



# UK MARINE TRAINING CENTRE (UMTC)

SAI POOJA BUILDING, SHOP NO. 4, PLOT NO. 36, SECTOR - 34. KAMOTHE, NAVI  
MUMBAI - 410 209 MAHARASHTRA, INDIA.

EMAIL : umtcindia1234@gmail.com | PH : +91 9673855053, +91 7021406134

## March 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. (a) Sketch a Stress/Strain curve for a mild steel test specimen. (2)  
(b) With reference to the curve sketched in part (a), explain EACH of the following:
- (i) modulus of elasticity; (2)
  - (ii) percentage elongation; (2)
  - (iii) ultimate tensile stress; (2)
  - (iv) yield stress. (2)

2019/MAR/Q1						
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- Q2. (a) State, with reasons, the control actions that may be suitable for EACH of the following processes:

1. settling tank oil temperature; (2)
2. jacket water temperature; (2)
3. temperature of oil being purified. (2)

- (b) Sketch a block diagram of ONE of the control circuits for ONE of the processes in part (a). (4)

2019/MAR/Q2						
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- Q3. With reference to podded thrusters for main propulsion:

1. distinguish between podded and azimuthing thrusters; (4)
2. explain the meaning of thruster and tractor propellers, stating ONE advantage of tractor units; (4)
3. explain what is meant by tandem podded thrusters. (2)

2019/MAR/Q3						
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Q4 .Describe in detail 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)

2019/MAR/Q4						
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Q5.(a) Describe the operation of a vacuum sewage system. (5)

(b) List the advantages of a vacuum sewage system when compared to a conventional flushing system. (4)

(c) State why untreated sewage should not be allowed to stagnate. (1)

2019/MAR/Q5						
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Q6.(a) Describe, with the aid of a sketch, a constant speed, uni-directional, axial flow pump suitable for hydraulic applications. (6)

(b) Explain, with the aid of a sketch, how the axial flow pump can achieve higher pressures than its radial flow counterpart. (4)

2019/MAR/Q6						
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Q7. With reference to ships air conditioning plants:

a) state the temperatures and relative humidities at EACH of the points that are regarded as the boundaries of the comfort zone; ( 4)

b) explain how the temperatures and relative humidities could be maintained within the comfort zone when the ship is in EACH of the following locations:

(i) North West Europe in winter; (3)

(ii) Arabian Gulf in summer. (3)

2019/MAR/Q7						
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Q8. With reference to fixed CO2 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. (3)

b) State the procedure prior to the safe release of CO2 into the machinery space in the event of a 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)

2019/MAR/Q8						
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## SECTION - B

- Q9. a) Describe, with the aid of a sketch, a static excitation system for a generator. (8)  
(b) Explain TWO advantages of static excitation. (2)

2015/OCT	2015/ DEC	2019/March				
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- Q10. Describe how the starting torque of electric induction motors may be improved by using EACH of the following:

- (a) wound rotor; (5)  
(b) double cage. (5)

2014/DEC	2019/MAR/10					
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- Q11. With reference to the protection of electrical equipment in a distribution system:

- (a) state the aims of the protective devices; (3)  
(b) list the parameters that are monitored and acted upon by the protective devices; (4)  
(c) state, with reasons, THREE causes of electrical fires. (3)

2013/Mar	2017/ Mar	2019/March				
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## SECTION - C

- Q.12 With reference to the structure of a large passenger vessel:

- (a) describe how the spread of smoke and fire is prevented.  
(b) describe the standard fire test for a Class A-60 Division material.

2019/MAR/12	2018/Mar/Q12				
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- Q.13 . (a) Explain the function and location of EACH of the following:

- (i) watertight doors. (3)  
(ii) weathertight doors. (3)

- (b) Explain why it is essential that scuppers and freeing ports are operational at all times. (4)

2019/MAR/Q 13					
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Q.14 As Chief Engineer Officer of an older vessel which has recently been purchased, write a report to the Superintendent Engineer detailing the items that should be inspected to ensure that the *condition of assignment* are satisfactorily complied with. (10)

2014/DEC	2017/DEC/13	2019/MAR/14			
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## July 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. (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)

2014/DEC	2016/DEC	2019/JUL/Q1				
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Q2. With reference to automatic control systems:

(a) explain the term proportional band width; (2)

(b) state how the proportional band may be adjusted on EACH of the following:

(i) motion balance controllers (2)

(ii) force balance controllers. (2)

(c) explain the consequences if the proportional band is set incorrectly. (4)

2019/JUL/Q2						
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Q3. With reference to a keyless propeller designed for hydraulic (wet) fit and withdrawal:

(a) describe, with the aid of a sketch, how the propeller is fitted to the tail shaft; (6)

(b) state TWO advantages compared to a dry fit; (2)

(c) explain how the thrust is transmitted without the use of a key and keyway. (2)

2019/JUL/Q3						
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Q4. With reference to centrifugal pumps:

- (a) Explain how the performance may be assessed without the need to dismantle the pump; (3)
- (b) state the effects of misalignment between the driving motor and the pump; (3)
- (c) describe, with the aid of a sketch, how on a new replacement motor, alignment is checked and adjusted. (4)

2019/JUL/Q4						
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Q5 . With reference to the design, construction and materials used in the manufacture of plate type heat exchangers, explain why, in most cases, they are superior to tubular type heat exchangers. (10)

2013/JULY	2019/JULY /Q5					
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Q6 . 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)

2014/OCT T	2016/OCT T	2019/DEC /6				
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Q7. Explain the legal, administrative and technical responsibilities of a Chief Engineer Officer. (10)

2017/OCT /8	2019/JUL /7					
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Q8. With reference to CO<sub>2</sub> 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) state how the amount of gas to be released into the hold space is estimated. (3)

2019/JUL/8						
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## SECTION – B

Q9. With reference to voltage variation profiles caused by load changes imposed on alternating current generators when starting large motors online:

- sketch a voltage dip, showing an acceptable recovery time; (2)
- state FOUR salient factors that cause the variation in part (a); (4)
- outline FOUR salient factors that assist recovery from the deviation shown in part (a). (4)

2013/MAR	2013/OCT	2013/JUL	2016/DEC	2019/JUL/Q		
R	T	Y		9		

Q10. With reference to three-phase induction motor starters:

- explain why star-delta starters are employed; (2)
- explain what is meant by reduced voltage starting in the context of star-delta starters; (2)
- explain, with the aid of a power circuit, the sequence of operation of a start-delta starter. ( 6)

2017/DEC/10	2019/JULY/19					
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Q11. With reference to the protection of electrical power circuits:

- explain discrimination, describing how it is achieved. (5)
- state, with reasons, the type of fuses used for protection; (3)
- explain preferential tripping. (2)

2019/JUL/11						
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## SECTION – C

Q12. With reference to large fixed bladed propellers:

- describe, with the aid of a sketch, EACH of the following:
  - the effect of hull fouling; (3)
  - operation in clean hull, ballast condition. (3)
- explain why fitting a *light propeller* may be beneficial. (4)

2015/OCT	2019/JUL/12					
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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/MA R	2019/JUL/ 13					
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Q14. With reference to drydocking a vessel:

- (a) state the pre-docking information that should be given to the drydock authority; (5)
- (b) list the items to be inspected once the dock is empty. (5)

2013/OC T	2019/JUL/ 14					
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## 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. 1. (a) Describe the properties of EACH of the following alloys used in marine engineering, giving a practical example for which, EACH are suited:

- (i) cupro-nickel; (2)
- (ii) white metal; (2)
- (iii) titanium. (2)

(b) Discuss the merits of EACH of the following alloys for use in the casting of large propellers:

- (i) nickel aluminium bronze; (2)
- (ii) stainless steel. (2)

2019/OCT/Q1						
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Q2. With reference to fuel oil viscosity:

- (a) explain why correct fuel oil viscosity is necessary; (2)
- (b) describe TWO methods for the measurement of viscosity that are suitable for the inclusion into pneumatic or electronic control system; (6)
- (c) state, with reasons, a control action for a viscosity controller. (2)

2013/JULY	2013/DEC	2019/OCT/Q2				
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Q3. With reference to stern tube bearings:

- (a) explain why white metal lined bearings are susceptible to failure; (5)
- (b) outline the merits of non-metallic bearings. (5)

2016/APR	2019/OCT/Q3					
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Q4. Describe, with the aid of a sketch, the principle of operation of a static oily water separator that utilises a separating matrix and polishing pack. (10)

2019/OCT/Q4						
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EMAIL : umtcindia1234@gmail.com | PH : +91 9673855053 +91 7021604134

Q5. With reference to centrifugal pumps:

- (a) explain the operating principle of a centrifugal pump and state why it is unnecessary to fit a relief valve to it; (3)
- (b) explain why some pumps have a double entry impeller; (2)
- (c) describe a routine overhaul of a centrifugal pump, stating the inspections, measurements and possible replacement parts that may be required. (5)

2019/OCT/Q5						
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Q6. With reference to tunnel type bow thrusters:

- (a) explain why some vessels are fitted with more than one bow thruster; (2)
- (b) discuss the options available in terms of prime mover and transmission systems. (8)

2013/JULY	2016/JULY	2019/OCT/Q6				
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Q7. With reference to the lubrication of refrigeration compressors:

- (a) state the advantage of using fully synthetic 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)
- (d) state TWO reasons why an accumulation of oil in the evaporator is undesirable. (2)

2013/DEC	2015/OCT	2019/OCT/Q6				
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Q8. Accidents have occurred due to premature or accidental release of CO2 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. (2)
- (c) State how the liquid levels in the CO2 bottles may be checked in situ and how often this test should be carried out. (2)
- (e) (d) Explain why ship's general service air should not be used for blowing through and testing CO2 operating lines and suggest a suitable alternative. (3)

2019/OCT/Q8						
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## SECTION – B

- Q9. (a) Sketch a circuit diagram of a self-excited a.c. generator. (5)
- (b) Describe the operation of the circuit sketched in part (a). (5)



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Q10. (a) Describe the principle of operation of a ships Impressed Current Cathodic Protection system. (6)

(b) State the routine maintenance that should be carried out on an Impressed Current Cathodic Protection system. (4)

2019/OCT/9						
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Q11. With reference to electrical short-circuits: (a) state, with reasons, THREE factors that will influence the severity of a short circuit; (6)

(b) explain the role of reactance when selecting protective devices. (4)

2015/MAR	2016/ APR	2016/OCT	2019/OCT/11			
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## SECTION –C

Q12. As Chief Engineer Officer on a new vessel which is experiencing severe aft end vibration at full-service speed, write a report to the Engineer Superintendent suggesting reasons for the vibration and recommendations for further sister vessels presently under construction. (10)

2013/JULY	2016/DEC	2019/OCT				
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Q13. (a) State FOUR reasons for transverse watertight bulkheads in ship construction. (4)

(b) State the minimum number of transverse watertight bulkheads and their location. (4)

(c) Describe how watertight bulkheads are tested. (2)

2013/MAR	2016/OCT	2019/OCT/13				
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Q14. As Chief Engineer officer, write a dry dock specification for the repair of the following damage that has occurred, stating what factors have to be considered when costing the repairs.

Damage to water ballast tank number 1 port wing. The shell plating 15 mm thick for approx 2 metres square has to be removed and replaced along with the relevant damaged stiffeners. (10)

2013/MAR	2014/OCT	2016/OCT	2019/OCT/14			
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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.

### SECTION A

Q1. Q.(a) State THREE modes of heat transfer. (1)

(b) Describe how the design requirements of EACH of the following are met, detailing the materials used to promote or retard heat transfer:

(i) plate cooler in central cooling system; (3)

(ii) meat room in domestic provisions space; (3)

(iii) auxiliary steam system pipelines. (3)

2017/MAR/8	DEC/2019/Q1						
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Q2. . (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)

DEC/2019/Q2							
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Q3. 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)

DEC/2019/Q3							
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Q4. (a) Describe TWO systems of priming centrifugal pumps. (6)

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

2017/OCT/5	2019/DEC/Q4						
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Q5. With reference to multi-tubular heat exchangers, explain how EACH of the following contribute to satisfactory performance:

- (a) tube wall thickness;(2)
- (b) dense population of tubes in the tube plate;(2)
- (c) tube materials selection;(2)
- (d) coolant flow rates;(2)
- (e) unimpeded passage of coolant at entry and exit from the tubes. (2)

2014/APR	2019/DEC/Q5					
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Q6. (a) Sketch a diagrammatic arrangement of a fully automatic direct expansion domestic refrigerationsystem which supplies a number of cold rooms. (5)

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

2016/JULY	2018/MAR/Q6	2019/DEC/Q6				
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Q7. 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)

2016/JULY	2019/DEC/Q7					
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Q8. 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)

2019/DEC/Q8						
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## SECTION – B

Q9. With reference to the protective devices fitted to a main alternating current generator, explain EACH of the following:

- (a) overcurrent and short circuit protection; (2)
- (b) generator negative phase sequence; (2)
- (c) loss of field (excitation); (2)



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(d) undervoltage; (2)

(e) reverse power. (2)

2019/DEC/Q9					
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Q10. . (a) State the consequences of using direct on line starters for comparatively large sized a.c. induction motors. (2)

(b) Describe, with the aid of a sketch, an electronic soft starting system that may be used for large sized a.c. induction motors. (8)

2014/APR/Q9	2019/DEC/Q10				
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Q11. Explain the meaning of EACH of the following types of electrical equipment:

(i) intrinsically safe; (2)

(ii) flameproof; (2)

(iii) increased safety; (2)

(iv) pressurised enclosure. (2)

(b) State TWO types of lighting equipment that may be installed in the pump room areas of a crude petroleum carrier. (2)

2013/JULY	2016/JULY	2017/DEC/11	2019/DEC/11		
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## SECTION -C

Q12. . (a) Explain the principle of operation of an insulation resistance test, stating why the test is carried out on a regular basis. (6)

(b) Describe how EACH of the following electrical tests is carried out:

(i) resistance; (2)

(ii) continuity. (2)

2015/DEC	2018/JUL/Q11	2019/DEC/12			
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Q13. (a) Explain why fatigue cracks occur in a ship's hull, stating the locations where they may be found. (3)

(b) Describe the hull inspection that should be carried out in drydock to ascertain the maintenance and repairs that may need to be carried out. (7)

2013/DEC	2016/OCT	2019/DEC/13			
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Q14. With reference to structural fire protection in passenger ship accommodation spaces:

(a) define the meaning of Class A bulkheads, stating the requirements; (3)

(b) discuss the design of ventilation systems to prevent the spread of smoke and fire; (5)



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explain how the integrity of the bulkhead is retained with respect to ventilation trunkings, where A Class bulkhead have to be penetrated. (2)

2013/OCT	2017/DEC/12	2019/DEC/14				
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