

**BHARTIYA SKILL DEVELOPMENT UNIVERSITY****School of Electrical Skills****3rd Semester, 1st In-Sem. Examination****B. Voc. Program, Summer Semester (2018-19)****Course Code: ELE1301****Time: 1 Hour****Course Name: Electrical Assembly Operator Control Panel****Max. Marks: 20**

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks.

Section – A

05X01 = 05 Marks

Q.1. In accordance with NFPA 79, the overcurrent protection for lighting circuits shall be: -

- (a) $\leq 10A$ (b) $\leq 12A$ (c) $\leq 15A$ (d) $\leq 18A$

Q.2. Which of the following is not a valid slash rating for a power supply?

- (a) 208Y/120V (b) 240Y/131V (c) 480Y/277V (d) 600Y/347V

Q.3. Which of the following is the range of Ambient Temperature for electrical equipment as per the NFPA 79?

- (a) +5 to +40 °C (b) +5 to +35 °C (c) +10 to +40 °C (d) +5 to +40 °C

Q.4. Which one of the following is a Generic material that can be used as Insulating Barriers?

- (a) Mica (b) Phenolic (c) Epoxy (d) Unfilled nylon

Q.5. Which is the correct CCN for a Recognized Canada product?

- (a) DIVQ 7 (b) WHTY 8 (c) NKCR (d) NKCR2

Section – B

03X02 = 06 Marks

Q.1. Draw any warning sign relating to arch flash hazard that specifies the safety limits.

Q.2. Where is a safety transformer used?

Q.3. What is meant by an Electric Hazard? What are the types of Electric Hazards?

Section – C

03X03 = 09 Marks

Q.1. What is a Control Circuit? Mention the types of Control Circuits.

Q.2. Explain over current protection of Lighting Circuits.

Q.3. What are the different Power Supply System Configurations? Explain any one of them.

()

100

100

100

100

100



BHARTIYA SKILL DEVELOPMENT UNIVERSITY
School of Electrical Skills

3rd Semester, 1st In-Sem. Examination

B. Voc. Program, Summer Semester (2018-19)

Answer Key

Course Code: ELE1301

Course Name: Electrical Assembly Operator Control Panel

Max. Marks: 20

Section – A

05X01 = 05 Marks

Q.1. In accordance with NFPA 79, the overcurrent protection for lighting circuits shall be: -

- (a) $\leq 10A$ (b) $\leq 12A$ (c) $\leq 15A$ (d) $\leq 18A$

Ans. (c)

Q.2. Which of the following is not a valid slash rating for a power supply?

- (a) 208Y/120V (b) 240Y/131V (c) 480Y/277V (d) 600Y/347V

Ans. (b)

Q.3. Which of the following is the range of Ambient Temperature for electrical equipment as per the NFPA 79?

- (a) +5 to +40 °C (b) +5 to +35 °C (c) +10 to +40 °C (d) +5 to +40 °C

Ans. (d)

Q.4. Which one of the following is a Generic material that can be used as Insulating Barriers?

- (a) Mica (b) Phenolic (c) Epoxy (d) Unfilled nylon

Ans. (a)

Q.5. Which is the correct CCN for a Recognized Canada product?

- (a) DIVQ 7 (b) WHTY 8 (c) NKCR (d) NKCR2

Ans. (b)

Section – B

03X02 = 06 Marks

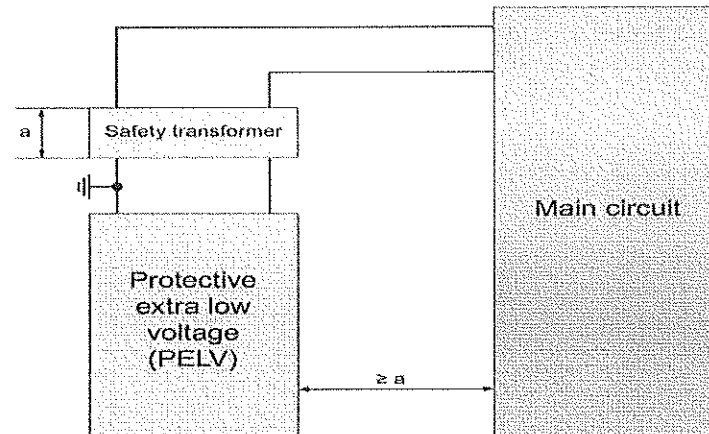
Q.1. Draw any warning sign relating to arch flash hazard that specifies the safety limits.

Ans.

Equipment type	480 V	MCC and Panels
Grounding	Grounded	
Working distance	400 mm	
Available 3ph bolted current	80 kA	
Flash protection boundary	36 inches	
Incident energy at work distance	4,72 cal/cm ²	
PPE level	2	

Q.2. Where is a safety transformer used?

Ans. The Safety transformer (isolation transformer!) may be used for supplying a PELV.



Q.3. What is meant by an Electric Hazard? What are the types of Electric Hazards?

Ans. "Electrical hazards" is taken to mean events of an electrical nature that pose a hazard to people. The essential ones to list here are electric shock and arcing faults. NFPA 79, requires electrical equipment to protect people from the following hazards:

- Electric shock due to direct or indirect contact
- Arc flashing

Section – C

03X03 = 09 Marks

Q.1. What is a Control Circuit? Mention the types of Control Circuits.

Ans. A control circuit is a circuit that carries the signals for the function and the controller. It does not carry the electrical power for the connected loads. The following control circuits are defined in UL 508A:

- Class 1 control circuit
- Class 2 control circuit
- Low-voltage limited energy circuit

Q.2. Explain over current protection of Lighting Circuits.

Ans. Overcurrent protection for lighting loads

- Lighting circuits are described in UL 508A
- Short-circuit protective devices for standard-duty incandescent lamp holders or fluorescent ballasts shall have a rating of ≤ 20 A, and shall not exceed the ampacity of the wiring.
- Short-circuit protective devices for lamp holders marked heavy duty for use with fluorescent or infrared lamps shall have a rating of ≤ 50 A, and shall not exceed the ampacity of the wiring.
- In accordance with NFPA 79, lighting circuits shall be protected with ≤ 15 A.

Q.3. What are the different Power Supply System Configurations? Explain any one of them.

Ans. 1. Slash rating

- A "slash rating" refers to a solidly grounded wye. The following two voltages occur in such a power system:
 - "Phase-to-phase"
 - "Phase-to-ground"
- Both voltages are specified in the case of a "slash rating". For example:
 - 208Y/120V, 240Y/131V, 480Y/277V, 600Y/347V
- The term "slash rating" refers to the slash used.
- The most frequently found industrial power system in the USA is the 480Y/277V system.

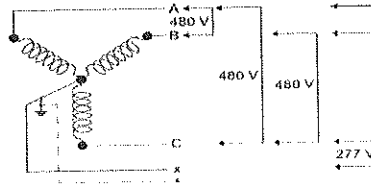


Figure: Grounded wye 480Y/277V

2. Straight rating

- A "straight rating" refers to power systems other than a solidly grounded wye.
- Only one voltage occurs in such power systems. The phase-to-phase voltage and the phase-to-ground voltage are equal in size if present.
- Such power systems can include:
 - Delta systems, grounded or ungrounded
 - Ungrounded wye systems
- If a "straight rating" is present, only one voltage will consequently be specified. For example:
 - 240 V, 480 V, 600 V

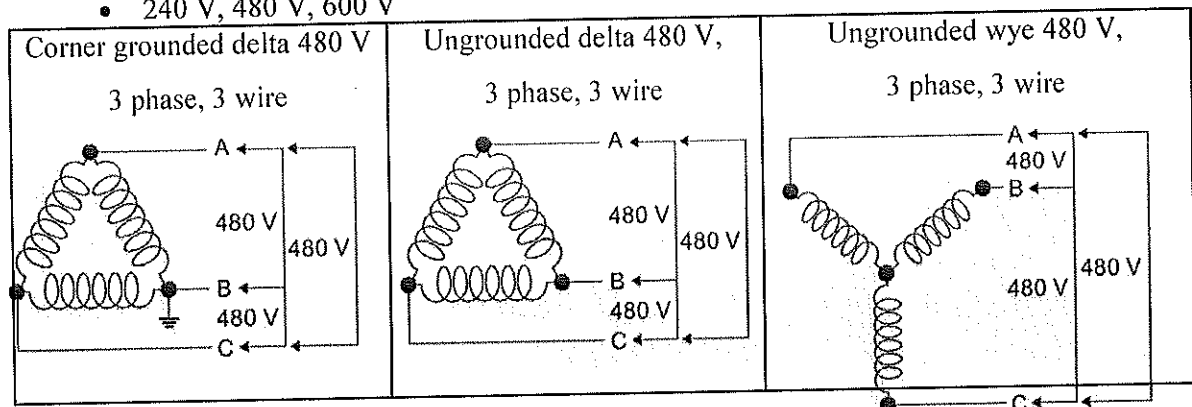


Figure: Delta system, grounded and ungrounded 480 V, ungrounded wye system 480 V

1. Other power supply system configurations

- The "midpoint grounded delta" is found more rarely.
- With this system, grounding is carried out between the phases, with the result that the short-circuit is switched at "high leg voltage". This is 208 V in the case of a 240 V midpoint grounded delta.

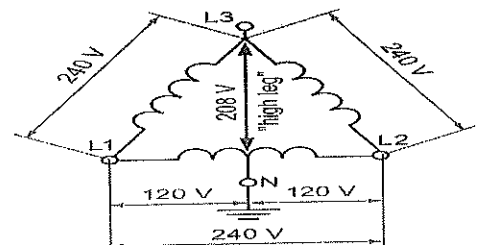


Figure: Midpoint grounded delta 240 V

()

Handwritten text, possibly bleed-through from the reverse side of the page. The text is faint and difficult to decipher but appears to be organized into several lines or paragraphs.

() ()

Handwritten text at the bottom of the page, likely bleed-through from the reverse side. It is very faint and spans across the width of the page.

**BHARTIYA SKILL DEVELOPMENT UNIVERSITY**

School of Electrical Skills

3rd Semester, 1st In-Sem. Examination

B. Voc. Program, Summer Semester (2018-19)

Course Code: ELE1302

Time: 1 Hour

Course Name: Electrical Design Developer

Max. Marks: 20

Instruction: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks.

Section – A

05X01 = 05 Marks

Q.1. According to SI units, unit of magnetic flux is: -

- (a) Tesla (b)
- NmA^{-1}
- (c) Weber (d)
- NC^{-1}

Q.2. 1 mA can also be written as: -

- (a) 0.01 A (b) 0.001 A (c) 100 A (d) 1000 MA

Q.3. The current which is perpendicular and into the paper plane is represented by: -

- (a)
- \otimes
- (b)
- \odot
- (c) both of these

Q.4. The relation between magnet field density and magnetic field intensity is given by: -

- (a)
- $B=\mu H$
- (b)
- $B=\alpha H$
- (c)
- $B=\Phi H$
- (d)
- $B=\rho H$

Q.5. The expression for flux linkage (λ) in a coil is given by: -

- (a)
- $\lambda=N\Phi$
- (b)
- $\lambda=\rho H$
- (c)
- $\lambda=NH$
- (d)
- $\lambda=pN$

Section – B

03X02 = 06 Marks

Q.1. Explain Ampere's Law in detail.

Q.2. Discuss the fringing effect. Why it occurs in magnetic circuits?

Q.3. Consider a coil having turns (N)=25. The toroid, on which the coil is wound, has an inside diameter of 5cm and outside diameter of 5.5cm. For current (i)= 3A, calculate the magnetic field intensity.**Section – C**

03X03 = 09 Marks

Q.1. Derive the magnetic flux relation considering air gaps in magnetic structures.

Q.2. Mention the differences between different types of magnetic materials.

Q.3. In the transformer, all flux lines in the core are assumed to cross the air gap. The structure dimensions are as follows: cross sectional area (A_m)= 20cm², mean path length (l_m)= 40cm, l_g = 2mm, and N =75 turns. In the linear region, the core permeability is assumed to be constant, with μ_r =4500. The coil current (i)= 30A. is below the saturation level. Calculate the flux density in the air gap (a) including the reluctance of the core as well as that of the air gap (b) ignoring the core reluctance in comparison to the reluctance of the air gap.

SOLUTION KEY

ELECTRICAL DESIGN DEVELOPER

Code - ELE 1302

I In-Sem Exam.

Section 'A' :-

Ans 1 :- (c) Weber

Ans 2 :- (b) 0.001A

Ans 3 :- (a) (X)

Ans 4 :- (a) $B = \mu H$

Ans 5 :- (a) $k = N\phi$

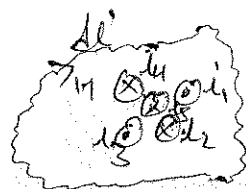
Section - B

Ans 1 :- Ampere's Law :-

The magnetic flux intensity (H) is produced by current carrying conductor can be obtained by means of Ampere's law.

* The ampere's law states that at any line integral of the magnetic field intensity of the magnetic field intensity along any closed path equals to the total current enclosed by this path.

$$\oint H \cdot dl = \sum I_i$$



\oint represents the contour
 H = magnetic field intensity in the direction.

Ans 12 Generally flux lines bulge slightly around air gap. This bulging effect is called fringing effect.

Ans 13

$$N = 25$$

$$d_1 = 5 \text{ cm}, d_2 = 5.5 \text{ cm}$$

$$i = 3 \text{ A}$$

$$H = ?$$

$$\Rightarrow H = \frac{Ni}{l} \leftarrow \text{-----} \textcircled{1}$$

$$= lm = 2\pi r_m$$

$$r_m = 5 + 5.5 = \frac{10.5}{2} \text{ cm} = 5.25 \text{ cm}$$

$$2\pi r \Rightarrow 2 \times 3.14 \times \frac{5.25}{100} \Rightarrow 0.329 \text{ m}$$

$$\Rightarrow \frac{25 \times 3}{0.329}$$

$$\Rightarrow 227.96 \text{ A/m Ans}$$

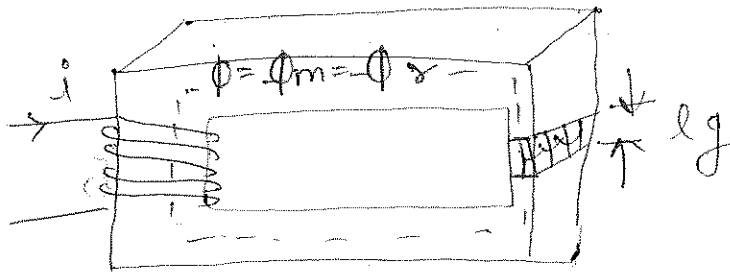
'Section C'

Ans 1 * In the magnetic structures of electrical m/c the flux lines have to cross two air gaps.

* To study the effect of air gaps, let us consider simple magnetic structures, consist of N turn coils on a magnetic core made up of iron.

* The objective is to establish a desired magnetic field in the air gap of length l_g by controlling the current i .

* We assume magnetic field intensity H_m to be uniform along the mean path length l_m , in the magnetic core.



* The magnetic intensity in air gap is denoted by H_g .

* By ampere's law

$$H_m = \frac{Ni}{l_m}, \quad H_g = \frac{Ni}{l_g}$$

$$\Rightarrow H_m \cdot l_m + H_g \cdot l_g = Ni$$

* The flux density (B) corresponding to H_g & H_m are

$$B_m = \mu_m \cdot H_m \quad \& \quad B_g = \mu_g \cdot H_g \quad \dots \dots \dots (2)$$

$$\frac{B_m}{\mu_m} = H_m \quad \& \quad \frac{B_g}{\mu_g} = H_g$$



$$\frac{B_m \cdot l_m}{\mu_m} + \frac{B_g \cdot l_g}{\mu_g} = N_i \quad \dots \dots \dots (3)$$

We can calculate the flux through density in magnetic circuits with air gap.

$$B_m = \frac{\phi_m}{A_m} \quad \dots \dots \dots (4)$$

$$\text{in air gap} = B_g = \frac{\phi_g}{A_g} \quad \dots \dots \dots (5)$$

$$\text{The } \phi_g \text{ flux} = B_g \cdot A_g \quad \dots \dots \dots (6)$$

By putting the value of eq (5) in eq (3)

$$\Rightarrow B_g = \frac{\phi_g}{A_g} \Rightarrow \phi \left[\frac{l_g}{A_g \cdot \mu_g} + \frac{l_m}{A_m \cdot \mu_m} \right] = N_i$$

The equation (7) is showing the relation with reluctance.

∴ The resulting reluctance will be

$$R = R_m + R_g \quad \dots \dots \dots (8)$$

Ans 2. Magnetic materials are the materials which allow ~~to~~ pass the flux of magnetic effect into them.

- There are mainly three different types of magnetic materials.

- These are Ferromagnetic, Paramagnetic and Diamagnetic.

(i) Ferromagnetic materials: The materials which are strongly attracted by the magnet. These materials have high permeability to flow or pass the flux into them.

examples: - Iron, Nickel, Cobalt.

These materials have high permeability of > 1 .

(ii) Paramagnetic: - These materials are not strongly attracted by the magnet's effect. These have low capability to flow the flux.

For example: - Aluminium.

The resulting magnetic force is zero in these type of materials.

* Diamagnetic materials: These materials are repelled by the magnetic circuit are known as diamagnetic materials.

It has the permeability of smaller than 1 .

For examples - Zinc, Sulphur, silver etc.

Ans 3 $A_m = 20 \text{ cm}^2$, $l_m = 40 \text{ cm}$, $l_g = 2 \text{ mm}$, $N = 75$ turns
 $\mu_r = 4500$, $i = 30 \text{ A}$, $B_g = ?$

$$\Rightarrow R_m = \frac{l_m}{\mu_0 \mu_r \cdot A_m} = \frac{40 \times 10^{-2}}{4\pi \times 10^{-7} \times 4500 \times 20 \times 10^{-4}}$$

$$R_m = 3.54 \times 10^4 \frac{\text{A}}{\text{wb}}$$

$$\Rightarrow R_g = \frac{l_g}{\mu_0 \mu_r \cdot A_g} = \frac{2 \times 10^{-3}}{4\pi \times 10^{-7} \times 20 \times 10^{-4}}$$

$$\Rightarrow 79.57 \times 10^4 \frac{\text{A}}{\text{wb}}$$

$$(a) \quad \Phi_g = \frac{N i}{R_m + R_g}$$

$$\therefore \text{Flux density } B_g = \frac{\Phi_g}{A_g}$$

$$B_g = \frac{N i}{(R_m + R_g) A_g} \Rightarrow \frac{75 \times 30}{3.54 \times 10^4 + 79.57 \times 10^4 \times 20 \times 10^{-4}}$$

$$= 1.3536 \text{ tesla.}$$

$$(b) \quad \Phi_g = \frac{N i}{R_g \cdot A_g} \Rightarrow \frac{75 \times 30}{79.57 \times 20 \times 10^{-4}}$$

$$\Rightarrow \frac{2250000}{1591.4}$$

$$\Rightarrow 14138.49 \text{ tesla or AT/wb}$$

**BHARTIYA SKILL DEVELOPMENT UNIVERSITY****School of Electrical Skills****3rd Semester, 1st In-Sem. Examination****B. Voc. Program, Summer Semester (2018-19)****Course Code: ELE1303****Time: 1 Hour****Course Name: Safety Electrical Installation Controller****Max. Marks: 20**

Instructions: Answer all questions from section A, each question carries one mark. Answer all questions from section B, each question carries two marks. Answer all questions from section C, each question carries three marks.

Section – A

05X01 = 05 Marks

- Q.1. Human body can withstand electrical shock up to
- (a) 100 Amps (b) 1 Amp (c) 30 mA (d) Few micro amps
- Q.2. _____ glands need to be provided for all outdoor cables terminations.
- (a) Heavy-duty (b) Brass (c) HMI (d) Double Compression
- Q.3. What temperatures are possible in an Arc flash accident at the Arc?
- (a) 200^o C (b) 1000^o C (c) 19400^oC (d) cannot be measured
- Q.4. Arc flash tested panels will blow the fault.....
- (a) Upwards (b) Sideways (c) both A and B (d) None of the above
- Q.5. Which agents are used for electrical fire quenching?
- (a) CO₂ (b) FM 200 (c) Inert Gases (d) All of above

Section – B

03X02 = 06 Marks

- Q.1. Why is it essential to provide earthing in electrical systems?
- Q.2. What are the benefits of regular visual inspection of electrical equipment?
- Q.3. Describe the hazards from electrical equipment.

Section – C

03X03 = 09 Marks

- Q.1. What safety precautions to be taken when you are carrying out the work in existing electrical installation?
- Q.2. What precautions to be taken for avoiding any electrical fire?
- Q.3. In new projects which pre-commissioning tests to be carried out.





BHARTIYA SKILL DEVELOPMENT UNIVERSITY

School of Electrical Skills

3rd Semester, 1st In-Sem. Examination

B. Voc. Program, Summer Semester (2018-19)

Course Code: ELE1303

Course Name: Safety Electrical Installation Controller

Max. Marks: 20

Section – A

05X01 = 05 Marks

Q.1. Human body can withstand electrical shock up to

- (a) 100 Amps (b) 1 Amp (c) 30 mA (d) Few micro amps

Ans. (c)

Q.2. _____ glands need to be provided for all outdoor cables terminations.

- (a) Heavy-duty (b) Brass (c) HMI (d) Double Compression

Ans. (d)

Q.3. What temperatures are possible in an Arc flash accident at the Arc?

- (a) 200^o C (b) 1000^o C (c) 19400^o C (d) cannot be measured

Ans. (c)

Q.4. Arc flash tested panels will blow the fault.....

- (a) Upwards (b) Sideways (c) both A and B (d) None of the above

Ans. (a)

Q.5. Which agents are used for electrical fire quenching?

- (a) CO₂ (b) FM 200 (c) Inert Gases (d) All of above

Ans. (a)

Section – B

03X02 = 06 Marks

Q.1. Why is it essential to provide earthing in electrical systems?

Ans. Earthing is the main avenue of safety in electrical systems. Proper earthing not only provides safety from shocks, it also provides stability to voltages, does not allow voltages to vary beyond certain limit, and aids protection provisions in solidly earthed system. Hence it is essential to provide proper earthing system.

Q.2. What are the benefits of regular visual inspection of electrical equipment?

Ans. Regular visual inspection of electrical equipment will assist in determining whether it is electrically safe. Visual inspection of electrical equipment may involve, in part:

1. looking for obvious damage, defects or modifications to the electrical equipment, including accessories, connectors, plugs or cord extension sockets, looking for discoloration that may indicate exposure to excessive heat, chemicals or moisture.
2. Checking that flexible cords are effectively anchored to equipment, plugs, connectors and cord extension sockets, looking for damage to flexible cords
3. Checking that operating controls are in good working order i.e. they are secure, aligned and appropriately identified
4. Checking that covers, guards, etc. are secured and working in the manner intended by the manufacturer or supplier
5. Checking that ventilation inlets and exhausts are unobstructed
6. Checking that the current rating of the plug matches the current rating of the associated electrical equipment.

Q.3. Describe the hazards from electrical equipment.

Ans. Hazards from electrical equipment or installations may arise from:

1. The design, construction, installation, maintenance and testing of electrical equipment or electrical installations
2. Design change or modification
3. Inadequate or inactive electrical protection
4. Electrical equipment being used in an area in which the atmosphere presents a risk to health and safety from fire or explosion, for example confined spaces
5. Type of electrical equipment. For example, 'plug in' electrical equipment that may be moved around from site to site, including extension leads, are particularly liable to damage
6. The age of electrical equipment and electrical installations
7. Work carried out on or near electrical equipment or electrical installations, including electric overhead lines or underground electric services, for example work carried out in a confined space connected to plant or services.
8. Exposure to high electromagnetic fields may also present a potential hazard for workers with some medical conditions, for example pace makers.

Section – C

03X03 = 09 Marks

Q.1. What safety precautions to be taken when you are carrying out the work in existing electrical installation?

Ans. To carry out work in the existing installation requires more attention and precautions to ensure safety. The work can be normal maintenance, repairs or expansion/ upgrading projects. No shortcuts should be taken to save time.

1. In case of such work, permit system or similar system must be established to inform all the stake holders. In case work is to be done in live installation, hot permit should be given to only the trained and authorized technical persons.
2. Use correct drawings
3. Ensure Proper Earthing
4. Disconnect supply to the work area and lock all the handles in 'off' position.
5. Display of proper instruction boards
6. Inform all the stake holders
7. Check all the back feeding possibilities
8. Switch off mode for all switchgears
9. Allow only authorized personnel
10. Avoid working in live installation as far as Possible.
11. Use of proper safety equipment

Once all work is completed; Make sure all the power and control connections are place and are tightened properly. Check disconnected cables in particular.

Remove all the tools, unused material, scrap, nut bolts etc. from the work area particularly from the panels, DB's and transformer cable boxes. May accidents happen due to tools left on bus bars.

Check the earthing connections. Remove the phase neutral earthing if done.

Take all the basic tests required for the installation health check. Do not avoid testing even if the installation was working prior to carrying out the work.

Q.2. What precautions to be taken for avoiding any electrical fire?

Ans. Any fire causes immense loss of property and life. Hence, due care should be taken to minimize the risk of fire so that fire does not start. Same is true in case of electrical fire.

If due care is taken while selecting equipment and installation methods, the possibility of electrical fire can be reduced to a very large extent.

Proper Material

Selection of Good Quality and proper material is essential as cheap and low quality material may not have good electrical & mechanical properties.

These can lead to faults. Also, new fire retardant, fire retardant low smoke or Halogen free fire resistant cables, wires are available. These can be used in high density areas. These materials emit lower smoke and also resist the propagation of fire.

Proper Installation Method

All openings in walls, beams, slabs used for carrying electrical systems/ cables/ wires etc. from one area to another must be sealed by fire retardant/ fire resistant material.

This can stop propagation of fire from one area to another. Vertical shafts in buildings must also be sealed at every level.

This stops the smoke from moving up as smoke is a major reason for fatalities in any fire.

Electrical Protection

Restrict electrical faults in the form of over load, short circuit protection, gas operated relays, over voltage protection, proper earthing and surge arrestors, earth leakage relays.

Necessary protections as demanded by IS standards need to be employed at every level right from substation.

Proper selection of switch gear, EF and OC relays, relay settings, proper rating in terms of current carrying capacities & breaking capacities of MCCB's & MCB's exact OC relay ranges for motor feeders, Earth leakage detection devices where ever required should be employed.

All these protections either preempt the tripping before actual disastrous faults or restrict the electrical faults there by restricting damage to equipment and avoid fire.

Elaborate Pre-Commissioning testes of Pre-commissioning testing of entire electrical installation including continuity, insulation resistance.

Insulation strength, physical and functional checks, earthing resistance need to be done properly and as recommended.

Faulty material and installation can be detected prior to commissioning in most cases if proper testing is done. This avoids accidents both electrical & fire.

Q.3. In new projects which pre-commissioning tests to be carried out.

Ans. Pre-commissioning tests as per standards and manufacturers recommendations have to be done to ensure correctness of installation and health of equipment after installation.

These tests help identifying flaws/ problems in the installation if present, that can lead to a faults and consequent accidents, fire during commissioning or operations.

These tests are particularly important for HT equipment and installation and once successful, indicate healthiness of system.

These tests will generally include.

- Insulation resistance for all equipment & cables
- Pressure testing of HT cables
- Earth resistance
- Functional tests including interlocks
- Relay setting & testing
- Phase sequence.
- Continuity of phases, neutral & earth.
- HV test.

It will be advisable if testing of HT installation including relay testing is carried out by independent testing agency.

Do not avoid proper testing to save time. This can lead to much larger time wastage and monetary losses along with increased possibility of fatal accidents.