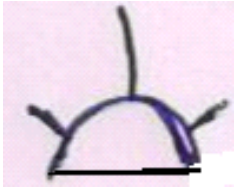
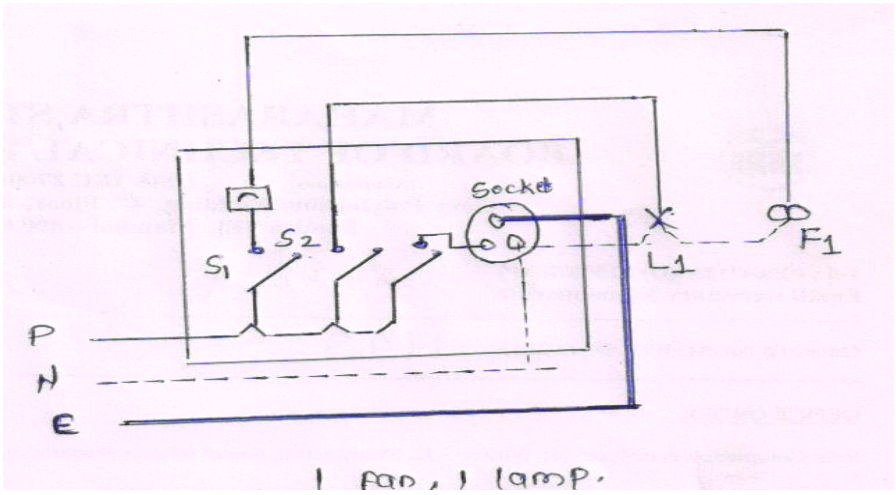
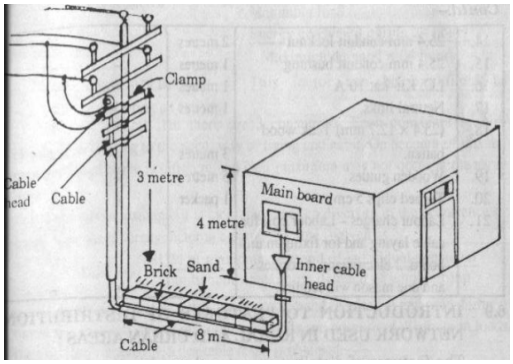
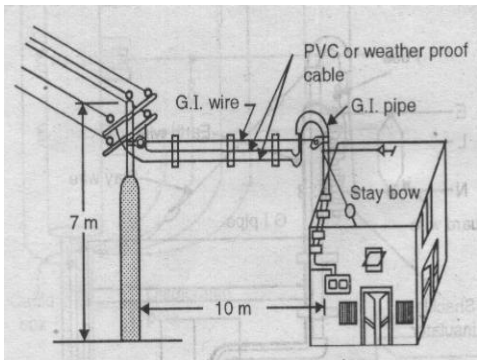
Important suggestions to examiners:

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. (Not applicable for subject English and communication skills)
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) In case some questions credit may be given by judgment on part of examiner of relevant answer based on candidate understands.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1	**Attempt any TEN of the following**	**20 Marks**
a)	**Give classification of Electrical Installation with suitable examples of each**	
Ans:	**Types of Electrical Installation:** **(2 Marks)** i) Internal Electrical Installation : (for example: Any Indoor Installation) ii) External Electrical Installation: (for example: Any Outdoor Installation) **OR** **For example application oriented:** a) Residential Electrical Installation : e.g. Domestic, home wiring b) Commercial Electrical Installation: e.g College, Mall, Hospital c) Industrial Electrical Installation : Small scale industry	
b)	**Draw symbols for lamp exhaust fan, Light socket and bell**	
Ans:	i) Lamp ii) Exhaust Fan iii) Light Socket iv) Bell     **(Each Symbols: 1/2Mark)**	

c)	**Draw Wiring diagram for 1 lamp and 1 fan**
Ans:	**Wiring diagram for 1 lamp and 1 fan** **(2 Marks)** 
d)	**Define service connection with neat diagram**
Ans:	**Service Connection:-** **(1 Marks)** It is the input conductor or wire which is carried out from supply company (authorities) pole to consumers' main board or premises. **Diagram:** **(1 Marks)**  **OR** 
e)	**State general rule for deciding no. of sub circuit for lighting and power circuit.**
Ans:	**General rule for deciding no. of sub circuit for lighting and power circuit:** **Lighting Circuit :-** **(1 Mark)** ➢ 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.

- Make the no. of lighting sub circuit for lighting load.

$$No.\ of\ \ Lighting\ \ Sub\ circuits = \frac{Total\ \ Electrical\ lighting\ \ load}{800\ W}$$ **OR**

$$No.\ of\ \ Lighting\ \ Sub\ circuits = \frac{Total\ \ No.of\ \ lighting\ \ point}{10}$$

Power Circuit :- **(1 Mark)**

- For power load there should be maximum 3000W for 2 to 3 points.
- For power load there should be maximum 2000W for 1 to 2 points. (old rule)
- Make the no. of power sub circuits for power load.

$$No.\ of\ \ power\ \ Sub\ circuits = \frac{Total\ electrical\ \ power\ load}{2000\ W\ or\ 3000\ W}$$

OR

$$No.\ of\ \ power\ \ Sub\ circuits = \frac{Total\ \ No.of\ \ power\ \ points}{2000\ W\ or\ 3000\ W}$$

f) List out various wiring accessories for conduit wiring.

Ans: **Following List various wiring accessories for conduit wiring :**

(Any four accessories required: 1/2 Mark each)

1) Elbow : To move the direction of the conductor path as per wiring installation

2) Lock nut: To hold and seal the conduit with their wires

3) Conduit box: To hold and inspect incoming and outgoing terminals

4) Inspection box: To inspect the path of wiring.

5) PVC accessories: like 1-Way to 4 Way junction box, Bend, 'T'

6) Lamp holder: It is the holding accessory. The different types of holders used such as angle holder, batten holder, pendent holder

7) Ceiling Rose: Ceiling rose are of two types: i) Two plate ii) Three Plate and it is used to give supply for ceiling fan and tubes.

8) Tube holder- It is used to hold the tube

9) Switch: the function of switch is to make ON/OFF. Switches are available in the rating of 6A and 16A

10) Plug: Two pin plugs, three pin plugs and 5 in one plug. 16A Power plate.

11) MCB: It is safety device available in 6A to 32A, 40 to 60A and Single pole to Four

pole MCB

12) Kit Kat Fuse: It is a safety device available in 6A to 32 A

13) Saddles, screws, rawal plug, etc

14) Switch board, ICDP Main Switch

15) All types of size of VIR & PVC wire

g) State the use of busbar, MCB, ELCB and DB

Ans:

i) Use of Bus-bar: - Distribute the load on 3-phase four wire systems. **(1/2 Mark)**

- To provide number of connection of incoming line to provide easy way to connect number of sub circuit.
- For better firm connection.
- To provide easy access during inspection & maintenance.
- To avoid unauthorized changes or connection

ii) Use of MCB: - **(1/2 Mark)**

- Function of MCB use to trip the circuit when there is over load and short circuit fault.
- At normal condition it act as a switch.

iii) Use of ELCB: - **(1/2 Mark)**

- An Earth Leakage Circuit Breaker (ELCB) is a device used to directly to detect earth fault current from an installation and cut off the circuit from power supply and avoid electrical shock to the person..

iii) Use of DB: - **(1/2 Mark)**

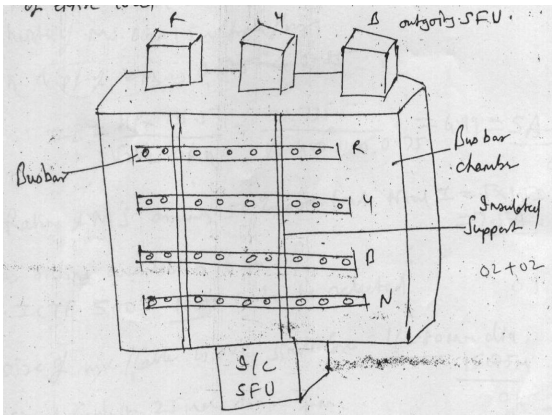
- To distribute the lighting load and power load

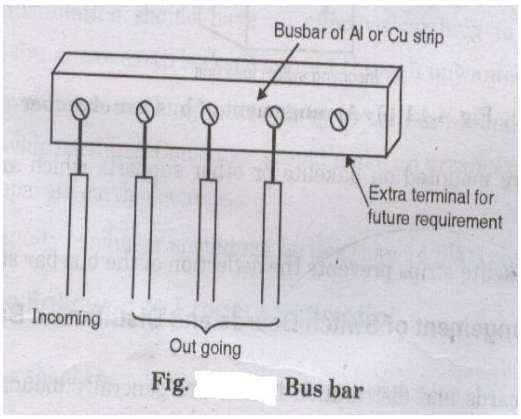
h) Differentiate between wire and cable

Ans: **(Any Two Points expected: 1 Mark each)**

S.No	Wire	Cable
i)	It is generally single core	It may be single core, Two core, 2.5 core, 3 core, 3.5 core and 4 core
ii)	Wires are used for LT Supply	Cables are used for LT and HT supply
iii)	Current & Voltage capacity for wire is less	Current & Voltage capacity for cable is More
iv)	Cost of wire is less.	Cost of cable is more.
v)	There are following types of wires: VIR, PVC, TRS/CTS/flexible etc	There are following types of cables: armored and unarmored.

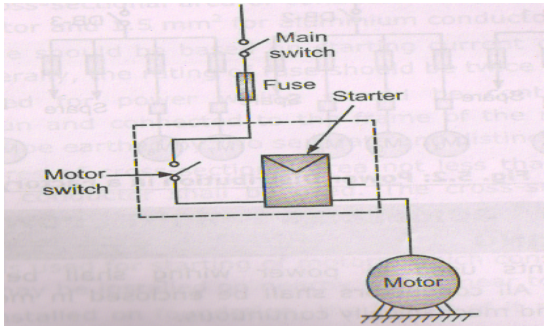
i)	**Draw a neat diagram for busbar chamber**
Ans:	**Diagram showing the arrangement of busbar Chember:** **(2 Marks)**





or equivalent figure

j)	**Draw a single line diagram for motor wiring circuit**
Ans:	**Single line diagram for motor wiring circuit:** **(2 Mark)**



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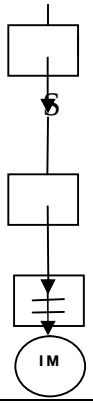
OR

(Diagram: 2 Mark)



3-ph,4 wire 400v A.C. supply
Energy meter

Main Fuse

ICTP

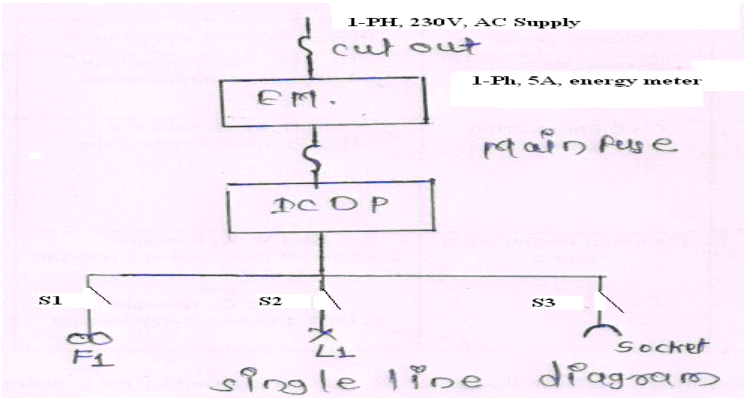
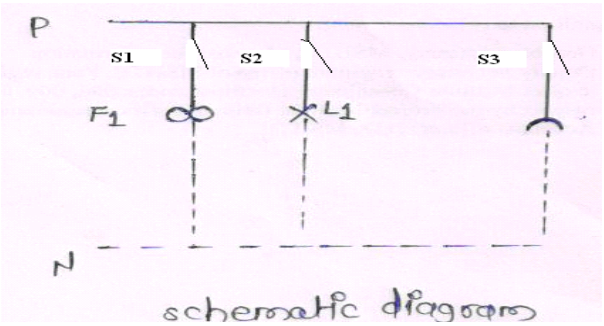
Star-delta starter

3 Ø Squirrel cage Induction motor

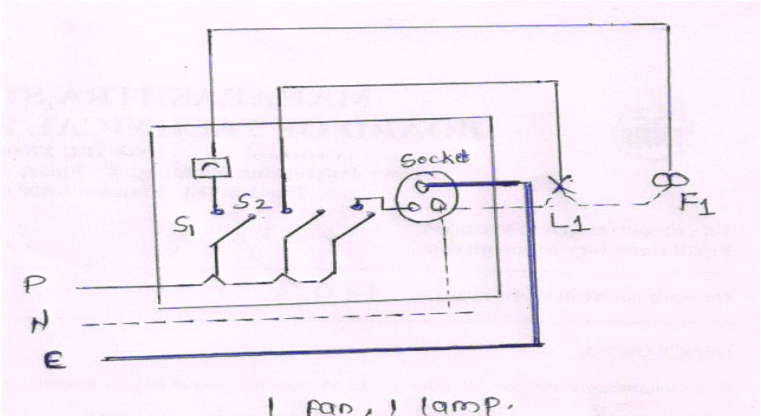
k)	**State the material and size of earth wire used for industrial installation**
Ans:	**The material used and size of earth wire used for industrial installation:** **(2 Mark)** 1. 8 SWG Copper Wire 2. 6 SWG GI Wire or Copper wire 3. If the total connected load more than 20 HP then Copper strips can be used as a earth wire
l)	**List out various types of tenders**
Ans:	**Types of Tender:** **(Any Two expected: 2 Marks each)** 1. Negotiated Tender 2. Limited competition or selective Tenders 3. Open competition ender
Q.2	**Attempt any Four of the following :** **16 Marks**
a)	**List out general rules and guidelines for installation of residential Electrification (any eight**
Ans:	**(Note: Similar to following rules any eight expected 1/2 Mark each point)** **Following rules and guidelines for installation of residential electrification:-** 1. Every installation is to be properly protected near the point of entry of supply cables by a two-pole linked main switch and a fuse unit. In a two wire installation if one pole is permanently earthed, no fuse, switch or circuit breaker is to be inserted in this pole. A 3-pole switch and fuse unit is to be used in 3-ph supply. 2. The conductors used are to be such that size of conductor should carry rated current and partial over load current safely. 3. The conductors installed are to be safe in all respects. 4. Every sub-circuit is to be connected to a distribution fuse board. 5. Every line (phase or positive) is to be protected by a fuse of suitable rating as per requirements. 6. A switch board is to be installed so that its bottom lies 1.25 to 1.5 meters above the ground floor. 7. A plugs and socket-outlets are to be of 3-pin type, the appropriate pin of socket being connected permanently to the earthing system. 8. All incandescent lamps, unless otherwise required, are to be hung at a height of 2.5 meters above the floor level. And ceiling fans are to be hung 2.75 meters above the

floor.

9. Lights and fans may be wired on a common circuit. Each sub-circuit is not to have more than a total ten points of lights, fans and socket-outlets. The load on each sub-circuit is to be restricted to 800 watts.
10. No fuse and switch is to be provided in earthed conductor.
11. Every circuit or apparatus is to be provided with a separate means of isolation such as a switch.
12. All circuit or apparatus requiring attention are to be provided with means of access to it.
13. In any building, light and fan wiring and power wiring are to be kept separate.
14. In 3-Phase, 4-wire installation the load is to be distributed equally on all phases.
15. No additional load is to be connected to an existing installation unless it has been ascertained that the installation can safely carry the additional load and that the earthing arrangements are adequate.
16. Lamp holders used in bath rooms are to be constructed or shrouded in insulating materials and fitted with protective shield and earth continuity conductor is not to be size less than 7/0.915 mm.
17. The metal sheaths or conduits for all wiring and metal coverings of all consuming apparatus or applications is to be properly earthed in order to avoid danger from electrical shock due to leakage or failure of insulation.
18. Each sub-circuit is to be protected against excessive current (that may occur either due to over load or due to failure of insulation) by fuse or automatic circuit breaker.
19. All light conductors are to be insulated or otherwise safe guarded to avoid danger.
    After completion of work the installations are to be tested (the test are to be carried out as described) before energisation.
20. Earth Resistance : should be very low for domestic installation it should be equal to or less than 5 ohm to 8 ohm
21. Insulation Resistance between conductor : should be very high for domestic installation it should be equal to or more than 1 mega ohm or it should be not be less than $= \frac{50\ M\Omega}{Number\ of\ outlet}$

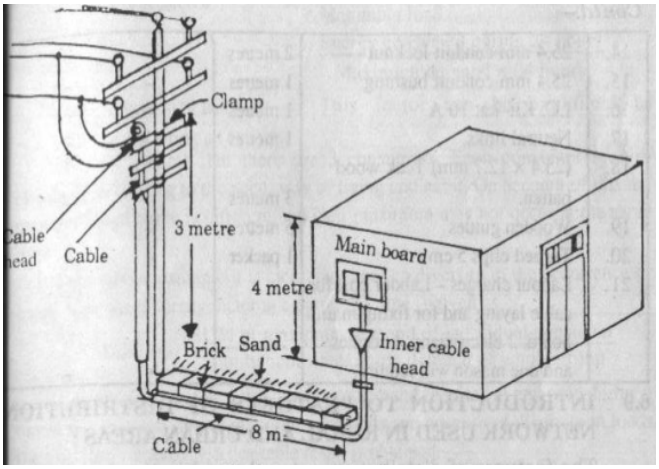
b)	**Define contract. State requirements of valid contract.**
Ans:	**Contract :** **(1 Marks)** It is the agreement between two parties, owner (party No.1) and contractor (party No.2) under some specific terms and conditions. **Following requirements of valid contract:** **(1/2 Mark for each requirements –Total 3 Mark)** 1. Contract should be written. 2. Contract should be signed by proper witness 3. Contractor licenses should be valid. 4. Contract should be signed by competent authority. 5. Contract should be signed by proper authorized persons. 6. It should be legally challenged in the court.
c)	**A room is to be fitted with 1 fan, 1 tube and one light socket. Draw single line diagram, schematic diagram and wiring diagram**
Ans:	**Single line diagram for 1 fan, 1 tube and one light socket** : **(2 Marks)**  **Schematic diagram for 1 fan, 1 tube and one light socket** : **(1 Marks)** 

Wiring diagram for 1 fan, 1 tube and one light socket : **(1 Marks)**



d) Draw a neat labeled diagram for underground service connection

Ans: **Underground service connection:** **Diagram : 4 Marks)**



or equivalent figure

e) Compare underground service connection and overhead service connection on the basis of safety, Labour cost, location and installation time

Ans: **Compare underground service connection and overhead service connection:**

(Each Point : 1 Mark)

S.No	Basis	Underground service connection	Overhead service connection
1	**Safety**	More safety	Less safety
2	**Labour cost**	Cost is more	Cost is Less
3	**location**	For thickly populated area	For general purpose it is

		it is preferred **OR** It is underground so repairing and maintenance is less	preferred **OR** It is open to sky so repairing and Maintenance is more
4	**Installation time**	More	Less

f) Prepare schedule of material for overhead service connection

Ans: **(Minimum Eight point expected: 1/2 Mark each point)**

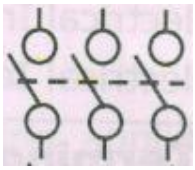
Scheduled of material for overhead service connection is as follows:

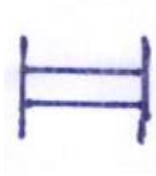
1. 2.5 Sqmm x 2 core PVC insulated cable or insulated wire
2. 'S' Shaped GI pipe 50 mm diameter
3. 8 SWG GI earth wire
4. Meter Board
5. Stay Wire
6. Stay insulator
7. Saddles for pipe
8. Screw required for pipe fitting
9. Bobbin insulator
10. Earthing sundry
11. Earthing plate
12. Bars Nutbolts
13. Sand
14. Charcoal
15. Pipe clamp
16. Miscellaneous

Q.3 Attempt any FOUR of the following : 16 Marks

a) Draw Symbols for i) ICTP ii) Ceiling Fan iii) Twin Tubes iv) Push Button

Ans: **i) ICTP** **ii) Ceiling Fan** **iii) Twin Tubes** **iv) Push Button**






(Each Symbols : 1 Mark)

b)	**A room consists of following load Tube points 4 Nos : 40 watt each, Fan points 3 nos : 100 watt each, Lamp points 2 nos : 60 watt each, 5A socket outlet 4 nos : 100 watt each, 15A socket outlet 2 nos: 1000 watt each,** **Find i) Total light load and power load** **ii) No. of sub circuits required** **iii) Rating of main switch** **iv) Rating of DB required**
Ans:	**Given Data: (All data is assumed it may vary or it may not be available, there will be only steps and this steps are expected)** **(Give stepwise Marks as mention below)** $Total\ \ load\ in\ \ = tubes \times watt\ \ = 4 \times 40 = 160\,W$ $= Fans \times watt\ \ = 3 \times 100 = 300\,W$ $= Lamps \times watt\ \ = 2 \times 60 = 120\,W$ $= Sockets\ \times\ watt = 4 \times 100 = 400\,W$ i) $Total connected lighting load in a house = 160+300+120 = 980W\ or\ 0.98KW$, **- (1/2 Mark)** ii) $Total\ connected\ \ Power\ load\ \ in\ a\ house = 2 \times 1000 = 2000W\ or\ \ 2.0\ KW$, **(1/2 Mark)** $Total\ load\ connected = 980 + 2000 = 2980\ or\ \ 2.980\ \ \ KW$ **(1/2 Mark)** iii) $Total\ load\ in\ = \frac{980}{800} = 1.225 \cong 2\ \ Nos\ lighting\ sub\ circuit$ **(1/2 Mark)** $Total\ load\ in\ = \frac{2000}{2000} = 1\ Nos\ \ \ Power\ \ sub\ circuit$ **(1/2 Mark)** iv) **Distribution Board**: So, 3 Number of MCB are required ---------- **(1/2 Mark)** Total Connected load is 2980 watt, so Number of sub circuit = 3 Nos. **v) Current rating of iron clad Main switch** = since more current is 23 A. Current rating **Iron clad main switch** = 32A ---------- **(1/2 Mark)** **vi) Value of current rating of iron clad main switch:** ---------- **(1/2 Mark)** **So Use: -** 250V, 32A, ISI mark Main switch of any company

c) Differentiate between MCB and ELCB

Ans: **(Any Four similar points expected: 1 Mark each)**

S.No	MCB	ELCB
1	Miniature circuit breaker operates automatically at the time of short circuit fault or over load	Earth Leakage circuit breaker operates automatically at the time of earth fault
2	The cost of the MCB is moderate	Cost of the ELCB is high compare to MCB
3	There is no need of replacement after tripping the MCB	There is no need of replacement after tripping the ELCB
4	MCB are designed for separate current rating	ELCB are designed for separate earth leakage current ratings

d) Compare residential installation and commercial installation on the basis of type of supply, purpose of installation, load capacity, general requirements

Ans: **(Each points : 1 Mark)**

S.No	Basis	Residential installation	Commercial installation
1	Type of Supply	Generally single phase	Generally 3 phase
2	Purpose of installation	Domestic purpose	Commercial purpose
3	load capacity	Lighting load is more, power load is less.	Power load is more, lighting load is less.
4	General requirements	MCB, ELCB and other safety measures willingly installed	Smoke detector & fire alaram protection, MCB, ELCB and other safety measures must be installed

e) State the design consideration for commercial installation

Ans: **(Minimum Eight point expected: 1/2 each point)**

The following points of design consideration commercial Installation:

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.

$$No.\ of\ \ Lighting\ \ Sub\ circuits = \frac{Total\ \ Electrical\ lighting\ \ load}{800\ W}$$

OR

$$No.\ of\ \ Lighting\ \ Sub\ circuits = \frac{Total\ \ No.of\ \ lighting\ \ po\,\text{int}}{10}$$

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

$$No.\ of\ \ power\ \ Sub\ circuits = \frac{Total\ \ electrical\ \ power\ \ load}{1000\,W\ \ or\ \ 2000\,W}$$

OR

$$No.\ of\ \ power\ \ Sub\ circuits = \frac{Total\ \ No.of\ \ power\ \ point s}{1000\,W\ \ or\ \ 2000\,W}$$

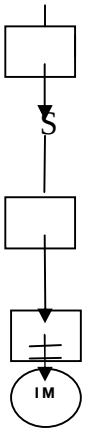
5) Find out total power consumption of every lighting and power sub circuits.
6) Find out rated Input current for every lighting and power sub circuit.

$P = V1 \cos\phi$ 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 of 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.

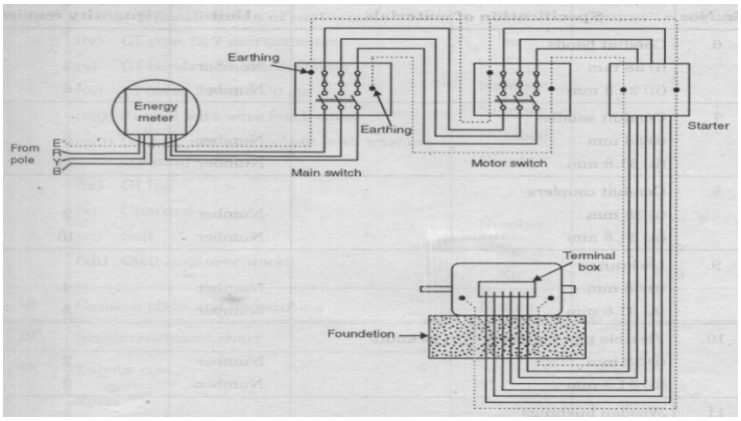
f) **A motor is to be operated with star delta starter. Draw wiring diagram showing connection for motor, starter and motor switch**

Ans: **Single line diagram -** **(4 Mark)**



3-ph,4 wire 400v A.C. supply
Energy meter
Main Fuse
ICTP
Λ / Δ starter
3 Ø Induction motor **OR**

Wiring diagram –



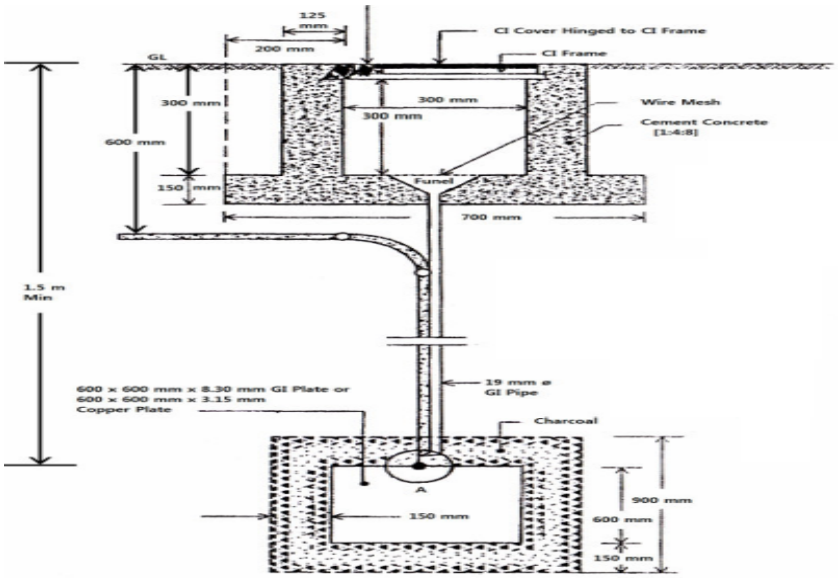
Or equivalent ckt dia.

Q.4	**Attempt any FOUR of the following : 16 Marks**
a)	**State the need of earthing. Draw neat diagram for plate earthing.**

Ans: **Need of Earthing:** **(2 Marks)**

1. To provide an alternative path for the leakage current to flow towards earth.
2. To save human life from danger of electrical shock due to leakage current.
3. To protect high rise buildings structure against lightening stroke.
4. To provide safe path to dissipate lightning and short circuit currents.
5. To provide stable platform for operation of sensitive electronic equipments.

Diagram for plate earthing : **(2 Marks)**



or equivalent figure

b) A room 4m x 5m is to be fitted with one tube, one fan and one 5A socket. Draw installation plan and wiring diagram. Calculate length of conduit and wire required.

Ans:

Note: 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.

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

$$Total\ \ load\ in\ \ Hall = tubes \times watt\ \ = 1 \times 40 = 40\,W$$

$$= Fans \times watt\ \ = 01 \times 60 = 60\,W$$

$$= Socket \times watt\ \ = 01 \times 100 = 60\,W$$

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

i) $Total\ load\ in\ \ Hall = 40 + 60 + 100 = 200\ \ \ watt$

$$Total\ load\ \ in\ \ Amps = \frac{200}{230} = 0.869 \cong 1\ Amp$$ ---------- **(1/2 Mark)**

iii) **Length of Conduit:**

= 1.5 + 4+2+1+2.5+10%

= 11+10%

= 12.1 Mtr

= 12 Mtr ---------- **(1/2 Mark)**

iv) **Length of Wire:**

= 12 x 3 +20 % extra

= 36+ 20%

= 43.2 or 440 mtr ---------- **(1/2 Marks)**

v) Rating Main switch: - since rated input current is 1 A.

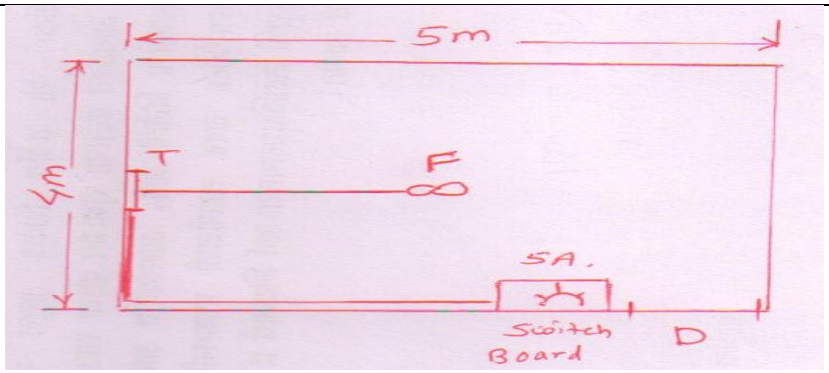
Assumed that Staring current = 1.5 times rated current

So starting current = 1.5x 1 = 1.5 A

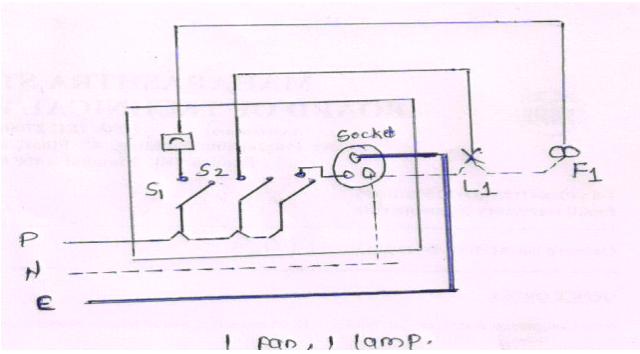
So Use:- ---------- **(1/2 Mark)**

230V, 6A, ISI mark Main switch of any company

Installation plan: ---------- **(1 Mark)**



wiring diagram :- --- **(1 Marks)**



or equivalent figure

c) Describe how rating of main switch, motor switch DB and cable is decided in industrial installation.

Ans: **(Reason of main switch:2 Marks & Reason of main switch B & cable : 2 Mark)**

1. Reason of Main Switch or Fuse Rating is decided in industrial installation:

- Rating of main switch or fuse is based up the starting current of motor.
- For calculating starting current is considered 2 times that of full load current,. Thus main switch is decided.
- If number of motors are there, then main switch is decided from following formula.

Incoming current = Starting current of highest rated m/c + Full load current remaining all m/c

Thus from incoming current main switch is decided

2. Reason of Cable Rating is decided in industrial installation:

- The current rating of cables for supply to motor is based up on the normal full load current of motor considering the overload capacity 50%
- We take 1.5 times the rated current or full load current. & thus cable rating is

	decided. **3. Reason of DB Rating is decided in industrial installation:** ➢ i.e MCB or fuse rating is decided from starting current of motor which explained above.
d)	**State any six requirements of valid contract.**
Ans:	**Following requirements of valid contract:** **(First Two point: 1 Mark each & other Four Point:1/2 Mark each –Total 4 mark)** 1. Contract should be written. 2. Contract should be signed by proper witness 3. Contractor licenses should be valid. 4. Contract should be signed by competent authority. 5. Contract should be signed by proper authorized persons. 6. It should be legally valid.
e)	**Give complete procedure for submission and opening of tender.**
Ans:	**Procedure of submission Procedure of Tender:-** **(2 Marks)** ➢ The tender is submitted from party No.2 (Bidder) to party No.1 (Owner) in sealed envelopes within the specification date & time period. ➢ The is submitted in envelops No.2 titled by envelop No.1 & envelop No.2. ➢ The content in every envelop is given an above. **OR** ➢ 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 **OR** ➢ According to old procedure three envelopes are there and in third envelope rate offered by the tenderer is given and it is mention at **" Envelop No.3"** **Procedure of Opening of Tender:-** **(2 Marks)** The sealed envelopes are opened in presence of representative of bidders. The procedure is as below ➢ The tenders are always opened at specified date & time in front of representative

	of every bidder. ➢ Initially envelop No.1 of every party is opened. The all documents which are given as above are checked if found O.K. then envelope No.2 of those parties is opened. ➢ If one of the party having the any short coming in envelop No.1 then the envelop No.2 of that party is not opened. ➢ The all contents in envelop No.1 are checked. It is as above & after opening the all envelops of all parties the comparative statement is done and for suitable company the contract is handed over. ➢ If one of the company having quotation of lowest price can be rejected by party No.1 (Owner) due to poor reputation, large works in hand, unsuitable drawing or without any reason. ➢ At first envelop No.1 of all parties are opened and comparative statement of all parties done. ➢ The rejected party of whose envelope No.1 is invalid there envelope No.2 are not opened it is freezed. ➢ For all reaming parties envelope No.2 opened and detailed comparative statement is done. ➢ For lowest eligible bidders the contract is handed over.
f)	**Define security deposit and earnest money deposit**
Ans:	**i) 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. **ii) 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 unsuccessful (not considered) bidder.
Q.5	**Attempt any TWO of the following : 16 Marks**
a)	**A three storeyed building has 10 shops on each floor. Each shop has 2 fan, 3 tubes, and one power socket. Draw complete wiring diagram for above load.**
Ans:	**Note: 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.** **Given Data: (The Assumed data may be vary (Give stepwise Marks as mention below)**

$$Total\ \ load\ in\ \ One\ Shop = tubes \times watt\ \ = 03 \times 40 = 120\,W$$

$$= Fans \times watt\ \ = 02 \times 60 = 120\,W$$

$$= Power\ Sockets \times watt = 01 \times 1000 = 1000W$$

$$Total\ load\ in\ \ One\ Shop = tubes\ in Watt + Fans\ in\ Watt + Socket\ \ in\ watt + Power\ Sockect$$

i) $Total\ load\ in\ \ one\ Shop = 120 + 120 + 1000 = 1240\ \ watt$ ---------- **(1 Mark)**

$$Total\ \ load\ \ in\ \ one\ shop\ \ Amps = \frac{1240}{230} = 5.391\ Amp\quad assu\min g\ \ p.f. = 0.9$$ - **(1/2 Mark)**

ii) $Total\ \ load\ \ in\ \ = \frac{240}{800} = 0.3 \cong 1\ \ Nos\ \ lighting\ \ sub\ \ circuit$ ---------- **(1/2 Mark)**

iii) $Total\ \ load\ \ in\ \ = \frac{1000}{2000} = 0.5 \cong 1\ Nos\ \ \ Power\ \ sub\ \ circuit$ ---------- **(1/2 Mark)**

iv) $Total\ load\ in\ \ one\ \ floor = Total\ Shop \times Total\ load\ in one\ shop$ -------- **(1/2 Mark)**

$$Total\ load\ in\ \ one\ \ floor = 10 \times 1240$$

$$Total\ load\ in\ \ one\ \ floor = 12400\ \ Watt$$

$$Total\ load\ in\ \ one\ \ floor = 12.400\ KW$$ ---------- **(1/2 Mark)**

v) $$Total\ load\ in\ \ One\ Floor\ in\ Amp = \frac{12400}{\sqrt{3} \times 415 \times 0.9}$$

$$Total\ load\ in\ \ One\ Floor\ in\ Amp = \frac{12400}{646.902}$$

$$Total\ load\ in\ \ One\ Floor\ in\ Amp = 19.1682\ Amp$$ ---------- **(1 Mark)**

vi) Total Load in Building = 3 floor x 1 floor total Load

= 3 x 12400

= 37200 watt

= 37.200 KW

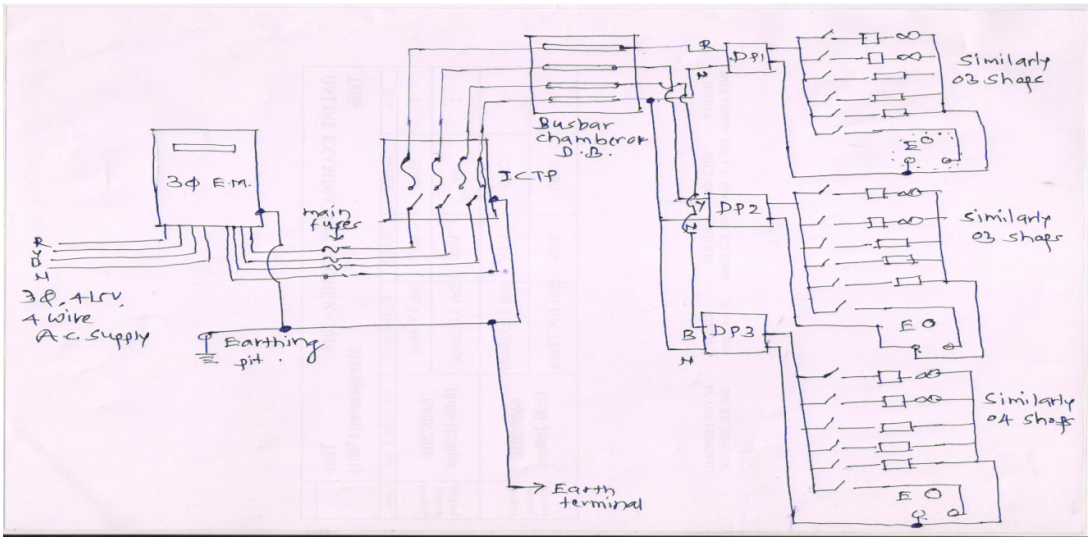
vii) $Total\ load\ in\ \ building = \frac{37200}{\sqrt{3} \times 415 \times 0.9}$ ---------- **(1/2 Mark)**

$$Total\ load\ in\ \ building = \frac{37200}{646.902}$$

Total load in building = 57.504 *Amp* ---------- **(1 Mark)**

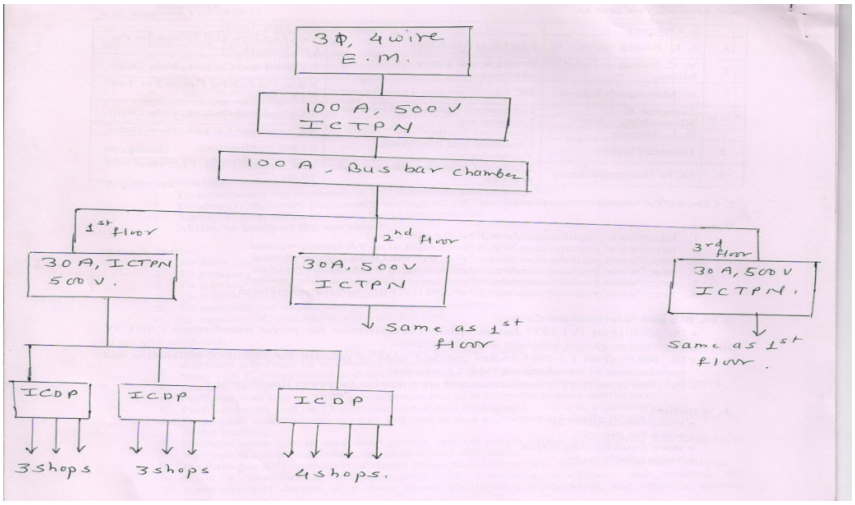
- For each floor 3-ph, 415 V, 4 Wire is to be supplied.
- On every phase 3 or 4 Shops are connected for every storeyed building.

Wiring Diagram for Lighting circuit in one shop:- (Similar to other shop & Building floor) **(1-Marks)**



or equivalent figure

Wiring Diagram for Main Board & Circuit: **(1-Marks)**



or equivalent figure

b)	**A hall of 10m x 6m is to be fitted with 8 fan and 15 tubes. Pare schedule of material for complete installation.**
Ans:	**Note: 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.**

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

$$Total\ \ load\ in\ \ Hall = tubes \times watt\ \ = 15 \times 40 = 600\,W$$

$$= Fans \times watt\ \ = 08 \times 60 = 480\,W$$

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

i) $Total\ load\ in\ \ Hall = 600 + 480 = 1080\ \ watt$ ---------- **(1 Mark)**

$$Total\ load\ in\ \ Amps = \frac{1080}{230} = 4.695 \cong 5\ Amp\ \ \ assu\min g\ \ p.f. = 1$$ --- **(1 Mark)**

ii) $No.\ of\ \ Sub\ circuit\ \ = \frac{1080}{800} = 1.35 \cong 2\ \ Nos\ lighting\ \ sub\ circuit$ ---------- **(1 Mark)**

$$According\ to\ \ point\ \ No.\ of\ \ Sub\ circuit\ \ = \frac{23}{10} = 2.3 \cong 3\ \ \ Nos\ lighting\ \ sub\ circuit$$

iii) Rating Main switch: - since rated input current is 16 A.

Assumed that Staring current = 1.5 times rated current

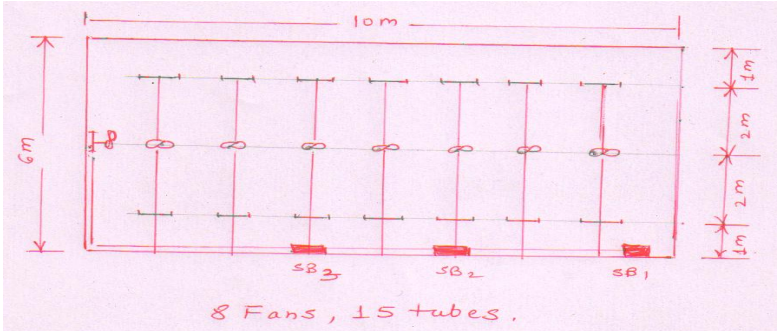
So starting current = 1.5x 5 = 7.5 A

So Use:- ---------- **(1 Mark)**

230V, 16A, ISI mark Main switch of any company

Cable selected: 1 Sqmm, Copper cable single core

Wiring Layout:



Conduit required :

= 1+1.5+1.5+5x7+3

= 3+35+3+10%

= 41+4.1

= 45 Mtr

Wire required :

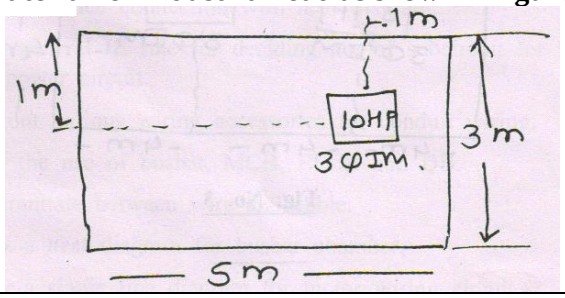
= 135+20%

= 162 Mtr

Note:- Cost of material it not required or may vary so do not stick on final figures

ii) 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	6A MCB for lighting load	03	45.00	135.00
3	PVC conduit (3 Mtr pipe) 1.5mm thickness	45 Mtr	15.00	300.00
4	Copper Earthing Plate	01	490.00	490.00
5	DP	01	150.00	150.00
6	Earthing Sundry	lumsump	200.00	200.00
7	6A Switch	23	10.00	260.00
8	Ceiling rose	23	10.00	180.00
9	2.5 Sqmm PVC wire Running earth	15 Mtr	7.00	105.00
10	Flexible wire for connection of tube & Fan	12 Mtr	5.00	60.00
11	1 Sqmm PVC wire with earth wire (90 Mtr -1 bundle)	02 Bundle	780.00	1560.00
12	Junction Box	25 approx.	07.00	175.00
13	10 x 12 Switch board with cutting	02	35.00	70.00
15	Labour Charges	23	110.00	2530
		Total Amount :-		**6465.00**
15	Contingencies+ profit margin	10% Amount:-		646.50
		Total Amount:-		**7111.50**
	iii) Cost of work:	Say Total Amount:		**7112.00**

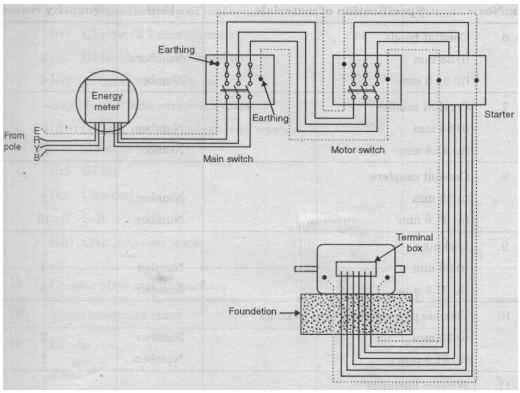
c)	**Prepare schedule of material for industrial load as shown in figure No.1** 
Ans:	**Note: Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer**. Assuming height of Ceiling 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 = 10 x 735.5 = 7355 W-------- **(1/2 Mark)** **Step No. 2:-** Input power of I. M = output power of I M / efficiency of IM motor.**(1/2 Mark)** Assuming efficiency of I.M is 80 % Input power of induction motor = 7355 / 0.8 = 9193.75 W **Step No. 3:-** To determine the rated current for I.M ---------- **(1/2 Mark)** $P = \sqrt{3}\, V_L\, I_L Cos\phi \qquad V_L = 415\, V$ $I_L = \frac{P}{\sqrt{3}\, V_L Cos\phi}$ $I_L = \frac{9193.75}{\sqrt{3} \times 415 \times 0.8} \qquad Cos\phi = 0.8\ assumption$ $I_L = 15.98\ Amp \qquad Rated\ current = 15.98\ Amps$ **Step No. 4:-** To determine the size & core of cable:- ---------- **(1/2 Mark)** Starting current is assumed two times rated input current for starting surge, momentary short circuit & overload. Starting current = 2 x 15.98 = 31.96 Amps **So use,** 10 Sqmm 3 core cable for the I.M. **Step No. 5:-** Determined the size length & dimensions of ICTP earth wire at input cable:- The rating of main switch is 450 V, 32 Amp ICTP ISI mark

Size of earth wire 8 SWG copper or 6 SWG GI ---------- **(1 Mark)**

Length of earth wire = 2 times length of cable

Length of input cable for I .M at actual

Step No.6: Draw the circuit Diagram. ---------- **(1Mark)**



or equivalent figure

Step No. 7:- Find out the estimation chart with material cost & labour cost: ----- **(4 Mark)**

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

Material Shedule:

1	32 A Busbar with Netural link	01
2	3-ph,4 wire 415V, 15-30A, A.C. supply Energy Meter	01
3	ICTP 450V,32A	02
4	Star Delta Starter	01
5	8 SWG Earthing Wire	0.5.kg
6	60 cm x 60cm x6.36 mm Copper Earthing Plate	01
7	Earthing nut-board	04
8	Earthing Sundry	lumsump
9	12x12 Wooden Board for SDB	02
10	Screw 3 inch length	12 No
11	Screw 1 inch length	06 No
12	R,Y,B Indication Lamp	03
13	PVC Tape	04
14	Saddles	1 box
15	32mm PVC conduit (3 Mtr pipe) 1.5mm thickness	7 pipe
17	10 Sqmm x 4 Copper armored cable	10 Mtr
18	Junction Box	03 approx.
19	Lug & gland	06 approx

Q.6	**Attempt the following :** **04 Mark**
a)	**Decide rating of main switch, DB, Motor switch and starter for following load.** **i) 1HP, 3-Ph Sq.cage IM, I_{FL} = 5A ii) 3 HP, 3-Ph Slip ring IM, I_{FL} = 8A**
Ans:	**(Rating point -2 Mark and Procedure – 2 Mark)**

Ratings of main switch, DB, Motor switch and Starter 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.

i) Rating for 1HP, 3-Ph Sq.cage IM, I_{FL} = 5A :-

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

$$Total\ power = 1\ HP \times 735.5 = 735.5\ watt$$

$$Total\ power = .735.5\ watt$$

$$Rated\ input\ current\ I_L = \frac{HP \times 735.5}{\sqrt{3}\, V_L \times \eta \times Cos\phi}$$

$$Rated\ input\ current\ I_L = \frac{1 \times 735.5}{\sqrt{3} \times 415 \times efficency \times P.f}$$

= 1.6 Amp

But IFL is given 5A, So use

- Main switch : ICTP, 415V, 8A or 5A
- DB : 3-Ph, 415V, 10A, Distribution board of two outlet
- Motor switch: 415V, 16A industrial plug socket
- Starter : 3-Ph, 415 V, 1 HP DOL Starter

ii) Rating for 3 HP, 3-Ph Slip ring IM, I_{FL} = 8A:-

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

$$Total\ power = 3\ HP \times 735.5 = 735.5\ watt$$

$$Total\ power = .2206.5\ watt$$

$$Rated\ input\ current\ I_L = \frac{HP \times 735.5}{\sqrt{3}\, V_L \times \eta \times Cos\phi}$$

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

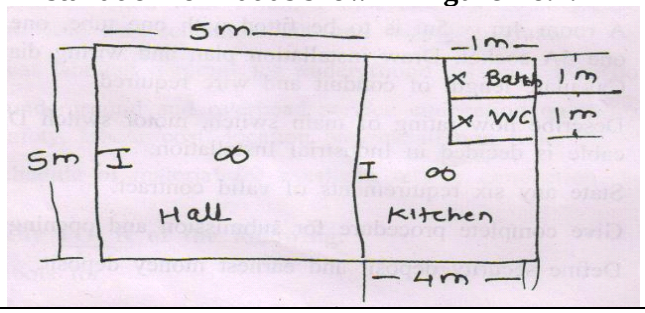
$$= 4.80 \text{ Amp}$$

But IFL is given 8A, So use

- Main switch : ICTP, 415V, 16A
- DB : 3-Ph, 415V, 16A, Distribution board of two outlet
- Motor switch: 415V, 32A industrial plug socket
- Starter : 3-Ph, 415 V, 3 HP Rotor resistance Starter

b) Attempt any ONE of the Following **12 Marks**

i) Estimate the cost of installation for flat as shown in figure No.2.



Ans: **(Costing of material is not required marks are only allotted for Material list: 12 Point Expected Each Point: 1 Marks –Total 12 Marks)**

$$Total\ \ load\ in\ \ Installation = tubes \times watt\ \ = 2 \times 40 = 80\,W$$

$$= Fans \times watt\ \ = 2 \times 60 = 120\,W$$

$$= Lamps\ in\ WC\ \&\ bath \times watt\ \ = 2 \times 40 = 80\,W$$ --- **(1 Mark)**

$$Total\ load\ in\ \ Hall = tubes\ in\ Watt + Fans\ in\ \ Watt + Lamps\ in\ WC\ \&\ Bath$$

i) $$Total\ load\ in\ \ Installation = 80 + 120 + 80 = 280\ \ watt$$ ---------- **(1 Mark)**

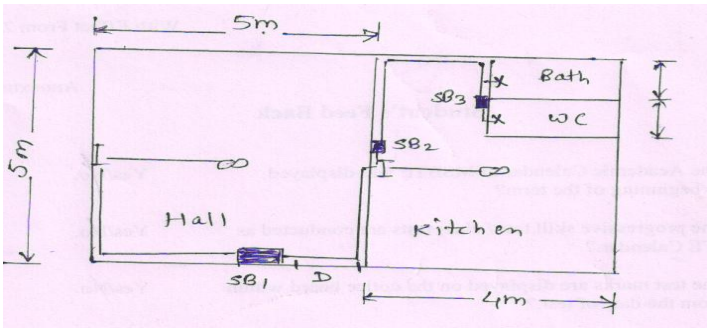
$$Total\ load\ in\ \ Amps = \frac{280}{230} = 1.217 \cong 2\ Amp$$ --- **(1 Mark)**

So Use:- ---------- **(1 Mark)**

230V, 5A, ISI mark Main switch of any company and lighting load 280 watt & 6 points.

Therefore one sub circuit is required

Wiring Layout: --- **(2 Mark)**



Length of the conduit: --- **(1 Mark)**

$$= 1.5_{V} + 4_{H} + 2.5_{H} + 4_{V} + 2.5_{H} + 2.5_{H} + 2.5_{H} + 3_{H} + 2_{H} + 10\%$$

$$= 11.5 + 10 + 10\%$$

$$= 21.5 + 10\%$$

$$= 21.5 + 2.2$$

$$= 24.2 \approx 24\ Mtr$$

Length of the Wire: --- **(1 Mark)**

$$= 24 \times 3 + 20\%$$

$$= 72 + 20\%$$

$$= 72 + 14.4$$

$$= 86.4 \approx 87\ Mtr$$

Schedule of Material: **(4 Mark)**

S.No	Material	Quantity	Rate	Total Amount
1	ICDP 250V, 6A	01	250.00	250.00
2	6A MCB for lighting load	01	45.00	45.00
3	PVC conduit (3 Mtr pipe) 1.5mm thickness	24 Mtr	15.00	360.00
4	1 Sqmm Copper Wire (90 mtr bundle)	01 mtr	650.00	650.00
5	Copper Earthing Plate	01	490.00	490.00
6	Earthing Sundry	lumsump	200.00	200.00
7	6A Switch	07	15.00	105.00

8	6A Three point socket	01	18.00	18.00
9	Ceiling rose	04	10.00	40.00
10	Angle holder	02	10.00	20.00
11	Junction Box	08	10.00	80.00
12	4 x 4 Switch board with cutting	03	20.00	60.00
13	25 x 8 screws	01	35.00	70.00
14	Raval plug	03	05.00	15.00
15	Labour Charges	08	110.00	880.00
		Total Amount :-		**3283.00**
16	Contingencies+ profit margin	10% Amount:-		328.30
		Total Amount:-		**3611.30**
	iii) Cost of work:	Say Total Amount:		**3611.00**

ii) Estimate the cost of installation for workshop as shown in figure No. 3

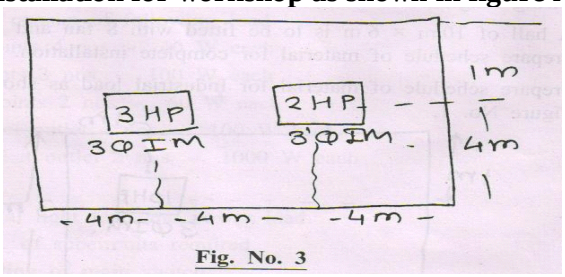
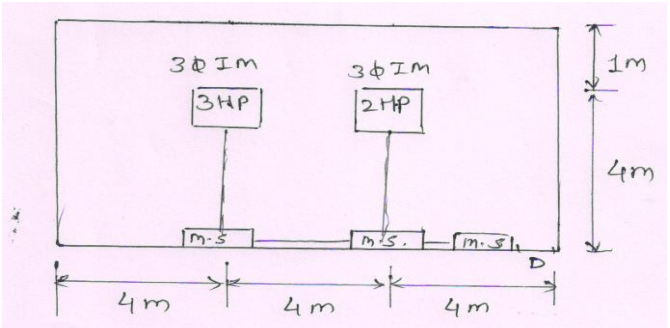


Fig. No. 3

Ans: **(Costing of material is not required marks are only allotted for Material list: 12 Point Expected Each Point: 1 Marks –Total 12 Marks)**



i) Rating for 3HP, 3-Ph I.M :-

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

$$Total\ power = 3\ HP \times 735.5 = 2206.05\ watt$$

$$Total\ power = .2206.05\ watt$$ ------ **(1 Marks)**

$$Rated\ input\ current\ I_L = \frac{HP \times 735.5}{\sqrt{3}\, V_L \times \eta \times Cos\phi}$$

$$Rated\ input\ current\ I_L = \frac{2206.5}{\sqrt{3} \times 415 \times efficency \times P.f}$$

$$Rated\ input\ current\ I_L = \frac{2206.5}{\sqrt{3} \times 415 \times 0.85 \times 0.85}$$

$$Rated\ input\ current\ I_L = 4.248\ Amp$$ ------ **(1 Marks)**

Starting current = 2 x 4.248 = 8.496 Amp ---------- **(1 Marks)**

So use, 2.5 Sqmm , 4 core cable copper cable , 500V grade should be selected rating of SFU, ICTP switch is 16A, 450V grade should be selected. -**(1 Marks)**

ii) Rating for 2HP, 3-Ph I.M :-

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

$$Total\ power = 2\ HP \times 735.5 = 1471\ watt$$

$$Total\ power = .1471\ watt$$ ------ **(1 Marks)**

$$Rated\ input\ current\ I_L = \frac{HP \times 735.5}{\sqrt{3}\, V_L \times \eta \times Cos\phi}$$ ------ **(1 Marks)**

$$Rated\ input\ current\ I_L = \frac{1471}{\sqrt{3} \times 415 \times efficency \times P.f}$$

$$Rated\ input\ current\ I_L = \frac{1471}{\sqrt{3} \times 415 \times 0.85 \times 0.85}$$

$$Rated\ input\ current\ I_L = 2.83\ Amp$$

Starting current = 2 x 2.83 = 5.66 Amp ---------- **(1 Marks)**

So use, 1.5 Sqmm , 4 core cable copper cable , 500V grade should be selected rating of SFU, ICTP switch is 16A, 450V grade should be selected. -**(1 Marks)**

Schedule of Material : **(4 Marks)**

S.No	Material of Material	Quantity	Cost of material
1	32 A Busbar with Netural link	01	1750.00
2	3-ph,4 wire 415V, 15-30A, A.C. supply Energy Meter	01	500.00

	3	ICTP 450V,16A	03	750.00
	4	DOL Starter	02	4000.00
	5	8 SWG Earthing Wire	0.5.kg	225.00
	6	60 cm x 60cm x6.36 mm Copper Earthing Plate	01	450.00
	7	Earthing nut-board	04	35.00
	8	Earthing Sundry	lumsump	3500.00
	9	12x12 Wooden Board for SDB	05	25.00
	10	Screw 3 inch length	18 No	30.00
	11	Screw 1 inch length	10 No	15.00
	12	R,Y,B Indication Lamp	03	60.00
	13	PVC Tape	04	40.00
	14	Saddles	1 box	25.00
	15	32mm PVC conduit (3 Mtr pipe) 1.5mm thickness	7 pipe	490.00
	16	2.5 Sqmm x 4 Copper aramoured cable	15 Mtr	150.00
	17	1.5 Sqmm x 4 Copper aramoured cable	10 Mtr	240.00
	18	Junction Box	03 approx.	30.00
	19	Lug & gland	06 approx	130.00
	20	Labour Charges	Lumsum	3000.00
			Total Amount :-	**15445.00**
	21	Contingencies+ profit margin	10% Amount:-	1544.50
			Total Amount:-	**16989.50**
		iii) Cost of work:	Say Total Amount:	16990.00

----------END----------