Subject Name & Code:

BASIC ELECTRICAL ENGINEERING-BE01R00051

Assignment – 4: LT Switchgear, Earthing, and Protective Devices

1. Explain LT switchgear and discuss various components used in LT panels.

LT (Low Tension) switchgear refers to the combination of switching, protection, metering, and control devices used in electrical circuits operating at voltages up to 1 kV AC (typically 415 V in three-phase systems). It is essential for safe distribution, isolation, and fault clearance in residential, commercial, and industrial installations.

Components of LT panels:

- **Incoming isolator / SFU** – For safe isolation and disconnection.
- **MCB / MCCB** – For overload and short-circuit protection.
- **ELCB / RCCB** – For earth leakage protection.
- **Contactors and relays** – For remote switching and control.
- **Busbars** – Copper or aluminium bars for power distribution.
- **Metering instruments** – Ammeter, voltmeter, energy meter.
- **Indicators and push buttons** – For local operation and status display.
- **Power factor correction capacitors** – To improve power factor.

---

2. Explain construction, working and applications of SFU.

Switch Fuse Unit (SFU) combines a load-breaking switch and a fuse in a single enclosure.

Construction:

- Metal or moulded case with a moving contact (switch) and fixed contacts.
- Fuse (HRC type) connected in series with the switch.
- Handle or knob for manual operation.

Working:

- Under normal conditions, the switch closes the circuit, and current flows through the fuse.
- During overload or short circuit, the fuse melts (blows), disconnecting the supply.
- The switch provides visible isolation for safe maintenance.

Applications:

- Motor starting circuits.
- Distribution boards in industries.
- Feeder protection in LT panels.
- Lighting and small power circuits.

---

3. Explain MCB, MCCB and ELCB with comparison table.

MCB (Miniature Circuit Breaker):
Current rating ≤ 125 A, for low-power circuits. Uses bimetal (overload) and solenoid (short circuit) for tripping. Not adjustable.

MCCB (Moulded Case Circuit Breaker):
Rating up to 1600 A, adjustable trip settings. Used for feeders, motors, and main distribution.

ELCB (Earth Leakage Circuit Breaker):
Detects leakage current to earth. Two types – voltage-operated (obsolete) and current-operated (RCCB).

Feature	MCB	MCCB	ELCB (RCCB)
Current rating	≤125 A	≤1600 A	≤100 A
Trip mechanism	Thermal-magnetic	Thermal-magnetic (adjustable)	Current imbalance
Protection	Overload, short circuit	Overload, short circuit	Earth leakage
Adjustable settings	No	Yes	No
Application	Final subcircuits	Main feeders, motors	Protection from electric shock

---

4. Explain earthing system in detail with types and advantages.

Earthing means connecting the metallic parts of an electrical installation to the general mass of earth to ensure safety.

Types:

- **Plate earthing:** GI or copper plate buried in earth with charcoal and salt.
- **Pipe earthing:** GI pipe buried vertically with funnel for water pouring.
- **Rod earthing:** Copper rod driven into ground (used in rocky areas).

- **Strip earthing:** GI strip buried horizontally.

Advantages:

- Prevents electric shock by keeping exposed metal at earth potential.
- Provides low-impedance path for fault current, helping protective devices operate.
- Drains lightning and static charges safely.
- Stabilizes voltage during faults.

---

5. Discuss the importance of earthing for human safety and equipment protection.

For human safety:

- If insulation fails, the equipment body becomes live. Earthing diverts fault current to ground, reducing touch voltage.
- ELCB/RCCB operates quickly if earthing is proper, disconnecting supply before lethal shock occurs.

For equipment protection:

- Prevents overvoltage stress on insulation.
- Reduces fire risk due to arcing.
- Ensures reliable operation of fuses and breakers during faults.

Without earthing, a fault could keep the equipment body at dangerous potential indefinitely.

---

6. Explain electrical safety precautions for domestic and industrial appliances.

Domestic:

- Use three-pin plugs with proper earthing.
- Avoid daisy-chaining extension boards.
- Keep appliances away from water.
- Install MCB and RCCB in distribution board.

Industrial:

- Regular insulation resistance testing.
- Lockout/Tagout (LOTO) during maintenance.
- Use of double-insulated tools.
- Periodic thermal imaging of panels.

---

7. Describe safety measures to prevent electrical accidents.

- **Proper earthing** of all metallic parts.

- **Use of PPE** – insulated gloves, mats, shoes.
- **Training** – first aid for electric shock, fire extinguisher use.
- **Warning signs** near high-voltage areas.
- **Safe distance** from live conductors.
- **Regular inspection** of cables, switches, and breakers.

---

8. Explain role of protective devices in electrical systems.

Protective devices detect abnormal conditions and disconnect faulty sections to prevent damage and hazard.

Device	Role
Fuse	Melts under overcurrent, isolates fault
MCB/MCCB	Automatic trip on overload/short circuit
RCCB/ELCB	Trip on earth leakage (mA level)
Relay	Sends trip signal to circuit breaker
Lightning arrester	Diverts surge voltage to earth

They ensure selectivity (only faulty part trips), reliability, and safety.

---

9. Numerical: SFU rating 63 A, load 45 A.

Given:
Rated current $I_r = 63\ A$
Load current $I_l = 45\ A$

To find:
Percentage loading, Remaining capacity

Formula:

$$\%\text{loading} = \frac{I_l}{I_r} \times 100$$
$$\text{Remaining capacity} = I_r - I_l$$

Solution:

$$\%\text{loading} = \frac{45}{63} \times 100 = 71.43\%$$

$$\text{Remaining capacity} = 63 - 45 = 18\ A$$

Final answer:

$$\boxed{71.43\%,\ 18\ A}$$

---

10. Numerical: Earth electrode resistance 5 Ω, fault current 10 A.

Given:
$R = 5\Omega,\ I_f = 10\ A$

To find:
Voltage rise V

Formula:

$$V = I_f \times R$$

Solution:

$$V = 10 \times 5 = 50\ V$$

Final answer:

$$\boxed{50\ V}$$

---

11. Numerical: Two earth electrodes of 8 Ω each in parallel.

Given:
$R_1 = 8\Omega,\ R_2 = 8\Omega$

To find:
Total resistance R_{eq}

Formula (parallel):

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

Solution:

$$\frac{1}{R_{eq}} = \frac{1}{8} + \frac{1}{8} = \frac{2}{8} = \frac{1}{4}$$
$$R_{eq} = 4\Omega$$

Final answer:

$$\boxed{4\Omega}$$