UK MARINE TRAINING CENTRE (UMTC)
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March 2018

Attempt TEN questions only as follows

SIX questions from each section A

TWO questions from section B

TWO questions from section C

Marks for each part question are shown in brackets.

SECTION A

Q1. 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)

2013/OCT	2016/July	2018/March				

Q2. (a) Explain EACH of the following control terms:

(i) cascade; (2)

(ii) split range. (2)

(b) Describe, with the aid of a sketch, a control system that may be enhanced by the inclusion of cascade control. (6)

2013/Dec	2016/APR	2018/March				

Q3With 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)

2014/Oct	2018/Mar					

Q4 (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)

2013/july	2014/Oct	2018/Mar				

Q5 (a) State the regulations pertaining to the main and auxiliary steering gear with reference to EACH of the following:

(i) rudder angle and time of operation; (2)

(ii) electrical supply. (3)

(b) With reference to a hydraulic steering gear, explain EACH of the following:

(i) the factors that may contribute to the failure of a hydraulic pipe coupling; (2)

(ii) what is meant by the single failure concept. (3)

2017/Dec/Q5	2018/Oct	2018/March				

Q6. (a) Sketch a diagrammatic arrangement of a fully automatic direct expansion domestic refrigeration system. (5)

(b) State, with reasons, FIVE desirable thermodynamic properties of a refrigerant. (5)

2016/July	2017/March	2018/March				

Q7. With reference to automatic sprinkler systems for fire fighting purposes:

(a) explain, with the aid of a Heat Release versus Time diagram, the difference between *fire control* and *fire suppression*; (6)

(b) state the limitations of using glass bulbs to activate sprinkler heads and suggest, with reasons, an alternative mechanism. (4)

2013/July	2017/March	2018/March				

Q8. 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)

2018/MAR/Q8						

SECTION – B

Q9. (a) Explain why it is necessary to provide reverse power for a.c generators operating in parallel. (2)

(b) Describe, with the aid of a sketch, a reverse power relay trip. (8)

2015/March	2018/July	2018/March				

Q10. Describe, with the aid of a sketch, an electronic soft starting system that may be used for large a.c. induction motors. (10)

2014/April	2016/Dec	2018/March				

Q11. (a) With reference to battery systems for emergency purposes, explain the precautions that must be taken with regard to personnel safety, storage and maintenance. (7)

(b) Explain how batteries are kept at the correct rate of charge. (3)

2018/March						

SECTION – C

Q.12 With reference to roll reduction systems, explain the principles of operation of EACH of the following, stating the advantages and disadvantages of EACH:

(a) bilge keels; (5)

(b) passive uncontrolled tanks. (5)

2014/July	2015/Dec	2016/July	2018/March		

Q.13. Explain, with the aid of a mid-ship half sectional sketch of a container ship, how strength is built into this type of vessel whilst still allowing access to the cargo holds. (10)

2013/Dec	2016/Dec	2018/March				

Q.14(a) With reference to the overhaul of a ship side valve in dry dock explain, as Chief Engineer Officer, what information should be given to the docking company prior to work commencing. (5)

(b) Describe how the valves would be overhauled stating the precautions to be taken before returning the ship to service. (5)

2015/Oct	2018/March				

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July 2018

Attempt TEN questions only as follows

SIX questions from each section A

TWO questions from section B

TWO questions from section C

Marks for each part question are shown in brackets.

SECTION A

Q1. (a) State the factors in the storage of Manual Arc Welding electrodes which will assist in producing good quality welds. (2)
(b) Explain the importance of edge preparation before welding. (2)
© Sketch Two methods of Plate Edge Preparation. (2)
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)

2017/Mar	2018/Jul					

Q2. As Chief EngineerOfficer onboard a vessel which has lost 50 Litres of Lubricating Oil from the stern tube system to sea overnight, write a report to the Superintendent Engineer outlining the actions taken to rectify the leakage and any other further recommendations. (10)

2018/JUL/Q2						

Q3. With reference to plate heat exchangers, explain how Each of the following design aspects promote heat transfer:

a) Material selection. (5)
b) Flow pattern. (3)
c) Extended surface area. (2)

2013/March	2017/Oct	2018/July				

Q4. 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 risk of engine room flooding. (10)

2013/Dec	2016/Apr	2018/July				

Q5. (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 part(a), is achieved within 45 seconds should leakage of system oil occur. (4)

2014/JULY	2015/Dec	2018/July				

Q6. With reference to refrigeration systems:

a) Explain why undercooling of the refrigerant at the condenser outlet is desirable. (3)
b) Describe, with the aid of a sketch, how a heat exchanger could be incorporated in the circuit to enhance undercooling. (5)
c) Explain the possible consequences of the refrigerant having a dryness fraction at the compressor suction. (2)

2014/Apr	2014/July	2016/Oct	2018/Jul			

Q7. With nrefernce to air recievers:

a) Explain why air receivers are prone to corrosion. (3)
b) State how corrosion can be prevented. (3)
c) If significant corrosion is detected during regular inspection explain how the air receiver may still be safely used in service until permanent repair can be effected. (4)

2018/JULY						

Q8. As Chief Engineer Officer, write a report to the Superintendent Engineer naming the items and describing the examinations that were carried out during a safety equipment survey with regards to fire safety. (10)

2014/April	2018/July					

SECTION – B

Q9. (a) Explain why it is necessary to provide reverse power protection for a.c. generators operating in parallel. (2)

(b) Sketch a generator protection circuit. (5)

(c) Explain how to check the operation of the reverse power trip. (3)

2013/Dec	2018/July					

Q10. Describe, with the aid of a circuit diagram, the operation of an automatic voltage regulator (AVR) which employs the use of thyristors. (10)

2013/DEC	2018/JULY					

Q11. (a) Explain the principle of operation of an insulation resistance test, stating why the test is carried out on regular basis. (6)
(b) Describe how each of the following electrical tests is carried out:
(i) Resistance (2)
(ii) Continuity (2)

2015/dec	2018/July					

SECTION –C

Q12. With reference to the structure of a large passenger ship, describe the requirement for preventing the spread of fire and smoke. (10)

2019/Mar	2018/Jul					

Q13. With reference to large bulk carriers:
(a) sketch a cross section of a bulk carrier through the mid-ship; (5)
(b) explain the design features that have evolved to minimise the possibility of failure. (5)

2013/MAR	2019/JUL/13					

Q14. (a) Explain the cause and effects of panting and pounding, indicating the affected areas. (5)

(b) Describe the constructional details designed to resist panting and pounding. (5)

2018/July						

October 2019

Attempt TEN questions only as follows

SIX questions from each section A

TWO questions from section B

TWO questions from section C

Marks for each part question are shown in brackets.

SECTION A

Q1. With reference to steels used in shipbuilding and marine engineering:

(a) describe EACH of the following types of failure;

(i) brittle failure; (2)

(ii) ductile failure. (2)

(b) Explain the term ductile to brittle transition stating the factor that determines ductile to brittle transition. (2)

(c) Describe a test to determine the value of brittle fracture of a specimen test piece. (4)

2018/OCT/Q1						

Q2. (a) Describe, with the aid of a sketch, an explosimeter for the detection of combustible gas. (6)

(b) Describe how the instrument sketched in part (a) is tested and calibrated. (4)

2018/OCT/Q2						

Q 3. With reference to propeller shaft alignment:

(a) state the objectives of a satisfactory alignment; [SEP]

(b) state the conditions that must be met to achieve satisfactory alignment; [SEP]

(c) Explain what is meant by fair curve alignment. (5)

2018/OCT/Q2						

Q4. Describe EACH of the following heat exchanger types, stating a suitable application for EACH type:

1.(a) parallel flow; (3)

2.(b) contra flow; (3)

3.(c) mixed flow. (4)

2015/DEC	2018/OCT					

Q5. With reference to centrifugal pumps:

a) State the operating principle of a centrifugal pump and why it is unnecessary to fit a relief valve to it. (2)
b) State two impeller types, explaining which type of application Each would be best suited for. (4)
c) Explain why cavitation occurs and how it is reduced by design. (4)

2015/March	2016/March	2017/Dec	2018/Oct			

Q6. With reference to a hydraulic steering gear, explain EACH of the following:

a) The factors that may contribute to the failure of a hydraulic pipe coupling. (2)
b) Why it is of the utmost importance that in the event of a hydraulic system failure that the rudder is locked and isolated of the affected area is achieved as soon as possible. (2)
c) The problems that may occurs when locking the rudder in heavy weather. (2)
d) Why hydraulic locking is preferable to mechanical means. (2)
e) What is meant by the single failure concept. (2)

2017/DEC	2018/OCT	2018/March				

Q7. As Chief Engineer Officer, prepare standing orders for working with gas cutting and gas welding equipment, including the storage of spare bottles. (10)

2015/DEC	2018/OCT					

Q8. With reference

(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)

2015/DEC	2018/OCT					

SECTION – B

Q9. Describe with the aid of a diagram, a shaft generator that uses a frequency converter. (10)

2013/OCT	2016/OCT	2018/OCT				

Q10. (a) Sketch a circuit diagram of an emergency generator power supply and distribution system, indicating the essential services provided. (6)

(b) State the emergency generator regulations. (4)

2018/OCT						

Q11. With reference to lithium –ion batteries:

a) Explain why this type of battery has been adopted for shipboard use. (4)

b) State ONE advantage and ONE disadvantage of lithium-ion batteries. (2)

c) Define each of the following:

i. Cell drift. (2)

ii. Thermal runaway. (2)

2018/OCT						

SECTION –C

Q12. (a) Describe the stresses that the hull of an ocean-going vessel is subjected to when it encounters heavy weather. (5)

(b) Explain why the bilge keels do not extend the full length of the vessel.(3)

2014/OCT	2017/March	2017/OCT	2018/OCT					

Q13. (a) With reference to bilge keels:

i. Describe how the design and method of attachement reduces the possibility of damage to the shell plate. (5)

ii. State what tests must be carried out. (2)

iii. Explain why the bilge keels do not extend the full length of the vessel. (3)

2014/OCT	2017/MAR	2017/OCT	2018/OCT					

Q14. With reference to tank inspection:

a) List six items that should be looked for in a tank inspection. (3)
b) State where erosion would be found in Ballast Tank. (2)
c) Write procedure for Enclosed Space Entry. (5)

2018/OCT				

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December 2019

Attempt TEN questions only as follows

SIX questions from each section A

TWO questions from section B

TWO questions from section C

Marks for each part question are shown in brackets.

Q1. Explain the effects of the addition of EACH of the following alloying elements to improve the characteristics of steels:

(a) chromium; (2)

(b) manganese; (2)

(c) molybdenum; (2)

(d) nickel; (2)

(e) vanadium. (2)

2018/DEC						

Q2. (a) Describe, with the aid of a sketch, a temperature measuring instrument that uses the principle of operation of a change in resistance with the application of heat. (6)

(b) Describe how the instrument sketched in part (a) is tested and calibrated. (4)

2018/DEC						

Q3. (a) Explain how power is transmitted through main propulsion shafting. (3)

(b) State THREE operational factors that may induce high stress in shaft coupling bolts. (3)

(c) Sketch a hydraulic type of shaft coupling bolt. (4)

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Q4. With reference to microbacterial infestation:

(a) list the engine room systems that may be affected by this type of contamination; (2)

(b) describe the conditions required for bacteria to evolve; (6)

(c) describe how the presence of microbial contamination could be detected. (2)

2014/July	2015/July	2015/OCT	2018/DEC			

Q5.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)

2014/DEC	2018/DEC/Q5					

Q6. With reference to a vapour compression refrigeration plant:

(a) explain the purpose of EACH of the following:

(i) expansion valve; (2)

(ii) room thermostat; (2)

(iii) high pressure cut out. (2)

(b) explain why EACH of the following conditions are desirable:

(i) superheating at the compressor suction; (2)

(ii) undercooling at the condenser outlet. (2)

2018/DEC							

Q7. (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 part (a). (5)

2017/OCT	2018/Dec					

Q8. As Chief Engineer Officer, describe the examinations that were carried out during a safety equipment survey with regard to fire safety. (10)

2018/DEC/Q8						

SECTION – B

Q9. With reference to the paralleling of a.c. generators:

(a) outline the requirements of synchronisation; (2)

(b) explain how KW power is shared; (1)

(c) explain how KVAR power is shared; (1)

(d) state SIX types of damage that may be caused when machines are incorrectly synchronised. (6)

2015/DEC	2018/Dec					

Q10. During a complete loss of electrical power, essential vital services can be maintained by means of an Uninterruptable Power Supply (UPS).

(a) Describe, with the aid of a block diagram, the operation of an a.c. input UPS arrangement. (7)

(b) List SIX essential services that the UPS or emergency batteries may support. (3)

M 2017/March	2018/DEC/Q10					

Q11. (a) With reference to an alkaline battery cell:

(i) describe a typical cell, stating the materials used; (4)

(ii) describe the process that takes place during discharge and charge; (2)

(iii) state the effects of overcharge. (2)

(b) State the advantages of an alkaline cell compared with a lead acid cell. (2)

2013/DEC	2018/DEC					

SECTION –C

Q12. When a vessel is in dry dock, the possible risks of fire in the machinery spaces are heightened due to the nature of the work being carried out. As Chief Engineer Officer, compile a set of standing orders instructing ship's staff on the actions to be taken should a serious fire occur. (10)

2014/July	2018/Dec					

Q13. With reference to double hulled oil tankers:

(a) sketch a mid ship cross section; (5)

(b) state the reason this type of design; (1)

(c) state FOUR disadvantages of this type of design. (4)

2013/OCT	2018/Dec					

Q14. During sea trials, extensive noise measurements are taken in accordance with the *Code of Practice for Noise Levels in Ships*.

(a) State and explain the unit of sound measurement. (2)

(b) State the noise level above which personnel are required to wear ear protection. (1)

(c) Explain how a ship's crew may be made aware of the hazards posed by exposure to excessive noise. (2)

(d) Explain how the noise levels can be reduced in the design of EACH of the following:

(i) diesel generators; (3)

(ii) ventilation fans and trunkings. (2)

2015/DEC	2106/Apr	2018/Dec				

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