain briefly with the aid of sketch the blowing through procedure of boiler water gauge glass.

Q.3 a) Sketch and describe a working principle of a freshwater generator. Explain how vacuum is created.

b) Describe some water treatment methods.

Q.4 What do you understand by a safe Matic steering gear system?

What is the function of the following in this type of system:

- a) Oil level detectors
- b) Automatic bypass / isolating valves
- c) Relief valves

Q.5 a) State the necessary conditions required prior to the synchronizing of electrical alternators.

b) Describe the type of cumulative damage that may be caused when alternators are incorrectly synchronized.

Q.6 a) Draw and outline a reefer system using secondary refrigerant for a large reefer cargo hold.

b) What are the various reasons for such a system to become less efficient?

Q.7 a) Draw and describe an oily water separator suitable for pumping out machinery space bilges.

b) Give the important regulations as per MARPOL regarding pumping out machinery space bilge water in open sea and in Special Areas.

Q.8 a) Describe the function of an accumulator in a hydraulic system used on board.

b) With the help of a block diagram explain a central hydraulic power system supplying various deck machinery.

Q.9 a) Draw a simple sketch of a Unit of a 2-stroke main engine and label the various parts.

b) Describe briefly the warming procedure of a large steam turbine giving reasons for the same.

Q.10 a) Describe how a 2-stroke main engine is prepared for manoeuvring after a 3-days stay in port.

b) Explain SOLAS requirements for UMS operations.

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Q.1 The pitch angle of a propeller blade measured at radii of 1, 1.5, 2, 2.5 & 3 meters are respectively 42, 32, 26, 22 and 19 degrees.

This propeller turns at 105 rpm and drives the ship at 22 knots. Calculate:

- a) Pitch of propeller
- b) Apparent slip

What are the interpretations of the result?

Q.2 a) Describe the warming up procedure of a main propulsion steam turbine.

b) Sketch and describe an open feed water system used for boilers.

Q.3 a) State the various types of pumps and describe with sketch a gear pump.

b) State the differences between Centrifugal and Positive displacement Pumps.

Q.4 a) Sketch and describe a rotary vane steering gear system.

b) What are the advantages and disadvantages of rotary vane steering over ram type?

Q.5 a) Briefly explain Parallel Operations of Generators.

b) Describe with sketch the arrangement of navigation light circuit with indicators and alarms.

Q.6 Sketch and describe a typical domestic refrigeration system on board a ship.

How is refrigerant leakage detected?

Q.7 Sketch and label an incinerator used on board.

What items cannot be burnt in an incinerator?

Q.8 a) What regular maintenance should be carried out on deck machinery? Include maintenance on prime movers of this machinery also.

b) What is function of accumulator in a Hydraulic system? Explain with sketch how it operates.

Q.9 a) Describe with sketch why sealing rings are provided in the stern tube?

b) Causes and action in case of scavenge fire.

Q.10 a) Briefly describe the duties of a watch of a manned machinery space in engine room.

b) Sketch and describe Bridge control of Main Engine.

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PM PAPER

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Q.1 A ship's propeller has a pitch of 6.0 meters. When running at 90 rpm, the ship's speed is 15.5 knots and speed of advance is 14.5 knots. If propeller efficiency is 70% and delivered power is 9000 kW, calculate:

- a) Real Slip b) Wake Fraction c) Thrust Power d) Apparent Slip

Q.2 a) Draw a line diagram of a complete feed water system for an auxiliary boiler, levelling all the principal items and showing the direction of flow in all lines.

b) Explain how the feed supply to the boiler is regulated.

c) State what means are provided to prevent oil contamination of the feed water.

Q.3 a) Make a line diagram of a domestic freshwater purification system from evaporator to taps.

b) State the purposes of the following in the system:

- i) Neutraliser unit ii) Hypo chlorinator unit
iii) Sand bed filter unit iv) Carbon filter bed unit

Q.4 a) Draw a four-ram electro-hydraulic steering system, showing:

- i) Pump isolating valves ii) Relief/Shock valves iii) Oil replenishing tank

b) Explain the consequences if the standby pumping unit is motored.

Q.5 a) Describe the procedure for maintenance of Batteries on board.

b) Describe with a sketch Navigation Light Circuit with indicators/alarms and an alternative power supply.

Q.6 a) Sketch an automated air conditioning unit, labeling the component parts.

b) With regard to harmful bacteria to human that may exist in an air conditioning unit.

i) State how bacteria can be transmitted through the air conditioning unit.

ii) State what measures are taken to maintain the system in an acceptable sterile state?

Q.7 A biological sewage system develops a fault, which necessitates opening the unit for repair. Detail

- a) The risks associated with opening the unit. b) The precautions necessary to reduce the risk.

Q.8 Sketch and short description of a hydraulic circuit of Deck Cranes and what all safety devices fitted for safety operation of crane?

Q.9 a) What are the differences between 4-stroke and 2-stroke engines?

b) What is meant by the term "Internal Combustion Engine"?

c) What is scavenging and mention the different types of scavenging adopted?

Q.10 Describe the arrangements necessary for effective engineering watches to be maintained for the purpose of safety during UMS operation.

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1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
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Q.1 A ship's speed is increased by 20% above normal for 8 hrs, reduced by 10% below normal for 10 hours, and then is maintained at the normal value for the remainder of the day. Calculate the percentage variation in fuel consumption for that day, as compared to the daily consumption at normal speed.

Q.2 a) List out the boiler mountings.

b) What are the steps to be carried out for warming up and firing a boiler from a cold condition? How long does it take to raise the steam from cold condition?

Q.3 a) What is osmotic pressure and briefly explain why pressure applied in RO system is very high.

b) Sketch and describe a low-pressure evaporator.

Q.4 Sketch and describe an electrohydraulic steering gear system. In case of failure of controls between bridge to steering gear room, what action is required to be taken?

Q.5 Sketch and describe any positive displacement pump. What precautionary measures are involved for these kinds of pumps?

Q.6 a) Sketch and describe a domestic refrigeration system used to maintain temperatures in meat, fish and vegetable rooms.

b) Explain the safeties in the domestic refrigeration system.

Q.7 a) Sketch and describe an Oily Water Separator.

b) Enumerate the function of the oil content monitor.

Q.8 a) Compare hydraulic systems over pneumatic systems.

b) Describe the operation of a hydraulic system used for deck cargo hold hatch cover opening with a simple sketch, incorporating safeties in the system.

Q.9 With suitable sketches explain the latest arrangements on stern tube lubricating system and the arrangements for mitigating the oil leakage into the sea.

Q.10 What is understood by unmanned machinery spaces? Explain the requirements regarding watchkeeping duties in an unmanned machinery space.

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PM PAPER

Date: - 13th-Nov-2024

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Q.1 Propeller has pitch of 5.5 mtr. When running at 80 RPM, the ship speed is 13.2 knots, speed of advance is 11.0 knots, propeller efficiency of 70% and delivered power is 300 kW. Calculate:

- a) Real Slip b) Wake Fraction c) Thrust Power d) Thrust

Q2 a) Write the advantages and disadvantages of water tube boilers and smoke tube boilers.

b) Define the following:

- i) Admiralty Coefficient ii) Fuel Coefficient iii) Pitch of Propeller
iv) Percentage Apparent Slip v) Percentage Real Slip

Q3 a) Sketch and describe a domestic freshwater generator used on board a ship.

b) Enumerate the various methods employed to make this water potable.

Q4 a) Sketch and describe a 4-ram hydraulic steering gear system.

b) Explain how the automatic fail-safe arrangement is achieved in such a system.

Q5 a) Name the three types of indicator cards taken for main engine on board a ship.

b) Sketch and describe briefly any two of these cards.

Q6 Describe the refrigeration cycle and the refrigerants used for refrigeration on board ships.

Q7 a) State the various Piping Systems found on board in Engine Room of a ship.

b) Sketch and describe a simple lubricating oil system for a 2-stroke diesel engine.

Q8 a) Discuss with a sketch the principle of operation of an Oily Water Separator (OWS).

b) State the factors that can lead to improper functioning of an OWS.

Q9 Write short notes on:

- a) Critical Speed of an Engine b) Rudder Arrestors c) Propeller Drop
d) Superheated Steam e) Hunting Gear

Q10 a) Describe, with sketch a controllable pitch propeller as used on a remote control system.

b) What are the functions of thrust shaft in propulsion?

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Q.1 The normal fuel consumption of a vessel at 15 Knots is 45 tons per day. It was decided to run the vessel at a lower speed to reduce the fuel consumption to 20 tons per day. Find the speed at which the vessel should be operated to achieve the above fuel consumption. Assume that fuel consumption per unit power per hour at lower speed is 10% higher than that at 15 Knots.

Q.2 Sketch and label a water tube boiler. What are the safeties provided on the same?

- Q.3** a) Why Centrifugal pumps require priming while positive displacement pumps do not require priming?
b) What do you understand by Net Positive Suction Head? What is its significance?
c) Why Centrifugal pumps are considered more suitable for use as cargo pumps on tankers?

Q.4 Sketch and describe a Rotary Vane Steering gear. What are its advantages?

- Q5** a) How is the Emergency Generator tested?
b) What are the places powered by the Emergency Generator?
c) What maintenance is carried out on Lead Acid Batteries?

Q6 Sketch and label a domestic refrigeration system and explain the functions of the following switches:
a) L.P. cut-out b) H.P. cut-out

- Q7** a) What are the requirements of the ODMCS
b) Sketch and label an Oily Water Separator.

- Q8** a) Write & explain the SOLAS requirements for Navigation Lights with a simple sketch.
b) Explain the effect of temperature on the performance of Hyd. Machinery.
c) What are the routine maintenance tasks carried out on deck machinery?

- Q9** a) State any ten important things you will do or check when on a watch in the engine room.
b) Sketch and describe the importance of emergency bilge suction.

- Q10** a) Explain the conditions that determine the composition of an E/Room watch. What are the responsibilities of a watchkeeping engineer and explain watch keeping routines in E/Room.
b) With a simple sketch, explain NPSH for the centrifugal pump.

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Q.1 A propeller rotates at 2 rev/sec with a speed of advance of 12 knots & a real slip of .30. The torque absorbed by the propeller is 250 kN-m and the thrust delivered is 300 kN. Calculate:

- a) the pitch of the propeller b) the thrust power c) the delivered power.

Q.2 Sketch and label a water tube boiler. What are safeties provided on the same? (25)

Q.3 With regards to Steering System:

a) What are SOLAS regulations with regards to testing of steering gear before departure? (10)

b) How you operate steering in case of following problems:

i) Telemeter transmitter failure ii) Motor power supply cable is burnt (10)

c) How safematic design is achieved in steering in case of Tankers of above 1000 GRT. (05)

Q.4 a) Explain the difference between two stroke and four stroke marine diesel engine. (10)

b) Sketch and describe main engine fuel line system with mixing column. (15)

Q.5 Describe the refrigeration cycle and the refrigerants used for refrigeration on board ships. (25)

Q.6 (a) Why Centrifugal pumps require priming while positive displacement pumps to not require priming.

(b) What do you understand by Net Positive suction Head? What is its significance? (10)

(c) Why Centrifugal pumps are considered more suitable for use as cargo pumps on tankers. (10)

Q.7 Write short notes on the following:

a) Use of circuit breaker and fuses. (8)

b) Operation of Emergency compressor (8)

c) Services to be supplied from Emergency Generator. (9)

Q.8 a) Sketch and describe a typical electrical distribution system. (15)

b) How paralleling of generators are carried out? (10)

Q.9 With reference to oil monitoring of bilge and tanker ballast discharges.

a) Describe with aid of a sketch, the general arrangements of an oil monitoring system. (15)

b) State the inputs that are recorded and output operation. (10)

Q.10 Write notes on following:

a) Precautions to be taken in Engine room for rough weather. (10)

b) Bridge control of main engine. (15)

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B) Real slip

(b) At 90 rev/min a propeller of 5 m pitch has an apparent slip of 15% and wake fraction of 0.10. calculate the real slip.

Q.2 a) Explain why boiler water test are necessary & which test are carried out.

b) Explain procedure to raise the steam in boiler from cold condition.

Q.3 Sketch and label Low Pressure Evaporator for FW generation.

Q.4 With a neat sketch describe 4-ram steering gears with feedback system.

Q.5 (a) Explain shipboard electrical distribution system.

(b) List up various safeties fitted on main switch board.

Q.6 (a) Draw a line sketch of refrigeration cycle.

(b) How is refrigerant leak detected in the plant?

Q.7 Sketch any oily water separator suitable for a vessel above 10000 GRT to use to pump E/R bilges with an effluent discharge of 15 ppm.

Q.8 (a) Explain the purpose of Deck Mooring Winch and Windlass Winch used on board ship.

(b) List the routine maintenances carried out on board.

Q.9 (a) Write notes on preparation for main Engine after receiving 2 Hrs notice.

(b) Explain for hydraulic system, effects of A) High viscosity

B) High temperature

Q.10 (a) What are different methods of Scavenging for Diesel Engines? Which is considered best?

(b) What are indications of Scavenge fire on 2 Stroke Diesel Engines? What action to be taken in case of Scavenge fire?

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GOVERNMENT OF INDIA

PAPER 1

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b) What are the steps to be carried out for warming up and firing a boiler from a cold condition? How long does it take to raise the steam from cold condition?

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Q.5 a) With a schematic sketch show arrangement for electrical distribution system board ships.

b) What are the safety features normally incorporated in the above system to prevent accidents, total loss of power, fire & explosion?

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b) What are the important properties of a refrigerant?

c) What are the functions of an expansion valve fitted in the system?

Q.7 Sketch and describe a biological sewage treatment plant.

Q.8 a) Describe the advantages and disadvantages of a hydraulic system used on board.

b) Explain the effect of air, water, dirt and insufficient cooling on the hydraulic system operation.

Q.9 With suitable sketches explain the latest arrangements on stern tube lubricating system and the arrangements for mitigating the oil leakage into sea.

Q.10 What is understood by unmanned machinery spaces? Explain the requirement regarding watch keeping duties in an unmanned machinery space.

----- X—X -----

GOVERNMENT OF INDIA

PAPER 2

Date: - 15th-May-2024

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any SEVEN from the remaining questions.
2. All questions carry equal marks.
3. Wherever applicable sketches should be drawn to support the answer.

Q.1 The effective power of ships is 1400 KW at 12 knots, the propulsive efficiency 65% and the fuel consumption is 0.3kg/kWh, based on shaft power. Calculate the fuel required to travel 10,000 nautical miles at 10 knots.

- Q.2** a) With basic sketch of water tube boiler, show positions of boiler mountings.
b) Explain briefly why boiler water tests are necessary and which tests are carried out?

- Q.3** a) What are the differences between roto-dynamic pump and positive-displacement pump?
b) With respect to reciprocating pump what arrangements can be provided to get a uniform flow at the discharge? Draw a sketch to explain the same.

- Q.4** a) Sketch and describe a rotary vane steering gear of a ship.
b) What are the differences between follow-up and non-follow up steering control system?

- Q.5** a) Describe the operation of controllable pitch propeller.
b) Describe the arrangement of navigational light circuit with indicators and alarms.

- Q.6** a) State the properties of refrigerant.
b) Sketch and describe the air conditioning plant for the accommodation of a ship.

- Q.7** a) What do you mean by scavenging of a diesel engine?
b) With the help of sketch distinguish between various methods scavenging.

- Q.8** a) Sketch and describe a biological type sewage treatment plant.
b) State the effluent standards required by regulations.

Q.9 Write short notes on:

- a) Engine load up program. b) Crash reversing c) Hunting gear d) Stern tube
e) FO system mixing column.

- Q.10** a) Sketch and describe a hydraulic windlass drive system.
b) Describe the purpose of hydraulic accumulator.

GOVERNMENT OF INDIA

PAPER 2

Date: - 6th-Feb-2024

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Wherever applicable sketches should be drawn to support the answer.

Q.1 A propeller 6 m diameter has a pitch ratio of 0.9, Blade area ratio of 0.48 and when running at 110 rpm has a real slip of 25% and wake fraction of 0.30. If the propeller delivered thrust of 300 KN and propeller efficiency is 65%. Calculate:

- (a) Blade area (b) Ship speed (c) Thrust power (d) Shaft power (e) Torque

Q.2 a) Sketch a smoke tube boiler showing important mountings.

b) Explain briefly with the aid of sketch the blowing through procedure of boiler water gauge glass.

Q.3 a) Explain any positive displacement pump with the help of a sketch and describe the relief arrangement provided for the system.

b) Discuss advantages and disadvantages of this pump as compared to centrifugal pump.

Q.4 a) Sketch and describe an electro-hydraulic steering gear.

b) How will you steer the ship if there is a loss of telemotor control?

Q.5 a) What are services provided by the emergency switch board?

b) What precautions and maintenance is required on lead acid batteries on ship?

Q.6 a) Draw and explain a reefer system using secondary refrigerant for a large reefer cargo holds.

b) Discuss the properties of refrigerants.

Q.7 a) Explain why is it necessary to treat the sewage generated on board? What treatment is carried out before pumping out sewage overboard?

b) List important regulations as per MARPOL for disposal of sewage from the ship within and outside Special Area.

Q.8 a) Sketch a simple hydraulic system used for anchor windlass.

b) What maintenance is required on the hydraulic system for trouble free operation?

Q.9 a) What is a scavenge fire and its causes in a 2-stroke engine?

b) How do engineers fight such a fire?

Q.10 a) Explain the procedure in engine room on two-hour notice for arrival port.

b) Explain the procedure in engine room on two-hour notice for departure.

GOVERNMENT OF INDIA

PAPER 1

Date: - 6th-Feb-2024

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Wherever applicable sketches should be drawn to support the answer.

Q.1 This pitch angles of a propeller blade measured at radii of 1, 1.5, 2, 2.5 and 3 meters are respectively 40° , 30° , 26° , 22° and 19° .

Calculate:

- i) the pitch of the propeller. This propeller turns at 100 rpm and drives the ship at 16 knots. If the wake fraction is 0.30 calculate
- ii) the apparent slip and
- iii) the real slip

Q.2 For a ships domestic fridge system, explain:

- a) Compressor
- b) Condenser
- c) Expansion Valve
- d) Evaporator

Q.3 For a Steering gear explain:

- a) Safe Matic steering
- b) Hunting gear
- c) Follow-up systems
- d) Non-follow up systems
- e) Rudder drop

Q.4 a) Explain: a) indicated power b) shaft power c) thrust power
d) delivered power e) hull efficiency

Q.5 Sketch and describe an OWS capable of complying with the 15 ppm discharge criteria of MARPOL.

Q.6 a) What are services provided by the emergency switch board?
b) What precautions and maintenance is required on lead acid batteries on ship?

Q.7 How is average pitch of propeller calculated? What is the Barred speed range, where is it indicated and why is it important?

Q.8 With a suitable sketch show how temperature and humidity are controlled in a ship's air conditioning system.

Q.9 Describe briefly how engine room watch keeping is performed under normal circumstances, as per IMO guidelines?

Q.10 With respect to a scavenge fire in a two-stroke engine:

- a) Enlist possible causes
- b) Methods to prevent scavenge fire
- c) Action taken in the event of a scavenge fire
- d) What enables automatic engine slow-down?

GOVERNMENT OF INDIA

Date: - 3rd-Nov-2023

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Wherever applicable sketches should be drawn to support the answer.

Q.1 A propeller of 5.5 diameter has pitch ratio of 0.8 when turning 120 RPM, the wake fraction is found is found to be 0.32 and real slip 37%. Calculate the ship speed, speed of advance and apparent slip.

- Q.2** a) Draw and Explain the Water tube boilers. (15 Marks)
b) What are the effects of salts in boiler feed water? What is the procedure for treatment of feed water? (10 Marks)

- Q.3** a) Explain with sketch the operation of a Low-Pressure Fresh Water Generator. (15 Marks)
b) Draw and explain the Post Treatment of F.W. produced above from the Tank in the consumer. (10 Marks)

- Q.4** a) Describe with sketch the working of the 4 Ram type hydraulic steering gear. (15 Marks)
b) Explain the Fail-safe arrangement in steering Gears. (10 Marks)

- Q.5** a) Describe the maintenance routines carried out for emergency batteries on board. (15 Marks)
b) What are the SOLAS requirements for navigation lights? (10 Marks)

- Q.6** a) What do you understand about global warming potential and ozone depleting substance with reference to the refrigerant gases? (15 Marks)
b) Discuss the properties of refrigerants. (10 Marks)

- Q.7** a) Draw and explain the principle of operation of the purifier? Explain the purpose of purifiers and why settling tank is not enough to complete the oil. (15 Marks)
b) Draw and explain the Construction and operation of a Ship's ODMC? What is IRD formula? (10 Marks)

- Q.8** a) Compare the advantages and disadvantages of electric and hydraulic drive for deck winches. (10 Marks)
b) Draw and explain with sketch a hydraulic accumulator with advantages and disadvantages. (15 Marks)

- Q.9** a) Enumerate the differences between Two stroke and Four stroke Marine diesel engine. (15 Marks)
b) Explain causes of crankcase explosions. (10 Marks)

- Q.10** a) Explain preparation of Diesel Engine for Arrival Port. (10 Marks)
b) Explain preparation of Diesel Engine for Departure Port. (15 Marks)

GOVERNMENT OF INDIA

Date: - 4th-Aug-2023

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 The daily fuel consumption of the ship at a speed of 16 knots is 48 tonnes. She has taken bunker for voyage of 1200 miles at the above speed and extra fuel for five days. She is to be proceed to a port 1300 miles away at a speed of 15.5 knots. Calculate:

- i) Bunker Remaining on board at the end of the voyage.
- ii) Time taken in hours to complete the above distance.

Q.2 a) What is the importance of maintaining boiler water to certain standards?

b) How poorly maintained water in the boiler can damage the boiler?

c) Describe any 4 boiler water tests carried out on board ships and indicate typical values for the same.

Q.3 a) Sketch cross section of a centrifugal pump.

b) Why centrifugal pumps are used extensively for cargo pumping?

c) What is cavitation and why it should be avoided?

Q.4 a) Explain with sketches 4-RAM electro hydraulic steering gear system.

b) State the requirements for emergency control for steering units as per IMO?

Q.5 a) With simple sketch, explain how electricity is produced by generator.

b) Explain routine maintenance required in Battery and Battery room.

Q.6 a) What is meant by BOD for biological sewage treatment plant?

b) Sketch and describe Biological sewage treatment plant.

Q.7 a) Write desirable properties of refrigerant gas.

b) Sketch and describe Domestic refrigeration system.

Q.8 a) With a simple sketch explain the basic hydraulic circuit of winch.

b) Why it is important to maintain cleanliness in hydraulic oil?

c) What are the routine maintenance carried out on deck machineries?

Q.9 Explain the following:

a) Why proper lubrication bearings inside the crank case important to prevent crank case explosion?

b) What are the tell-tale signs of an impending crank case explosion?

c) What are the regulatory requirements to prevent crank case explosion related accidents on ships?

Q.10 a) With block diagram explain bridge control system for Main Engine. What are the requirements of bridge control system?

b) What precautions are required to be taken in Engine room during rough weather?

----- X—X -----

GOVERNMENT OF INDIA

Date: - 12th-May-2023

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 A vessel left port with 560 tonnes of fuel in bunkers covering a journey of 5000 Nautical miles at a speed of 14 knots, arriving in port with a reserve of 80 tonnes. Calculate:

- i) The speed that would have enabled the ship to arrive at her destination with the same serve of fuel if she started off from port with 510 tonnes as bunkers.
- ii) Daily consumption of fuel at this new speed.

Q.2 a) Sketch an auxiliary boiler and label the following mountings.

b) What is importance of carrying out boiler water treatment. What chemicals are used to maintain the quality of boiler water?

Q.3 a) Why fresh water treatment is necessary? How it is carried out on board the ship?

b) Draw a schematic diagram of reverse osmosis process of producing fresh water. Show the salient pressure at each stage.

Q.4 a) With simple sketch explain the working of the stabilizers.

b) Explain the advantages and disadvantages of Rotary Vane Steering System?

c) Explain purpose of providing isolating valves and by pass valves in ram type steering?

Q.5 a) Explain shipboard electrical distribution system.

b) Explain the purpose of providing circuit breakers and fuses in electrical distributions system.

Q.6 a) What are the desirable properties of a refrigerant?

b) Sketch and describe simple refrigeration system used for domestic refrigeration system.

Q.7 a) Sketch and describe biological sewage treatment plant.

b) Explain regulation for condition and discharging sewage overboard.

Q.8 a) Sketch and describe biological sewage treatment plant.

b) Explain function of accumulator, prime mover, filters fitted on deck hydraulic system.

Q.9 a) Explain the scavenging fire & the reasons for a scavenging fire.

b) Explain a crankcase explosion.

Q.10 Explain the procedure for taking over watch in manned engine room and various checks required to be carried out during watch.

GOVERNMENT OF INDIA

Date: - 6th-Feb-2023

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 The area of indicator diagram taken of one cylinder of a six cylinder, four stroke internal combustion engine is 378 sq.mm, the length is 70 mm and the indicator spring scale is 1 mm = 1.5 bar. The diameter of the cylinder is 205mm, stroke 300 mm and rotational speed 360 revolutions per minute. If frictional loss in the engine is 2.5 KW and transmission efficiency is 95%, propeller efficiency is 97% and hull efficiency is 98% find the

- | | |
|-----------------------------------|--------------------|
| a) Indicated power of the engines | b) Delivered power |
| c) Thrust power | d) Effective power |

State any assumption taken in your calculation (25)

Q.2 a) Describe how a Boiler gauge glass is blown through. (10)

b) State the procedure for raising steam in a boiler from cold. (10)

c) At what pressure are boiler safety valves set. (5)

Q.3 a) With a block diagram explain Reverse Osmosis System of Fresh water generation on board. (10)

b) Sketch and name parts of low-pressure evaporator. (15)

Q.4 a) What are the different modes of steering gear controls provided on the bridge of a ship explaining the significance of each system? (10)

b) Explain with the help of a simple sketch, how a rudder order signal results in achieving the desired rudder angle? (15)

Q.5 a) Explain shipboard electrical distribution system. (15)

b) Explain the purpose of providing circuit breakers and fuses in electrical distribution system. (10)

Q.6 a) Sketch and describe a typical cargo-hold refrigeration system. What is the role of the secondary refrigerant? (20)

b) Some refrigerant gases (Like Freon 12) have been banned, and new types of refrigerant gases have been introduced. What is the main reason for this? (5)

Q.7 a) Sketch and describe typical oily water separator for E/room bilges. (15)

b) Explain the working of oil content monitor. (10)

Q.8 a) Explain purpose of accumulator in hydraulic circuit. (10)

b) Write a common failure of hydraulic circuit and remedial measures. (15)

Q.9 a) Draw a timing diagram of a 'two stroke diesel engine'. (10)

b) Draw a sectional diagram of a large 2 stroke diesel engine marking its parts and describe them briefly. (15)

Q.10 Write notes any two of the following: (25)

a) Engine room watch routines.

b) Bridge control of main engine.

c) Precautions to be taken in Engine room for rough weather.

----- X—X -----

GOVERNMENT OF INDIA

Date: - 14th-Nov-2022

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 The pitch angle of a propeller blade measured at radii of 1, 1.5, 2, 2.5 & 3 meters are respectively 42, 32, 26, 22 and 19 degrees. This propeller turns at 105 rpm and drives the ship at 22 knots. Calculate:

i) Pitch of propeller

ii) Apparent slip

What are the interpretations of the result?

Q.2 a) Describe the warming up procedure of a main propulsion steam turbine. (15)

b) Sketch and describe an open feed water system used for boilers. (10)

Q.3 a) State the various types of pumps and describe with sketch a gear pump. (15)

b) State the differences between Centrifugal and Positive displacement pumps. (10)

Q.4 a) Sketch and describe a rotary vane steering gear system. (15)

b) What are advantages and disadvantages of rotary vane steering over ram type. (10)

Q.5 a) Briefly explain Parallel Operation of Generators.

b) Describe with sketch the arrangement of navigation light circuit with indicators and alarms.

Q.6 Sketch and describe a typical domestic refrigeration system on board a ship. (20)

How is a refrigerant leakage detected? (5)

Q.7 Sketch and label an incinerator used on board. (20)

What items can not be burnt in Incinerator. (5)

Q.8 a) What regular maintenance should be carried out on deck machinery. Include maintenance on prime movers of this machinery also. (15)

b) What is function of accumulator in a Hydraulic system? Explain with sketch how it operates. (10)

Q.9 a) Describe with a sketch why are seals provided in the stern tube?

b) Causes and action in case of scavenge fire.

Q.10 a) Briefly describe the duties of a watch of a manned machinery space in engine room.

b) Sketch and describe Bridge control of Main Engine.

----- X—X -----

GOVERNMENT OF INDIA

Date: - 10th-Oct-2022

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 Propeller has pitch of 5.5 mtr. When running at 80 RPM, ship speed is 13.2 knots, speed of advance 11.0 knots, propeller efficiency of 70% and delivered power 300 kw.

Calculate:-

- a) Real Slip b) Wake fraction c) Thrust power d) Thrust

Q.2 a) Write advantages and disadvantages of water tube boiler and smoke tube boiler.

b) Define the following:

- 1) Admiralty coefficient 2) Fuel coefficient 3) Pitch of propeller
4) Percentage appearance

Q.3 a) Sketch and describe a domestic fresh water generator used on board a ship.

b) Enumerate various methods employed to make this water potable.

Q.4 a) Sketch and describe a 4 ram hydraulic steering gear system.

b) Explain how automatic fail safe arrangement is achieved in such system.

Q.5 Sketch and describe any positive displacement pump. What precautionary measures are involved for these kinds of pumps.

Q.6 a) State and describe a domestic refrigeration system used to maintain temperatures in meat, fish and vegetable rooms.

b) Explain the safeties in the domestic refrigeration system.

Q.7 a) Sketch and describe a Oily Water Separator.

b) Enumerate the safeties in the domestic refrigeration system.

Q.8 a) Compare hydraulic systems over pneumatic systems.

b) Describe the operation of hydraulic system used for deck cargo hold hatch cover opening with a simple sketch, incorporating safeties in the system.

Q.9 Write short notes on:

- a) Critical speed of an Engine b) Propeller Drop c) Superheated Steam
d) Rudder Arrestors e) Hunting Gear

Q.10 a) Describe with sketch a controllable pitch propeller as used on remote control system.

b) What are the functions of thrust shaft in propulsion?

GOVERNMENT OF INDIA

Date: - 12th-Sept-2022

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 A Ship of 11500 tonne displacement travels at a speed of 14.4 knots when developing 3200k W Shaft power. Calculate:

- a) The value of admiralty coefficient
- b) The percentage increase in shaft power required to increase the speed by 1.5 knots.
- c) The percentage increase in speed of the ship if the shaft power is increased to 3800k W.

Q.2 Write short notes on the following:

- a) Propeller drop (8)
- b) Rudder drop (8)
- c) Blowing down the gauge glass of a boiler. (8)

Q.3 Sketch and describe the working principle of a gear pump. State with a reason, what type of pump would this pump be classified as. What type of liquids would this pump be most suitable for pumping?

- Q.4** a) Sketch and describe a steering gear used in large vessel.
b) What action will you take in case of Telemeter failure of steering gear?

Q.5 Write notes on purpose and application of the following:

- a) ACB b) MCB c) Fuses d) MCCB

Q.6 a) State the properties of a refrigerant.

b) Sketch and describe simple refrigeration cycle for domestic refrigeration & cargo spaces.

Q.7 a) Explain importance of BOD for biological sewage plant.

b) Sketch and describe Disinfecting and comminuting sewage plant.

Q.8 a) Describe the advantage and disadvantage of a hydraulic system used on board.

b) Explain the effects of the following on a hydraulic system.

- i) Air in the system ii) Dirty oil

Q.9 a) Describe a fuel oil system used for Propulsion of main engine?

b) Explain in brief the use of various parts in above system viz. filters, purifiers, quick closing valves, heaters, fuel pump etc.

Q.10 a) Describe the safe watch keeping arrangements necessary in engine room when carrying dangerous cargo?

b) List the indicators and alarms provided with bridge control of M/E.

GOVERNMENT OF INDIA

Date: - 7th-July-2022

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 The area of an indicator diagram taken of one cylinder of a 4 cylinder, four stroke engine is 378 sq.mm and length is 70 mm. Indicator spring scale is 1 mm = 100 KN / sqm. Diameter of cylinder is 250 mm, stroke of cylinder 310 mm and rotational speed 6 revs per second. Calculate indicated power of engine.

Q.2 a) Define the following:

- i) Efficiency of a machine
 - ii) Fuel coefficient
 - iii) Specific fuel consumption
- b) Distinguish between water tube and fire tube boiler.

Q.3 a) Sketch & describe a domestic fresh water treatment plant as used on board ships.

b) Why is water passed through a carbon filter?

Q.4 a) Describe the process of preparing a boiler for survey.

b) Describe the firing of a boiler to raise steam.

Q.5 a) Sketch and describe a positive displacement pump.

b) Enumerate the differences between a positive displacement pump and Roto-dynamic pump.

Q.6 With respect to Air Conditioning Plant:

- a) Sketch & briefly describe a single duct system.
- b) Sketch & describe a double duct system.
- c) State the comfortable room condition parameters of temperature and relative humidity.

Q.7 a) What is Biological Oxygen Demand (BOD) for sewage plant?

b) Sketch and describe oily water separator used for pumping out Engine Room Bilges.

Q.8 Explain the following:

- a) Advantages and disadvantages of hydraulic unit for winches.
- b) Routine maintenance carried on deck machinery (Windlass, winches, cranes, etc).
- c) Necessity of cooling / heating of hydraulic oil.

Q.9 a) With a simple sketch, explain the operating principle for impulse and reaction turbine.

b) Explain with simple sketches the scavenging system for large 2- stroke engines.

Q.10 Write notes on the following:

- a) Scavenge fire
- b) Crank case explosion.

GOVERNMENT OF INDIA

Date: - 13th-May-2022

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 The speed of a ship is increased to 18% above normal for 7.5 hours then reduced to 9% below normal for 10 hours. The speed is then reduced for the remainder of the day so that the consumption for the day is the normal amount. Find the percentage difference between the distance travelled in that day and the normal distance travelled per day. (25)

Q.2 Sketch and describe a water tube boiler used for running turbine of cargo pumps. State advantages of using superheated steam for turbines. (25)

Q.3 Sketch and describe any positive displacement pump. What precautionary measures are involved for these kinds of pumps? (25)

Q.4 Sketch and describe an electro hydraulic steering gear system. In case of failure of controls between bridge to steering gear room, what action is required to be taken? (25)

Q.5 Sketch & describe an electrical distribution system on board a ship. With all safety devices & interlock. (25)

Q.6 Draw a block diagram of a typical domestic refrigeration system on board a ship. (20)
How is a refrigerant leakage detected? (5)

Q.7 a) Explain the operation of a waste incinerator with the help of a simple block diagram. (15)

b) Give some important regulations as per MARPOL Annex VI for burning waste in an incinerator. (10)

Q.8 Sketch and describe a hydraulic system used on board for anchor windlass. (25)

Q.9 Name the three types of indicator cards taken for a main engine on board a ship. (5)

Sketch and describe briefly any two of these cards. (20)

Q.10 State any ten important things that you will do in engine room when on watch. (15)

What all things will you check / do on 2 hrs notice to arrival port in E/R. (10)

----- X—X -----

GOVERNMENT OF INDIA

Date: - 7th-March-2022

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 Area of the Indicator diagram taken off one cylinder of a six cylinders, four stroke engine was 500 mm². Length of the diagram is 100 mm. The indicator spring constant is 1mm = 2 bar. The diameter of the cylinders is 300 mm stroke is 620 mm and rotational speed is 10 revs / sec. Calculate the indicated power of the engine assuming that all cylinders develop equal power. (25)

Q.2 What do you understand by the term NPSH. Elaborate all factors that are taken into account while calculating the NPSH of a pumping system. (15)

Q.3 a) Sketch block diagram of a reverse osmosis plant for generation of fresh water. (15)
b) Describe various methods employed to make it safe for drinking. (10)

Q.4 a) Draw outline of a 4 ram hydraulic steering gear system. (15)
b) Explain how automatic fail safe arrangement is achieved in such system. (10)

Q.5 a) Write short notes on followings: ACB, MCCB and MCB (15)
b) Give a brief outline off the care and maintenance lead acid batteries.

Q.6 a) Draw and explain a reefer system using secondary refrigerant for a large reefer cargo hold. (15)
b) Discuss the properties of refrigerants. (10)

Q.7 a) Draw outline of the working of an oily water separator. (20)
b) List items that cannot be burnt in an incinerator. (5)

Q.8 a) Describe the advantage and disadvantage off a hydraulic system used on board. (15)
b) Explain the effect of air, water, dirt and insufficient cooling on the hydraulic system operation. (15)

Q.9 Sketch and describe a fuel oil line system of a main engine with mixing column. (20)
State the purpose of mixing column in the system. (5)

Q.10 a) State any ten important things that you will do check when on a watch in the engine room. (15)
b) Sketch and describe the importance of emergency bilge suction. (10)

----- X—X -----

GOVERNMENT OF INDIA

Date: - 13th-January-2022

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 A propeller rotates at 2 rev/s with a speed of advance of 12 knots and real slip of 0.30. The torque absorbed by the propeller is 250 kN-m and the thrust delivered is 300 kN. Calculate:

- a) The pitch of the propeller b) The thrust power c) The delivered power (25)

Q.2 a) Sketch a boiler, which can be used in port, as well as during sailing. (15)

b) Mention any ten mountings fitted on this boiler and explain their functions. (10)

Q.3 a) Explain with a block diagram, how waste heat from main engine is used for producing fresh water on board the ship? (15)

b) Describe some methods of making this water potable for drinking? (10)

Q.4 a) Block diagram of an electro-hydraulic steering gear? (15)

b) How will you steer the ship if there is a loss of telemotor control? (10)

Q.5 a) Describe procedure for starting emergency generator manually. (15)

b) Explain the requirements for navigation lights. (10)

Q.6 a) Sketch and describe a refrigeration system using Freon as refrigerant. Explain how temperatures of each room is independently maintained? (15)

b) What do you understand about global warming potential and ozone depleting substances with reference to refrigerant gases? (10)

Q.7 a) Explain why is it necessary to treat the sewage generated on board? What treatment is carried out before pumping out sewage overboard? (10)

b) Sketch and describe the functioning of a biological sewage treatment plant. (15)

Q.8 a) Sketch a simple hydraulic system used for anchor windless. (15)

b) What maintenance is required on the hydraulic system for trouble free operation? (10)

Q.9 a) Explain the principle of operation of 2 stroke engine. (10)

b) Sketch and explain timing diagram of a 2 stroke engine. (10)

c) Why is such engine preferred for use as main propulsion engine? (5)

Q.10 Explain necessary preparations required in engine room by the watch-keeper on receiving 2 hours notice prior departure of the vessel. (25)

GOVERNMENT OF INDIA

Date: - 8th-November-2021

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 A propeller rotates at 2 rev/s with a speed of advance of 12 knots and real slip of 0.30. The torque absorbed by the propeller is 250 kN-m and the thrust delivered is 300 kN. Calculate:

- a) The pitch of the propeller b) The thrust power c) The delivered power

Q.2 a) Explain briefly who boiler water test are necessary and which test carried out. (15)

b) Explain the procedure to fire the boiler from cold condition. Clearly explain why intermittent firing is adopted. (10)

Q.3 a) Draw outlines a domestic fresh water generator. (20)

b) Enumerate various methods employed to make this water potable. (5)

Q.4 a) Sketch and describe a 4 ram hydraulic steering gear system. (15)

b) Explain how automatic fail safe arrangement is achieved in such system. (10)

Q.5 a) Sketch & describe a typical ship's Electrical Distribution system. (Block Diagram) (15)

b) Briefly explain how maintenance of emergency batteries are carried out on board ship. (10)

Q.6 Why secondary refrigeration is required for the cargo hold refrigeration? Sketch and describe cargo hold refrigeration system. (25)

Q.7 Sketch and describe the construction and operation of a 15 PPM oily water separator. How it is efficiency ensured? (Block Diagram) (25)

Q.8 With respect Deck Machinery, discuss: (25)

- a) Maintenance on cargo handling equipment b) Maintenance on hatch cover
c) Procedure for heaving and dropping anchor d) With simple sketch the working of an Air whistle.

Q.9 a) With respect to marine diesel engines explain with suitable sketches the following: (5 x 3)

- i) Scavenging & Different types of Scavenging.
- ii) Scavenge fire & Reasons for the same
- iii) Prevention of Scavenge fire

b) Sketch & describe a fuel oil line of a Diesel Engine. (10)

Q.10 Sketch and describe block diagram a simple CO₂ total flooding system for machinery space. How is re-entry into Engine Room done after CO₂ flooding? (25)

----- X—X -----

GOVERNMENT OF INDIA

Date: - 15th-September-2021

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 A vessel loads bunkers for a voyage of 4500 miles at 16 knots. The main engine consumes 50 tons per day at this speed, the auxiliary plant requiring 2 tons per day. Just before sailing, the vessel is ordered to proceed on voyage at 14 knots. After 7.5 days of sailing, orders are received to proceed for the rest of the voyage at 16.2 knots, calculate:

- a) The time to complete the voyage.
- b) The bunkers remaining on arrival. (25)

- Q.2** a) Explain briefly why boiler water test is necessary and which tests are carried out. (10)
- b) Sketch any one type of boiler. (10)
- c) Explain procedure to fire boiler to cold condition. (5)

- Q.3** a) Differentiate two stroke engines and four stroke engines. (10)
- b) Briefly describe the various applications of screw pumps and reciprocating pumps on board the ship. (15)

- Q.4** a) Give an account of SOLAS requirements for steering gear. (10)
- b) Sketch and describe a 4 ram steering incorporating the safematic operation. (15)

- Q.5** a) Sketch and describe Ships electrical distribution system. (15)
- b) Write short notes on battery maintenance. (10)

- Q.6** a) Draw and describe a line sketch of domestic refrigeration cycle. (10)
- b) Explain working principle of vapour compressed ac system. (10)
- c) Explain desirable properties of refrigerant. (5)

- Q.7** a) Sketch and describe biological sewage treatment plant. (20)
- b) Explain regulation for condition and discharging sewage overboard. (5)

- Q.8** a) Describe the function & dangers of an accumulator in a hydraulic system used on board. (15)
- b) What maintenance is required on a hydraulic system for trouble free operation? (15)

- Q.9** a) Sketch and describe a fuel line system of a main engine with mixing column. (20)
- b) State the purpose of mixing column in the system. (5)

- Q.10** Describe the arrangements necessary for effective engineering watches to be maintained for the purpose of safety during UMS operation. (25)

GOVERNMENT OF INDIA

Date: - 12th-August-2021

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 A ship of 12100 t displacement is 120m long, 17.5 m beam and floats at a draft of 7.5m in SW. The propeller has a face pitch ratio of 0.75 and when coming at 100 r.p.m. produces ships speed of 12 knots with a real ship of 30%. Calculate the apparent slip and pitch & diameter of the propeller. The wake fraction (w) may be found from the expression. $W = 0.5 C_b - 0.05$ (25)

Q.2 Draw and label a water tube exhaust gas economizer fitted on ships. (25)

Q.3 (a) Sketch and describe a reciprocating pump. (15)

(b) Explain the purpose of a pressure relief valve fitted on this pump. (10)

Q.4 (a) Explain with sketches the rotary vane steering gear system. (15)

(b) What are the IMO requirements for testing of the steering gear units? (10)

Q.5 (a) Sketch and describe a typical emergency electrical distribution system on board a ship. (15)

(b) Enlist the SOLAS requirements for the emergency power supply system fitted on ships. (10)

Q.6 (a) Sketch and describe a typical cargo-hold refrigeration system. What is the role of the secondary refrigerant? (20)

(b) Some refrigerant gases (like Freon 12) have been banned, and new types of refrigerant gases have been introduced. What is the main reason for this? (5)

Q.7 (a) Sketch and describe an oily water separator suitable for pumping out machinery space bilges. (15)

(b) Give the important regulations as per MARPOL regarding pumping out machinery space bilge water in open sea and in a special area. (10)

Q.8 (a) Describe the function & dangers of an accumulator in a hydraulic system used on board. (10)

(b) What maintenance is required on a hydraulic system for trouble free operation? (15)

Q.9 Explain the following:

(a) Step by step development of a crank case explosion.

(b) Sketch and describe a crank case relief valve fitted on a large IC engine.

Q.10 Describe the arrangements necessary for appropriate and effective engineering room watches to be maintained for the purpose of safety under normal circumstances and UMS operations.

GOVERNMENT OF INDIA

Date: - 8th-April-2021

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 A ship's propeller has a pitch of 6.0 mtrs. When running at 90 rpm, the ship's speed is 15.5 knots and speed of advance is 14.5 knots. If propeller efficiency is 70% and delivered power is 9000kW, calculate:

- a) Real Slip (6)
- b) Wake Fraction (7)
- c) Thrust Power (6)
- d) Apparent Slip (6)

Q.2 (a) Draw a line diagram of a complete feed water system for an auxiliary boiler, leveling all the principle items and showing the direction of flow in all lines. (10)

(b) Explain how the feed supply to the boiler is regulated. (5)

(c) State what means are provided to prevent oil contamination of the feed water. (10)

Q.3 (a) Make a line diagram of domestic fresh water purification system from evaporator to taps. (10)

(b) State the purposes of the following in the system (15)

- (i) Neutraliser unit.
- (ii) Hypo Chlorinator unit
- (iii) Sand bed filter unit
- (iv) Carbon filter bed unit

Q.4 (a) Draw a four ram electro-hydraulic steering showing: (15)

(i) Pump isolating valves (ii) Relief / Shock valves (iii) Oil replenishing tank.

(b) Explain the consequences if stand by pumping unit is motored. (10)

Q.5 (a) Describe the procedure for maintenance of Batteries on board. (10)

(b) Describe with sketch Navigation Light Circuit with indicators / alarms and alternative power Supply. (15)

Q.6 (a) Sketch an automated air conditioning unit labeling the component parts. (15)

(b) With regard to harmful bacteria to human that may exist in an air conditioning unit. (10)

- (i) State how bacteria can be transmitted throughout the air conditioning unit.
- (ii) State what measures are taken to maintain the system in an acceptable sterile state?

Q.7 A Biological sewage system develops a fault which necessitates opening the unit for repair.

Detail:-

(25)

- (a) The risk associated with opening the unit
- (b) The precautions taken to reduce the risk

Q.8 Sketch and short description of a hydraulic circuit of Deck Cranes and what all safety devices find the safe operation of crane?

(25)

Q.9 (a) What are the differences between 4 stroke and 2 stroke engine?

(10)

(b) What is meant by the term "Internal Combustion Engine"?

(5)

(c) What is scavenging and mention the different types of scavenging adopted?

(10)

Q.10 Describe the arrangements necessary for effective engineering watches to be maintained for the purpose of safety during UMS operation.

(25)

----- X-X -----

GOVERNMENT OF INDIA

Date: - 7th-Jan-2021

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 (a) The pitch angles of a propeller blade measured at radii of 0.5, 1.0, 1.5 and 2.0 meters are respectively 38, 28, 23 and 20 degrees. Calculate the pitch of the propeller. (10)

(b) During the voyage when the propeller was turning @98 rpm, the actual speed of the ship was 12.3 knots. Calculate % of apparent slip. (10)

(c) Make analysis of the above answer. (5)

Q.2 (a) What is the purpose of a boiler in Engine Room? (10)

(b) Explain the procedure to fire the boiler from cold condition. Clearly explain why intermittent firing is adopted. (15)

Q.3 (a) With block diagram explain reverse osmosis system of FW generation on board. (10)

(b) With simple sketch show the domestic fresh water treatment on board. (15)

Q.4 With the help of a suitable sketch, explain four ram steering gear system. (25)

Q.5 (a) Describe procedure for starting the emergency generator manually. (10)

(b) Explain the requirements for navigation lights. (15)

Q.6 (a) Sketch and describe domestic refrigeration system on board. (10)

(b) What are the advantages of using double duct system over single duct system for air conditioning? (15)

Q.7 With the help of a suitable sketch, describe an oily water separator used for pumping out engine room bilges. (25)

Q.8 (a) Sketch a simple hydraulic system used for anchor windlass. (15)

(b) What maintenance is required on the hydraulic system for trouble free operation? (10)

Q.9 List your duties before and during bunkering. Why is it important to carryout bunker sampling when bunkering is in progress? (25)

Q.10 (a) Explain the procedure in engine room on two hours notice for arrival port. (12)

(b) Explain the procedure in engine room on two hours notice for departure. (13)

----- X—X -----

GOVERNMENT OF INDIA

Date: - 5th-Nov-2020

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 A ship of 18,000 tonne displacement carries 500 tonne of fuel. If the fuel co-efficient is 47250 when the ship's speed is 12 knots. Calculate:-

- a) The range of operation of the ships, and
- b) The percentage difference in the range of the ship's operation if the speed of the ship is increased by 5%. (25)

Q.2 a) Sketch and describe a water tube boiler. Discuss its advantages over a smoke tube boiler. (15)

b) Explain briefly with the aid of sketch the blowing through procedure of boiler water gauge glass. (10)

Q.3 a) Sketch and describe a working principle of a fresh water generator. Explain how vacuum is created. (15)

b) Describe some water treatment methods. (10)

Q.4 What do you understand by a safematic steering gear system? What is the function of the following in this type of system:- (10)

- a) Oil level detectors (5)
- b) Automatic bypass / isolating valves, and (5)
- c) Relief valves (5)

Q.5 a) State the necessary conditions required prior to the synchronizing of electrical alternators.

b) Describe the type of cumulative damage that may be caused when alternators are incorrectly synchronized. (10)

Q.6 a) Draw and outline a refrigeration system using secondary refrigerant for a large refrigerated cargo hold. (15)

b) What are the various reasons for such a system to become less efficient? (10)

Q.7 a) Draw and describe an oily water separator suitable for pumping out machinery space bilges.

b) Give the important regulations as per MARPOL regarding pumping out machinery space bilge water in open sea and in special Areas. (10)

Q.8 a) Describe the function of an accumulator in a hydraulic system used on board. (10)

b) With the help of a block diagram explain a central hydraulic power system supplying various deck machinery. (15)

Q.9 a) Draw a simple sketch of a Unit of a 2 stroke main engine and label the various parts? (15)

b) Describe briefly the warming procedure of a large steam turbine giving reasons for the same. (10)

Q.10 a) Describe how a 2 stroke main engine is prepared for Maneuvering after a 3 days stay in Port? (15)

b) Explain SOLAS requirement for UMS operations. (10)

GOVERNMENT OF INDIA

Date: - 5th-Feb-2020

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 The effective power of ship is 1400 KW at 12 knots, the propulsive efficiency 65% and the fuel consumption 0.3 kg/KW hr., based on shaft power. Calculate the fuel required to travel 10,000 nautical miles at 10 knots.

Q.2 i) What are the advantages of a water tube Boiler? (5)

ii) Sketch and describe a water tube Boiler used on board. (20)

Q.3 a) What are the advantages of RO plant and low pressure distillation plant? (5)

b) What are the factors affecting the production of fresh water in each of the above? (5)

c) Draw & outline diagram a fresh water hydrophor system. (15)

Q.4 i) Show by sketch what are the six degrees of freedom of a ship? (5)

ii) Describe the action of a) Tilting fin system b) Anti – rolling tanks. (15)

iii) What are antiheeling tanks? How the liquid is transferred? (5)

Q.5 a) Draw & outline diagram a ship's electric power distribution system from Main & emergency switch boards to various consumers including the charging of emergency batteries. A simple line sketch will suffice. (15)

b) What is the principle of operation of a Transformer? Why it is required in a distribution system? (10)

Q.6 a) Why the perishable foodstuff needs refrigeration? (6)

b) What are the storage temperature of Vegetable, Meat and Fish in general? (3)

c) What is defrosting cold room? Why defrosting is done? How it is done? (6)

d) What are legionella bacteria in Air conditioning plants? How it is caused? What protective measures can be taken to overcome this? (10)

Q.7 a) Why the oily mixture is heated during OWS operation? (5)

b) Make a neat sketch of Oily Water Separator for a vessel trading through special areas and describe its operation. (20)

Q.8 a) Explain effect of temperature on performance of Hydraulic Machineries (8)

b) What are the routine maintenance carried out on deck machineries. (7)

c) Write & Explain SOLAS requirements for Navigation Light with simple sketch. (10)

Q.9 a) What are the adverse effects of the after end seal leakage to the propeller shafting? (5)

b) Discuss the advantages and disadvantages of controllable pitch propulsion (10)

c) What is rope guard and why it is fitted? (5)

d) What is meant by keyless propeller mounting? (5)

Q.10 a) What is barred speed range with respect to direct coupled diesel engines and why it is important? (10)

b) Describe with a flow diagram the sequence of operations while starting a direct coupled diesel engine remotely. (15)

GOVERNMENT OF INDIA

Date: - 6th-Nov-2019

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 The normal fuel consumption of a vessel at 15 Knots is 45 tons per day. It was decided to run the vessel at a lower speed to reduce the fuel consumption to 20 tons per day. Find the speed at which vessel should be operated to achieve above fuel consumption. Assume that fuel consumption per unit power per hour at lower speed is 10% higher than that at 15 knots. (25)

Q.2 Sketch and label a water tube boiler. What are safeties provided on same. (25)

Q.3 a) Why Centrifugal pumps require priming while positive displacement pumps to not require priming. (05)

b) What do you understand by Net Positive suction Head. What is its significance? (10)

c) Why Centrifugal pumps are considered more suitable for use as cargo pumps on tankers. (10)

Q.4 Sketch and describe a Rotary Vane Steering. What are its advantages? (25)

Q.5 a) How Emergency Generator is tested? (05)

b) What all places power is supplied from Emergency Generator? (05)

c) What maintenance is carried out on Lead acid Batteries? (15)

Q.6 Sketch and label Domestic refrigeration system and explain functions of the following switches:

a) L.P. cut out b) H.P. cut out. (25)

Q.7 (a) What are the requirements of ODMCS? (05)

b) Sketch and label Oily Water Separator. (20)

Q.8 a) Write & explain SOLAS requirements for Navigation Light with simple sketch. (10)

b) Explain effect of temperature on performance of Hyd. Machineries (7)

c) What are the routine maintenance carried out on deck machineries? (08)

Q.9 a) State any ten important things that you will do / check when on a watch in the engine room. (15)

b) Sketch and describe the importance of emergency bilge suction. (10)

Q.10 a) Explain conditions that determine composition of E/Room watch. What are the responsibilities of a watch keeping engineer and explain watch keeping routines in E/Room. (15)

b) What is the function thrust shaft in propulsion system? (10)

----- X—X -----

GOVERNMENT OF INDIA

Date: - 5th-Aug-2019

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 A vessel loads bunker for a voyage of 5000 miles at 16 knots. The main engine consumes 50 tonnes per day at this speed, the auxiliary plant requiring 2 tonnes per day, which is independent speed. Just before sailing at 1824 hours on 3rd March, the vessel is ordered to proceed on voyage at 14.0 knots. At 0624 hours on 11th March, orders are received to proceed for the rest of the voyage at 16 knots.

Calculate:-

- a) The estimated time of arrival. (12)
- b) The bunkers remaining on arrival (13)

Q.2 a) Explain why regular testing of water in auxiliary boilers is desirable. (10)

b) For each test normally carried out, state – (10)

(i) Reasons for making the test,

(ii) Acceptable values for any particular type of auxiliary boiler.

c) Action required when measured values differ appreciably from desired values. (05)

Q.3 a) Sketch & describe the reverse osmosis system for the production of drinking water on board the ships. (15)

b) State – (10)

(i) Pre-treatment used with RO equipment.

(ii) The Post-treatment necessary.

Q.4 State some built in measures by which steering gear mechanism can be kept operational in the event of breakage of rudder actuator, pipe failures, motor burn out etc. (25)

Q.5 a) Sketch and describe a typical ships electrical distribution system? (15)

b) Explain how paralleling of generator's carried out. (10)

Q.6 For a fully automatic provisions refrigeration system incorporating a number of rooms:

a) Sketch a line diagram detailing the devices incorporated into the refrigeration system to protect the machinery and equipment against malfunction. (15)

b) Explain how critical temperature restricts plant operation and how these limitations overcome? (5)

c) What is the effect on the environment of the release of refrigerants into the atmosphere? (5)

Contd.....

Q.7 With reference to oil monitoring of bilge and tanker ballast discharges.

- a) Describe with aid of a sketch, the general arrangements of an oil monitoring system. (15)
- b) State the Inputs that are recorded and output operation. (10)

Q.8 a) Explain the purpose of Deck Mooring Winch and Windlass Winch used on board ship. (10)

- b) List the routine maintenances carried out on board. (15)

Q.9 Write short notes on:-

- a) Use of indicator card on board (10)
- b) Protection / Precautions against Crank Case Explosion (10)
- c) Why pre-heating of main engine is carried out? (5)

Q.10 Explain the arrangements required for ensuring safe engineering watch when carrying dangerous cargo. (10)

----- X—X -----

GOVERNMENT OF INDIA

Date: - 9th-May-2019

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 a) A propeller has diameter of 6m, pitch ratio 1.12 and works at apparent slip of 7%. For Ship speed of 15 Knots determine the RPM of the Engine. (25)

b) If the wake fraction is 0.373 find the real ship. (05)

Q.2 a) Sketch and describe a typical domestic refrigeration system on board a ship. (20)

b) How is a refrigerant leakage detected? (05)

Q.3 a) Sketch and describe a gear pump. How the flow of liquid is controlled in this pump. (20)

b) Why these pumps are fitted with relief valves while centrifugal pumps are not. (05)

Q.4 With Regards to Steering System:

a. What are SOLAS regulations with regards to testing of steering gear before departure. (10)

b. How you operate steering in case of following problems:

i) telemotor transmitter failure ii) Motor power supply cable is burnt (10)

c. How safematic design is achieved in steering in case of Tankers of above 10000 GRT. (05)

Q.5 Sketch & describe a reverse osmosis plant for generation of fresh water. Describe various methods employed to make it safe for drinking marks. (25)

Q.6 a) Sketch and label an Air conditioning Plant of Vessel. (20)

b) Why in case of tankers, the plant should be used on recirculation mode only. (05)

Q.7 Sketch an auxiliary boiler and label all its mounting. Explain the use of the following:

a) Economiser b) Super heater. (25)

Q.8 a) What Regular Maintenance should be carried out on deck machinery. Include maintenance on Prime movers of this machinery also. (15)

b) What is function of accumulator in a Hydraulic system. Explain with sketch how it operates. (10)

Q.9 a) What are different methods of Scavenging for Diesel Engines. Which is considered best. (10)

b) What are indications of Scavenge fire on 2 Stroke Diesel Engines. What action to be taken in case of Scavenge fire. (15)

Q.10 a) What checks are made before unmanning The Engineroom. What is safe procedure for entry in case of alarm in unmanned condition. (15)

b) What Precautions are taken in Engine Room in case of rough weather? (10)

----- X—X -----

GOVERNMENT OF INDIA

Date: - 7th-Feb-2019

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 The speed of a ship is increased to 20% above normal for 8.0 hours and then reduced to 10% below normal for 10 hours. The speed is then reduced for the remainder of the day so that the consumption for the day is the normal amount. Find the percentage difference between the distance travelled in that day and the normal distance travelled per day.

Q.2 a) Sketch a boiler water level gauge glass suitable for low pressure boiler. (15)

b) Explain the procedure of blowing through of such a gauge glass. (10)

Q.3 a) What is osmotic pressure & briefly explain why pressure osmosis applied in R.O. system is very high? (15)

b) Sketch & describe low pressure evaporator? (10)

Q.4 Write short notes on the following:

- a) SOLAS requirement for Steering Gear. (8)
- b) Navigation light circuit and its requirements as per SOLAS. (8)
- c) Routine battery maintenance. (9)

Q.5 Write short notes on the following:

- a) Use of circuit breaker and fuses. (8)
- b) Operation of Emergency compressor. (8)
- c) Services to be supplied from Emergency Generator. (9)

Q.6 Describe the refrigeration cycle and the refrigerants used for refrigeration on board ships.

Q.7 Sketch & describe sewage treatment plant. (Block Diagram)

Q.8 a) Sketch & describe a Hydraulic Windlass drive system. (15)

b) Describe the purpose of hydraulic accumulator. (10)

Q.9 a) Name the three types of indicator cards taken for main engine on board a ship. (10)

b) Sketch & describe briefly any two of these cards. (15)

Q.10 Write notes on following:

- a) Precautions to be taken in Engine room for rough weather. (10)
- b) Bridge control of main engine. (15)

GOVERNMENT OF INDIA

Date: - 8th-Nov-2018

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be draw to support the answer.

Q.1 The area of indicator diagram taken on one cylinder of a 9 cylinder 2 stroke engine is 400 mm^2 , length of diagram is 65mm. Spring scale is $1\text{mm} = 1.5 \text{ bar}$. Cylinder diameter is 700 mm, stroke is 1650 mm. If it is running at 110 rpm, calculate the indicator power developed. State the assumption made. If the mechanical efficiency is 95%, the transmission losses are 4%. Propeller efficiency is 95%. Determine the thrust power.

- Q.2** a) Explain the difference between two stroke and four stroke engine.
b) Explain and describe the cooling water system of main engine.

- Q.3** a) Explain and describe the working of fresh water generator.
b) Is this water fit for human consumption and boiler use? Comment.

- Q.4** a) Sketch and describe a steering gear system used in large vessels.
b) What action you will take in case of total failure of steering gear.

- Q.5** a) Explain shipboard electrical distribution system.
b) List up various safeties fitted on main switch board.

- Q.6** a) Draw a line sketch of refrigeration cycle.
b) How is refrigerant leak detected in the plant?

Q.7 Sketch an oily water separator suitable for a vessel above 10000 GRT to use to pump E/R bilges with an effluent discharge of 15 ppm.

- Q.8** a) Sketch a simple emergency fire pump.
b) Explain air in the system, dirty oil and insufficient cooling on a hydraulic system.

- Q.9** a) Sketch main engine fuel line system with mixing column.
b) What is the purpose of mixing column.

- Q.10** a) Write at least 10 important checks you will check during E/R watch.
b) What checks and action you will take on 1 hrs notice to E/R on arrival port.

GOVERNMENT OF INDIA

Date: - 9th-Aug-2018

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be draw to support the answer.

Q.1 The daily fuel consumption of the ship at a speed of 16 knots is 48 tonnes. She has taken bunker for voyage of 1200 miles at the above speed and extra fuel for five days. She is to proceed to a port 1300 miles away at a speed of 15.5 knots. Calculate:

- i) Bunker remaining on board at the end of the voyage. (12)
- ii) Time taken in hours to complete the above distance. (13)

Q.2 a) What is the importance of maintaining boiler water to certain standards? (8)

b) How poorly maintained water in the boiler can damage the boiler? (9)

c) Describe any 4 boiler water tests carried out on board ships and indicate typical values for the same. (8)

Q.3 a) Sketch cross section of a centrifugal pump. (8)

b) Why centrifugal pumps are used extensively for cargo pumping? (9)

c) What is a cavitation and why it should be avoided? (8)

Q.4 a) Explain with sketches 4-RAM electro hydraulic steering gear system. (15)

b) State the requirements for emergency control for steering units as per IMO? (10)

Q.5 a) With a schematic sketch show arrangement for electrical distribution system on board ships. (15)

b) What are the safety features normally incorporated in the above system to prevent accidents, total loss of power, fire & explosion? (10)

Q.6 a) Sketch and describe a vapour compression refrigeration system. (8)

b) What are the important properties of a refrigerant? (9)

c) What are the functions of an expansion valve fitted in the system? (8)

Q.7 Sketch and describe a biological sewage treatment plant. (25)

- Q.8** a) Describe the advantages and disadvantages of a hydraulic system used on board. (10)
b) Explain the effect of air, water, dirt and insufficient cooling on the hydraulic system operation. (15)

Q.9 Explain the following:

- a) Why proper lubrication bearings inside the crank case important to prevent crank case explosion? (8)
b) What are the tell-tale signs of an impending crank case explosion? (8)
c) What are the regulatory requirements to prevent crank case explosion related accidents on ships? (9)

- Q.10 a)** With Block diagram explain bridge control system for Main Engine. What are the requirements of bridge control system. (15)
b) What precautions are required to be taken in Engine room during rough weather? (10)

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GOVERNMENT OF INDIA

Date: - 8th-May-2018

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be draw to support the answer.

Q.1 Propeller has pitch of 5.5mtr. When running at 80 RPM, ship speed is 13.20 knots, speed of advance 11.0 knots, propeller efficiency of 70% and delivered power 300kw.

Calculate:

- a) Real Slip. b) Wake fraction c) Thrust power d) Thrust

Q.2 a) Write advantages and disadvantages of water tube boiler and smoke tube boiler.

b) Define the following:-

- 1) Admiralty coefficient 2) Fuel Coefficient 3) Pitch of propeller
4) Percentage apparent slip 5) Percentage real slip

Q.3 a) Sketch and describe a domestic fresh water generator used on board a ship.

b) Enumerate various methods employed to make this water potable.

Q.4 a) Sketch and describe a 4 ram hydraulic steering gear system.

b) Sketch and describe briefly any two of these cards.

Q.5 a) Name the three types of indicator cards taken for main engine on board a ship.

b) Sketch and describe briefly any two of these cards.

Q.6 Describe the refrigeration cycle and the refrigerants used for refrigeration on board ships.

Q.7 a) State the various Piping Systems found on board in Engine room of a ship.

b) Sketch and describe a simple lubricating oil system for a 2 Stroke diesel engine.

Q.8 a) Discuss with a sketch the principle of operation of an Oily Water Separator (OWS).

b) State the factors which can lead to improper functioning of OWS.

Q.9 Write short notes on:

- a) Critical Speed of an Engine b) Propeller Drop c) Superheated Steam
d) Rudder Arrestors e) Hunting Gear

Q.10 a) Describe with sketch a controllable pitch propeller as used on remote control system.

b) What are the functions of thrust shaft in propulsion?



GOVERNMENT OF INDIA
FIRST MATE OF A FOREIGN GOING SHIP PHASE II
FUNCTION: NAVIGATION

Code AW

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1. A ship's speed is increased by 20% above normal for 8 hrs, reduced by 10% below normal for 10 hours and then is maintained at the normal value for the remainder of the day. Calculate the percentage variation in fuel consumption for that day, as compared to the daily consumption at normal speed.

Q.2. a) List out the boiler mountings (10 marks)

b) What are the steps to be carried out for warming up and firing a boiler from a cold condition? How long does it take to raise the steam from cold condition? (15 marks)

Q.3. a) What is osmotic pressure and briefly explain why pressure applied in RO system is very high (10 marks)

b) Sketch and describe a low pressure evaporator. (15 marks)

Q.4. Sketch and describe an electro hydraulic steering gear system. In case of failure of controls between bridge to steering gear room, what action is required to be taken?

Q.5. Sketch and describe any positive displacement pump. What precautionary measures are involved for these kinds of pumps?

Q.6. a) Sketch and describe a domestic refrigeration system used to maintain temperatures in meat, fish and vegetable rooms (15 Marks)

b) Explain the safeties in the domestic refrigeration system (10 Marks)

Q.7. a) Sketch and describe a Oily Water Separator (15 Marks)

b) Enumerate the function of the oil content monitor (10 Marks)

Q.8. a) Compare hydraulic systems over pneumatic systems (10 marks)

b) Describe the operation of hydraulic system used for deck cargo hold hatch cover opening with a simple sketch, incorporating safeties in the system (15 marks)

Q.9. With suitable sketches explain the latest arrangements on stern tube lubricating system and the arrangements for mitigating the oil leakage into sea.

Q.10. What is understood by unmanned machinery spaces? Explain the requirements regarding watch keeping duties in an unmanned machinery space.

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GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

FUNCTION: NAVIGATION (Management Level)

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX. MARKS: 200

NOTES:

1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks, i.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

Q. 1 Area of the Indicator diagram taken off one cylinder of a six cylinders, four stroke engine was 500mm^2 . Length of the diagram is 100mm . The Indicator spring constant is $1\text{mm}=2\text{ bar}$. The diameter of the cylinders is 300 mm , stroke is 620 mm and rotational speed is 10 revs/sec . Calculate the Indicated power of the engine assuming that all cylinders develop equal power.
Ans (1315.2 kW)

Q. 2 a) Sketch and describe a water tube Aux. boiler. How circulation of water takes place in such Boiler. (15 Marks)
b) List important mountings of a boiler, stating their use. (10 Marks)

Q. 3 Enumerate the differences between centrifugal and reciprocation pump. How will you use a centrifugal pump for hold bilges?

Q. 4 Sketch and describe an electro hydraulic steering gear system. What is the function of the hunting gear? What action is required to be taken in case of failure of telemotor system between the wheel house and the steering gear? (25 Marks)

Q. 5 Describe with sketch the navigation light circuit of a ship including indicators, alarms and alternative power supply. (25 Marks)

Q. 6 a) Sketch and describe a typical cargo-hold refrigeration system. (15 Marks)
b) In the refrigeration system for the cargo holds, what is the role of the secondary refrigerant? (5 Marks)
c) Some refrigerant gases (like Freon 12 have been banned, and new types of refrigerant gases are being introduced. What is the main reason for this? (5 Marks)

Q. 7 Sketch and describe chemical sewage treatment plant.

Q. 8 I) Sketch the windlass of a ship.
II) Explain the heaving up and letting go operations.
III) Which part of the system takes the weight of the anchor and cable at sea and at anchorage?

Q. 9 a) Describe the arrangement and operation of a controllable pitch propeller? (15 Marks)
b) List out some of its advantage and disadvantage? (10 Marks)

Q. 10 a) State any ten important things that you will do in engine room when on watch. (15 Marks)
b) What all things will you check/do in E/R on 2 hrs notice till arrival port.



GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

FUNCTION: NAVIGATION (Management Level)

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX. MARKS: 200

NOTES:

1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks. I.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

Q. 1 The daily consumption of a ship at 15 knots is 40 tons. Calculate the speed of the ship if the consumption is reduced to 25 tons per day and the specific consumption at the reduced speed is 18% more than at 15 knots.

Required

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- Q. 2 a) Explain the difference between two stroke and four stroke engine
b) Explain and describe the cooling water system of main engine?

- Q. 3 a) Sketch and describe the working principle of a centrifugal pump.
b) How is such a pump utilized as:
i. Cargo hold bilge pump; and
ii. Emergency fire pump placed above the sea water line.

Q. 4 Compare & contrast the working principle of a 2 stroke diesel engine (Give cycle diagram) with that of a 4 stroke engine (Give cycle diagram).

Q. 5 Explain advantages & disadvantages of Steam, Electric & Hydraulic drives for winches.

- Q. 6 a) Draw and describe a line sketch of refrigeration cycle?
b) Explain properties of refrigerant?
c) Explain working principle of vapour compressed ac system?

- Q. 7 a) Sketch and describe biological sewage treatment plant?
b) Explain regulation for condition and discharging sewage overboard?

- Q. 8 a) State the necessary conditions required prior to the synchronizing of electrical alternators.
b) Sketch and describe the navigation light circuit

- Q. 9 a) Explain Advantages and disadvantages of stabilizers.
b) Draw and Explain how the port and star board side fin stabilizers reduce the rolling of the vessel.

Q. 10 Explain the procedure for taking over watch in manned engine room and various checks required to be carried out during watch?

GOVERNMENT OF INDIA

Date: - May-2017

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 Hours

PASS MARKS: 100

MAX. MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions.
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1 The pitch of a ship's propeller is 6m. At 105 rpm, the apparent slip is 10% and the real ship 24 %. Calculate ship speed and wake fraction.

Q.2 a) Differentiate two stroke engines and four stroke engines. (10 marks)

b) Briefly describe the various applications of screw pumps and reciprocating pumps on board the ship. (15 marks)

Q.3 a) Sketch and describe a gear pump, mentioning their applications. (15 marks)

b) Briefly describe the various applications of screw pumps and reciprocating pumps on board the ship. (10 marks)

Q.4 a) Give an account of SOLAS requirements for steering gear. (10 marks)

b) Sketch and describe a 4 ram steering incorporating the safematic operation. (15 marks)

Q.5 a) Sketch & describe a fuel line system of a main engine with mixing column. (20 marks)

b) State the purpose of mixing column in the system. (05 marks)

Q.6 a) Describe the warming up procedure of a main propulsion steam turbine. (15 marks)

b) Sketch and describe an open feed water system used in boilers. (10 marks)

Q.7 a) What is meant by BOD? (05 marks)

b) Sketch and describe a biological sewage treatment plant (20 marks)

Q.8 Describe with the sketch, the hydraulic system used for windlass on board the ship.

Q.9 a) Describe the differences between fixed pitch propeller and a controllable pitch propeller. (05 marks)

b) Describe the propeller mounting method with a neat sketch. (20 marks)

Q.10 Explain the following with respect to main propulsion engine;

a) Scavenge fire and the ways to mitigate those (15 marks)

b) The purpose of turbocharger and the air cooler (10 marks)



GOVERNMENT OF INDIA
FIRST MATE OF A FOREIGN GOING SHIP PHASE II
FUNCTION: NAVIGATION

Code AY

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX MARKS: 200

Notes:

1. Question No. 1, is compulsory. Attempt any seven from the remaining questions
2. All questions carry equal marks.
3. Whenever applicable sketches should be drawn to support the answer.

Q.1. A Ship of 15000 tonnes displacement has an admiralty coefficient based on shaft power is 420, the mechanical efficiency of the machinery is 83%, shaft losses, 6%, propeller efficiency 65% , At a particular speed the thrust power is 2550KW, Calculate
a) Indicated power b) ship speed c) Effective power if hull efficiency is 98%.

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Q.2 Sketch and describe the working of an oily water separator fitted in the E/R (20 Marks)
State various factors affecting its operation. (05 Marks)

Q.3 Sketch and describe a water tube boiler used for running turbine of cargo pumps. State Advantages of using superheated steam for turbines.

Q.4 a) Mention the methods by which the ship's stability is taken care of against rolling (05 Marks)

b) Sketch and describe

i) Bilge keel ii) anti rolling tanks

(20 Marks)

Q.5 a) Mention the minimum safeties required to be adopted in electrical circuits (05 Marks)

b) Mention the SOLAS regulations regarding emergency source of supply (10 Marks)

c) Describe the fire fighting arrangement for main switch board (10 Marks)

Q.6 Sketch and describe a domestic fresh water generator used on board s ship. Enumerate various methods employed to make this water potable.

Q.7 a) Name the three types of indicator cards taken for a main engine on board a ship (05 Marks)

b) Sketch and describe briefly any two of these cards (20 Marks)

Q.8 Sketch a simple hydraulic system used for anchor windlass and briefly describe the use of oil tank, pumps, control valves, hydraulic motors and filters.

Q.9 Sketch and Describe an electrician distribution system on board a ship. With all safety devices & interlock.

Q.10 List various heavy weather precautions that need to be taken with respect:

a) Main propulsion plant

b) Steering gear



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GOVERNMENT OF INDIA**FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)****FUNCTION: NAVIGATION (Management Level)****PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS****TIME: 3 HOURS****PASS MARKS: 100****MAX. MARKS: 200****NOTES:**

1. Question No. 1 is compulsory Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks. i.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

- ✓ **Q.1** A vessel loads bunkers for a voyage of 4500 miles at 16 knots. The main engine consumes 50 tons per day at this speed, the auxiliary plant requiring 2 tons per day. Just before sailing, the vessel is ordered to proceed on voyage at 14 knots. After 7.5 days of sailing, orders are received to proceed for the rest of the voyage at 16.2 knots. Calculate
- a. The time taken to complete the voyage.
 - b. The bunkers remaining on arrival.
- ✓ **Q.2** a. Sketch an auxiliary boiler and label the important mountings.
b. What is importance of carrying out boiler water treatment. What chemicals are used to maintain the quality of boiler water?
- Q.3** a) Write various type of Rotary Pumps and describe any one of them?
b) Write advantages and disadvantages between Centrifugal and Rotary Pumps?
- Q.4** a) Sketch and describe the four ram steering gear system?
✓ b) Explain the purpose of hunting gear and relief valves in system?
- Q.5** a) Sketch and describe by block diagram the power distribution of main switch board?
✓ b) List up various safeties fitted on main switch board?
- Q.6** a) Draw and explain a reefer system using secondary refrigerant for a large reefer cargo hold.
✓ b) Discuss the properties of refrigerants.
- Q.7** a. Explain the operation of a waste incinerator with the help of a simple block diagram
b. Can the incinerator be used for burning rags, oily rags, plastic and used cooking oil from the galley.
- Q.8** a) Sketch and describe a line diagram of deck hydraulic machinery system?
✓ b) Explain function of accumulator, prime mover, filters fitted on deck hydraulic system?
- Q.9** a) Sketch a Main Engine Structure of a 2 stroke D.Eng. labeling all parts?
✓ b) What are the precautions to be taken for a UMS vessel?
- ✓ **Q.10** a) Write at least 10 important checks you will check during E/R watch?
b) What checks and action you will take on 1 hrs notice to E/R on arrival port?



GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

FUNCTION: NAVIGATION (Management Level)

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX. MARKS: 200

NOTES:

1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks. I.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

Q. 1 The daily consumption of a ship at 15 knots is 40 tons. Calculate the speed of the ship if the consumption is reduced to 25 tons per day and the specific consumption at the reduced speed is 18% more than at 15 knots.
required 5

- Q. 2 a) Explain the difference between two stroke and four stroke engine
b) Explain and describe the cooling water system of main engine?

- Q. 3 a) Sketch and describe the working principle of a centrifugal pump.
b) How is such a pump utilized as:
I. Cargo hold bilge pump; and
II. Emergency fire pump placed above the sea water line.

Q. 4 Compare & contrast the working principle of a 2 stroke diesel engine (Give cycle diagram) with that of a 4 stroke engine (Give cycle diagram).

Q. 5 Explain advantages & disadvantages of Steam, Electric & Hydraulic drives for winches.

- Q. 6 a) Draw and describe a line sketch of refrigeration cycle?
b) Explain properties of refrigerant?
c) Explain working principle of vapour compressed ac system?

- Q. 7 a) Sketch and describe biological sewage treatment plant?
b) Explain regulation for condition and discharging sewage overboard?

- Q. 8 a) State the necessary conditions required prior to the synchronizing of electrical alternators.
b) Sketch and describe the navigation light circuit

- Q. 9 a) Explain Advantages and disadvantages of stabilizers.
b) Draw and Explain how the port and star board side fin stabilizers reduce the rolling of the vessel.

- Q. 10 Explain the procedure for taking over watch in manned engine room and various checks required to be carried out during watch?



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GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

FUNCTION: NAVIGATION (Management Level)

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX. MARKS: 200

NOTES:

1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks. i.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

- Q. 1** The daily fuel consumption of the ship at 15 knots is 40 tonnes. When the vessel is 1100 nautical miles from port it is found that the bunkers are reduced to 115 tonnes. If the ship reaches the port with 20 tonnes of fuel on board, calculate the reduced speed and the time taken in hours to complete the voyage? (25)
- Q. 2** a) Explain briefly why boiler water test are necessary and which tests are carried out. (10)
b) Sketch Cochran boiler. (10)
c) Explain procedure to fire boiler from cold condition (5)
- Q. 3** a) With block diagram explain Reverse Osmosis System of Fresh water generation on board. (15)
b) Sketch and name parts of low pressure evaporator. (10)
- Q. 4** a) With simple sketch explain the working of the stabilizers. (9)
b) Explain the advantages and disadvantages of Rotary Vane steering system? (8)
c) Explain purpose of providing isolating valves and by-pass valves in ram type steering? (8)
- Q. 5** a) Explain shipboard electrical distribution system. (15)
b) Explain the purpose of providing circuit breakers and fuses in electrical distribution system. (10)
- Q. 6** a) What are the desirable properties of a refrigerant? (10)
b) Sketch and describe simple refrigeration system used for domestic refrigeration system. (15)
- Q. 7** a) Sketch and describe typical oily water separator for E/room bilges. (15)
b) Explain the Working of oil content monitor. (10)
- Q. 8** a) Explain purpose of accumulator in hydraulic circuit. (10)
b) Write common failures of hydraulic circuit and remedial measures? (15)

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6/5/16-PM

✓ **Q. 9** a) Describe the procedure for starting and reversing the diesel engine? (15)

b) Why turbine warming up is necessary? How it is carried out? (10)

✓ **Q.10** a) Describe the safe watch keeping arrangements necessary in engine room when carrying dangerous cargo? (15)

b) List the indicators and alarms provided with bridge control of M/E? (10)



GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

FUNCTION: NAVIGATION (Management Level)

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX. MARKS: 200

NOTES:

1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks. i.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

- Q. 1** The area of indicator diagram taken of one cylinder of a Six cylinder, four stroke internal combustion engine is 378sq.mm, the length is 70mm, and the indicator spring scale is 1mm=1.5 bar. The diameter of the cylinder is 250 mm, stroke 300 mm, and rotational speed 360 revolutions per minute. If frictional loss in the engine is 2.5 KW and transmission efficiency is 95%, propeller efficiency is 97% and hull efficiency is 98% find the
- (I) Indicated power of the engine. $35.721 / 214.326$ (25)
 - (II) Delivered power 201.23
 - (III) The thrust power 195.12
 - (IV) Effective power 191.256
- State any assumptions taken in your calculations.
- Q. 2** a) Describe how a Boiler gauge glass is blown through? (10 Marks)
b) State the procedure for raising steam in a boiler 'from cold'. (10 Marks) (15)
c) At what pressure are boiler safety valves set? (5 Marks)
- Q. 3** Why is it necessary to treat the water produced by the distillation plant before using it as drinking water? (10 Marks)
Explain with a sketch a typical potable water treatment system. (15 Marks)
- Q. 4** a) Sketch and Describe a rotary vane steering gear system. What factors decide the number of vanes to be used. (15 Marks) (10)
b) What are advantages and disadvantages of rotary vane steering over ram type. (10 Marks) (5)
- Q. 5** a) Briefly explain Parallel Operations of Generators. (10 Marks)
b) Describe with sketch the arrangement of navigation light circuit with indicators and alarms. (15 Marks) (12)
- Q. 6** a) Sketch and describe a typical domestic refrigeration system on board a ship (20 Marks) (15)
b) How is a refrigerant leakage detected? (5 Marks) (3)
- Q. 7** a) Sketch and describe an oily water separator. (15 Marks)
b) Describe the working principle of oil content monitor (10 Marks) (10)

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- ✓ Q. 8 Describe routine maintenance including lubrication of deck machinery (windlass, mooring winches and cranes). (25 Marks) (12)
- ✗ Q. 9 a) Draw a timing diagram of a 'two stroke diesel engine'
b) Draw a sectional diagram of a large 2 stroke diesel engine showing 10 or more parts and describe them briefly:
- Q. 10 a) Describe the safe watch keeping arrangements necessary in engine room when carrying dangerous cargo? (15 Marks)
b) List the indicators and alarms provided with bridge control of M/E? (10 Marks) (12)



GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

FUNCTION: NAVIGATION (Management Level)

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX. MARKS: 200

NOTES:

1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks, i.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

Q. 1 The pitch angle of a propeller blade measured at radii of 1, 1.5, 2, 2.5 & 3 metres are respectively 42, 32, 26, 22 and 19 degrees.

This propeller turns at 105 rpm and drives the ship at 22 knots.

calculate:

(i) Pitch of propeller

(ii) Apparent slip

What are the interpretations of the result? (25)

Q. 2 a) Describe how the propeller thrust is transmitted to the hull and why such an arrangement fitted as closed to the engine as possible? (15)

b) Why are seals provided in the stern tube? (10)

Q. 3 a) State the various types of Displacement pumps and describe with sketch anyone of them. (15)

b) State the advantages & disadvantages between Centrifugal Pump and Positive displacement Pumps (10)

Q. 4 a) Explain with help of diagram, the working of an electro hydraulic steering gear. (15)

b) How is Emergency steering carried out in case of telemotor failure. (10)

Q. 5 Explain the procedure to be followed for the maintenance of lead acid batteries on board the ship. What precaution to be observed while handling lead acid batteries? (25)

Glitch - PM

- Q. 6** a) Sketch and describe a reefer system using Freon as refrigerant. Explain how temperature of each room is independently maintained. (15)
b) Describe the desirable properties of a refrigerant. (10)

- Q. 7** a) What are the harmful effects of discharging untreated sewage in to the sea. (10)
b) What are important regulations as per MARPOL controlling disposal of sewage from the ships. (15)

- Q. 8** a) Describe the function & dangers of an accumulator in a hydraulic system used on board. (15)
b) What maintenance is required on a hydraulic system for trouble free operation. (10)

- Q. 9** Write Short note on:
a) Causes / Action taken on Crankcase Explosions. (10)
b) Effect of Crash Stop on Engine. (05)
c) How Pre-Heating of Main Engine is Carried Out. (10)

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- Q. 10** Write notes any two of the following:
a) Engine room watch routines
b) Bridge control of main engine
c) Precautions to be taken in Engine room for rough weather

*float
discharge
fuel smell
original cost*
(25)



GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION (Management Level)

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX. MARKS: 200

NOTES:

1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks. i.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

- Q. 1** A vessel left port with 560 t of fuel in the bunker tanks, covering a distance of 5000 nautical miles at a speed of 14 knots, arriving with 80 t ROB. Calculate (a) The reduced speed-it would have to maintain, so as to arrive with same ROB, if the initial fuel quantity was only 510t (b) The daily consumption at this speed. (25)
- Q. 2** What are the steps to be carried out for warming up and firing a boiler from a cold condition? How long does it take to raise steam from 'cold' condition? (25)
- Q. 3** a) Explain the essential components of Bilge & ballast and fire line system. (15)
b) State the differences of a positive displacement pump and Framo pump. (10)
- Q. 4** a) Sketch and describe the Telemotor system and fail safe arrangement in a steering gear. (20)
b) Explain the purpose of Rudder Arrestors. (5)
- Q. 5** a) Sketch & describe a fuel oil line of a Diesel Engine. (15)
b) State the effects of a Crash Stop on a Diesel Engine? Explain how it is carried out. (10)
- Q. 6** a) Sketch and describe a Single Duct Air Conditioning System (20)
b) State the comfortable conditions required for Air-Conditioning towards temperature and Relative Humidity? (5)
- Q. 7** Sketch and describe the construction and operation of a 15 PPM oily water separator. How is its efficiency ensured? (25)
- Q. 8** a) Sketch and describe a Hydraulic Windlass drive system. (20)
b) Describe the purpose of hydraulic accumulator. (5)
- Q. 9** Write short notes on:
a) Scavenge fires explaining how they are caused & action taken in case of a large fire in a slow speed diesel engine. (10)
b) Sequence of events leading to a Crankcase explosion. (10)
c) Explain how batteries maintenance is carried out. (5)
- Q. 10** a) Sketch and describe a Controllable Pitch Propeller as used on a remote control System. (20)
b) What is the function of thrust shaft in propulsion system? (5)



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FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

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NOTES:

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3. Wherever applicable sketches should be drawn in support of the same.

Q.1 In a ship steaming at full speed (Full ahead), the daily consumption of Fuel is 25 tons. When the ship comes down to 'half ahead' on engine, consumption of fuel drops to 12.8 tons per day. Find the ratio of reduced speed to full speed.

Q.2 Write short notes on:

- a) Critical Speed of an Engine
- b) Propeller Drop
- c) Superheated Steam
- d) Rudder Arrestors
- e) Hunting Gear

Q.3 a) List some advantages and disadvantages of a centrifugal pump over a positive displacement pump?
b) Why centrifugal pumps are not considered to be self-priming? Sketch any one priming device.

Q.4 Sketch and describe a Rotary Vane Type Steering gear. State its advantages and disadvantages.

Q.5 a) Sketch and describe an Electrical Distribution system on board a ship. (15)

b) Explain briefly the principle of paralleling two generators. (10)

Q.6 Sketch & describe the ship's air conditioning plant.

Q.7 a) Sketch and Describe a Biological Type Sewage Treatment Plant? (20)

b) State the effluent standards required by local authorities? (5)

cont...page 2

Page ...2

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11/5

11/5

- Q. 8** With respect to Deck Machinery, discuss :
- a) Maintenance on cargo handling equipment (7)
 - b) Maintenance on hatch cover. (6)
 - c) Procedure for heaving and dropping anchor. (6)
 - d) With simple sketch the working of an Air Whistle (6)
- Q. 9** a) Sketch a Main Engine Structure of a 2 Stroke Diesel Engine, labelling all the parts. (15)
- b) State the precautions to be taken for a UMS vessel (10)
- Q.10** Write notes any two of the following:
- a) Engine room watch routines
 - b) Bridge control of main engine
 - c) Precautions to be taken in Engine room for rough weather.



GOVERNMENT OF INDIA

VIKRAM

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FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

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PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

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NOTES:

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3. Wherever applicable sketches should be drawn in support of the same.

Q. 1 a) Define pitch of a propeller. (05)

b) A propeller 6 meter in diameter has a pitch ratio of 0.9, Blade area ratio 0.48 and When turning at 110 rev/min, has a real slip of 25%, and wake fraction of 0.30. If propeller delivers a thrust of 300 kN and the propeller efficiency is 0.65, calculate

(a) Blade area (b) Ship speed (c) Thrust power (d) Shaft power (20)

Q. 2 a) Sketch a boiler water level gauge glass suitable for low pressure boiler. (15)

b) Explain the procedure of blowing through of such a gauge glass. (10)

Q. 3 a) Enumerate the difference between centrifugal and a positive displacement pump. (10)

b) Which pump is suitable for discharging of oil from cargo oil tanks and why.

Draw characteristic curves of this pump. (15)

Q. 4 a) Sketch & Describe a Steering Gear as used in large vessel. (20)

b) What action will you take in case of Telemotor failure of Steering Gear. (05)

Q. 5 a) Sketch & Describe a typical Ship's Electrical Distribution System (15)

b) Briefly explain how maintenance of emergency Batteries are carried out on Board Ship. (10)

Page 2

PAGE 2 of 2
P.M.

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Q. 6 a) Sketch & Describe a typical refrigeration cycle for a Cargo Refrigeration System

(20) (15)

b) How is refrigerant leak detected, in the plant?

(15) (10)

Q. 7 a) Sketch any one type of sewage treatment plant.

b) Sketch and describe oily water separator used for pumping out Engine room bilges.

Q. 8 Explain the following :

a) Advantage and Disadvantages of Hydraulic unit for winches.

(9)

b) Routine maintenance carried out on Windlass and Winches on deck.

(8)

c) Necessity of cooling/heating of Hydraulic oil.

(8)

Q. 9 a) Sketch a Main Engine Structure of a 2 Stroke Diesel Engine, labeling all the Parts & state the Mountings.

(15)

b) State the precautions to be taken for UMS vessel.

(10)

Q. 10 Describe the arrangements necessary to insure a safe engineering watch is maintained at sea.



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FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

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NOTES:

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3. Wherever applicable sketches should be drawn in support of the same.

Q. 1 A ship of 12000 t displacement is 120 m long, 17.5 m beam and floats at a draft of 7.5 m in SW. The propeller has a pitch of 3.52 m and, when running at 100 r.p.m. produces ship's speed of 12 knots. Calculate the apparent slip and real slip. The wake fraction (w) may be found from the expression $W = 0.5 C_b - 0.05$

Q. 2 Sketch a simple fuel oil burner of a large marine boiler. What factors can cause a faulty operation of such a burner.

Q. 3 Sketch a Fresh Water generator on board a ship utilising waste heat from jacket cooling water system of the marine diesel engine. What treatment is required for making it fit for consumption in boiler? Would water produced thus require any treatment to make it potable?

Q. 4 Sketch a Rotary Vane steering gear system. Show how Telemotor receiver, pump link and the steering gear feedback gears are attached. Explain their movements during working.

Q. 5 Write short notes on the following:
a) Use of circuit breaker and fuses
b) Operation of Emergency Compressor
c) Services to be supplied from Emergency Generator

Q. 6 Sketch and explain an accommodation Air Conditioning System used on board a ship. How is humidity of conditioned air maintained by such a system?

Q. 7 Sketch and describe the working of a biological sewage treatment plant. Describe routine maintenance that would be required on such plant.

Q. 8 Where and why automatic constant tension mooring winch is used onboard a ship. Explain working of such equipment with help of a sketch.

Q. 9 With the help of sketch distinguish between various methods of scavenging a diesel engine. What do you mean by scavenging?

Q. 10 Sketch and describe a simple CO₂ total flooding system for machinery space. How is re-entry into Engine Room done after CO₂ flooding?



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3. Wherever applicable sketches should be drawn in support of the same.

- P.S. J.K.*
- Q. 1** A vessel loads bunkers for a voyage of 4500 miles at 16 knots. The main engine consumes 50 tonnes per day at this speed, the auxiliary plant requiring 2 tonnes per day, which is independent of speed. Just before sailing at 1824 hours on 3rd March, the vessel is ordered to proceed on voyage at 14 knots. At 0624 hours on 11th March, orders are received to proceed for the rest of the voyage at 16.2 knots. Calculate:
- a) The estimated time of arrival. (25)
 - b) The bunkers remaining on arrival. (25)
- Q. 2** Sketch and describe dual fire boiler. Show important mountings on the boiler. (25)
- Q. 3** a) Explain briefly various method of FW generation used on board. (10)
b) Sketch Engine room bilge piping system. (10)
c) What is the function of emergency bilge suction and where it is located? (5)
- Q. 4** Sketch and describe 4-Ram steering System showing the feedback arrangement. State the requirements for emergency control of steering? (25)
- Q. 5** a) Explain the purpose and operation of emergency compressor? (13)
b) List the services to be supplied from emergency generator? (12)
- Q. 6** a) Sketch and describe refrigeration system used for cargo holds on board. Explain how different hold temperatures are controlled? (15)
b) Sketch a simple single duct air conditioning system. (10)
- Q. 7** a) Sketch and describe typical oily water separator for E/room bilges. (15)
b) Explain the Working of oil content monitor. (10)
- Q. 8** a) Explain purpose of accumulator in hydraulic circuit. (10)
b) Write common failures of hydraulic circuit and remedial measures? (15)
- Q. 9** a) Describe the procedure for starting and reversing the diesel engine? (15)
b) Why turbine warming up is necessary? How it is carried out? (10)
- Q. 10** a) Describe the safe watch keeping arrangements necessary in engine room when carrying dangerous cargo? (15)
b) List the indicators and alarms provided with bridge control of M/E? (10)



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NOTES:

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2. All questions carry equal marks. i.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

- Q. 1 A Propeller of 5.8 m diameter has a pitch ratio of 0.8 when turning at 110 rpm, the wake fraction is found to be 0.3 and real slip 35%. Calculate:
- a) Ships speed
 - b) Speed of advance
 - c) Apparent slip
- Q. 2
- a) Give reasons for conducting boiler test and treatment.
 - b) List the tests which are done on boiler water on board the ship.
 - c) What are the important mountings on a boiler?
 - d) What are the safety devices fitted on auxiliary boiler?
- Q. 3
- a) Describe with a sketch the working of simple centrifugal Pump.
 - b) Draw a typical ballast system of a ship?
- Q. 4
- a) Explain with a sketch a safematic electro hydraulic steering gear system.
 - b) What is the use following in above:
 - i) Isolating valves
 - ii) Relief valve
 - iii) Low level alarms
- Q. 5
- a) Draw a schematic diagram of ship electrical distribution System.
 - b) Write briefly purpose / application of the following:
 - i) ACB
 - ii) MCCB
 - iii) MCB
 - iv) Fuses
- Q. 6 Sketch & describe the air conditioning plant for the accommodation of a ship.
- Q. 7
- a) Explain with a sketch any one sewage system used on board ship.
 - b) State the regulations for the disposal of sewage.
- Q. 8
- a) Explain the principal of operation of 2 - stroke cycle engine.
 - b) Sketch and explain timing diagram of a 2 - stroke cycle engine.
 - c) Why is such an engine preferred for use as main propulsion engine.
- Q. 9 Briefly describe the duties of a watch keeper of a manned machinery space in engine room.

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FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

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NOTES:

1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks. i.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

Q. 1 The daily fuel consumption of the ship at 15 knots is 40 tonnes. 1100 nautical miles from port it is found that the bunkers are reduced to 115 tonnes. If the ship reaches the port with 20 tonnes of fuel on board, calculate the reduced speed and the time taken in hours to complete the voyage. (25)

Q. 2 a) Explain briefly why boiler water tests are necessary and which tests are carried out. (12)

b) Explain the procedure to fire the boiler from cold condition. Clearly explain why intermittent firing is adopted. (13)

Q. 3 a) With block diagram explain Reverse Osmosis System of F.W. generation on board (15)

b) With simple sketch show the domestic fresh water treatment on board (10)

Q. 4 a) What are the tests carried out on a steering system prior to departure? (10)

b) Sketch and label 4 ram steering system (15)

Q. 5 a) Sketch and describe cargo hold refrigeration system on board. Which cooling media is adopted for it and why? (20)

b) What are the advantages of using double duct system over single duct system in air-conditioning? (5)

Q. 6 a) Sketch and describe oily water separator. (20)

b) Explain important parameters controlled by biological plant for sewage. (5)

Q. 7 a) Explain with a simple sketch basic hydraulic system for any machinery (10)

b) Explain effect of a) Air in oil b) Dirty oil c) Insufficient cooling on hydraulic system (15)

Q. 8 a) With simple illustration explain NPSH for centrifugal pump. Explain its importance (13)

b) Explain warming up procedure for steam turbine (12)

Q. 9 a) Write notes on main engine after two hours notice. (12)

b) Explain how turbo-charger washing is carried out and at what rpm's? (13)

Q. 10 Write notes on any of the two: (25)

a) Scavenge fire.

b) Crank case explosion.

c) Engine room watch keeping routines



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3. Wherever applicable sketches should be drawn in support of the same.

- Q. 1 ✓ The daily consumption of a ship at 17 knots is 42 tons. Calculate the speed of the ship if the consumption is reduced to 28 tons per day and the specific consumption at the reduced speed is 18% more than at 17 knots. (25)
- Q. 2 ✓ a) Describe how a Boiler gauge glass is blown through? (10)
b) State the procedure for raising steam in a Boiler 'from cold'. (10)
c) At what pressure are Boiler safety valves set? (05)
- Q. 3 ✓ With respect of a reciprocating pump what arrangements can be additionally provided to get a relatively uniform flow at the discharge? Draw a pump sketch to explain the same. (25)
- Q. 4 ✓ a) Explain with a sketch a 'safematic' electro hydraulic steering gear system. (15)
b) What is the use of following in above?
i) Isolating valves ii) Relief valve iii) Hunting lever (10)
- Q. 5 a) Describe the operation of a controllable pitch propeller (10)
b) Describe with sketch the arrangement of navigation light circuit with indicators and alarms (15)
- Q. 6 ✓ a) State the properties of a refrigerant. (5)
b) Sketch and describe simple refrigeration cycle for domestic refrigeration and cargo spaces. (20)
- Q. 7 ✓ a) Sketch and describe a simple Incinerator, used on ships (20)
b) What could be the causes of a discolored exhaust from a Main Engine? (5)
- Q. 8 ✓ a) With a simple sketch, describe a simple Hydraulic System for Pumps. (15)
b) Why should air be avoided in the Hydraulic System? (5)
- Q. 9 ✓ With the help of simple sketches show the construction and working principle of a Reaction Turbine. (25)
- Q. 10 ✓ Briefly describe the duties of a watch keeper of a manned machinery space in engine room. (25)



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GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

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NOTES:

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2. All questions carry equal marks. i.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

- Handwritten: JKE 28*
- Q. 1** ✓ The area of an Indicator diagram taken of one cylinder of a 4 cylinder, four Stroke engine is 378 sq mm and length is 70 mm; Indicator spring scale is 1mm = 100 KN/sqm; Diameter of cylinder is 250 mm; Stroke of cylinder 310 mm and rotational speed 6 revs per second. Calculate Indicated power of engine? *38.431* (25)
- Q. 2** a) Define the following: (15)
i) Efficiency of a machine ii) Fuel Coefficient
iii) Specific Fuel Consumption
b) Distinguish between water tube and fire tube boiler? (10)
- Q. 3** ✓ a) Sketch & describe a domestic fresh water treatment plant as used on board ships (20)
b) Why is water passed through a carbon filter? (5)
- Q. 4** ✓ a) Sketch and describe a Rotary Vane Steering Gear of a ship (20)
b) What is the function of a Hunting Gear? (5)
- Q. 5** ✓ a) Sketch a simple Electrical Distribution on board a ship (20)
b) How is parallel operation of generators achieved? (5)
- Q. 6** ✓ a) Sketch and describe a Direct Refrigeration System on board a ship, showing circuits for Veg room, Meat room & Fish room (20)
b) What are the safety devices which protect a Refg plant? (5)
- Q. 7** ✓ Sketch and describe a Biological Sewage treatment plant and explain the reasons why a sewage treatment plant is required?
- Q. 8** a) Sketch and describe a simple Emergency Fire Pump (15)
b) Where are Deep-well Pumps used ? (5)
c) Show with a simple sketch how stripping of a Cargo is achieved (5)
- Q. 9** ✓ a) Sketch and Describe a 4 Stroke Timing diagram of a diesel engine (20)
b) What is a Turning Gear & why is it used? (5)
- Q. 10** a) State the Chief Mates duties during Bunkering operation (20)
b) Why is Bunker Sampling done? (5)



GOVERNMENT OF INDIA

10/JAN/2012 (PM) (4)

FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

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TIME: 3 HOURS

PASS MARKS: 100

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NOTES:

1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks.
3. Wherever applicable sketches should be drawn in support of the same.

- Pg 64 JK
- Q.1 A vessel of 12,000 tons displacement consumes fuel at the rate of 72 tonnes per day at 14 kn, of which 3 tones per day are consumed by the auxiliary plant. Calculate the bunkers required to complete a passage of 2500 miles at 13 kn, allowing for 3 days of reserve at a speed of 15kn.
- Q.2 (a) What is NPSH. Explain its significance with respect to Shipboard applications?
(b) With the help of characteristic curves, explain which type of pump is more suitable for pumping out cargo in oil tankers?
- Q.3 (a) What is crank case explosion?
(b) What are the reasons for the same?
(c) What provision is given for an early warning for its occurrence?
(d) What actions should be taken in case of an alarm of the above device?
- Q.4 (a) Sketch and describe a fresh water generator plant on board using waste heat from the main engine system.
(b) What are the causes for a drop in the production capacity of the plant?
- Q.5 Explain with a sketch an electro hydraulic steering gear system used on a 65,000 GT oil tanker?
- Q.6 a) Sketch and describe an oily water separator.
b) Describe the working principle of oil content monitor.
- Q.7 (a) Describe the arrangement and operation of a controllable pitch propeller?
(b) List out some of its advantage and disadvantages?
- Q.8 (a) Sketch a simple hydraulic system used for anchor windlass and briefly describe the use of oil tank, pump, control valves, hydraulic motors and filters.
(b) What symptoms will be shown if there is ingress of following in hydraulic oil?
(i) Air (ii) Water (iii) Dirt
- Q.9 (a) What are the reasons for conducting boiler water test and treatment?
(b) What impurities may be present in boiler water?
(c) What tests are done to identify boiler water condition?
(d) What chemicals are used to take care of different impurities and improve condition of boiler water?
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GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

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NOTES:

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3. Wherever applicable sketches should be drawn in support of the same.

Q.1 On increasing the speed of a vessel by 1.5 knots it is found that daily consumption of fuel is increased by 25 tonnes and the percentage increase in fuel consumption for a voyage of 2250 nautical miles is 20.

Estimate:

- (a) Original daily fuel consumption
- (b) Original speed of the ship (25)

Q.2 a) Sketch and describe a remote control system suitable for a CPP Propeller. (15)

b) State the advantages and disadvantages of CPP v/s Fixed Pitch Propellers (10)

Q. 3 Write short notes on:

- a) Protection / Precautions against Crankcase Explosions (05)
- b) Use of Indicator Cards (05)
- c) Effects of Crash Stop on Engine (05)
- d) Soot Blowers (05)
- e) Why Pre-heating of Main Engine is carried out. (05)

Q. 4 a) Sketch & describe a Direct expansion unit for Meat, Fish, Vegetable Rooms (15)

b) State the safety devices which protect refrigeration plants (10)

Q. 5 a) Sketch & describe a typical Ship's Electrical Distribution system (15)

b) Briefly explain how paralleling of generators is carried out (10)

Q. 6 a) Sketch & describe a gear pump (20)

b) How is flow rate controlled? (05)

Q.7 a) Explain the difference between Osmosis & Reverse Osmosis (05)

b) Sketch & Describe a Reverse Osmosis plant as used on ships. (20)

Q. 8 a) Sketch and describe a 4 Ram Steering gear system (15)

b) Explain how a vessel will be steered with total loss of hydraulic oil (10)

Q.9 With respect to Marine Boilers:

- a) State all Boiler Mountings (10)
- b) State the tests carried out on boiler water (10)
- c) Purpose of Economiser (05)



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- 25/15/40/16/56/13/69/11/80/1/9
- 25
- Q. 1 The daily fuel consumption of the ship at 15 knots is 40 tonnes. When the vessel is 1100 nautical miles from port it is found that the bunkers are reduced to 115 tonnes. If the ship reaches the port with 20 tonnes of fuel on board, calculate the reduced speed and the time taken in hours to complete the voyage? (25)
- 8 Q. 2 a) Explain briefly why boiler water test are necessary and which tests are carried out. (10) 6
b) Sketch Cochran boiler. (10) 6
c) Explain procedure to fire boiler from cold condition (5) 3
- 10 Q. 3 a) With block diagram explain Reverse Osmosis System of Fresh water generation on board. (15) 9
b) Sketch and name parts of low pressure evaporator. (10) 7
- 7 Q. 4 a) What are the tests carried out on steering gear prior to departure? (10) 6
b) Sketch and describe 4 ram steering system. (15) 7
- Q. 5 a) Explain procedures to maintain batteries. (10) .
b) Explain how electricity is generated by an alternator. (15)
- 7 Q. 6 a) Sketch and describe domestic refrigeration system on board. (15) 11
b) What are the advantages of using double duct system over single duct system in air-conditioning. (10) 0
- 57 Q. 7 a) Sketch and describe oily water separator. (15) 9
b) Explain importance of parameters controlled by biological plant for sewage. (10) 6
- 2 Q. 8 a) Explain with a simple sketch basic hydraulic system for any deck machinery. (9) 3
b) Explain Ram type and rotary vane type actuators. (8)
c) Explain effect of i) Air in oil ii) Dirty oil iii) Insufficient cooling on hydraulic system. (8) 5
- Q. 9 a) Sketch and describe propeller shafting arrangements for transferring propeller thrust to hull. (15)
b) Explain warming up procedure for steam turbine. (10)
- 7 Q. 10 a) Write down main engine preparation after 2 hr. notice (15) 6
b) Explain how turbo-charger washing is carried out and at what rpm? (10)



GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE - II)

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09/8/2012

PAPER: ENGINEERING KNOWLEDGE, INSTRUMENTS & CONTROL SYSTEMS

TIME: 3 HOURS

PASS MARKS: 100

MAX. MARKS: 200

NOTES:

1. Question No. 1 is compulsory. Attempt any SEVEN questions from the remaining.
2. All questions carry equal marks. i.e. 25 marks each
3. Wherever applicable sketches should be drawn in support of the same.

- Handwritten: 1st part*
- Q. 1** Propeller has pitch of 5.5mtr. When running at 80 RPM, ship speed is 13.2 knots, speed of advance 11.0 knots, propeller efficiency of 70% and delivered power 3000kw. Calculate a) Real Slip b) Wake fraction c) Thrust power d) Thrust (25)
- Q. 2** a) Write advantages and disadvantages of water tube boiler and smoke tube boiler. (10)
b) Define the following:-
1) Admiralty coefficient 2) Fuel coefficient 3) Pitch of propeller
4) Percentage apparent slip 5) Percentage real slip. (15)
- Q. 3** a) Why fresh water treatment is necessary? How it is carried out on board the ship? (10)
b) Draw a schematic diagram of reverse osmosis process of producing fresh water. Show the salient pressure at each stage. (15)
- Q. 4** a) With simple sketch explain the working of the stabilizers. (9)
b) Explain the advantages and disadvantages of Rotary Vane steering system? (8)
c) Explain purpose of providing isolating valves and by-pass valves in ram type steering? (8)
- Q. 5** a) Explain shipboard electrical distribution system. (15)
b) Explain the purpose of providing circuit breakers and fuses in electrical distribution system. (10)
- Q. 6** a) What are the desirable properties of a refrigerant? (10)
b) Sketch and describe simple refrigeration system used for domestic refrigeration system. (15)
- Q. 7** a) What is Biological Oxygen Demand for sewage plant? (10)
b) Sketch and describe oily water separator used for pumping out Engine Room bilges. (15)
- Q. 8** Explain the following:
a) Advantages and disadvantages of hydraulic unit for winches. (9)
b) Routine maintenance carried on deck machinery (Windlass, winches, cranes etc) (8)
c) Necessity of cooling/heating of hydraulic oil. (8)
- Q. 9** a) With a simple sketch explain the operating principle for impulse and reaction turbine. (13)
b) Explain with simple sketches scavenging system for large 2-Stroke engines. (12)
- Q.10** Write notes on the following:
a) Scavenge fire b) Crank case explosion (25)



GOVERNMENT OF INDIA

FIRST MATE OF A FOREIGN GOING SHIP (PHASE – II)

FUNCTION: NAVIGATION (Management Level)

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- Handwritten: Xerox gap*
- Q. 1 A ship of 15,000 tonnes displacement has an admiralty coefficient of 420, based on shaft power. The mechanical efficiency is 83%, shaft losses are 6%, propeller efficiency of 60%. At a particular speed thrust power is 2550kw; calculate the indicated power & ships speed. (25)
- Q. 2 Sketch and describe dual fired boiler showing approximate positions of important mountings. (25)
- Q. 3 a) What is osmotic pressure & briefly explain why pressure osmosis applied in R.O system is very high? (7)
b) Sketch & describe low pressure evaporator. (18)
- Q. 4 With a simple sketch explain 4 ram steering system, showing feedback arrangement. (25)
- Q. 5 Sketch & describe secondary refrigeration system used for cargo holds. How temperatures are controlled in individual cargo hold. (25)
- Q. 6 a) Explain characteristics of centrifugal pump with the help of simple sketch. (10)
b) Sketch & describe double-duct air conditioning system. What are its advantages? (15)
- Q. 7 a) What is meant by BOD? (5)
b) Sketch & describe sewage treatment plant. (20)
- Q. 8 a) What is meant by scavenging? Explain briefly various scavenging methods for large 2 stroke engine. (15)
b) How M/E is prepared for manoeuvring, after 2 hours notice? (10)
- Q. 9 a) What are routine maintenance carried out on deck machineries. (8)
b) Explain with simple sketch, basic hydraulic circuit (7)
c) Explain causes of scavenge fire & extinguishing procedures. (10)
- Q. 10 Write notes on any two of the following; (25)
a) SOLAS requirement for steering Gear.
b) Navigation light circuit and its requirements as per SOLAS.
c) Routine battery maintenance.



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- Korone gagan*
- Q.1.** When a ship is 800 nm from port, its speed is reduced by 20% thereby reducing the daily consumption by 42t, and arriving in Port with 50t on board. If the fuel consumption in t/hour is given by the expression $(0.136 + 0.001V^3)$, where V is the speed in knots, estimate: *14.987*
- a) The reduced consumption per day *42.078*
 - b) The amount of fuel on board when speed was reduced *166.971*
 - c) The percentage decrease in consumption for the latter part of voyage and *49.954*
 - d) The percentage increase in time for this latter period. *25%* (25)
- Q.2** (a) State 2 means by which propeller is attached to a propeller shaft. (05)
(b) Describe any one means by which it can be attached or removed. (20)
- Q. 3** With respect to Preparation of Diesel Propulsion plant:
- (a) Describe the procedure 24 Hours prior vessels departure (10)
 - (b) Describe the procedure 2 Hrs before vessels departure (10)
 - (c) On Finished with Engine (05)
- Q. 4** (a) Describe the process of preparing a boiler for survey (12)
- (b) Describe the firing of a boiler to raise steam (13)
- Q.5** (a) Sketch and describe a positive displacement pump. (15)
- (b) Enumerate the differences between a positive displacement pump and a Roto-dynamic pump. (10)
- Q.6** With respect to Air Conditioning Plant:
- (a) Sketch & briefly describe a single duct system (10)
 - (b) Sketch & describe a double duct system (10)
 - (c) State the comfortable room condition parameters of temperature and relative humidity (05)
- Q 7** (a) State the various Piping Systems found on board in Engine room of a ship. (05)
- (b) Sketch and describe a simple lubricating oil system for a 2 Stroke diesel engine. (20)
- Q.8** (a) Discuss with a sketch the principle of operation of an Oily water Separator (20)
- (b) State factors which can lead to improper functioning of OWS (05)
- Q.9** Write short notes on: (25)
- (a) Critical Speed of an Engine
 - (b) Propeller Drop
 - (c) Superheated Steam
 - (d) Rudder Arrestors
 - (e) Hunting Gear



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Xerox gag
Q. 1 Propeller has a pitch of 6 mtr. When running at 90 rpm, ship speed is 15.6 knots and speed of advance is 14.5 knots, propeller efficiency of 70% and delivered power 9000 kw.

Calculate: a) Real slip b) Wake fraction c) Thrust power d) Apparent slip (25)

Q. 2 a) What do you understand by the term NPSH? (10)

b) Elaborate all factors that are taken into account while calculating the NPSH of a pumping system. (15)

Q. 3 a) Sketch and describe a domestic fresh water generator used on board a ship. (20)

b) Enumerate various methods employed to make this water potable. (5)

Q. 4 a) Sketch and describe a 4 ram hydraulic steering gear system. (15)

b) Explain how automatic fail-safe arrangement is achieved in such system. (10)

Q. 5 a) Name the three types of indicator cards taken for main engine on board a ship. (5)

b) Sketch and describe briefly any two of these cards. (20)

Q. 6 Describe the refrigeration cycle and the refrigerants used for refrigeration on board ships. (25)

Q. 7 Draw an oily water separator suitable for use on board a vessel above 10,000 GRT to be used to pump Engine Room bilges with an effluent discharge of 15ppm. (25)

Q. 8 a) Describe the advantages and disadvantages of a hydraulic system used on board. (10)

b) Explain the effect of the following on a hydraulic system.

i) Air in the system ii) Dirty oil iii) Insufficient cooling. (15)

Q. 9 a) Sketch and describe a fuel line system of a main engine with mixing column. (20)

b) State the purpose of mixing column in the system. (5)

Q. 10 a) State any ten important things that you will do in engine room when on watch. (15)

b) What all things will you check/ do on 2 hrs notice to arrival port in E/R. (10)
