# SAMUNDRA INSTITUTE OF MARITIME STUDIES

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## MEO CLASS 4

Function 5

## MARINE ELECTROTECHNOLOGY

# Quick Reference Notes

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**Q1. MAIN SWITCH BOARD (MSB) SAFETIES:**

**Ans- <u>Electrical safeties:</u>**

- Dead front type switchboard, Fuses, Relays, Circuit breakers, Earth fault indicators, Under voltage relay, Reverse power trip, Preferential trip, Over current trip, Short circuit trip, Arc chute, Ebonite Rod ( to remove static charge).

**<u>General safeties:</u>**

- Insulated hand gloves, dry boiler suits, shoes without metallic part, Rubber pad in front of switchboard, 0.6m gap behind switchboard, Panel doors to be earthed, interlocked handles for opening doors.
- No water, oil, or steam pipeline in its vicinity.

**Q2. DIFFERENCE BETWEEN BATTERY AND CELL.**

**Ans-** The difference between cells and batteries is that a cell is a single unit which converts chemical energy to electrical energy to deliver a voltage while a battery is composed of a number of cells in series to get increased voltage. A battery can therefore, also be referred to as cells.

**Q3. DIFFERENCE BETWEEN AC AND DC.**

| | AC | DC |
|---|---|---|
| **1.Amount of energy that can be carried** | Safe to transfer over longer city distances and can provide more power. | Voltage of DC cannot travel very far until it begins to lose energy. |
| **2. Cause of the direction of flow of electrons** | Rotating magnet along the wire. | Steady magnetism along the wire. |
| **3. Frequency** | The frequency of alternating current is 50Hz or 60Hz depending upon the country. | The frequency of direct current is zero. |
| **4. Direction** | It reverses its direction while flowing in a circuit. | It flows in one direction in the circuit. |
| **5. Current** | It is the current of magnitude varying with time. | It is the current of constant magnitude. |
| **6. Flow of Electrons** | Electrons keep switching directions -forward and backward. | Electrons move steadily in one direction or 'forward'. |
| **7. Obtained from** | A.C Generator and mains. | Cell or Battery. |
| **8. Passive Parameters** | Impedance | Resistance only |
| **9. Power Factor** | Lies between 0 & 1 | It is always 1. |
| **10. Types** | Sinusoidal, Trapezoidal, Triangular, Square. | Pure and pulsating. |

**Q4. STEERING GEAR SAFETIES.**

**Ans- Hydraulic safeties:**

- Level switch, low level, low low level alarm for hydraulic oil tank.
- Relief valve.
- Manual bypass valve.
- Low pressure valve.
- High lub oil temp. Cut out.
- Low level cut out

**Electrical safeties:**

- Electrical and mechanical stopper for rudder.
- Electrical motor overload alarm.
- Power failure alarm.
- High temp. Alarm.
- Self starting after power failure.
- Short-circuit trip.
- Phase failure alarm.
- 200% insulation in motor.

**Q5. WHAT IS PREFERENTIAL TRIP AND REVERSE POWER TRIP ?**

**Preferential trip:**

Preferential trip is a kind of electrical arrangement on ship which is designed to disconnect the non-essential circuit i.e. non-essential load from the main bus bar in case of partial failure or overload of the main supply The non-essential circuits or loads on ships are air conditioning, exhaust and ventilation fans, and galley equipment's which can be disconnected momentarily and can be connected again after fault finding. The main advantage of preferential trip is that it helps in preventing the operation of main circuit breaker trip and loss of power on essential services and thus prevents blackout and overloading of generator.

**Reverse power trip:**

There is not much difference between an alternator and electric motors from the engineer's perspective. They are both based on similar principles. So just imagine what would happen if an alternator suddenly would act as a motor. This is only possible in systems where two or more generators are running in parallel. Hence this type of protection system is used only if there is more than one alternator on board a ship. The system is designed in such a way that it will release the breaker and prevent motoring of alternator if a reversal of power occurs. This protection device is also used to prevent damage to the prime mover, which might be stopped due to some fault. Though it is extremely difficult to detect reverse current with an alternating current system, reverse power can be detected and protection can be provided by reverse power relay

**Q6. WHAT IS ACTIVE POWER AND REACTIVE POWER?**

**Ans-** Consider an ideal alternating current (ac) circuit consisting of a source and a generalized load, where both the current and voltage are sinusoidal. If the load is purely resistive, the two quantities reverse their polarity at the same time, the direction of energy flow does not reverse, and only real power flows. If the load is purely reactive, then the voltage and current are 90 degrees out of phase and there is no net power flow. This energy flowing backwards and forwards is known as reactive power.

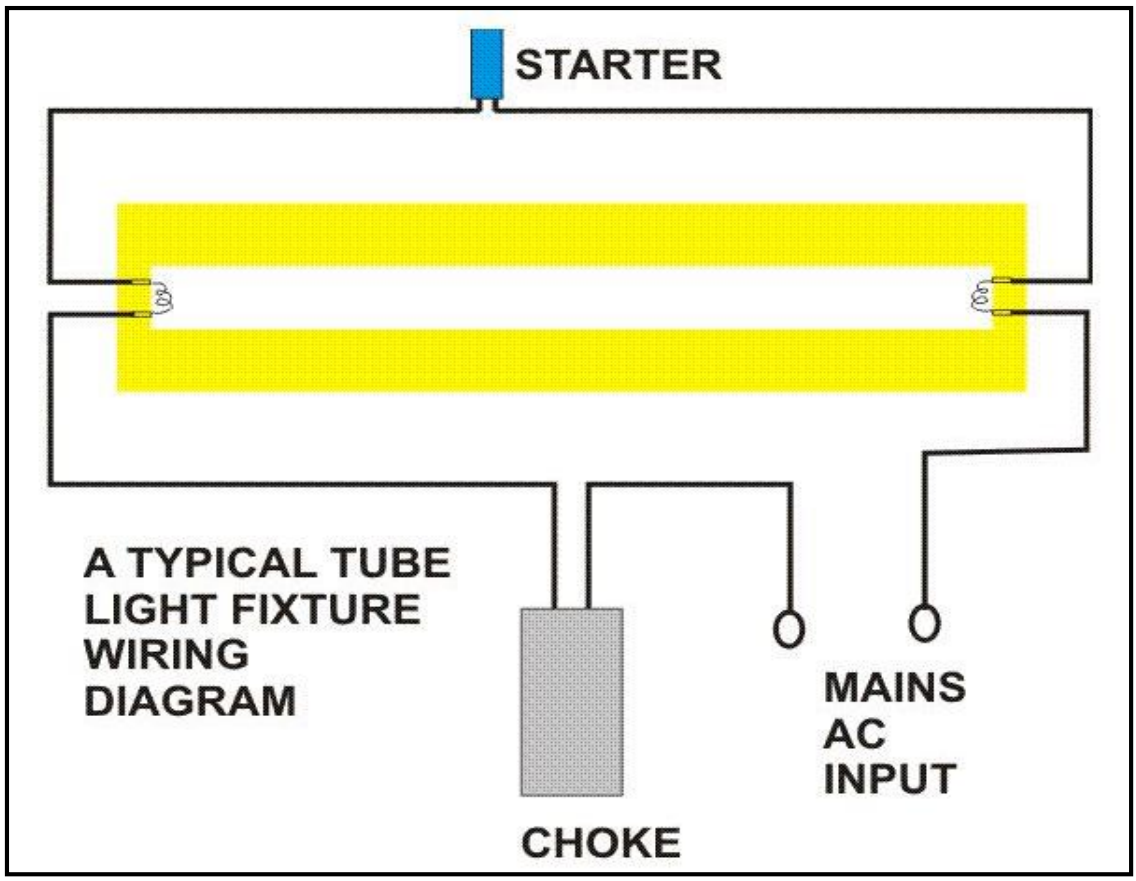
Since there is no any power loss when current flows through the pure inductor or capacitor, but the energy is stored in the form of magnetic field(in inductor) or static field (in capacitor). So the reactive power is the power used for magnetizing or is stored in capacitor in the form of static field.

Actually no any system is loss less. So active power is the power that is lost in the form of heat in the system or we can say active is the power used in the system to compensate for loss.

**Q7. HOW TUBE LIGHT WORKS?**

**Ans-** A fluorescent lamp basically consists of a long glass gas discharge tube. Its inner surface is coated with phosphorous and is filled with an inert gas, generally argon, with a trace of mercury. The tube is then finally sealed at low pressure with two filament electrodes each at its both ends. These electrode filaments are used to preheat the tube and initiate a rapid conduction of electrons between the two end electrodes. The process initially requires a relatively high amount of power. The energy also converts some of the mercury from a liquid to a glass. Electrons then collide with the gaseous mercury atoms, increasing the amount of energy. As electrons return to their original energy level, they begin to release light. However, the light they emit is ultraviolet, and not visible to the naked eye, so another step needs to take place before we can see the light. This is why the tube was coated with phosphorous. Phosphors will give off light when exposed to light. When exposed to the ultraviolet light, the particles emit a white light which we can see. Once the conduction of electrons between the electrodes is complete, no more heating of the filaments is required and whole system works at a much lower current

Here is one example of a tube light fixture consisting of a large heavy square "choke" or "ballast" and a small cylindrical "starter." Let's try to understand how the whole system works. Please refer to the circuit diagram on the right as you read the following points: The choke is in fact a large inductor. It consists of a long copper winding over iron laminations. An inductor by nature always has a tendency to throw back the stored current in it, every time the power through it is switched OFF. This principle of the choke is exploited in lighting a fluorescent tube light. When an AC voltage is applied to a tube light fixture, the voltage passes through the choke, the starter, and the filaments of the tube. The filaments light up and instantly warm up the tube. The starter is made up of a discharge bulb with two electrodes next to it. When electricity passes through it an electrical arc is created between the two electrodes. This creates light, however the heat from the bulb causes one of the electrodes (a bimetallic strip) to bend, making contact with the other electrode. This stops the charged particles from creating the electrical arc that created light. However, now that the heat from the light is gone, the bimetallic strip cools and bends away from the electrode, opening the circuit again. At this point, the ballast or choke "kick's back" it's stored current, which again passes through the filaments and ignites the tube light once again. If the tube does not sufficiently charge up, subsequent kicks are delivered by the choke due to rapid switching of the starter, so that finally the tube strikes. After this the choke only acts like a low impedance current limiter to the tube as long as the light is kept illuminated.




**Q8. E/R CRANE SAFETIES AND WORKING OF DRUM WHEN POWER FAILS.**

**Ans- <u>Overhead crane safeties:</u>**

1) The most important safety feature of the crane is the electromagnetic fail safe brakes which do not allow the crane to fall with the load even when there is failure of power. For this:

- Normally centrifugal brakes are used which are fitted inside the rotating drum.
- The brake pads are always in applied state and pushed by magnetic springs when not in operation or when there is a power failure.
- As the crane is operated or the power is supplied, the spring gets pulled inward or compressed due to the electromagnetic effect of the current. This allows the crane to be operated normally.

2) Emergency stop is provided in the remote so that the operator can stop the crane at any time.

3) The motor is fitted with distance limit switch in both transverse and longitudinal direction

4) Mechanical stoppers are provided for both directions in case the electrical distance limit trips fail.

5) The up and down travel of the hook is also attaches with automatic stopper to avoid overloading of the motor.

6) The motor is fitted with thermal protection trip. When the motor windings get overheated, trip will

activate saving the motor winding from burning.

7) Load limit switch is also fitted which will trip the motor if the load to be lifted is above the crane capacity.

8) It's the responsibility of senior officers to operate the crane and to make sure all the personnel involve in any lifting operation are at a safe distance during operation of the crane.

9) Additional tools like i-bolts, shackle, wire sling, belts etc. used for lifting must be checked before use.

10) It should be noted that no one walks or stand below the crane when it is in the loaded condition.

**Working of brake drum when power fails:-**

1) **Electromagnetic brakes:**
   The main parts of an electromagnetic brakes are:
   - The brakes shoes, which are connected to two levers,
   - The spiral springs, which are connected to the levers, and
   - The electromagnetic solenoid, which is connected to the two levers.

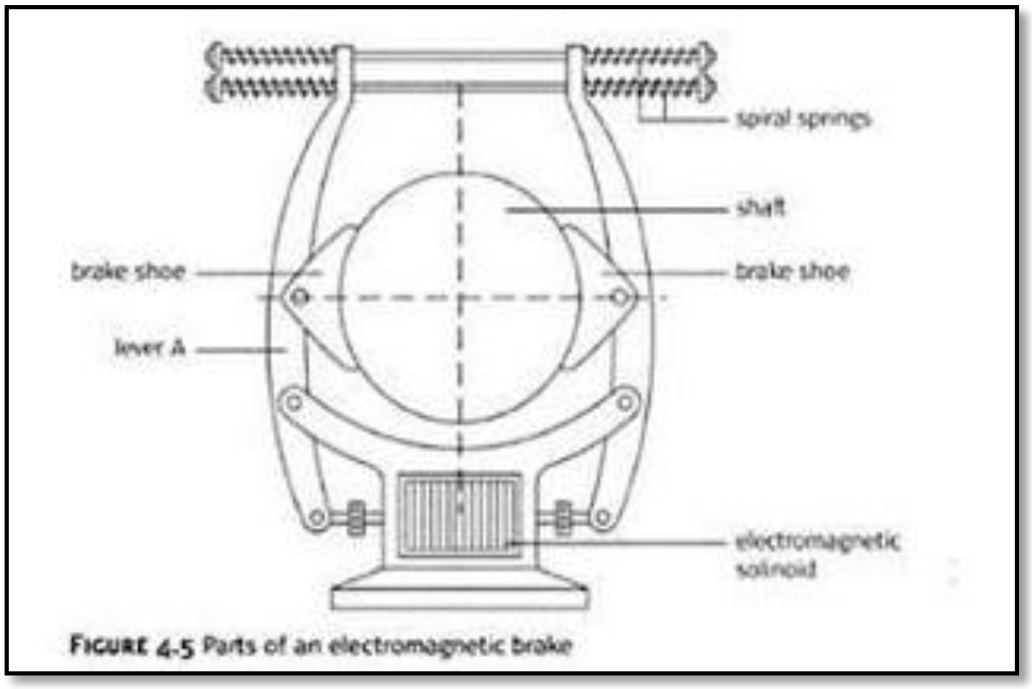


FIGURE 4-5 Parts of an electromagnetic brake

Electromagnetic brakes are usually found on machines like cranes and lifts and they work as back up braking systems. These brakes only work when the electricity supply stops, to make sure that, for example, the load carried by the crane, or the lift that moves up and down in a building does not fail. If the load that the crane or the lift was carrying fell, it could cause serious damage tom property, as well as serious injuries or even death to people underneath the load or in the lift. The braking action of an electromagnetic brake works as follows:

- When the electricity is flowing, the electromagnetic solenoid uses magnetic force to pull the two levers in towards it, which keeps the springs attached to the top of the levers open.
- The open springs keeps the brake shoes, which are positioned on each shoes, which are

positioned on each side of a shaft, away from the shaft while it is turning.

- When the electricity stops flowing, the electromagnetic solenoid stops working, with the magnetic force gone, the spiral springs closes, which pushes the brakes shoes against the shaft to stop it from tuning.

2) **Thrust Brakes:**

The main parts of a thruster brake system are:

- The hydraulic centrifugal pump, which is connected to a thruster piston.
- The thruster piston which is connected to the pump and to the braking springs.
- The braking springs, which are connected to the piston.
- The friction pads and
- The brake disc

**Q9. TYPES OF CIRCUIT BREAKERS?**

**Ans-** According different criteria there are different types of circuit breaker.

- **According to their arc quenching media the circuit breaker can be divided as-**

1) Oil circuit breaker.

2) Air circuit breaker.

3) SF circuit breaker.

4) Vacuum circuit breaker.

- **According to their services the circuit breaker can be divided as-**

1) Outdoor circuit breaker

2) Indoor breaker.

- **According to the operating mechanism of circuit breaker they can be divided as-**

1) Spring operated circuit breaker.

2) Pneumatic circuit breaker.

3) Hydraulic circuit breaker.

- According to the voltage level of installation types of circuit breaker are referred as-

1) High voltage circuit breaker.

2) Medium voltage circuit breaker.

3) Low voltage circuit breaker.

**Q10. CAPACITOR, RESISTOR AND INDUCTOR AND ITS USES.**

**Ans: Capacitors** are components that are used to store an electrical charge and are used in timer circuits.

A capacitor may be used with a resistor to produce a timer. Sometimes capacitors are used to smooth a current in a circuit as they can prevent false triggering of other components such as relays. When power is supplied to a circuit that includes a capacitor - the capacitor charges up. When power is turned off the capacitor discharges its electrical charge slowly.

**Uses of capacitors are** energy storage, pulsed power, filter circuit, sensors, motor starters etc.

**Inductor**, also called a coil or reactor, is a passive two-terminal electrical component which resists changes in electric current passing through it. It consists of a conductor such as a wire, usually wound into a coil. When a current flows through it, energy is stored temporarily in a magnetic field in the coil. When the current flowing through an inductor changes, the time-varying magnetic field induces a voltage in the conductor, according to Faraday's law of electromagnetic induction , which opposes the change in current that created it. An inductor is characterized by its inductance, the ratio of the voltage to the rate of change of current, which has units of henries (H). Inductors have values that typically range from 1 μH (10 −6 H) to 1 H.

**Uses of Inductors are** analogy circuits, signal processing, transformers, limit fault currents etc.

The electrical **Resistance** of an electrical conductor is the opposition to the passage of an electric current through that conductor. The SI unit of electrical resistance is the ohm ( Ω ).

The resistance (R) of an object is defined as the ratio of voltage across it ( V) to current through it ( I).

**Uses of resistors are** light bulbs, fuse, voltmeters, potentiometers, digital circuits, voltage stabilizers.

**Q11. BATTERY DETAILS, CAPACITY, RATING CHARGING AND DISCHARGING.**

**Ans:** The voltage of a lead acid battery when at rest (not supplying current or being charged) will vary according to how fully charged the battery is. The graph shown to the right represents a typical 24 volt lead acid battery which has not been charged or had current drawn from it for a couple of hours.

**Battery Discharge Characteristics**

A full charged battery will have a voltage of around 25.5 volts. As current is drawn off and the level of charge is reduced, the voltage will fall quite quickly at first (again it would be necessary to stop drawing current for a couple of hours to be able to measure the true voltage of the battery).

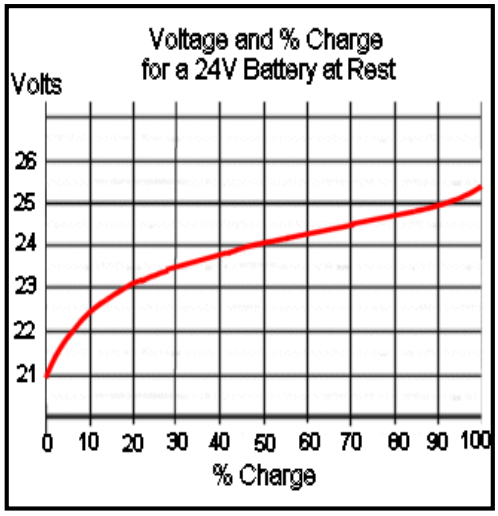
With further drawing of current, the rate of voltage drop slows down and will reach around 24.0 volts when the battery is at half capacity. As the battery approaches the fully discharged state, the voltage starts to fall more quickly again. It is important for a battery to never be fully discharged, so your inverter will normally disconnect the supply when the voltage is around 22 volts.

An interesting point to note here is that when an inverter or other power load is drawing a high current from the battery, the voltage will drop. This may mean that the battery needs to be somewhere over 50% charged to avoid the inverter cutting out due to low voltage. The larger the battery, the smaller this voltage drop will be, and the greater the % of the charge will be useable when drawing high currents.

**Battery Charging**

If a voltage is applied to the battery which is greater than the battery's voltage, a current will flow

through the battery in the reverse direction ~~to~~ when it is supplying current, and the battery will charge. The rate of charge or current that will flow will depend on the difference between the battery voltage and the voltage that is applied to it (from solar panels etc).




Solar panels intended for a 24 volt system are likely to be capable of producing over 30 volts. This voltage ensures that the panels are capable of charging the battery fully. While it is beneficial to a battery's performance and life to be fully charged on regular occasions, however once a battery has been charged to its full capacity, it is important not to continue charging as this will damage the battery. A Charge Controller is necessary to ensure that the battery is not over charged.

**Battery Efficiency**

The Lead Acid battery is not 100% efficient at storing electricity - you will never get out as much as you put in when charging. Overall, an efficiency level of 85% is often assumed. The efficiency will depend on a number of factors including the rate of charging or discharging. The higher the rate of charge or discharge, the lower the efficiency. The state of charge of the battery will also affect charge efficiency. With the battery at half charge or less, the charge efficiency may be over 90%, dropping to nearer 60% when the battery is above 80% charged.

However it has been found that if a battery is only partially charged, efficiency may be reduced with each charge. If this situation persists (the batteries never reaching full charge), the life of the battery may be reduced.

**Battery connections:-**

In the **SERIES CONNECTION**, batteries of like voltage and Amp-Hr capacity are connected to increase the Voltage of the battery bank. The positive terminal of the first battery is connected to the negative terminal of the second battery and so on, until the desired voltage is reached. The final Voltage is the sum of all the battery voltages added together while the final Amp-Hr, Cranking Performance and Reserve Capacity remain unchanged.

In **PARALLEL CONNECTION**, batteries of like voltages and capacities are connected to increase the capacity of the battery bank. The positive terminals of all batteries are connected together, or to a common conductor, and all negative terminals are connected in the same manner. The final voltage remains unchanged while the capacity of the bank is the sum of the capacities of the individual batteries of this connection. Amp-Hrs, Cranking Performance and Reserve Capacity increases while Voltage does not.

**BATTERY CAPACITY AND RATING**

The capacity of a battery is amount of charge available in ampere-hours (Ah).The capacity of a battery is measured by discharging at a constant current until it reaches terminal voltage (usually its 1.75volts). Those is usually done at constant temperature of 25 degree Celsius (77F). The capacity is calculated by multiplying the discharge current value by the time required to reach terminal voltage.

Another common term used is battery`s rated capacity. Manufacturers specify the rated capacity of a battery in Ah at a specified discharge rate. Battery capacity varies with discharge rate. The higher the discharge rate, lower is the battery capacity. Lower discharge rate results in higher capacity.

The rated capacity for lead acid batteries is usually specified at the 8, 10 or 20 hour rates.

**Q12. WHAT IS MEANT BY INTRINSICALLY SAFE?**

**Ans:** The theory behind intrinsic safety is to ensure that the available electrical and thermal energy in the system is always low enough that ignition of the hazardous atmosphere cannot occur. This is achieved by ensuring that only low voltages and currents enter the hazardous area, and that all electric supply and signal wires are protected by Zener safety barriers. Sometimes an alternative type of barrier known as a galvanic isolation barrier may be used. Ex- Walkie talkie, Two Radio communication equipment.

**Q13 INSULATED NEUTRAL SYSTEM AND EARTH NEUTRAL SYSTEM.**

**Ans: Insulated Neutral System:** When the neutral of the generator is completely insulated from earth or ship`s hull it is called insulated neutral system. It is very advantageous because it does not pose any danger to human life even if there is a single earth fault because the whole ship will be at same potential leading to no damage to machinery and life. N alarm system will detect this earth fault.

**Earthed Neutral System:** When the generators neutral is connected to the earth or ship`s hull it is called earth neutral system. A single fault can cause very large current to flow causing damage to the machinery. But still it is used in HV systems because if there is only one earth fault the machinery will trip and protect the equipment.

**Q14 EXPAIN INDUCTION MOTOR?**

**Ans.** Induction motor is an asynchronous AC motor in which supply is given to the stator and the rotor gets induced emf.

**Principle:**

When multi-phase supply is fed on the stator, it creates a rotating magnetic field. This induces an emf in the rotor and since the rotor is closed, a current passes through the rotor winding which creates a magnetic field.

The rotor magnetic field will act in such a manner so as to oppose the main magnetic field and hence the rotor will try to catch upon follow the rotating stator magnetic field. Finally the rotor will obtain a constant speed.

**Q15 SINGLE PHASING OF A 3 PHASE INDUCTION MOTOR?**

**Ans-**

- During normal running of a 3-phase induction motor, if by some chance one of the phase becomes opened, this effect of open circuit in 1 phase is called Single phasing.
- A running motor will continue to run with high current in other two phases or a physical damage to the motor due to disturbance in balanced supply.
- Stationary 3-phase motor will not start as two phases will not be able to provide rotating magnetic field.

## Q16 INSULATION OF MOTOR AND MEGGER TESTING?

**Ans.** Motors insulation is tested using a MEGGER. It is a portable instrument used to measure insulation resistance. It consists of a direct ohm meter and a hand driven DC generator or battery.

**Causes of insulation failure:**

1. Moisture
2. Dust and dirt deposits
3. Oil and grease
4. Vibration

**How to test:**

1. Short the two probes together and switch to "MΩ" and press the test button. The pointer should indicate approx. Zero.
2. Disconnect the motor from live power supply and lock off acc. to the standard procedure.
3. Confirm that a reliable earth connection is obtained by connecting the probes of 2 separate earth points on the equipment frame for low res. Continuity.
4. Measure and log the phase-to-phase insulation resistance values. (for eg. U-V, V-W, U-W).

## Q17 TESTS FOR REPAIRED MOTORS?

**Ans.** Following checks must be made before returning motor to service:

1. Check for 'open circuit', 'short circuit', 'Earth fault' and insulation resistance.
2. Check that windings have been connected correctly.
3. Do not connect a motor designed to run in DELTA in STAR formation.
4. Check the direction of rotation before connecting the motor to load.

## Q18 CIRCUIT FAULTS, HOW TO TEST AND EFFECTS?

**Ans:**

- An Open circuit fault will not allow the motor to start. If the fault occurs in 1 phase when the motor is running, the current in other two phases will increase and burn out the motor.
- A Short circuit fault will cause high current to flow in the windings which may burn out.
- An earth fault provides an easy path for current to flow through the wires and earth.

- How to check these faults for a removed motor:

**OPEN Circuit:** Earth one end of the wire and using multimeter or megger switched to res. Value, check between wire at different points and earth. Resistance should show minimum value.

**EARTH fault:** Open circuit where possible and check the res. Between wire near "open" ends and earth. Resistance should show maximum value.

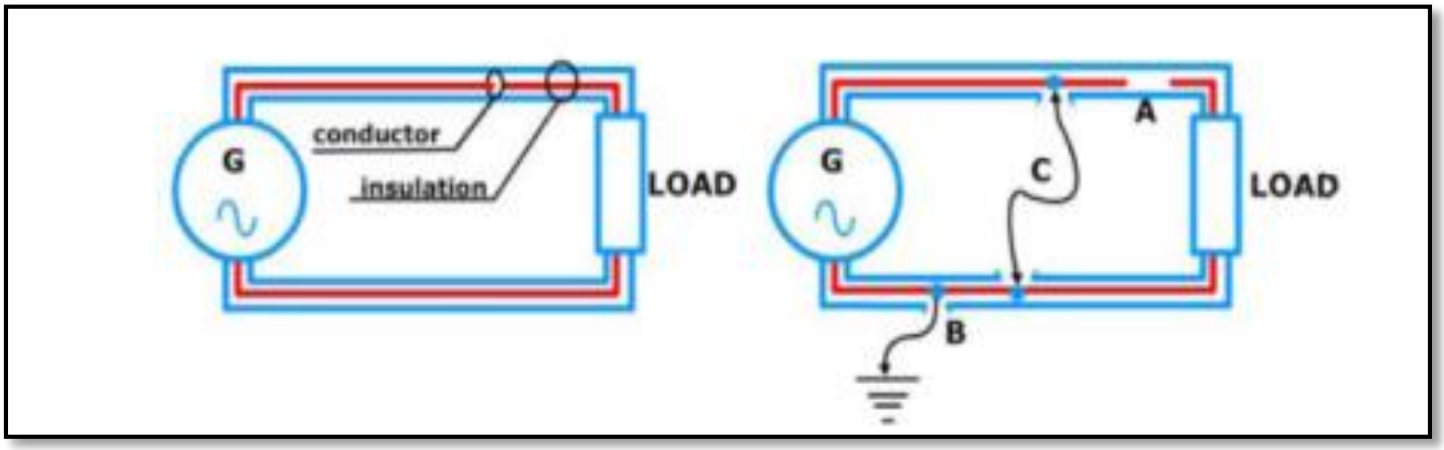
**SHORT circuit fault:** Remove the terminals at the panel. Turn all switches for that circuit to ON position. Check for resistance between positive and negative sides of the conductor. A reading of less than infinite indicates the fault.

**Types of circuit Faults**

Three basic circuit faults can occur:

An **open-circuit** faults is due to a break in the conductor, as at **A,** so that current cannot flow.

An **Earth Fault** is due to a break in the insulation, as at **B** allowing the conductor to touch the hull or an earthed metal enclosure.




A **Short-Circuit** fault is due to a double break in the insulation, as a **C**, allowing both conductors o be connected so that a very large current by-passes or short circuits the load.

**Q19 .DIFFERENT TYPES OF MOTOR STARTERS.**

**Ans** When an induction motor starts, it draws 8-10 times the full load current. This is because:

1. The conductors used in rotor are bars and not wires. Thus they possess low resistance.
2. Both ends of the rotor are shorted using rings which carries large current in short circuited path.
3. Initially the slip (relative motion b/w rotor and stator magnetic field) is maximum.

This starting surging current reduces as the motor accelerates up to its running speed. This causes a

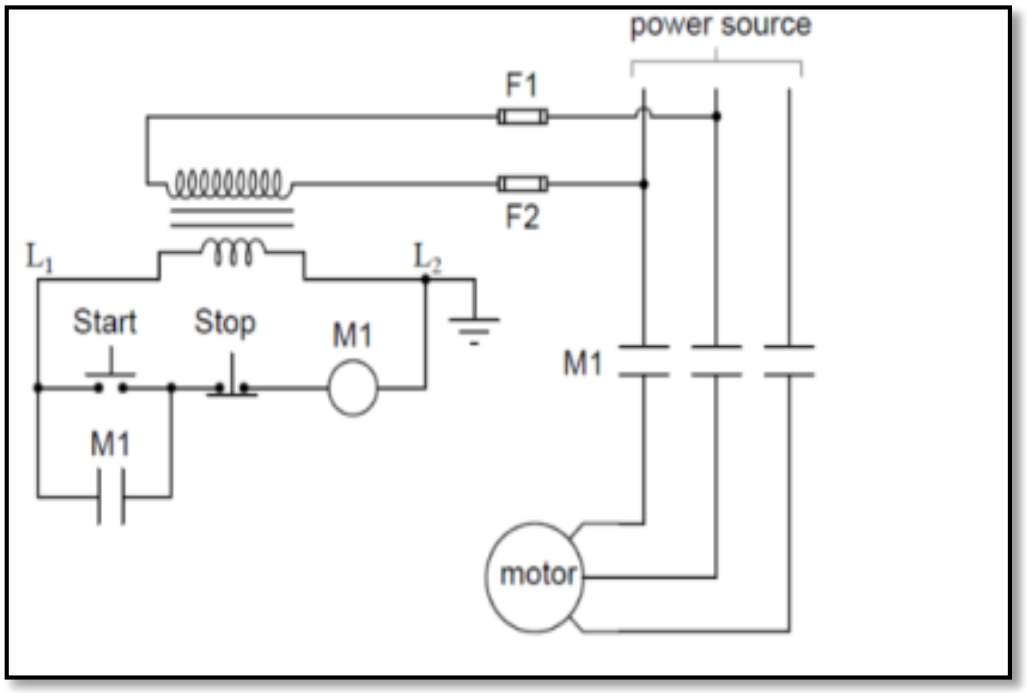
voltage dip at the supply bus bars and is accepted if the voltage dip is not greater than 15% within the run-up period.

For large motors like cargo pumps and bow thrusters, this voltage dip is unacceptable as it malfunctions the other sources.

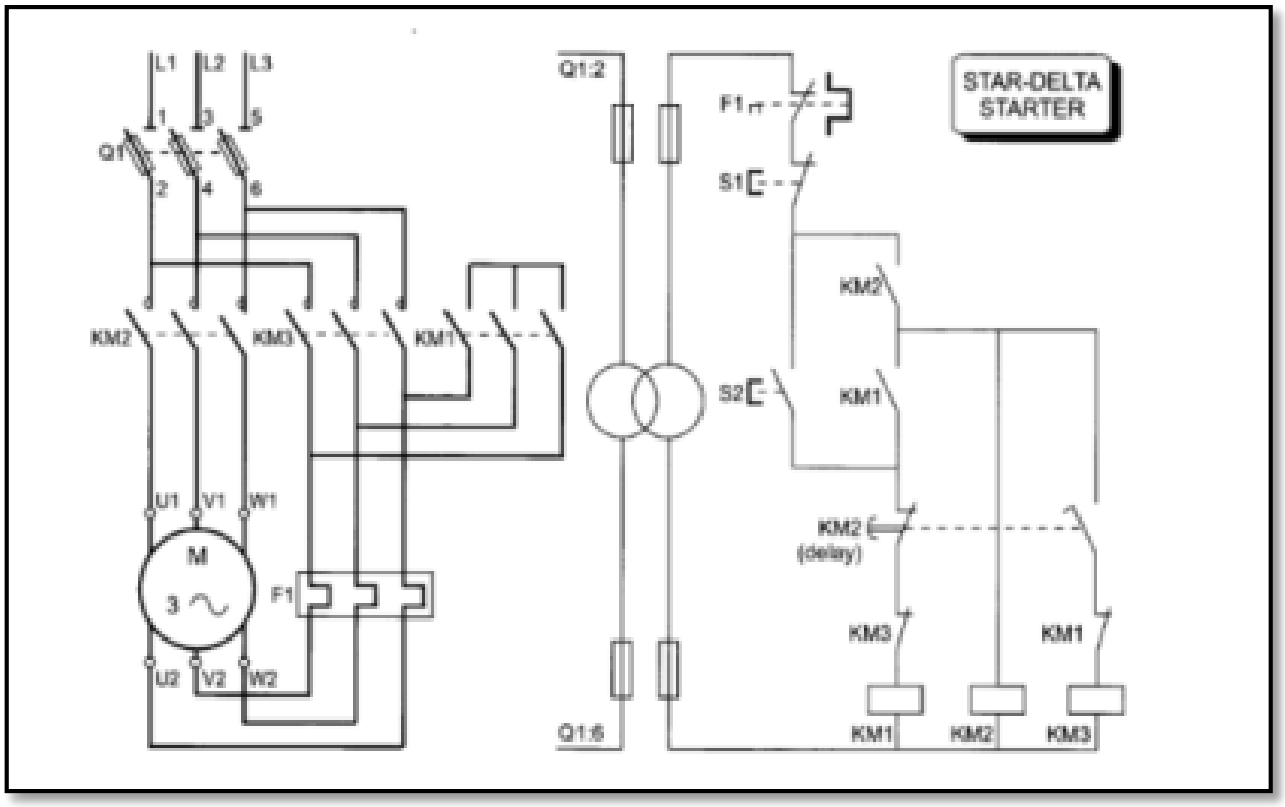
Hence to limit the starting current, induction motors are started at reduced voltage and then have the full supply of voltage.

**Types of starters:**

**DOL (Direct on-line):** This is a very simple starting arrangement which is used for majority of induction motor drives. It does not limit the starting current.



**Start Delta starting:** It is used to reduce starting current in 6 terminal motor designed to run in delta connection. It is the most cost effective method of reduced vo ltage starting. The motor starts in star and then run in delta.

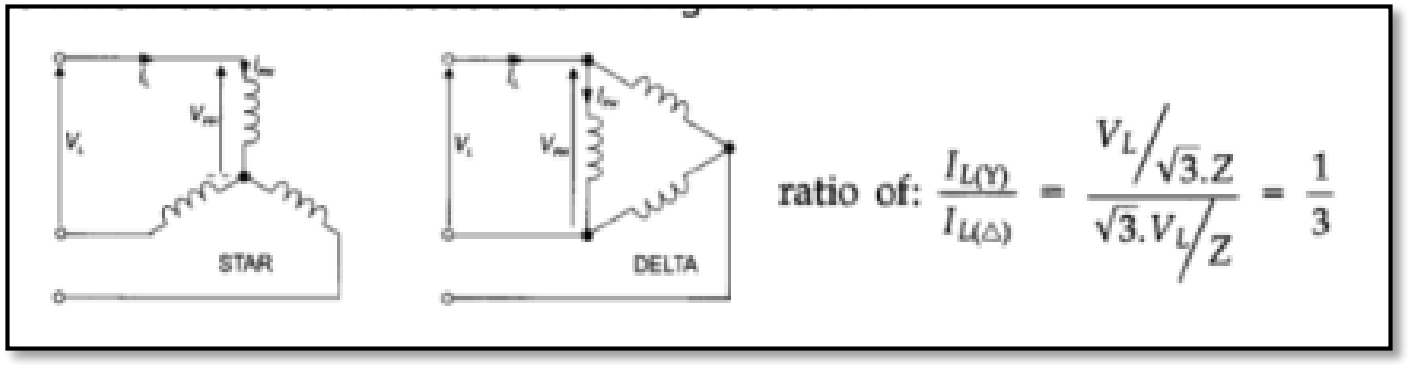



To provide an electrical interlock between contactors KM1 and KM3. This is to prevent a full short-circuit fault across the supply lines during the changeover from star to delta

Comparison between Star and Delta operation

At the instant of starting when the supply has just been switched on the motor has not yet started to rotates, there is no mechanical output from the motor. The only factor which determine the current taken by the motor are the supply voltage (V) and the impedance of the motor phase winding (Zph).

Compare the starting current when star connected to the starting current when delta connected as in fig.



**Auto transformer:**

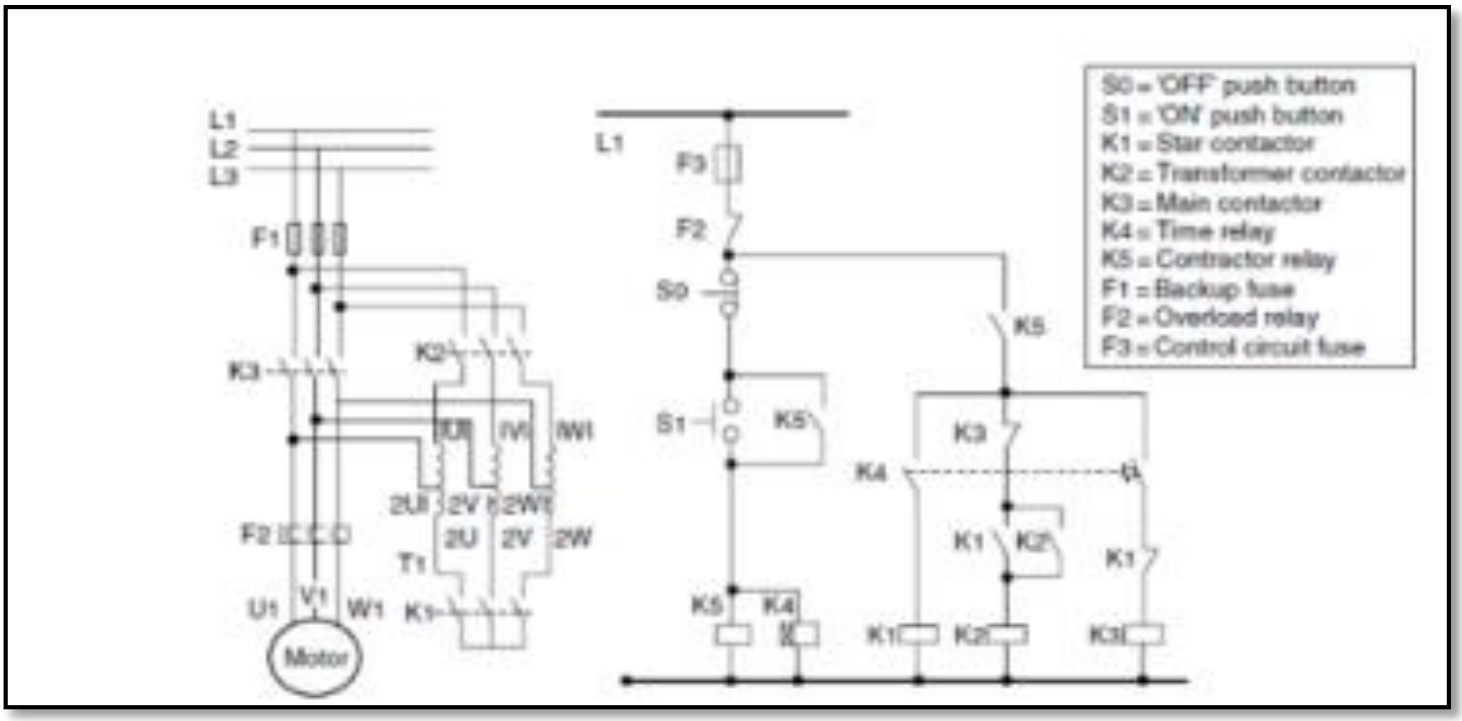
The operating principle of this starter is that a step down transformer is used to provide reduced voltage to the motor while starting

Three autotransformers are connected in the start configuration and taps are selected, to provide an adequate current for the motor.

The motor is allowed to accelerate and then the full voltage is applied.

When the 'start' button is pressed contactors **K1** and **K2** close together. This applies a reduced voltage to the motor windings, **U1, V1, W1** via the autotransformer.

After a pre-set time delay, which allows the motor to run up, contactor K1 opens.




This ends the autotransformer action and the motors is connected to the main supply through part of the autotransformer windings, which merely act as series choked coils.

Now K3 closes and the whole voltage is applied to the motor.

K2 opens and disconnects the transformer from the supply.

So the sequence is:

K1 and K2 closes; time delay.. … K1 opens; K3 closes; K2 opens.

The motor is never disconnected from the driving voltage and this prevents current surges and experienced in Star – Delta starter. The power and control circuit are shown side by side in diagram.

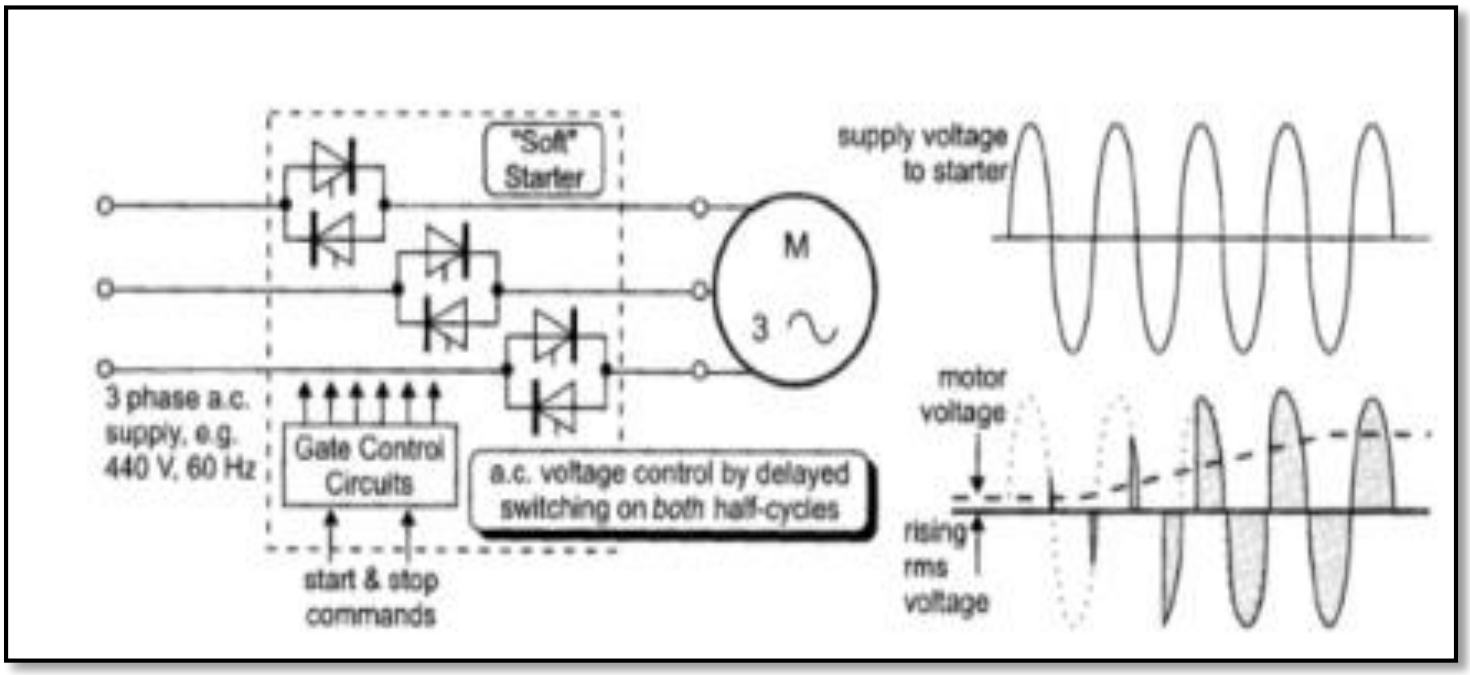
**Soft starter:**

This method of supplying a gradually increasing a.c. voltage during start up generally refers to an efficient electronic switching techniques.

A basic method shown in fig. is to use back-to-back connected thyrsitors or trias in the supply lines which

are gated to delay 'turn-on' within each a.c. half cycle.

This delayed switching applies a reduced average a.c. voltage to the motor.




The applied motor voltage is gradually ramped up by the starter software program until the full voltage level is reached.

To achieve maximum efficiency, the electronic switching circuit can be now by-passed for normal running.

A 'soft' starter may be further adapted to become a voltage controller over the motor operating load range. In this type of efficient 'energy manager' application, the controller monitor the motors power factor which is a measure of the motor leading.

On light load and full voltage, the power factor is low so the controller reduces the motor voltage which reduces current while improving power factor and efficiency.

**Note**- This type of 'soft start / energy manager' is not a speed controller. To electrically change the speed of an induction motor it is necessary to vary the applied frequency,

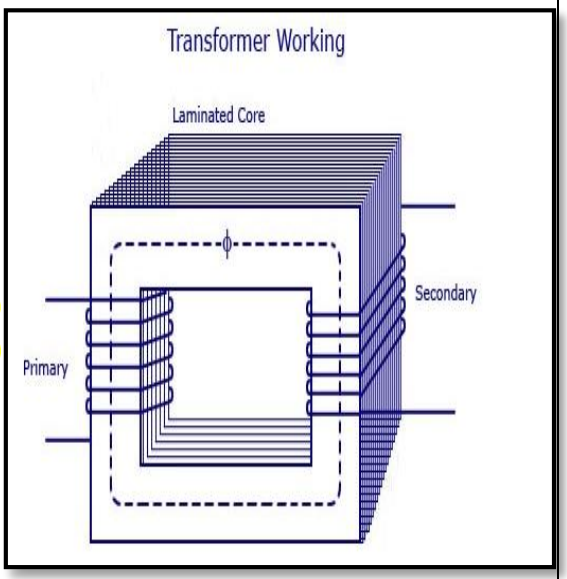
## Q20 MOTOR SAFETIES

**Ans.** Motor protection and safeties:

1. Overcurrent and single phasing protection relays
2. Under voltage relay
3. Short circuit relay(Trigger fuses for HV systems)
4. Temperature sensor for motor insulation

## Q21. WHAT IS TRANSFORMER AND DIFFERENT TYPES OF TRANSFORMER?

**Ans-Type and Principle**




A transformer can be defined as a static device which helps in the transformation of electric power in one circuit to electric power of the same frequency in another circuit. The voltage can be raised or lowered in a circuit, but with a proportional increase or decrease in the current ratings.

The main principle of operation of a transformer is mutual inductance between two circuits which is linked by a common magnetic flux. A basic transformer consists of two coils that are electrically separate and inductive, but are magnetically linked through a path of reluctance. The working principle of the transformer can be understood from the figure below.

**Types**

1. **Core- Type Transformer**
2. **Shell-Type Transformer**

Transformers can also be classified according to the type of cooling employed. The different types according to these classifications are:

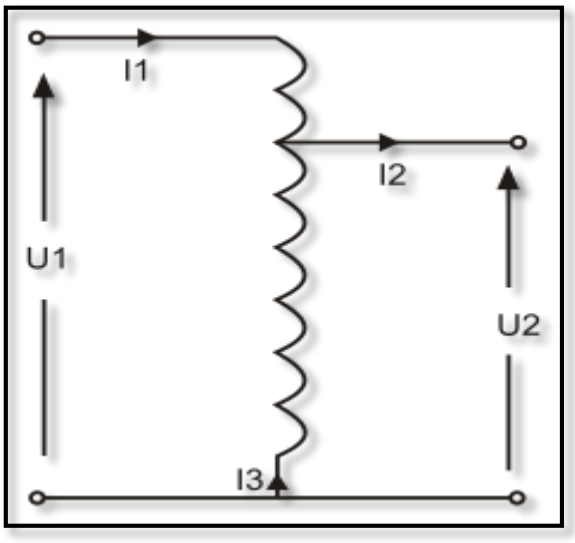
1. **Oil Filled Self-Cooled Type**
2. **Oil Filled Water Cooled Type**
3. **Air Blast Type**

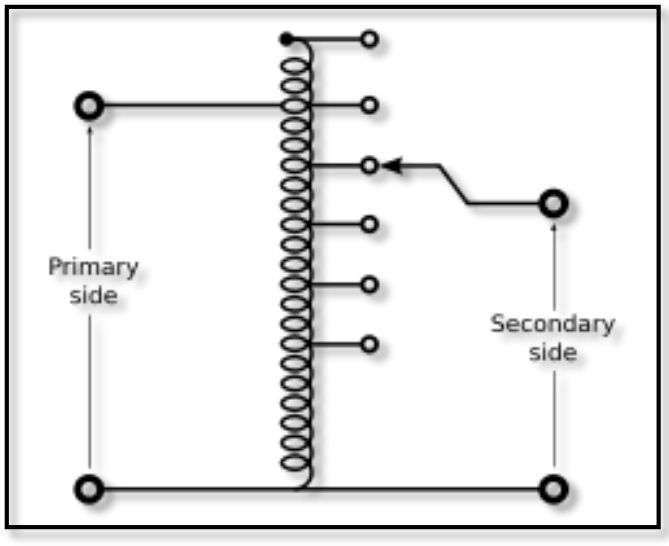
**Auto Transformer**

In an autotransformer, portions of the same winding act as both the primary and secondary sides of the transformer. The winding has at least three taps where electrical connections are made. Autotransformers have the advantages of often being smaller, lighter, and cheaper than typical dual-winding transformers, but the disadvantage of not providing electrical isolation.

An autotransformer has a single winding with two end terminals, and one or more terminals at intermediate tap points, or a transformer in which the primary and secondary coils have part or all of their turns in common. The primary voltage is applied across two of the terminals, and the secondary voltage taken from two terminals, almost always having one terminal in common with the primary voltage. The primary and secondary circuits therefore have a number of windings turns in common.

Autotransformers are often used to step up or step down voltages in the 110-115-120 V range and voltages in the 220-230-240 volt range—for example. Providing 110 V or 120 V (with taps) from 230 V input, allowing equipment designed for 100 or 120 volts to be used with a 230 volt supply




**Welding Transformer**:-

A welding transformer is a step down transformer that reduces the voltage from the source voltage to a lower voltage that is suitable for welding, usually between 15 and 45 volts. The secondary current is quite high. 200 to 600 amps would be typical, but it could be much higher. The secondary may have several taps for adjusting the secondary voltage to control the welding current. The taps are typically connected to a several high-current plug receptacles or to a high-current switch.

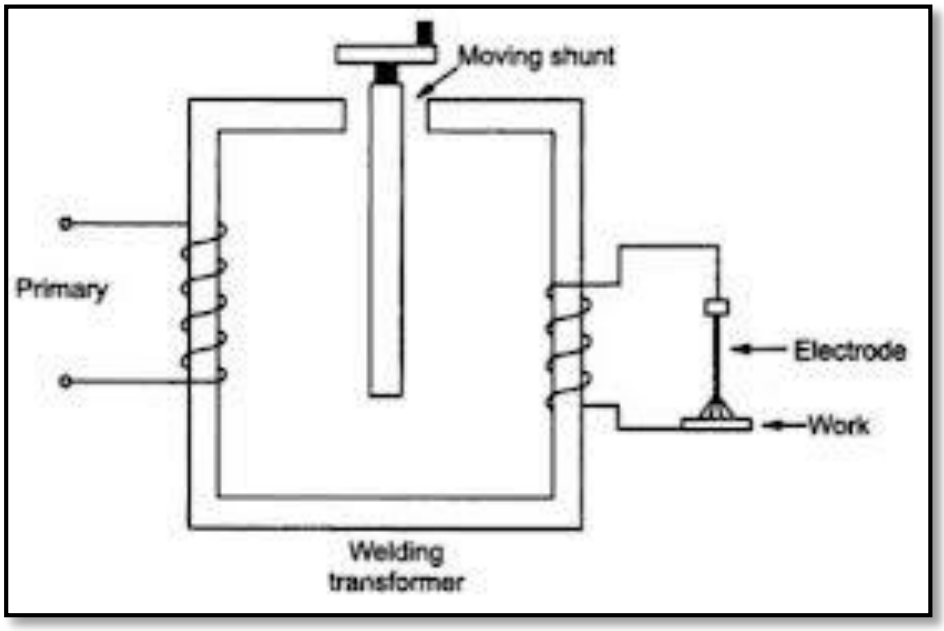
For welding with direct current (DC) a rectifier is connected to the secondary of the transformer. There may also be a filter choke (inductor) to smooth the DC current. The entire transformer and rectifier assembly may be called a transformer or welder, but "welding power supply" would be more appropriate term.

**Speculation:**

The impedance of a welding transformer may be higher that the impedance of a transformer designed for some other purpose. The transformer impedance may play a role in the process of establishing an arc and controlling the current.

**About 3-phase**

Large welding transformers are most likely to be designed for three phase input. There are many smaller transformers that are designed for single phase input.




The alternating current in the primary coil has a constantly changing magnetic field which induces a fluctuating magnetic field in the secondary coil. This means a voltage (potential difference) of alternating values is induced. Because there are more coils in the secondary coil the voltage is larger than that in the first coil. If the wire is part of a complete circuit (which it is) then a current will flow.

The first answer is correct, energy cannot come from nowhere so if current energy is converted into potential difference then the current will be smaller. The power will stay the same because the potential difference 'pushing' the electrons through is larger.

**Power (P) (Watts) = Current (C) (amps) x Voltage (v) (volts).**

Power stations do this so that less energy is transferred to the environment as heat when in the cables above the ground. The resistance of the cables causes electrons to slow and 'build up' and cause friction with each other creating heat... this would mean money is lost for the company so they step up the voltage to give a smaller current so less heat is lost.

They step it down again near houses so that the voltage is safe for domestic use.

**Q22 WHY TRANSFORMER RATED IN KVA?**

- There are 2 losses in transformer.
- One is copper loss which depends on current affected by the power factor.

This is why transformers are rated in KVA and not KW.

Single phase KVA = Amps x Volts/1000. Single phase KW = Amps x Volts x pf/1000.

3 phase KVA = Amps x Volts x 1.73/1000. 3 phase KW = Amps x Volts x 1.73 x pf/1000.

**Q:23 - DIODES TYPES AND THEIR USES?**

**Ans-** A diode allows electricity to flow in one direction only and blocks the flow in the opposite direction. They may be regarded as one-way valves and they are used in various circuits, usually as a form of protection. There are different types of diode but their basic functions are the same. These are noted below along with examples of diodes in use

- **Light Emitting Diode (LED):** It is one of the most popular types of diodes and when this diode permits the transfer of electric current between the electrodes, light is produced.
- **Avalanche Diode:** This type of diode operates in the reverse bias, and used avalanche effect for its operation.
- **Laser Diode**: This type of diode is different from the LED type, as it produces coherent light. These diodes find their application in DVD and CD drives, laser pointers, etc.
- **Schottky Diodes**: These diodes feature lower forward voltage drop as compared to the ordinary silicon PN junction diodes. The voltage drop may be somewhere between 0.15 and 0.4 volts at low currents, as compared to the 0.6 volts for a silicon diode.
- **Zener diode:** A **Zener diode** is a type of diode that permits current not only in the forward direction like a normal diode, but also in the reverse direction if the voltage is larger than the breakdown voltage known as "Zener knee voltage".
- **Photodiode**: Photodiodes are used to detect light and feature wide, transparent junctions. Photodiodes can also be used to generate electricity, used as solar cells and even in photometry.
- **Varicap Diode or Varactor Diode**: This type of diode feature a reverse bias placed upon it, which varies the width of the depletion layer as per the voltage placed across the diode.
- **Rectifier Diode**: These diodes are used to rectify alternating power inputs in power supplies.
- **Small signal or Small current diode** - These diodes assumes that the operating point is not affected because the signal is small
- **Large signal diodes** - The operating point in these diodes get affected as the signal is large.
- **Transient voltage Supression diodes** - This diode is used to protect the electronics that are sensitive against voltage spikes.
- **Gold doped diodes** - These diodes use gold as the dopant and can operate at signal frequencies even if the forward voltage drop increases.
- **Super barrier diodes** - These are also called as the rectifier diodes. This diodes have the property of low reverse leakage current as that of normal p-n junction diode and low forward voltage drop as that of Schottky diode with surge handling ability.
- **Point contact diodes** - The construction of this diode is simpler and are used in analogy applications and as a detector in radio receivers
- **Peltier diodes** - This diode is used as heat engine and sensor for thermoelectric cooling.
- **Gunn diode** - This diode is made of materials like GaAs or InP that exhibit a negative differential resistance region.

**USES**:-Aside from the many electronic appliances and gadgets we commonly use today, diodes are also used in public facilities. Traffic lights, scoreboards, and vending machines are examples of diode-dependent devices.

**Q24: ZENER DIODE AND ITS USES? HOW IT IS DIFFERENT FROM NORMAL DIODE?**

**Ans:** A **Zener diode** is a type of diode that permits current not only in the forward direction like a normal diode, but also in the reverse direction if the voltage is larger than the breakdown voltage known as "Zener knee voltage" or "Zener voltage".

A Zener diode exhibits almost the same properties, except the device is specially designed so as to have a greatly reduced breakdown voltage, the so-called Zener voltage.

The Zener diode is therefore ideal for applications such as the generation of a reference voltage (e.g. for an amplifier stage), or as a voltage stabilizer for low-current applications

**Q25- SILICON CONTROL RECTIFIERS OR THYRISTORS AND ITS USES?**

**Ans-**A silicon *controlled rectifier is a semiconductor **device that acts as a true electronic switch.

It can change alternating current into direct current and at the same time can control the amount of power fed to the load.

Thus SCR combines the features of a rectifier and a transistor.

Thyristors, or silicon controlled rectifiers, SCRs are used in many areas of electronics where they find uses in a variety of different applications. Some of the more common applications for them are outlined below:

- AC power control (including lights, motors etc).
- Overvoltage protection crowbar for power supplies.
- AC power switching.
- Control elements in phase angle triggered controllers.
- Within photographic flash lights where they act as the switch to discharge a stored voltage through the flash lamp, and then cut it off at the required time.

**Q26: - WHAT IS OXYGEN METER OR OXYGEN SENSOR?**

**Ans:** An **oxygen sensor** (or ***lambda sensor***) is an electronic device that measures the proportion of oxygen ($O_2$) in the gas or liquid being analysed.

The most common application is to measure the exhaust gas concentration of oxygen for internal combustion engines in automobiles and other vehicles. Divers also use a similar device to measure the partial pressure of oxygen in their breathing gas.

There are many different ways of measuring oxygen and these include technologies such as zirconia, electrochemical (also known as Galvanic), infrared, ultrasonic and very recently laser methods. Each method has its own advantages and disadvantages.

**USES:-**If the air–fuel ratio of a combustion engine is rich or lean. Since oxygen sensors are located in the exhaust stream, they do not directly measure the air or the fuel entering the engine but when information from oxygen sensors is coupled with information from other sources, it can be used to indirectly determine the air-fuel ratio.

**Q27. BRUSHLESS ALTERNATOR.**

**Ans:** A brushless alternator is composed of two sections: main alternator and the smaller exciter. The exciter has stationary field coils and a rotating armature (power coils). The main alternator uses the opposite configuration with a rotating field and stationary armature. A bridge rectifier, called the rotating rectifier assembly, is mounted on a plate attached to the rotor. Neither brushes nor slip rings are used, which reduces the number of wearing parts. The main alternator has a rotating field as described above and a stationary armature (power generation windings).

**Q28. SELF-EXCITED GENERATOR.**

**Ans:** A kind of excitation of generators where the magnetic field of the main poles is excited by a current supplied to the windings of the main poles from the armature (rotor) winding. A self-excited generator is thus distinguished from a separately excited generator, in which the windings of the main poles receive current from an external source. Self-excitation is made use of most often in DC generators. When a self-excited generator is started, the initial current in the field winding is produced by the electromotive force (emf) induced in the armature winding by the residual magnetic field of the main poles. To sustain self-excitation, the initial current must reinforce this field. The additional magnetic flux increases the emf in the armature and, consequently, the current in the windings of the main poles. Because, however, of magnetic saturation in the magnetic circuit, the increments in magnetic flux corresponding to equal increments in current become smaller as the current builds up. The process of self-excitation continues as long as the emf in the armature exceeds the voltage drop in the field winding. At a certain magnitude of the magnetic flux, electric equilibrium is reached, and there is no further increase in magnetic flux, armature emf, and excitation current. Self-excitation can be achieved when the value of the resistance of the field winding does not exceed a certain limit, which depends on the electric parameters of the generator.

**Q29. PARALLING OF A/E MANUALLY.**

**Ans:**

- All meters and indicators must have in good working order.
- Start the incoming generator with the correct staring procedure.
- Check the working condition by readings pressure gauges, thermometer and audible and visual.
- Watch for a minutes until prime mover come to stable.
- Check the voltage of existing and incoming generator on the switchboard,
- Move the selector switch to incoming generator. At that time, synchroscope pointer will rotate clockwise or counter clockwise direction. Check the frequency and voltage of existing and incoming.
- Carry out the adjustment by means of speed adjuster of prime mover to obtain the condition such that synchroscope pointer rotate in the clockwise direction at a speed of about 4sec/rev.
- Close the circuit breaker of incoming generator when the pointer reaches just before 12’ O Clock position.
- Made off the selector switch.
- Made load shearing the two generators by the speed adjuster of generator.

**Q30. MAINTENANCE OF ALTERNATOR.**

**Ans:**

- Ventilation passages &air filters to clean.
- Insulation resistance to check for Stator, rotor winding. If low, then varnish to be done
- Air gap to check using plastic feeler gauge. Bearing oil to be renewed.
- Use vacuum cleaner to remove dirt/ dust.
- Terminal box cover gasket integrity to check.
- Terminal connections to check for tightness.
- AVR components, diodes to keep free from oil, moisture or any dirt.
- Heaters to be checked.

**Q31. ALTERNATOR SAFETIES AND HOW WILL YOU TRY OUT REVERSE POWER TRIP AND WHY REVERSE POWER TRIP?**

**Ans:** The three main type alternator protection are:

**a**. **Over current protection.**

**b. Reverse power trip**

**c. Under voltage trip**

When two generators are running in parallel and one generator can carry the load, reverse power trip can be tested by load shifting using governor control. When the load has shifted sufficiently and the off loaded generator is carrying a small percentage of load, its breaker trips and fuel supply to its prime mover cuts off. This means reverse power relay has operated. The relay can be tested by simulation (using the test push button on the relay) to see if it initiates a trip signal.
Reverse power trip is provided to protect generator. Situation of a generator is feeding a system through switchgear having several generators connected in parallel with this generator. The flow of current, when the system is running normally, is from the generators to the switchgear. If one generator experiences problems and its terminal voltage falls below the system voltage, the generator will act as a motor, just as a motor can act as a generator, and current will flow from the switchgear to the generator. This is reverse power. The effects can range from minor to extreme in the event of a complete mechanical failure of the generator which fails.

**Q32. SYNCHRONIZING METHODS.**

**Ans:** Synchroscope is the main method.

Back-up methods are

a. Lamp dark method
b. Lamp bright method
c. Rotating lamp method or Sequence methods (preferable)

**Q33. PARTS OF ALTERNATOR AND ITS CONSTRUCTION.**

**Ans:** The main parts of alternator are its stator and rotor. Stator core is assembled from laminated steel with the windings housed in slots around the inner periphery of the cylindrical core. And stator coils are interconnected to form three separate phase winding with six ends.

Two constructional forms of rotor are

a. Salient pole type

b. Cylindrical type

The salient pole type has projecting poles bolted or keyed onto the shaft hub. Field excitation windings are fitted around each pole.

In cylindrical type rotors the excitation windings are wedged into axial slots around the steel rotor. Unwound sections of the rotor form the pole faces between the winding slots.

**Q34. MEGGER WORKING. HOW TO TEST IR RESISTANCE? WHY YOU CAN'T USE MULTIMETER FOR THE SAME?**

**Ans: <u>MEGGER WORKING</u>**

There are two types of megger:-

1) Hand operated megger
2) Electronic type megger

• In hand operated megger electromagnetic induction effect is used to produce the test voltage i.e. armature arranges to move in permanent magnetic field or vice versa.

• Where as in electronic type megger batteries are used to produce the testing voltage.

• As the voltage increases in external circuit the deflection of pointer increases and deflection of pointer decreases with a increases of current.

• Hence, resultant torque is directly proportional to voltage & inversely proportional to current.

• When electrical circuit being tested is open, torque due to voltage coil will be maximum & pointer shows 'infinity' means no shorting throughout the circuit and has maximum resistance within the circuit under test.

• If there is short circuit pointer shows 'zero', which means 'NO' resistance within circuit being tested.

**<u>IR RESISTANCE:-</u>**

It is the resistance offered by insulating materials b/w a conductor and the ground or body or among the conductors for applied voltage.

**Test Procedure:-**

1) Test your tester by connecting both the probes together and press the test button, the display must indicate '0'. If not, don't proceed further.
2) Check for proper grounding of megger terminals. For that, connect the earth terminal of megger to ground and other terminal also to ground at different place.
3) Carry out insulation checks of conductors. For that without disturbing the earth terminal of megger, connect +ve probe to conductor under test. Press the button and note down the reading.
4) If it is less, don't run the machinery.

- Multimeter is not used for IR test because an ordinary multi-meter is designed to measure lower, more finite impedances.
- With a megger tester, a voltage of not less than 500 volts DC is used for testing the insulation resistance of windings. With a multimeter, the voltage used is not more than 3-volts DC. The former uses high impedance testing and is therefore more accurate than a multimeter.

**Q35. THERMOCOUPLE?**

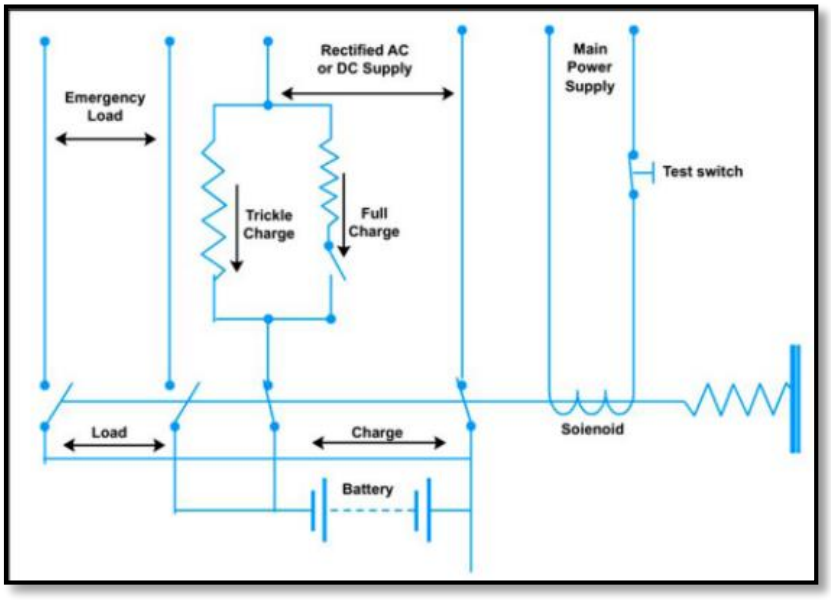
**Ans:** A Thermocouple is a sensor used to measure temperature. Thermocouples consist of two wire legs made from different metals. The wires legs are welded together at one end, creating a junction. This junction is where the temperature is measured. When the junction experiences a change in temperature, a voltage is created. The voltage can then be interpreted using thermocouple reference tables (linked) to calculate the temperature.

There are many types of thermocouples, each with its own unique characteristics in terms of temperature range, durability, vibration resistance, chemical resistance, and application compatibility. Type J, K, T, & E are "Base Metal" thermocouples, the most common types of thermocouples. Type R, S, and B thermocouples are "Noble Metal" thermocouples, which are used in high temperature applications (see thermocouple temperature ranges (linked) for details).

Thermocouples are typically selected because of their low cost, high temperature limits, wide temperature ranges, and durable nature.

**Q36. TRICKLE CHARGING CIRCUIT FOR BATTERY?**

**Ans:**



- Trickle charging is the charge given to the battery that is already fully charged. It compensates for the loss of battery capacity due to internal leakage between plates. It is a small makeup current for topping up purpose, to ensure that the battery is fully charged at all times.

- Trickle charging is at slightly higher than the batter rated voltage.

**Q37. HOW MANY WAYS TO CHARGE BATTERY?**

**Ans:** Batteries onboard are charged by two methods:-

1) **Quick charging:** It is charged by constant voltage method i.e. a constant voltage is applied to the battery. This is the quickest method of charging.

2) **Trickle charging:** Trickle charging is the charge given to the battery that is already fully charged. It compensates for the loss of battery capacity due to internal leakage between plates. It is a small makeup current for topping up purpose, to ensure that the battery is fully charged at all times.

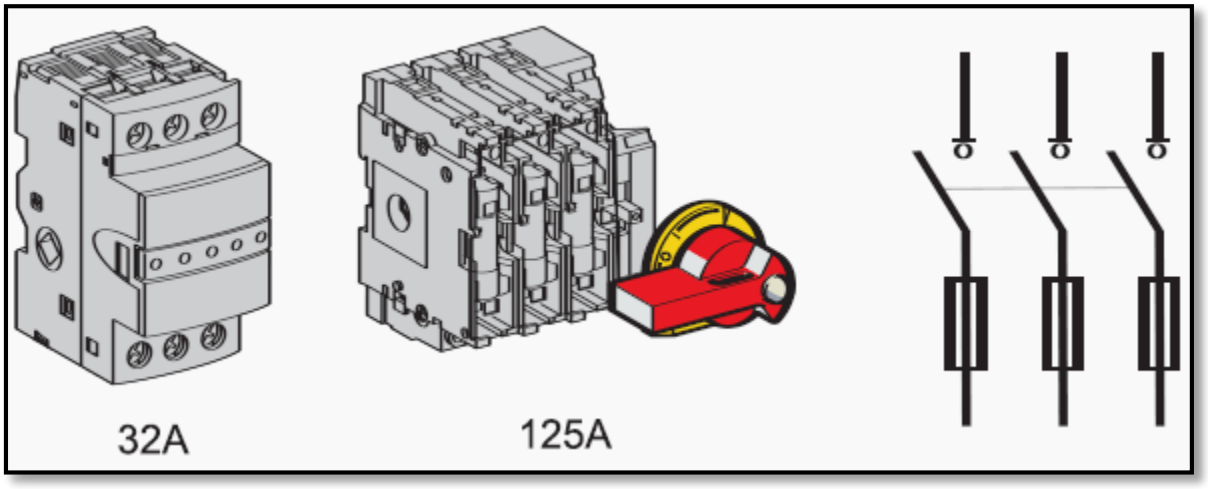
**Q38 SHORT CIRCUIT PROTECTION FOR MOTORS?**

**Ans:** Two protection devices are commonly used for this:

- **Fuses**, which break the circuit by melting and must be replaced afterwards,
- **Magnetic circuit breakers** which automatically break the circuit and only require to be reset.

**Fuses:-**

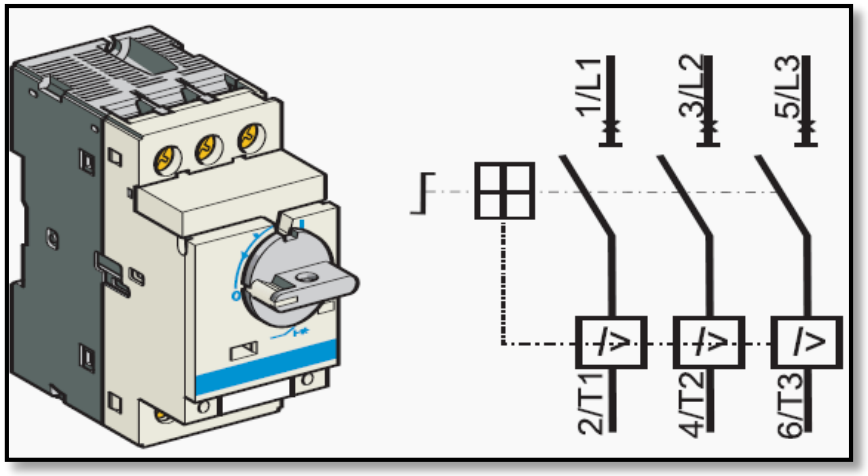
Fuses perform phase-by-phase (single pole) protection with a high break capacity at low volume. They limit I2t and electro-dynamic stress.




**They are mounted:**

- On special supports called fuseholders,
- Or on isolators in the place of sockets and links.

**Magnetic circuit breakers:-**




These circuit breakers protect plant from short circuits within the limits of their breaking capacity and by means of magnetic triggers (one per phase). Magnetic circuit breaking is all-pole from the outset: one magnetic trigger will simultaneously open all the poles.

For low short-circuit currents, circuit breakers work faster than fuses. This protection complies with the IEC 60947-2 standard. To break a short-circuit current properly, there are three imperatives:

- Early detection of the faulty current,
- Rapid separation of the contacts,
- Breakage of the short-circuit current.

Most magnetic circuit breakers for motor protection are current-limiting devices and so contribute to coordination. Their very short cut-off time breaks the short-circuit current before it reaches its maximum amplitude.

**Q39. WHAT IS ELECTRICITY? HOW IT FLOWS?**

**Ans:** An electric current is a flow of electric charge. In electric circuits this charge is often carried by moving electrons in a wire. It can also be carried by ions in an electrolyte, or by both ions and electrons such as in a plasma.

DC "flows" from negative to positive (that is, the electrons move in that direction). AC reverses direction in a cyclic manner; that is, a 50Hz AC line reverses direction 50 times per second, 60Hz reverses 60 times per second, 400Hz reverse 400 times per second, and so on. That's why "Hertz" used to be called "cycles per second."

**Q40. DIFFERENCE BETWEEN AC AND DC?**

**Ans:**

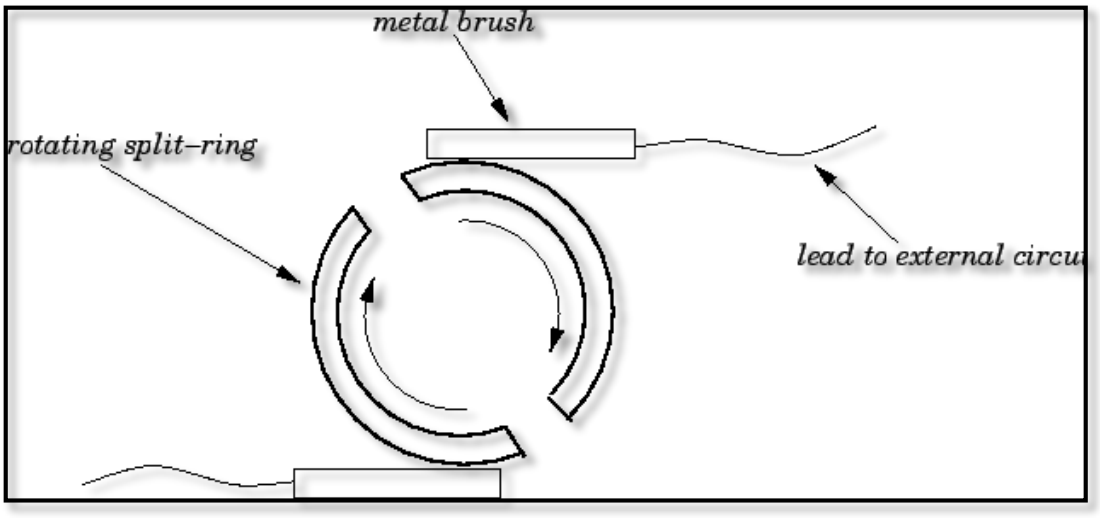
| | **Alternating Current** | **Direct Current** |
|---|---|---|
| **Amount of energy that can be carried** | Safe to transfer over longer city distances and can provide more power. | Voltage of DC cannot travel very far until it begins to lose energy |
| **Cause of the direction of flow of** | Rotating magnet along the wire. | Steady magnetism along the wire. |
| **Frequency** | The frequency of alternating current is 50Hz or 60Hz depending upon the country. | The frequency of direct current is zero. |
| **Direction** | It reverses its direction while flowing in a circuit. | It flows in one direction in the circuit. |
| **Current** | It is the current of magnitude varying with time | It is the current of constant magnitude. |
| **Flow of Electrons** | Electrons keep switching directions - forward and backward. | Electrons move steadily in one direction or 'forward'. |
| **Obtained from** | A.C Generator and mains. | Cell or Battery. |
| **Passive Parameters** | Impedance. | Resistance only |
| **Power Factor** | Lies between 0 & 1. | It is always 1. |
| **Types** | Sinusoidal, Trapezoidal, Triangular, Square. | Pure and pulsating. |

**DIRECT CURRENT** is produced by following methods:-

1) Batteries
2) DC generator

**The Direct Current Generator**

Most common electrical appliances (*e.g.*, electric light-bulbs, and electric heating elements) work fine on AC electrical power. However, there are some situations in which DC power is preferable. For instance, small electric motors (*e.g.*, those which power food mixers and vacuum cleaners) work very well on AC electricity, but very large electric motors (*e.g.*, those which power subway trains) generally work much better on DC electricity. Let us investigate how DC electricity can be generated.

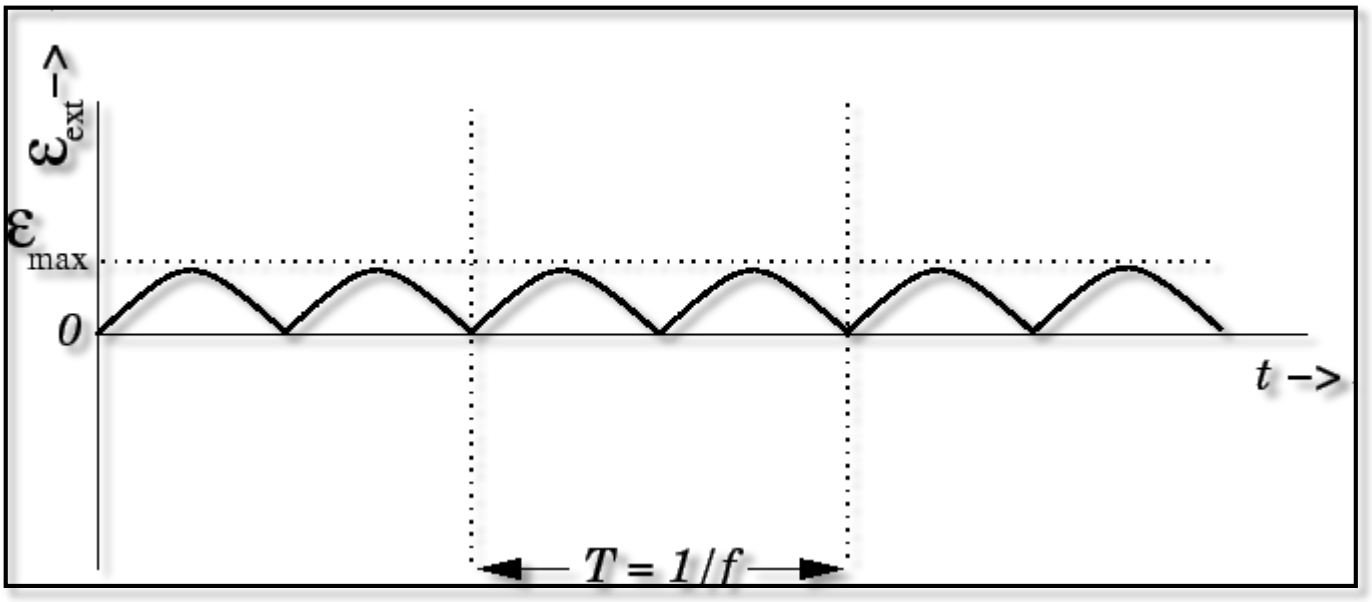



*A split-ring commutator.*

A simple DC generator consists of the same basic elements as a simple AC generator: *i.e.*, a multi-turn coil rotating uniformly in a magnetic field. The main difference between a DC generator and an AC generator lies in the manner in which the rotating coil is connected to the external circuit containing the load. In an AC generator, both ends of the coil are connected to separate slip-rings which co-rotate with the coil, and are connected to the external circuit via wire brushes. In this manner, the emf $\mathcal{E}_{\rm ext}$ seen by the external circuit is always the same as the emf $\mathcal{E}$ generated around the rotating coil. In a DC generator, the two ends of the coil are attached to different halves of a single split-ring which co-rotates with the coil. The split-ring is connected to the external circuit by means of metal brushes. This combination of a rotating split-ring and stationary metal brushes is called a *commutator*. The purpose of the commutator is to ensure that the emf $\mathcal{E}_{\rm ext}$ seen by the external circuit is equal to the emf $\mathcal{E}$ generated around the rotating coil for *half* the rotation period, but is equal to minus this emf for the other half (since the connection between the external circuit and the rotating coil is reversed by the commutator every half-period of rotation). The positions of the metal brushes can be adjusted such that the connection between the rotating coil and the external circuit reverses whenever the emf $\mathcal{E}$ generated around the coil goes through zero. In this special case, the emf seen in the external circuit is simply

$$\mathcal{E}_{\rm ext} = |\mathcal{E}| = \mathcal{E}_{\rm max}\,|\sin(2\pi\, f\, t)|.$$

Figure below shows $\mathcal{E}_{\rm ext}$ plotted as a function of time, according to the above formula. The variation of the emf with time is very similar to that of an AC generator, except that whenever the AC generator would produce a negative emf the commutator in the DC generator reverses the polarity of the coil with respect to the external circuit, so that the negative half of the AC signal is reversed and made positive. The result is a bumpy direct emf which rises and falls but never changes direction. This type of pulsating emf can be smoothed out by using more than one coil rotating about the same axis, or by other electrical techniques, to give a good imitation of the direct current delivered by a battery. The *alternator* in a car (*i.e.*, the DC generator which recharges the battery) is a common example of a DC generator of the type discussed above. Of course, in an alternator, the external torque needed to rotate the coil is provided by the engine of the car.




*Emf generated in a steadily rotating DC generator.*

**Q41. HOW 440V IS CONVERTED TO 220V?**

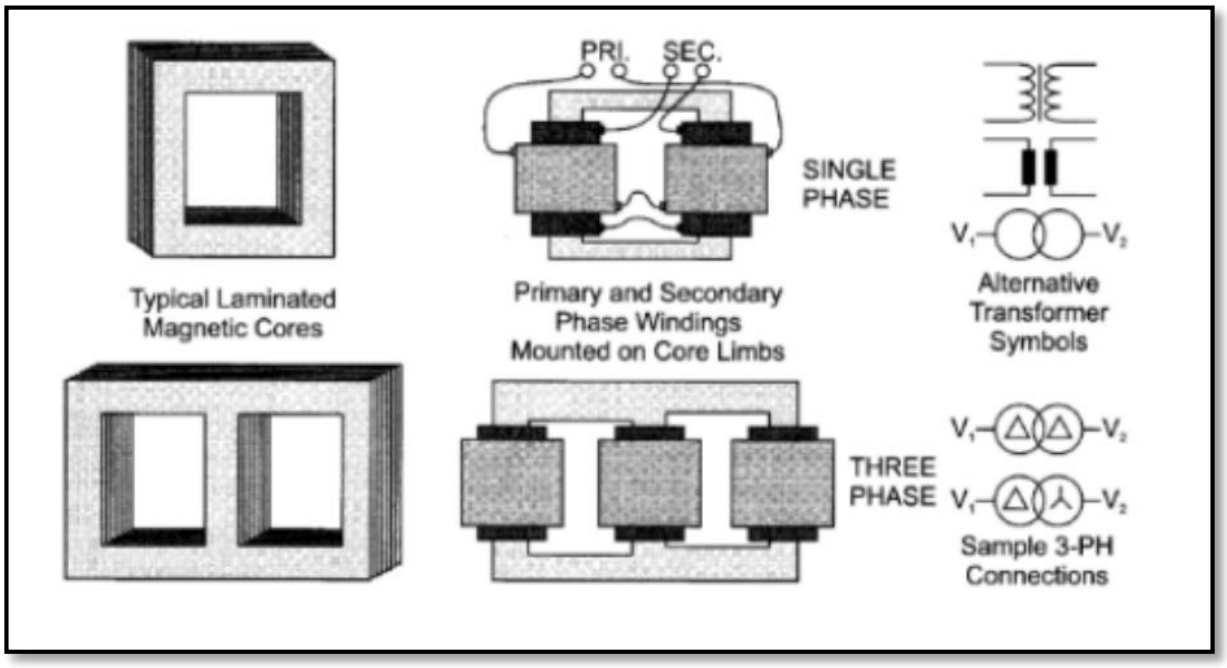
**Ans:** 440V can be converted into 220V in two ways:-

1) By transformer: With the help of step down transformer we can convert 440V to 220V.
2) Direct method: From the 440V supply we can take one phase with neutral and it will be 254V and there will be losses also. So can use this method but generally it is not preferred.

**Q42. HOW THE PHASE GOT CHANGED?**

**Ans:** LV systems onboard ship is typically 3-phase a.c./440V, 60 Hz, while fixed lighting and other low power loads are supplied with 220 V a.c. single-phase from very efficient STATIC TRANSFORMER units.

These type of transformers have efficiency more than 90%.




**Q43. WHAT IS THERMOCOUPLE?**

**Ans:** A thermocouple is a device used extensively for measuring temperature. Learn how the device works here.

- A thermocouple is comprised of at least two metals joined together to form two junctions. One is connected to the body whose temperature is to be measured; this is the hot or measuring junction. The other junction is connected to a body of known temperature; this is the cold or reference junction. Therefore the thermocouple measures unknown temperature of the body with reference to the known temperature of the other body.

**<u>Working Principle</u>**

The working principle of thermocouple is based on three effects, discovered by Seebeck, Peltier and Thomson. They are as follows:

**1) Seebeck effect:** The Seebeck effect states that when two different or unlike metals are joined together at two junctions, an electromotive force (emf) is generated at the two junctions. The amount of emf generated is different for different combinations of the metals.

**2) Peltier effect:** As per the Peltier effect, when two dissimilar metals are joined together to form two junctions, emf is generated within the circuit due to the different temperatures of the two junctions of the circuit.

**3) Thomson effect:** As per the Thomson effect, when two unlike metals are joined together forming two junctions, the potential exists within the circuit due to temperature gradient along the entire length of the conductors within the circuit.

In most of the cases the emf suggested by the Thomson effect is very small and it can be neglected by making proper selection of the metals. The Peltier effect plays a prominent role in the working principle of the thermocouple.

**Q44. WHAT IS OHM'S LAW , FARADAY'S LAW AND KIRCHOFF'S LAW ?**

**Ans: 1.Ohm's law :** If the temperature and other conditions remain constant , the current through a conductor is proportional to the applied potential difference and it remains constant. Current = applied voltage/ resistance of conductor

Resistance = applied voltage / current in conductor

**2. (a) Faraday's first law :** Whenever there is a change in the magnetic field linked with a circuit , an induced e.m.f is produced in it.

**(b) Faraday's second law:** The magnitude of induced e.m.f is equal to the rate of change of the magnetic flux linked with a closed circuit.

Therefore faraday's laws gives the magnitude of the induced e.m.f.

**3. Kirchoff's law:** There are two laws as follows.

**(a) Kirchoff's first law:** The algebraic sum of all current at a junction in any network is zero. This law is also known as current law or junction rule. It is based on law of conservation of charge, and is applicable for parallel circuits.

**(b) Kirchoff's second law:** In any closed circuit ( or mesh ) , the algebraic sum of the products of the current and resistance of each part of the circuit is equal to the resultant e.m.f of the circuit. This law is also known as voltage law or loop rule. It is based on law of conservation of energy, and is applicable for series circuits.

**Q45: WHAT IS THE FUNCTION OF THYRISTOR?**

**Ans:** A thyristor is also known as SCR (silicon controlled rectifier ) – is like a very fast static switch and is good for controlling large amounts of power ( called power regulation ) and for controlling the speed of dc motors. Another typical application is to make dimmers for lighting circuits.

**Q46: DEFINE LEAD ACID BATTERY AND ITS SPECIFIC GRAVITY.**

**Ans: Lead acid battery**: It is the oldest type of rechargeable battery. Despite having a very low energy – to – weight ratio and a low energy – to – volume ratio , its ability to supply high surge currents means that the cells have a relatively large power – to – weight ratio . These features, along with their low cost, makes it attractive for use in motor vehicles to provide the high current required by automobile starter motors.

**Specific gravity:** The most accurate way to test the state of charge of a battery cell is to determine the specific gravity of the battery electrolyte. The higher the specific gravity of the electrolyte the higher the state of charge. The best way to truly monitor your system over it lifetime is to regularly take and record specific gravity readings.

**Q47: WRITE DOWN THE PROCEDURE FOR IR TEST.**

**Ans: <u>Test procedure</u>**

1. Test your tester.
2. Connect both probe, press test button, it shows zero.
3. Connect for proper earthing, to connect the negative terminal to ground and positive also to the ground at a different place test the reading, it must show zero.

4. Carry out insulation test of the conductor without disturbing the earth (-) terminal of the megger. Connect the (+) probe in to the conductor. Press the test button note down the reading. It must be more than min. (1.5 m ohm) it should be less, do not operate high voltage machineries. It must be min. (KV + 1) m ohm.
   Eg. If 440 V then IR = 0.44 + 1 = 1.44M ohm.
   For 11 KW, IR = 11 + 1 = 12 M ohm.

**Q48: OVERLOADING CAPACITY OF STEERING MOTOR AND WHY?**

**Ans:** Each feeder circut for steering must be protected by a circuit breaker on the switchboard that supplies it and must have an instantaneous trip set at a current of at least –

(1) 300% and not more than 375% of the rated full – load current of one steering – gear motor for a direct –current motor.
(2) 175% and not more than 200% of the locked – rotor current of one steering – gear motor for an alternating – current motor.

**Q 49: OVERLOADING CAPACITY OF MOTOR AND WHY?**

**Ans:** It is defined as the excessive heating due to motor overcurrent and failure of motor to start.

An overload AC electric motor will begin to slow down and draw more current than normal. This will cause internal overheating.

**Q50: USE OF TESTER IN A HOUSEHOLD SUPPLY.**

**Ans:** A simple low – cost electrical voltage tester is used to determine if an electrical wire or component has been turned off, or if electrical power is present.

A voltage tester, also called a "neon tester '' consists of a holder containing a neon bulb. Two probes are attached to the holder. The neon bulb will light when the probes touch the hot and neutral power lines or anything connected to those lines when power is present on the wires.

**Q51: WHY DON'T WE GET A SHOCK WHILE TESTING FOR VOLTAGE WITH A LINE TESTER?**

**Ans:** Rating of voltage is 230V only. The current is low enough not to hurt us and just enough to light up the bulb. But the same tester can't be used to check higher voltages.

Since, our body resistance is very high we do not experience a shock.

**Q52.WHAT IS AN ALTERNATOR?**

**Ans:** An alternator is an electro-mechanical device comprising of stator, rotor winding and an external exciter for supplying excitation voltage. Alternator generates electricity when coupled with a prime mover. Alternator on a ship is exposed to harsh weather and sea conditions, due to which, its capacity and efficiency tends to reduce. It is very important to have proper maintenance on the alternator part of the generator as per planned maintenance or as and when required.

**Q53.ALTERNATOR MAINTENANCE**

**Ans:** Before starting any maintenance work on the alternator, all safety precaution should be taken and the alternator should be shut and locked down. Also, post notice and ply cards on relevant places and alternator heater to be isolated. Clean the alternator ventilation passage and air filter.

- Check the Insulation resistance of stator and rotor winding.
- Air gap between stator and rotor to be checked and maintained between 1.5 to 2 mm.
- Slip rings to be checked for even wear down to be renewed if required.
- Carbon brushes to be clean and checked for free movement.
- The brush contacting pressure to be checked by spring balance.
- Automatic Voltage Regulator to be checked and cleaned off oil and dust.
- The lube oil level of pedestal bearing to be maintained and renewed as per planned maintenance.
- A vacuum cleaner can be used to remove dust accumulated in the inner parts of alternator.
- The terminal box cover gasket to be checked for proper oil and water tightness.
- All the connection in the terminal box to be tightened properly.
- Cable gland to be checked for integrity.
- Forced Ventilation around alternator must be maintained all the time.
- Check heater for proper operation.
- The foundation bolts of the alternator to be checked for tightness.

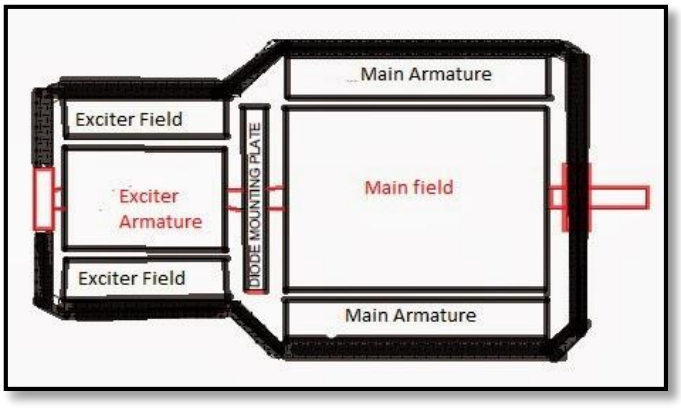
After maintenance is performed, a no load test should be carried out and general condition such as noise, temperature, voltage generated etc. of the alternator should be observed and noted.

**Q54.BRUSHLESS ALTERNATOR WITH DIAGRAM**

**Ans:** A brushless alternator is composed of two alternators built end-to-end on one shaft. Smaller brushless alternators may look like one unit but the two parts are readily identifiable on the large versions. The larger of the two sections is the main alternator and the smaller one is the exciter. The exciter has stationary field coils and a rotating armature (power coils). The main alternator uses the opposite configuration with a rotating field and stationary armature. A bridge rectifier, called the rotating rectifier assembly, is mounted on the rotor. Neither brushes nor slip rings are used, which reduces the number of wearing parts. The main alternator has a rotating field as described above and a stationary armature (power generation windings).

Varying the amount of current through the stationary exciter field coils varies the 3-phase output from the exciter. This output is rectified by a rotating rectifier assembly, mounted on the rotor, and the resultant DC supplies the rotating field of the main alternator and hence alternator output. The

Result of all this is that a small DC exciter current indirectly controls the output of the main alternator



**AVR**

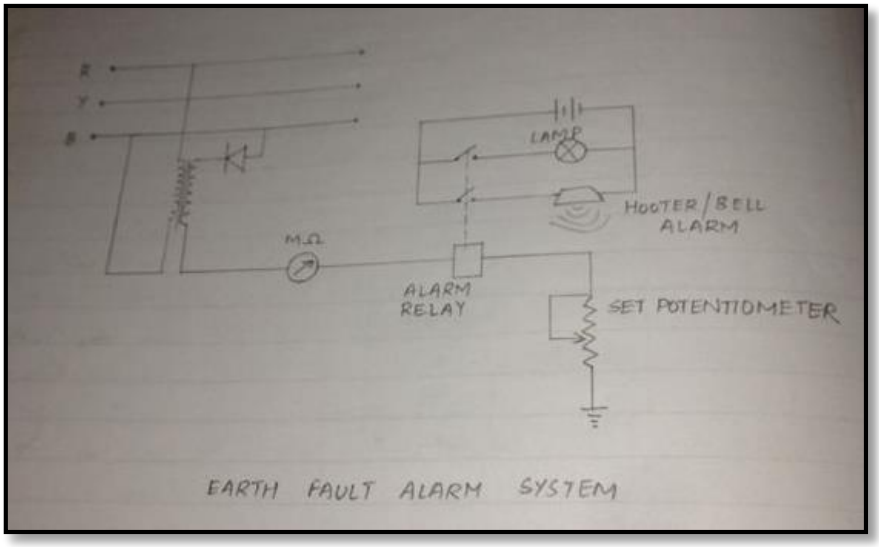
AVR stands for Automatic Voltage Regulator. The AVR maintains a constant or stable output voltage during operation, usually by varying the field voltage. The voltage sensing unit transforms down, rectifies and smoothest the generator output voltage .this produces a low voltage dc signal that is proportional to the ac generator voltage. This actual dc signal is compared with a set dc value produced by a reference circuit of zener diodes and resistors.an error signal output from comparator is then amplified and made suitable for driving the field circuit regulating thyristors.

**Q55. HOW DOES REVERSE POWER HAPPEN?**

**Ans:** Reverse power generally describes a condition where the prime mover of a generator is not supplying sufficient torque to keep the generator rotor spinning at the same frequency as the grid to which the generator is connected. In other words, the generator has actually become a motor and is drawing current from the grid to which is connected and is supplying torque to the prime mover which is supposed to be supplying torque to the generator

**Q56.EARTH FAULT. (ALARM SYSTEM CIRCUIT DIAGRAM)**

**Ans:** Earth fault occurs when some phase conductor touches neutral (for earthed system) or ground potential.
Earth leakage is the current which is leaking from phase to earth under normal operation. Is may be happening because of capacitive effect between phase and ground or sometime very high resistance appearing between phase and ground.




**Q57.CB PROTECTION INCLUDING SHUNT TRIP, UNDER VOLTAGE AND THERMAL TRIP.**

**Ans:** A circuit breaker is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and interrupt current flow. Unlike a fuse, which operates once and then must be replaced, a circuit breaker can be reset (either manually or automatically) to resume normal operation. Circuit breakers are made in varying sizes.

A shunt trip is a solenoid device on a circuit breaker that trips the circuit breaker by applying a voltage to the shunt trip. This trip mechanism is not part of the instantaneous and short time-delay trip of the

breaker, but as the term implies, it is a shunt mechanism which operates in parallel with, but independent of, the breakers current actuated trip.

The under voltage trip accessory trips the circuit breaker when the voltage drops to a value between 35% and 70% of the control voltage. If the under voltage trip is not energized, it is impossible to close the circuit breaker, either manually or electrically. An attempt to close the circuit breaker produces no movement of the main contacts. Closing is allowed when the supply voltage of the under voltage trip reaches 85% of the rated voltage.

Thermal circuit protectors utilize a bimetallic strip electrically in series with the circuit. The heat generated by the current during an overload deforms the bimetallic strip and trips the breaker.

**Q58 .WORKING OF SMOKE AND FIRE DETECTOR**

**Ans:** A smoke detector is a device that senses smoke. Most smoke detectors work either by optical detection (photoelectric) or by physical process (ionization), while others use both detection methods to increase sensitivity to smoke.
An optical detector is a light sensor. The components of the light sensor are the light source (incandescent bulb or Light-emitting diode), a lens, and a photoelectric receiver (typically a photodiode). When smoke enters the light is reflected and this causes less light to fall at the receiver, this generates a alarm.
An ionization smoke detector uses a radioisotope such as americium-241 to produce ionization in air; a difference due to smoke is detected and an alarm is generated. Ionization detectors are more sensitive to the flaming stage of fires than optical detectors, while optical detectors are more sensitive to fires in the early smouldering stage.

**Fire detector**

There are two methods for detecting fire from the presence of heat;
Fixed temperature heat detectors operate when the ambient temperature increases sufficiently to predetermined level where the heat detector will operate; or
A rate-of-rise heat detector operates when the ambient temperature increases over time equal to or greater than the rate of change the detector was manufactured to operate.
Most common type of fixed temperature heat detector is a fusible link comprising a eutectic alloy. An eutectic alloy is mixture of two or more metals whose melting point at a lower temperature than the individual metal. When the ambient temperature increases to the eutectic temperature, the alloy changes state from a solid to a liquid, like solder. This enables a spring held under pressure to release and make an electrical circuit to actuate an alarm.

**Q59.STROBOSCOPIC EFFECT**

**Ans:** The stroboscopic effect is a visual phenomenon caused by aliasing that occurs when continuous motion is represented by a series of short or instantaneous samples. It occurs when the view of a moving object is represented by a series of short samples as distinct from a continuous view, and the moving object is in rotational or other cyclic motion at a rate close to the sampling rate.

Because of the illusion that the stroboscopic effect can give to moving machinery, it is advised that single-phase lighting is avoided. For example, a factory that is lit from a single-phase supply with basic lighting will have a flicker of 100 or 120Hz(depending on country, double the nominal frequency), thus any machinery rotating at multiples of 50 or 60rpm may appear to not be turning, increasing the risk of

injury to an operator. Solutions include deploying the lighting over a full 3-phase supply, or by using high-frequency controllers that drive the lights at safer frequencies.

**Q60.MAINTENANCE ON MSB**

**Ans:** Any maintenance on busbars should only be performed when the ship in dry dock or Black out condition:

1. Open the door for main and emergency switchboards where inspection is to be performed
2. Carryout visual inspection of copper plate and nut bolts. Mark any missing or burn out areas
3. By hand or using a metal or plastic stick (where access for hand is not possible), tap the bus plates gently so as to make out for any loose connection. Ensure to wear electrical gloves even when bus bar is not live
4. The busbars are mechanical supported inside the switchboard by means of insulators, which may be of rubber or ceramic materials (bad conductors). Check for any damages in the insulator part
5. By using an adjustable spanner or particular size spanner, tighten the nuts in the busbar connection for main and emergency switch boards
6. Check the tightness of the wire connections, which is connected to the circuit breakers
7. Clean the bus bar and switchboard area with the help of vacuum cleaner
8. If u find any loose connection or spark, black-out the particular and adjacent bus bar before tightening the nut
9. If u find any metal piece or nut bolts missing or inside the panel, ensure to remove it as the same can cause short circuit or fire

The ship's electrical officer is required to inspect the busbar periodically for record keeping and also as stated by the preventive maintenance system. This is done to avoid any type of accident from electrical faults on ships. When doing such inspection the following highest safety measures are to be taken with all required PPEs as the Bus bar is "LIVE":

- Check the load in the running generator by means of KW meter provided in the main switchboard.
- Open the bus bar access door provided at the backside of MSB or ESB.
- Do the visual inspection and by the help of infrared temperature gun, measure the temperature of copper plates and bus bar connection. It should not be more than given limits depending upon the generator load. Example if the generator load is 50%, the room temperature is 28 deg c, the bus bar temperature must be within 50 deg c, if the temperature is too high then something is abnormal.

**Q61. TEMPERATURE CLASS MOTOR**

**Ans:** In 1977, the Electric Instrument Rules Committee of the Japanese Industrial Standards Committee discussed the classes of electrical insulation and drew up JIS C 4003: Classes of electrical insulation, to clarify the classes of motor insulation and their maximum allowable
Temperatures (Table 1)

| Insulation class | Maximum permissible temperature ( $^0$C) |
|---|---|
| Y | 90 |
| A | 105 |
| E | 120 |

| | |
|---|---|
| B | 130 |
| F | 155 |
| H | 180 |
| C | 180 & above |

**The following are brief explanations of those insulation techniques:**

**i) Class-Y insulation**: Withstands a temperature of up to 90°C; typically made of cotton, silk, or paper
**ii) Class-A insulation**: Withstands a temperature of up to 105°C; reinforced Class-Y materials with impregnated varnish or insulation oil
**iii) Class-E insulation**: Withstands a temperature of up to 120°C
**iv) Class-B insulation**: Withstands a temperature of up to 130°C. This has a form that inorganic material is hardened with adhesives. This is the first insulator using this structure.
**v) Class-F insulation**: Withstands a temperature of up to 155°C; for example, made of Class-B materials that are upgraded with adhesives, silicone, and alkyd-resin varnish of higher thermal endurance
**vi) Class H insulation**: Withstands a temperature of up to 180°C; for example, made of inorganic material glued with silicone resin or adhesives of equivalent performance
**vii) Class-C insulation**: Withstands a temperature of up to 180°C or higher; made of 100% inorganic material as explained above, electrical insulation is classified with its maximum allowable temperature. By adopting an insulation technique of higher thermal endurance, electric instruments can be downsized.

**Q62. WHY ONLY AC IS USED ON BOARD?**

- AC can be generated at high voltages, but DC cannot be generated at high voltages because sparking starts at the commutator at high voltage, due to which commutator gets damaged.
- High voltages AC generators are much simpler and cheaper than DC generators of the same range. It is because in AC generators there is no commutator which is costly part and is damaged.
- Alternating current can be stepped up or stepped down with a static device called transformer. When voltages is stepped up current decreases to a small value. Small current produces less heat and can be transmitted through a thin conductor. Thus it is possible to transmit AC at high voltages. This reduces the size of conductor, transmission losses are increases transmission efficiency. At the receiving station, voltages can be stepped down to the required value by using step down transformer. This is most important reason for generating and using electrical energy as AC.
- A.C. induction motors are simplest in construction, cheaper in cot and require less maintenance whereas D.C. motors are complicated.
-

**Q63. IF YOUR OVERHAULED MOTOR IS NOT STARTING, WHAT WILL YOU CHECK?**

**Ans:**

- Ensure the terminal for power supply is in good condition. Check the connection bar for terminal (U, V, W). Connection type - STAR OR DELTA.
- Confirm the power supply VOLTAGE for electric motor. 230/400.
- Using the multimeter, check the continuity of winding from phase to phase ( U to V, V to W , W to U ).Each phase to phase must have a continuity if winding is OK.
- Check the motor winding ohms reading using multimeter or ohmmeter for phase to phase terminal( U to V,V to W ,W to U ).The ohms reading for each winding must be the same (or nearly the same).

- Insulation resistance of motor winding using Insulation tester meter set to the 500 Volt scale (1000v DC). 1. Check from phase to phase (U to V, V to W, W to U) and 2. Check from phase to earthing (U to E, V to E , W to E ). Minimum test value of the electric motor is 1 Meg Ohm (1 MΩ).
- If every step is completed, decide the condition of electrical motor either OK or NEED TO REPAIR.

**Q64. SINGLE PHASING, HOW WILL YOU COME TO KNOW WHICH PHASE HAS GONE HOW YOU WILL TEST?**

**Ans: <u>Single phasing:</u>**

- In single phasing, one of the three phases of motor one phase goes wrong i.e. open circuit fault occurs in any of the one phase wire.
  - When a three phase motor is "single phased", it is a power system problem, not a motor problem. A three phase motor needs three EQUAL phases in order to operate properly. When the symmetry of the motor is interrupted by the loss of a phase, the motor will die quickly unless the controls have single phase protection. Many heater type overload relays do not have this.

**<u>How to know single phasing occurs:</u>**

- Obvious signs are a louder than normal humming from the motor and/or a shaft that vibrates rather than rotating.
- Motor will draw excess current
- It will overheat
- If fault not diagnosed & rectified, then motor will burn

**<u>Causes:</u>**

- Single phasing occurs as a result of several possibilities. A loose wire, a bad connection, bad starter contacts, overload relay problems, a bad breaker, a blown fuse, and other things can cause this destructive condition.

**<u>How to test:</u>**

- Testing for this possibility needs to be done quickly since motors are not happy with this condition at all. The obvious test is to look at the current in each phase. This is where multiple meters will help so you can see all three phases at once. You can also look at the voltage, again with multiple meters if possible. Look at the phase to ground readings first. The phase to ground voltage will equal the phase to phase voltage divided by 1.7; thus 480 volts phase to phase will be 277 volts phase to ground. The advantage of taking phase to ground measurements is that each reading is independent of whatever is happening in the other phases. However, you can read phase to phase if you want. You would see an unbalance there too. The phase to ground reading will show you the bad phase, though; this will make troubleshooting easier.
- These tests need to be made as close to the motor as possible, preferably in the motor's connection box while the motor is driving the load. If the motor is not connected, or you take your readings at the starter or breaker with the motor off, you can get fooled. A bad set of contacts in a contactor or breaker can just barely touch and still tell you that you have good voltage. Ask those same contacts to deliver enough current to run a loaded motor, and the voltage will take a dive.
- You could continue to test at various stages of the power system upstream of the motor, but that keeps subjecting the motor to the stress of running in the single phase condition. Otherwise, make sure the circuit is off and locked out, and then start taking things apart.
- The first place to look is at those suspect contactor contacts. But, Bo Diddley said "you can't judge a book by looking at the cover." Contacts can be like me - real ugly but still functional. Contacts that are gone don't work very well, though. Also look at the connections in and out

of the contactor. Loose or burned wires or terminals are probably the second most frequent offenders.

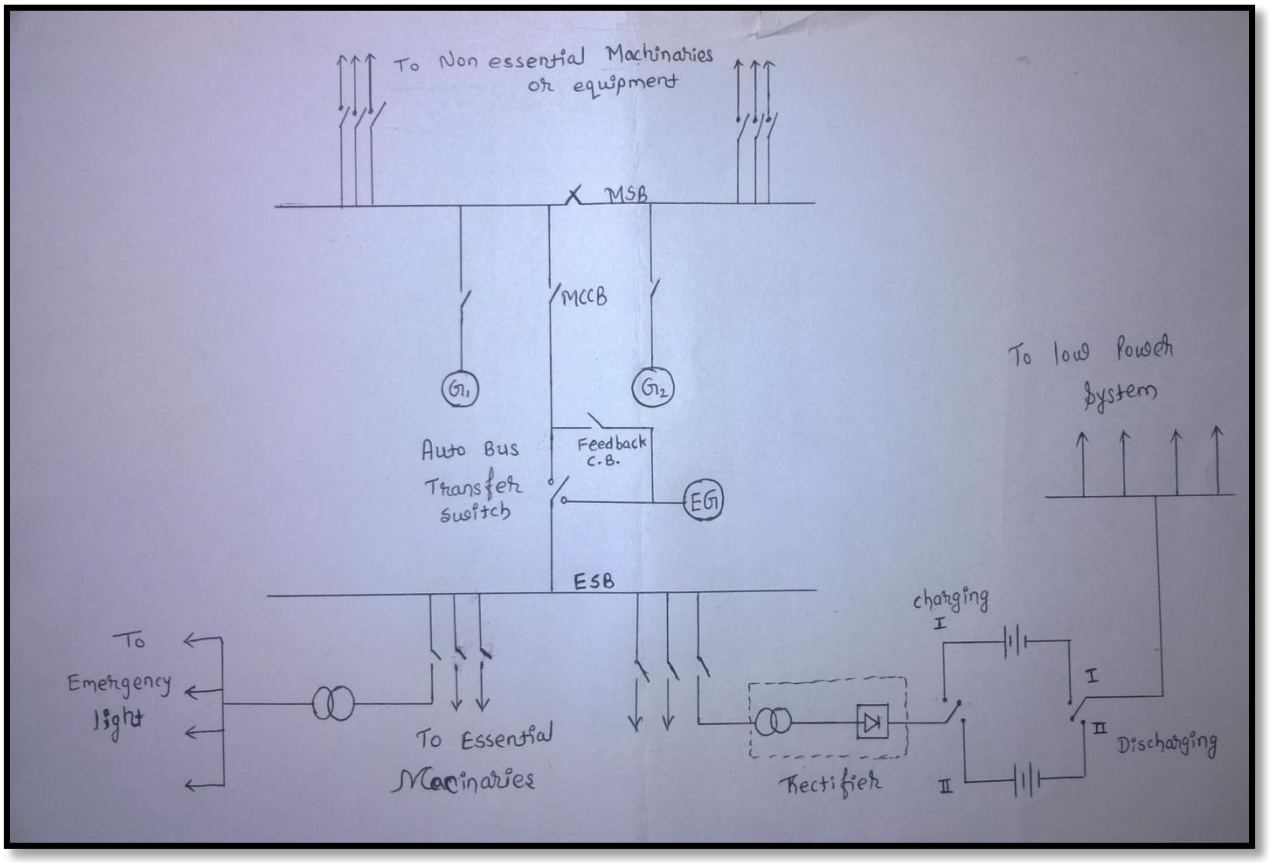
- If the contactor looks good, take continuity readings from the line to the load side of each phase of the overload relay. It should look like a short circuit.
- If everything is good at the starter, check wires, connections, and devices ahead of the starter until the problem is found and corrected.

**Q65. WHY DO WE USE 440V SUPPLY FOR MOTORS AND 220V SUPPLY FOR LIGHTING (ACCOMMODATION)? WHAT ARE THE ADVANTAGES?**

**Ans-**

- Using 440 volt for motors will result in the reduction of motor load current, half the value of current resulting from the use of 220 volts. The load current is responsible for the energy line losses, by the formula, kw loss = I.I.R/1000. So with less current, at 440 volts, there will be a reduction in line losses when 440volts is used for, motors rather 200 volts. ALSO, with higher current, the wire size for 220 volt motors will be twice bigger than those used for 440 volt motors. It means, there will be higher cost of installation cost on 220 volt motors than those for 440 volt motors.
- For lighting, 220 volts is used giving residential users, a safe line voltage. Most lights are rated not above 220 volts, including lamp ballasts.
- And ships having 440 volts 3 phase supply will have near to 220 volts of supply for single phase, generally all the accommodation lights will be of single phase.

**Q66. AUTOMATIC BUS TRANSFER (ABT) SWITCH OPERATION**
**Ans:**



- It connects Main Switch Board (MSB) to emergency switch board (ESB) when main supply is available.
- It connects emergency generator (EG) to Emergency Switch Board (ESB) automatically when main supply fails.
- It does not allow paralleling of M/G with E/G or shore supply with E/G.
- When on shore supply, in case of shore supply power failure Emergency Generator will switch over.

**Q67. WHAT IS THE DIFFERENCE BETWEEN STAR DELTA AND AUTO TRANSFORMER STARTER? WHY IS STAR USED FOR STARTING AND CHANGE OVER TO DELTA? WHY NOT STAR ALWAYS?**

**Ans:** Star Delta method used reduced supply voltage in starting. The method achieved low starting current by first connecting the stator winding in star configuration, and then after the motor reaches a certain speed, throw switch changes the winding arrangements from star to delta configuration. By connecting the stator windings, first in star and then in delta, the line current drawn by the motor at starting is reduced to one-third as compared to starting current with the windings connected in delta. At the time of starting when the stator windings are start connected, each stator phase gets voltage $V(L)/\sqrt{3}$ , where V(L) is the line voltage. Since the torque by an induction motor is proportional to the square of the applied voltage, star- delta starting reduced the starting torque to one – third that obtainable by direct delta starting.

**Auto Transformer**

The operation principle of auto transformer method is similar to the star delta starter method. The starting current is limited by (using a three phase auto transformer) reduce the initial stator applied voltage. The auto transformer starter is more expensive, more complicated in operation and bulkier in construction when compared with the star – delta starter method. But an auto transformer starter is suitable for both star and delta connected motors, and the starting current and torque can be adjusted to a desired value by taking the correct tapping from the auto transformer. When the star delta method is considered, voltage can be adjusted only by factor of $1/\sqrt{3}$

**Why change over to delta?**

If motor is designed to run in delta but is run as star connected,and on full load,then each stator phase winding will be carrying an overcurrent of $\sqrt{3}$* times rated phase current because phase and line current are equal in a star connection.This will cause overheating and eventually burnout unless tripped by the overcurrent relay.

**Q68. WHAT IS ISOLATION TRANSFORMER?**

**Ans:** An **isolation transformer** is a transformer used to transfer electrical power from a source of alternating current (AC) power to some equipment or device while isolating the powered device from the power source, usually for safety reasons. Isolation transformers provide galvanic isolation and are used to protect against electric shock, to suppress electrical noise in sensitive devices, or to transfer power between two circuits which must not be connected. A transformer sold for isolation is often built with special insulation between primary and secondary, and is specified to withstand a high voltage between windings. Isolation transformers block transmission of the DC component in signals from one circuit to the other, but allow AC components in signals to pass. Transformers that have a ratio of 1 to1 between the primary and secondary windings are often used to protect secondary circuits and individuals from electrical shocks.

**Q69. PRINCIPLE OF TRANSFORMER AND WHAT HAPPENS TO CURRENT AND VOLTAGE DURING TRANSFORMATION?**

**Ans:** Electrical power transformer is a static device which transforms electrical energy from one circuit to another without any direct electrical connection and with the help of mutual induction between two windings. It transforms power from one circuit to another without changing its frequency but may be in different voltage level. The **working principle of transformer** is very simple. It depends upon Faraday's law of electromagnetic induction. Actually, mutual induction between two or more winding is responsible for transformation action in an electrical transformer.

Say you have one winding which is supplied by an alternating electrical source. The alternating current through the winding produces a continually changing flux or alternating flux that surrounds the winding. If any other winding is brought nearer to the previous one, obviously some portion of this flux will link with the second. As this flux is continually changing in its amplitude and direction, there must be a change in flux linkage in the second winding or coil. According to Faraday's law of electromagnetic induction, there must be an EMF induced in the second. If the circuit of the later winding is closed, there must be an electric current flowing through it. This is the simplest form of electrical power transformer and this is the most basic of **working principle of transformer**.

**Current and voltage during transformation:-**

If it is a step up transformer then current will reduce and voltage will increase and if its a step down transformer then current will increase and voltage will decrease.This is becuase to maintain same power.

**Q70. CAN DC BE TRANSFORMED? IF YES HOW AND IF NO WHY?**

**Ans:** No because a transformer works on the principle of electromagnetic induction, which requires a voltage source that changes with time (alternating source). Thus a dc supply is unidirectional, the transformer cannot work, and you will get no output.

**Q71. WORKING OF REVERSE POWER RELAY? ALONG WITH VALUE**

**Ans:** A reverse power relay is a directional power relay that is used to monitor the power from a generator running in parallel with another generator or the utility. The function of the reverse power relay is to prevent a reverse power condition in which power flows from the bus bar into the generator. This condition can occur when there is a failure in the prime mover such as an engine or a turbine which drives the generator. It detect those fault and acts to trip the generator circuit breaker.

**Value of reverse power relay**

The reverse power relay is usually set to 5% to 15% of the motoring power required by prime mover. By motoring power we mean the power required by the generator to drive the prime mover at the rated rpm. This is usually obtained from the manufacturer of the prime mover (turbine or engine). Time delay range is 0.5-3s

**Q72. IS REVERSE POWER RELAY MSB SAFETY?**

**Ans:** No it is generators safety because it avoids generator running as a motor and drawing current from the another generator running in parallel and overloading its,causing other generator to trip.

**Q73. THERMOCOUPLE**

**Ans:** A thermocouple is a temperature-measuring device consisting of two dissimilar conductors that contact each other at one or more spots.It works on the principle of seeback effect. It produces a voltage when the temperature of one of the spots differs from the reference temperature at other parts of the circuit. Thermocouples are a widely used type of temperature sensor for measurement and control.

**Types**

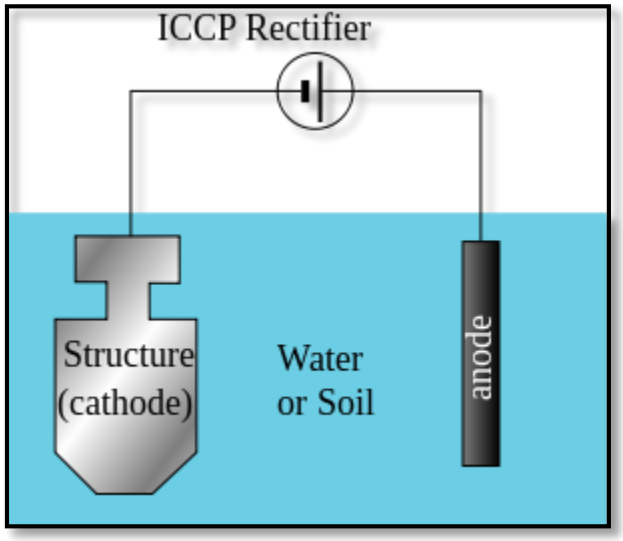
- **Type E** (chromel – constantan) has a high output (68 μV/°C) which makes it well suited to cryogenic use. Additionally, it is non-magnetic. Wide range is −50 °C to +740 °C and Narrow range is −110 °C to +140 °C.
- **Type J** (iron – constantan) has a more restricted range than type K (−40 °C to +750 °C), but higher sensitivity of about 50 μV/°C. TheCurie point of the iron (770 °C) causes a smooth change in the characteristic, which determines the upper temperature limit.
- **Type K** (chromel – alumel) is the most common general purpose thermocouple with a sensitivity of approximately 41 μV/°C (chromel positive relative to alumel when the junction temperature is higher than the reference temperature). It is inexpensive, and a wide variety of probes are available in its −200 °C to +1350 °C / -330 °F to +2460 °F range.

**Q74. ICCP FULL EXPLANATION**

**Ans: Corrosion:** The ship's hull is corroding in sea water. Generally this is electro-chemical reaction in which the metal combines with an oxygen, to form a metal oxide or other compound. This depends upon the nature of the environment. Different metals have different tendencies to corrode, activity or potential. Some metals and alloys have two positions in the series, marked Active and Passive. The active position is when the corrosion is occurring and approaches the electro-chemical series position for the material. The passive position relates to a non-corroding situation where the material is protected by a self forming surface film.
If two metals are placed in an electrolyte (e.g. sea water or damp soil) and are in direct electrical contact, a current will pass through the electrolyte from the more active metal onto the least active metal.

**ICCP**

A metal also can be made cathodic by electrically connecting it to another metallic component in the same electrolyte through a source of direct electric current. The current flow from this metallic component must be sufficient to overcome the natural corrosion current. Thus we will direct the current flow to occur off the surface of added metallic component (anode), into the electrolyte and onto the metal (cathode). All we need is to measure what the natural corrosion current is. So we add one more electrode – reference cell – completely passive metal. The potential difference between the hull and reference cell will form the natural corrosion current. So another electrode – anode - with a power source is introduced so that the current flow from this electrode is sufficient to overcome the natural corrosion current. Because an external current source is employed, this type of protection is termed 'IMPRESSED CURRENT CATHODIC PROTECTION'.




A source of direct current is required, this is generally obtained from mains power units that contain a transformer and rectifier.
The magnitude of this current may be automatically controlled in response to a continuous monitor of the cathode / electrolyte potential or may be manually controlled after intermittent measurement.
The impressed current anode material is ideally non-consumed by the passage of current from it into the electrolyte, in practice the materials used are a compromise between this ideal and the cost and physical properties of available materials. Impressed current anodes are made from graphite, silicon iron, lead alloys some with platinum dielectrodes, platinised titanium or more exotic combinations such as platinum clad niobium. The selection of the correct anode material is critical in the formulation of an effective and economic cathodic protection scheme.

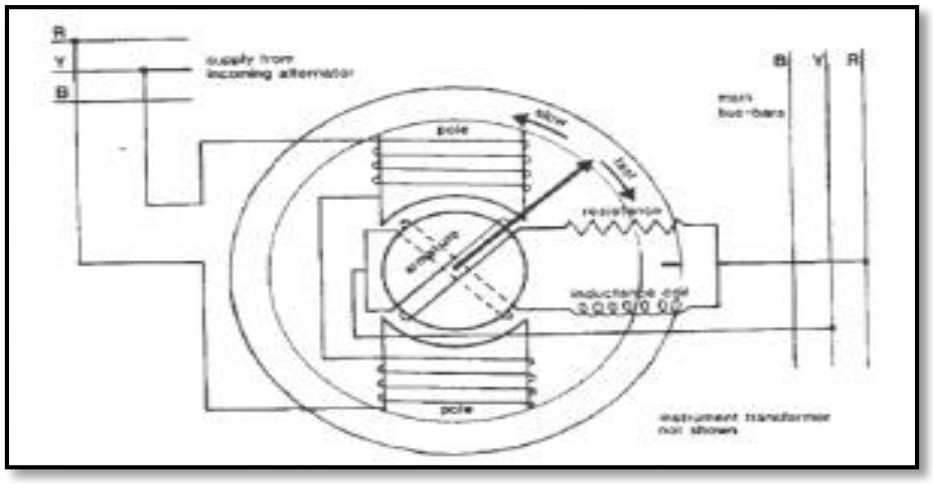
Generally, for a given current demand, less impressed current anodes than sacrificial anodes are required for protection, as high anode currents are feasible.
Impressed current systems of cathodic protection are more sophisticated in design than sacrificial systems.

**Q75. TWO GEN RUNNING IF ONE GEN LOAD DROPS WHAT IS THE FAULT.**

**Ans:** Reasons- Engine is not developing power,some problem with governor. Speed drop set too tight

**Q76. HOW TO SYNCHRONIZE GENERATORS ON A SHIP?**

**Ans:** Synchronizing of an incoming generator or alternator is very important before paralleling it with another generator. The synchronizing of the generator is done with the help of synchroscope or with three bulb method in case of emergency. It is of utmost importance that before paralleling the generators the frequency and voltage of the generators need to be matched.




## Synchroscope method

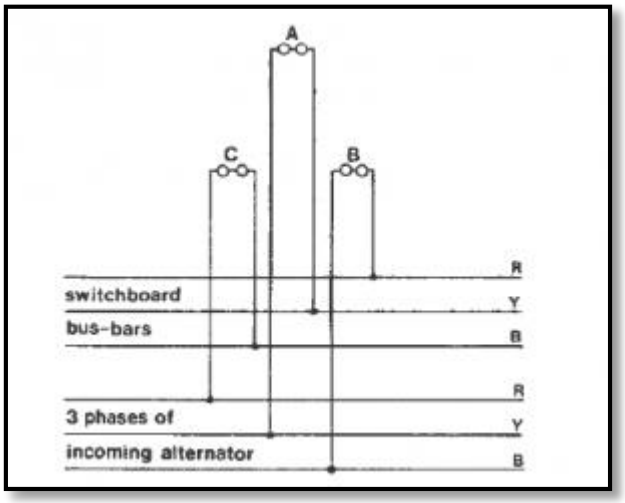
1. The synchroscope consists of a small motor with coils on the two poles connected across two phases. Let's say it is connected in red and yellow phases of the incoming machine and armature windings supplied from red and yellow phases from the switchboard bus bars.
2. The bus bar circuit consists of an inductance and resistance connected in parallel.
3. The inductor circuit has the delaying current effect by 90 degrees relative to current in resistance.
4. These dual currents are fed into the synchroscope with the help of slip rings to the armature windings which produces a rotating magnetic field.
5. The polarity of the poles will change alternatively in north/south direction with changes in red and yellow phases of the incoming machine.
6. The rotating field will react with the poles by turning the rotor either in clockwise or anticlockwise direction.
7. If the rotor is moving in clockwise direction this means that the incoming machine is running faster than the bus bar and slower when running in anticlockwise direction.
8. Generally, it is preferred to adjust the alternator speed slightly higher, which will move the pointer on synchroscope is in clockwise direction.
9. The breaker is closed just before the pointer reaches 12 o clock position, at which the incoming machine is in phase with the bus bar

When the synchroscope is approaching 12 o'clock the "slip" (differential) between the sine waves is approaching minimum (slip is zero when the synchroscope is at 12 o'clock) and the voltage differential between the phases is minimal (it's zero when the synchroscope is at 12 o'clock). Due to time taken to close the synchronoscope switch, it is generally done at 11 o'clock. Due to the small delay to close, by doing at 11 o'clock, we are achieving closing close to 12 o'clock.

**Q77. HOW WILL YOU SYNCHRONIZE WITHOUT SYNCHROSCOPE?**

**Ans:** This method is generally used when there is a failure of synchroscope. In case of failure a standby method should be available to synchronize the alternator, and thus the emergency lamp method is used.

Three lamps should be connected between three phases of the bus bar and the incoming generator should be connected as shown in the diagram:-




1. The lamps are connected only in this manner because if they are connected across, the same phase lamps will go on and off together when the incoming machine is out of phase with the switchboard.
2. In this method as per the diagram the two lamps will be bright and one lamp will be dark when incoming machine is coming in phase with the bus bar.
3. The movement of these bright and dark lamps indicates whether the incoming machine is running faster or slower.
4. For e.g. there is a moment when lamp A will be dark and lamp B & C will be bright, similarly there will be instance when B is dark and others are bright and C is dark and other two are bright. This example indicates that machine is running fast and the movement of the lamps from dark and bright gives an clockwise movement
5. Clockwise movement indicates fast and anti-clockwise direction indicates slow running of incoming generator.

**Q78. EXPLAIN BRUSHLESS ALTERNATORS?**

**Ans:** A brushless alternator is composed of two sections: main alternator and the smaller exciter. The exciter has stationary field coils and a rotating armature (power coils). The main alternator uses the opposite configuration with a rotating field and stationary armature. A bridge rectifier, called the rotating rectifier assembly, is mounted on a plate attached to the rotor. Neither brushes nor slip rings are used, which reduces the number of wearing parts. The main alternator has a rotating field as described above and a stationary armature (power generation windings).

Residual magnetism is a property in which certain amount of excitation remains back in the conductor even after the removal of the magnets. It is required as we need some magnetism to start off the generation before the field winding has power to produce the full field.

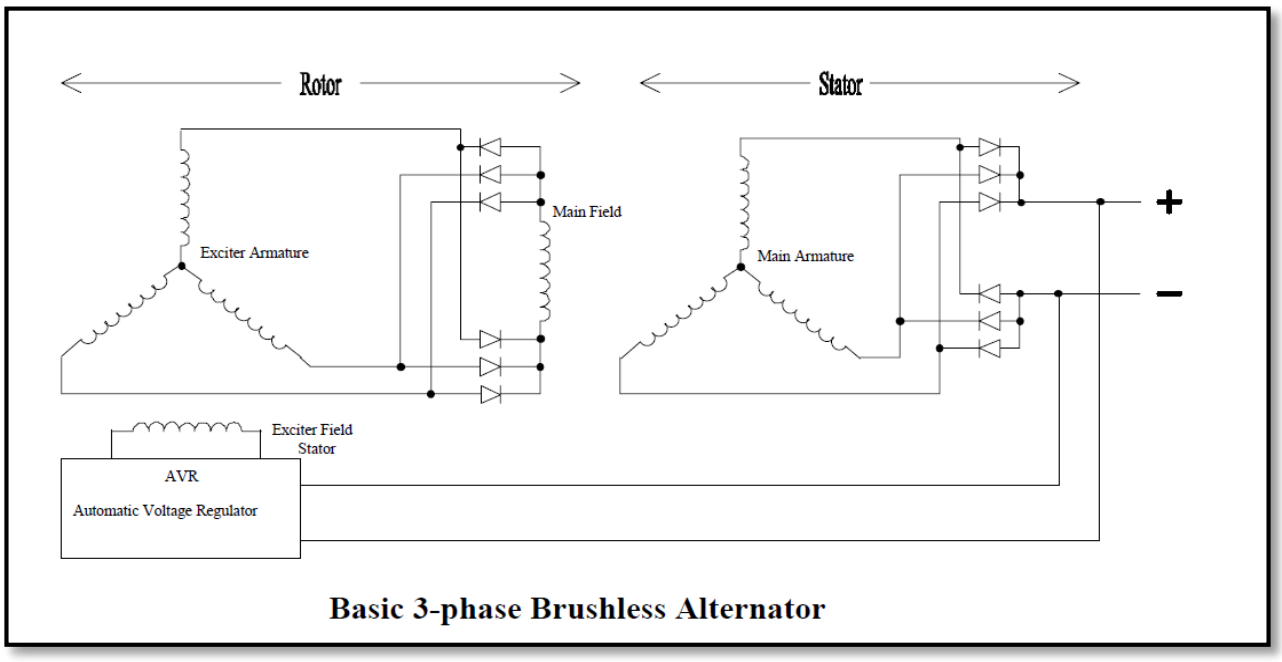
Varying the amount of current through the stationary exciter field coils varies the 3-phase output from the exciter. This output is rectified by a rotating rectifier assembly, mounted on the rotor, and the resultant DC supplies the rotating field of the main alternator and hence alternator output. The result of all this is that a small DC exciter current indirectly controls the output of the main alternator.

***Basic Theory***

When an electric current is passed through a coil of wire, a magnetic field is produced (an electromagnet). Conversely, when a magnetic field is moved through a coil of wire, a voltage is induced in the wire. The induced voltage becomes a current when the electrons have some place to go such as into a battery or other
load. Both of these actions take place in alternators, motors and generators or dynamos. Voltage is generated when a coil of wire is moved through a magnetic field. It doesn't matter whether the coil is moving or the magnetic field is moving. Either configuration works equally well and both are used separately or in combination depending on mechanical, electrical and other objectives. The old DC generators (dynamos) used a stationary field and rotating armature. Automotive alternators use the opposite configuration with a rotating field and stationary armature. In a brushless alternator, both configurations are used in one machine.

***Terminology***

The stationary part of a motor or alternator is called the **stator** and the rotating part is called the **rotor**. The coils of wire that are used to produce a magnetic field are
called the **field** and the coils that produce the power are called the **armature**.




**Basic 3-phase Brushless Alternator**

**Q79. WHAT IS AVR?**

**Ans:** AVR-means automatic voltage regulator AVR regulates the voltage of a generator. When voltage drops, due to load increase, AVR gives voltage to exciter and exciter more excites the alternator and voltage improve.

The AVR senses the voltage in the main generator winding and controls the power fed to the exciter stator and hence the main rotor to maintain the generator output voltage within the specified limits, compensating for load, speed, temperature and power factor of the generator.

A frequency measuring circuit continually monitors the shaft speed of the generator and provides under-speed protection of the excitation system by reducing the generator output voltage proportionally with speed below a pre-settable threshold. A further enhancement of this feature is an adjustable VOLT per Hertz slope to improve engine recovery time on turbo charged engines. Soft start circuitry is included to provide a smooth controlled buildup of generator output voltage. Uncontrolled excitation is limited to a safe period by internal shutdown of the AVR output device. This condition remains latched until the generator has stopped. Provision is made for the connection of a remote voltage trimmer, allowing the

user fine control of the generator's output. The AVR has the facility for droop CT connection, to allow parallel running with other similarly equipped generators.

**Q80. WHAT IS REVERSE POWER TRIP?**

**Ans:** There is not much difference between an alternator and electric motors from the engineer's perspective. They are both based on similar principles. So just imagine what would happen if an alternator suddenly would act as a motor. This is only possible in systems where two or more generators are running in parallel.

Hence this type of protection system is used only if there is more than one alternator on board a ship. The system is designed in such a way that it will release the breaker and prevent motoring of alternator if a reversal of power occurs. This protection device is also used to prevent damage to the prime mover, which might be stopped due to some fault. Though it is extremely difficult to detect reverse current with an alternating current system, reverse power can be detected and protection can be provided by reverse power relay.

Situation of a generator is feeding a system through switchgear having several generators connected in parallel with this generator. The flow of current, when the system is running normally, is from the generators to the switchgear. If one generator experiences problems and its terminal voltage falls below the system voltage, the generator will act as a motor, just as a motor can act as a generator, and current will flow from the switchgear to the generator. This is reverse power. The effects can range from minor to extreme in the event of a complete mechanical failure of the generator which fails.
Assume that the generator normally produces an amount of power equal to P, and that when operating as a motor, it will absorb a similar amount, P. Therefore, the net effect on the grid will be the same as if it experienced a step increase in load equal to 2P. Depending on the size of the grid and the strength of the remaining generation, a step increase of 2P could result in a significant frequency change on the grid.
There could be prime mover damage in some instances (especially steam turbines).

Reverse power protection is used for anti-motoring. This function is used for protection of prime mover not generator. It can cut-off the fuel supply and stop the prime mover.

**Q81. HOW DO YOU TEST REVERSE POWER TRIP?**

**Ans:** When two generators are running in parallel and one generator can carry the load, reverse power trip can be tested by load shifting using governor control. When the load has shifted sufficiently and the off loaded generator is carrying a small percentage of load, its breaker trips and fuel supply to its prime mover cuts off. This means reverse power relay has operated. The relay can be tested by simulation to see if it initiates a trip signal.

**Q82. HOW ELECTRICITY PRODUCED ONBOARD SHIP?**

**Ans:** The electrical power demand aboard ship will vary according to ship type and day by day operational needs. The meet of power demand, two or more generator and is backed up by an emergency generator.

**Power generation On board**

Shipboard power is generated using a prime mover and an alternator working together. For this an alternating current generator is used on board. The generator works on the principle that when a magnetic field around a conductor varies, a current is induced in the conductor.
The generator consists of a stationary set of conductors wound in coils on an iron core. This is known as the stator. A rotating magnet called the rotor turns inside this stator producing magnetic field. This field cuts across the conductor, generating an induced EMF or electro-magnetic force as the mechanical input causes the rotor to turn.
The magnetic field is generated by induction (in a brushless alternator) and by a rotor winding energized by DC current through slip rings and brushes. Few points to be noted about power on board are:

- AC, 3 phase power is preferred over DC as it gives more power for the same size.
- 3 phases is preferred over single phase as it draws more power and in the event of failure of one phase, other 2 can still work

**Q83. WHAT IS THE PROCEDURE FOR TESTING EMERGENCY GENERATOR ONBOARD?**

**Ans:** Emergency generator on ship provides power in case the main generators of the ship fails and creates a "dead or blackout condition". According to general requirement, at least two modes of starting an emergency generator should be available. The two modes should be – battery start and hydraulic or pneumatic start

**Testing of Emergency Generator**

The testing of ship's emergency generator is done every week (as part of weekly checks) by running it unloaded to check ifit starts on battery mode. The hydraulic start is done every month to ensure that it is working fine. Also every month automatic start of generator is also done to check its automatic operation and to see whether it comes on load

**Procedure for Battery Start**

1 Go to the emergency generator room and find the panel for emergency generator.

2 Put the switch on the test mode from automatic mode. The generator will start automatically but will not come on load.

3 Check voltage and frequency in the meter.

4 Keep the generator running for 10-15 min and check the exhaust temp and other parameters.

5 Check the sump level.

6 For stopping the generator, put the switch in manual and then stop the generator

**Procedure for Hydraulic Start**

1 Out the switch in manual mode as stated above and check the pressure gauge for sufficient oil pressure.

2 Open the valve from accumulator to generator.

3 Push the spring loaded valve and the generator should start.

4 Check voltage and frequency.

5 Keep the generator running for 10-15 min and check the exhaust temp and other parameters.

6 Check the sump level

7 For stopping, use the manual stop button from the panel.

8 After stopping the generator, pressurize the hydraulic accumulator to desired pressure.

9 Close the valve from accumulator to generator.

**Procedure for Automatic Start**

1 For automatic start, we know that there is a breaker which connects Emergency Switch Board (ESB) and Main Switch Board (MSB); and there is also an interlock provided due to which the emergency generator and Main power of the ship cannot be supplied together.

2 Therefore, we simulate by opening the breaker from the tie line, which can be done from the MSB or the ESB panel.

3 After opening the breaker, the emergency generator starts automatically with the help of batteries and will supply essential power to machinery and pumps connected to ESB.

4 For stopping the generator, the breaker is closed again and due to the interlock the generator becomes off load.

5 Now again put the switch to manual mode to stop the generator.

6 Press stop and the generator will stop

**Q84. HOW TO START DIESEL GENERATOR?**

**Ans: Procedure for preparing a diesel generator for starting**

- Set the engine to local control.
- Set up the fuel oil service system.
- Set up the auxiliary fresh water cooling system.
- Check the level of oil in – the sump, the governor and the alternator free end bearing and top up if required.
- Switch the generator engine pre lubricating oil pump to 'auto' operation and check that the lubricating oil pressure builds up. The engine should be pre lubricated at least 2 minutes prior to start. The pre lubricating pump starter is mounted on a panel separate from the generator local

control panel near the generator.

- Check the pressure before and after the lube oil filters.
- Check the air pressure in the starting air receiver.
- Turn the engine at least one complete revolution using the turning gear with the cylinder indicator cocks open. Remove the turning gear.
- Close the cylinder indicator cocks.

**Procedure to start a diesel generator engine locally**

- Prior to starting the generator engine following maintenance once all the steps above have been completed bar the engine over manually as follows:
- Select the control switch to BLOCKED.
- Remove the cover over the flywheel near the starter motor.
- Lift the release button on the top of the starter motor of engage the starter motor pinion wheel. The pinion wheel will move forward under spring pressure.
- With the indicator cocks open, engage the ratchet spanner fitter with the dedicated engine barring square socket on the starter motor shaft and turn the engine over at least two full turns.
- Remove the tool, lift the release push button and push the pinion wheel back until it latches in position and replace the flywheel cover.
- Blow through the engine manually from local.
- Close the indicator cocks
- Select the control switch to the LOCAL position and manually start the engine by pressing the START push button on the local control panel main starting valve. Allow the engine to run up to normal speed.
- Make a thorough check of the engine to ensure that there are no leaks and the engine is running smoothly and firing on all cylinders.
- Check that the LO pressures and temperatures are normal.
- Check that the pressure drop across the filters is normal.
- Check that the FO pressure and temperature are normal.
- Change over the control switch to REMOTE.

**Q85. WHAT IS THE PROCEDURE TO TAKE ALTERNATOR ONLOAD?**

**Ans:**

- TAKING ALTERNATOR ON LOAD IN AUTO MODE
- Turn the relevant MODE SELECTION switch at the main switch board synchronization panel to the AUTO position.
- Turn the relevant ACB CONTROL switch at the main switchboard synchronization panel to the close position.
- The ACB receives a close command and closes and the load shared with other running generators.
- TAKING ALTERNATOR ON LOAD IN MANUAL MODE
- Turn the relevant MODE SELECTION switch at the main switchboard synchronization panel to

the MANU position.

- Turn the synchroscope switch at the main switchboard synchronization panel to the incoming generator position (G1 OR G2 OR G3). The LED indicator ring on the synchroscope will begin to rotate.
- Adjust the GOVERNOR CONTROL switch (raise/lower) until the synchroscope is moving slowly in the clockwise (fast) direction (approximately one revolution every five to ten seconds)
- As the synchroscope approaches the twelve o'clock position (synchronism), turn the ACB CONTROL switch at the main switchboard synchronization panel to the CLOSE position.
- The ACB will receive a close command and will close. The CAN close indication at the relevant generator panel will be lit. Turn the SYNCHROSCOPE switch to OFF position.
- Manual balancing of the load is achieved by use of the GOVERNOR CONTROL switch

**Q86. WHAT ARE THE DIFFERENT MOTOR SAFETIES?**

**Ans:**

1. **SHORT CIRCUIT PROTECTION**
   **I**n HV motor protection scheme, the back- up fuses are the trigger type. This type of fuses releases a trigger actuated by a spring held in a tension until the element melts. When released, the trigger may be used to indicate a blown fuse or to trip a circuit breaker or contactor.

2. **OVER CURRENT & SINGLE PHASING PROTECTION**
   It is provided by inverse time OCR with differential function for single phase fault.

3. **UNDER VOLTAGE PROTECTION**
   Under voltage protection is by a separate relay which actuates the LO.

**Q87. WHAT IS SIGNIFIANCE OF SLIP IN INDUCTION MOTOR?**

**Ans:** Slip speed is the difference between the synchronous speed (Ns) of the rotating magnetic flux and actual rotor speed (Nr). Slip is usually expressed as a percentage of the synchronous speed

$$S = Ns\text{-}Nr/Nr * 100$$

If the load torque on the motor is increased, the rotor will tend to slow down (increasing the slip) which allow the rotor conductors to cut the flux at an increased rate. This causes more current to flow in the rotor which is matched by more stator supply current to meet the increased shaft torque demand. The motor will now run at this new, slightly reduced speed. The fall of motor speed between no-load and full load is very small (between 1% and 5%) so induction motor are considered to be almost constant speed machines.

**Q88. WHAT IS DIFFERENCE BETWEEN SYNCHRONOUS & ASYNCHRONOUS MOTOR?**

**Ans:** In a typical AC motor, a rotating magnetic field is produced in the stator. The speed of this rotating field is called the synchronous speed and is determined only by the frequency of the power supply and the number of poles of the machine. A synchronous motor is one in which the rotor rotates at the same speed as the rotating magnetic field in the stator. An asynchronous motor is one in which the rotor rotates at a speed slower than the synchronous speed.

When people refer to asynchronous motors, they are generally referring to AC induction motors. A typical "squirrel cage" AC induction motor has a stationary winding called a stator and a rotor that is made from electrical steel and conductive bars of aluminum or copper which are shorted on each end. In an induction motor, the input current creates a rotating magnetic field in the stator. This changing magnetic field induces currents in the rotor's conductive bars which results in an attraction between the rotating magnetic field of the stator and the induced magnetic field of the rotor. Because a changing magnetic field is required to induce currents in the rotor, the rotor will always rotate slower than the synchronous speed of the magnetic field in the stator. The difference between these two speeds is called "slip" and is usually given as a percentage of the synchronous speed.

**Q89. WHY COPPER BARS IN INDUCTION MOTOR ARE SHORTED?**

**Ans:** Due to relative cutting between flux and rotor conductors induces e.m.f. later producing current in the copper bars. Copper bars are short circuited by using end ring so that induced current will circulate through the path. In short copper bars are shorted to provide path to circulate induced current.

**Q90. WHY COPEER BARS IN INDUCTION MOTOR ARE SKEWED?**

**Ans:** The squirrel cage is skewed so that the force applied to the rotor it continuous. If they were straight then force would be jerky as whole of the bar is cutting the magnetic field lines at same time. With the bar skewed the amount of the bar cutting the field line grows continuously and the next bar starts cutting the field line grows continuously and the next bar starts cutting the field lines as the first finishes, also slots are skewed to get uniform torque, reduce the magnetic locking (also called COGGING effect) between stator and rotor, and thirdly the magnetic humming noise during running condition.

**Q91. WHAT ARE STEERING MOTOR SAFETIES?**

- **Ans:** Overload alarm
- 200% insulation in motor
- High temperature alarm
- Self starting after power failure
- Short circuit trip
- Phase failure alarm
- One of the steering motor is fed from the emergency bus

**Hydraulic side there is two trips**

- Low level cutout
- High lube oil temperature cutout

**Q92. WHAT IS PREFERENTIAL TRIPPING? WHAT IS DASHPOT?**

**Ans:** Preferential trip is a kind of electrical arrangement on ship which is designed to disconnect the non-essential circuit i.e. non-essential load from the main bus bar in case of partial failure or overload of the main supply The non-essential circuits or loads on ships are air conditioning, exhaust and ventilation fans, and galley equipment's which can be disconnected momentarily and can be connected again after fault finding. The main advantage of preferential trip is that it helps in preventing the operation of main circuit

breaker trip and loss of power on essential services and thus prevents blackout and overloading of generator.

**Construction and Working**

The preferential trip circuit consists of an electromagnetic coil and a dashpot arrangement to provide some delay to disconnect the non-essential circuits. Along with this, there is also an alarm system provided, which functions as soon as an overload is detected and trips start operating. There are some mechanical linkages also in the circuit which instantaneously operates the circuit and completes the circuit for preferential trips.

The dashpot arrangement consists of a small piston with a small orifice and which is placed inside a small cylinder assembly. This piston moves up against the fluid silicon and the time delay is governed by the orifice in the piston.

**Working of Preferential Trip**

The current passes through the electromagnetic coil and the linkages are kept from contacting using a spring arrangement. As soon as the current value increases the limit, the electromagnetic coil pulls the linkage up against the spring force and operates the instantaneous circuit and the alarm system. The lower linkage completes the circuit for the preferential trip circuit.

The current passes through the coil in the preferential trip circuit which pulls the piston in the dashpot arrangement. The movement of this piston is governed by the diameter of the orifice and the time delay made by the same. The preferential trip operates at 5, 10 and 15 seconds and the load is removed accordingly. If the overload still persists, then an audible and visual alarm is sounded.

The preferential trip is one of those important electrical circuit diagrams which help in removing the excessive load from the main bus bar, thus preventing situation like blackout which is a dangerous incident to ship, especially when the ship is sailing in restricted or congested waters.

**Q93. WHAT DOES DIFFERENT POSITION OF THE SYNCHROSCOPE NEEDLE MEAN; WHAT IS THE DIFFERENCE BETWEEN 6 O CLOCK AND 12 CLOCK?**

**Ans:** 6 o’clock means that out of synchronisation. We cannot parallel the incoming generator. 12 o’clock means the perfect synchronised condition (voltage, frequency and phase sequence match).

**Q94. WHY DO WE CLOSE THE SWITCH AT 11 O'CLOCK AND NOT AT 12 O' CLOCK?**

**Ans:** When the synchroscope is approaching 12 o'clock the "slip" (differential) between the sine waves is approaching minimum (slip is zero when the synchroscope is at 12 o'clock) and the voltage differential between the phases is minimal (it's zero when the synchroscope is at 12 o'clock). Due to time taken to close the synchronoscope switch, it is generally done at 11 o’clock. Due to the small delay to close, by doing at 11 o’clock, we are achieving closing close to 12 o’clock.

**Q95. WHY IS A MEGGER USED FOR INSULATION TEST AND NOT A MULTI METER?**

**Ans:** With a megger, a voltage of not less than 500 volts DC is used for testing the insulation resistance of windings. With a multi-meter, the voltage used is not more than 3-volts DC. Megger uses high impedance testing and is therefore more accurate than a multi-meter

**Q96. WHAT ARE THE SAFETIES ON MSB?**

**Ans:** Circuit breakers, fuses and over current relays are used. The panels are dead front panel, that is, we cannot open the panel for maintenance until we switch off the power to the panel by circuit breaker.

**Q97. WHEN DOES REVERSE POWER FLOW?**

**Ans:** Situation of a generator is feeding a system through switchgear having several generators connected in parallel with this generator. The flow of current, when the system is running normally, is from the generators to the switchgear. If one generator experiences problems and its terminal voltage falls below the system voltage, the generator will act as a motor, just as a motor can act as a generator, and current will flow from the switchgear to the generator. This is reverse power. The effects can range from minor to extreme in the event of a complete mechanical failure of the generator which fails.

**Q98. WHAT IS THE HARM IF REVERSE POWER FLOWS?**

**Ans:** Assume that the generator normally produces an amount of power equal to P, and that when operating as a motor, it will absorb a similar amount, P. Therefore, the net effect on the grid will be the same as if it experienced a step increase in load equal to 2P. Depending on the size of the grid and the strength of the remaining generation, a step increase of 2P could result in a significant frequency change on the grid.

There could be prime mover damage in some instances (especially steam turbines).

**Q99. HOW IS THE PROTECTION AGAINST REVERSE POWER GIVEN?**

**Ans:** Reverse power protection is used for anti-motoring. This function is used for protection of prime mover not generator. It can cut-off the fuel supply and stop the prime mover.

**Q100. HOW DO YOU TEST REVERSE POWER TRIP?**

**Ans:** When two generators are running in parallel and one generator can carry the load, reverse power trip can be tested by load shifting using governor control. When the load has shifted sufficiently and the off loaded generator is carrying a small percentage of load, its breaker trips and fuel supply to its prime mover cuts off. This means reverse power relay has operated. The relay can be tested by simulation (using the test push button on the relay) to see if it initiates a trip signal.

**Q101. WHAT IS THE FULL FORM OF ACB?**

**Ans:** Air circuit breaker. It is normally used at 400V and higher current applications (generator breakers).

**Q102. IF YOU PRESS THE ACB CLOSE BUTTON ON AN IDLE GENERATOR WHAT WILL HAPPEN?**

**Ans:** Normally, the breaker won't close until you synchronise, so even if you press the breaker close, it will not close. The breaker has under-voltage protection which will not let you close it.

**Q103. WHAT IS UNDER-VOLTAGE PROTECTION?**

**Ans:** It prevents closure of the breaker by mistake, or the generator that is coming on load during parallel operation. It also provides protection against loss of voltage while machinery is connected to the switchboard.

**Q104. WHAT IS THE MEANING OF PREFERENTIAL TRIP? WHY IS IT PROVIDED?**

**Ans:** Preferential trip is a kind of electrical arrangement on ship which is designed to disconnect the non-essential circuit i.e. non-essential load from the main bus bar in case of partial failure or overload of the main supply. It lets the critical loads run (like steering gear) and trips the non-essential loads (like AC and galley) and is a safety feature.

**Q105. WHAT IS THE PURPOSE OF THE EARTH FAULT INDICATION ON THE SWITCH BOARD?**

**Ans:** It detects and indicates phase to earth fault on a circuit.

**Q106. IF YOU GET AN EARTH FAULT ALARM WHAT WILL YOU DO?**

**Ans:** The fault can be investigated by first identifying areas of ship that have a high chance of earth fault (example deck lighting or pantry equipment) and then switching off their supplies one at a time to see if the alarm is gone. When a particular load clears the alarm, we know that that circuit is having earth fault and we can go and repair it.

**Q107. WHAT IS DIRECT CURRENT?**

**Ans:** Uni-directional flow of current.

**Q108. WHAT IS ALTERNATING CURRENT?**

**Ans:** Bi-directional flow of current in a sinusoidal form with a positive and negative peak.

**Q109. WHAT IS MEANT BY PHASE IN AC?**

**Ans:** Two or more AC voltages or currents that are out of step with each other. Their peaks and zero points do not match up at the same points in time. This is meant by phase.

**Q110. IS THERE PHASE IN DC?**

**Ans:** No

**Q111. WHY IS DC NOT MUCH IN USE NOW?**

**Ans:** AC generators are a better technology and voltage transformation (by transformers) is easy is possible in AC and not DC.

**Q112. WHERE ARE YOU LIKELY TO SEE IT USED?**

**Ans:** Battery powered DC is generally used in navigation, control and safety systems mainly in navigation, radar, safety systems, antenna and communication systems and emergency lighting.

**Q113. WHAT DOES THREE-PHASE CURRENT MEAN?**

**Ans:** Three current sinusoidal waveforms equal in magnitude but with a phase shift of 120 degrees.

**Q114. WHAT IS RMS VALUE?**

**Ans:** Root mean square value is the peak value divided by square root of 2.

**Q115. WHAT IS THE MEANING OF POWER FACTOR?**

**Ans:** Power factor is the cosine of the angle between voltage and current waveform.

**Q116. WHAT IS THE USUAL VALUE YOU SEE ONBOARD?**

**Ans:** Usually 0.8.

**Q117. WHAT IS THE BEST VALUE POSSIBLE?**

**Ans:** 1 is the best value possible. That is possible with a purely resistive load.

**Q118. WHAT IS THE BENEFIT OF IMPROVING POWER FACTOR?**

**Ans:** Power factor close to 1 means for the same real power in kW, the load current is less and hence the $I^2R$ losses are less. The system efficiency is higher as the losses are lower. Improved voltage regulation is achieved.

**Q119. HOW CAN IT BE IMPROVED?**

**Ans:** Power factor improvement capacitor banks are used if the loads are mainly resistive.

**Q120. WHAT IS THE MEANING OF SAYING I AND V ARE IN PHASE?**

**Ans:** The angle between the I and V waveforms is zero which means the load is purely resistive.

**Q121. WHY ARE MOTOR RATINGS GIVEN IN KW AND THAT OF ALTERNATOR AND TRANSFORMER GIVEN IN KVA?**

**Ans-**

- A volt is not the same thing as watt.
- A volt ampere is the unit of measurement of apparent power which is the product of supply voltage and load current.
- The Watt on the other hand is the unit of measurement for true power which is the product of supply voltage, load current and the power factor of the load.
- The reason that a motor is rated in Watts and not in VA is twofold. Firstly, it is in-phase component of the load (and supply the losses), while the reactive component provides the magnetic field. The in-phase component of current, multiplied by the supply voltage is true power in watts. Secondly the mechanical load of the motor is measured is Watts so it makes an absolute sense to express the output power of a motor in watts too, so that the two can be matched.
- A transformer on the other hand is rated accordingly to the product of its rated voltage and rated current, in the other words in terms of its apparent power in volt amperes. This is because the transformer designer has no way to know what type of load (resistive, inductive, capacitive) is going to be connected to his transformer , so has to allow for the 'worse case' scenario, so that the windings do not become overheated. The only way to do this is to specify the max. rated current which, when applied by the rated voltage, results in volt amperes, not watts.
    - ✓ kW is the output mechanical power of a motor and is expressed in kW.
    - ✓ kVA is the net (apparent) power input to the transformer. This input power is the output + losses.
    - ✓ kW = kVA x system power factor

**Q122. WHERE DOES REACTIVE POWER GO?**

**Ans:** Reactive power is not 'lost'. It is delivered to the motor where it sustains the electric field that enables the motor to convert the real power (electrical) into mechanical torque.

**Q123. WHAT IS A SEMI CONDUCTOR?**

**Ans:** Substance as germanium or silicon whose electrical conductivity is intermediate between that of a metal and an insulator; its conductivity increases with temperature and in the presence of impurities

**Q124. WHAT IS DOPING?**

**Ans:** Doping intentionally introduces impurities into an extremely pure (also referred to as intrinsic) semiconductor for the purpose of modulating its electrical properties. The impurities are dependent upon the type of semiconductor. Lightly and moderately doped semiconductors are referred to as extrinsic. A semiconductor doped to such high levels that it acts more like a conductor than a semiconductor is referred to as degenerate.

**Q125. WHAT HAPPENS TO INSULATION WHEN TEMPERATURE RISES?**

**Ans:** For insulators, an increase in temperature will cause their resistance to decrease -which is why excessive temperature is often the main reason why insulation fails

**Q126. WHAT HAPPENS TO RESISTANCE OF CONDUCTORS WHEN TEMPERATURE RISES?**

**Ans:** For conductors an increase in temperature will cause their resistance to increase.

**Q127. WHAT IS AN INDUCTION MOTOR?**

**Ans:** An induction motor is an alternating current motor in which the primary winding on one member (usually the stator) is connected to the power source and a secondary winding or a squirrel-cage secondary winding on the other member (usually the rotor) carries the induced current.

**Q128. WHAT IS "SLIP"?**

**Ans:** An AC (Amplitude Current) induction motor consists of two assemblies - a stator and a rotor. The interaction of currents flowing in the rotor bars and the stators' rotating magnetic field generate a torque. In an actual operation, the rotor speed always lags the magnetic field's speed, allowing the rotor bars to cut magnetic lines of force and produce useful torque. This speed difference is called the slip.

**Q129. WHAT IS A SYNCHRONOUS MOTOR? WHERE IS IT USED?**

**Ans:** A constant-speed motor, the speed being dependent on the frequency of the ac supply and the number of poles for which it is designed.

**USES** -Synchronous motors find applications in all industrial applications where constant speed is necessary. Improving the power factor as Synchronous condensers. Electrical power plants almost always use synchronous generators because it is important to keep the frequency constant at which the generator is connected. Low power applications include positioning machines, where high precision is required, and robot actuators.

**Q130. WHAT IS AN AVO METER?**

**Ans:** The Avometer was a British brand of multimeter, latterly owned by Megger. It is often called simply an AVO and derives its name from the first letter of the words amperes, volts, ohms

**Q131. HOW DO YOU CHECK CONTINUITY?**

**Ans:** Set the multimeter in resistance mode and then check with probes the resistance between the points or circuit under check. If the resistance is low or zero, it means continuity. If it is high or infinite, it means open circuit.

**Q132. WHAT LIMITS THE ELECTRICAL LOAD?**

**Ans:** The available power is fixed and the voltage is fixed, so the setting of the breaker or fuse is the normal current of the load. If the load exceeds the rated current, then the breaker or fuse will operate and limit the load.

**Q133. WHAT IS THE VOLTAGE USED IN A MEGGAR?**

**Ans:** 500V DC.

**Q134. HOW DOES CURRENT FLOW DURING WELDING?**

**Ans:** The current flows through the electrode and to the clamp. That's how it flows in MIG, stick, flux cored. On Tig, the electricity flows through the electrode also except that now that's the only function of it, the rod is held in your hand and electrode in the other.

**Q135. WHAT IS THE VOLTAGE USED FOR IGNITION IN BOILERS/INCINERATORS ETC.?**

**Ans:** Normally 10,000V (10kV).

**Q136. WHY IS IT DIFFERENT FROM THAT FOR WELDING?**

**Ans:** It is higher as the ignition requires break down of air gap for park to occur. The air breaks down at this high voltage of 10kV. Therefore, it is higher than normal welding voltage.

**Q137. IF SO WHY DON'T YOU GET A SHOCK?**

**Ans:** Because the whole hull is at the same potential, so there is no potential difference to get a shock.

**Q138. WHAT IS SAFE VOLTAGE TO PREVENT SHOCK?**

**Ans:** Normally 50V. It depends on the body resistance and how conducting the path is (example use of insulating boots or mat may allow slightly higher voltage to be safe)

**Q139. WHAT IS THE MEANING OF ACB, MCCB, NFB?**

**Ans:** Air circuit breaker for 400V higher current ratings. Moulded case circuit breaker for 400V medium current ratings. No Fuse Breaker – 75 A capacity

**Q140. WHAT IS A MAGNETIC CONTACTOR? WHERE IS IT USED?**

**Ans:** A contactor is an electrically controlled switch used for switching a power circuit, similar to a relay except with higher current ratings. Contactors are used to control electric motors, lighting, heating, capacitor banks, and other electrical loads.

**Q141. WHAT IS A RELAY? HOW IS IT DIFFERENT FROM A MAGNETIC CONTACTOR?**

**Ans:** Contactor is a heavy duty switch whereas the relay is light duty switch. Relays can be as simple as 12 V DC solenoids with 12 V, 0.5 A rated contacts. They are used to detect faults on the power system and signal a local or remote switching device (breaker) to trip the circuit.

**Q142. WHAT IS THE MEANING OF OVERLOAD?**

**Ans:** An overload is a current over and above the normal load current (over the load). In other words greater than the original design current. This can be a momentary overload such as the starting current for a motor which is usually ignored or it can be a sustained overload such as plugging in too many appliances at once or a motor that has faulty bearings or gets jammed

**Q143. WHAT IS MEANING OF SHORT CIRCUIT?**

**Ans:** A short circuit occurs when conductors are connected (shorted) together by a fault. This is normally phase to phase fault due to failure of insulation by something cutting the wires, fires, etc.

**Q144. HOW IS PROTECTION PROVIDED FOR OL AND SC?**

**Ans:** Damage from short circuits and overloads can be reduced or prevented by employing fuses, circuit breakers, or other overload protection, which disconnect the power in reaction to excessive current. The tripping time is much less (in milli seconds) for short circuit due to very high currents but can higher (a few seconds) due to currents say 1.1 to 1.5 times the normal current.

**Q145. WHAT IS THE FUNCTION OF A FUSE?**

**Ans:** Fuse places a limit on the amount of current that can be drawn by an electric circuit by opening (blowing or melting) when the current exceeds a pre-set limit. This protects the circuit and the surroundings from fire or damage in the case of an overload or short circuit.

**Q146. WHAT IS THE NORMAL SETTING OF OVERLOAD RELAYS?**

**Ans:** Normally 90-100% of rated normal current. Sometimes can be set to 105% of rated current.

**Q147. HOW DOES A THERMAL OVERLOAD RELAY WORK?**

**Ans:** The bi-metallic strip in the relay heats up by the over load current and the movement in the bi-metallic strip causes the breaker to trip. The breaker has to be reset (turn off) before turning on again. Sometimes it takes a time delay for the bi-metallic strip to cool down after which the breaker can be reset and switched on.

**Q148. WHAT IS SINGLE PHASING?**

**Ans:** Single phasing is a condition in three phase motors and transformers wherein the supply to one of the phases is cut off.

**Q149. HOW CAN IT HAPPEN?**

**Ans:** Single phasing is caused by the use of single-phase protection devices such as fuses. Three phase loads should be protected by devices which cause the interruption of power to all three phases simultaneously when a fault occurs. Defective contacts or loose connections in three phase breakers can also cause single phasing.

**Q150. WHAT IS THE HARM CAUSED BY THIS?**

**Ans:** Single phasing causes higher than rated currents in the healthy phases of loads such as motors causing over heating of the motor and consequently motor failure.

Single phasing can sometimes cause excessive noise and vibration in motors.

**Q151. WHAT PROTECTION IS PROVIDED AGAINST THIS?**

**Ans:** Single phasing can be identified by special protective relays which can identify and isolate the connected loads. Smaller motors rely on over current and negative phase sequence relays. Motor protection relays for larger motors come readily fitted with protection against single phasing.

**Q152. WHY IS IT NECESSARY THAT INCOMING ALTERNATOR FREQUENCY IS MORE THAN BUS BAR?**

**Ans:** Prior to paralleling alternators together, the frequency of the incoming alternator is made slightly higher. This is to ensure that the incoming generator will take some of the bus load. If the incoming generator is slow it will become motorized and will add load onto the bus. If this happens it is possible to cause other generators to trip off line.

**Q153. WHAT IS DARK LAMP AND BRIGHT LAMP METHOD FOR SYNCHRONIZING? HOW IS THE CONNECTION MADE?**

**Ans:** Formerly, three light bulbs were connected between the generator terminals and the system terminals. As the generator speed changes, the lights will rise and fall in intensity at a rate proportional to the difference between generator frequency and system frequency. When the voltage at the generator is opposite to the system voltage (either ahead or behind in phase), the lamps will be bright. When the voltage at the generator matches the system voltage, the lights will be dark. At that instant, the circuit

breaker connecting the generator to the system may be closed and the generator will then stay in synchronism with the system.

**Q154. APART FROM RENEWING BEARINGS IS THERE ANY REASON FOR OPENING UP MOTORS FOR MAINTENANCE?**

**Ans:** Insulation checks and renewal (example using insulation spray on stator winding insulation).

**Q155. WHY IS THIS REVERSE POWER USED INSTEAD OF REVERSE CURRENT IN ALTERNATORS?**

**Ans:** It is extremely difficult to detect reverse current with an alternating current system, reverse power can be detected and protection can be provided by reverse power relay.

**Q156. WHAT IS THE MEANING OF EXCITATION IN AN ALTERNATOR?**

**Ans:** An electric generator or electric motor consists of a rotor spinning in a magnetic field. The magnetic field may be produced by permanent magnets or by field coils. In the case of a machine with field coils, a current must flow in the coils to generate the field, otherwise no power is transferred to or from the rotor. The process of generating a magnetic field by means of an electric current is called excitation.

**Q157. HOW IS IT SUPPLIED?**

**Ans:** The rotor's magnetic field is supplied by a rotor winding energized with direct current through slip rings and brushes.

**Q158. WHAT IS A BRUSH LESS ALTERNATOR?**

**Ans:** A brushless alternator is composed of two sections: main alternator and the smaller exciter. The exciter has stationary field coils and a rotating armature (power coils). The main alternator uses the opposite configuration with a rotating field and stationary armature. A bridge rectifier, called the rotating rectifier assembly, is mounted on a plate attached to the rotor. Neither brushes nor slip rings are used, which reduces the number of wearing parts. The main alternator has a rotating field as described above and a stationary armature (power generation windings).

**Q159. HOW IS THE EXCITATION ACHIEVED IN THIS?**

**Ans:** Varying the amount of current through the stationary exciter field coils varies the 3-phase output from the exciter. This output is rectified by a rotating rectifier assembly, mounted on the rotor, and the resultant DC supplies the rotating field of the main alternator and hence alternator output. The result of all this is that a small DC exciter current indirectly controls the output of the main alternator.

**Q160. WHAT IS THE MEANING OF RESIDUAL MAGNETISM?**

**Ans:** Residual magnetism is a property in which certain amount of excitation remains back in the conductor even after the removal of the magnets.

**Q161. WHY AN AIR COMPRESSOR IS STARTED UNLOADED?**

**Ans:** The air pressure inside the compressor cylinder offers resistance to the movement of the piston. Hence started unloaded. Ask 4/E or 2/E in ship.

**Q162. HOW IS THE SPEED OF A 3-PHASE INDUCTION MOTOR VARIED?**

**Ans:** The speed of a normal 3-phase induction motor is a function of the frequency of the supply voltage. Changing the speed of such a motor hence requires building a 3-phase power frequency convertor. This can be realised by using power MOSFETs (or IGBTs) capable of handling high voltages and fast switching speeds.

**Q163. HOW IS THE DIRECTION OF ROTATION VARIED?**

**Ans:** By changing the phase sequence (from say R-Y-B to R-B-Y)

**Q164. HOW DOES THIS CAUSE A ROTATION TO CHANGE?**

**Ans:** Due to the change in phase sequence, the rotating magnetic field changes direction and the rotor rotates in the opposite direction.

**Q165. HOW IS THE SPEED OF A DC MOTOR VARIED?**

**Ans:** To vary the speed of a DC motor we need a constant voltage power supply with a series POT resistor of higher watt rating. A Pulse Width Modulator (PWM) can be used.

**Q166. HOW IS THE DIRECTION VARIED?**

**Ans:** A general purpose DC motor can be reversed by changing the polarity of either the armature or the field but not both.

**Q167. WHAT IS A DIODE?**

**Ans:** In electronics, a diode is a two-terminal electronic component with asymmetric transfer characteristic, with low (ideally zero) resistance to current flow in one direction, and high (ideally infinite) resistance in the other. A semiconductor diode, the most common type today, is a crystalline piece of semiconductor material with a p-n junction connected to two electrical terminals

**Q168. WHAT IS A ZENER DIODE?**

**Ans:** A zener diode is a special kind of diode which allows current to flow in the forward direction in the same manner as an ideal diode, but will also permit it to flow in the reverse direction when the voltage is above a certain value known as the breakdown voltage, "zener knee voltage" or "zener voltage."

**Q169. WHAT IS A THYRISTOR? WHAT IS AN SCR?**

**Ans:** A thyristor is a solid-state semiconductor device with four layers of alternating N and P-type material. They act as bistable switches, conducting when their gate receives a current trigger, and continue to conduct while they are forward biased (that is, while the voltage across the device is not reversed).

A silicon-controlled rectifier (or semiconductor-controlled rectifier) is a four-layer solid state device that controls current. It is a type of thyristor.

**Q170. HOW DOES AN INVERTER WORK?**

**Ans:** An inverter converts DC supply into AC by use of electronic devices such as diodes and thyristors.

**Q171. HOW DOES A TUBE LIGHT WORK?**

**Ans:** When voltage is applied to the fluorescent lamp, here's what happens:

The starter (which is simply a timed switch) allows current to flow through the filaments at the ends of the tube. The current causes the starter's contacts to heat up and open, thus interrupting the flow of current. The tube lights.

Since the lighted fluorescent tube has a low resistance, the ballast now serves as a current limiter.

When you turn on a fluorescent tube, the starter is a closed switch. The filaments at the ends of the tube are heated by electricity, and they create a cloud of electrons inside the tube. The fluorescent starter is a time-delay switch that opens after a second or two. When it opens, the voltage across the tube allows a stream of electrons to flow across the tube and ionize the mercury vapor.

Without the starter, a steady stream of electrons is never created between the two filaments, and the lamp flickers. Without the ballast, the arc is a short circuit between the filaments, and this short circuit contains a lot of current. The current either vaporizes the filaments or causes the bulb to explode.

**Q172. WHAT IS THE FUNCTION OF THE CHOKE?**

**Ans:** The choke has two main functions. In conjunction with the starterit causes the tube to ignite by using the back emf to create a plasma in the tube and it controls the current through the tube when it is ignited.

**Q173. WHERE IS A SLIP RING USED AND WHERE IS A COMMUTATOR USED?**

**Ans:** Slip rings are commonly found in slip ring motors, electrical generators for **alternating current** systems and alternators. They can be used on any rotating object to transfer power. A commutator is a common feature of **direct current** rotating machines. By reversing the current direction in the moving coil of a motor's armature, a steady rotating force (torque) is produced.

**Q174. WHAT IS CAPACITANCE?**

**Ans:** Capacitance is the ability of a body to store an electrical charge. Anybody or structure that is capable of being charged, either with static electricity or by an electric current exhibits capacitance. C = Q/V where Q is the charge and V is the voltage

**Q175. DOES CURRENT FLOW THOUGH A CAPACITOR?**

**Ans:** No. Current (or more specifically, charge) flows into one plate, and an opposing current (charge) flows out of the other plate, but the current (except for leakage current) does not flow across the dielectric. The result is that there is a charge differential between the plates.

**Q176. WHAT IS THE UNIT FOR CAPACITANCE?**

**Ans:** Farad

**Q177. WHAT IS A NEUTRAL?**

**Ans:** In multiphase circuits, the conductor used to carry unbalanced current. In single-phase systems, the conductor used for a return current path.

**Q178. WHAT IS THE DIFFERENCE BETWEEN NEUTRAL AND EARTH?**

**Ans:** The ground or "earth" wire is a circuit's safety protective wire that normally carries no current.

**Q179. WHAT IS A SYNCHRONOUS CONDENSER?**

**Ans:** A synchronous condenser is a device identical to a synchronous motor, whose shaft is not connected to anything but spins freely. Its purpose is not to convert electric power to mechanical power or vice versa, but to adjust conditions on the electric power transmission grid. Its field is controlled by a voltage regulator to either generate or absorb reactive power as needed to adjust the grid's voltage, or to improve power factor.

**Q180. WHERE AND WHY IS IT USED?**

**Ans:** Used for power factor correction as a synchronous capacitor.

**Q181 .IF A MOTOR IS WOUND STAR AND YOU WANT TO CHANGE TO DELTA WHAT SHOULD YOU DO?**

**Ans:** Open the terminal connection box. Remove the shorting link connecting the common connection (star) point of A2, B2 and C2. With the 3 phase windings marked A1A2, B1B2, C1C2, connect A2 to B1, B2 to C1 and C2 to A1.

**Q182. HOW DO YOU TEST REVERSE POWER TRIP, HIGH CURRENT TRIP, PREFERENTIAL TRIP?**

**Ans:** Reverse power trip – refer answer for question 11.

High current (over load trip) – Set your overload relay high current trip setting to say 75% of the rated current. Run the motor. The relay will trip the breaker. Another way of testing it is pushing the trip button on the relay which trips the breaker.

Preferential trip – With one generator running, try to switch on additional loads to overload the generator. Preferential trip will trip all the non-critical loads.

**Q183. WHAT IS RESIDUAL MAGNETISM? WHERE IS IT IMPORTANT?**

**Ans:** Residual magnetism is a property in which certain amount of excitation remains back in the conductor even after the removal of the magnets. It is required as we need some magnetism to start off the generation before the field winding has power to produce the full field.

Sometimes, when you change the running direction of a E/R blower (from supply to exhaust) it trips. Why?

If the flaps of the blower are not set or opened properly or the filters are clogged, the air supply is affected and the blower may be overloaded causing it to trip. Ask E/O for more information.

**Q184. WHAT IS THE REGULAR MAINTENANCE DONE ON BATTERIES?**

**Ans:** Every week the cell voltage is checked. The specific gravity is monitored using the battery hydrometer. The terminals are lubricated to prevent corrosion. Sometimes load tests are done on the batteries.

**Q185. WHAT SAFETY PRECAUTIONS NEED TO BE TAKEN DURING MAINTENANCE ON BATTERIES?**

**Ans:** The room needs to be ventilated to prevent explosions due to gases generate by the battery. Protective clothing, gloves and eye protection should be used to prevent acid splash over. No flames or ignition sources should be brought near batteries. Never short both positive and negative terminals as this will cause short circuit and high energy flashover. When disconnecting batteries, always disconnect negative terminals first and vice versa when reconnecting.

**Q186. WHY IS SPECIAL LIGHTING USED IN BATTERY ROOMS?**

**Ans:** Spark proof lighting is used as explosive gases may be generated during battery charging and so there should be no sparks in the room.

**Q187. WHAT IS THE VOLTAGE AVAILABLE FROM EACH CELL IN A LEAD ACID BATTERY?**

**Ans:** 2 V DC.

**Q188. WHAT IS THE FULL BATTERY VOLTAGE?**

**Ans:** 24 V DC.

**Q189. HOW IS THIS VOLTAGE ACHIEVED?**

**Ans:** By connecting 12 cells in series. 12 x 2 V = 24 V is total battery bank voltage.

**Q190. WHAT IS THE MEANING OF A NORMALLY OPEN CONTACT?**

**Ans:** The contact is open in the normal (de-energised condition).

**Q191. HOW DOES A SALINOMETER FUNCTION?**

**Ans:** It detects the salinity in parts per million (ppm) and provides a alarm signal and also initiates a command to the bypass valve of a fresh water generator. Ask E/O and look in your ship Fresh water generator manual for more details.

**Q192. HOW DOES THE AIR COMPRESSOR START AND STOP AUTOMATICALLY?**

**Ans:** The air reservoir has pressure switch which is set for cut-off and cut-in depending on the pressure desired. When the pressure drops below the cut-in setting, the switch energises the contactor coil and the compressor starts. When the pressure reaches the cut-off setting, the switch opens its closed contact in series with the power circuit to contactor and cuts supply to the contactor.

**Q193. HOW IS THE COLD ROOM TEMPERATURE MAINTAINED?**

**Ans:** The cold room has temperature switch (thermostat) which has a cut-in and cut-off temperature setting. Depending on the setting, the compressor cuts when the temperature rises and cuts-off when the temperature cools down to the set value.

**Q194.WHAT IS A SELF-MONITORING ALARM CIRCUIT?**

**Ans:** It self-monitors the health of the alarm circuit. That is, it senses whether the power supply to the alarm circuit is healthy and all the relays and contacts are functioning normally. Check with E/O for more details.

Out at sea, if there is a black out during your watch, what action will you take?

After a black out the emergency generator comes on; On restoring the main supply we are closing the circuit breaker of the main generator without bothering about synchronizing. How is this possible?

There is a power link connection breaker between the main generator and the emergency generator. During black out, this breaker trips. The emergency generator starts and its breaker closes and feeds only the emergency loads. During restoration, the main generator is started again and its breaker is closed. As the link breaker is still open, there is no paralleling between main and emergency generator.

**Q195. HOW DOES THE EMERGENCY GENERATOR START AUTOMATICALLY?**

**Ans:** It is activated by a under voltage relay. When there is blackout, the under voltage relay senses loss of voltage and starts up the emergency generator. Similarly when the power is restored, the relay stops the emergency generator.

**Q196. IF ALL YOUR AIR BOTTLES ARE AT LOW PRESSURE AND THERE IS A BLACKOUT HOW DO YOU START THE GENERATORS?**

**Ans:** If main air bottles are empty, the emergency air bottle can be used to start the main generator. If even the emergency air bottle is empty, then it can be filled by running emergency air compressor (powered by emergency generator). Once the emergency air bottle is filled, this air can be used to start the main generator.

**Q197. WHAT IS A SHAFT GENERATOR?**

**Ans:** A shaft generator is coupled to the main engine. It uses the main engine as its prime mover and has a frequency converter (thyristor controlled) that converts the variable engine speed to near constant speed and produces electrical power. It can only be employed at sea speed (full speed) and not at manoeuvring speed.

**Q198.EVEN THOUGH THE MAIN ENGINE RUNS AT VARYING SPEEDS, HOW DOES THE ALTERNATOR MAINTAIN CONSTANT FREQUENCY?**

**Ans:** By use of thyristor controlled frequency (rpm) converters.

**Q199.WHY IS 440 V USED FOR MOTORS AND 110/220 V USED FOR LIGHTING?**

**Ans:** Motor load currents are large. Motors are 3-phase loads. A higher 440V voltage means lesser current for the same power and hence losses and size of cable wires is lower. Lighting is single phase loads and its load currents are small, hence lower voltage means less insulation in the cable wires.

**Q200. FOR A GIVEN LINE VOLTAGE, FOUR HEATING COILS WILL PRODUCE MAXIMUM HEAT WHEN CONNECTED IN-**

**Ans:** Parallel

**Q201. THE UNIT OF ABSOLUTE PERMITTIVITY OF A MEDIUM IS-**

**Ans:** Farad/ metre

**Q202. THE UNIT OF ELECTRIC INTENSITY IS-**

**Ans:** Volt/ metre

**Q203. IN PRACTICE, EARTH IS CHOSEN AS A PLACE OF ZERO ELECTRIC POTENTIAL BECAUSE IT-**

**Ans:** Has almost constant potential

**Q204. CURRENT CARRIED BY EACH OF THE TWO LONG PARALLEL CONDUCTORS IS DOUBLED. IF THEIR SEPARATION IS ALSO DOUBLED, FORCE BETWEEN THEM IS**

**Ans:** Increase two fold

**Q205. THE DIRECTION OF INDUCED EMF CAN BE FOUND WITH THE HELP OF -**

**Ans:** Lenz's Law

**Q206. PERMANENT MAGNETS ARE GENERALLY MADE OF-**

**Ans:** Alnico alloys

**Q207.The rate of rise of current through an inductive coil is maximum-**

**Ans:** At the start of the current flow

**Q208.What is power factor? What are the ways to improve it?**

**Ans:** Ration of true power and apparent power. Using capacitors and synchronous motors.

**Q209.What is star / delta?**

**Ans:** In star $V_L = \sqrt{3}\, V_{ph}$

In delta $V_L = V_{ph}$

**Q210.WHY IS A CAPACITOR USED IN SINGLE PHASE MOTORS, FLUORESCENT TUBE LIGHTS AND ELECTRONIC CIRCUITS.**

**Ans:** To provide a $90^0$ phase shift to the incoming supply necessary for starting the motor. To provide boost voltage for starting, power factor correction and to minimize radio interference. For stabilizing voltage, filtration and coupling.

**Q211.WHAT IS A SOLENOID?**

**Ans:** Single layered coil.

**Q212.WHAT IS A PHOTO CELL?**

**Ans:** A cell whose resistance varies with intensity of light.

**Q213. WHAT IS A MAGNETIC PICK-UP?**

**Ans:** An electromagnet used as a speed or position sensor.

**Q214.WHAT IS AN ELECTRIC TACHOMETER?**

**Ans:** A generator producing voltage proportional to speed.

**Q215.WHAT IS AN OVERLOAD RELAY?**

**Ans:** A safety trip for an electrical equipment which carries over-rated current.

**Q216. WHAT IS COLOUR CODE OF RESISTORS, PLEASE EXPLAIN?**

**Ans:** Colours to denote value. In four band colour coding, the first band indicates the first digit, the second band: the second digit and the third band: the number of zeroes.

The values are as given below:
Black : 0, Brown : 1, Red : 2, Orange : 3, Yellow : 4, Blue : 5, Green : 6, Violet : 7, Grey : 8, White : 9.

**Q217. WHAT IS RESIDUAL MAGNETISM?**

**Ans:** Magnetism remaining in a Ferro magnetic material after the removal of magnetizing force.

**Q218. EXPLAIN WHAT HAPPENS IF A DC MOTOR IS FED WITH AC SUPPLY?**

**Ans:** Motor will run at low speed, sparking at brushes, heat due to eddy current will finally burn the motor.

**Q219. WHAT ARE THE BASIC PARTS OF A DC MOTOR?**

**Ans:** Rotor and stator, field poles, commutator, brushes, fan impeller, bearing & housing, end covers and name plate.

**Q220. WHAT ARE THE EXCITATION METHODS USED IN AN ALTERNATOR?**

**Ans:** Rotary : Using rotating diode rectifiers, primary exciter and main exciter.

Static : Excitation given by brushes and slip rings.

**Q221. WHAT ARE THE PARTS OF A BRUSHLESS AC GENERATOR?**

**Ans:** Yoke, armature, stator, rotor, primary exciter, main exciter, rotary diode rectifier assembly, impeller, bearing & housing, end cover, terminal block, AVR.

**Q222. HOW CAN THE DIRECTION OF ROTATION OF AN AC MOTOR BE REVERSED?**

**Ans:** By interchanging any two supply lines.

**Q223. WHAT CAN BE POSSIBLE REASONS FOR A MOTOR FAILING TO START?**

**Ans:** No power , Fuse blown , Overload trip, contactor coil burnt , Contactors contacts bad, control circuit relay faulty, stop switch open circuit and start switch does not operate, hold on contact does not make and motor burnt.

**Q224. WHAT IS MEANT BY 'SINGLE PHASING'?**

**Ans:** When one supply is open circuit in a three phase motor.

**Q225.WHERE IS A ROTOR WOUND AC MOTOR USED?**

**Ans:** For starting heavy torques, mostly used on portable machines and small winches.

**Q226.WHAT ARE THE DIFFERENCES BETWEEN SYNCHRONOUS AND INDUCTION MOTOR?**

**Ans: Synchronous motor:** Constant speed on all loads, can be operated on a wide range of power factors, not self-starting, requires dc excitation.

**Induction Motor:** Speed varies with load, operates on lagging power factor, self-starting, no dc excitation required.

**Q227. WHAT IS THE SPECIFIC GRAVITY OF ELECTROLYTE USED IN LEAD ACID BATTERY?**

**Ans:** 1280 at full charge and 1180 at discharge.

**Q228. COMPARE BETWEEN LEAD ACID AND NICKEL-CADMIUM BATTERIES?**

**Ans:** Lead acid : Dilute $H_2SO_4$, spongy and $PbSO_2$, low efficiency, 2 volt per cell, less strong, requires more maintenance, less efficient wrt temperature, discharges fast, low cost, problem of sulfation.

NiCd : KOH, Ni & Cd, high efficiency, 1.2V per cell, robust, less maintenance, more efficient wrt temp difference, retains charge for longer periods, expensive, no sulfation.

**Q229. WHAT IS A CURRENT TRANSFORMER AND VOLTAGE TRANSFORMER?**

**Ans:** Current transformers used for sensing load currents and as inputs to indicating instruments.

Voltage transformers used for step-up / step-down voltages.

**Q230. WHAT ARE THE SAFETY PRECAUTIONS WHEN WORKING ON ELECTRICAL EQUIPMENTS?**

**Ans:** Switch off power, wear proper protective clothing, safety shoes, Notice board : Do not switch on – Men at work, stand on rubber mat, remove metal rings, watch bracelets, use proper insulated tools, check power supply with voltmeter and double check the voltmeter with known power supply, keep one person stand-by with proper safety gears, inform authority and get proper work permit. In case of electrical shock, give proper first aid, check heart beat and pulse.

**Q231. EXPLAIN HOW THE EMERGENCY GENERATOR STARTS UP IN THE EVENT OF TOTAL POWER FAILURE**

**Ans:** The start up of the emergency generator is initiated by an electrical relay which monitors the normal mains power supply. Falling mains frequency or voltage causes the 'start up' relay to operate the generator starting equipment. The prime mover may be electrically cranked for its own 24 v battery and starter motor or air started from its own air reservoir fitted local to the generator engine. A manual start up may also be initiate by push buttons in the main control room and in the emergency generator room. Also when power loss occurs, the breaker feeding the emergency switch board from the main switch board opens. This breaker is interlocked with the emergency generator breaker which is normally open under normal circumstances but in the event of total power failure this breaker will close when the breaker feeding the emergency generator will feed the emergency switch board

**Q232. NAME THE TRIPS FOUND ON A GENERATOR CIRCUIT BREAKER**

**Ans:** Over current, under voltage, reverse power

**Q233.WHEN WORKING ON BATTERIES, WHAT PRECAUTIONS SHOULD BE TAKEN?**

**Ans:** Ensure the space is well ventilated, do not smoke or use naked lights and also wear protection clothing such as apron, gloves and face shield.

**Q234.WHAT IS MEANT BY THE TERM TYPE EX'P?'**

**Ans:** ex'p' – pressurization

This is where equipment is pressurized to prevent any gases entering equipment

**Q235.WOULD YOU ENTER AN ENCLOSED SPACE IF THE $O_2$ LEVELS WERE RECORDED AS 19% OR BELOW?**

**Ans:** No

**Q236. WHAT IS THE PURPOSE OF THE OVER CURRENT PROTECTION TRIP?**

**Ans:** The purpose of the over current protection trip is to trip the generator in over load situations. The trip is usually set at 150% operating capacity and has a time delay of usually 20 sec. this allows for short periods of overload currents. If also protects against a short circuit in the generator

**Q237.WHAT IS DONE TO ENSURE EMERGENCY GENERATOR IS ALWAYS AVAILABLE AND WILL START?**

**Ans:** The system should be checked regularly and operated weekly to ensure its availability if required. Fuel tanks should be kept full, ample cooling water in radiator cooling system and starting equipment should be functional i.e, batteries should be charged fully or air receiver full

**Q238.DESCRIBE HOW A SELF EXCITED A.C.GENERATOR WOULD WORK.**

**Ans:** The self-excited a.c. generator basically consists of a synchronies motor where 3 phase supply is generated an a.c. exciter and a rotary rectifier and a static excitation device. The rotating diodes change a.c. into D.C. for the d.c. excitation current, which is supplied through bushes. The exciter in conjunction with the AVR is used to monitor the correct voltage under load changes.

**Q239.HOW DO YOU ENSURE THAT BATTERIES ARE ALWAYS IN GOOD WORKING ORDER?**

**Ans:** Where lead acid batteries are used they require a constant trickle charge, but for both types of batteries a regular charge of up is necessary.
Check state of battery reaching a hydrometer; lead acid – specific gravity 1270. Alkaline is 1190 but SB for alkaline batteries does not change much during charge or discharge
Ensure cells are covered with electrolyte if not top up with distilled water. Keep batteries dry and clean
Terminals should be smeared with petroleum jelly

**Q240.HOW WOULD YOU KNOW ABOUT EARTH FAULT IN THE SYSTEM?**

**Ans:** Finding an earth fault would be by the process of elimination i.e., circuit breakers would be opened and closed until earth fault disappeared, taking care which breaker were being opened and closed as they may be supply essential at the time. It would be good practice to start with places such as the galley and laundry where fault are common

**Q241.WHAT CONDITIONS ARE NECESSARY TO PARALLEL TWO GENERATORS?**

**Ans:** The speed of both machines must be same i.e., the frequency and the voltages must be same in phase

**Q242.WHAT ARE THE CAUSES OF SINGLE PHASING?**

**Ans:** Single phasing can be caused when one of the three back up fuses blows or if one of the conductor conducts is in open circuit.

**Q243. WHAT ARE THE ADVANTAGE AND DISADVANTAGES OF ALKALINE BATTERIES?**

**Ans:** The advantages of alkaline batteries are that they retain charge on open circuit and even if discharged, it can be left for long periods without adverse effects
The disadvantages are that they require a greater number of cells to produce a particular voltage
They are also more expensive than lead acid batteries

**Q244.WHAT IS SEQUENTIAL STARTING?**

**Ans:** Sequential starting is the automatic starting of essential equipment when power is returned after a power failure, i.e. equipment such a steering gear

**Q245.DESCRIBE HOW SYNCHRONIZING LAMPS ARE SUED TO PARALLEL A GENERATOR**

**Ans:** This is normally used as a backup alternative way to the synchroscope; the lamps are connected between the incoming generator and the bus bars

The sequence method is the most preferred one as it displays a rotation of lamp brightness, which indicates whether the incoming machine is running fast (clockwise) or slow (anticlockwise). As with the synchroscope the lamp sequence must appear to rotate slowly clockwise. Correct synchronization occurs when the top or keys lamp is dark and the two bottom lamps are equally bright

**Q246.WHAT GAS IS GIVEN OFF BY BATTERIES WHILE CHARGING?**

**Ans:** Hydrogen

**Q247.WHAT ARE THE TWO MAIN TYPES OF BATTERIES COMMONLY USED ON BOARD SHIPS?**

**Ans:** Lead acid and alkaline

**Q248. WHAT IS MEANT BY PREFERENCE TRIPPING?**

**Ans:** Preference tripping is the tripping of non-essential load when an overload condition occurs on a generator. If a generator overload develops the preference trip relay operates an alarm and acts to trip selected non-essential loads. These load may trip at set intervals depending on how essential the .load first trip 5 sec, second trip 10 sec

**Q249. WHAT ART THE ESSENTIALS SUPPLIED BY THE EMERGENCY SWITCH BOARD?**

Essentials are emergency lighting, alarm, communication, water tight doors and other services necessary to maintain safety and to permit safe evacuation of the ship by life boats. Also you will find a steering gear motor, emergency air start compressor, and emergency fire pump motor are supplied from the emergency switch board

**Q250. Describe How An A.C. Motor Works?**

**Ans:** Most ac motors on ships and the induction or squirrel cage motor types, the principle of operation for which is as follows. The starter is made up of 3 separately phased windings, to which a 3 phase supply is connected. The rotor has a series of copper conductors along its axis, which are joined by rings at the ends to form a cage. When the motor is started, the rotating magnetic field induces an EMF in the cage and thus a current flow. The current carrying conductor in a magnetic field produces the motor effect, which turns the rotor. The motor speed builds up to a value just less than the speed of rotation of the magnetic field. The motor speed depends upon the EMF induced in the rotor and this depends upon the difference in speed between the conductors and the magnetic field.
The number of different fixed speeds is possible by changing the number of poles (conductors).

**Q251.WHAT WOULD YOU DO IF YOU FOUND AN ENGINEER IN ELECTRIC SHOCK?**

**Ans:** First raise alarm then isolate or switch off the current. If this is not possible, pull or push the victim away from the source, taking care not to make electrical contact with the victim or the electrical source, i.e., use something non conductive
Once the victim has been removed from the electrical source if the breathing is feasible or ceased artificial respiration should be started at once. Delay on starting artificial respiration can prove fatal
Note: if artificial respiration is started once 70% of the victims recover. If there is 3 minutes delay only 20% of the victims recover.

**Q252.WHAT IS THE AVR?**

**Ans:** The function of the AVR is to regulate the exciter fields current automatically, comparing the generator terminal voltage with the standard set voltage and thus maintaining the generator terminal voltage to a constant value regardless of load changes.

**Q253. WHAT LOADS ARE CONSIDERED AS NON ESSENTIALS?**

**Ans:** Loads considered as non-essentials are air conditioning and ventilation, laundry, galley, refrigeration and deck equipment

**Q254. WHAT IS SINGLE PHASING OF MOTOR?**

**Ans:** Single phasing is where are the 3 phases supplying the motor becomes disconnected. The motor will continue to run it this happens and can result in motor burnout. The effect of single phasing is to increase the current in the two remaining lines and cause the motor to become very noisy due to uneven torque produced.

**Q255. NAME THE TRIPS FOUND IN A GENERATOR CIRCUIT BREAKER.**

**Ans:**

- Over current
- Under voltage
- Reverse power

**Q256. EXPLAIN REGULATION REGARDING POWER SUPPLY FOR STEERING GEAR.**

**Ans:** The electrical supply must be from two widely separated supplies i.e., one from the main switch board and the other from emergency board
Electrical leafs and fuses are allow 100% over load, giving only short circuit protection
If failure does occur on one system, the standby system will cut in within 45 sec
The steering motor will have sequential starting.

**Q257.WHAT WOULD YOU CONSIDER A MINIMUM INSULATION READING RESISTANCE?**

**Ans:** Insulation resistance must be kept above at least 1 MW, the higher the insulation resistance the better, companies have their own regulation but most companies only allow reading above 5 M ohms

**Q258. WHAT IS MEANT BY THE TERM TYPE EX'E?'**

**Ans:** Ex'e' - increased safety equipment

Increased safety equipment is based primarily on the elimination of 'open sparking' i.e., equipment does not have contacts

**Q259. WHAT IS THE PURPOSE OF THE OVER CURRENT PROTECTION TRIP?**

**Ans:** It is to trip the generator in overload situations. The trip ix usually set at 150% operating capacity and has a time delay of usually 20 sec. this allows for short periods of overload currents. It also protects against a short circuit in the generator.

**Q260. WHAT IS MINIMUM CURRENT CAN BE REGARDED AS FATAL?**

**Ans:** A shock current as low as 15 mA ac or dc can be fatal

**Q261. HOW CAN YOU REVERSE THE DIRECTION OF MOTOR?**

**Ans:** By swapping any two supply line connections over.

**Q262. WHAT IS LOAD SHARING?**

**Ans:** It is equal balance of loads between generators irrespective of load changes.

**Q263. WHEN WORKING ON BATTERIES WHAT PRECAUTIONS SHOULD BE TAKEN?**

**Ans:** Ensure the space is well ventilated, do not smoke or use naked lights and also wear protective clothing such as apron, gloves and face shields.

**Q264. WHAT IS THE NORMAL READING ON AND INSULATI0N TEST METER?**

**Ans:** Infinity is normal reading, but reading should be kept above 5 ohms

**Q265. WHAT IS MEANT BY PROTECTION DISCRIMINATION?**

**Ans:** This is the ability of a protection system to disconnect only faulty circuits and to maintain the electrical supplies to healthy one
Discrimination is advised by coordinating the current ratings and the time settings of the fuses and over current relays used between the generator and the load
The devices nearest the load having the lowest current rating and shortest operating time; these nearest the generator having the highest current rating and the longest operating time i.e., a motor fault on a centrifugal pump would not cause the generator breaker to trip.

**Q266. WHAT IS THE TERM EX'I?'**

**Ans:** Ex'I' – intrinsically safe

Equipment with circuits that do not generate enough heat to ignite a gas. This generally means limiting circuits to less than 30v. 50mA

**Q267.WHY DO YOU REQUIRE EARTH LAMPS ON 220V DISTRIBUTION BOARD WHEN YOU HAVE THEM ON THE MAIN SWITCH BOARD?**

**Ans:** You require earth lamps on the 220v distribution board as well the main switch board, due to the air gap in step down transformer i.e., 440v earth lamps cannot detect earth on 220v systems due to the gap

**Q268. WHEN WOULD A STAR/DELTA STARTER USED ON A MOTOR?**

**Ans:** Where slow moving high criteria load obis involves the starting time must be considered because of the heating effect of the starting current and in this case a star/delta starter would be used
The star/delta starter first connects the starter windings in star and when running charges over to delta. The star connection results in about 58% line voltage being applied to each phase with therefore a reduction in starting current. The starting torque reduced to about 1/3 of its direct on line value

**Q269.WHAT SORT OF STARTING CURRENT DO YOU GET WITH A DIRECT ON LINE STARTER?**

**Ans:** 6 – 8 times full load current

**Q270. WHAT IS MEANT BY THE TERMS TYPE EX'P'?**

**Ans:** ex'p'; - pressurization

This is where equipment is pressurized to prevent any gases entering equipment.

**Q271. WHAT IS MEANT BY THE TERM EX'D'**

**Ans:** Ex'd' – flame proof enclosure

this is an enclosure that will withstand an internal explosion of flammable gas within itself and dissipate heat from that explosion before reaching outside atmosphere, which could ignite the gas in surrounding atmosphere i.e., a ship's battery locker should be classed as Ex'd'.

**Q272.WHAT IS REVERSE POWER PROTECTION FOR?**

**Ans:** Generators intended to operate in parallel must have a reverse power protection trip. A reverse power relay monitors the direction of power flowing between the generator and the switch board
If a prime mover failure occurred the generator would act as a motor. The reverse power relay detects the fault and acts to trip the generator circuit breaker.

**Q273. WHAT IS THE PURPOSE OF UNDER VOLTAGE TRIP?**

**Ans:** It is fitted to all generator breakers. Its main function is to trip the breaker when severe voltage dip (around 50%0. the under voltage trip on a generator circuit breaker also prevents it trip on a generator circuit breaker also prevents it being closed when the generator voltage is very low or absent

**Q274. WHAT IS THE FUNCTION OF FUSE?**

**Ans:** The function of the fuse is to give short circuit protection and also over load protection and operates in milliseconds.

**Q275. EXPLAIN WHAT WOULD HAPPEN IF YOU WERE TO LOSE A GENERATOR**

**Ans:** First the standby generator set would start up and automatically put itself on the board. If this did not happen, the ship would 'black out' and after a time delay usually 30 seconds the eme.

**Q276. WHAT IS THE FUNCTION OF A CIRCUIT BREAKER?**

**Ans:** The circuit breaker is an isolating switch that also acts as a fuse. It has two designed ratings: one normal safe working current and the other against overload, which may also have a time delay.

**Q277. WHAT IS BATTERY USED FOR A BOARD SHIPS?**

**Ans:** They are used for supplying essential power to radio equipment, telephone exchange, fire detection, general alarm circuit etc. these system are after supplied from two sets of batteries worked on a regular charge/discharge cycle
They are also used as emergency supplies i.e., emergency generator startup and emergency lighting being used in this case in a 'stand by' role to give power when main supplies fail

**Q278. WHERE ON THE SHIP IS THE EMERGENCY GENERATOR LOCATED?**

**Ans:** The emergency generator is located remotely from the engine room, usually on the Accommodation in deck or at weather deck level or above.

**Q279. WHAT ARE DISADVANTAGES AND ADVANTAGES OF A LEAD ACID BATTERY?**

**Ans:** The advantages of a lead acid battery are they require fewer cells to achieve particular voltage an d are reasonably priced
The disadvantages are they require regular attention to keep fully charged, always require a trickle charge and they discharge on open circuit

**Q 280 EXPLAIN HOW THE EMERGENCY GENERATOR STARTS UP IN THE EVENT OF TOTAL POWER FAILURE?**

**Ans-**The startup of the emergency generator is initiated by an electrical relay, which monitors the normal mains power supply. Failing mains frequency or voltage causes the 'start up' relay to operate the generator starting equipment. The prime movers may be electrically cranked from its own 24v battery and starter motor or air started from its own air reservoir filled local to the generator engine. A manual start up may also be initiated by push buttons in the main control room and in the emergency generator room
Also when power loss occurs, the breaker feeding the emergency switch board from the main switch board opens. This breaker is interlocked with the emergency generator breaker, which is normally open under normal circumstances, but in the event of total power failure, this breaker will close when the breaker feeding the emergency board from the main board opens. Thus the emergency generator will feed the emergency switch board.