D. MARINE
Study Material

MEO CLASS 2 WRITTEN: MET

(MARINE ELECTRO TECNOLOGY)

FOR INDIAN COMPETENCY EXAM

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Study Material

JAN-2025

SECTION-1

1.a) What is feedback control? Explain open loop and close loop systems with reference to shipboard applications? (8)
b) What is P,PI and PID control. Make a neat comparison among all these methods of controlling with examples. (8)

2025/JAN/01	

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2. Briefly describe following with respect to protective relaying
a) Principle of working and characteristics of Induction type relays. (6)
b) Static and digital relays. (5)
c)Protection of alternators, motors, transformer and busbar. (5)

2025/JAN/02	

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3a) 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?

2024/JUL/03	2025/JAN/03	

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4 With reference to a 3 speed a.c. cage motor driven cargo winch:
a) Sketch a circuit diagram for a pole change motor. (8)
b) Describe how speed changes and braking are achieved. (8)
With respect to High Voltage Electric system

2023/APR/04	2023/JUN/04	2023/SEP/04	2024/JUN/03	2024/JUL/04	2025/JAN/04	

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5a) What are the reasons for using high voltage on board ships" Foumerate the advantages and disadvantages of using HV systems onboard ships"
b) There are mainly four types of high voltage testing methods applied on high voltage equipment and these are

i) Sustained low frequency tests ii) Constant DC/AC test iii)High frequency test and iv) Surge or impulse test Briefly explain how these tests are conducted. (10)

2025/JAN/05		

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SECTION-II

6.a) Describe International protection rating and types of insulation. by A total load of 8000 kW at 0.8 power factor is supplied by two alternators in parallel. One alternator supplies 6000kW at 0.9 power factor Find the KVA rating of the other alternator and the power factor. (10)

2024/FEB/04	2025/JAN/06

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7.a) Electric motors contain a stationary member as well as a rotating member. For each of the following machines, identify in which part of the motor three field winding and the armature winding is located: three phase induction motor, three phase synchronous motor, d.c. motor. (6)

b) A 220 V, d.c. shunt motor has an armature resistance of 0.5 ohm and an armature current of 40 A on full load. Determine the reduction in flux necessary for a 50 per cent reduction in speed. The torque for both conditions can be assumed to remain constant. (10)

2022/NOV/09	2021/JAN/06	2016/JAN/09	

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(8.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 is useful power? (6)

A 440 V load of 400 kW at 0.8 (lagging) power factor is jointly supplied by two alternator A and B. The kW load on A is 150 kW and the kVAr load on B is 150 kVAr (lagging). Determine the kW load on B, the kWAr

load on A, the power factor of operation on each machine and the current loading of each machine. (10)

2022/APR/09 –	2023/APR/08 –	2024/JUL/08	2025/JAN/08

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9a) Explain the preference for a 60 Hz system. Describe the dangers of running a 50 Hz system from a 60 Hz supply. (6)
b) A ring-main, 900m long, is supplied at a point A at a p. d. of 220V. At a point B, 240m from A, a load of 45A is drawn from the main, and at a point C, 580m from A, measured in some direction, a load of 78A is taken from the main. If the resistance of the main (lead and return) is 0.25 ohm per kilometre, calculate the current which will flow in each direction round the main from the supply point A and the potential difference across the main, at the load where it is lowest. (10)

2021/APR/07	2022/APR/10	2023/APR/09	2024/JUL/09	2025/JAN/09

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10.a) (i) What is direct-connected alternator? (3)
(ii) How is a direct-connected exciter arranged in an alternator?
(b) Find the synchronous impedance and reactance of an alternator in which a given field current produces an armature current of 200 A on short circuit and a generated e. m. f. of 50V on open-circuit. The armature resistance is 0.1 ohm. To what induced voltage must the alternator be excited if it is to deliver a load of 100 A at a p.f. of 0.8 lagging, with a terminal voltage of 200 V.

2018/AUG/10	2023/APR/10	2024/JUL/10	2025/JAN/10

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FEB-2025

1.a) Describe the circuit breaker for an a.c. generator using a sketch to show how arcing is Controlled. (6)

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. (5)
c) Give a safe procedure to follow should a main circuit breaker fail to open under fault Condition. (5)
2024/DEC/05 **2025/FEB/01**
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2.a) With respect to measuring instruments what is the difference between analogue and digital measuring instruments. Explain the working principle of each type.(6)
b). Describe with the aid of simple sketches one analogue and one digital measuring instrument you have used onboard. (10)
2022/DEC/02 **2025/FEB/02**
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3. With respect to power transformers explain the following protections (16)
a. Overload protection
b. Overcurrent protection for phase faults
c. Earth Fault protection
d. Differential protection
Click Here to See the Answer

4. In a.c. generators, voltage dip occurs in two stages.
a) i) Sketch a voltage-time graph showing the pattern of voltage dip.(4)
ii) 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. (4)
b) Explain EACH of the following categories of voltage control:
(i) Error operated.
(ii) Functional.
2022/DEC/04 **2025/FEB/04**
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5.In some circumstances electrical current may be Induced into the shafting of rotating machinery.
a) state the problem that may be caused by this current.(6)
b) explain with the aid of sketches, how currents may be avoided or reduced in the following instances: 1) d.c. machines il) main shafting fitted with a bronze propeller. (10)
2022/DEC/05 2025/FEB/05
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SECTION-2

6.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 (6)
b. Draw the circuit of Half-wave rectifier and its output waveform. A diode whose internal resistance is 20 Q is to supply power to 1000 load from 110 V (RMS) source. Calculate (10)
(i) peak load current, (ii) DC load current, (iii) AC load current
2022/DEC/06 2025/FEB/06
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7.a) By means of a schematic circuit diagram illustrate the peak rectifier. If the supply voltage is v(t) = Vra Sin wt, what is the voltage across the load resistor? (6)
b. A. d.c. motor takes an armature current of 110 A at 480 V. The resistance of the armature circuit is 0.22. The machine has six poles, and the armature is lap-connected with 864 conductors. The flux per pole is 0.05 Wb. Calculate: a) The speed; b) The gross torque developed by the armature(10)
2023/MAR/07 2023/JUN/07 2024/NOV/07
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8.a) 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? (5)

b) A three-phase induction motor is wound for four poles and is supplied from a 50 Hz system. Calculate:
a) The synchronous speed.
b) The speed of the rotor when the slip is 4 per cent.
c) The rotor frequency when the speed of the rotor is 600 r/min.
2025/FEB/08
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9.a) What is leakage flux as it applies to the iron-core transformer? How is it considered in the analysis of the transformer? (6)
b. Three conductors fitted side by side in the stator of a salient-pole alternator. Each generates a maximum voltage of 200V (sinusoidal). The angle subtended at the centre of the stator between adjacent conductors is 20 electrical degrees. If the three conductors are connected in series, find: (i) the r.m.s. value of the effective voltage and (ii) the 'breadth factor. Using the theory that is the basis of this problem, give one reason why three-phase current has been introduced.(10)
2025/FEB/09
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10.a) What are the factors which determine the synchronous speed of a motor? (6)
b). A twelve-pole, three-phase, delta-connected alternator runs at 600 rev/min and supplies a balanced star-connected load. Each phase of the load is a coil of resistance 35 ohm and inductive reactance 25 ohm. The line terminal voltage of the alternator is 440V. Determine (i) frequency of supply, (ii) current in each coil, (iii) current in each phase of the alternator, (iv) total power supplied to the load.
2022/DEC/10 **2025/FEB/10**
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MARCH-2025

1. a) Briefly explain the principle of Operation of induction Motors

b) What is slip for an induction motor?
c) Draw a simple ladder logic diagram of star delta starting of an induction motor (4)
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2. What is Zener diode and how does it regulate the voltage? What happens to the series current,
load current and Zener current when the d.c Input voltage of a Zener regulator increases? Draw a , neat diagram of Zener regulator and explain. (16)
2022/APR/05
Click Here to See the Answer

3. 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. 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 measurements (16)
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4. What are the conditions for producing sustained oscillations? Classify oscillations with respect to frequency range, principle involved, etc. It is possible to produce oscillatiorts with RC networks in phase shift oscillator Discuss in detail (16)
Click Here to See the Answer

5. What is the soft starting of an Induction Moter? Describe a gesuit using thyristors used for soft starting. Discuss its advantages and disadvantages (16)
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SECTION-2

6.a) Describe International protection rating and types of insultos (6)
BIA 72 KVA transformer supplies a heating and lighting load of 12w 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/04
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7.a) Which of the following three motors has the poorest speed regulation shunt motor, series motor, or cumulative compound motor? Explain. (6)
b) A 440V shunt motor takes an armature current of 30A at 700 rev/min. The armature resistance 10.7ohm. If the flux Is suddenly reduced 20 per cent, to what value will the armature current rise momentarily? Assuming unchanged resisting torque to motion, what will be the new steady values of speed and armature current? Sketch graphs showing armature current and speed as functions of time during the transition from initial to final, steady-state conditions. (10)
2023/MAR/10 **2024/SEP/07**
Click Here to See the Answer

8a) What is back emf? Derive the relation for the back emf and the supplied voltage in terms of armature resistance. (6)
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 per cent
(iii) The rotor frequency when the speed of the rotor is 600 r/min
Click Here to See the Answer

9 a) What are the factors which determine the synchronous speed of a motor?

b) Three conductors fitted side by side in the stator of a salient-pole alternator. Each generates a maximum voltage of 200V (sinusoldal) The angle subtended at the centre of the stator between adjacent conductors is 20 electrical degrees if the three conductors are connected in series, find (a) the rimis value of the effective voltage and (b) the "breadth factor Using the theory that is the basis of this problem, give one reason why three-phase current has been introduced. (10)

2024/SEP/09

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10) Compare the effectiveness of a current limiting circuit breaker with that of a HRC fuse (6) A coil having a resistance of 10 ohm and an inductance of 0.15 H is connected in series with a capacer acress a 100V, 50 He supply if the current and the voltage are in phase what will be the value of the current in the circuit and the voltage drop across the coil?

2023/SEP/10 **2024/MAR/10** **2024/JUN/10** **2024/AUG/10** **2024/SEP/10**

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APRIL-2025

SECTION – I

Q1. Differentiate between half 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. (16)

2023/MAR/Q3 2023/AUG/Q1 2024/JUN/Q5 2025/APR/Q1

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Q2. A. Describe with the aid of a simple sketch the arrangement of the three-phase winding of an
alternator showing the neutral point. (6)
B. Explain why for most ships the neutral point is insulated. (5)
C. Explain why in some installation the neutral point is Earthed? (5)

2023/MAR/Q4 2023/AUG/Q2 2025/APR/Q2

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Q3. A. State the necessary conditions required prior to the synchronizing of electrical alternators. (4)
B. Describe the type of cumulative damage that may be caused when alternators are incorrectly
synchronized. (4)
C. Explain how the damage referred to in (b) can be avoided / reduced. (4)
D. For two alternators operating in parallel state the consequences of: (4)
(i) Reduced torque from the prime mover of one machine.
(ii) Reduced excitation on one machine.
2023/AUG/Q3 2023/SEP/Q1 2024/OCT/Q3 2025/APR/Q3
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Q4. A. What is intrinsic electric safety? (6)
B. Can live maintenance be done on intrinsically safe circuits? (5)
C. Describe intrinsically safe equipment used on board ship. (5)
2023/AUG/Q4 2025/APR/Q4
Click Here to See the Answer

Q5. A. (i) Sketch a diagrammatic arrangement of a static or self-excited alternator. (5)
(ii) Describe the operation of the self-excited alternator. (5)
B. State why the voltage dip is less in the self-excited alternator than in brushless or conventional
alternators. (6)
2023/AUG/Q5 2025/APR/Q5
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SECTION – II

Q6. A. What are factors on which the speed of a motor depends? Discuss them for series and shunt
motors. (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 □□, 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)
2023/AUG/Q6 2025/APR/Q6
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Q7.a) Derive an expression for the emf induced in an A.C. generator. (6)
b) A 3000 KVA, 6-pole alternator runs at 1000 r.p.m. in parallel with other machines on 3300V bus-
bars. The synchronous reactance is 25%. Calculate the synchronizing power for one mechanical degree
of displacement and the corresponding synchronizing torque. (10)
2023/AUG/Q7 2025/APR/Q7
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Q8. A. Explain the purpose of interpoles and state their magnetic polarity relative to the main poles of
both generators and motors. (6)
B. A 200V, long-shunt compound-wound generator has a full-load output of 20kW. The various
resistances are as follows: armature (including brush contact) 0.15 ohm, series field 0.025 ohm,
interpole field 0.028 ohm, shunt field (including the field-regulator resistance) 115 ohm. The iron losses
at full load are 780W, and the friction and windage losses 590W. Calculate the efficiency at full load.
(10)
2023/AUG/Q8 2024/JAN/Q9 2025/APR/Q8
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Q9. A. What are the factors which determine the synchronous speed of a motor? (6)
B. A 72 KVA transformer supplies (a) a heating and lighting load of 12 KW at unity power factor (b) a

motor load of 70 kVA at 0.766 (lagging) power factor.
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Calculate the minimum rating of the power-factor improvement capacitors which must be connected in
the circuit the ensure that the transformer does not become overloaded. (10)
2023/AUG/Q9 2025/APR/Q9
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Q10. (A) Compare the effectiveness of a current limiting circuit breaker with that of a HRC fuse. (6)
(B) Evaluate for a frequency of 15 kHz, the amplification and the phase difference between input and
output signals of a voltage amplifier using a triode having an amplification factor of 48 and a mutual
conductance of 1.2 mA/V with an anode-load resistant of 160 k□□. The output p.d. is fed by a coupling
capacitor of negligible reactance to a subsequent circuit of resistance 480 k□□ and the total shunt
capacitance is 90 μF. (10)
2023/AUG/Q10 2025/APR/Q10
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JUNE-2025

1. 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. Discuss the various methods of testing the insulation of HV system. Mention the significance of Pl test, why 3 terminals insulation testers are used in HV insulation measurements.
2025/MAR/03 **2025/JUN/01**

2. Briefly describe following with respect to protective relaying:
a) Principle of working and characteristics of Induction type relays.

b) Static and digital relays.
c) Protection of alternators, motors, transformer and busbar.
2025/JAN/02 **2025/JUN/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?
2024/JUL/03
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4. Discuss the fundamental principles and advantages of electrical propulsion systems in marine vessels compared to conventional mechanical propulsion. What are some of the components that make up an electrical propulsion system?
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5.a) Briefly explain the principle of Operation of Induction Motors.
b) What is slip for an induction motor?
c) Draw a simple ladder logic diagram of star delta starting of an induction motor.
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6.a) Describe International protection rating and types of insulation.
b) A total load of 8000 kW at 0.8 power factor is supplied by two alternators in parallel. One alternator supplies 6000 kW at 0.9 power factor. Find the kVA rating of the other alternator and the power factor.
2025/JAN/06 **2025/JUN/06**
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7.a) D.C. motors are used where very high torque and/or precise speed control is required. How does the control of magnetic field flux and armature current relate to the starting characteristics of a D.C. motor in such applications?

b) A 220 V, D.C. shunt motor has an armature resistance of 0.5 ohm and an armature current of 40 A on full load. Determine the reduction in flux necessary for a 50 per cent reduction in speed. The torque for both conditions can be assumed to remain constant.
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8.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 is useful power?
b) A 440 V load of 400 kW at 0.8 (lagging) power factor is jointly supplied by two alternators A and B. The kW load on A is 150 kW and the kVAr load on B is 150 kVAr (lagging). Determine the kW load on B, the kVAr load on A, the power factor of operation on each machine, and the current loading of each machine. (10)
2023/APR/08 **2024/JUL/08** **2025/JAN/08** **2025/JUN/08**
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9.a) Explain the preference for a 60 Hz system. Describe the dangers of running a 50 Hz system from a 60 Hz supply. (6)
b) A ring-main, 900 m long, is supplied at a point A at a p.d. of 220 V. At a point B, 240 m from A, a load of 45 A is drawn from the main, and at a point C, 580 m from A, measured in the same direction, a load of 78 A is taken from the main. If the resistance of the main (lead and return) is 0.25 ohm per kilometer, calculate the current which will flow in each direction round the main from the supply point A and the potential difference across the main, at the load where it is lowest.
2023/APR/09 **2024/JUL/09** **2025/JAN/09** **2025/JUN/09**
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10.a) (i) What is a direct-connected alternator?
(ii) How is a direct-connected exciter arranged in an alternator?
b) Find the synchronous impedance and reactance WhatsApp alternator in which a given field current produces an armature current of 200 A on short circuit and a generated e.m.f. of 50 V on open-circuit. The armature resistance

is 0.1 ohm. To what6 induced voltage must the alternator be excited if it is to deliver a load of 100 A at a p.f. of 0.8 lagging, with a terminal voltage of 200 V.
2023/APR/10 **2024/JUL/10** **2025/JUN/10**
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JULY-2025

Q1. A) Describe the circuit breaker for an A.C. generator using a sketch to show how arcing is controlled. (6)
(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. (5)
(C) Give a safe procedure to follow should a main circuit breaker fail to open under fault Condition. (5)
2024/DEC/05 **2025/FEB/01**
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Q2. A. With respect to measuring instruments what is the difference between analogue and digital measuring instruments. Explain the working principle of each type. (6)
B. Describe with the aid of simple sketches one analogue and one digital measuring instrument you have used onboard. (10)
2022/DEC/02 **2025/FEB/02**
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Q3. With respect to power transformers kindly explain the following protections (16)
a. Overload protection
b. Overcurrent protection for phase faults
c. Earth Fault protection
d. Differential protection
2022/DEC/03 **2025/FEB/03**
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Q4. A. In A.C. generators, voltage dip occurs in two stages.
I. Sketch a voltage-time graph showing the pattern of voltage dip. (4)
II. 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. (4)
B. Explain EACH of the following categories of voltage control:
(i) Error operated. (4)
(ii) Functional. (4)
2022/DEC/04 **2025/FEB/04**
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Q5. In some circumstances electrical current may be induced into the shafting of rotating machinery.
a) State the problem that may be caused by this current. (6)
b) Explain with aid of sketches, how currents may be avoided or reduced in the following instances:
(i) D.C machines
(ii) Main shafting fitted with a bronze propeller (10)
2022/DEC/05 **2025/FEB/05**
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Q6. A. Explain the significance of the root- mean- square value of an alternating current or voltage
waveform: Define the form factor of such a wave form. (6)
B. Draw the circuit of Half-wave rectifier and its output waveform. A diode whose internal resistance is 20□□ is to supply power to 1000 □□ load from 110 V (RMS) source. Calculate
(i) peak load current, (ii) DC load current, (iii) AC load current. (10)
2022/DEC/06 **2025/FEB/06**
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Q7. a. By means of a schematic circuit diagram illustrate the peak rectifier. If the supply voltage is v(t)
= Vra Sin wt., what is the voltage across the load resistor? (6)

b. A D.C. motor takes an armature current of 110 A at 480 V. The resistance of the armature circuit is 0.2Ω. The machine has six poles and the armature is lap-connected with 864 conductors. The flux per pole is 0.05 Wb. Calculate:
(i) The speed.
(ii) The gross torque developed by the armature. (10)
2022/DEC/07 **2025/FEB/07**
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Q8. 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)
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 per cent.
iii. The rotor frequency when the speed of the rotor is 600 r.p.m. (10)
2022/DEC/08 **2025/FEB/08**
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Q9. A. What is leakage flux as it applies to the iron-core transformer? How is it considered in the analysis of the transformer? (6)
B. Three conductors fitted side by side in the stator of a salient-pole alternator. Each generates a maximum voltage of 200V (sinusoidal). The angle subtended at the center of the stator between adjacent conductors is 20 electrical degrees. If the three conductors are connected in series, find (i) the r.m.s. value of the effective voltage and (ii) the 'breadth factor'. Using the theory that is the basis of this problem, give one reason why three-phase current has been introduced. (10)
2022/DEC/09 **2025/FEB/09**
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Q10. A. What are the factors which determine the synchronous speed of a motor? (6)
B. A twelve-pole, three-phase, delta-connected alternator runs at 600 rev/min and supplies a balanced star-connected load. Each phase of the load is a coil of

resistance 35 ohm and inductive reactance 25 ohm. The line terminal voltage of the alternator is 440V. Determine (a) frequency of supply (b) current in each coil (c) current in each phase of the alternator (d) total power supplied to the load. (10)

2022/DEC/10 **2025/FEB/10**

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AUG-2025

SECTION – I

Q1. A. Explain the meaning of the term power factor correction. (16)
B. State TWO advantages of power factor correction.
C. Explain, with the aid of a circuit diagram, how power factor correction can be affected in a three phase
circuit using capacitors.
D. Explain one method other than the use of capacitors by means of which power factor correction may be affected.

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Q2. A. Describe with the aid of a simple sketch the arrangement of the three-phase winding of an alternator showing the neutral point. (6)
B. Explain why for most ships the neutral point is insulated. (5)
C. Explain why in some installation the neutral point is Earthed. (5)

2023/MAR/04 **2023/AUG/02** **2025/APR/02** **2025/AUG/02**

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Q3. A. State the necessary conditions required prior to the synchronizing of electrical alternators. (4)
B. Describe the type of cumulative damage that may be caused when alternators are incorrectly synchronized. (4)
C. Explain how the damage referred to in (b) can be avoided / reduced. (4)
D. For two alternators operating in parallel state the consequences of: (4)

(i) Reduced torque from the prime mover of one machine.
(ii) Reduced excitation on one machine.
2023/JUN/01 **2023/AUG/03** **2023/SEP/01** **2024/OCT/03**
2025/APR/03 **2025/AUG/03**
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Q4. A. What is intrinsic electric safety? (6)
B. Can live maintenance be done on intrinsically safe circuits? (5)
C. Describe intrinsically safe equipment used on board ship. (5)
2023/AUG/04 **2025/APR/04** **2025/AUG/04**
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Q5. A. (i) Sketch a diagrammatic arrangement of a static or self-excited alternator. (5)
(ii) Describe the operation of the self-excited alternator. (5)
B. State why the voltage dip is less in the self-excited alternator than in brushless or conventional alternators. (6)
2023/AUG/05 **2025/APR/05** **2025/AUG/05**
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Q6. A. What are the factors on which the speed of a motor depends? Discuss them for series and shunt motors. (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 ⍰⍰, 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)
2023/AUG/06 **2025/APR/06** **2025/AUG/06**
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Q7. Two three phase 415 V alternators supply a ship's load comprising:
(1) Lighting totalling 800 kW at unity power factor; and
(2) Motors totalling 1700 kW at power factor 0.7 lag.
One alternator supplies 1400 kVA at power factor 0.75 lag.
(a) Calculate each of the following for the other alternator:
(i) The kVA output; (ii) The power factor; (iii) The line output current. (16)

2025/AUG/07

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Q8. A. With reference to an A.C. generator used in marine practice derive an expression for the frequency of the generated e.m.f. in terms of the speed of the machine and the number of poles. (6)
B. A 200V, long-shunt compound-wound generator has a full-load output of 20kW. The various resistances are as follows: armature (including brush contact) 0.15 ohm, series field 0.025 ohm, interpole field 0.028 ohm, shunt field (including the field-regulator resistance) 115 ohm. The iron losses at full load are 780W, and the friction and windage losses 590W. Calculate the efficiency at full load. (10)

2025/AUG/08

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Q9. A. What are the factors which determine the synchronous speed of a motor? (6)
B. A 72 KVA transformer supplies (a) a heating and lighting load of 12 KW at unity power factor (b) 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 the ensure that the transformer does not become overloaded. (10)

2023/AUG/09 **2025/APR/09** **2025/AUG/09**

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Q10. (A) Compare the effectiveness of a current limiting circuit breaker with that of a HRC fuse. (6)
(B) Evaluate for a frequency of 15 kHz, the amplification and the phase difference between input and output signals of a voltage amplifier using a triode having an amplification factor of 48 and a mutual conductance of 1.2 mA/V with an anode-load resistant of 160 k□□. The output p.d. is fed by a coupling capacitor of negligible reactance to a subsequent circuit of resistance 480 k□□ and the total shunt capacitance is 90 μF. (10)

2023/AUG/10 **2025/APR/10** **2025/AUG/10**

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SEP-2025

1. Differentiate with the aid of simple sketches between the following types of electronic circuits.
(1) Rectifier circuit
(ii) Amplifier circuit
(iii) Oscillator circuit.
2024/FEB/01 **2024/DEC/04** **2025/SEP/01**
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2. With reference to U.M.S. operation:
a) State with reasons the essential requirements for unattended machinery spaces.
b) As Second Engineer, describe how you would respond to the irretrievable failure of the machinery space fire alarm system whilst the ship is on voyage.
2023/JAN/04 **2024/FEB/02** **2024/NOV/04** **2025/SEP/02**
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3. Explain the matching of an induction electric motor to a pump required for main circulating duty, with the aid of pump characteristic and torque/slip diagrams
2022/NOV/02 **2024/FEB/03** **2024/AUG/05** **2025/SEP/03**
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4. With reference to a three-phase shipboard electrical distribution system
a) Enumerate the advantages of an insulated neutral system
b) Enumerate the disadvantages of an insulated neutral system
c)Describe how the Earthed neutral system is Earthed

d) Compare the use of an insulated neutral system as opposed to the use of an Earthed neutral system with regard to the risk of electric shock from either system.

2024/FEB/04 **2024/MAR/05** **2024/DEC/01** **2025/SEP/04**

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5a) Sketch a magnetic overload device incorporating a dashpot and explain how the current and time settings of the device may be varied.

b) With the aid of a sketch, outline the essential features of a three stage "preferential tripping" scheme for the main generators of a ship.

2024/FEB/05 **2025/SEP/05**

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SECTION-II

6a) Describe Ingress protection rating and types of insulation.

(6) b) A total load of 8000 kW at 0.8 power factor is supplied by two alternators in parallel. One alternator supplies 6000kW at 0.9 power factor. Find the KVA rating of the other alternator and the power factor. (10)

2024/FEB/04

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7.a) Electric motors contain a stationary member as well as a rotating member. For each of the following machines, identify in which part of the motor three field winding and the armature winding is located: three phase induction motor, three phase synchronous motor, D.C. motor (6)

b) A 220 V, D.C. shunt motor has an armature resistance of 0.5 ohm and an armature current of 40 A on full load. Determine the reduction in flux necessary for a 50 per cent reduction in speed. The torque for both conditions can be assumed to remain constant

2023/APR/07 **2024/JUL/07** **2025/JAN/07** **2025/SEP/07**

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8.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 is useful power? (6)

b) A 440 V load of 400 kW at 0.8 (lagging) power factor is jointly supplied by two alternators A and B. The kW load on A is 150 kW and the kVAr load on B is 150 kVAr (lagging).

Determine the kW load on B, the kWAr load on A, the power factor of operation on each machine and the current loading of each machine. (10)

2022/APR/09 **2023/APR/08** **2024/JUL/08** **2025/JAN/08** **2025/JUN/08** **2025/SEP/08**

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9a) Explain the preference for a 60 Hz system. Describe the dangers of running a 50 Hz system from a 60 Hz supply. (6)

b) A ring-main, 900m long, is supplied at a point A at a p. d. of 220V.At a point B, 240m from A, a load of 45A is drawn from the main, and at a point C, 580m from A, measured in some direction, a load of 78A is taken from the main. If the resistance of the main (lead and return) is 0.25 ohm per kilometer, calculate the current which will flow in each direction round the main from the supply point A and the potential difference across the main, at the load where it is lowest.

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10.a) (i) What is direct-connected alternator? (3)
(ii) How is a direct-connected exciter arranged in an alternator?
(b) Find the synchronous impedance and reactance of an alternator in which a given field current produces an armature current of 200 A on short circuit and a generated e. m. f. of 50V on open-circuit. The armature resistance is 0.1 ohm. To what induced voltage must the alternator be excited if it is to deliver a load of 100 A at a p.f. of 0.8 lagging, with a terminal voltage of 200 V. (10)

2023/APR/10 **2024/JUL/10** **2025/JUN/10** **2025/SEP/10**

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OCT-2025

Q1. With reference to shipboard electrical distribution systems:
(a) Describe the meaning of the term earth fault.
(b) Explain why insulated neutral is preferred for low voltage systems.
(c) Sketch a circuit diagram of one arrangement for detecting phase to earth faults for a star neutral earthing resistor (NER).
(d) How is the ohmic value of a NER calculated to limit the earth fault current to the full load rating of a three-phase neutral earthed A.C.generator.

2025/OCT/01

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Q2. In the event of a failure, of the main electrical power supply on a ship, an emergency source of power must be available, state the circuits which must be fed from such a source and discuss the reasons governing the selection of such circuits. (16)

2023/JUN/02 **2023/SEP/02**

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Q3. With reference to squirrel cage, induction, electric motors:
A. Describe the construction of such a motor. (6)
B. Sketch the torque against speed curve of such a motor. (6)
C. Describe a method employed by a retrofitted device used to improve the part load performance of an induction motor. (4)
2021/APR/01 **2023/JUN/03** **2023/SEP/03**
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Q4. With reference to a 3 speed A.C. cage motor driven cargo winch:
A. Sketch a circuit diagram for a pole change motor. (8)
B. Describe how speed changes and braking are achieved. (8)
2023/APR/04 **2023/JUN/04** **2023/SEP/04** **2024/JUN/03** **2024/JUL/04** **2025/JAN/04**
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Q5. With reference to the condition monitoring of electrical machinery:
A. State TWO important parameters that may be recorded. (8)
B. Explain how the parameters are measured and what defects may be revealed. (8)
2024/MAY/14 **2024/AUG/05** **2025/APR/14**
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Q6. (a) Explain the significance of the root- mean- square value of an alternating current or voltage waveform. Define the form factor of such a wave form. (6)
(b) A total load of 8000 kW at 0.8 power factor is supplied by two alternators in parallel. One alternator supplies 6000 kW at 0.9 power factor. Find the kVA rating of the other alternator and the power factor.(10)
2021/MAR/06 **2021/SEP/06** **2023/APR/04** **2023/OCT/04** **2025/SEP/04**
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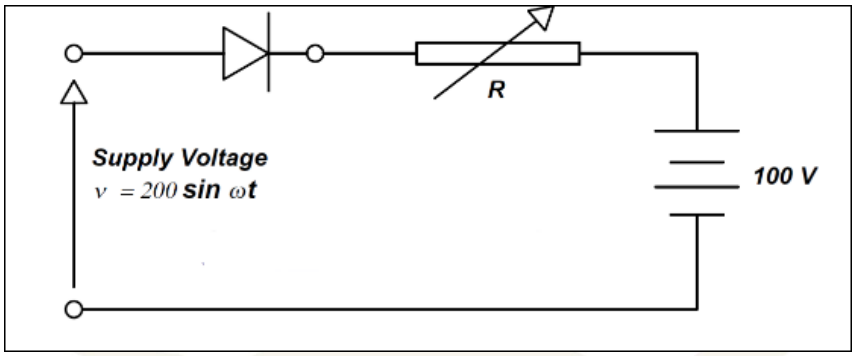
Q7. A. By means of a schematic circuit diagram illustrate the peak rectifier. If the supply voltage is $v(t)= V_m Sin\omega t$, what is the voltage across the load resistor? (6)

B. A battery-charging circuit is shown below in Fig. The forward resistance of the diode can be considered negligible and the reverse resistance infinite. The internal resistance of the battery is negligible. Calculate the necessary value of the variable resistance R so that the battery charging current is 1.0 A (10)



2023/JAN/07 **2023/MAR/07** **2023/JUN/07** **2024/NOV/07**
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Q8. A. Why is it important to maintain high efficiency of operation and low values of voltage regulationfor power transformers? (6)
B. A 100 KVA transformer has 400 turns on the primary and 80 turns on the secondary. The primary and secondary resistances are 0.3 Ω and 0.01 Ω respectively, and the corresponding leakage reactances are 1.1 Ω and 0.035 Ω respectively. The supply voltage is 2200 V. Calculate:
(i) The equivalent impedance referred to the primary circuit.
(ii) The voltage regulation and secondary terminal voltage for full load having a power factor of
(a) 0.8 lagging and
(b) 0.8 leading. (10)
2023/MAR/08 **2023/JUN/08** **2024/JUN/07** **2024/AUG/07** **2024/NOV/08**
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Q9. 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)

B. The low-voltage release of an A.C. motor-starter consists of a solenoid into which an iron plunger is drawn against a spring. The resistance of the solenoid is 35 ohms. When connected to a 220 V, 50 Hz, A.C. supply the current taken is at first 2 A, and when the plunger is drawn into the "full-in" position the current falls to 0.7 A. Calculate the inductance of the solenoid for both positions of the plunger and the maximum value of flux-linkages in weber-turns for the "full-in" position of the plunger. (10)

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Q10. 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)

B. Three batteries A, B and C have their negative terminals connected together, between the positive terminals of A and B there is a resistor of 0.5 ohm and between B and C there is a resistor of 0.3 ohm.

Specifications of the three batteries are given below:

Battery A 105 V, Internal resistance 0.25 ohm

Battery B 100 V, Internal resistance 0.2 ohm

Battery C 95 V, Internal resistance 0.25 ohm

Determine the current values in the two resistors and the power dissipated by them. (10)

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