MEO CLASS 2
WRITTEN: MET
(MARINE ELECTRO TECNOLOGY)

FOR INDIAN COMPETENCY EXAM
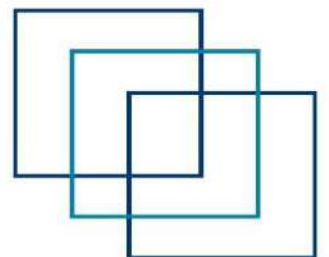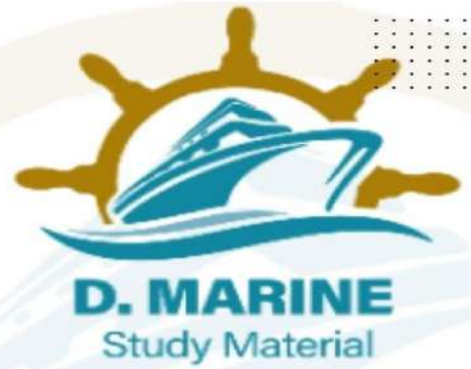
JAN-2024
SECTION – I

Q1. A. Sketch a main engine shaft driven generator arrangement with an electronic system for frequency correction; (8)

B. Describe the operation of the generator arrangement sketched in (A). (8)

2022/SEP/Q1   2024/JAN/Q1

Click Here to See the Answer

Q2. With reference to testing High Voltage equipment:

(a) Explain why earthing down is considered essential. (3)

(b) Briefly describe the procedures of earthing down (3)

(c) describe how an insulation resistance test is carried out on High Voltage equipment, making reference to personnel safety; (4)

(d) Describe, with the aid of a sketch, a method to detect earth leakage in EACH of the following systems: (6)

(i) Earthed

(ii) Insulated

2022/SEP/Q2 2024/JAN/Q2

Click Here to See the Answer

Q3. Explain What is meant by, and the significance of, four of the following terms. (16)

a. Voltage Stabilization,

b. Filter choke;

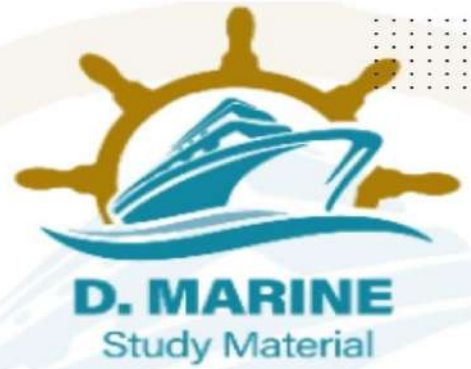c. Impedance,

d. Rectification,

e. Grid bias voltage.

2022/SEP/Q3 2022/OCT/Q9 2024/JAN/03

Click Here to See the Answer

Q4. Explain the meaning of 'P' and 'N' types semi-conductor materials and give a brief description of the mechanism by which current passes through them. (16)

2022/SEP/Q4 **2024/JAN/Q4**
Click Here to See the Answer

Q5. With reference to electronic control systems:
A. Draw a simple block diagram for temperature control; (8)
B. Describe each component shown in the diagram in (a). (8)
2022/SEP/Q5 **2023/OCT/Q2** **2024/JAN/Q5**
Click Here to See the Answer

SECTION – II

Q6. a) Derive the expression for current and voltage relations between line and phase values in the star and delta cases. Draw vector diagram. (6)
b) A balanced delta connected load is connected to a 415V, 50 Hz Supply. If the per phase impedance of the load is (8+j12) ohm, calculate (i) the phase current of the load. (ii) line current (iii) power consumed by each phase.
024/JAN/Q6
Click Here to See the Answer

Q7. A. Discuss different methods of speed control of a D.C. series motor by adjusting field ampere turns. (6)
B. A 230 V, D.C. shunt motor runs at 1000 r.p.m and takes 5 amperes. The armature resistance of the motor is 0.025▢ and shunt field resistance is 230 ▢ Calculate the drop in speed when the motor is loaded and takes the line current of 41 amperes. Neglect armature reaction. (10)
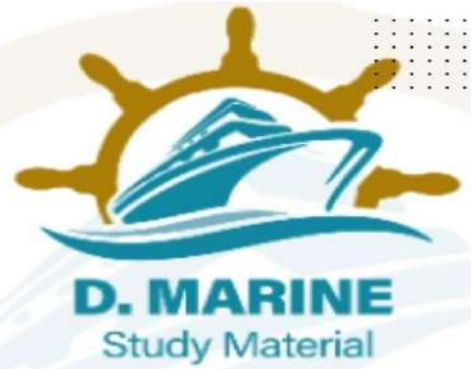**2023/JULY/Q9** **2023/DEC/Q9** **2024/JAN/Q7**
Click Here to See the Answer

Q8. A. What are the factors which determine the synchronous speed of a motor? (6)

B. The star-connected rotor of an induction motor has a stand-still resistance of 4.5 ohms/phase and a resistance of 0.5Ω/phase. The motor has an induced emf of 50 V between the slip-rings at stand-still on open circuit when connected to its normal supply voltage. Find the current in each phase and the power factor at start when the slip-ring is short-circuited. (10)

2022/SEP/Q8 **2023/FEB/Q8** **2024/JAN/Q8**

Click Here to See the Answer

Q9. 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 0.028ohm, 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)

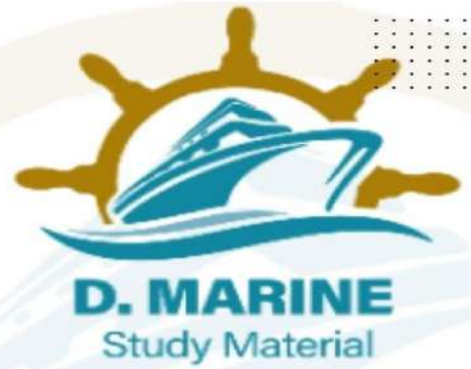**2022/SEP/Q9** **2023/AUG/Q8** **2024/JAN/9**

Click Here to See the Answer

Q10. A. (I) What is direct-connected alternator? (3)
(ii) How is a direct-connected exciter arranged in an alternator? (3)
B. A 440V shunt motor tenets an armature current of 30A at 700 rev/min. The armature resistance is 0.7ohm. If the flux is suddenly reduced by 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)

2022/AUG/Q10 **2022/SEP/Q10** **2024/JAN/Q10**
Click Here to See the Answer

FEB-2024

SECTION – I

Q1. Differentiate with the aid of simple sketches between the following types of electronic circuits; (16)
A. Rectifier circuit
B. Amplifier circuit
C. Oscillator circuit
2022/FEB/Q3 2022/MAR/Q1 2024/FEB/Q1
Click Here to See the Answer

Q2. With reference to U.M.S. operations:
A. State with reasons the essential requirements for unattended machinery spaces. (8)
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. (8)
2022/APR/Q2 2023/JAN/Q4 2024/FEB/Q2
Click Here to See the Answer

Q3. Explain the matching of an induction electric motor to a pump required for main circulating duty, with the aid of pump characteristic and torque/ship diagrams. (16)
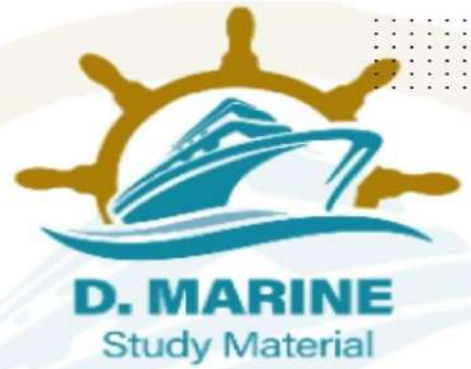**2022/NOV/Q2 2024/FEB/Q3**
Click Here to See the Answer

Q4. With reference to a three-phase shipboard electrical distribution system:

A. Enumerate the advantages of an insulated neutral system. (4)
B. Enumerate the disadvantages of an insulated neutral system. (4)
C. Describe how the earthed neutral system is Earthed. (4)
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. (4)
2017/SR09 2024/FEB/Q4
Click Here to See the Answer

Q5. a) Sketch a magnetic overload device incorporating a dashpot and explain how the current and time settings of the device may be varied. (8)
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. (8)
2024/FEB/Q5
Click Here to See the Answer

SECTION – II

Q6. a) Explain the applications of PN junction diode. (6)
b) A full-wave, 1 -phase rectifier employs a double diode valve, the internal resistance of each element of which may be assumed constant at 500 �. The transformer r.m.s. secondary voltage from the centre- tap to each anode is 300 V and the load has a resistance of 2000 ⏪. Evaluate: (10)
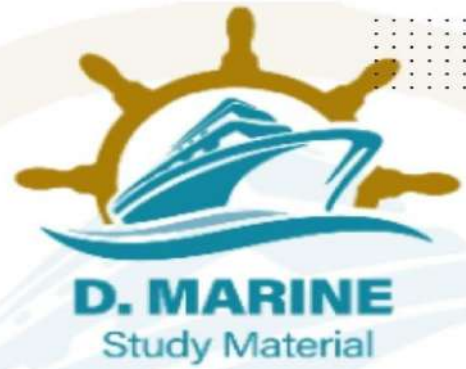(i) mean load current.
(ii) r.m.s. value of load current
(iii) the d.c. output power
(iv) the input power to the anode circuit
(v) the rectification efficiency
2023/FEB/Q6 2024/FEB/Q6
Click Here to See the Answer

Q7. A. What is back emf? Derive the relation for the back emf and the supplied voltage in terms of armature resistance. (6)

b) An 8kw, 230V, 1200 rpm d.c shunt motor has Ra = 0.7Ω. The field current is adjusted until, on no- load with a supply of 250V, the motor runs at 1250 rpm and draws armature current of 1.6 amps. A load torque is then applied to the motor shaft which causes Ia to raise to 40 A and the speed falls to 1150 rpm. Determine the reduction in the flux per pole due to the armature reaction. (10)

2023/FEB/Q7 2024/FEB/Q7

Click Here to See the Answer

Q8. A. What are the factors which determine the synchronous speed of a motor? (6)

B. The star-connected rotor of an induction motor has a stand-still resistance of 4.5 ohms/phase and a resistance of 0.5Ω/phase. The motor has an induced emf of 50 V between the slip-rings at stand-still on open circuit when connected to its normal supply voltage. Find the current in each phase and the power factor at start when the slip-ring is short-circuited. (10)

2022/SEP/Q08 2023/FEB/Q8 2024/FEB/Q8

Click Here to See the Answer

Q9. a) Explain how drooping characteristics cater for stable operation when running in parallel. (6)

b) Two shunt generators X and Y work in parallel. Their external characteristics may be assumed to be a linear over their normal working range the terminal voltage of X falls 265V on no load 230V when delivering 350Ato the busbars, while the voltage of Y falls from 270 V on no load to 240V when delivering 400A to the bus bars. Calculate the current with each machine delivers when they
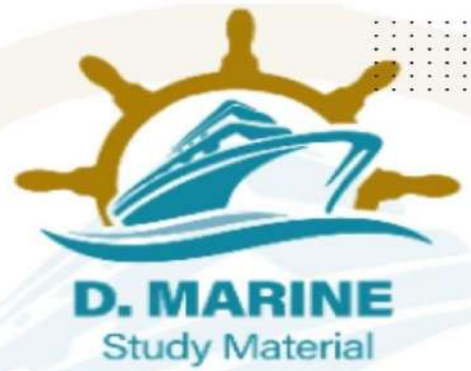
share a common load of 500A. what is thw bus bar voltage under this condition and the power delivered by each machine. (10)
2023/FEB/Q9 2024/FEB/Q9
Click Here to See the Answer

Q10. a) Describe how protection against short circuit is provided. (6)
b) An eight – pole alternator running at a speed of 720rev/min supplies current to synchronous and induction motors with forty – eight poles. Calculate the frequency and speed of rotation of the motors if the induction motor runs with 2 percent slip. (10)
2023/FEB/Q10
Click Here to See the Answer

MAR-2024

SECTION – I

Q1. A. Sketch a main engine shaft driven generator arrangement with an electronic system for frequency
correction; (8)
B. Describe the operation of the generator arrangement sketched in (A). (8)
2022/SEP/Q1 2024/JAN/Q1 2024/MAR/Q1
Click Here to See the Answer

Q2. With reference to electronic control systems:
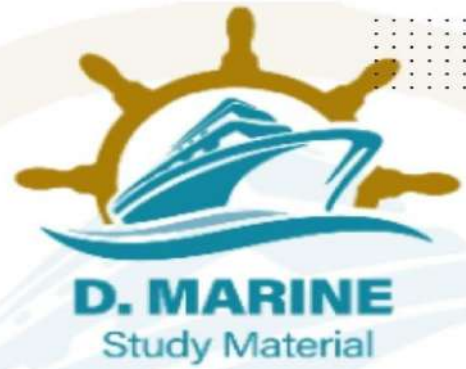A. Draw a simple block diagram for temperature control; (8)
B. Describe each component shown in the diagram in (a). (8)
2022/SEP/Q5 2023/OCT/Q2 2024/JAN/Q5 2024/MAR/Q2
Click Here to See the Answer

Q3. a) Sketch a circuit diagram for an automatic voltage regulator illustrating how the A.V.R. utilizes a Silicon-controlled rectifier to control the excitation system for an alternator. (8)
b) Describe how the A.V.R. monitors output and controls the excitation system. (8)
2021/DEC/Q2 2023/FEB/Q1 2024/MAR/Q3
Click Here to See the Answer

Q4. It is proposed to operate a Bow thruster unit from a 3.3 KV electrical supply. Outline suitable options for the design of installation under each of the following heading.
A. Protection of main switch board
B. Overload of a bow thruster motor
C. Cable protection (16)
2017/SR09 2024/MAR/Q4
Click Here to See the Answer

Q5. With reference to a three-phase shipboard electrical distribution system:
A. Enumerate the advantages of an insulated neutral system. (4)
B. Enumerate the disadvantages of an insulated neutral system. (4)
C. Describe how the earthed neutral system is Earthed. (4)
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. (4)
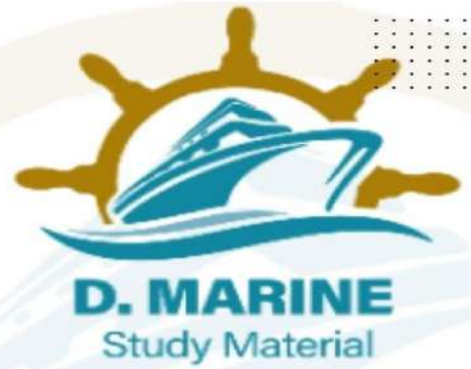**2024/FEB/Q4 2024/MAR/Q5**
Click Here to See the Answer

SECTION – II
Q6. A. A series circuit having resistance, Inductance and capacitance is to be operated on a constant voltage supply of available frequency. Indicate graphically how changes will take place in the

current and voltage in resistance, inductance and capacitance, and also capacitive reactance and inductive reactance. (6)

B. A resistance of 130 Ω and a capacitor of 30μF are connected in parallel across a 230 Volt, 50Hz supply. Find the current in each component, total current, phase angle and the power consumed. (10)

2023/SEP/Q6 2024/MAR/Q6

Click Here to See the Answer

Q7. A. Explain the working principal of a three-phase induction motor. What are the various types of rotors? (6)

B. An 18.65Kw, 6-pole, 50Hz, 3 phase slip ring induction motor runs at 960 rpm on full load with a rotor current per phase of 35A, allowing 1Kw for mechanical losses, find the resistance per phase of 3- phase rotor winding. (10)

2023/MAR/Q9 2023/SEP/Q7 2024/MAR/Q7

Click Here to See the Answer

Q8. a) Explain why the iron losses in a transformer are substantially independent of the load current. (6)

b) The equivalent circuit for a 200/400-V step-up transformer has the following parameters referred to the low-voltage side. (10)

Equivalent resistance = 0.15 ⍰; Equivalent reactance = 0.37 ⍰

Core-loss component resistance = 600 ⍰; Magnetising reactance = 300Ω When the transformer is supplying a load at 10 A at a power factor if 0.8 lag, Calculate,
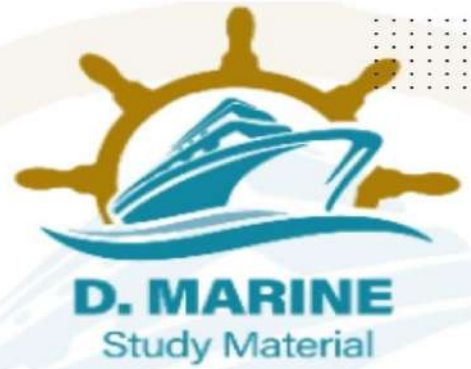
i) the primary current

ii) secondary terminal voltage.

2024/MAR/Q8

Click Here to See the Answer

Q9. A. Sketch a graph of starting current, and torque against the speed of rotation for a single cage motor. (6)

B. A 230V motor, which normally develops 10Kw at 1000 rev/min with an efficiency of 85%, is to be used as a generator. The armature resistance is 0.15Ohm and the shunt field resistance is 220Ohm. If it is driven at 1080 rev/min and the field current is adjusted to 1.1A by means of the shunt regulator what output in Kw could be expected as a generator, if the armature copper loss was kept down to that when running as a motor. (10)

2023/SEP/Q9 2024/MAR/Q9
Click Here to See the Answer

Q10. A. Compare the effectiveness of a current limiting circuit breaker with that of a HRC fuse. (6)

B. A coil having a resistance of 10 Ohm, and an inductance of 0.15 H is connected in series with a capacitor across a 100V, 50Hz 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? (10)
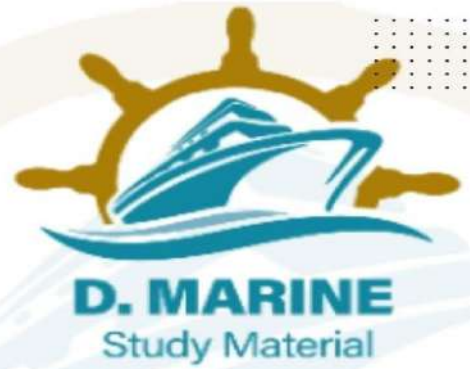
2022/MAR/Q10 2023/SEP/Q10 2024/MAR/Q10
Click Here to See the Answer

APR-2024

SECTION – I

Q1. Differentiate between squirrel cage and wound rotor motor of the three phases: a.c. induction. In respect of the following: (16)
A. Rotor construction,
B. Torque characteristic,
C. Speed variation.
2023/JULY/Q1 **2023/DEC/Q1** **2024/APR/Q1**
Click Here to See the Answer

Q2. With reference to an emergency source of electrical power in cargo ships: (16)
A. Describe a typical power source.
B. Give a typical list of essential services, which must be supplied simultaneously;
C. Explain how the emergency installation can be periodically tested.
2023/JULY/Q2 **2023/OCT/Q4** **2023/DEC/Q2** **2024/APR/Q2**
Click Here to See the Answer

Q3. The direct online start of squirrel cage motor is used for most electrical drives on A.C. powered ships. Describe with sketches as necessary one method of overcoming each of the following Problems:
A. High starting current. (8)
B. Low starting torque. (8)
2023/JULY/Q3 **2023/OCT/Q5** **2023/DEC/Q3** **2024/APR/Q3**
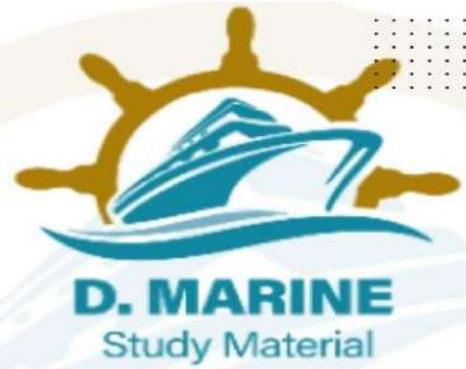**Click Here to See the Answer**

Q4. a) (i) Discuss the various hazards and problems which are associated with electric cable Insulation in the event of fire.
(ii) Suggest remedies for these problems. (8)
b) State how the spread of fire may be reduced by the method used for installing electric cables. (8)

2023/JULY/Q4 **2023/DEC/Q4** **2024/APR/Q4**
Click Here to See the Answer

Q5. a) What are the causes of overheating of an induction motor? (4)
b) What preventive measures are provided against damage to an induction motor in installed condition? (3)
c) What is the purpose of 'fuse back up protection' provided to an induction motor? (3)
d) How does an induction motor develop torque? (3)
e) What is the condition to be satisfied for achieving maximum running torque in an induction motor? (3)
2023/JULY/Q5 **2024/APR/Q5**
Click Here to See the Answer

SECTION – II

Q6. A. What are the characteristics of PN junction diode? Point out its specifications. Also point out the significance of dynamic and static resistances. (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)
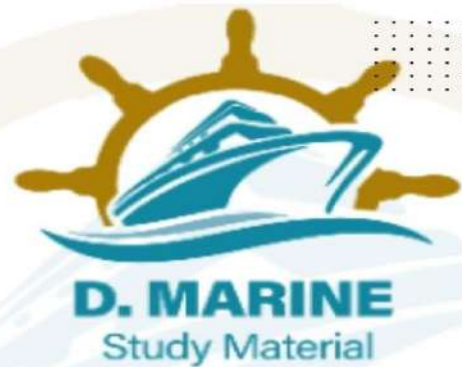**2023/JULY/Q6** **2023/DEC/Q6** **2024/APR/Q6**
Click Here to See the Answer

Q7. A. Describe the no-load saturation characteristic of a D.C. generator. (6) B. A d.c. motor takes an armature current of 110 A at 480 V. The resistance of the armature circuit is 0.2 ⬚. 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)
2023/JULY/Q7 **2023/DEC/Q7** **2024/APR/Q7**
Click Here to See the Answer

Q8. A. What is a commutator? Discuss its rectifying action in detail. (6)
B. Calculate the e.m.f. generated by a 4-pole, wave wound armature having 40 slots with 18 conductors per slot when driven at 1000 r.p.m. The flux per pole is 0.015 wb. (10)
2023/JULY/Q8 **2023/DEC/Q8** **2024/APR/Q8**
Click Here to See the Answer

Q9. A. Discuss different methods of speed control of a D.C. series motor by adjusting field ampere turns. (6)
B. A 230 V, D.C. shunt motor runs at 1000 r.p.m and takes 5 amperes. The armature resistance of the motor is 0.025⍰ and shunt field resistance is 230 ⍰ Calculate the drop in speed when the motor is loaded and takes the line current of 41 amperes. Neglect armature reaction. (10)
2023/JULY/Q9 **2023/DEC/Q9** **2024/JAN/Q7** **2024/APR/Q9**
Click Here to See the Answer

Q10. A. Why is a synchronous motor not self-starting? What are the various ways in which it can be started? (6)
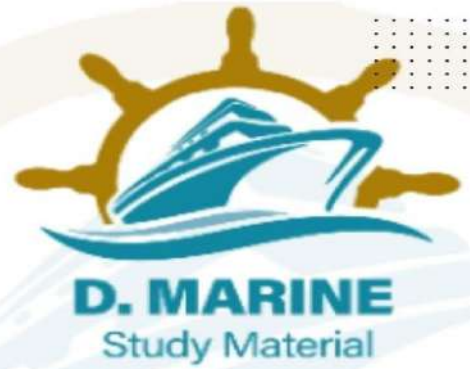B. A 500V, single phase synchronous motor gives a net output mechanical power of 7.46kW and operates at 0.9 power factor lagging. Its effective resistance is 0.8 Ω. If the iron and friction losses are 500 w and excitation losses are 800w, calculate the armature current and the commercial efficiency. (10)
2023/JULY/Q10 **2023/DEC/Q10** **2024/APR/Q10**
Click Here to See the Answer

JUN-2024

Q1. With reference to electronic control systems
A. Draw a simple block diagram for temperature control. (8)
B. Describe each component shown in the diagram in (a). (8)
2023/OCT/Q2 2024/JAN/Q5 2024/MAR/Q2 2024/JUN/Q1
Click Here to See the Answer

Q2. Compare methods of obtaining speed regulation of three-phase induction motors generally used in tankers by means of:
A. Rotor resistance.
B. Cascade system.
C. Pole-changing.
Give examples where each system may be employed with advantage. (16)
2022/OCT/Q2 2023/APR/Q2 2024/JUN/Q2
Click Here to See the Answer

Q3. 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 change and braking are achieved. (8)
   2023/JUNE/Q4 2023/SEP/Q4 2024/JUN/Q3
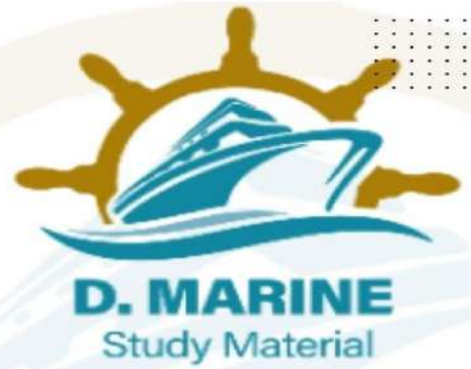**Click Here to See the Answer**

Q4. What is a marine high voltage system? Sketch and describe a shipboard high voltage switch board and its protective devices. (16)
2023/MAR/Q1 2024/JUN/Q4
Click Here to See the Answer

Q5. 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

Click Here to See the Answer

SECTION – II

Q6. A. Explain what is meant by the terms wave form, frequency and average value. (6)

B. A moving coil ammeter, a thermal ammeter and a rectifier are connected in series with a resistor across a 110 V sinusoidal a.c. supply. The circuit has a resistance of 50 Ω to current in one direction and, due to the rectifier, an infinite resistance to current in the reverse direction. Calculate:

(i) The readings on the ammeters.

(ii) The form and peak factors of the current wave. (10)

2019/NOV 2024/JUN/Q6

Click Here to See the Answer

Q7. A. Why is it important to maintain high efficiency of operation and low values of voltages regulation for power transformers? (6)
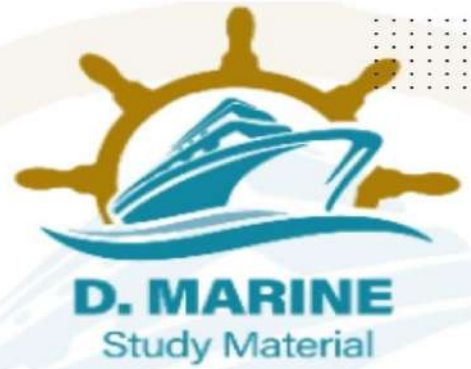
B. A 100 KVA transformer has 400 turns on the primary and 80 turns on the secondary. The primary
and secondary resistances are 0.3 Ω and 0.01 Ω respectively, and the corresponding leakage reactances are 1.1 Ω and 0.035 Ω respectively. The supply voltage is 2200 V. Calculate:

(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/JAN/Q8 2023/MAR/Q8 2023/JUNE/Q8 2024/JUN/Q7
Click Here to See the Answer

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. 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)
2023/JAN/Q9 2023/JUNE/Q9 2023/OCT/Q9 2024/JUN/Q8
Click Here to See the Answer

Q9. A. With the aid of delta and star connection diagrams, state the basic equation from which 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. (10)
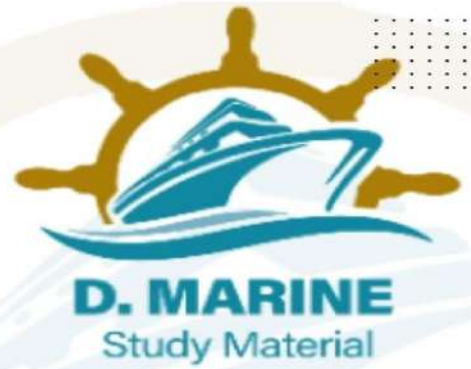i. Battery A 105 V, Internal resistance 0.25 ohm
ii. Battery B 100 V, Internal resistance 0.2 ohm
iii. Battery C 95 V, Internal resistance 0.25 ohm
Determine the current values in the two resistors and the power dissipated by them.

2023/JAN/Q10 **2023/JUNE/Q10** **2023/OCT/Q10** **2024/JUN/Q9**
Click Here to See the Answer

Q10. A. Compare the effectiveness of a current limiting circuit breaker with that of a HRC fuse. (6)
B. A coil having a resistance of 10 Ohm, and an inductance of 0.15 H is connected in series with a capacitor across a 100 V, 50 Hz 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? (10)
2023/SEP/Q10 **2024/MAR/Q10** **2024/JUN/Q10**
Click Here to See the Answer

JUL-2024

SECTION – I
Q1. A. Give a brief outline of the care and maintenance that should be given to the stator and rotor of an A.C. generator. (8)
B. Explain what is likely to occur if the driving power of one A.C. generator suddenly fails when two generators are running in parallel. What safety devices are usually provided for such events? (8)
2022/OCT/Q1 **2023/APR/Q1** **2024/JUL/Q1**
Click Here to See the Answer

Q2. Compare methods of obtaining speed regulation of three-phase induction motors generally used in tankers by means of:
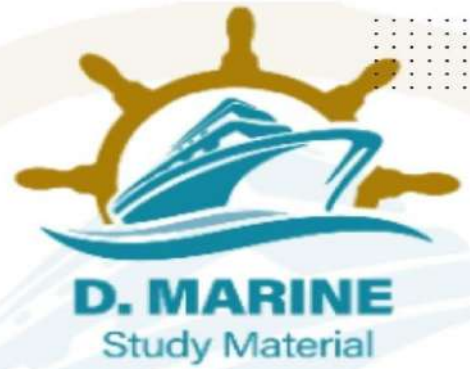A. Rotor resistance.
B. Cascade system.
C. Pole-changing.
Give examples where each system may be employed with advantage. (16)

2023/APR/Q2 2024/JUN/Q2 2024/JUL/Q2
Click Here to See the Answer

Q3. A. Explain how the efficiency and regulation of a transformer can be assessed by open circuit and short circuit tests? (8)
B. What is meant by equivalent resistance? (4)
C. What is meant by all day transformer efficiency? (4)
2024/JUL/Q3
Click Here to See the Answer

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/Q4 2023/JUNE/Q4 2023/SEP/Q4 2024/JUN/Q3
2024/JUL/Q4
Click Here to See the Answer

SECTION – II
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)
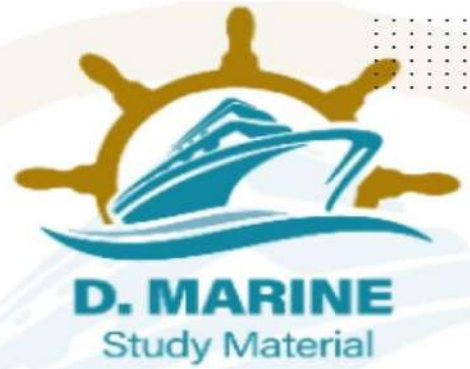2022/JUN/Q6 2023/APR/Q6 2023/JUNE/Q6 2024/JUL/Q6
Click Here to See the Answer
Q7. A. Electric motors contain a stationary member as well as a rotating member. For each of the following machines, identify in which part of the motor three field winding and the armature winding are located: three phase 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) 2023/APR/Q7 2024/JUL/Q7

Q8. 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 KVAr load on A, the power factor of operation on each machine and the current loading of each machine. (10) 2022/APR/Q9 2023/APR/Q8 2024/JUL/Q8

Q9. A. Explain the preference for a 60 Hz system. Describe the dangers of running a 50 Hz system from a 60 Hz supply. (6)
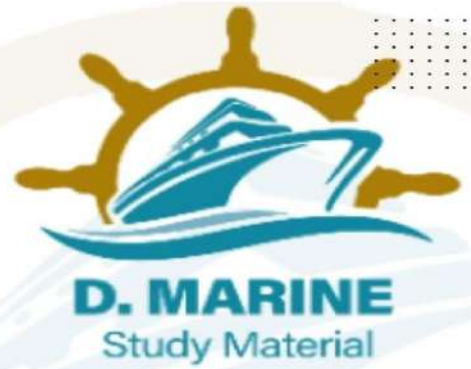
B. A ring-main, 900m long, is supplied at a point A at a p.d. of 220V. At a point B, 240m from A, a load of 45A is drawn from the main, and at a point C, 580m from A, measured in same direction, a load of 78A is taken from the main. If the resistance of the main (lead and return) is 0.25 ohm per kilometre, 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) 2022/APR/Q10 2023/APR/Q9 2024/JUL/Q9

Q10. A. (i) What is direct-connected alternator? (3)
(ii) How is a direct-connected exciter arranged in an alternator? (3)
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 100A at a p.f of
0.8 lagging, with a terminal voltage of 200V. (10)
2023/APR/Q10 **2024/JUL/Q10**
Click Here to See the Answer

AUG-2024
SECTION – I

Q1. a) Describe the working principle of a Programmable Logic
Controller (PLC) used in ship automation systems. How does a PLC
enhance the safety and efficiency of shipboard operations? (8)
b) Explain the process of programming a PLC for an emergency
shutdown sequence on a marine engine. What considerations
should be taken into account to ensure reliable operation in critical
situations? (8)
2024/AUG/Q1
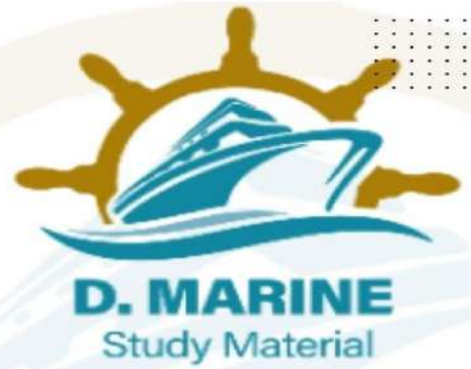**Click Here to See the Answer**

Q2. a) Explain the construction and working principle of three-
phase induction motor used on ships. How is the direction of
rotation of the motor reversed? (8)
b) Discuss the maintenance procedures for an electric propulsion
motor on a ship. What common faults can occur in the motor, and
how would you diagnose and repair them? (8)
2024/AUG/Q2
Click Here to See the Answer

Q3. With reference to electronic control systems
A. Draw a simple block diagram for temperature control. (8)
B. Describe each component shown in the diagram in (a). (8)
2023/OCT/Q2 **2024/JAN/Q5** **2024/MAR/Q2** **2024/JUN/Q1**
Click Here to See the Answer

Q4. a) Explain the concept of power factor in electrical systems. Why is it important to maintain a high- power factor on board a ship? (8)
b) Discuss the methods used to correct power factor on ships. How does power factor correction improve the efficiency of the electrical system? (8)
2024/AUG/Q4
Click Here to See the Answer

Q5. Explain the matching of an induction electric motor to a pump required for main circulating duty, with the aid of pump characteristic and torque/ship diagrams. (16)
2022/NOV/Q2 **2024/FEB/Q3** **2024/AUG/Q5**
Click Here to See the Answer

SECTION – II

Q6. A. Explain what is meant by the terms wave form, frequency and average value. (6)
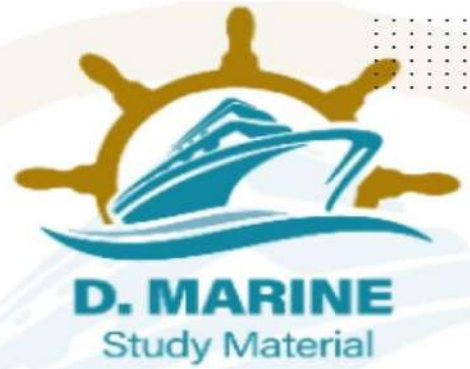B. A moving coil ammeter, a thermal ammeter and a rectifier are connected in series with a resistor across a 110 V sinusoidal a.c. supply. The circuit has a resistance of 50 Ω to current in one direction and, due to the rectifier, an infinite resistance to current in the reverse direction. Calculate:
(i) The readings on the ammeters.
(ii) The form and peak factors of the current wave. (10)

D. MARINE
Study Material

2024/JUN/Q6 **2024/AUG/Q6**
Click Here to See the Answer

Q7. A. Why is it important to maintain high efficiency of operation and low values of voltages regulation for 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/Q8 **2023/JUNE/Q8** **2024/JUN/Q7** **2024/AUG/Q7**
Click Here to See the Answer

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)
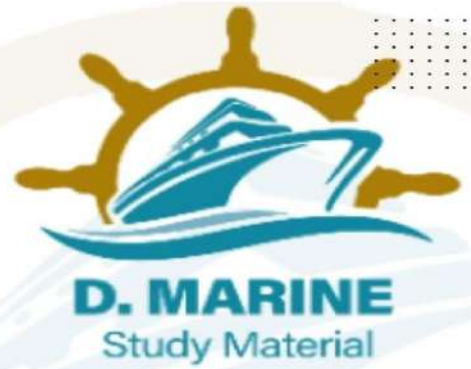B. The low-voltage release of an A.C. motor-starter consists of a solenoid into which an iron plunger is drawn against a spring. The resistance of the solenoid is 35 ohms. When connected to a 220 V, 50 Hz, A.C. supply the current taken is at first 2 A, and when the plunger is drawn into the "full-in" 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)
2023/JUNE/Q9 **2023/OCT/Q9** **2024/JUN/Q8** **2024/AUG/Q8**
Click Here to See the Answer

Q9. A. With the aid of delta and star connection diagrams, state the basic equation from which 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. (10)

i. Battery A 105 V, Internal resistance 0.25 ohm
ii. Battery B 100 V, Internal resistance 0.2 ohm
iii. Battery C 95 V, Internal resistance 0.25 ohm

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

2023/JUNE/Q10 **2023/OCT/Q10** **2024/JUN/Q9** **2024/AUG/Q9**
Click Here to See the Answer

Q10. A. Compare the effectiveness of a current limiting circuit breaker with that of a HRC fuse. (6)

B. A coil having a resistance of 10 Ohm, and an inductance of 0.15 H is connected in series with a capacitor across a 100 V, 50 Hz 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? (10)

2022/MAR/Q10 **2023/SEP/Q10** **2024/MAR/Q10**
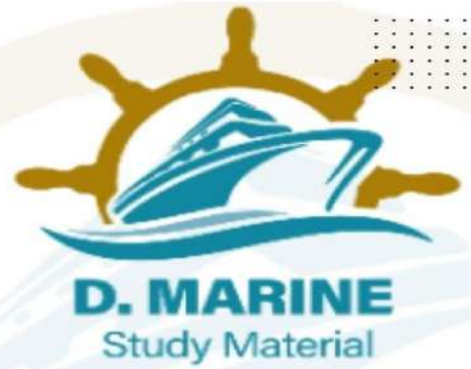**2024/JUN/Q10**
2024/AUG/Q10
Click Here to See the Answer

SEP-2024
SECTION – I

Q1. a) Explain the construction and the periodic maintenance required of a Vacuum Circuit Breaker (VCB). (8)

b) Compare the construction, operation, and usage of Vacuum Circuit Breakers (VCB) with Air Circuit Breakers (ACB). (8) **2024/SEP/Q1**

Click Here to See the Answer

Q2. a) Explain the construction and working principle of Star-Delta Starter with the help of circuit diagram. What are the advantages and limitations of using a Star-Delta Starter for starting an induction motor. (10)
b) Describe the maintenance procedures for a motor starter. What are the common faults, and how would you troubleshoot them. (6) **2024/SEP/Q2**

Click Here to See the Answer

Q3. Explain the methods used to control the speed of a 3 Phase induction motors. Draw and Explain a
Variable Frequency Drive used for optimization of energy efficiency of auxiliary machineries on board vessels. (16)
2022/APR/Q1 **2022/JUL/Q2** **2023/NOV/Q1** **2024/SEP/Q3**
Click Here to See the Answer

Q4. What is the meant by "excitation" in an alternator? With the help of a neat diagram of brushless alternator labelling all the important parts. explain how the excitation is achieved in a brushless alternator. (16)
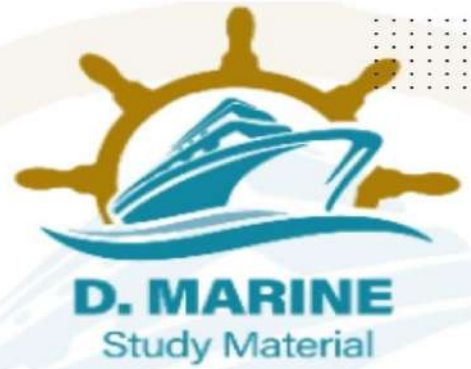**2022/MAR/Q2** **2022/JUN/Q4** **2023/NOV/Q3** **2024/SEP/Q4**
Click Here to See the Answer

Q5. a) Explain the construction, working principle, and characteristics of a Zener Diode. Discuss its applications in electronic circuits. (8)

b) What is a Zener Barrier? With the help of a diagram, explain how a Zener Barrier works in an intrinsic Safe Circuit and discuss its importance in hazardous environments. (8)

2024/SEP/Q5

Click Here to See the Answer

SECTION – II

Q6. A. What are the characteristics of PN junction diode? Point out its specifications. Also point out the significance of dynamic and static resistances. (6)

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 the ensure that the transformer does not become overloaded. (10)

2024/SEP/Q6

Click Here to See the Answer

Q7. A. Which of the following three motors has the poorest speed regulation: shunt motor, series Motor or cumulative compound motor? Explain. (6)
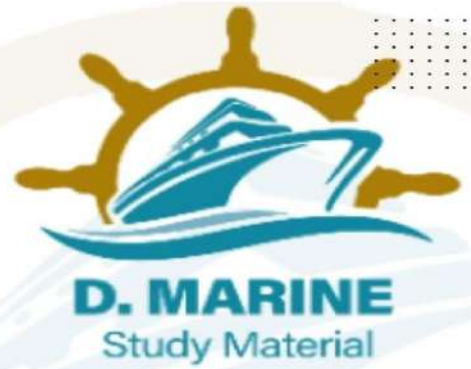
B. A 440V shunt motor takes an armature current of 30A at 700 rev/min. The armature resistance is 0.7ohm. If the flux is suddenly reduced by 20 per cent, to what value will the armature current rise momentarily? Assuming unchanged resisting torque to motion, what will be the new steady values of speed 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)

2022/OCT/Q10 **2023/MAR/Q10** **2024/SEP/Q7**

Click Here to See the Answer

Q8. A. 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. (10)

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.

2022/APR/Q7 2022/JUN/Q8 2024/SEP/Q8

Click Here to See the Answer

Q9. A. What are the factors which determine the synchronous speed of a motor? (6)

B. Three conductors fitted side by side in the stator of a salient-pole alternator. Each generates 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)

2021/DEC/Q8 2024/SEP/Q9

Click Here to See the Answer

Q10. A. Compare the effectiveness of a current limiting circuit breaker with that of a HRC fuse. (6)

B. A coil having a resistance of 10 Ohm, and an inductance of 0.15 H is connected in series with a capacitor across a 100 V, 50 Hz 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? (10)
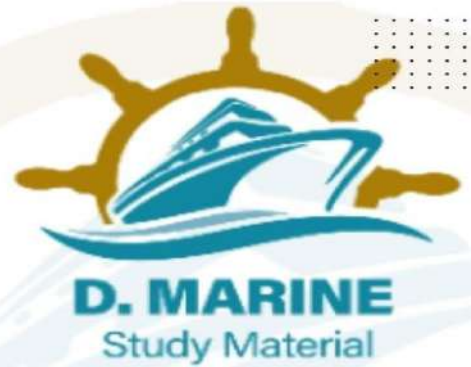
2023/SEP/Q10 2024/MAR/Q10 2024/JUN/Q10 024/AUG/Q10 2024/SEP/Q10

Click Here to See the Answer

OCT-2024
SECTION – I

Q1. With reference to electronic control systems
A. Draw a simple block diagram for temperature control. (8)
B. Describe each component shown in the diagram in (a). (8)

2024/JAN/Q5 2024/MAR/Q2 2024/JUN/Q1 2024/AUG/3 2024/OCT/Q1

Click Here to See the Answer

Q2. A. Describe a brush less alternator with a.c. exciter static A.V.R. (8)
B. State the output voltage characteristics for this type of machine. (8)

2022/APR/Q4 2023/JAN/Q2 2023/OCT/Q2

Click Here to See the Answer

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)
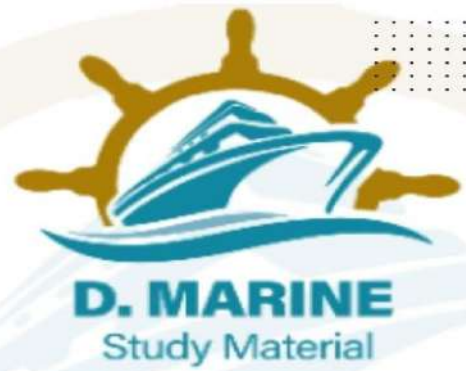(i) Reduced torque from the prime mover of one machine.
(ii)Reduced excitation on one machine.

2023/JUNE/Q1 2023/AUG/Q3 2023/SEP/Q1 2024/OCT/Q3

Click Here to See the Answer

Q4. Explain the effect of reduced voltage on standard squirrel cage motors with respect to EACH of the
following: (16)
(a) Burn outs
(b) Starting current
(c) Starting torque
(d) Speed.
2023/MAR/Q5 **2024/OCT/Q4**
Click Here to See the Answer

Q5. With the aid of a block diagram, briefly describe the effect which negative voltage feedback has on
an amplifier and state the advantages resulting from the use of negative feedback. (16)
2024/OCT/Q5

Q6.a) What is the effect on the field flux of an alternator current in the synchronous motor that leads the terminal voltage. (6)
b) A 1,000-kVA, 11,000-V, 3-ɸ, star-connected synchronous motor has an armature resistance and reactance per phase of 3.5 Ω and 40 Ω respectively. Determine the induced e.m.f. and angular retardation of the rotor when fully loaded at
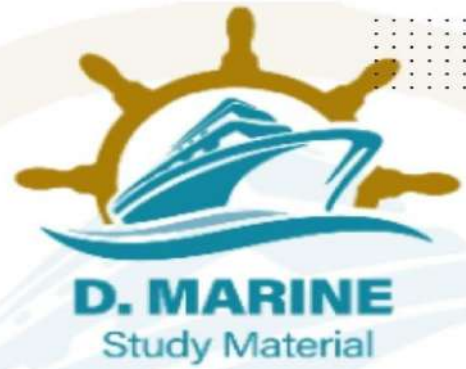(a) unity p.f.
(b) 0.8 p.f. lagging
(c) 0.8 p.f. leading. (10)
2024/OCT/Q6
Click Here to See the Answer

Q7.a) Explain the process of voltage buildup in a self-excited shunt generator. (6)

b) A shunt-wound generator has a magnetisation-curve given by the figures below. The total resistance in the field circuit is 20 Ohm and the armature resistance is 0.02 Ohm. With the machine on load, estimate the e.m.f. generated and the armature current when the terminal voltage of the machine is 140V. (10)

Field current (I)_amperes	1.2	2.8	5.0	7.0	7.7	9.0	11.0
Generated e.m.f. (e)_Volts	46	88	126	149	154	162	168

2024/OCT/Q7
Click Here to See the Answer

Q8. a) Explain how excitation of the rotor is produced and supplied. (6)

b) A 75-kW, 400-V, 4-pole, 3-phase star connected synchronous motor has a resistance and synchronous reactance per phase of 0.04 Ohm and 0.4 Ohm respectively. Compute for full-load 0.8 p.f. lead the open circuit e.m.f. per phase and mechanical power developed. Assume an efficiency of 92.5%. (10)
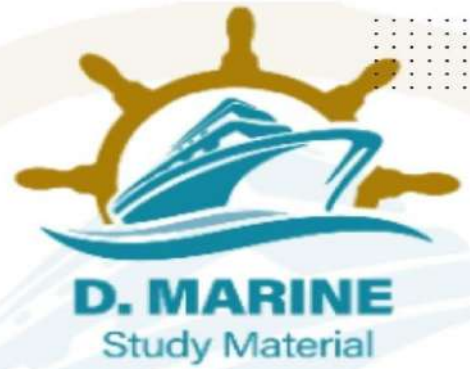
2024/OCT/Q8
Click Here to See the Answer

Q9.a) Explain the principles of A.C. Motors starting and speed control, including the effect on efficiency. (6)

b) A 3-phase induction motor has a 4-pole, Y-connected stator winding. The motor runs on 50-Hz supply with 200V between lines. The motor resistance and standstill reactance per phase are 0.1 Ω and 0.9 Ω respectively. Calculate (a) the total torque at 4% slip (b) the maximum torque

(c) the speed at maximum torque if the ratio of the rotor to stator turns is 0.67. Neglect stator impedance. (10)

2024/OCT/Q9

Click Here to See the Answer

Q10.a) Draw the complete phasor diagram of the transformer under no-load conditions. (6)

b) The following results were obtained on a 50 KVA transformer: open circuit test-primary voltage, 3300 V. secondary voltage, 415 V. primary power, 430 W. Short circuit test primary voltage, 124 V. primary current, 15.3 A. primary power, 525 W. secondary current full load value. Calculate: (10)

(i) The efficiencies at full load and at half load for 0.7 power factor

(ii) The Voltage regulations for power factor 0.7 (i) lagging, (ii) leading

(iii) The secondary terminal voltages corresponding to (i) and (ii)

2024/OCT/Q10

Click Here to See the Answer

NOV -2024
SECTION – I

Q1. A. Explain why it is necessary to have reverse power protection for alternators intended for operation. (4)

B.(i) Sketch a reverse power trip. (6)

(ii) Briefly explain the principle on which the operation of this power trip is based and how tripping is activated. (6)
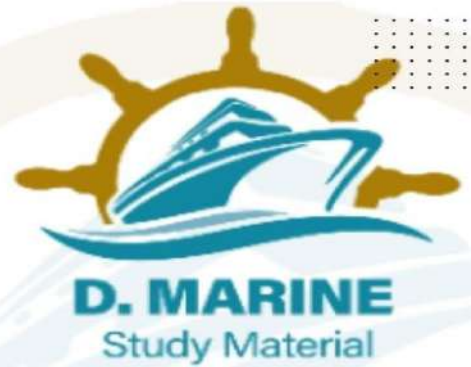
2023/JAN/Q1 **2024/NOV/Q1**

Click Here to See the Answer

Q2. A. Describe a brush less alternator with a.c. exciter static A.V.R. (8)

B. State the output voltage characteristics for this type of machine. (8)

2022/APR/Q4 2023/JAN/Q2 2023/OCT/Q2

Click Here to See the Answer

Q3. With the aid of sketch describe the main features and principle of operation of a D.C. moving coil meter. If such a meter is designed to give full scale deflection with 150 m, State how it may be adapted:
(i) As an ammeter to read up to 150 A: (ii) As a voltmeter to read up to 150 V. No calculations are required. (16)

2023/JAN/Q3 2024/NOV/Q3

Click Here to See the Answer

Q4. With reference to U.M.S. operation:
A. State with reasons the essential requirements for unattended machinery spaces. (8)
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. (8)

2022/APR/Q2 2023/JAN/Q4 2024/FEB/Q2 2024/NOV/Q4

Click Here to See the Answer

Q5. With reference to preferential tripping in a marine electrical distribution system.
A. State why this facility is required. (6)
B. With the aid of a sketch, describe a typical arrangement to provide three stages of tripping an instantaneous protection against short circuit. (10)
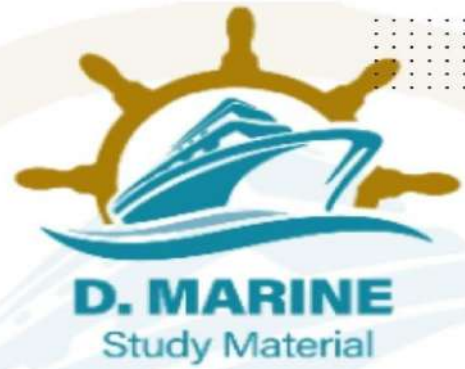
2022/FEB/Q5 2022/JUL/Q4 2023/JAN/Q5 2024/NOV/Q5

Click Here to See the Answer

SECTION – II

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)

2023/APR/Q6 2023/JUNE/Q6 2024/JUL/Q6 2024/NOV/Q6
Click Here to See the Answer

Q7. A. By means of a schematic circuit diagram illustrate the peak rectifier. If the supply voltage is v(t) = VmSin⁏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)

Supply Voltage
$v = 200\ sin\ \omega t$

R

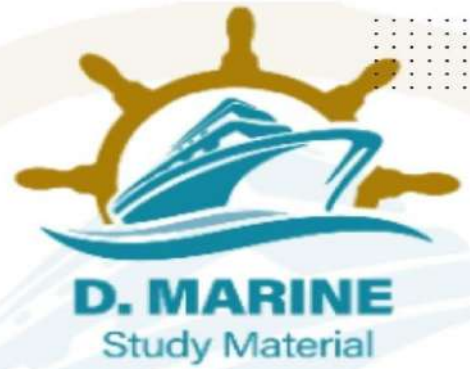100 V
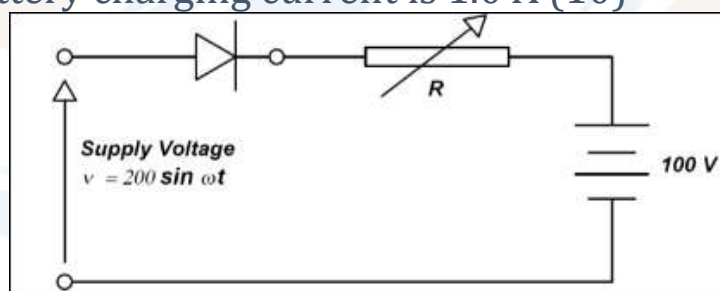
2023/JAN/Q7 2023/MAR/Q7 2023/JUNE/Q7 2024/NOV/Q7
Click Here to See the Answer

Q8. A. Why is it important to maintain high efficiency of operation and low values of voltage regulation for 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/Q8 2023/JUNE/Q8 2024/JUN/Q7 2024/AUG/Q7 2024/NOV/Q8

Click Here to See the Answer

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)

**2023/JAN/Q9 2023/JUNE/Q9 2023/OCT/Q9 2024/JUN/Q8 2024/AUG/Q8 2024/NOV/Q9**

Click Here to See the Answer

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.
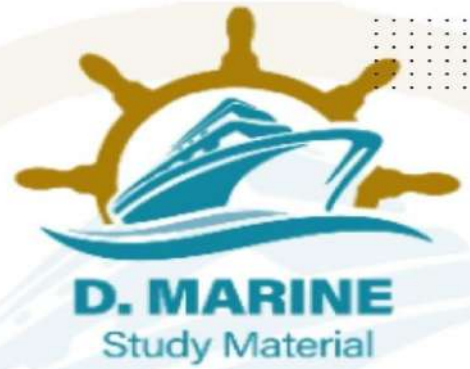
Battery A 105 V, Internal resistance 0.25 ohm
Battery B 100 V, Internal resistance 0.2 ohm
Battery C 95 V, Internal resistance 0.25 ohm
Determine the current values in the two resistors and the power
dissipated by them. (10)
2023/OCT/Q10 2024/JUN/Q9 2024/AUG/Q9 2024/NOV/Q10
Click Here to See the Answer

DEC-2024

SECTION – I

Q1. With reference to a three-phase shipboard electrical
distribution system: (16)
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/Q4 2024/MAR/Q5 2024/DEC/Q1
Click Here to See the Answer

Q2. a) i. Describe the characteristics of a D.C. motor. (8)
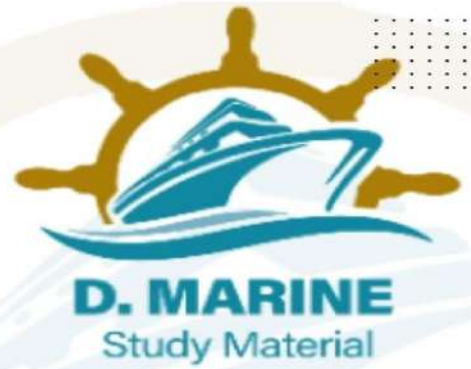ii. Explain the advantages of such a motor for deck machinery.
b) Describe with the aid of a sketch a control system for the motor
in (A). (8)
2024/DEC/Q2
Click Here to See the Answer

Q3. List at least two 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/DEC/Q3
Click Here to See the Answer

Q4. Differentiate with the aid of simple sketches between two of the following types of electronic circuits.
A. Rectifier circuit (6)
B. Amplifier circuit (5)
C. Oscillator circuit (5)
2024/FEB/Q1 **2024/DEC/Q4**
Click Here to See the Answer

Q5. 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)
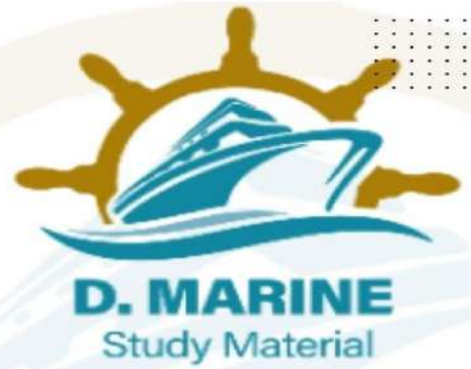**2022/DEC/Q1** **2024/DEC/Q5**
Click Here to See the Answer

SECTION – II

Q6. A. Explain what is meant by the terms wave form, frequency and average value. (6)
B. A moving coil ammeter, a thermal ammeter and a rectifier are connected in series with a resistor across a 110 V sinusoidal A.C. supply. The circuit has a resistance of 50 Ω to current in one direction and, due to the rectifier, an infinite resistance to current in the reverse direction. Calculate:

(i) The readings on the ammeters.
(ii) The form and peak factors of the current wave. (10)
2024/JUN/Q6 2024/AUG/Q6 2024/DEC/Q6
Click Here to See the Answer

Q7. A. What is leakage flux as it applies to the iron-core transformer? How is it taken into account in the analysis of the transformer? (6)
B. The following results were obtained on a 50 KVA transformer: open circuit test-primary voltage, 3300
V; secondary voltage, 415 V; primary power, 430 W. Short circuit test-primary voltage, 124 V; primary current, 15.3 A; primary power, 525 W; secondary current, full load value.
Calculate:
(i) The efficiencies at full load and at half load for 0.7 power factor
(ii) The Voltage regulations for power factor 0.7
(i) Lagging,
(ii) Leading
(iii) The secondary terminal voltages corresponding to (i) and (ii). (10)
2024/DEC/Q7
Click Here to See the Answer

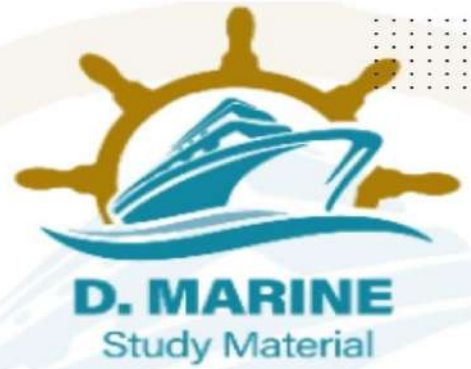Q8. A. What is Silicon controlled rectifier (SCR)? How is the breakover voltage of the SCR defined? (6)
B. A d.c. motor takes an armature current of 110 A at 480 V. The resistance of the armature circuit is 0.2Ω. The machine has six poles and the armature is lap-connected with 864 conductors. The flux per pole is 0.05 Wb. Calculate: (a) The speed; (b) The gross torque developed by the armature. (10)
2024/DEC/Q8
Click Here to See the Answer

Q9. A. List the factors that determine the maximum developed torque of the induction motor. (6)

B. The primary and secondary windings of a 500 KVA transformer have resistance of 0.42 Ω and 0.0019 Ω respectively. The primary and secondary voltages are 11000 V and 415 V respectively and the core loss is 2.9 kW, assuming the power factor of the load to be 0.8. Calculate the efficiency on

(i) Full load

(ii) Half load. (10)

2024/DEC/Q9

Click Here to See the Answer

Q10. A 100 kW, 460 V shunt generator was run as a motor on no load at its rated voltage and speed. The total current taken was 9.8 A, including a shunt current of 2.7 A. The resistance of the armature circuit at normal working temperature was 0.11Ω Calculate the efficiencies at i. Full load; ii. Half load. (16)

2024/DC/Q10

Click Here to See the Answer