Important suggestions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance.
4) While assessing figures, examiner may give credit for principle components indicated in a figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) Some of the questions are not clearly indicative of the exact answer expected. In such cases, credit may be given by judgment of relevant answer based on candidate's understanding.

**Page No: 1 to 20 Model Answer Paper Solution and Page No: 21 to 22 Question Paper & Summery of Marking Scheme**

**Q.1 A) Attempt any Six of the following**

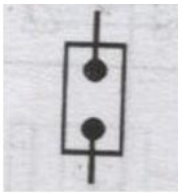
**a) State the I.E rule 29.** **(2 Marks)**

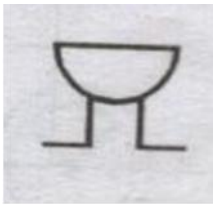
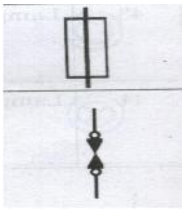
**Rule 29:-** Construction, Installation, protection, operation and maintenance of electrical supply lines and apparatus.

All electrics supply lines and apparatus shall be of sufficient in mechanical strength and size for the work they may be required to do and shall be conducted, install and protected in accordance with I.S.I,s specifications.

**b) Draw the symbols for:-** **( Each symbol 1/2 Marks)**

**Neutral link** **Earth** **Buzzer** **Fuse**



**c) State the important function of ELCB and its long form.**

**(Function-1 Mark & Long form-1Mark)**

- **Function of ELCB:-** Protect circuit from earth fault.
- **Long form of ELCB:-** Earth Leakage Circuit Breaker

**d) State the sub circuit rule for designing lighting circuit (load) and power circuit (power load)** **( Each circuit 1 Marks)**

**Lighting Circuit (load):-**

- Each sub circuit should not have more than a total 10 points (including lights, fans and 5A socket outlet)
- Each sub circuit should not exceed 800 watts.

**Power Circuit (load):-**

- For power load there should be maximum 3000W for 2 to 3 points.
- For power load there should be maximum 1000W for total 1 to 2 points. (old rule)

**e) Define the term "Tender'.** **(2 Marks)**

**Tender:-**

Tender is offer or invitation of the work between any two parties. This offer may be written or non written. This offer is given by party no.1 (owner) to party no.2 (contractor- who have to complete the work).

**f) Define the term "Contractor'.** **(2 Marks)**

**Contractor:-**

Contractor is the person or group of persons or any company who have accepted the challenge for completion of the project work by accepting the all tender conditions with legal agreement from party no.1 (owner).

**g) List different tests before commencement of supply to an installation**

**(2- Marks any two test expected)**

i) Insulation resistance test between conductors.

ii) Insulation resistance test between conductor and earth.

iii) Earth resistance test

iv) Short circuit test

v) Polarity test

vi) Earth continuity test

**h) Classify Electrical installation.**

**(Main type -1 Mark & Application type-1 Mark any one each type expected)**

**Main Types:- A) Internal installation b) External Installation**

**As per the application wise** i) Residential Installation

ii) Commercial Installation

iii) Industrial Installation

**B) Attempt any Two of the following----------8 Marks**

**a) State four important rules to be followed for service connection (Each rules-1 Marks)**

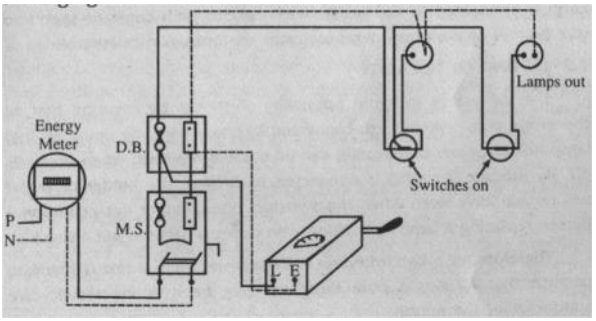
**Important Rules for service connection:- (Any Four rules expected)**

i) All electrical supply lines wires, fittings and apparatus belonging to him should be in consumer premises.
ii) The cut-out for the service line must be earthed.
iii) The neutral should be earthed.
iv) If the voltage for the service connection is medium, high or extra high voltages then caution notice should be placed near to the main board.
v) The size of the service connection should be proper it should not over heat at rated load.If the load is in between 0 to 1KW then 10 SWG hard drawn copper wire or equivalent service wire is used. If the load is in between the 1KW to 2.5 KW then 8 SWG hard drawn copper or equivalent wires can be used. If the load is in between the 2.5KW then 6 SWG hard drawn copper or equivalent wires can be used as a service wire.
vi) Length of the service connection should be proper to achieve permissible voltage drop (+-5%)
vii) If the connected load is more than 5Kw then three phase is economical and used.etc.

Viii) Ground Clearance for service connection is as per I.E. rule

**b) Explain the testing of the installation for verification of current and circuit continuity.**
**(Figure-2 Mark, Current verification-1 Mark & Verification of continuity-1 Mark)**

**Procedure verification of current and circuit continuity Figure:-**




**Installation continuity test procedure is as follows:-**

1) First make off the main switch.
2) Insert all loads and lamps in their sockets and holders.
3) Make ‘ON’ one by one switch in the installation.
4) Make the connection of Megger as follows,-

L – Line terminal is connected to outgoing phase terminal of main switch.

E – Earth terminal of Megger is connected to neutral terminal of main switch .

5) Rotate the handle of Megger at near about 100 to 120 rpm measure the insulation resistance.

**Conclusion: -** If the measured resistance is zero Ω then there is circuit continuity if this resistance indicates more than zero ohms then there may be loose connection or open.

**Verification of current in the installation:-**

- It is a ON-line test after switched ON the main switch one by one circuit switch is operated and if the lamp glows then circuit is OK and current is verified.

**c) Write precautions against shock (any four)** **(Each Precautions -1 Mark)**

i) Avoid working on live parts and switch them off before starting the work on them.
ii) Insulate yourself on the insulating material like wood, plastic etc before starting the work on live mains. Your hands and feet must be dried.
iii) At the time of working on high voltage be sure that the floor is not made of conductive material, i.e. of concrete etc.
iv) Be sure that any part of your body may not come in contact with the earth, metallic casing, and metal plates or cross arms at the time of working on high voltage.
v) Avoid working at those places where your head is liable to touch the live parts, mains and always make the current off before starting the work, if it is unavoidable.
vi) Always use your feet with your shoes wear on, rather your hand at the time of removing the person from shock, if any insulated material is not available.
vii) Do not forget to put on safety belt before starting work above ground level.
viii) Rubber mats should be placed in front of electrical bands and switch boards.

**Q.2 Attempt any Four---------- 16 Marks**

**a) State the necessity of earthing and factors deciding earth resistance.**
**(Necessity-2 Marks & Factor of earth resistance- 2 Marks)**

**Necessity of earthing:-**

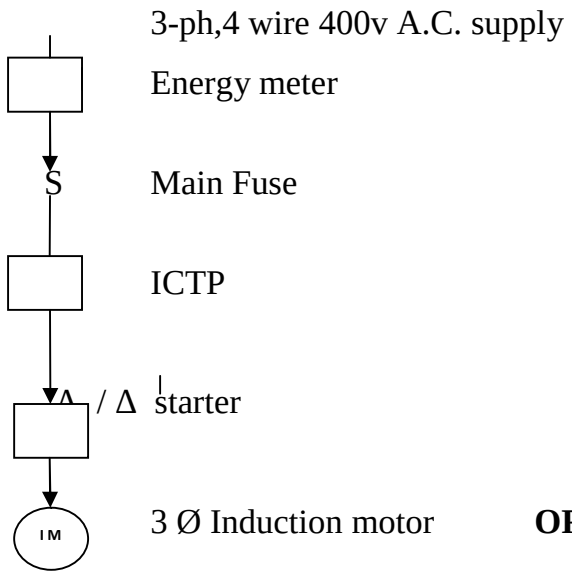
- Earthing is protects human from shocks.
- Earthing provides protection to the electrical machinery due to leakage current.
- Earthing provides protection to Tall Building & structure against lightening stroke

**Factors deciding earth resistance**

- Material of earth electrode and earth wire.
- Size of earth electrode and earth wire.
- Temperature of the soil surrounding the earth electrode.
- Moisture of the coil surrounding the earth electrode.
- Depth of earth electrode in the earth.
- Quality & Quantity of coal and charcoal in the earth electrode pit.

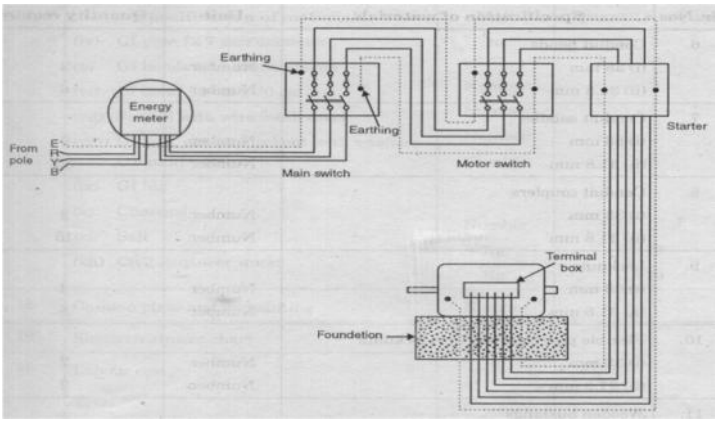
**b) Draw and label single line diagram for 3-phase induction motor connected to supply with star-delta starter.** **(4 Marks)**

**Single line diagram -**




**OR**

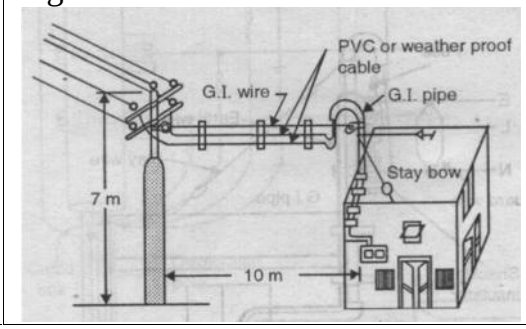
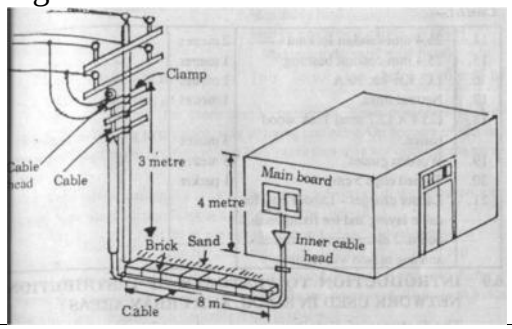
**Wiring diagram –**




**c) Compare overhead and underground service connection.**

**(Expected any Four Point-1 Mark each point)**

| S.No | overhead service connection | underground service connection |
|---|---|---|
| 1 | It is economical. | Cost is more |
| 2 | It is open to sky so repairing and Maintenance is more | Repairing and maintenance is less |
| 3 | Appearance is poor. | Appearance is good |
| 4 | Normally it is preferred for consumers. | Normally it is preferred for Residential commercial And Industrial consumers |
| 5 | PVC or weather proof cable or conductors are preferred | Armored cables are preferred |

| | | |
|---|---|---|
| 6 | Less safety | More safety |
| 7 | Fig:   | Fig:   |

**d) List the names of different types of contract (any 8)** **(Each types 1/2 Marks)**

**Different types of contract:-**

1) Lump sum contract
2) Item rate contract
3) Cost + % rate contract
4) Target rate contract
5) Material supply contract
6) Labour contract
7) Sub contract
8) All in one contract
9) D.G.S. of 'D' rate contract
10) Cost plus(+) percentage variable rate contract
11) Cost plus(+) fluctuating fees rate contract

**e) State the sequence to be followed to prepare estimate of factory unit.** **(4 Marks)**

**Sequence to be followed for estimation of factory unit:-**

1) Find out output power of every machine in watts.
    1) 1 HP = 735.5 w
    2) 1 BHP = 746 w
    3) 1 KVA = 1000 VA. Assume P.f.
2) Find out Input power of every machine by assuming the efficiency of every machine.

$$\text{Input power of machine} = \frac{\text{output power of machine}}{\text{Efficiency of machine}}$$

3) Find out Input current of every machine for 1-ph machine.

Input power = V I cos ¤

V = Input voltage = 230V

Cos ¤ = P.f.

I = Input current

If the machine is 3-ph

Input power = $\sqrt{3}$ $V_L$ $I_L$ cos ¤

$V_L$ = Line voltage = 400V

$I_L$ = Line current or Input current

Cos ¤ = P.f.

4) Find out size and core of cable required for every machine size of cable is decided by starting current. Which is assumed two times Input current to sustend starting surge, overload momentary short circuit and future expansion.
5) Find out total Electrical load of given factory.
6) Determine the Input current required for whole factory.

$P = \sqrt{3} V_L I_L \cos Ø$

7) Determine the size & core of Input cable required for whole factory. To decide the size of current is assumed two times rated Input current for future expansion, overload starting surge and momentary short circuit.
8) List out the material required for factory electrification.
9) Make the estimation chart for material and labour also.
10) Find out total cost of estimation by assuming contingencies changes and profit margin.

**f) Compare MCB and ordinary fuse.** **(Expected any four point-1 Mark each point)**

| S.No | MCB | Ordinary Fuse |
|---|---|---|
| 1 | Miniature circuit breaker operates automatically at the of fault or over load | Ordinary fuse melts automatically at the of fault or over load |
| 2 | The cost of the MCB is more | Cost of the fuse is less |
| 3 | There is no need of replacement after tripping the MCB | Fuse must be replaced after the fault |
| 4 | MCB are designed for separate current rating | In the fuses there three types a) Kit kat fuse b) Glass fuse c) HRC fuse |
| 5 | MCB operates on heating effect on bimetallic strip | Fuse melts thermal effect |

**Q.3 Attempt any Two---------- 16 Marks**

**a) Given Data:- ( The Assumed data may be vary) (Give stepwise Marks as mention below)**

1) Total power load = 10 x 500W = 5000W &

2) Total Lighting load = 25 plug point x 100 = 2500 W
30 light point x 40 = 1200 W
30 fan point x 60 = 1800 W

**Total load = 5500 V for 85 Points---------- (1 Mark)**

Total load = total power point load + total lighting load

Total load = 5000 + 5500 = 10500 W = 10.5 KW---------- **(1 Mark)**

$$I_L = \frac{P}{\sqrt{3}\, V_L Cos¤} \qquad Assumention\ Cos¤ = 1$$

$$I_L = \frac{10500}{\sqrt{3} \times 400 \times 1}$$

$$I_L = 15.15\ Amp$$

$$\text{No. of Power sub circuit} = \frac{5000}{1000W\ or\ 2000W}$$

**Power sub circuit = 5 or 2.5 ---------- (1 Mark)**

$$\text{No. of lights sub circuit} = \frac{5500}{800} = 6.75 \cong 7\ Nos$$ ---------- **(1 Mark)**

$$\text{No. of lighting sub circuit as per point} = \frac{85}{10} = 8.5 \cong 9\ Nos$$

**Sub circuit is suitable for lighting = 9---------- (1 Mark)**

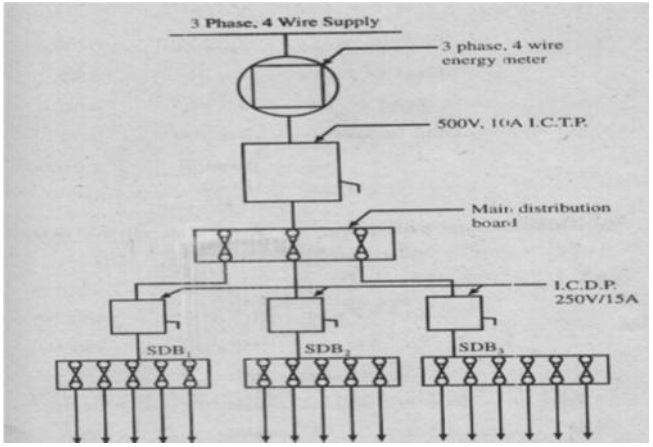
Total Power + lighting = 3+ 9 = 12 sub circuits to be distributed over 3 phases.

R-Phase = 1 p + 3L = 4 sub circuit---------- **(1 Mark)**

Y-Phase = 1 p + 3 L = 4 sub circuit---------- **(1 Mark)**

B-Phase = 1 p + 3L = 4 sub circuit

**Single line diagram:- ----------(1 Mark)**




**b) Given Data:- ( The Assumed data may be vary) (Give stepwise Marks as mention below)**

$4$ *ligthing circuit* $= 4 \times 800 = 3200\,W$ *or* $3.2\,KW$ , ---------- **(1 Mark)**

$2$ *power sub – circuit* $= 2 \times 2000 = 4000\,W$ *or* $4\,KW$ ---------- **(1 Mark)**

*Total load connected* $= 3.2 + 4 = 7.2\,KW$ ---------- **(1 Mark)**

*Assu* min *g* sup *ply voltage* $1-$ *ph,* $230V, 50Hz,$ & *Cos¤* $= 1$ *and height of bunglow is* $3\,m$ ---- **(1 Mark)**

*The rated current for service wire or input conductor* $= \frac{P}{V}$ ---------- **(1 Mark)**

*The rated current for service wire or input conductor* $= \frac{7.2}{230}$

*The rated current for service wire or input conductor* $= \frac{7200}{230}$

*The rated current for service wire or input conductor* $= 31.30$ *Amps* ---------- **(1 Mark)**

So use 10 Sqmm PVC insulated cable as a service wire or 6 SWG hard drawn copper wire as service wire or 7/16 SWG PVC wire . The schedule of material is as follows. ---------- **(1 Mark)**

**Schedule of material :-** ----------**(1 Mark)**

| S.No | Schedule of Material | Quantity |
|---|---|---|
| 1 | PVC insulated cable or insulated wire | 15 mm ( 1.5 times of 10 m) |
| 2 | S shaped G I pipe 50 mm diameter | 10 m |
| 3 | Earth wire 8 SWG | 20 m |
| 4 | Meter board | 01 Nos. |
| 5 | Stay wire | 10 m |
| 6 | Stay insulator | 01 Nos. |
| 7 | cement | 01 Bag |
| 8 | sand | 01 Bag |
| 9 | Miscellaneous | |

**c) Prepare a plan and estimate for providing electrical installation to a one BHK residential unit with WC and bath. Write the necessary assumption.** **(8 Marks)**

**Design consideration of electrical installation in 1 BHK Residential Unit:-**

1) Find out the type of load and total electrical load for the given residential installation.

2) Differentiate this total electrical load in lighting load and power load.

3) Make the no. of lighting sub circuit for lighting load.

No. of lighting sub circuit = $\frac{\text{Total electrical lighting load}}{}$

$$\text{Or}$$

$$\text{No. of lighting sub circuits} = \frac{\text{Total no. of lighting point}}{10}$$

4) Make the no. of power sub circuits for power load.

$$\text{No. of lighting sub circuits} = \frac{\text{Total electrical power load}}{\text{1000 w or 2000w}}$$

$$\text{Or}$$

$$\text{No. of power sub circuits} = \frac{\text{Total no. of power points}}{\text{1000w or 2000 w}}$$

5) Find out total power consumption of every lighting and power sub circuits.

6) Find out rated Input current for every lighting and power sub circuit.

$P = V1 \cos ¤$ P = Input power for every sub circuit

V = voltage = 230 V

I = Input current for every sub circuit

7) Determine the size of wire required for every sub circuit by considering overload starting surge and future expansion.

8) Draw the single line diagram.

9) Mark the batten on plan layout.

10) Find out the total length batten required for every sub circuit and whole residential installation.

11) Find out the total length and size of wire required for every sub circuit.

12) List out the material required for whole residential installation.

13) Find out cost of material and labour in estimation chart.

14) Find out the total cost of estimation with profit margin and contingencies charges.

15) Find out per point charges.

16) Draw the circuit diagram.

**Q.4 Attempt any Four---------- 16 Mark**

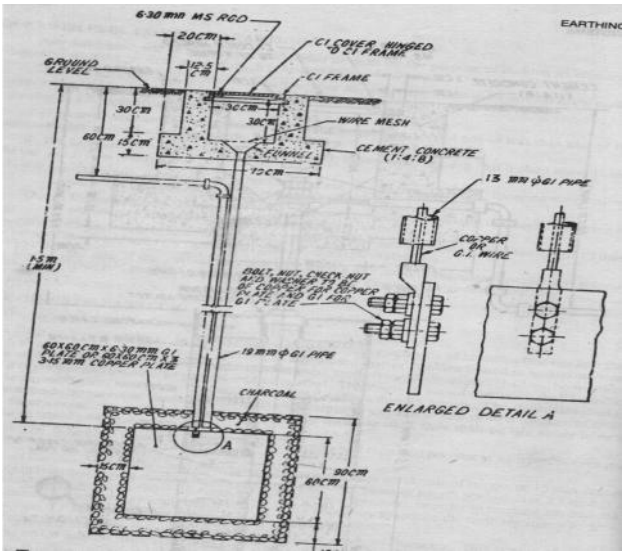
**a) What are the general requirements of residential installation?**

**(Expected Four Point-1 Mark each point)**

**Requirement of residential installation:- (Any Four Expected)**

i) Light & power sub circuits should be separately provided.
ii) Switches & fuses should be located in live wire.
iii) Earthing should be provided with earth wire of 18 SWG copper or 16 SWG GI wire.
iv) Socket outlets should be of 3 pin type.
v) Switch board should be mounted at the height of 1.2 m to 1.3 m above the ground surface.
vi) The wire should carry rated current without overheating.
vii) All safety precautions for example. Fuse, MCB, ELCB should be installed.
Similar these any point

**b) Draw a neat sketch of plate earthing and label it.** **(4 Mark)**



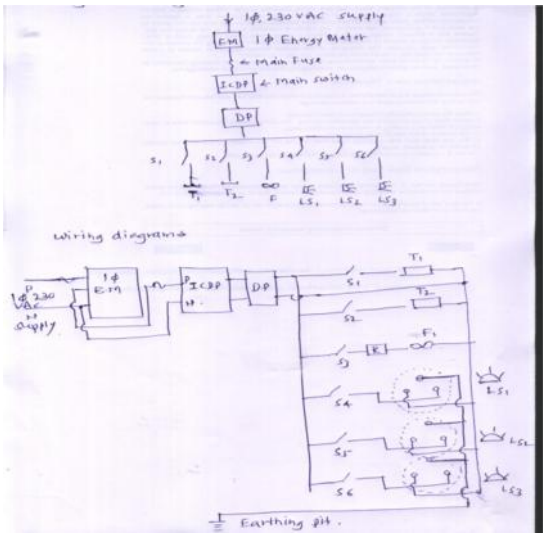

**c) State the design considerations to prepare estimate for a factory installation**

**(Expected Four Point-1 Mark each point)**

**Design consideration to prepare estimate for a factory installation:-**

i) Input current of the motor
ii) Selection of size of cable and conduit
iii) Determination of rating of fuse
iv) Selection of rating of main switch
v) Distance between Main board and control board
vi) Type of supply for every machine
vii) Earthing type and its size

**d) Given Data :-** **(4 Marks)**




**or equivalent figure**

**e) Explain the meaning of earnest money deposit and security deposit. (Each meaning -2 Mark)**

**Earnest Money deposit (EMD) :-** **(2 Marks)**

EMD is a deposit taken as a guaranty from the bidder if the tender is accepted by the owner and if the contractor ( bidder) refuses to accept that work in that case the EMD is not returned to that party it is generally 2 to 5 percent estimated cost. It is refundable to every successful bidder.

**Security Deposit (SD):-** **(2 Marks)**

Security deposit is amount or deposit given by the contractor to the owner till satisfactory completion of the project work. Generally it is a 5 to 10 % of the total estimated cost.

**f) What is meant by bus-bar? Give its function**

**(Explanation-2 Mark, Figure-1 Mark & Function-1 Mark)**

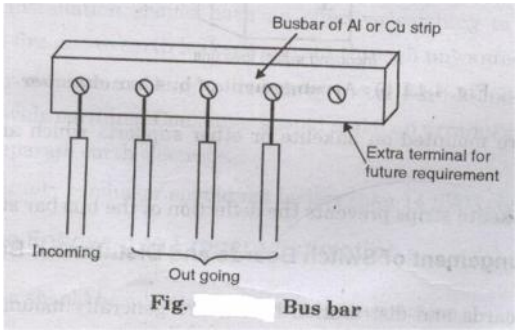



Fig. Bus bar

**or equivalent figure**

The electrical load of commercial installation is large therefore 3-phase 4 wire power service connection is provided to satisfy the requirement of the entire load. Thus to distribute the load on this 3-phase four wire system, bas-bar chamber is used. Bus-bar is a copper or aluminum conductor (strip) to which number of inputs and number of outputs can be connected.

Incoming and outgoing wires or cables are connected to bus-bar by screw and nut arrangement.

**OR**

Bus bar is arrangement of Copper or Aluminum strips to distribute load from 3-ph, 400 V, 4 wire, system to satisfy requirement of entire load.

It consists of 4 bus bar strips made by copper of aluminum, incoming SFU and free outgoing SFU. It is mounted on the Bakelite insulators / strips

**Function of Bus-bar**: - Distribute the load on 3-phase four wire system.

**Q.5 Attempt any Two: ----------16 marks**

**a) Given Data: - (The Assumed data may be vary)** **(Give stepwise Marks as mention below)**

Assuming height of Ceiling if 3 m from the floor.

Motor is installed 1 M away from the nearest wall.

Height of Main Switch is 1.2 M from the floor

**Step No. 1:-** The out power of induction motor = 5 x 735.5 = 3677.5 W---------- **(1 Mark)**

**Step No. 2:-** Input power of I. M = output power of I M / efficiency of IM motor. --------- **(1 Mark)**

Assuming efficiency of I.M is 80 %

Input power of induction motor = 3677.5 / 0.8 = 4596.87 W

**Step No. 3:-** To determine the rated current for I.M ---------- **(1 Mark)**

$$P = \sqrt{3}\, V_L\, I_L Cos¤ \qquad V_L = 400\, V$$

$$I_L = \frac{P}{\sqrt{3}\, V_L Cos¤}$$

$$I_L = \frac{4596.87}{\sqrt{3} \times 400 \times 0.8} \qquad Cos¤ = 0.8\ assumption$$

$$I_L = 8.293\ Amp \qquad Rated\ current = 8.293\ Amps$$

**Step No. 4:-** To determine the size & core of cable:- ---------- **(1 Mark)**

Starting current is assumed two times rated input current for starting surge, momentary short circuit & overload. Starting current = 2 x 8.293 = 16.586 Amps

So use,

2.5 Sqmm 3 ½ core cable or 4core cable for the I.M.

**Step No. 5:-** Determined the size length & dimensions of ICTP earth wire at input cable:- **(1 Mark)**

The rating of main switch is 450 V, 20 Amp ICTP ISI mark

Size of earth wire 8 SWG copper or 6 SWG GI

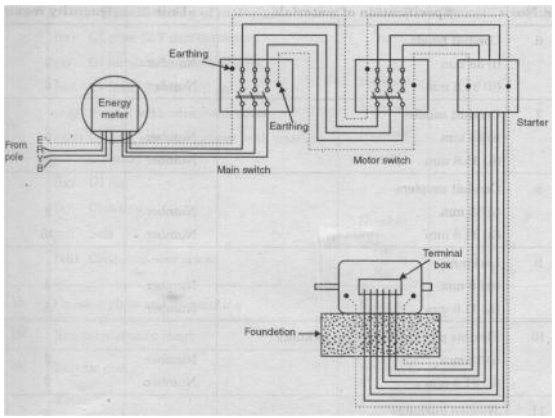
Length of earth wire = 2 times length of cable

Length of input cable for I .M at actual

**Step No. 6:-** Find out the estimation chart with material cost & labour cost: ---------- **(2 Mark)**

**Length of cable - it should be calculated as per their assumed distances**

**Step No. 7:** Draw the circuit Diagram. ---------- **(1 Mark)**




**or equivalent figure**

**b) Given Data: (The Assumed data may be vary)** **(Give stepwise Marks as mention below)**

$$Total\ load\ in\ \ Hall = tubes \times watt\ \ = 12 \times 40 = 480\ W$$

$$= Fans \times watt\ \ = 06 \times 60 = 360\ W$$

$$= Sockets \times watt = 03 \times 100 = 300 W$$

$$Total\ load\ in\ \ Hall = tubes\ in Watt + Fans\ in Watt + Socket\ in\ watt$$

$$Total\ load\ in\ \ Hall = 480 + 360 + 300 = 1140\ watt$$ ---------- **(1 Mark)**

$$Total\ load\ in\ \ Amps = \frac{1140}{230} = 4.956 \cong 5\ Amp \quad assu\min g\ \ p.f. = 1$$

Rating main switch: - since more current is 5 A.

Assumed that Staring current = 1.5 times rated current

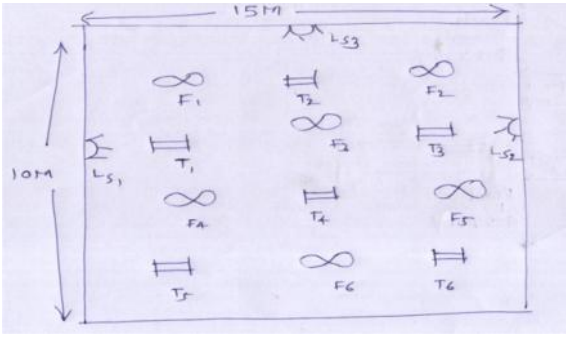
So starting current = 1.5x 5 = 7.5 A

So Use:-

240V, 16A, ISI mark Main switch of any company

$$No.\ of\ \ lighting\ sub\ circuit = \frac{1140}{800} = 1.425 \cong\ 2$$ ---------- **(1 Mark)**

**Layout Drawing:-** **(2-Marks)**




**or equivalent figure T= Double Tube Set**

**Note:- Cost of material may vary so do not stick on final figures**

**Schedule & cost of Material: -** **(4-Marks)**

| S.No | Material of Material | Quantity | Rate | Total Amount |
|---|---|---|---|---|
| 1 | ICDP 250V,16A | 01 | 250.00 | 250.00 |
| 2 | Fuses 250V, 16A | 02 | 45.00 | 90.00 |
| 3 | PVC conduit | 30 app. | 22.00 | 660.00 |
| 4 | Copper Earthing Plate | 01 | 490.00 | 490.00 |
| 5 | Earth Wire 18 SWG Cu. | 60 Mtr app. | 03.00 | 180.00 |
| 6 | DP | 01 | 80.00 | 80.00 |
| 7 | Earthing Sundry | lumsum | 200.00 | 200.00 |
| 8 | 6A S.P.S.T. | 21 | 10.00 | 210.00 |
| 9 | 6A Three point socket | 03 | 12.00 | 36.00 |
| 10 | Ceiling rose | 18 | 08.00 | 144.00 |
| 11 | 1/18 SWG Copper wire | 02 Bundle | 230.00 | 460.00 |
| 12 | Labour Charges | 21 | 35.00 | 735.00 |
| | | **Total Amount :-** | | **3535.00** |
| 13 | Contingencies+ profit margin | 10% Amount:- | | 353.50 |
| | | **Total Amount:-** | | **3888.50** |

**c) Explain the design consideration of electrical installation in commercial building (8 Marks)**

**Design consideration of electrical installation in commercial building:-**

1) Find out the type of load and total electrical load for the given commercial installation.
2) Differentiate this total electrical load in lighting load and power load.
3) Make the no. of lighting sub circuit for lighting load.

$$\text{No. of lighting sub circuit} = \frac{\text{Total electrical lighting load}}{800\ \text{w}}$$

Or

$$\text{No. of lighting sub circuits} = \frac{\text{Total no. of lighting point}}{10}$$

4) Make the no. of power sub circuits for power load.

$$\text{No. of lighting sub circuits} = \frac{\text{Total electrical power load}}{1000\ \text{w or } 2000\text{w}}$$

Or

$$\text{No. of power sub circuits} = \frac{\text{Total no. of power points}}{1000\text{w or } 2000\ \text{w}}$$

5) Find out total power consumption of every lighting and power sub circuits.

6) Find out rated Input current for every lighting and power sub circuit.

P = V1 cos¤ P = Input power for every sub circuit

V = voltage = 230 V

I = Input current for every sub circuit

7) Determine the size of wire required for every sub circuit by considering overload starting surge and future expansion.
8) Draw the single line diagram.
9) Mark the batten on plan layout.
10) Find out the total length batten required for every sub circuit and whole commercial installation.
11) Find out the total length and size of wire required for every sub circuit.
12) List out the material required for whole commercial installation.
13) Find out cost of material and labour in estimation chart.
14) Find out the total cost of estimation with profit margin and contingencies charges.
15) Find out per point charges.
16) Draw the circuit diagram.

**Q.6 Attempt any Four: ----------16 Marks**

**a) Compare residential and commercial installation:**

**(Expected any four point-1 Mark each point)**

| S.No | Basis | Residential installation | Commercial installation |
|---|---|---|---|
| 1 | Load capacity | Less | High |
| 2 | Input Supply | Generally single phase | Generally 3 phase |
| 3 | Purpose | Domestic purpose | Commercial purpose |
| 4 | Type of Load | Lighting load is more, power load is less. | Power load is more, lighting load is less. |
| 5 | Distribution | Bus bar chamber is not required | Bus bar chamber is required |
| 6 | Safety precautions | It is not public place so as per our convenience fuse MCB can be used. | It is public place so fuse MCB, MCCB should be compulsory used. |
| 7 | Sub-circuit | The lighting sub-circuit and power sub-circuit are separated | The lighting sub-circuit and power sub-circuit are separated |

| | | | |
|---|---|---|---|
| 8 | Power factor improvement | There is no need of power factor improvement device | If the power factor is poor then there is need of power factor improving device |
| 9 | Caution | There is no need of caution notice for residential installation | If supply voltage is equal to or more then 400V then there is need of caution notice |

**b) Explain procedure for submission of 'tender'** **(4 Marks)**

**Procedure:-**

- The system of submitting tender documents is also called as two envelope system.
- The treasury challan, deposit, call receipt, forwarding letter the copies of registration certificate, income tax clearance certificate, and list of machinery to be used to be sealed in one envelope.
- The tender set itself with quoted value should be sealed in another envelope: these two sealed envelopes should again be put in one coverer and sealed. On the top of this cover, the name of the work, address of the receiving authority should be written. These envelopes are then handed over in person or send by post to the address mentioned before the specified time and date.

**c) Explain how rating of cables and fuses are decided for motor installation.**

**(Rating point -2 Mark and Procedure – 2 Mark)**

**Ratings of cables & fuses are decided by the following points:-**

- Type & Capacity of motor which is used in the installation.
- Supply providing to the motor which is used in installation.
- Power factor of the motor.
- Future expansion.
- Starting surge, over load and momentary short circuit on the motor.

**The procedure is as follows:-**

$$Total\ \ power = Total\ H.P \times 735.5$$

$$Total\ \ power = ..... watt$$

$$Rated\ input\ current\ I_L = \frac{HP \times 735.5}{\sqrt{3}\, V_L \times \text{¦} \times Cos\text{¤}}$$

$$Rated\ input\ current\ I_L = \frac{..... \times 735.5}{\sqrt{3} \times 415 \times efficency \times P.f}$$

$$= \ldots\ldots\ldots \text{ Amp}$$

It is assumed that starting current is two times rated input current.

Starting current = 2 x …….. = …….. Amp by this ampere rating the size and type of cable is decided. The fuses are also selected for this current.

**d) Given Data: - (The Assumed data may be vary)** **(Give stepwise Marks as mention below)**

Assuming P.f. of motor 0.85 & η = 0.8

$$Total\ power = Total\ H.P \times 735.5$$

$$For\ Machine\ No.1\ Rated\ input\ current\ I_L = \frac{HP \times 735.5}{\sqrt{3}\, V_L \times ¦ \times Cos¤}$$

$$Rated\ input\ current\ I_L = \frac{5 \times 735.5}{\sqrt{3} \times 415 \times 0.85 \times 0.8}$$

**Current in Motor No. 1:- = 7.524 Amp ---------- (3 Marks)**

It is assumed that starting current is two times rated input current.

Starting current = 2 x 7.524 = 15.04 Amp

So use, 2.5 Sqmm , 3 ½ core cable Aluminum 1/ 2.80 mm , 600V grade should be selected rating of SFU, ICTP switch is 16A, 450V grade should be selected.

Assuming p.f. of motor 0.85 & η = 0.8

$$Total\ power = Total\ H.P \times 735.5$$

$$For\ Machine\ No.2: Rated\ input\ current\ I_L = \frac{HP \times 735.5}{\sqrt{3}\, V_L \times ¦ \times Cos¤}$$

$$Rated\ input\ current\ I_L = \frac{3 \times 735.5}{\sqrt{3} \times 415 \times 0.85 \times 0.8}$$

**Current in Motor No. 2:- = 4.514 Amp ---------- (3 Marks)**

It is assumed that starting current is two times rated input current.

Starting current = 2 x 4.514 = 9.029 Amp

So use, 1.5 Sqmm , 3 ½ core cable Aluminum 1/ 2.80 mm , 600V grade should be selected rating of SFU, ICTP switch is 16A, 450V grade should be selected.

Assuming p.f. of motor 0.85 & η = 0.8

$$Total\ power = Total\ H.P \times 735.5$$

$$For\ Machine\ No.3: Rated\ input\ current\ I_L = \frac{HP \times 735.5}{\sqrt{3}\, V_L \times ¦ \times Cos¤}$$

$$Rated\ input\ current\ I_L = \frac{1 \times 735.5}{\sqrt{3} \times 415 \times 0.85 \times 0.8}$$

**Current in Motor No. 3:- = 1.504 Amp ----------(2 Marks)**

It is assumed that starting current is two times rated input current.

Starting current = 2 x 1.504 = 3 Amp

So use, 0.5 Sqmm , 3 ½ core cable Aluminum 1/ 2.80 mm , 600V grade should be selected

rating of SFU, ICTP switch is 8A, 450V grade should be selected.

**Rating of main switch for all motors:-**

Rating of main switch for all motors = staring current of highest rated m/c + Full load current of all remaining machines

Rating of main switch for all motors = Staring current of 5 H.P + Full load current of 3 H.P & 1 H.P

= 15.04 + 4.514+1.504

Rating of main switch for all motors = **21.058 Amp**

Main switch for all Motors is selected 32A, 500V, ICTP used

**e) List eight example of commercial installation.**

**(Any Eight Point expected-each point 1/2 point)**

Example of commercial Installation:

1) Hospital
2) Schools
3) Colleges
4) Banks
5) Shopping malls
6) Large temples
7) Auditorium
8) Cinema theaters
9) Showrooms etc.

**f) Draw a sketch of pipe earthing:-** **(4 Marks)**

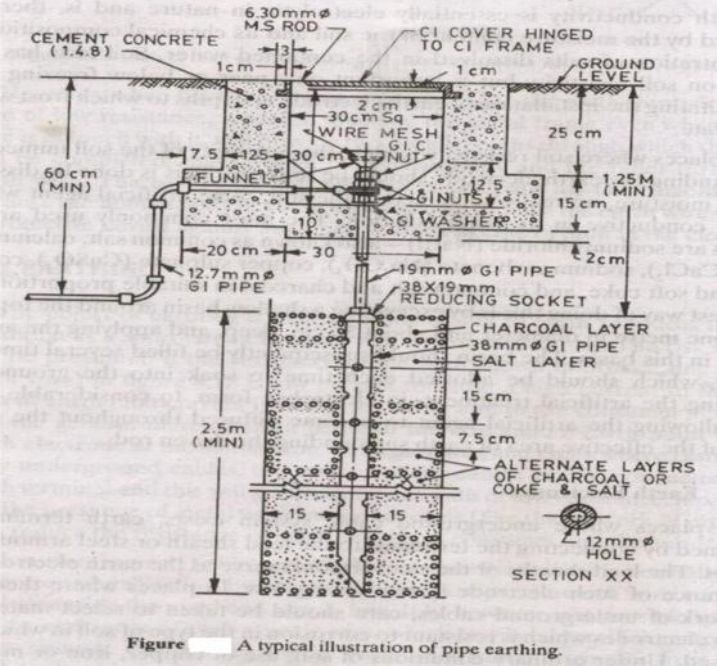



**Figure** A typical illustration of pipe earthing.

**END**

**Page No: 21 to 22 Question Paper & Summery of Marking Scheme**

**Q.1 A) Attempt any Six of the following**

a) State the I.E rule 29. **(2 Marks)**

b) Draw the symbols for:- **( Each symbol 1/2 Marks)**

c) State the important function of ELCB and its long form.
**(Function-1 Mark & Long form-1Mark)**

d) State the sub circuit rule for designing lighting circuit (load) and power circuit (power load)
**( Each circuit 1 Marks)**

e) Define the term "Tender'. **(2 Marks)**

f) Define the term "Contractor'. **(2 Marks)**

g) List different tests before commencement of supply to an installation
**(2- Marks any two test expected)**

h) Classify Electrical installation.
**(Main type -1 Mark & Application type-1 Mark any one each type expected)**

**B) Attempt any Two of the following----------8 Marks**

a) State four important rules to be followed for service connection **(Each rules-1 Marks)**

b) Explain the testing of the installation for verification of current and circuit continuity.
**(Figure-2 Mark, Current verification-1 Mark & Verification of continuity-1 Mark)**

c) Write precautions against shock (any four) **(Each Precautions -1 Mark)**

**Q.2 Attempt any Four---------- 16 Marks**

**a**) State the necessity of earthing and factors deciding earth resistance**.**
**(Necessity-2 Marks & Factor of earth resistance- 2 Marks)**

b) Draw and label single line diagram for 3-phase induction motor connected to supply with star-delta starter. **(4 Marks)**

c) Compare overhead and underground service connection.
**(Expected any Four Point-1 Mark each point)**

d) List the names of different types of contract (any 8) **(Each types 1/2 Marks)**

e) State the sequence to be followed to prepare estimate of factory unit. **(4 Marks)**

f) Compare MCB and ordinary fuse. **(Expected any four point-1 Mark each point)**

**Q.3 Attempt any Two---------- 16 Marks**

a) Given Data: **(Give stepwise Marks as mention below)**

b) Given Data: **(Give stepwise Marks as mention below)**

c) Prepare a plan and estimate for providing electrical installation to a one BHK residential unit with WC and bath. Write the necessary assumption.----------**(8 Marks)**

**Q.4 Attempt any Four**---------- **16 Mark**

a) What are the general requirements of residential installation?
**(Expected Four Point-1 Mark each point)**

b) Draw a neat sketch of plate earthing and label it. **(4 Mark)**

c) State the design considerations to prepare estimate for a factory installation
**(Expected Four Point-1 Mark each point)**

d) Given Data :- Figure **(4 Marks)**

e) Explain the meaning of earnest money deposit and security deposit. **(Each meaning -2 Mark)**

f) What is meant by bus-bar? Give its function
**(Explanation-2 Mark, Figure-1 Mark & Function-1 Mark)**

**Q.5 Attempt any Two:** ----------**16 marks**

a) Given Data: **(Give stepwise Marks as mention below)**

b) Given Data: **(Give stepwise Marks as mention below)**

c) Explain the design consideration of electrical installation in commercial building **(8 Marks)**

**Q.6 Attempt any Four:** ----------**16 Marks**

a) Compare residential and commercial installation:
**(Expected any four point-1 Mark each point)**

b) Explain procedure for submission of ‘tender’ **(4 Marks)**

c) Explain how rating of cables and fuses are decided for motor installation.
**(Rating point -2 Mark and Procedure – 2 Mark)**

d) Given Data: **(Give stepwise Marks as mention below)**

e) List eight example of commercial installation.
**(Any Eight Point expected-each point 1/2 point)**

f) Draw a sketch of pipe earthing:- **(4 Marks)**

**END**