ELECTRICAL ENGINEER INTERVIEW QUESTIONS

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Transformers Components	
Component	**Description**
Core	• The core is the magnetic circuit that provides a low reluctance path for the magnetic field between the primary and secondary windings. It is usually made of laminated iron or steel to reduce eddy current losses.
Windings	• The windings are coils of wire that are wrapped around the core. The primary winding is connected to the input voltage, and the secondary winding is connected to the output voltage.
Insulation	• Insulation is used to separate the windings and prevent electrical contact between them. It is usually made of a thin layer of paper, plastic, or varnish.
Tap changer	• A tap changer is a device that allows the number of turns in the winding to be adjusted, changing the turns ratio and hence the output voltage.
Cooling system	• A transformer generates heat due to losses in the core and windings. A cooling system, such as oil or air, is used to dissipate this heat and prevent the transformer from overheating.
Bushings	• Bushings are insulated devices that connect the transformer to the power system. They provide electrical isolation and support for the high-voltage conductors that connect to the windings.
Conservator tank	• A conservator tank is a container that holds oil, which is used as a cooling medium for the transformer. It also provides space for the expansion and contraction of the oil due to temperature changes.
Breather	• A breather is a device that filters and dehumidifies the air that enters and exits the conservator tank, preventing moisture from entering the transformer and reducing the risk of internal faults.
Buchholz relay	• A Buchholz relay is a protective device that detects faults such as internal arcing, partial discharge, or overheating in the transformer. It operates by detecting changes in the gas or oil levels in the conservator tank.
Protective relays	• Protective relays are devices that detect abnormal conditions in the transformer and disconnect it from the power system to prevent damage. They operate based on various parameters, such as voltage, current, or temperature.

Transformers Tests

1 - Insulation Resistance Test

- Used to measure the insulation resistance of the transformer components.
- Apply HV DC then measure resistance.
- Indicate the condition of the insulation.

2 - Insulation Resistance Test

- Used to measure the turns ratio of the transformer (Primary and Secondary Windings.
- Apply voltage on winding then measure the voltage induced in the other winding.
- Percentage between voltages is the turns ratio of the primary and secondary windings.
- Accurate test.
- East to perform.

3 - Winding Resistance Test

- Used to measure the resistance of the transformer windings (primary and secondary).
- Done using LV DC source + Multimeter

4 - Polarity Test

- Conducted to verify the polarity of the transformer windings.
- Apply DC source to the primary then measure secondary voltage.
- Polarity of the windings determined based on the direction of the induced voltage in the secondary winding.
- Simple and quick.
- Prevent damage of the transformer during installation.

5 - Open Circuit Test

- Performed to determine:
    - No Load Losses.
    - Magnetizing Current.
- Keep the secondary open circuited then apply voltage on the primary winding, then measure the primary (current and voltage).
- Calculate (No-Load Losses & Magnetizing Current).
- Determine the equivalent circuit then calc Efficiency and Regulation.

6 - Short Circuit Test

- Performed to determine:
    - Full Load Current.
    - Transformer Impedance.
- Keep the secondary short circuited then apply voltage to the primary winding, then measure the primary (current and voltage).
- Calculate (Full-Load Current & Impedance).
- Determine Winding Resistance.
- Determine Leakage Inductance.

7 - Sweep Frequency Response Analysis (SFRA)

- Non-destructive test used to detect any changes in the transformer mechanical structure.
- It can detect Winding Deformation or Shorted-Turns.
- It makes comprehensive assessment of the transformer condition.

Transformers Tests

8 - Dissolved Gas Analysis Test (DGA)

- Used to detect the presence of combustible gases in the transformer oil.
- Analyze a sample of the transformer oil to detect any changes in the gas concentration.
- It can detect incipient faults before they become major problems which allows predictive maintenance.

9 - Partial Discharge Test

- Used to detect any partial discharges occurring within the transformer insulation.
- Apply HV to the transformer, then measure any partial discharge in the insulation.
- Can detect insulation faults before they cause significant issues to the transformer.

10 - Dielectric Withstand Test

- Apply HV to the transformer to test the ability of the insulation to withstand any voltage stress.
- Detect insulation weakness and that enables us to ensure the safety and reliability of the transformer.

11 - Thermal Imaging Test

- Uses infrared imaging to detect hot spots or temp gradients.
- It can detect problems such as:
    - Loose Connections.
    - Overload Components.
- It provides a non-invasive assessment of the transformer condition.

MCC (Motor Control Center) Components

Component	Specifications
Motor starter	• Controls the start, stop, and speed of the motor.
Overload protection	• Protects the motor from damage due to overcurrent or overheating.
Circuit breaker	• Provides short circuit protection for the motor and MCC.
Control transformer	• Provides power to control circuits.
Control relays	• Control the operation of the motor starter.
Control switches	• Provide the operator with the means to control the motor.
Push buttons	• Provide the operator with the means to start, stop, or reset the motor.
Pilot lights	• Indicate the status of the motor (e.g. running, stopped, fault).
Terminal blocks	• Conductors that distribute power to the motor starters and other components.
Busbars	• Provides mechanical support for the switchgear components.
Enclosure	• Houses the MCC and provides protection from the environment.

MCC (Motor Control Center) Test

Test	Specifications
Insulation resistance test	• Determines the integrity of the MCC insulation.
Contact resistance test	• Determines the condition of the MCC contacts.
Hi-pot test	• Determines the ability of the MCC to withstand high voltage.
Functional test	• Verifies that the MCC is operating correctly and as designed.
Circuit breaker test	• Determines the condition of the circuit breaker and verifies proper operation.
Overload relay test	• Verifies that the overload relay is set correctly and trips the motor starter when necessary.
Ground fault test	• Determines the condition of the ground fault protection system.
Voltage drop test	• Measures the voltage drop across MCC components to ensure proper operation.
Power quality analysis	• Analyzes the quality of the power supply to the MCC.
Temperature rise test	• Determines the temperature rise of the MCC components under operating conditions.

Pre - Commissioning Procedures for Motors

Test	Specifications
Visual Inspection	• Inspect the motor for any physical damage or defects.
Mechanical checks	• Check the motor alignment, coupling, bearing condition, lubrication, and other mechanical components.
Electrical checks	• Verify that the motor is wired correctly, and that the voltage, current, and frequency are within the specified range.
Insulation Resistance test	• Measure the insulation resistance of the motor windings.
Megger Test	• Measure the insulation resistance of the motor windings with a high-voltage tester.
Polarization Index Test	• Measure the insulation quality of the motor windings.
Hi-pot Test	• Test the insulation strength of the motor windings by applying a high voltage.
Rotor bar Test	• Test the rotor bars for any defects.
Bearing Insulation Test	• Test the insulation resistance of the motor bearings.
Vibration Analysis	• Measure the vibration levels of the motor to detect any abnormalities.
Thermal Imaging	• Use an infrared camera to identify hot spots on the motor that may indicate a problem.
Load Test	• Test the motor under load to verify its performance and efficiency.

11 KV Switchgear Components

Test	Specifications
Circuit breaker	• Interrupts the flow of electricity in the event of a fault.
Current transformer	• Measures current in the system and provides signals for protection relays.
Voltage transformer	• Measures voltage in the system and provides signals for protection relays.
Isolator/ disconnector	• Provides a visible means of isolating equipment from the power system for maintenance or repair.
Earthing switch	• Connects the equipment to earth for safety reasons.
Protection relay	• Monitors the system for faults and sends a signal to the circuit breaker to trip if necessary.
Control panel	• Provides the operator with the means to control the switchgear and monitor its status.
Busbars	• Conductors that connect the incoming and outgoing circuits to the switchgear.
Cable box	• Houses the cable connections and provides a means of cable termination.
Support structure	• Provides mechanical support for the switchgear components.

To test a Medium Voltage (MV) switchgear, the following tests should be performed:

Test	Specifications
Insulation Resistnace	• Measure insulation resistance between phases and phase-to-earth. • It involves measuring the insulation resistance between the phases and between each phase and the earth using a megger or insulation tester. • The insulation resistance test of switchgear ensures safety, prevents equipment damage, extends equipment life, and complies with regulations by detecting insulation faults early on.
Contact Resistance	• Measure contact resistance between phases and phase-to-earth using a low-resistance ohmmeter. • The contact resistance test of switchgear ensures the reliability and efficiency of the electrical connections by detecting and correcting any defects in the contact surfaces.
High Voltage	• This test is performed to check the switchgear's ability to withstand high voltage. • It involves applying a voltage higher than the rated voltage of the switchgear for a specific duration of time. • The high voltage test of switchgear ensures the electrical strength and integrity of the insulation system, verifying that it can withstand the rated voltage and preventing breakdowns or electrical faults.
Circuit Breaker Timing	• This test is performed to check the opening and closing time of the circuit breaker. • It involves measuring the time taken by the circuit breaker to open and close under different load conditions. • The circuit breaker timing test of switchgear ensures the proper functioning and coordination of the circuit breaker components, allowing for the detection and correction of any malfunctions and preventing damage to the system.
Partial Discharge	• This test is performed to check for partial discharge within the switchgear. • It involves applying a high voltage to the switchgear and monitoring for partial discharges using a partial discharge detector. • The Partial Discharge test of switchgear helps to identify any insulation defects that may lead to electrical breakdowns or failure, allowing for timely repairs and maintenance to prevent costly damage to the system.
Thermal Imaging	• This test is performed to check for any hot spots within the switchgear. • It involves using a thermal imaging camera to capture images of the switchgear and identify any areas where the temperature is higher than normal.

Type of FA System	Description	Advantages	Disadvantages
Conventional	• Uses zones to identify the location of a fire • Only identifies the zone where the fire is located, not the exact location.	• Cost-effective • Suitable for small buildings with a simple layout.	• Limited information about fire location • Limited capacity for expansion.
Addressable	• Uses individual devices to pinpoint the exact location of a fire. • Each device has a unique address for easy identification. • Can identify the type of device that triggered the alarm, such as a smoke detector or heat detector.	• Provides detailed information about fire location. • Suitable for large buildings with complex layouts. • Allows for customization and flexibility in design and layout.	• More expensive than conventional systems. • More complex installation and programming. • Requires more maintenance and testing.
Analogue Addressable	• Uses a loop to communicate with individual devices and can pinpoint the exact location of a fire • Can identify the type of device that triggered the alarm • Monitors the status of devices in real-time, allowing for early detection and prevention. • Can provide additional information such as temperature and smoke levels.	• Provides detailed information about fire location. • Suitable for large buildings with complex layouts. • Allows for customization and flexibility in design and layout. • Can integrate with other building systems for more efficient control.	• Most expensive type of fire alarm system. • More complex installation and programming. • Requires more maintenance and testing. • Requires specialized training for programming and maintenance.
Wireless	• Uses wireless technology to communicate with individual devices. • Can pinpoint the exact location of a fire. • Provides flexibility in installation and design.	• Easy and cost-effective installation and expansion. • Suitable for retrofitting in existing buildings. • Can be more expensive than hard-wired systems in some cases.	• Susceptible to interference and signal loss. • Requires more maintenance and testing compared to hard-wired systems.

Fire Alarm System Components	
Component	**Description**
Control Panel	• The central hub of the fire alarm system receives signals from detectors and triggers alarms and notifications.
Detectors	• Devices that sense heat, smoke, or other indicators of a fire send signals to the control panel. Types of detectors include ionization, photoelectric, and heat detectors.
Manual Call Points	• Manual devices used to trigger a fire alarm in case of emergency. These can be wall-mounted or portable.
Notification Appliances	• Devices that alert building occupants to a fire, such as strobe lights, sirens, or speakers.
Power Supply	• The power source for the fire alarm system can be from a dedicated circuit or backup battery.
Communication Equipment	• Devices that allow the fire alarm system to communicate with other building systems, emergency services, or remote monitoring stations.
Ancillary Devices	• Optional devices that can enhance the functionality of the fire alarm system, such as air sampling smoke detectors or voice evacuation systems.

Type of Earthing Systems	Description	Advantages	Disadvantages
TT (Separate)	• A separate earth electrode is provided for each electrical installation, and these electrodes are connected to the main earthing terminal through separate conductors.	• Offers a high level of safety against electric shock	• Can be expensive to install due to the need for multiple earth electrodes.
TN-S (Combined)	• A single earth conductor is used to connect all earth electrodes in the installation, and the same conductor is used to connect the electrical system to the earth electrode.	• Cost-effective and easy to install.	• May not offer the same level of protection as other systems, as a fault in the earth conductor could result in a break in the protective earth connection for the entire installation.
TN-C-S (Combined)	• Uses a single conductor for both the protective earth and the neutral conductor, which is separated at the point of supply.	• Cost-effective and easy to install.	• Can pose a risk of electric shock if the neutral conductor is accidentally broken or damaged, and can be difficult to detect a broken neutral conductor.
IT (Isolated)	• The electrical system is completely isolated from the earth, and a separate earthing conductor is provided, which is connected to an earth electrode. A monitoring device is used to detect any earth fault and sound an alarm. The fault must be located and repaired before the system can be used.	• Offers a high level of protection against electric shock.	• Can be more expensive to install than other systems, and requires regular testing and maintenance of the monitoring device. In case of a fault, the system must be completely shut down and repaired before it can be used again.
TN-C (Combined)	• Uses a single conductor for both the protective earth and the neutral conductor, which is not separated at the point of supply.	• Can be cost-effective and easy to install	• Can pose a risk of electric shock if the neutral conductor is accidentally broken or damaged, and can be difficult to detect a broken neutral conductor.

Type of Earthing Systems	Description
TT (Separate)	• The TT earthing system is where each electrical device is connected to its own local earth electrode. The earthing electrode is connected to the earth pit directly, and not connected to any other conductive material. This type of earthing system is commonly used in residential areas.
TN-S (Combined)	• The TNS earthing system is a combination of the TN and TT earthing systems. The electrical devices are connected to a common earth point, which is then connected to both the earth electrode and the earth pit. This type of earthing system is commonly used in medium-sized industrial and commercial buildings.
TN-C-S (Combined)	• The TN-C-S earthing system is a combination of the TN and IT earthing systems. The electrical devices are connected to a common earth point, which is then connected to the earth electrode and the earth pit through a monitoring resistor. This type of earthing system is commonly used in larger industrial and commercial buildings.
IT (Isolated)	• The IT earthing system is where the electrical devices are isolated from the earth, and the only connection to the earth is through a monitoring resistor. The monitoring resistor is used to detect any earth fault currents and is typically set at a low value to ensure rapid detection. This type of earthing system is commonly used in sensitive electronic equipment.
TN-C (Combined)	• The TN-C earthing system is where the combined neutral and protective conductor (PEN) serves as the earth connection for electrical devices. The PEN conductor is connected to the earth electrode, which is then connected to the earth pit. This type of earthing system is commonly used in small commercial and residential buildings.

Type of Switchgear	Description	Advantages	Disadvantages
Air-insulated switchgear (AIS)	• Uses air as the insulation medium.	• Low cost, easy to maintain, reliable.	• Large footprint, limited voltage levels, not suitable for areas with high pollution or humidity.
Gas-insulated switchgear (GIS)	• Uses SF6 gas as the insulation medium.	• Compact design, high reliability, low maintenance, suitable for high voltage levels.	• High cost, complex design, requires specialized personnel, potential environmental issues.
Hybrid switchgear	• Combines AIS and GIS technologies.	• Compact design, lower cost than GIS, suitable for high voltage levels.	• Still relatively new technology, requires specialized personnel.
Vacuum switchgear	• Uses a vacuum as the insulation medium.	• Low maintenance, environmentally friendly, suitable for high voltage levels.	• Limited current carrying capacity, high cost, requires specialized personnel.
Solid-insulated switchgear (SIS)	• Uses solid materials such as epoxy resin as the insulation medium.	• Low maintenance, environmentally friendly, suitable for indoor use.	• Limited voltage levels, high cost, limited availability.

Type of CB	Description	Advantages	Disadvantages
Miniature Circuit Breaker (MCB)	• Typically used in residential and commercial settings. Automatically trips when it detects an overload or short circuit.	• Inexpensive, easy to install, and widely available.	• Limited capacity, can be less reliable than other types, and may not protect against all types of faults.
Molded Case Circuit Breaker (MCCB)	• Typically used in industrial settings. Automatically trips when it detects an overload or short circuit. Offers higher current-carrying capacity than MCBs.	• More reliable than MCBs, higher current-carrying capacity, and can provide more precise protection settings.	• More expensive than MCBs and may require more complex installation.
Air Circuit Breaker (ACB)	• Typically used in high-voltage applications. Automatically trips when it detects an overload or short circuit. Offers high current-carrying capacity and adjustable protection settings.	• Can handle high currents and can be adjusted to specific protection settings.	• More expensive than MCCBs and may require more complex installation.
Oil Circuit Breaker (OCB)	• Typically used in high-voltage applications. Uses oil to extinguish arcs when a fault is detected. Offers high current-carrying capacity and is highly reliable.	• Highly reliable and can handle high currents.	• Can be expensive to install and maintain, and may pose environmental hazards.
Gas Circuit Breaker (GCB)	• Typically used in high-voltage applications. Uses gas to extinguish arcs when a fault is detected. Offers high current-carrying capacity and is highly reliable.	• Highly reliable and can handle high currents.	• Can be expensive to install and maintain, and may pose environmental hazards.

Types of CCTV Systems			
Aspect	**Analog CCTV**	**IP CCTV**	**HD-SDI CCTV**
Image Quality	• Lower resolution, less clarity.	• Higher resolution, more clarity.	• High definition, very clear.
Cost	• Generally less expensive.	• More expensive.	• More expensive.
Installation	• Requires coaxial cable, more difficult to install.	• Uses network cables, easier to install.	• Requires coaxial cable, more difficult to install.
Scalability	• Limited scalability due to cable distance limitations.	• Highly scalable due to network architecture.	• Limited scalability due to cable distance limitations.
Remote Access	• More difficult to remotely access video.	• Easier to remotely access video via internet connection.	• More difficult to remotely access video.
Storage	• Limited storage capacity.	• Higher storage capacity due to network architecture.	• Limited storage capacity.
Analytics	• Limited analytics capabilities.	• More advanced analytics capabilities.	• Limited analytics capabilities.
Power Supply	• Uses analog power supply.	• Uses Power over Ethernet (PoE).	• Uses analog power supply.

ELV Cables						
Cable type	**Voltage Rating**	**Typical Applications**	**Conductor Material**	**Insulation Material**	**Advantages**	**Disadvantages**
Coaxial Cable	• Up to 50V.	• Telecommunications, security systems, low voltage lighting.	• Copper.	• Polyethylene or Teflon	• Low attenuation, high bandwidth, noise-free signal transmission.	• High cost, not suitable for high power applications.
Ethernet Cable	• Up to 50V.	• Computer networking, security systems, automation systems.	• Copper.	• Polyethylene or PVC.	• Widely available, low cost, easy to install.	• Limited transmission distance, not suitable for high power applications.
Twisted Pair Cable	• Up to 50V.	• Telecommunications, security systems, low voltage lighting.	• Copper.	• Polyethylene or PVC.	• Low cost, easy to install, low electromagnetic interference.	• Limited transmission distance, not suitable for high power applications.
Optical Fiber Cable	• Up to 50V.	• Telecommunications, security systems, data centers.	• Glass or plastic.	• Polyethylene or PVC.	• High bandwidth, low attenuation, immune to electromagnetic interference.	• High cost, requires specialized installation and maintenance.

UPS	
Term	**Definition**
UPS (Uninterruptible Power Supply)	• A device that provides backup power to electrical devices in case of a power outage or other electrical interruption.
Battery Backup	• A key component of a UPS system, the battery backup provides power to connected devices when the main power source is interrupted.
Voltage Regulation	• UPS systems can also regulate the voltage of the power being supplied to devices, ensuring that the voltage remains stable even if the input voltage fluctuates.
Surge Protection	• A UPS system can also protect connected devices from power surges and other electrical disturbances that can damage electrical components.
Online UPS	• An online UPS system provides continuous power to connected devices by running the power through the battery backup at all times.
Offline UPS	• An offline UPS system only activates the battery backup when the main power source fails, meaning that there may be a brief interruption in power before the battery backup kicks in.
Line-interactive UPS	• A line-interactive UPS system is similar to an offline UPS, but it also includes a voltage regulator to ensure stable power output during power fluctuations.
Runtime	• The amount of time a UPS system can provide backup power to connected devices. This depends on the capacity of the battery backup and the power consumption of the devices being supplied.
Capacity	• The amount of power that a UPS system can supply to connected devices. This is measured in volt-amperes (VA) or watts (W) and is typically listed on the product specifications.
Automatic Shutdown	• A feature of some UPS systems that automatically shuts down connected devices if the backup battery is running low on power, preventing damage to the devices.
SNMP Support	• Some UPS systems support SNMP (Simple Network Management Protocol), allowing them to be monitored and managed remotely from a network management console.
Redundancy	• In critical applications, redundant UPS systems may be used to provide backup power in case one of the UPS systems fails.