

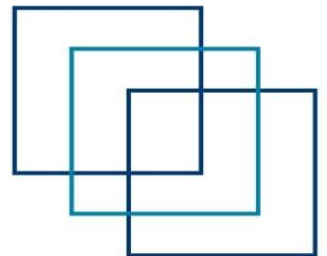


ELECTRO TECHNICAL OFFICER : WRITTEN

FOR INDIAN COMPETENCY EXAM

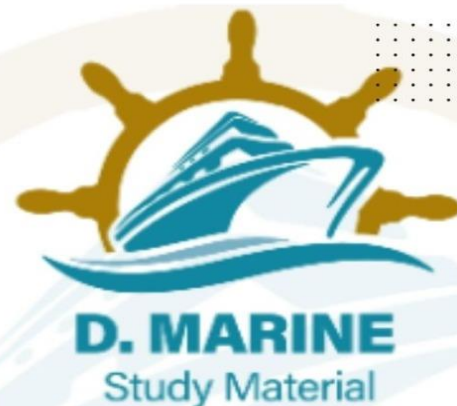


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JAN-2026

1. List the factors that cause deterioration of the frequency response of a transistor amplifier. Explain how each factor affects the performance of the amplifier and the portion of the frequency range where it is effective. (16)

2024/APR/01 **2025/SEP/02** **2026/JAN/01**

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2. Sketch and describe the method of speed control of synchronous motors by variable frequency. State the advantages of this method over the other methods of speed control. (16)

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3. What is soft starting of an Induction motor? Describe with a circuit using thyristors used for soft starting. Discuss its advantages and dis-advantages. (16)

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SECTION II

4.a) Why is it important to maintain high efficiency of operation? And low values of voltages regulation for power transformers? (6)

b) A shunt motor supplied at 230 V runs at 900 rpm. When the armature current is 30 A, the resistance of the armature circuit is 0.4Ω , calculate the resistance required in series with the armature circuit to reduce the speed to 500 rpm. Assume that the armature current is 25 Amps. (10)

2022/DEC/04 **2024/APR/04** **2026/JAN/04**

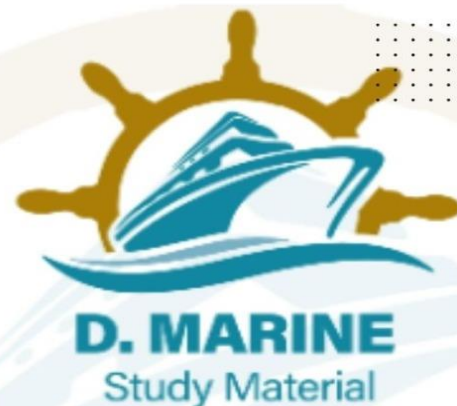
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5.a) What is back emf? Derive the relation for the back emf and the supplied voltage in terms of armature resistance

b) The earth-lamps on a main switchboard comprise two 240V 60W lamps connected in the usual manner. The potential difference at the busbars is 220V. Damage by sea water occurs to a distribution cable so that the



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insulation resistance to the earth is reduced to 16 ohms and 6 ohms for +ve and -ve cables respectively. Find by calculation

- (a) which of the two lamps burns the brighter; and
- (b) the additional load on the generators occasioned by the fault. The resistance of the cables and the ship's structure may be neglected, and that of the lamps taken as constant at the value corresponding to the 60W rating (10)

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6. A coil of inductance 2 H and unknown resistance is connected to a D.C. supply of 100 volts. After 4 ms the current has risen to 75% of its final steady state value. Calculate EACH of the following:

- (a) the resistance by the coil;
- (b) the energy stored in the coil when the current has reached its steady state value; (6)
- (c) the time taken for the current to fall to 50% of its steady state value when the supply is switched off. (4)

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SECTION-III

7. Discuss the following with respect to International Safety Management (ISM) Code:

- a) Emergency preparedness, drills & training. (6)
- b) Reporting of near miss, non-conformities, accidents/incidents, and hazardous occurrences. (5)
- c) Risk assessment, Identification of critical equipment, tests, and minimum spares requirement (5)

2024/APR/07

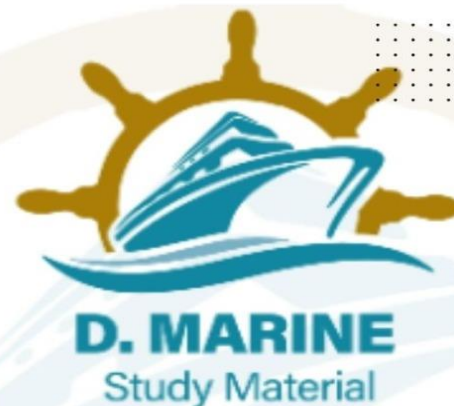
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8. With reference to a recent ILO notice on the health hazards from asbestos.

- a) state where asbestos may be found on board ship. (6)
- b) state the health risks from asbestos (5)



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c) outline the precautions necessary to minimize exposure to asbestos during an emergency repair. (5)

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9. Petroleum vapours are dangerous substances and when mixed with air can be ignited.

a) i) sketch an explosimeter or combustion gas indicator which can be used to check the atmosphere of a tank or pumproom. (5)

ii) describe the explosimeter and its operation

iii) state one reason that may cause the explosimeter to give a false reading (5)

b) for flammable mixtures, explain the meaning of the terms lower and upper flammable limits

2024/APR/09 **2026/JAN/09**

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FEB-2026

SECTION-I

1.a) Discuss the criteria of the classification of marine high voltage for A-C. and D.C. Systems. Sketch a Ships high voltage distribution system and explain its features. (8)

b) Discuss the various methods of testing the insulation of HV system. Mention the significance of PI Test, why 3 terminals insulation testers are used in HV insulation measurement (8)

2024/AUG/02 **2026/FEB/01**

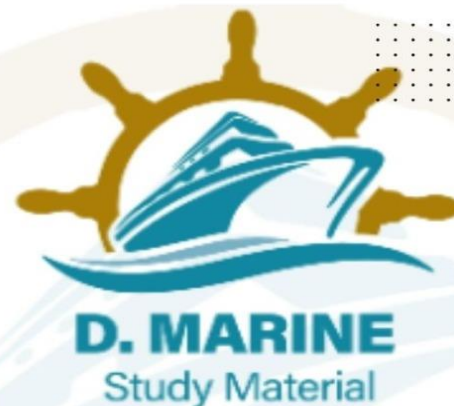
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2.a) Describe the circuit breaker for an a.c. generator using a sketch to show how arcing is Controlled. (8)

b) Explain the sequence of events that might occur if the breaker opens on a short circuit and state the check you would require following such event (4)



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c) Give a safe procedure to follow should a main circuit breaker fail to open under fault Condition (4)

2023/MAR/01 **2024/AUG/02**

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3.a) Explain how the efficiency and regulation of a transformer can be assessed by open circuit and short circuit tests?

b) What is meant by equivalent resistance? (12)

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SECTION – II

4.a) Explain the potential hazards if liquid-cooled transformers are used.(6)

b) What are the losses in transformers? Mention the various factors which affect these losses. In a 25 KVA, 3300/233 V, single phase transformer, the iron and full-load Cu. losses are respectively 350 and 400 watts. Calculate the efficiency at half-full load, 0.8 power factor. (10)

[Click Here to See the Answer](#)

5.a) List the factors that determine the **starting torque** of the three-phase induction motor. How does this torque generally compare with the value of the rated torque? (6)

5 b. A three phase, six pole,delta connected induction motor is supplied at 380 V, 60 Hz. It draws a current of 45 A at a power factor of 0.85 lag. The stator losses are 4 kW and the windage and friction losses total 3 kW. It runs at 19 rev/s. Calculate EACH of the following:

(a) the rotor copper loss;

(b) the shaft output power; (3)

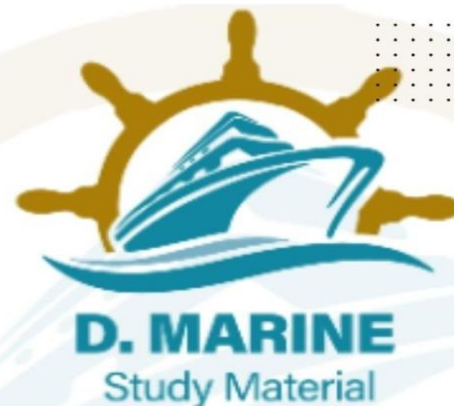
(c) the shaft output torque. (4)

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6.a) With the aid of delta and star connection diagrams, state the basic equation from which the delta-star and star- delta conversion equation can be derived. (6)



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- b) Three identical coils are delta connected to a 3 ph, 440 V, 60 Hz supply and consume a total power of 9 kW at a power factor of 0.8 lag.
(a) Calculate the resistance and inductance of EACH coil. (5)
(b) If the same three coils are now connected in star to the same supply, calculate the current in each line if:
(i) one coil is short circuited;
(ii) one coil is open circuited. (5)

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SECTION-III

7. With reference to Annex V of **MARPOL 73/78** that deals with the prevention of pollution of the sea by garbage from ships -

a) Define the following terms:

- i) Garbage
- ii) Nearest land
- iii) Special areas (8)

b) State the regulations governing the disposal of garbage outside special areas. (8)

2023/MAR/07 **2024/OCT/07**

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8. a) Explain the working principle of a **hyper mist** fire suppression system on ships. How does this system differ from traditional water-based fire suppression methods? (8)

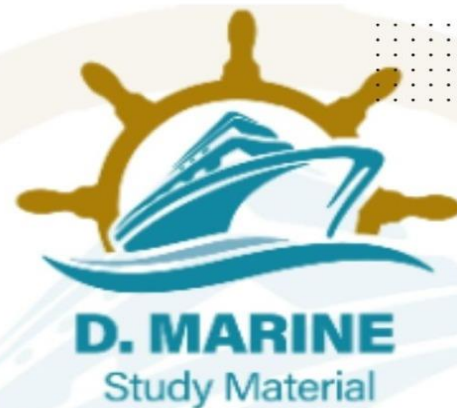
b) Discuss the installation, maintenance, and testing requirements for a hyper mist system on board ships. How does regular upkeep ensure the system's effectiveness in an emergency? (8)

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9. a) Briefly describe the environmental impact of **NO_x** and **SO_x** and allowable limitations as per Annex VI of MARPOL in emission control areas and outside emission control areas. (8)



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b). Briefly describe methods to control NO_x emission

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MAR-2026

1 a) What are safety incorporated in ACB of ship's generator and prime mover? (10)

b) Explain the procedure to test reverse power relay. (6)

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2. a) What are the advantages and disadvantages of Neutral insulated system (6)

b) An Alternator does not build up any voltage after start. Describe step by step procedure to solve the problem for all reasons. (10)

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3. a) Draw circuit diagram and explain working of star/delta starter. (8)

b) Explain with diagram how direction of single-phase induction motor is reversed. (8)

2021/OCT/01

2022/JAN/01

2025/NOV/02

2026/MAR/03

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SECTION II

4.a) Why is it important to maintain high efficiency of operation? And low values of voltages regulation for power transformers? (6)

b) A shunt motor supplied at 230 V runs at 900 rpm. When the armature current is 30 A, the resistance of the armature circuit is 0.4 Ω , calculate the resistance required in series with the armature circuit to reduce the speed to 500 rpm. Assume that the armature current is 25 Amps. (10)

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2024/APR/04

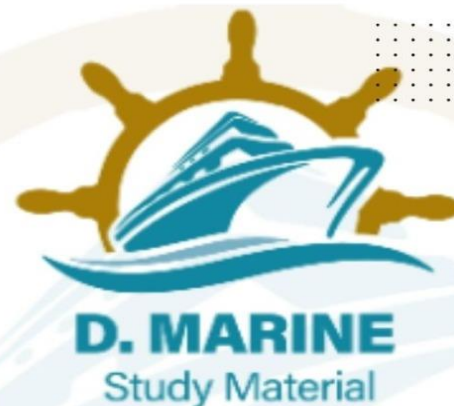
2026/JAN/04

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- 5.a) What is back emf? Derive the relation for the back emf and the supplied voltage in terms of armature resistance (6)
- b) The earth-lamps on a main switchboard comprise two 240V 60W lamps connected in the usual manner. The potential difference at the busbars is 220V. Damage by sea water occurs to a distribution cable so that the insulation resistance to the earth is reduced to 16 ohms and 6 ohms for +ve and -ve cables respectively. Find by calculation (a) which of the two lamps burns the brighter; and (b) the additional load on the generators occasioned by the fault. The resistance of the cables and the ship's structure may be neglected, and that of the lamps taken as constant at the value corresponding to the 60W rating. (10)

2022/DEC/05 **2026/MAR/05**

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6. A coil of inductance 2 H and unknown resistance is connected to a D.C. supply of 100 volts.
- After 4 ms the current has risen to 75% of its final steady state value, Calculate EACH of the following:
- (a) the resistance of the coil;
- (b) the energy stored in the coil when the current has reached its steady state value; (6)
- (c) the time taken for the current to fall to 50% of its steady state value when the supply is switched off. (4)

2026/JAN/06 **2026/MAR/06**

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SECTION-III

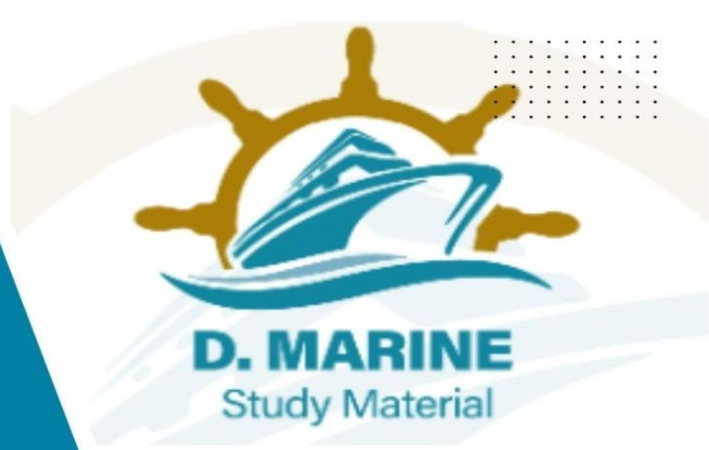
7. i) Describe CO₂ fixed firefighting system for machinery spaces and cargo spaces of a bulk carrier.
- "i) Explain safety precautions taken prior to release of CO₂ to the engine room. (8)

2021/JAN/09 **2021/APR/08** **2021/JUL/08** **2022/FEB/08**

2026/MAR/07



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8 i) Sketch and describe hydraulic circuit of steering gear incorporating automatic isolation system.

ii) Explain 'emergency steering' (4)

iii) Describe the routine tests of steering gear as per SOLAS requirement. (4)

2021/APR/09 **2021/AUG/07** **2026/MAR/08**

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9.(a) (i) With respect to the hazardous areas of tankers, explain the term flameproof (Exd) for electrical equipment. (6)

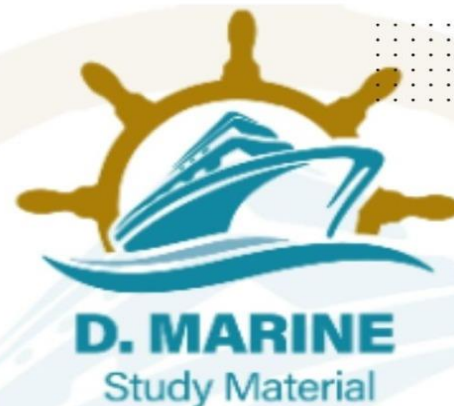
(i) State the type of electrical equipment that would be protected in this way. (4)

(b) List likely defects of flameproof equipment. (6)

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APR-2026

- 1(a) Describe the circuit breaker for an A.C. generator using a sketch to show how arcing is Controlled. [8]
(b) Explain the sequence of events that might occur if the breaker opens on a short circuit and state the check you would require following such event; Give a safe procedure to follow should a main circuit breaker fail to open under fault Condition. [8]

2023/MAR/01 2024/AUG/02 2026/FEB/02 2026/APR/01

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2. In a ship's **power system**, the neutral on the low voltage side is not grounded, but it is mandatory to ground the neutral in high voltage systems. Discuss in detail for the above difference and with suitable sketches, explain the different earthing arrangements for HV system. [16]

2023/MAR/02 2026/APR 02

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- 3(a) In A.C. generators, voltage dip occurs in two stages. Sketch a voltage-time graph showing the pattern of voltage dip. Referring to this graph, state with reasons the effect on the electrical system of a small power installation when a large load is suddenly switched on.

- (b) Explain EACH of the following categories of voltage control:

(i) Error operated;

(ii) Functional.

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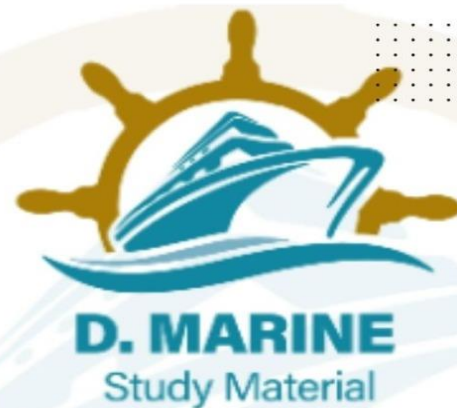
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SECTION: II

- 4 (a) Why is a **synchronous motor** not self-starting? What are the various ways in which it can be started?



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(b) Differentiate Ge and Si diode characteristics. The reverse bias saturation current for a P-N junction diode is $1.0 \mu\text{A}$ at 300 K. Determine its AC resistance at 150 mV forward bias, [10]

2023/MAR/Q4 **2026/APR/04**

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5 (a) Describe the **no-load saturation** characteristic of a D.C. generator.

5 (b) A coil of inductance 2H and unknown resistance is connected to a D.C. supply of 100 volts. After 4 ms the current has risen to 75% of its final steady state value. Calculate EACH of the following: [10]

[Click Here to See the Answer](#)

6(i) the resistance by the coil:

(ii) the energy stored in the coil when the current has reached its steady state value;

(a) What is **back emf**? Derive the relation for the back emf and the supplied voltage in terms of armature reactance.

(b) Two earth lamps at 120 V, 15 W are used on a 110 V distribution circuit. Due to damage to a motor, the resistance of the positive line is reduced to 10 ohm and that of the negative line to 5ohm. Find the voltage across each lamp and the extra load on the generator due to the fault. [10]

2023/MAR/Q6 **2026/APR/06**

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SECTION: III

7. With reference to **Annex V** of MARPOL 73/78 that deals with the prevention of pollution of the sea by garbage from ships-

(a) Define the following terms:

(i) Garbage.

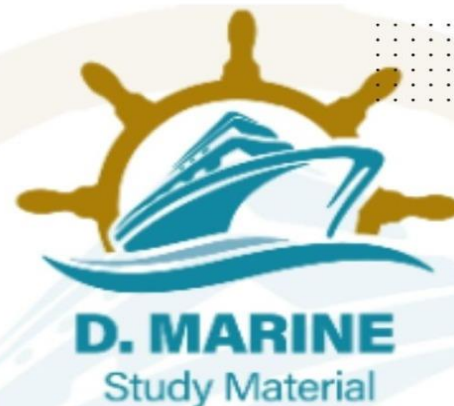
(ii) Nearest land.

(iii) Special areas.

(b) State the regulations governing the disposal of garbage outside special areas.



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2023/MAR/Q7 **2026/APR/07**

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8 With reference to oil monitoring of effluent from oil tanker cargo discharges:

- (a) Describe with a sketch, the general arrangement of an oil discharge monitoring and control system. [8]
- (b) State the inputs that are recorded. [4]
- (c) Explain the difficulties encountered with the efficient operation of the oil monitoring system. [4]

2022/SEP/Q7 **2023/MAR/Q8** **2026 /APR/08**

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9. Explain the principle of **port State control** and give in detail the verification the Port State Control Officer may carry out with reference to the following:

- (a) Emergency generator
- (b) Auxiliary steering gear
- (c) Lifeboat engine
- (d) Bilge pump
- (e) SOPEP

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JUNE-2026

Q1. a) Compare the methods of obtaining speed regulation of a three-phase induction motor generally used in tankers by means of:

i. Rotor resistance ii. Cascade system iii. Pole-changing

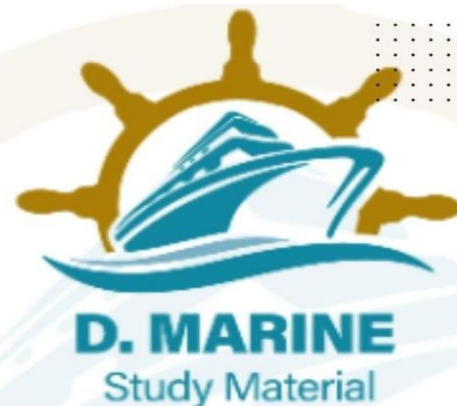
Give examples where each system may be employed with advantage.

2023/DEC/Q1

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Q2. Tank liquid level sensors are an integral part of ships. Describe, with the aid of suitable sketches, the working principle of:

- (a) Capacitive type level sensor
- (b) Ultrasonic level sensor
- (c) Float

2023/DEC/Q2

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Q3. With reference to squirrel cage, induction, electric motors:

- (a) Describe the construction of such a motor.
- (b) Sketch the torque-speed curve of such a motor.
- (c) Describe a method employed by a retrofitted device used to improve the part-load performance of an induction motor.

2023/DEC/Q3

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Q4. (a) Explain the significance of the root mean square value of an alternating current or voltage wave form; Define the form factor of such a wave form.

(b) A 72 kVA transformer supplies a heating and lighting load of 12 kW at unity power factor and a motor load of 70 kVA at 0.766 (lagging) power factor.

Calculate the minimum rating of the power factor improvement capacitors which must be connected in the circuit to ensure that the transformer does not become overloaded.

2023/DEC/Q4

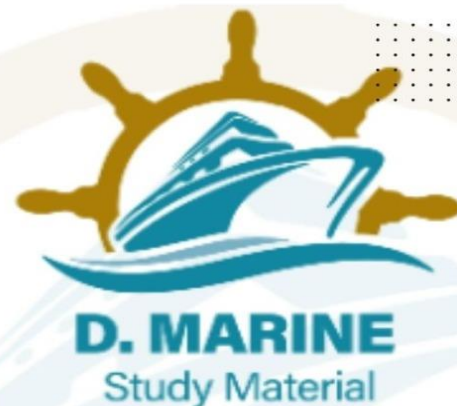
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Q5. (a) Show how the power that is transferred across the air gap of the three-phase induction motor is represented. Explain the terms. what portion of this power is useful power?

(b) A 440 V shunt motor takes an armature current of 30 A at 700 rev/min. The armature resistance is 0.7Ω . If the flux is suddenly reduced by 20 percent, to what value will the armature current will rise momentarily?



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Assuming unchanged resisting torque to motion, what will be the new steady value of speed and armature current? Sketch graphs showing armature current and speed as function of time during the transition from initial to final, steady-state conditions.

2023/DEC/Q5

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Q6. (a) What are the factors that determine the synchronous speed of a motor?

(b) A three-phase induction motor is wound for four poles and is supplied from a 50 Hz system. Calculate:

(i) The synchronous speed.

(ii) The speed of the rotor when the slip is 4 percent.

(iii) The rotor frequency when the speed of the rotor is 600 r/min.

2023/DEC/Q6

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Q7. With reference to the Maritime Labour Convention (MLC) 2006, discuss the requirements for seafarers regarding:

(a) Minimum age to work onboard vessels.

(b) Seafarers Employment Agreements.

(c) Hours of work and hours of rest.

2023/DEC/Q7

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Q8. With reference to entry into enclosed spaces onboard:

(a) Define an "Enclosed space" and give examples of enclosed spaces onboard.

(b) Describe the checks for testing the atmosphere inside such enclosed spaces.

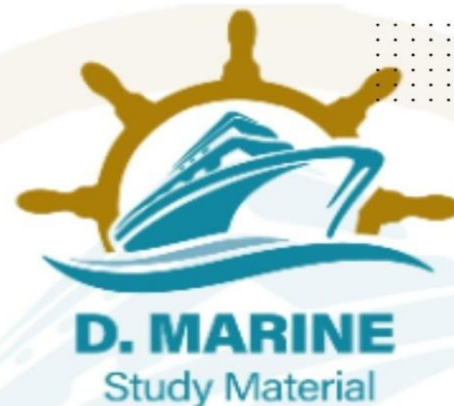
(c) Explain safety precautions taken prior to entry into enclosed spaces onboard a vessel.

2023/DEC/Q8

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Q9. With reference to the free fall lifeboat of an ocean-going ship, explain:

- (a) Periodical maintenance, tests, and checks on the lifeboat and releasing gear.
- (b) Secondary means of lowering.
- (c) Lifeboat drills.

2023/DEC/Q9

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JULY-2026

Q1. (a) State essential electrical services on board that are able to be operable under fire conditions.

(b) Explain how electric cables for the essential services in part (a) pass through bulkheads whilst maintaining gastight and watertight integrity.

(c) State the requirements for the cables which supply electrically driven emergency fire pumps.

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Q2. (a) Sketch a circuit diagram of a push-button direct-on-line (DOL) contactor starter for a three-phase motor incorporating overload and short-circuit protection. [8]

(b) Indicate, on a sketch, the typical characteristic curves of current and torque against speed. State the disadvantages of a direct-on-line start squirrel cage induction motor.

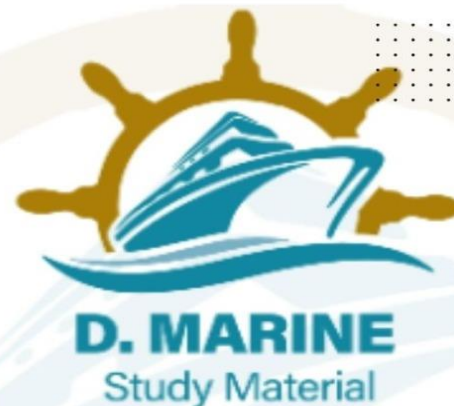
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Q3. Differentiate between half-wave and full-wave rectification. State where half-wave rectification may be used and the purpose for which it is not well adapted. Sketch a bridge connection by which full-wave rectification may be obtained.

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Q4.(a) What design factor limits the maximum torque of a d.c. motor?

(b) A shunt motor runs on no load at 700 r/min off a 440 V supply. The resistance of the shunt circuit is $240\ \Omega$. The following table gives the relationship between the flux and the shunt current:

Shunt Current (A)	0.5	0.75	1.0	1.25	1.75	2.0
Flux per Pole (mWb)	6	8	9.4	10.2	11.2	11.5

Calculate the additional resistance required in the shunt circuit to raise the no-load speed to 1000 rpm.

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Q5. (a) On what factors does the capacitance of a parallel-plate capacitor depend?

(b) A tuned circuit consisting of a coil having an inductance of $200\ \mu\text{H}$ and a resistance of $20\ \Omega$ in parallel with a variable capacitor is connected in series with a resistor of $8000\ \Omega$ across a 60 V supply having a frequency of 1 MHz. Calculate:

(a) The value of C to give resonance.

(b) The dynamic impedance and the Q factor of the tuned circuit.

(c) The current in each branch.

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Q6.(a) The capacitor-start induction-run motor has a much higher starting torque than the resistance split-phase motor. Explain.

(b) An eight-pole armature is wound with 480 conductors. The magnetic flux and the speed are such that the average e.m.f. generated in each conductor is 2.2 V, and each conductor is capable of carrying a full-load current of 100 A. Calculate the terminal voltage on no load, the output current on full load and the total power generated on full load when the armature is:

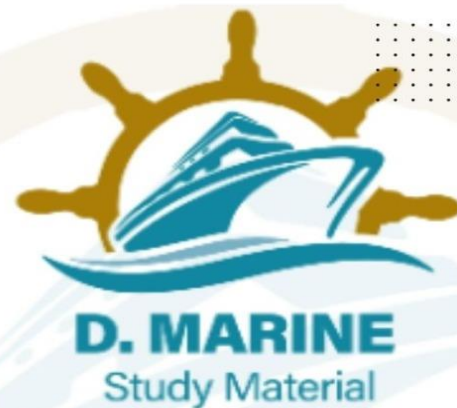
(i) lap connected.

(ii) wave connected.

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Q7. Explain the cargo hold fire detection system used on ships. Discuss the maintenance procedures for this system and outline the steps taken when a fire is detected in the cargo hold.

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Q8.(a) The ISM Code requires the company to establish procedures for preparing for and responding to potential emergency shipboard situations. How does the SMS ensure that these emergency procedures are continually evaluated for effectiveness?

(b) How does the ISM Code dictate the procedure for reporting accidents and hazardous occurrences? What is the objective of reporting a "near miss" if no damage or injury occurred?

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Q9. Briefly discuss the following with respect to safety of navigation:

(a) Bridge Navigation Watchkeeping Alarm System (BNWAS)

(b) Long Range Identification and Tracking of Ships (LRIT)

(c) Voyage / Simplified Voyage Recorder (VDR/S-VDR)

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