Government of the People's Republic of Bangladesh

Department of Shipping

Sample **Written/Oral** Question Bank

Marine Engineer Officer Class 2 and 1 Combined

General Engineering Knowledge

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Table of Contents

1.0 Auxiliary Machinery 3
1.1 Pumps and Systems 3
1.2 Fire Fighting Appliances 5
1.3 Lubricating Oil.....10
1.4 Fuel Oil 12
1.5 Heat Exchangers 14
1.6 Steering Gear, Stabilizers and Hydraulics.....16
1.7 Pollution & Pollution prevention.....21
1.7.1 Bilge & Oily water Separators.....21
1.8 Fridges and Air Conditioning 24
1.9 Shafting, Propellers and Thrusters.....28
1.10 Fresh Water Generator.....34
1.11 Deck machinery 35
2.0 Materials.....36
3.0 Control Engineering.....38
4.0 Maritime Laws & Ship Personnel Management.....43
5.0 Maintain Safety and security of the vessel, crew and passengers 49
6.0 Management of Personnel.....51
7.0 Maintenance & Repair 51
8.0 Detect & Identify the Cause of Machinery Malfunctions & Correct Faults 53

1.0 Auxiliary Machinery

1.1 Pumps and Systems

1.Describe with the aid of a block diagram, a vacuum stripping system for the cargo tanks of a product carrier.(10)

2.State the inspections, instructions and maintenance that should be carried out on main sea water pipelines, strainers and ship's side valves to minimize the risks of engine room flooding.(10)

3.With reference to centrifugal pumps:

a. Describe how each of the following improves pump performance

(i) raising the speed of rotation. (ii) Multi-staging. (4)

b. Explain the advantages of using centrifugal pumps instead of positive displacement pumps for lubricating oil circulating duties.(6)

4.(a) Describe two methods of priming centrifugal pumps.(6)

(b)List the advantages of the priming methods described in (a).(4)

5.With reference to centrifugal pumps

(a)Sketch the pump characteristic curves showing head against power, flow and efficiency.(3)

(b)Define NPSH.(1)

(c)Describe pump cavitation, explaining how it affects the pump.(6)

6.With reference to chemical tankers:

(a) Sketch a cargo pumping and stripping system, labelling the component parts and indicating the direction of fluid flow. (6)

(b)State the requirements of the regulations evolved to reduce pollution of the sea by chemical tanker cargoes. (4)

7.(a) Sketch an oil tanker pumping and stripping system labelling component parts and indicating direction of liquid flow. (6)
(b) Describe the operation of the cargo and stripping system in (a).(4)

8.With reference to centrifugal pumping systems describe a means that will enhance the system performance for each of the following:

a) Large discharge heads (2)
b) Large volume flow (2)
c) Large suction lift (2)
d) Cavitation (2)
e) Reduced energy consumption (2)

9. With reference to an electrically driven centrifugal sea water pump:

a) Gives four reasons why output may fall off (4)
b) State causes for pump vibration (3)
c) Describe a test to prove the pump capacity (3)

10. What is suction and discharge cavitations? Write down the symptoms, causes and remedial action against cavitation. (10)

11.a) The vertical shaft of a centrifugal sea water pump has become worn in way of the packed gland to such an extent that sealing is becoming difficult.

i) explain the factors which may have contributed to the excessive wear. (4)
ii) state one possible method of refurnishing the shaft (2)

b) Sketch a flexible packing unit suitable for a sea water pump and explain how it works. (4)

12. With reference to diesel engine driven emergency fire pumps:

a) define their limitations as regards suction lift, output and jet throw (4)
b) explain how and why they are isolated from the main fire pump. (3)
c) state how such pumps are primed. (2)

d) define the conditions under which such units would be used. (1)

13. (a) Sketch a self-contained totally submerged pump for emptying tanks of hazardous liquid chemical cargo.
(b) Explain why this pump is used for such service.
(c) Identify the safety features incorporated in the pump design.

14. State the inspections, instructions and maintenance that should be carried out on main sea water pipelines, strainers and ship's side valves to minimise the risks of engine room flooding. (10)

15. (a) State the affinity laws for a centrifugal pump. (3)
(b) State the effects on the pump affinity laws of fitting a slightly smaller diameter impeller. (2)
(c) Explain, with the aid of a Head versus Flow diagram, why a two speed pump is preferable to throttling where high and low capacities are demanded for a large sea water circulating pump. (5)

1.2 Fire Fighting Appliances

1.The company with which you are employed requests that all Chief Engineer Officers prepare standing orders regarding the prevention and detection of fires in the machinery spaces. Compile such a list of orders to be submitted to central office. (10)

2.With reference to inert gas provided for firefighting purposes:
(a) Describe with the aid of a sketch a system for the detection and extinguishment of hold fires.(7)
(b)Explain the criteria that determines the amount of gas to be released into a hold and how this is estimated.(3)

3.(Plan a route) As C/E How you prepare your ship for a Cargo ship Safety Equipment Survey(enable a surveyor to conduct a Safety Equipment Survey in an efficient manner, stating briefly the equipment inspected in such a survey(10).

4.a)Describe with the aid of a sketch, a bulk CO2 firefighting system for smothering machinery spaces in the event of a fire. (6)
b) State the regulations that control capacity, quantity and duration of discharge. (2)
c) compare advantages and limitations with that of a battery cylinders installation. (2)

5.With reference to fixed installations for dealing with a machinery space fire
(a)Sketch a CO2 bottled system. (5)
(b)Explain how the system sketched is protected from overpressure. (2)
(c)State the periodic maintenance that is required. (3)

6.Describe with the aid of a sketch, a Hi Fog water spray fire-fighting system capable of automatically extinguishing a machinery space fire. (10)

7.Describe a procedure for testing the operation of the machinery space CO2 smothering system.(10)

8.(a)Explain with the aid of a sketch, a method to combat fires that may occur on the non-enclosed decks of a vehicle ferry. (6)
(b)State TWO advantages and TWO disadvantages of the method described in (a).(4)

9.(a)Describe, with the aid of a sketch, a high expansion foam system. (6)
(b)State TWO advantages and TWO disadvantages of high expansion foam.(4)

10.(a)Describe with the aid of a sketch, EACH of the following types of fire detector; (3X2)
(i) Ionisation
(ii) Infra-red.

(b)Explain why reliance cannot be placed on a single type of fire detector (4)

11.A machinery space fire has been extinguished and the vessel is now proceeding on voyage. As the Chief Engineer Officer of the vessel, write a letter to the company's Superintendent Engineer concerning the circumstances attending the fire.(10)

12.Describe with the aid of a sketch, a fixed foam firefighting system that employs foam making equipment. (10)

13.Concerning the CO2 Total flooding fixed firefighting installation:
a. In the event of a fire in the engine compartment what checks would be made before operating the system?(3)
b. After the system has been discharged how soon could re-entry be attempted?(3)
c. Describe the procedure that would be adopted to ensure safe reoccupation of the compartment.(2)
d. What subsequent routines would be initiated? (2)

14.a) Briefly describe SCBA .(5)
b) Describe the procedure that you will use in the event of fire, to find a missing person in a smoke-filled accommodation area.(3)
c) How will you instruct the search party?(2)

15. with referee to SCBA, give the instruction to the person who is searching party.
a) How you will check for the SCBA before entry.(5)
b) Enclosed space fire and what is your action? (5)

16.(a) As a 2/E with a few months, which points must be checked for CO2 fixed installation.(4)
(b) Portable fire extinguisher.(3)
(c) Other firefighting equipment.(3)

17.Assuming that a series of fire has started on top of a diesel generator,

a) Comment on what are the likely causes of the fire.(3)

b) The steps you would take in some order of priority.(3)

c) What will be almost certainly, the immediate consequence of this type of fire?(4)

18. Innumerable the maintenance jobs carried out for a fixed fire fighting installation on board a ship. What special test a surveyor May ask during the special survey for above installation.(10)

19.a) With respect to FFA items Which certificates A PSC officer May ask to produce
b)During PCS inspection it is discovered that some of the Fixed CO2 bottlers found empty. What course of action you Will take as a C/E in Such a situation.
c) What could be legal consequence of taking out ship in Such a condition.

20. When a vessel is in drydock, the possible risk of fire in the machinery spaces are heightened due to the nature of the work being carried out. As a chief engineer compile a set of standing orders instructing the ship's staff on the actions to be taken should a serious fire occur. (10)

21. In shipboard fire detection system state:

a) The problems in positioning sensor heads in engine room. (3)
b) How tests are carried out on the different types of sensor heads. (5)
c) Why a mixture of sensor types are preferable in the engine room. (2)

22. With reference to entry of personnel into enclosed spaces

a) State what minimum oxygen content in the atmosphere within a space could be considered safe. (2)
b) Explain, with the aid of a sketch, the operation of an oxygen meter suitable for checking the atmosphere within an enclosed space. (4)
c) Explain the procedures to check the accuracy of the meter. (2)

d) Explain why indication of satisfactory oxygen content does not necessarily mean that it is safe to enter a space. (2)

23. Accidents have occurred due to premature or accidental release of CO2 into the machinery spaces.

(a) State the safety procedure that the Chief Engineer Officer should adopt with respect to maintenance being carried out on the system by contractors. (3)

(b) State the procedure prior to the safe release of CO2 into the machinery space in the event of fire. (4)

(c) Describe the factors that should be considered prior to re-entry of the machinery spaces after the release of CO2 gas. (3)

24. With reference to fresh water HI-FOG fire fighting systems:

(a) sketch such a system; (6)

(b) state how the system in (a) is activated; (2)

(c) state, with a reason, a suitable location for the above system. (2)

25. The company, with which you are employed, requests that all Chief Engineer Officers prepare standing orders regarding the prevention and detection of fires in the machinery spaces. Compile such a list of recommendations to be submitted to central office. (10)

26. Following a serious machinery space fire, the engine room was abandoned and an inert gas smothering agent used to extinguish the fire.

Write a report to the Superintendent Engineer detailing the sequence of events which led to this course of action and the subsequent actions taken to enable the vessel to proceed on passage. Include conclusions and recommendations in the report. (10)

27. As Chief Engineer Officer, describe the examinations that were carried out during a safety equipment survey with regard to fire safety. (10)

28. With reference to fixed C02 smothering systems for ships machinery spaces:
(a) State the safety procedure that the Chief Engineer Officer should adopt with respect to maintenance being carried out on the system by contractors whilst the vessel is in port.
(b) State the procedure prior to the safe release of C02 into the machinery space in the event of a fire.(3)
(c) Describe the factors that should be considered prior to re-entry of the machinery spaces after the release of CO2 gas. (3)

29. With reference to CO2 gas provided for fire fighting purposes:
(a) describe, with the aid of a sketch, a system for the detection and extinguishment of hold fires; (7)
(b) state how the amount of gas to be released into the hold space is estimated. (3)

30. Accidents have occurred due to premature or accidental release of CO, into the machinery spaces.
(a) State the safety procedures that the Chief Engineer Officer should adopt with respect to maintenance being carried out on the system by shore contractors. (3)
(b) Explain why the Chief Engineer and ships staff should still have to check on work carried out by shore contractors.
(c) State how the liquid levels in the C02 bottles may be checked in situ and how often this test should be carried out. (2)
(d) Explain why ship's general service air should not be used for blowing through and testing C02 operating lines and suggest a suitable alternative. (3)

1.3 Lubricating Oil

1. Describe, with the aid of a sketch, the operation of a self-cleaning purifier for the treatment of lubricating oil, explaining the automatic de-sludge control cycle. (10)

2. A lubricating oil centrifuge runs smoothly at rated speed with a clean bowl and correctly fitted dam ring

(a) List with reasons, the factors that may mal adjust the interface.(5)

(b)Describe with the aid of a sketch the correct operating position of the interface and how the dam ring achieves this. (5)

3.(a)State SIX properties that may be tested in used lubricating oil. (6)

(b) Name the possible deterioration in FOUR of the properties tested in (a). (4)

4.The necessity has arisen for the complete replacement of the main engine lubricating oil. As Chief Engineer write a report to head office justifying this heavy expenditure, explaining the temporary steps to avoid further trouble on the voyage and suggesting permanent measures to avoid repetition. (10)

5. (a)What is Hydrodynamic lubrication? How Such lubrication is achieved.(5)

(b)why slow speed Injection not used for long period.(5)

6.(a) What is Flash lubrication& where it is employed.(5)

(b)Write down the properties of cylinder lubrication oil.(5)

7. With reference to micro bacterial infestation:

a) List the E/R systems that may be affected by this type of contamination. (2)

b) Explain the condition required for bacteria to evolve. (3)

c) Describe how the presence of microbial contamination can be detected. (2)

d) Describe the action to be taken after microbial contamination is detected. (3)

8. a) State three operational circumstances that may enable water to enter LO system.(2)

b) Describe two tests that may be carried out to determine the presence of water.(4)

c) Describe a quantative test to ascertain the degree of water in lubricating oil. (2)

d) State three methods of extracting water contained in lubricating oil. (2)

9. As Chief Engineer Officer write a report to the company superintendent engineer concerning bacterial attack of lubricating oil in the sumps of the main engine and one of the generator engines. The report should explain how the attack was detected, damage found in the engines, investigations into the possible cause of the attack, how the immediate problem was resolved and how future incidents may be prevented. (10)

1.4 Fuel Oil

1. With reference to the pour point of fuel oil:
(a) Define the term pour point. (2)
(b) Explain how the pour point of a fuel oil may be estimated onboard using simple testing equipment. (4)
(c) Explain the consequence of bunkering a fuel with a pour point of 35ºC.(4)

2.(a)Describe a procedure to be observed when taking bunkers. (7)
(b)State the effect if EACH of the following in a fuel oil: (3)
(i) High density; (ii) High pour point; (iii) High water content.

3.(a) Sketch a block diagram showing how fuel viscosity is controlled. (5)
(b) Describe the operation of the system sketched in (a). (5)

4. Following bunkering operations, it is discovered that the vessel received a quantity which was short of what was stipulated in the pre-delivery document. As Chief Engineer write a Letter of Protest to the Master of the bunkering vessel. (10)

5.With reference to fuel oil:
(a) Describe, with the aid of a sketch, an apparatus for determining the flash

point; (4)
(b) State why the closed flash point is specified rather than an open flash point. (2)
(c) State the health hazards of fuel oil testing. (4)

6. (a)List FIVE on board tests that may be carried out on fuel oil intended for bunkers. (5)
(b) Describe the tests listed in (a).(5)

7.(a)Why viscosity is so important for Ships Engines? How desired viscosity is attained?(5)
(b) Innumerate the possible detrimental consequences on engine component and beyond.(5)

8.(a) Describe a safe H.O bunkering operation for a Ship (7).
(b) Why bunker samples are so important to ships (3)

9.(a)What is flash point? Why flash point is considered so important for E/R bunker fuel.(5)
(b) For which engines comparatively low flash point fuel is allowed in $ not mal E/Rand why? (5)

10. Write short notes on the following (10)
a) Flammability b)Flash point c)pour point d) Fire point

11.Why low sulfur fuel is increasingly gaining popularity? Write down the consequences of using high sulfur fuel in ships.(10)

12. With reference to taking of bunkers:
a) State the safety precautions that should be observed when bunkering (3)
b) Explain the importance of taking samples when bunkering (2)
c) Describe a preferred method of taking bunker samples. (1)

d) State the effect of each of the following in a bunker fuel oil (3)

I. High density

II. High pour point

III. High water contaminant

13. Following bunkering operations, it is discovered that the vessel received a quantity which was short of what was stipulated in the pre-delivery document.
As Chief Engineer Officer, write a Note of Protest to the Master of the bunkering vessel. (10)

14. During bunkering operations, a section of deck bunker line starts leaking fuel oil from a pinhole at the mid section of the pipe.
(a) As Chief Engineer Officer, state the immediate actions to be taken to avoid a potential pollution incident; (4)
(b) Explain how a permanent repair could be made, stating any precautions to be taken and any further inspections that would be required. (6)

1.5 Heat Exchangers

1. Describe the principle of operation of EACH of the following heat exchanger types, stating a suitable application for each type
(a) Parallel flow (3)
(b) Contra flow (3)
(c) Mixed flow (4)

2.(a) Sketch an engine room fresh water central cooling system, indicating the water temperature at salient points. (6)
(b) State with reasons four advantages of the system compared with one which is totally sea water cooled. (4)

3. Explain the design factors that contribute to the effectiveness of a multi-tube heat exchanger. (10)

4.(a) Sketch a longitudinal cross section of a tubular heat exchanger detailing the fixtures and expansions of the tube nest arrangement. (4)
(b) List the materials used in the construction of a tubular heat exchanger, stating the reasons why these materials are used. (3)
(c) Explain three methods used for tube protection of heat exchangers. (3)

5. With reference to hear exchanger: (4 X 2.5)
(a) Sketch and describe of a multi tubular at exchanger
(b) Sketch a cooler showing how differential expansions are accommodates
(c) U tube is used as heater and not as heat exchanger
(d) What are the preventive measures to impingement attack?

6. with reference to multi tubular oil coolers describe: (4 X 2.5)
(a) Indications of tube leakages
(b) How a leak can be detected if the cooling media is seawater
(c) Explain how you would go about finding the cause of the leak
(d) If the leak was the tube plate expansion explain how you would rectify this fault
(e) If the leak was due to the localized but deep pitting of a tube what other factors would you need to check

7.(a)Sketch and describe a plate type heat exchanger. (8)
(b)State two advantages and two did advantages of such exchanger mentioned in (a)

8. With reference to the sea water side of a heat exchanger and associated pipeline arrangement:

a) List four materials used and state type of deterioration likely to occur in each (4)
b) Describe how corrosion is reduced (3)
c) Explain how erosion in minimized. (3)

9. With reference to multi tubular oil coolers, describe:

a) indications of tube leakage (2)

b) reasons for tube failure (2)

c) steps to locate a leak (2)

d) temporary corrective steps to stop leakage (2)

e) permanent corrective steps to stop leakage.(2)

10. a) Describe how the arrangement whereby a sea water circulatory system is subjected to an impressed electrical current. (6)

b) Explain the purpose of this arrangement and why it has a tendency to increase maintenance. (2)

c) State how in such a system the valves and coolers are protected. (2)

11. (a) Sketch an engine room fresh water central cooling system, indicating the water temperatures at salient points on the system. (6)

(b) State, with reasons, FOUR advantages of the system sketched in part (a) compared to one which is totally sea water cooled. (4)

1.6 Steering Gear, Stabilizers and Hydraulics

1.With reference to fin stabilizers:

(a) Sketch a block diagram showing an automatic control system. (4)

(b) Describe the operation of the system sketched in (a).(4)

(c) Explain how the stabilizing fin forces are generated.(2)

2.(a) Sketch a line diagram showing the layout and components of an hydraulic system with a variable delivery, pressure compensated pump and accumulator suitable for the operation of deck machinery. (5)

(b) Describe the operation of the system sketched in (a). (5)

3. With reference to electro-hydraulic deck cargo cranes:
(a) State FOUR reasons for tripping out on high oil temperature. (4)
(b) State with reason the safety devices or limit switches that are fitted with respect to hoisting, luffing and slewing. (6)

4. As Chief Engineer Officer appointed to a newly acquired older vessel, compile a list of all the checks that would be required of the ships' steering gear and associated equipment, given that no handover from the previous owners had taken place. (10)

5. Sketch a hydraulic circuit for a four ram steering gear that allows FIVE combinations to be used, identifying EACH ram and valve combination. (10)

6.(a) Sketch the hydraulic circuit for a ram type steering gear that complies with the single failure concept and automatic isolation.(6)
(b) Describe how automatic isolation for the hydraulic circuit sketched in (a) is achieved within 45 seconds should leakage of system oil occur. (4)

7.With reference to hydraulic powered deck machinery systems using constant speed, constant delivery, positive displacement, unidirectional pumps:
a. State four types of pump design; (6)
b. Describe how the flow rate is varied; (2)
c. Describe how direction of flow may be reversed.(2)

8.With reference to steering gear, explain each of the following:
(a) Why rudder movement is restricted; (2)
(b) Why telemotor receivers are spring loaded; (2)
(c) Why spring links are incorporated between pump and rudder; (2)
(d) Why hunting gear is provided; (2)
(e)How the st-by pump is prevented from motoring. (2)

9. With reference to steering gear:

(a) Sketch a rotary vane steering gear.(3)

(b) Describe how it operates.(3)

(c) Give one reason why more than four chambers are rarely used.(4)

10. With reference to steering gears:

(a)Sketch a constant speed unidirectional, variable stroke axial type, rotary positive pump for hydraulic power applications.(5)

(b) Explain how it meets an infinitely variable demand in both directions.(4)

(c)Give one important advantage it possesses over its radial stroke counterpart.(1)

11. With reference to steering gears:

(a) Draw a line diagram of the hydraulic system four a ram steering gear, labeling the principal items.(4)

(b) Describe how the cushioning and relief arrangements functions.(3)

(c) State with reasons how piston and cylinder wear in the pump effect the action,(3)

12. (a)Compare the difference between a ‘Follow-up’ and a ‘Non Follow-up’ Steering gear system.(5)

(b)Explain the Working of a non ‘Follow-up’ system. Which uses a fixed delivery pump, with the help of a simple labeled line diagram?(5)

13.Suggest with reasons the most likely causes of the trouble if temperature of the Oil in a Steering gear System rises to a pronounced degree under the following simultaneous Prevailing conditions: (4X2.5)

1.Pumps running at correct speed

2.Shock and relief Valves tightly shut

3.Ammeter reading Normal

4.No air in system.

14.Describe the single failure sequence for four ram type steering gear? Or How a four ram gear can be operated on two rams only.(10)

15.What are the possible causes of sluggish operation/Movement of steering gear? or What is the possible reason for rudder taking longer time than required to archive a certain angle? Give some possible remedial action.(10)

16.a) With reference to steering gear explain each of the following: (4)

1. Follow up steering
2. Non follow up steering

b) Explain why steering gear is tested under load at sea from 35 degree one side to 30 degree on the other. State when test is carried out and the reason for this test. (2)

c) Explain why electro hydraulic systems are preferred to all electric systems. (2)

d) Explain why hydraulic locking is preferable to mechanical locking of the rudder (2)

17. With reference to the 1978 SOLAS protocol which outlines the requirements for steering gear tests and drills:

a) Describe the test procedure to be carried out within 12 hours before departure.(4)
b) Describe the emergency steering drills that should take place at least once every three months. (4)
c) State how often the test described in Q(a) should be carried out for ships which regularly engage on voyage of short duration. (2)

18. With reference to ram steering gears, explain:

i) the purpose of the Rapson slide. (4)
ii) why the minimum number of rams is two. (1)
iii) how a four-ram gear can be operated on two rams only. (2)
iv) what precautions are to be observed under conditions in (iii)? (3)

19. With reference to hydraulic steering gears explain why:

i) relief valves are provided as well as shock valves. (4)

ii) the pump is of constant speed, variable stroke. (4)

iii) the ram glands are fitted with soft moulded packing. (2)

20. As Chief Engineer Officer appointed to a newly acquired older vessel, compile a list of all the checks that would be required of the ship's steering gear and associated equipment, given that no hand over from the previous owners had taken place.

21. With reference to a ram type steering gear, explain how it may be determined that defective steering may be due to EACH of the following, stating the actions that should be taken to maintain steering capability:

(a) a twisted rudder stock; (5)

(b) worn pump internals; (3)

(c) air in the system. (2)

22. The steering gear operation of a vessel that recently experienced a heavy storm is found to be abnormally sluggish.

(a) State FIVE reasons for possible malfunction of the gear. (5)

(b) State the corrective actions that may be carried out at sea, that will allow the vessel to continue to the nearest port. (5)

23.With reference to activated fin stabilisers, explain EACH of the following:

(a) why such units are preferred to passive tanks in large vessels; (3)

(b) why these units are preferred for passenger and fast cargo ships; (3)

(c) why partial, rather than maximum damping of ship movement in heavy weather, is advisable for reasons other than overstressing the fin stocks and activating gear. (4)

1.7 Pollution & Pollution prevention

1.7.1 Bilge & Oily water Separators

1.List the instructions for the operation, maintenance and monitoring of a bilge water processing unit to ensure compliance with the current MARPOL convention on the discharge of oily bilge water. (10)

2.Describe with the aid of a sketch the operation of a static Oily Water Separator which conforms to current MARPOL regulations and utilizes a pump on the discharge side of the separator. (10)

3.(a) Sketch an oily water separator capable of reducing the oil content of its discharge to less than 15ppm. (5)
(b) Describe the operation of the separator sketched in (a) stating how its efficiency can be affected by the use of detergents. (5)

4.Write reference to oil monitoring of bilge and tanker ballast discharges:
(a) Describe with the aid of a sketch, the general arrangement of an oil monitoring system; (6)
(b) State the inputs that are recorded; (2)
(c) Explain the difficulties encountered with the efficient operation of the oil monitoring system. (2)

5. (a) Describe a vacuum type sewage system. (5)
(b) List the advantages of such system. (3)
(c) Explain why untreated sewage should not be allowed to stagnate. (2)

6.(a)Describe the principle of operation of a biological sewage treatment plant.(4)
(b) Explain how anaerobic conditions may occur within a sewage treatment plant, stating the hazards that may be encountered. (4)

(c) Explain the meaning and significance of the term biological oxygen demand.(2)
(d) Explain why, on a long sea passage, it is inadvisable to bypass the unit.

7.(a) Sketch an aerobic system for the treatment of raw sewage. (4)
(b) Explain the operation of the system sketched. (4)
(c) Explain TWO situations that can occur in an aerobic sewage treatment plant that may induce the system to revert to an anaerobic system. (2)

8. With reference to an exhaust gas cleaning system,
(a) Define the term open loop system and close loop system. (2)
(b) How the above systems ensure the compliance of Sox emissions from the vessel? (4)
(b) Enumerate the emission limits and wash water discharge criteria. (4)

9. (a) Sketch and describe an exhaust gas cleaning system. (7)
(b) List the regular maintenance and record keeping to be carried out on the above system. (3)

10. With reference to oil water separators state
(a) Why in the separation of oil and water, static means are used for bilge and ballast water and dynamic means for lubricating oil and fuel.(4)
(b) How oil density and mixture temperature affect separation. (3)
(c) How and why maximum throughput of bilge or ballast water is restricted.(3)

11. (a) Explain why the supply p/p should be matched to its associated static oily water separator and be of the positive rotary Displacement type
(b)state how complicity of compartment subdivision is static O.W.S contributes to factor effectiveness in operation
(c) Give two reasons why air relief valves are frequently mounted on separator shell

12.With reference to oily water separators, Explain why:
(a)Internal baffles are commonly fitted.(3)
(b)Coalescers are provided in the second stage. (3)
(c)Rotary positive displacement pumps are preferably to centrifugal pumps for supply purposes.(4)

13.With reference to oil content monitoring and control system:
(a) Explain with the aid of a sketch the principle of operation of oil content monitoring equipment, which can be found fitted to engine room bilge discharge line.(10)

14. With reference to static oily water separators, Explain clearly: Why
(a) Syphon breakers are provided (3)
(b)Certain practice taken during starting up and shutting down may lead to oil carry over with the water.(3)
(c)Equal importance should also be placed on external physical factor to minimize the chances of oil carry over with water.(4)

15. Describe the operating procedure of an OWS? (10)

16.With reference to sewage treatment plant describe: (5X2)
(a) What is BOD?
(b) What is coliform count?
(c) What is suspended solids
(d) Capacity regulation for sewage treatment?
(e) IMO regulation for sewage treatment?

17. (a)What is a convention?, What is the Difference convention and law.
(b) Name the Pollution conventions of IMO.

18.What are the annexes of MARPOL 73/78 convention. Describe each annex briefly (10)

19. Describe a fixed firefighting installation suitable for CHEMICAL TANKERS

20. Fighting Chemical tanker fire in cargo area hold what dangers one can anticipate and how one can overcome that dangers.(10)

1.8 Fridges and Air Conditioning

1.(a) Describe with the aid of a sketch a twin duct air conditioning system.(6)
(b)Outline a maintenance procedure to prevent the contamination of an air conditioning system by Legionella bacteria. (3)
(c) State ONE advantage of the system sketched in (a).(1)

2. With reference to ships air conditioning plant:
(a) Define the term comfort zone; (2)
(b)State the objective of maintaining the conditioned air within the comfort zone; (3)
(c) State with reasons, FIVE areas from which conditioned air must not be recirculated. (5)

3. With reference to refrigeration systems define EACH of the following terms (10)
(a) Latent heat(enthalpy)
(b) Vapor pressure
(c) Saturation
(d) Superheat
(e) Sub cooling
(f) Zeotropic blend
(g) Azeotropic blend
(h)Temperature glide

4. With reference to ship's air conditioning systems;
(a) Explain the conditions that will permit bacteria to proliferate; (3)

(b) Explain TWO means by which micro-organisms may enter the human body from a contaminated system; (2)
(c) Describe a cleansing regime that will minimize the risk of bacterial contamination.(5)

5.(a) Sketch a fully automated air conditioning system for accommodation spaces, annotating the relevant temperatures and relative humidifies throughout the system.(7)
(b) Describe how harmful bacteria is eliminated from an air conditioning system. (3)

6. (a) With reference to vapor compression refrigeration plant explain why each of the following conditions are desirable: (2 X3)
(i) Superheating at the compressor suction;
(ii) Undercooling at the condenser outlet.
(b) Describe with the aid of a Pressure-Enthalpy diagram, how the evaporator cooling load is affected by the conditions stated in (a). (4)

7. (a) With reference to air conditioning, state the effects of each of the following faults: (3 X 2)
(i) Corroded return air trunkings;
(ii) Blocked evaporator drains;
(iii) Defective capacity control.
(b) State the main health danger that may arise in an air conditioning plant and the measures that should be taken to prevent in occurring. (4)

8.With reference to the lubrication of refrigeration compressors:
(a) State how flocculation of lubricating oil is prevented; (2)
(b)Explain why oil may be carried over from the compressor; (2)
(c) Describe with the aid of a sketch, a device which returns oil from the comppressor discharge to the compressor sump.(6)

9.Describe five faults that occur in a correctly charged domestic refrigeration unit, stating the indications of each fault and how it may be remedied. (10)

10. With reference to the lubrication of a reciprocating Freon refrigeration compressor:
(a) State with reasons, the characteristics required by the lubricating oil; (4)
(b) Discuss each of the following with respect to cause and remedy: (3 X 2)
(i) Copper plating;
(ii) Freon cloud point;
(iii) Freon floc point.

10.(a) Sketch a twin duct air conditioning system, labelling the component parts ad indicating the direction of air flow. (5)
(b) Explain the advantages of the twin duct system over other systems. (2)
(c) Describe the measures that should be carried out to nullify the risk of legionella bacteria in an air conditioning system. (3)

11. (a) Sketch a diagrammatic arrangement pf a fully automatic direct expansion refrigeration system which supplies a number of cold compartments. (5)
(b)Describe the operation of the system sketched in (a). (5)

12. State with reasons why the following actions might be advisable if the temperature of the ship's cold lockers rises steadily although the compressor runs continuously:
(a) Defrost the evaporator. (2)
(b) Top up" with refrigerant. (2)
(c) Clean both side of the condenser. (2)
(d) Overhaul compressor. (2)

13. With reference to a refrigerating system state:-
(a) What may happen when oil is carried over to the evaporator?(2)
(b) How air may be removed from the system. (2)
(c) The symptoms of overcharged. (2)
(d) The effect of ice on evaporator coil. (2)
(e) The meaning of "Short cycling". (2)

14. With reference to a refrigerating system:-

(a) Describe with the help of a sketch, the working principle of a there mosaic expansion valve (TEV) (5)

(b) What are the problems that could be encounter if the expansion valve selected for the system us undersized and oversized respectively.(5)

15.With the reference to refrigeration -

(a) State the reason why the following properties make it attractive and desirable to be used as a refrigerant – (5)

(I) High specific enthalpy

(ii) Low condensing “P”

(b) Explain with an aid of diagram how the throughput of a refrigerant for a reciprocating type compressor is controlled. (5)

16. With reference to onboard refrigeration unit, state why:

a) Excessive opening of the expansion valve can result in severe icing at the suction side of the compressor. (3)
b) Regular cleaning the sea water side of the condenser is necessary.(2)
c) Frosting can take place on the evaporator coil despite continuous removal of the ice mechanically. (2)
d) Sometimes the compressor runs continuously without reducing the temperature in the meat or fish room. (3)

17. With reference to reciprocating compressors for refrigeration duties:

a) Sketch the relief and unloading arrangements. (4)
b) Explain why relief and unloading arrangements are provided. (2)
c) A refrigerating compressor on stop/start is observed to be in order and the system is not short of gas and there is no air in the system. State the reasons for the excessive running of the compressor. (4)

18. With reference to the lubrication of refrigerationcompressors:
(a) state the advantage of using fullysynthetic oils; (2)
(b) explain why oil may be carried over from the compressor; (3)
(c) describe a device which returns oil from the compressor discharge to the compressor sump; (3)
state TWO reasons why an accumulation of oil in the evaporator is undesirable. (2)

19. (a) With reference to a vapour compression refrigeration plant,
explain why EACH of the following conditions are desirable:
(i) superheating at the compressor suction; (3)
(ii) undercooling at the condenser outlet. (3)
(b) Describe, with the aid of a Pressure-Enthalpy diagram, how the evaporator cooling load is affected by the conditions stated in Q2(a). (4)

20. With reference to ships' air conditioning systems:
(a) state the effects of EACH of the following faults:
(i) corroded return air trunkings; (2)
(ii) blocked evaporator drains; (2)
(iii) defective capacity control. (2)
(b) state the main health hazard that may arise in the air conditioning plant, stating the conditions that need to arise and the measures that should be taken to prevent this occurring. (4)

1.9 Shafting, Propellers and Thrusters

1.(a) Sketch a muff type propeller coupling. (5)
(b) Describe the actions to be taken if the coupling sketched in (a) does not readily disconnect during routine tail shaft inspection in drydock. (5)

2. With reference to stern tubes:

(a) Describe with the aid of a sketch an inboard seal arrangement of radial (face) design suitable for oil or water lubrication. (8)
(b) As Chief Engineer Officer outline the steps that may be taken to reduce a slight seepage of oil from an oil lubricated stern tube outboard seal. (2)

3.(a) Sketch an outboard radial seal as fitted to an oil lubricated stern tube. (5)
(b) Explain the procedure for replacing seal sketched in (a) whilst the ship is afloat. (5)

4. (a) Sketch a typical azimuthing podded thruster.(4)
(b) Explain SIX advantages of adopting azimuthing podded units for main propulsion compared with conventional in line shafting driven propellers. (6)

5. With reference to tunnel type bow thrusters:
(a) Explain why some vessels are fitted with more than one bow thrusters. (2)
(b) Discuss the options available in terms of prime mover and transmission systems. (8)

6. With reference to white metal lined stern tube bearings:
(a) Explain why large diameter bearings are susceptible to failure. (5)
(b) Discuss the merits of non-metallic bearings. (5)

7.A propeller shaft bearing is found to be running hot whilst a vessel is on a long passage. As Chief Engineer write a report to head office outlining the actions that were taken to complete the voyage safely. (10)

8.(a) Explain how power is transmitted through main shafting. (2)
(b) State FOUR operational factors that may induce high stress in coupling bolts. (4)
(c) Sketch a hydraulic type coupling bolt. (4)

9. With reference to oil filled stern tube systems:
(a) Describe with the aid of a sketch, a lip type aft seal arrangement;(6)
(b)Explain how the sealing rings may be removed without the removal of the

tail shaft.(4)

10.(a) Sketch a hydraulically tensioned shaft coupling bolt which incorporates a tapered sleeve fitted between the bolt and the coupling holes.(4)
(b)(i) Describe how the bolt assembly sketched in (a) is fitted.(3)
(ii) State the advantages of this type of arrangement compared to conventional arrangements. (3)

11.(a) Sketch a line diagram of a stern tube two header tank hydrostatic system of lubrication including cooling arrangements for the inboard seal and the direction of oil circulation. (8)
(b) State why large ships with large changes in draught are fitted with two header tanks.(2)

12. A company proposes to order a vessel with a main engine that is capable of being reversed with a controllable pitch propeller. As Chief Engineer serving on a similar vessel write a letter to the company's Superintendent Engineer stating the advantages of the provision of a controllable pitch propeller compared with the added complication and expense. (10)

13.(a) Sketch an outboard radial seal fitted to an oil lubricated stern tube. (5)
(b) State the materials used for the component parts of the seal sketched in (a). (2)
(c) Explain how seal design in (a) prevents leakage and caters for shaft movement. (3)

14. As Chief Engineer appointed to a new vessel that experiences severe aft end vibration, write a letter to the shipping company describing the vibration and suggesting possible solutions. (10)

15.With reference to oil lubricated stern tubes, bearings and tail shafts :

(a) Describe how propeller shaft / stern tube bearing clearance is measured.(5)

(b) Describe how seals are prevented from causing groove in the tailshaft. (5)

16. Sketch a line diagram of a modern air guard stern tube sealing arrangement and its advantages.(10)

17. With reference to main thrust block arrangements:

a) Explain how the tilting pads assist in the formation of an oil wedge. (2)
b) Describe the actions that may be taken if upon inspection pads are found to be
    i) Badly scored. (2)
    ii) Wiped. (2)
c) Explain how thrust clearance may be measured stating a typical value. (2)
d) State the possible effects if the thrust clearance is incorrect. (2)

18. With reference to main thrust blocks:

a) identify the critical clearances and state why they are critical. (3)
b) describe with sketches how clearances are adjusted. (4)
c) give reasons why such bearings sometimes overheat although clearances are adequate. (3)

19. With reference to sleeved keyless propeller assemblies:

a)
    i) State with reasons the metals used in the manufacture of the sleeve and tail end shaft. (2)
    ii) State the type and thickness of material used to bond the sleeve to the propeller boss. (1)

b) When removing the propeller from the tail end shaft state why the following procedure are not recommended:
    i) Application of push off force by means of wedges or jacks and draw off force by strong back. (1)
    ii) Expansion of propeller boss by local heating with gas torches. (1)

c) State the correct procedure for removal of the propeller from tail end shaft. (5)

20. With reference to propeller shaft couplings:

a) sketch a coupling enabling external withdrawal of propeller shafts. (4)

b) give a general description of the coupling. (4)

c) give one advantage and one disadvantage of this coupling compared to the solid flange coupling. (2)

21. (a) Make a simplified sketch of the essential features incorporated in a propeller shaft and boss whereby servo signals are transmitted via the revolving shaft to the controllable pitch propeller.

(b) State what regular maintenance and test checks are necessary to ensure maximum reliability of the gear at all times.

22. (a) Why is resonance such an important factor in assessing shipboard vibration?

(b) After leaving drydock, where the propeller and tailshaft had been removed for survey as well as work on the main propulsion machinery, considerable vibration occurred at the aft end. Discuss the main factors which could cause these vibrations and state the checks you would make or other things you would try to eliminate some causes so as to narrow down the possibilities.

23. (a) Give reasons why main transmission shaft bearings occasionally become overheated.

(b) What can the ship's engineer do to overcome this over-heating problem?

(c) Describe a monitoring system for a shaft bearing.

24. With reference to fin stabilisers:

(a) sketch a block diagram showing an automatic control system; (4)

(b) describe the operation of the system sketched in part (a); (4)

(c) explain how the stabilising fin forces are generated. (2)

25. With reference to stern tube bearings:

(a) explain why white metal lined bearings·are susceptible to failure; (5)

(b) outline the merits of nonmetallic bearings. (5)

26. As Chief Engineer Officer on board a vessel which has lost 500 litres of lubricating oil from the stern tube system overnight, write a report to superintendent outlining the actions taken to rectify the leakage and any other further recommendations. (10)

27. With reference to tunnel type bow thrusters:

(a) explain why some vessels are fitted with more than one bow thruster;

(b) discuss the options available in terms of prime mover and transmission systems.

28. (a) Sketch a muff type propeller shaft coupling. (5)

(b) Describe the actions to be taken if the coupling sketched in part (a) does not readily disconnect during routine tailshaft inspection in drydock. (5)

29. With reference to main propulsion shaft systems:

(a) describe a method of hydraulic jacking to check bearing loads; (5)

(b) sketch the Bearing Load versus Shaft Lift Dial Gauge Reading graph obtained by the method described in part (a), annotating the graph and how the characteristic of bearing load is obtained. (5)

30. (a) Describe, with the aid of a sketch, the principle of operation of a modern shaft torsion meter. (8)

(b) Explain why it is important in terms of hull efficiency to measure and compare shaft torque and speed. (2)

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

1.10 Fresh Water Generator

1.Outline a planned maintenance scheme for the portable water system for both storage and distribution. (10)

2.(a) Explain the principles of osmosis and reverse osmosis.(4)
(b) Describe how reverse osmosis is used for production of fresh water on board ship. (4)
(c) State the limitation of the quality of the permeate in a single pass reverse osmosis system, describing how the quality of the permeate could be improved. (2)

3.(a) Sketch a block diagram of the various treatment stages of fresh water system from evaporator to cold water distribution.(4)
(b)Explain the purpose of each of the stages labelled in (a).(6)

4.(a) Explain EACH of the following: (2 X2)
(i) osmosis
(ii) the reverse osmosis process.
(b) Explain TWO advantages and TWO disadvantages of producing fresh water reverse osmosis.(4)
(c) State the pre-treatment and post treatment required during the reverse osmosis process. (2)

5. With reference to bacteria harmful to humans in drinking and washing water:
(a) state the constraints placed on the installation and use of systems for shipboard production of fresh water; (3)
(b) state the maintenance and treatment recommended for fresh water tanks; (3)
(c) describe how the entire fresh water system can be made free from bacteria; (3)
(d) state an acceptable residual value in the fresh water tanks to ensure the correct concentration of treatment in the system. (1)

1.11 Deck machinery

1.(a) Sketch a cargo space inert gas system for producing washed cooled gas from EITHER a main boiler or from an independent gas generator module. (5)
(b)Describe the operation of the system sketched above making reference to the safety features. (5)

2.(a) Sketch a line diagram showing the layout and components of a hydraulic system with a variable delivery pressure compensated pump and accumulator suitable for the operation of deck machinery.(5)
(b) Describe the operation of the system sketched in (i).(5)

3. (a) Sketch & describe the brake test procedure for mooring winch. (8)
(b) What is brake rendering and why it is required? (2)

4. With reference to rudder inspection in dry dock,
(a) Determine the principle clearances checked for rudder during docking with the aid of a sketch. (6)
(b) Interpret the results of these calibrations and running clearances limit. (4)

5. With the aid of sketch describe briefly supporting arrangement of a semi balanced rudder with pintle support. (10)

6. What do you mean by Rocking test. Briefly describe the procedure of rocking test(10)

7. As Chief Engineer Officer, write a procedure listing recommendations for the safety precautions to be adopted when servicing accommodation lifts. (10)

8. With reference to deck machinery:
(a) sketch a line diagram showing the layout and components of a hydraulic system with a variable delivery, pressure compensated pump and accumulator, suitable for the

operation of deck machinery; (5)
(b) explain the advantages of using electrically driven machinery over hydraulically driven winches and windlasses. (5)

2.0 Materials

1.(a) Describe with the aid of a Strain vs Time diagram, how a creep test is carried out to determine the strain rate of the material under test (7)
(b) Explain EACH of the phases sketched in the diagram in (a). (3)

2. With reference to machinery parts under cyclic loading, describe, with the aid of sketches, how the propagation of even the smallest cracks can lead to total component failure. (10)

3. With reference to the metallurgy of plain carbon steel:
(a) Construct an iron carbon equilibrium diagram. (6)
(b) Explain each of the following: (2X2)
(i) austenite
(ii) cementite

4.(a)Sketch an iron-carbon equilibrium diagram. (5)
(b) State a typical composition oof steel suitable for ships plate. (2)
(c) Sketch the micro structure of a steel suitable for ship's plate. (3)

5. Describe with the aid of a diagram the following types of material failure, stating ONE practical example of each
(a) Creep (5)
(b) Fatigue (5)

6.(a)Outline the properties of FOUR different materials suitable for salt water

piping. (8)

(b) List the information to be supplied to the dockyard for the manufacture of replacement salt water piping. (2)

7.(a) Describe each of the following metallurgical processes: (3 X 2)

(i) Work hardening;

(ii) Nitriding;

(iii) Cold working.

(b) With reference to the components parts of shipboard machinery and equipment state with reasons, 2 examples of EACH of the processes described may be found. (4)

8.(a)State the factors in the storage of welding electrodes which will assist in producing good quality welds. (2)

(b) Explain the importance of edge preparation before welding. (2)

(c) Sketch TWO methods of plate edge preparation. (2)

(d) A hairline crack is detected in a pressure component, as Chief Engineer Officer, state the factors to be taken into account in reaching a decision on the method of weld repair. 4

9.(a) Discuss the types of NDT application used in marine engineering (5)
(b)Why NDT is necessary?(5)

10.Explain the following mechanism structural failure in relation to the effects of notches surface finish, loading and environment condition

(a) Ductile fracture (3)

(b) Brittle fracture (3)

(c) Corrosion fatigue.(4)

11. Briefly explain the different type of cast iron and their properties.(10)

12. Briefly explain the classification of steel, their properties and uses.(10)

13. (a) Explain what is 'caustic embrittlement'. (4)
(b) State where this action is likely to occur in marine application. (3)
(c) State how micro-examination could show that the metal was subjected to caustic cracking rather than corrosion fatigue. (3)

14. The reliability of a salt water system is vital to the safe operation of ships. With this in mind, discuss how most suitable materials are selected for shipboard sea water systems. How do you maintain such a system in good working condition? (10)

15. 13. Explain the methods adopted in modern shipbuilding practice to prevent hull fractures due to corrosion fatigue, making reference to the sequence of assembly of the plating and welding and the subsequent protection on completion of construction. (10)

16. (a) Describe, with the aid of sketches, how the test pieces for a Class 1 pressure vessel are obtained. (6)
(b) List the tests which are carried out on the test pieces described in part (a). (4)

17. (a) State the factors in the storage of welding electrodes which will assist in producing good quality welds. (2)
(b) Explain the importance of edge preparation before welding. (2)
(c) Sketch TWO methods of plate edge preparation. (2)
(d) A hairline crack is detected in a pipe, as Chief Engineer Officer, state the factors to be taken into account in reaching a decision on the method of repair. (4)

18. With reference to machinery parts under cyclic loading, describe, with the aid of sketches, how the propagation of even the smallest of cracks can lead to total component failure. (10)

3.0 Control Engineering

1. With reference to pneumatic instruments and control systems:

(a) Sketch a regenerative control air dryer as fitted downstream from the instrument air compressor or reducing valve. (6)
(b) Explain the operation of the dryer sketched in (a) (4)

2. With reference to pneumatically controlled valves:
(a) State the reason for fitting valve positioners; (4)
(b) Explain valve hysteresis and how it affects the process;(2)
(c) Describe how design and routine maintenance can limit hysteresis. (4)

3.Describe with the aid of a sketch, a system which gives a remote reading of the water in an auxiliary boiler, showing how the pneumatic signal can be produced proportional to water level. (10)

4.Describe with the aid of a sketch the principle of operation of a capacitance electrode measuring transmitter. (10)

5.(a)Explain each of the following control systems: (2.5 X2)
(i) Cascade;
(ii) Split range;
(b)Describe a control system that may be enhanced by the inclusion of cascade and split range control. (5)

6. Discuss the advantages of an electrical, remote monitoring and control system compared to a pneumatic system. (10)

7.(a) Sketch a block diagram showing the layout of a control system suitable for bridge operation of a direct reversible main propulsion system. (6)
(b) With reference to the control system sketched in (a) describe the programmed sequence followed when the bridge control is moved from stop to slow ahead. (4)

8.(a) Explain the meaning of the following control terms:

i. proportional control action;(2)
ii. integral control action; (2)
(b)Suggest, with reasons, a typical shipboard application for EACH of the following:
i. proportional control action; (2)
ii. proportional plus integral control action; (2)
iii. on-off control (2)

9. With reference to the operation of governors fitted to alternator prime movers intended for parallel operations;
(a) Explain what is meant by governor droop; (2)
(b) State a typical value for droop; (2)
(c) Explain why an isochronous characteristic is undesirable; (2)
(d) Explain how load sharing is achieved; (2)
(e) With the aid of a load frequency diagram show how two generators share the electrical load. (2)

10. With reference to automatic control:
(a) Sketch a pneumatic proportional plus integral controller; (6)
(b) Explain the term integral saturation (2)
(c) Explain the action to be taken by the operator in the event of integral saturation occurring. (2)

11.With reference to pneumatic control valves
(a) Sketch a reverse acting control valve (6)
(b) Explain why a reverse acting arrangement would be used, stating ONE application for this valve (4)

12. Describe, with the aid of a block diagram, the operation of a load sensing electronic governor controller for an A.C generator.(10)

13.Explain EACH of the following control terms:

(a) Cascade; (3)
(b) Split range. (3)
(c) Describe a control system that may be enhanced by the inclusion of cascade and split range control. (4)

14. (a) Draw a block diagram of a pneumatic PID control system for M/E Jacket Cooling Water (JCW) outlet temperature control and describe its operation in response to an increase in M/E load. (5)
(b) Write the PID controller output equation, stating what each parameter stands for. (3)
(c) Compare and contrast between JCW outlet temperature and JCW inlet water temperature control schemes. (2)

15. (a) Explain what is meant by 25% PB (2)
(b) Define what is meant by an integral action time (I.A.T) (2)
(c) Explain the concept of integral control action & state the main objective of incorporating I-action to R control to obtain what is commonly known as PI control(2)
(d)In a reverse acting control system (jkt cooling) why A.T.C v/v used (4)

16.Referring to a modulating type Master-slave automatic combustion control (ACC) system: (10)
(a) Describe, with the help of a block diagram, the sequence of operation when load increases and how it ensures proper combustion through proper phasing of air and fuel.

17. Referring to single-element M/E lubricating oil (LO) inlet temperature control system:
(a) Draw a block diagram of one such system, assuming that an electronic PI controller is employed. (3)
(b) Explain what 'fail-safe' means in relation to the final control element, and suggest, with reasons, the most appropriate choice for the system in question. (3)
(c) Explain how the automatic feedback control system maintains the LO temperature when engine load increases. (2)

(d) If the temperature sensing element of the temperature transmitter is fouled, illustrate how the actual LO temperature will be affected following an increase in engine load. (2)

18. With reference to a water level control system using a pneumatic direct-acting proportional controller:
(a) With the help of a diagram, describe how the controller responds to a dropping water demand. (3)
b) How is the control loop operation affected if the fixed restrictor is fully clogged? (3)
c) State the two factors which influence the correct setting of the reversing switch. (4)

19. (a) State the principle of a capillary type viscometer.
(b) Sketch a shipboard pneumatic PID Fuel oil viscosity control system and describe its sequence of operation in response to a rise in main engine load. (5)
(c) State the general precautions associated with handling of DP cell.(5)

20. (a) With a sketch, explain the principle of operation of a Linear Variable Differential Transformer (LVDT) transducer. (6)
(b) State some shipboard applications of this transducer.(4)

21. Referring to Steering Gear Control System: (10)
(a) State the goal of automatic steering.
(b) Explain the function of each of the following settings/adjustments commonly provided on gyro-controlled automatic steering system, namely proportional, integral, rate, weather and rudder limit.
(c) Explain the concept of ‘non-follow-up’ steering, and state the precaution to be taken when using this mode.
(d) With a flow chart, show how a gyro-controlled steering gear system responds to an error in ship’s heading.
(e) State some likely causes of ‘erratic’ steering.
(f) Briefly state the intention of an ‘adaptive’ autopilot

22. Explain the following terms used in instrumentation and control: (10)

a) Transducer
b) Transmitter
c) Measured variable
d) Controlled variable
e) Suppressed zero
f) Open loop

23. Describe a method of calibrating a pressure gauge onboard ship. (10)

24. Sketch and describe each of the following level sensors: (10)

iii) Float
iv) Displacer
v) Immersed resistor
vi) Capacitive probe
vii) Bubbler tube
viii) Ultrasonic method

25. What do you mean by controller tuning? Describe a method of tuning a controller.(10)

4.0 Maritime Laws & Ship Personnel Management

1.With respect to international convention on Load line 1966

(a) Explain the objectives for establishment such convention. (2)

(b) State the condition of assignment of freeboard. (4)

(c) What is meant by type ‘A’ & ‘B’ ship? (4)

2. With regard to SOLAS’74 convention;

(a) What are the main objectives of the adoption of the convention?(2)

(b) What main principals have been utilized to achieve the above objectives of the convention? (4)

(c) What are the main responsibilities of marine administration with regard to surveys and the issue of certificate? (4)

3. (a) What is classification society? (2)

(b)Define the following; (4 X 2)

i. Annual survey

ii. Docking survey

iii. Special survey

iv. H.S.S.C

4. According to MARPOL Annex-I define

i. Initial survey (4)

ii. Intermediate survey(3)

iii. Periodic survey (3)

5. (a) What level of segregation is required for fuel oil systems on board which are to operate within and outside emission control areas? (5)

(b) Describe change over procedure of fuel and cylinder lubricating oil for entering ECA to non ECA area and vice versa. (5)

6.The protection of the Marine environment is of utmost importance today. Discuss. How would you as a C/E of a tanker ensure protection of the environment by compliance with the various Regulation of MARPOL 73/78 Annex 1 for prevention and control of pollution at sea? (10)

7.(a) Differentiate between annual, intermediate, renewal, damage & repair surveys. (3)

(b) What are the purposes of each survey onboard? (3)

(c) Enlist all statutory certificates carried onboard, their issuing authority, and the IMO Convention under which they are issued. (4)

8. List the methods and aids to prevent pollution of the environment by ships under IMO Conventions and steps you can take for its successful implementation on a ship prior its voyage, where you have joined as Chief Engineer (10)

9. Explain “Port State Control” (PSC) Inspection. Underline its authority for exercising and the basis of such inspections. Enumerate the relevant regulations article and annexes of SOLAS 74, LOAD LINES 66, MARPOL 73/78, STCW 78 and TONNAGE 69, which forms the provisions for PSC. (10)

10. With reference to “ISM Code” write short notes on
(a) Role of company office (2)
(b) Advantage of drills and exercises (3)
(c) Documented procedure (3)
(d) Management Review (2)

11. Explain the key features of UNCLOS. Enumerate the key areas covered under the convention. (10)

12.With reference to PSC inspection of vessel:
(a) Explain detainable deficiency with reference to a PSC inspection (4)
(b) Describe the procedure to be followed for timely release of a vessel detained for serious structural deficiencies under PSC. (6)

13. (a) With reference to the 0.5% Sulphur limit applied to residual fuel oils applicable from 1 Jan 2020. Enumerate the regulations in the MARPOL convention according which this 0.5% Sulphur limit is applied globally.(4)
(b) Prepare a plan for changing over of ships fuel oil tanks and engine fuel oil systems to low (0.5%) Sulphur fuel oil so that the ships tanks are ready to Comply with the new regulations. (6)

14. (a) Discuss the procedure of entry into force of an IMO Convention after its Adoption?(3)
(b) State the provision and its importance towards entry into force of the convention.(3)
(c) For a convention of important technical nature state the general rules/ conditions observed by the states for its entry into force. Explain the terms (4)

(i) Accession
(ii) Signature subject to Ratification, acceptance or approval.

15. (a) Describe the background and relevance of the International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001. (2)
(b) Define the following under Bunker Conventions and explain how they differ from other similar Conventions such as CLC'92

1) Pollution damage (2)
2) Bunker oil (2)
3) Time limits for claims (2)
4) Exclusions (2)

16. With reference to Port State Control Inspection,
(a) What are "clear ground" and "ISM related deficiencies" for a Port State Control Officer to conduct a more detailed inspections of the ship.(4)
(b) List out five deficiencies, which may lead to detention of the vessel. Also enumerate the cause of such deficiency and preventive action you, as Chief Engineer, will take to avoid reoccurrence of such detainable deficiencies. (6)

17. Referring to the Maritime Labor Convention (MLC) 2006, discuss:-
(a) Flag State & Port State responsibilities.(4)
(b) On-board & On-shore Complaint Procedures. (4)
(c) Detainable deficiencies. (2)

18. Explain the following terms
(a) Charter party (2)
(b) Freight (2)
(c) Lay time, Demurrage and off-hire (2)
(d) Bareboat charter (2)
(e) Bill of lading (2)

19. With reference to MARPOL Annex 6, chapter 4 explain the following terms-

(a) SEEMP (2)

(b) EEDI and EEXI (2)

(c) EEOI (2)

(d) DCS (2)

(e) Initial IMO Greenhouse Gas strategy (2)

11. What do you mean by DPA. How DPA plays crucial role in enhancing Maritime safety.(10)

12. Enumerate the functions of a safety committee on board a ship. Why safety committee's performance improve the overhaul safety of a ship.(10)

13. Reference to the classification of ships:

a) what is the purpose of classification and the primary role of the classification society? (3)
b) how do classification societies contribute to international legislation and through what channel? (2)
c) under what circumstances could a ship be deemed 'out of class'? (2)
d) under classification rules, what are the obligations of the ship owner and operator? (3)

14. Referring to the role of IMO and its impact on the marine industry-:

(a) explain what is meant by the term 'convention'. (3)

(b) what conditions determine when a convention can enter into force? (4)

(c) explain the 'tacit' amendment procedure and describe how it is used. (3)

15. With reference to international legislation:

(a) identify 4 conventions which currently have major influence on ship operations. (2)

(b) explain the meaning of 'protocol' to a convention. (2)

(c) differentiate between a 'convention1 and a 'resolution'. (3)

(d) what is meant by an 'annex' and in which conventions are to be found? Give an example. (3)

16. As a Chief engineer how you will implement ISM on your vessel. Briefly discuss the item associated with Engine Room. (10)

17. (a) Briefly discuss the procedure of fuel oil change over from LSFO to VLSFO prior entry into SECA area. (6)
(b) List the documentation required upon Fuel Oil change over. (2)
(c) As a C/E how you will ensure the compliance of MARPOL annex VI. (2)

18. (a) What is SEEMP? State the key features and how it is implemented. (5)
(b) What is CII? State the Ship’s category based on CII and how it is implemented. (5)

19. As a chief engineer , How you ensure proper record keeping of following statutory documents;
(a) NoX Technical File . (5)
(b) Inventory of Hazardous Material Record book. (5)

20. 14. With reference to the International Convention for the Control and Management of Ships' Ballast Water and Sediments:
(a) state the aims of the Ballast Water Management Convention; (2)
(b) explain the difference between ballast water standards D-1 and D-2 (2)
(c) state, with reasons, the documentation required by ships in international traffic to manage their ballast water and sediments. (6)

21. As Chief Engineer Officer write a set of standing orders that comply with the company's SMS system.
State who should be reading and signing them. (10)

5.0 Maintain Safety and security of the vessel, crew and passengers

1.(a) Sketch a line diagram of an autonomous inert gas generator. (5)
(b) Explain the operation of the system sketched in (a). (5)

2. As Chief Engineer Officer, write a report to the Superintendent Engineer listing recommendations for the safety precautions to be adopted when serving accommodation lifts. (10)

3. As a prerequisite to its promotion program, the head office of your company requests prospective Chief Engineer Officers to submit a letter, detailing the responsibilities of a Chief Engineer. As an aspiring Chief Engineer Officer compile such a letter. (10)

4. As Chief Engineer prepare standing orders for working with gas cutting and gas welding equipment, including the storage of gas bottles. (10)

5.(a) Discuss the merits of a condition monitoring system compared to other maintenance regimes. (5)
(b)Describe how the data gathered, is stored and evaluated on a computer based vibration analysis system. (5)

6.(a) State the advantages of machinery control monitoring. (4)
(b) Explain how condition monitoring is carried out. (6)

7.(a) List SIX alarms/trips that are fitted on an auxiliary boiler, describing how each would be tested. (6)
(b) Describe how the safety valves would be tested under working conditions. (4)

8. A hydraulically operated ballast valve in the duct keel has failed to close:
AS C/E state the procedure for each of the following:

(a) Safe entry into the duct keel by engine room staff; (6)
(b) Ascertaining the possible cause of the malfunction. (4)

9. (a) While maneuvering, your vessel ran aground and your large slow speed main engine abruptly stopped due to the grounding. As the chief engineer of the vessel, describe your immediate action after the grounding and the check that must be made before attempting to operate the main diesel engine. (6)
(b) Describe briefly the scope, preparation and documentation for the above damage survey. (4)

9.(a)What is safety? How it differs with security in ships. (5)
(b) what is the guiding convention with regard to ship's Safety, Briefly describe the lifesaving safety equipment on board a ship.(5)

10. Briefly describe HOW security is managed on board. What are the a tion need to be taken When security level raised to three. (10)

11. (a) Define following two terms: - “Hazard” and “Risk”.
(b) Distinct between “Hazard” and “Risk”
(c) Briefly describe the risk assessment methodology and procedures of risk assessment.
12. As Chief Engineer Officer, prepare standing orders for working with gas cutting and gas welding equipment, including the storage of spare bottles. (10)

13. (a) The International Management Code for the Safe Operation of Ships and for Pollution Prevention, is commonly referred to as the ISM code.
Explain the objectives of ISM and how are they achieved. (5)
(b) List FIVE emergency scenarios for which contingency plans may be developed under ISM with respect to the engine room. (5)

6.0 Management of Personnel

1. As a prerequisite to its promotion programme, the head office of your company requests prospective Chief Engineer Officers to submit a report, detailing the responsibilities of a Chief Engineer Officer.

As an aspiring Chief Engineer Officer compile such a report. (10)

2. Explain the legal, administrative and technical responsibilities of a Chief Engineer Officer. (10)

7.0 Maintenance & Repair

1.Describe the in-water survey to classification society requirements of the underwater structure of a very large carrier. (10)

2. (a) State what is meant by machinery condition monitoring.(2)
(b) Describe how condition monitoring is carried out. (3)
(c)State how the information obtained is used to indicate machinery condition trends. (3)
(d) Explain the relevance of machinery condition monitoring to approved planned maintenance systems. (2)

3.State the inspections and maintenance that should be carried out on main sea water pipelines, strainers & ships side valves to minimize risks of engine room flooding. (10)

4. (a) With reference to ship surveys, describe how you as a chief engineer should prepare the vessel to ensure a smooth and successful class survey without any ‘condition of class (CoC)’. (7)
(b) With reference to vessel planned maintenance system, differentiate ‘preventive maintenance’ from ‘corrective maintenance’. (3)

5. With reference to ship dry-docking procedures:

(a) Describe how the vessel is prepared for dry dock. (4)
(b) Discuss the pre-docking information required by the dry dock authority. (3)
(c) Describe the check points while the vessel is undocking from the graveyard. (3)

4. (a)Name the types of maintenance followed on board a ship.
(b) What is a planned maintenance system? Why this maintenance is superior than other type of maintenance.(10)

5. WHAT IS A CLASS in shipping domain, Why classification service is so essential For maintaining ship safety.(10)

6. What are the different type of surveys for a ship. How as C/ E you prepare a ship for Dry docking survey. (10)

7. With reference to diesel engine maintenance:
(a) Describe the various means that are available to check the condition of a diesel engine as a guide to when maintenance is actually needed; (5)
(b) Compare the methods described in part (a) with the use of planned maintenance schemes (5)

8. Describe the in-water survey to classification society requirements, of the underwater structure of a very large carrier (10)

9. (a) Explain the Harmonised System of Survey & Certification (HSSC). (4)
(b) With reference to the load line certificate explain what will be inspected and how these items are kept in compliance. (6)

10. (a) Discuss the merits of a condition monitoring system compared to other maintenance regimes. (5)
(b) Describe how the data is gathered, stored and evaluated on a computer based vibration analysis system. (5)

8.0 Detect & Identify the Cause of Machinery Malfunctions & Correct Faults

1.Explain the possible causes of engine overload at design revolutions in EACH of the following situations:
(a) The overloading has occurred over a gradual period; (4)
(b) The overloading becomes apparent during the trial of a new or modified vessel (6)

2. The unattended machinery spaces (UMS) monitoring and control system of your ship has recently started to give false alarms and incorrect data printouts:
(a) State, with reasons, possible causes if the false alarms and readings are
i) localised to a particular area of engine operation; and
ii) general to the engine room.
(b) State, with reasons, the action you, as Chief Engineer, would take to ensure continued safe operation of the vessel if the defects were general to the engine room; and
(c) Explain the procedure you, as Chief Engineer, would adopt in order to locate and rectify a general fault in the UMS system.