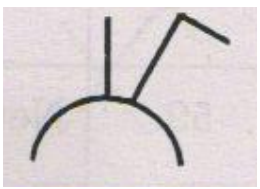
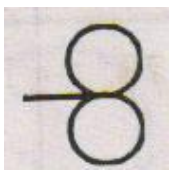
Important suggestions to examiners:

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.

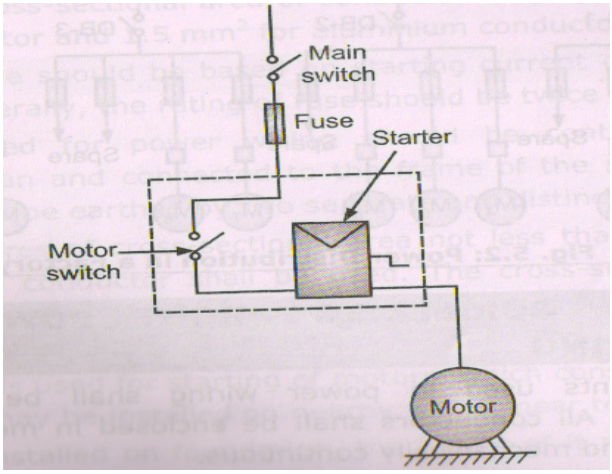
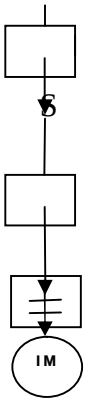
Q.1	**Attempt any TEN of the following**	**20 Marks**
a)	**Define electrical installation.**	
Ans:	**Meaning of Electrical installation :** **(2 Marks)** Electrical installation is a process of estimation and erection of electrical wiring with materials, and electrical machines used by electricians and electrical engineers for a specific location.	
b)	**State the meaning of following symbol.** $\frac{2N-220V}{2\times 50\,mm^2+1\times 25\,mm^2}$	
Ans:	**Meaning of symbol** **(2 Marks)** $\frac{2N-220V}{2\times 50\,mm^2+1\times 25\,mm^2}$ ➢ DC Circuit 220V, (110 V between outer conductors and neutral) ➢ Two Conductors of 50 mm^2 with neutral of 25mm^2	
c)	**Draw the IS symbols for following: (i)combined switch and socket outlet (ii) bracket fan**	
Ans:	**(i) Combined switch and socket outlet : (ii) bracket fan** **(Each Symbol : 1 Mark)**  	

d)	**State the types of overhead service connection.**
Ans:	**The types of overhead service connection:** **(2 Marks)** i) Regular service connection or PVC /weather proof service connection ii) Bare conductor service connection
e)	**State the meaning of: (i) MCB (ii) ELCB**
Ans:	**Meaning of Following –** **(1 Marks each)** **(i) MCB :** Miniature circuit breaker **(ii) ELCB :** Earth Leakage circuit breaker
f)	**Write any two rules for residential electrification installation.**
Ans:	**(Note: Similar to following rules any Two expected 1 Mark each point)** **Following rules for residential electrification installation:-** 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

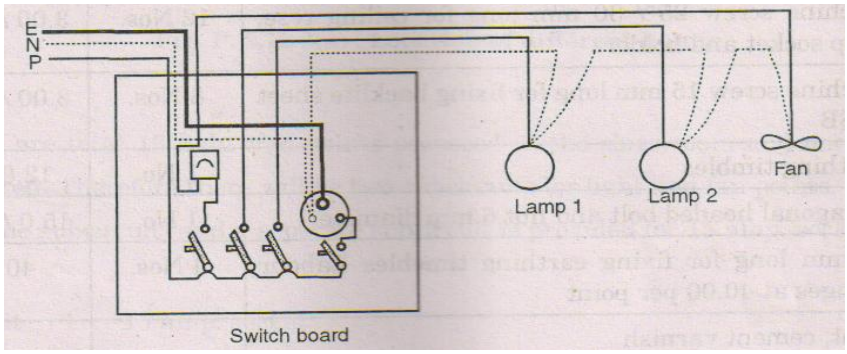
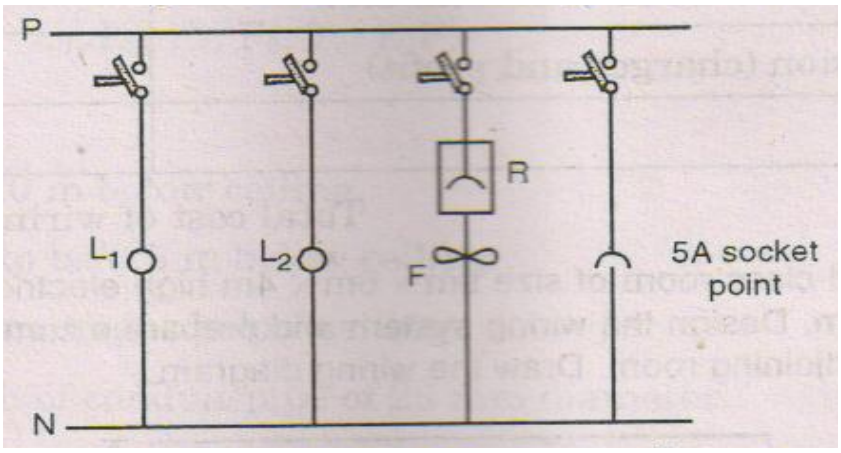
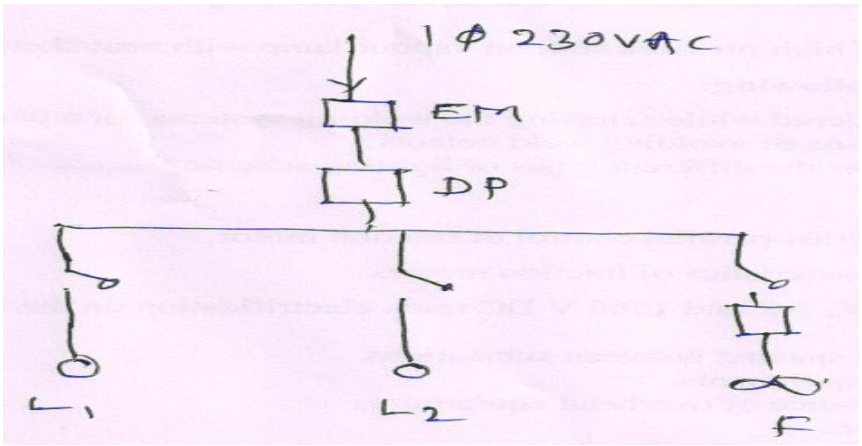
more than a total ten points of lights, fans and socket-outlets. The load on each sub-circuit is to be restricted to 800 watts.

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 $= \frac{50\ M\Omega}{Number\ of\ outlet}$

g)	**Write any four examples for commercial installation.**
Ans:	**(Any four types are expected: 1/2 Mark each)** **Examples of commercial Installation: (Any four examples expected)** 1) Hospital 2) Schools 3) Colleges 4) Banks 5) Shopping malls 6) Large temples 7) Auditorium 8) Cinema theaters 9) Show-rooms etc.
h)	**Write functions of: (i) main switch (ii) bus-bar**
Ans:	**i) Main switch:** To give the main supply to the system or (motor) with fuse protection inside. **(1 Mark)** **ii) Function of Bus-bar**: - Distribute the load on 3-phase four wire systems. **(1 Mark)**
i)	**State any two factors on which the size of bus bar chamber depends.**
Ans:	**Meaning of Bus-bar:** **(2 Marks)** ➢ 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 **For the above advantages bus bar chamber is required for larger installation**. **OR** 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.

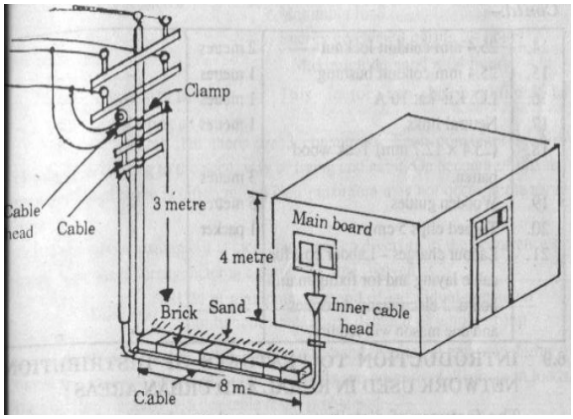
j)	**Draw the single line diagram showing motor circuit wiring with all necessary equipments.**
Ans:	**Single line diagram:** **(2 Mark)**  **or equivalent figure** **OR** **(Diagram: 2 Mark)**  3-ph,4 wire 400v A.C. supply Energy meter Main Fuse ICTP Star-delta starter 3 Ø Squirrel cage Induction motor
k)	**Name the starters used for following motors: (i) induction motors of high rating (ii) D.C. series motor**
Ans:	**Name the starters used for following motors :** **(Each Name of Starter : 1 Mark)** **i) Induction motors of high rating:** i) Star-Delta Starter ii) Auto transformer starter iii) Soft start starter. **ii) D.C Series Motor :** i) Armature resistance starter (Two point starter)

l)	**Define: (i) contract (ii) tender**
Ans:	**i) Contract :** **(1 Marks)** It is the agreement between owner (party No.1) and contractor (party No.2) under some specific terms and conditions. **ii) Meaning Tender:-** **(1 Marks)** 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 has to complete the project work).
Q.2	**Attempt any Four of the following :** **16 Marks**
a)	**List different methods of wiring in electrical installation.**
Ans:	**Different Methods of Wiring in Electrical Installation :** **(1 Marks for any four Method)** 1) Cleat wiring 2) Batten wiring 3) Wooden casing capping wiring 4) PVC conduit wiring 5) PVC casing capping wiring 6) Concealed wiring
b)	**Define the following: (i) security deposit (ii) 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.

c)	**Two light points, one ceiling fan are to be wired with three switches on a single switch board. Draw the following: (i) wiring diagram in looping in system (ii) single line diagram**
Ans:	**(i) Wiring diagram in looping in system:** **(2 Marks)**  **OR**  **(ii) Single line diagram** : **(2 Marks)** 

d) With the help of diagram explain underground service connection.

Ans: **Underground service connection:** **(Diagram : 2 Marks & Explanation :2 Marks)**



or equivalent figure

Explanation:

- Generally for thickly populated cities or for factory premises underground service connection is preferred.
- Normally underground cable is laid 1 meter below the ground level.
- For laying of cable, cable trench is used and with the help of bricks and sand cable is laid.
- In underground service connection armoured or unarmoured cables are used according to requirement.
- Service cable is connected to the distribution line through a cable joint box, mounted on the supplier's distribution pole.
- If the proper protection against mechanical damage is to be provided then it is run through GI pipe or MS pipe.

e) Compare overhead service connection and underground service connection on the basis of appearance, life, initial cost, safety.

Ans: **(Any four points expected 1 Mark each)**

S.No	Basis	Overhead service connection	Underground service connection
1	**Appearance**	Appearance is poor. OR not so good	Appearance is good.
2	**Life**	Less	More
3	**Initial cost**	Low	High
4	**Safety**	Less safety	More safety

f)	**List the material required for 11KV HT service consumer.**
Ans:	**Eight major electrical equipments required in 11 kV HT substation:** **(Explanation is not expected Any eight Equipment expected-1/2 Mark each)** **i) Busbar: -** Bus bar is common conductor to which incoming & outgoing lines are connected. It is generally made from ACSR conductor. Cross section of conductor depends on current. In Substation, there are three bus bar: 1) Incoming bus bar (33KV/66KV) 2) Station bus bar (11 KV) 3) Outgoing bus bar (11KV) **ii) Power Transformer:-** Its function is to step down the incoming voltage to outgoing voltage without change in frequency. **iii) Auxiliary Transformer: -** Its function is to step down the input voltage (11 KV) to distribution voltage (3-ph, 4wire, 440V) to give supply to control room, area lighting, staff quarters etc, **iv) Lighting Arrester:** - It is provided for protection of substation, transformer against lighting stroke **v) Earth switch: -** It is used for safety purpose. It is closed during maintenance to discharge capacitor. **vi) Isolator: -** Its function is to isolate the circuit whenever required. e.g at the time of maintenance. **vii) Circuit Breaker: -** It is protective device. It open or break the circuit whenever there is fault & protect the equipment. **viii) Relay:** It sense that faults & gives signal to tripping circuit of C.B to open. **ix) Instrumental Transformer (CT & PT**):- C.T & P.T are used for measurement of electrical quantities also C.T. is used for protection purpose. **x) Horn Gap Fuse: -** It is provided to primary side of transformer for protection against over current **xi) Control Room: -** It is constructed near to switchyard in which control panel is installed from which various circuits are controlled by operator. **xii) Control Panel: -** Control panel consists of different types of relays to detect different types of faults. **xii) PLCC (Power Line carrier communication):-** It is used for direct communication between substations to generating station also between two major substations. For this purpose same transmission line carries communication signal.

	xiii) Series Reactor: - To limit the short circuit current **xiv) Shunt Reactor: -** It supplies lagging KVAR to control voltage of transmission line. **xv) Series Capacitor: -** It supplies leading KVAR **xvi) Shunt Capacitor: -** For power factor improvement.
Q.3	**Attempt any FOUR of the following : 16 Marks**
a)	**State any four general requirements of electrical installation. Explain any one.**
Ans:	General requirements of electrical Installation: **(1/2 Mark for any four requirement)** 1) Safety (Electrical & Mechanical) 2) life 3) Appearance 4) cost 5) Maintenance & Repairing 6) Future expansion **Explanation: (2 Marks for any One requirement explanation)** 1) Electrical installation should be electrically and Mechanically safe. All precautions should be taken. 2) Life of installation should be long. 3) Appearance should be good and decorative. 4) It should be economical 5) Maintenance & repairing should be simple and less. 6) Future expansion can be easily done.
b)	**State the procedure for deciding the no. of sub circuits in residential installation with suitable example.**
Ans:	**The principles of circuit design in lighting circuits**: **Lighting Circuit :- (2 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 :- **(2 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

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

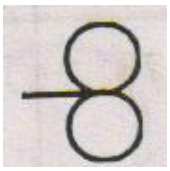
c) **Study the following single line representation shown in Fig. No. 1 and answer the following: (i) Identify the method of wiring system**
(ii) Identify the two symbols and give its meaning
(iii) State how many wire are required in between parts D & F.
(iv) Calculate the total length of wire.

Ans:

(i) The method of wiring system: PVC Casing Capping OR surface conduit wiring. **(1 Mark)**

(ii) Identify the two symbols and give its meaning : (Any Two) **(1 Mark)**

i) Lamp ii) Bracket Fan iii) DB iv) Switch Board

(iii) State how many wire are required in between parts D & F: **(1 Mark)**

i) Two Wires or Five wires

(iv) Calculate the total length of wire: **(1 Mark)**

Horizontal Run + Vertical Run +10 % of (HR +VR) =

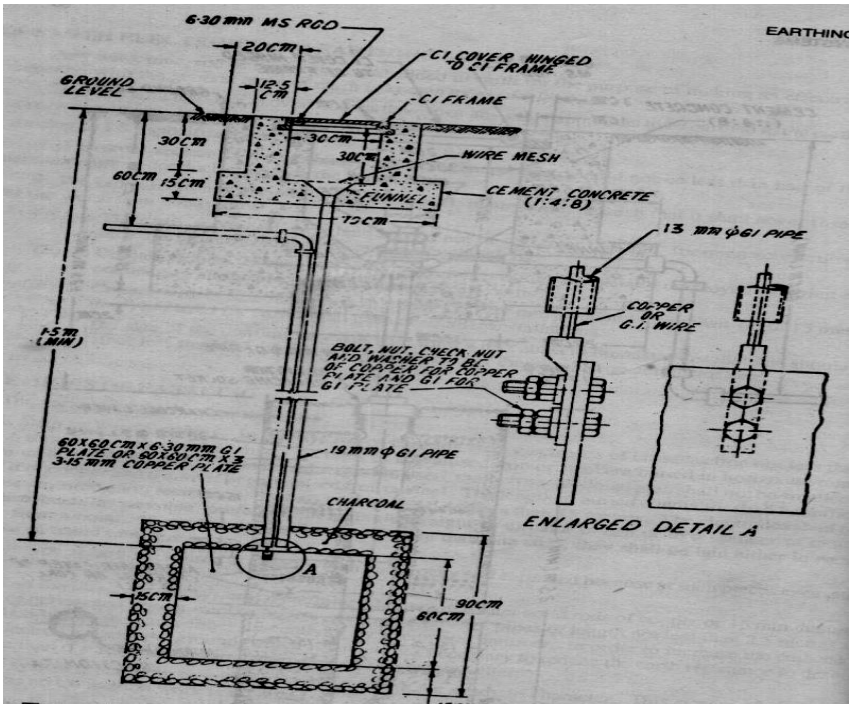
OR

= 1 x 5 Mtr + 3 x 1 Mtr + 1.5 x 2 Mtr + 4x1 Mtr + 2x3 Mtr + 2 x 2 Mtr+ 3 x 2 Mtr + 3x3 Mtr + 2x 2 Mtr

= 44 Mtr + 10 %

Total length of wire = 49 Mtr

d)	**State the sequence to be followed for preparation of estimate for commercial electrical installation.**
Ans:	**(Minimum Eight point expected 1/2 each point)** **The consideration the sequence to be followed for prepare estimate commercial electrical 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** $No.\ of\ \ \ power\ Sub\ circuits = \frac{Total\ \ No.of\ \ \ power\ \ po\,\text{int}\,s}{1000\,W\ \ or\ 2000\,W}$ 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.

e)	**Draw a neat labelled diagram of plate earthing.**
Ans:	**Sketch of plate earthing:** **(4 Mark)** 
f)	**A 3-ph 3-wire connection is to be given to a premises in which an electric motor of 50 H.P. is to be installed. 40 meters of wire ran from the main switch is required for this purpose. Determine the size of the wire to be used if the available voltage is 400 V.**
Ans:	**Data:** 50 HP Motor, 40 Mtr Wire Run, Voltage : 3-ph 400V Assume : P.F : 0.8 & Efficiency : 0.8 *For 50 HP Machine : Rated input current* $I_L = \frac{HP \times 735.5}{\sqrt{3}\, V_L \times \eta \times Cos\phi}$ --------- **(1 Mark)** *Rated input current* $I_L = \frac{50 \times 735.5}{\sqrt{3} \times 400 \times 0.8 \times 0.8} = \frac{36775}{443.392}$ *Rated input current* $I_L = 82.94\, Amp$ ---------- **(1 Mark)** Starting Current: 2 x 82.94 = 165.88 Amp---------- **(1 Mark)** So use, 95 Sqmm , 3 ½ core cable Aluminum 1/ 2.80 mm , 600V grade should be selected rating of SFU, ICTP switch is 100A, 450V grade should be selected. **(1 Mark)**

Q.4	**Attempt any FOUR of the following :** **16 Marks**
a)	**State the purpose of earthing. Also give two different methods to reduce earth resistance.**
Ans:	**Purpose of earthing:** **(Meaning-2 Mark & Methods -2 Mark)** Connecting the metallic frame of the electrical machines /any electrical equipment body etc to ground is known as earthing. Earthing protected against the electric shock. **OR** • Earthing provides protection to the electrical machinery due to leakage current. • Earthing provides protection to Tall Building & structure against lightening stroke • Earthing protects human from shocks. **Different methods to reduce earth resistance.** 1. Pouring the water in the earthing pit regularly 2. By increasing size of earth wire. 3. By tightening of all earthing connection. 4. By increasing volume of Charcoal and salt.
b)	**State different design consideration for residential installation.**
Ans:	**(Note: Similar to following design consideration for residential installation any Four Point expected: 1 Mark each point)** 1. 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. 2. The electrical wire or conductor which is used for residential installation should not be over heated at its rated load. 3. The permissible voltage drop in the wire should be proper (+ or – 5%) 4. The every metal point of the electrical device must be earthed. 5. The earth resistance should be maintained it should be very low or in between 5 to 8 ohm.

6. The switch board should be installed at the height of 1.2 meter to 1.3m from ground surface.

7. The main board should be installed at the height of 1.5m to 1.75 m from the ground surface.

OR (Expected any four points)

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 a size that it may carry 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 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 meters above the 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 of ten points of lights, fans and socket-outlets. The load on each sub-circuit is to be restricted to 800 watts. If a separate circuit is installed for fans only.

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.
    a. 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 $= \frac{50\ M\Omega}{Number\ of\ outlet}$

c) State and explain design consideration in industrial installation.

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

Explanation of design consideration in industrial installation :-

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 = $V I \cos \phi$

V = Input voltage = 230V

$\cos \phi$ = P.f.

I = Input current

If the machine is 3-ph

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

V_L = Line voltage = 400V

I_L = Line current or Input current

$\cos \phi$ = 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.

OR

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) With suitable example explain tender notice.

Ans:

Tender Notice **(4 Mark)**

Sealed quotations are invited from reputed manufacturing & suppliers for supply of 3-phase 250 KVA, 11 KV/400V transformer, quantity one to the under mentioned polytechnic as per the terms & conditions specifies in tender form available in the office.

The estimated cost is Rs. 4 lacs & cost of blank tender form is 1000/-

Last date for issue the tender form & document is 30 April 2014 & it should be submitted before 5 pm of 15 may 2014.

Right of rejection the tender without any intimation is kept.

Tender form available place

Date & Time:

Name of the officer to contact –

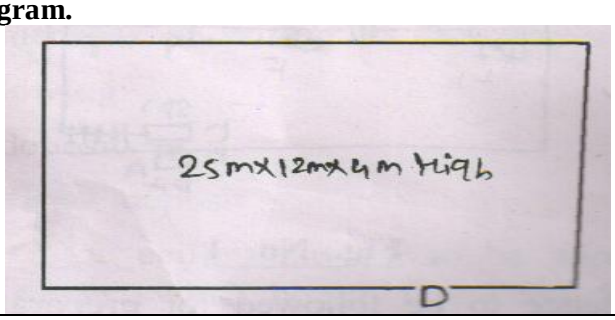
Place: Principal

Date: ABC Polytechnic

Mumbai

Phone: Fax: e-mail Id:

e)	**Write the detailed for submission and opening of a tender document.**
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 **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. **OR** ➢ 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)	**Explain how comparative statements are useful for selection of contractors.**
Ans:	After opening of all tenders, details in all tenders are written in only one page i.e. in one look and then comparison is made. **Following conditions are verified in comparative statement:** **(Any Four point are expected: 1 Mark each)** 1. The contract licenses validity duration 2. The quoted cost of total project work 3. Drawing details of the project works 4. Work in hand of the contractor. 5. Demand draft for S.D & EMD.
Q.5	**Attempt any TWO of the following :** **16 Marks**
a)	**The plan of a large hall for use as a tutorial hall for the polytechnic students is given in Fig. No. 2. The room is required to be provided with electrical wiring in batton system. Mark the location of MB, SB and electrical points on the plan of the hall using electrical symbols. Also decide the rating of MS, DB and other important materials and draw single line diagram.** 
Ans:	**Given Data: (The Assumed data may be vary)** **(Give stepwise Marks as mention below)** Area = A = 25m x 12m = 300 **Assuming** U.F. = 0.45, coefficient of utilization = 0.8 Waste light factor = 1 I = 225 lux **Solution:** $Total\ \ Lumens\ required = \frac{A\ I\ W}{CD}$ ---------- **(1/2 Marks)** $Total\ \ Lumens\ required = \frac{300 \times 225 \times 1}{0.5 \times 0.8}$ $Total\ \ Lumens\ required = 168750$ ---------- **(1/2 Marks)**

If 80 watt Lamp is used in hall having efficiency 40 lumens/watt:

$$Total\ required\ wattage = \frac{Gross\ Lumens}{Lamp\ efficency}$$ ---------- **(1/2 Marks)**

$$Total\ required\ wattage = \frac{168750}{40}$$ ---------- **(1/2 Marks)**

$$Total\ required\quad Wattage = 4218.7\ \ watt$$

It is assumed that 80 watt lamps are used for the workshop:

$$Number\ of\ Lamps\quad required = \frac{Gross\ \ Lumens}{Wattage\ of\ \ each\ lamp}$$ ---------- **(1/2 Marks)**

$$Number\ of\ \ Lamps\quad required = \frac{4218.7}{80}$$ ---------- **(1/2 Marks)**

$$Number\ of\ \ Lamps\ required = 54\ \ Nos\ lamps$$ ---------- **(1/2 Marks)**

- Twin Lamps are used, so 27 units each consisting of two numbers of 80 watts lamp will be provided in hall in 9 rows spacing in 3 Mtr
- The hall is used for special purpose emergency, 15 lamps of 100 watt are additionally installed.
- Also addition to above 11 Fans, there are Two 3-pin socket outlet on each switch board.

Calculation of Load :

Assuming load of fan 80 watts and sockets outlet 100 watt

Total Wattage = 54 x 80 watt + 15 x 100 watt + 11 x 80 watt + 4 x100 watt
Total Wattage = 7100 watts ---------- **(1/2 Marks)**

$$No.\ of\ \ lighting\ sub\ circuit = \frac{7100}{800} = 8.875 \cong\ \ 9\ \ No$$ ---------- **(1/2 Marks)**

$$Total\ load\ in\ \ Amps = \frac{7100}{\sqrt{3} \times 400 \times 0.9} = 11.40 \cong 12\ Amp\quad assu\min g\ \ p.f. = 0.9$$ **(1/2 Marks)**

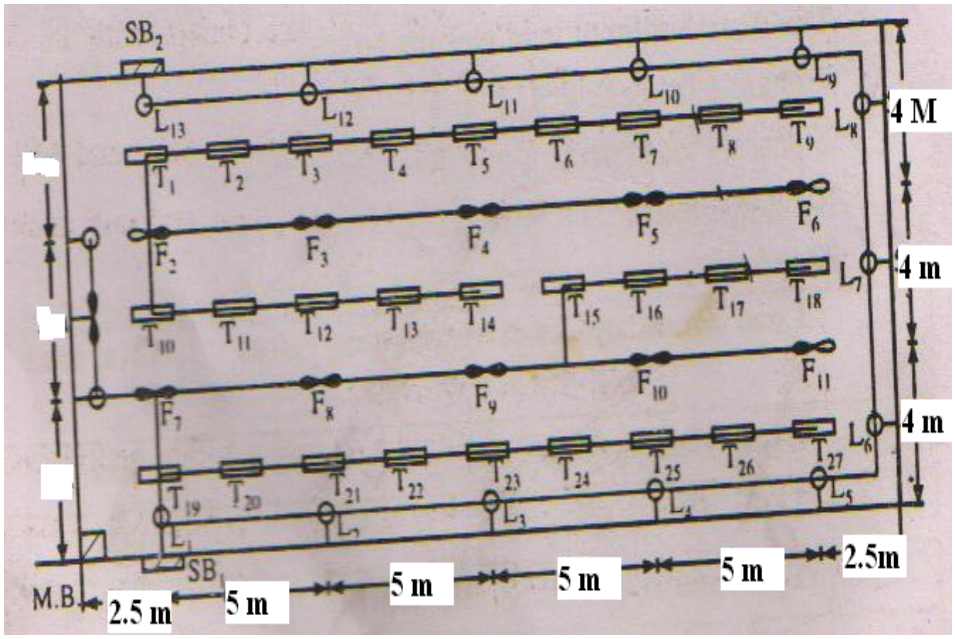
So, total required voltage : 3- phase 400 volt and 4 wire supply are used and 15 A, 400 V ICTP is required for all load and Three 10 A, 250V, ICDP switches will be used for sub distribution boards to control sub circuit.

- **The Distribution of Load circuits is** :

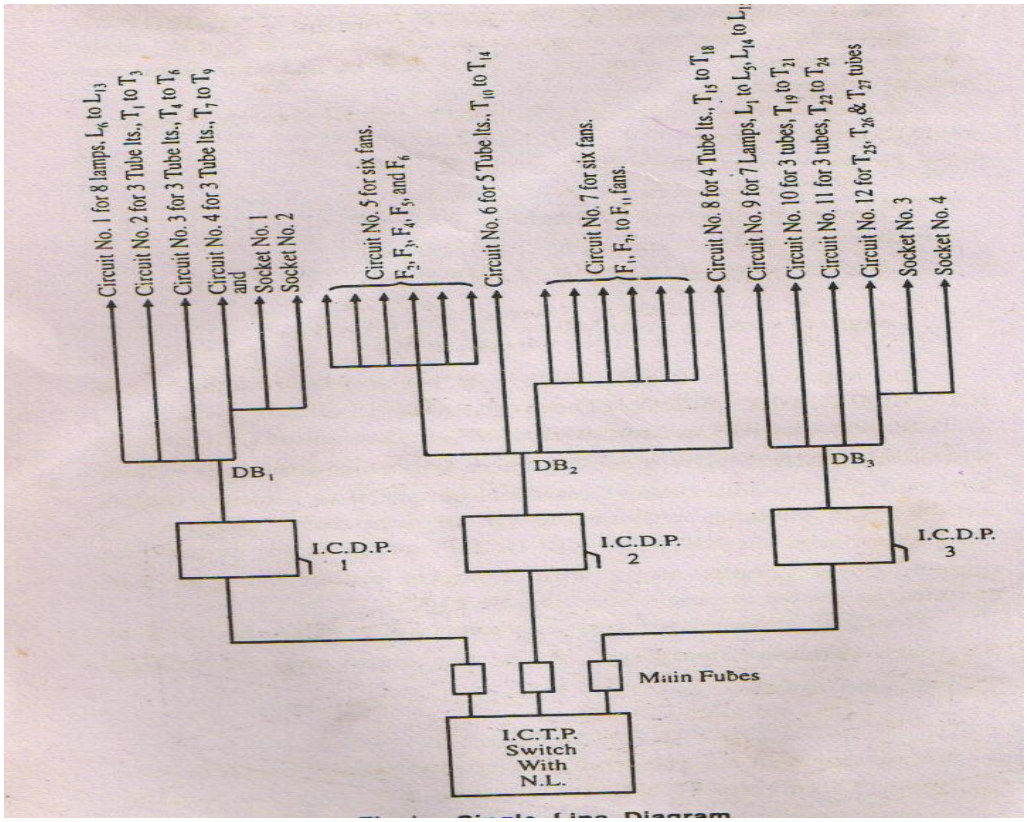
- R Phase : load circuit : 1,2,3,4
- Y Phase : load circuit : 5,6,7,8
- B Phase : load circuit: 9,10,11,12 (Each load circuit is controlled by SP Switch)

Ckt No	Load circuit and its points	Total load
1	L_6, L_7, L_8, L_9, L_{10}, L_{11}, L_{12}, L_{13} = 100 X 8	800 Watt
2	T_1, T_2, T_3, = 3 x 2 X 80	480Watt
3	T_4, T_5, T_6, = 3 x 2 X 80	480 watt
4	T_7, T_8, T_9, and two socket outlet = 3 x 2 X 60+200	560 watt
5	F_2, F_3, F_4, F_5, and F_6= 5 X 80	400 watt
6	T_{10}, T_{11}, T_{12}, T_{13} and T_{14} = 2 x 80 x 5	800 Watt
7	F_1, F_7, F_8, F_9, F_{10} and F_{11}= 6X 80	480 watt
8	T_{15}, T_{16}, T_{17}, and T_{18} = 2 x 80 x 8	640 watt
9	L_1, L_2, L_3, L_4, L_5, L_{14}, and L_{15}, = 100 X 7	700 Watt
10	T_{19}, T_{20}, and T_{21}, = 3 x 2 X 80	480 watt
11	T_{22}, T_{23}, and T_{24}, = 3 x 2 X 80	480 watt
12	T_{25}, T_{26}, and T_{27}, and 2 sockets	680 watt

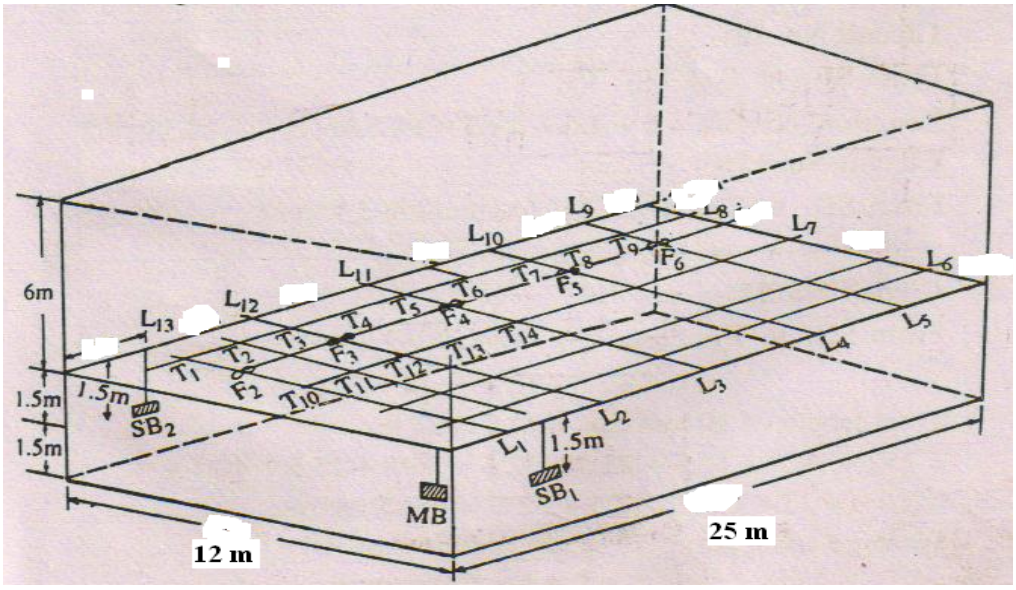
- **Installation Plan : ---------- (1 Mark)**



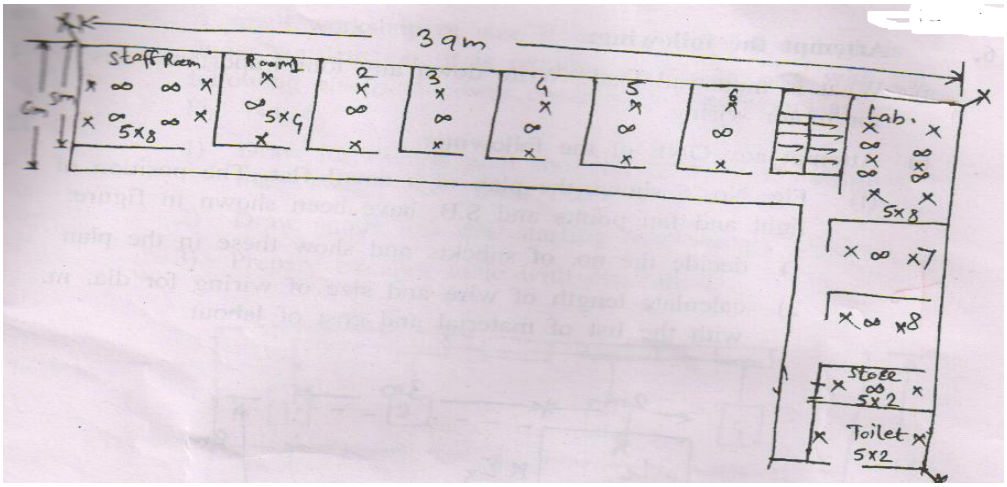
Single Line Diagram : ---------- (1 Mark)



Wiring Layout : ---------- **(1 Mark)**



b) **The ground floor plan of a double storeyed school building is shown in Fig. No. 3. The roof lights and fans are also indicated on it. First floor is similar to ground floor. In**

	each room 6A socket outlet has to be provided. Calculate the total voltage and decide the roof sub ckts. Draw the single line diagram showing arrangement of switch boards and DB from E.M. for complete school building. Assume if data required.
Ans:	

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

1) **Total Load for shop & Store :**

$$Total\ \ load\ in\ \ One\ Shop = Lamp \times watt\ \ = 02 \times 60 = 120W$$ ---------- **(1 Mark)**

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

$$Total\ load\ in\ \ One\ Shop = Lamp\ \ in Watt + Fans\ in\ Watt$$

$$Total\ load\ in\ \ one\ \ Shop = 120 + 60 = 180\ \ watt$$ ---------- **(1 Mark)**

$$Total\ load\ in\ \ 8\ Shop + 1\ Store = 180 \times 09 = 1720\ \ watt$$

2) Similarly Total Load for staff room and lab :

$$Total\ \ load\ in\ Staff\ \ room + Lab = Lamp \times watt\ \ = 10 \times 60 = 600W$$

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

$$Total\ load\ in\ \ One\ \ Shop = Lamp\ \ in\ Watt + Fans\ in\ \ Watt$$

$$Total\ load\ in\ \ Staff\ \ room\ \&\ Lab = 600 + 480 = 1080\ watt$$ ---------- **(1 Mark)**

3) Similarly Total Load for Toilet :

$Total\ \ load\ in\ Toilet = Lamp \times watt\ \ = 2 \times 60 = 120\ W$

$Total\ load\ in\ \ Store = Lamp\ \ in\ Watt + Fans\ in\ \ Watt$

$Total\ load\ in\ \ Staff\ \ room\ \&\ Lab = 120 = 120\ watt$ ---------- **(1 Mark)**

4) Similarly Total Load for sockets in single storeyed building:

$= Sockets \times watt\ \ = 12 \times 100 = 1200\ W$

5) Similarly Total Load for Single storeyed building :

$Total\ load\ in\ \ \sin gle\ Building\ \ = 1760 + 1080 + 120 + 1200 = 4160\ watt$

6) Similarly Total Load for Double storeyed building :

= 2 floor x 1 floor total Load

= 2 x 4160

= 8320 watt ---------- **(1/2 Mark)**

= 8.32 KW

7) Total Load in Amp:

$Total\ load\ in\ \ Two\ storered\ Building\ Amps = \frac{8320}{\sqrt{3} \times 400 \times 0.9} = 13.35 Amp\ \ \ assu\min g\ \ p.f. = 0.9$

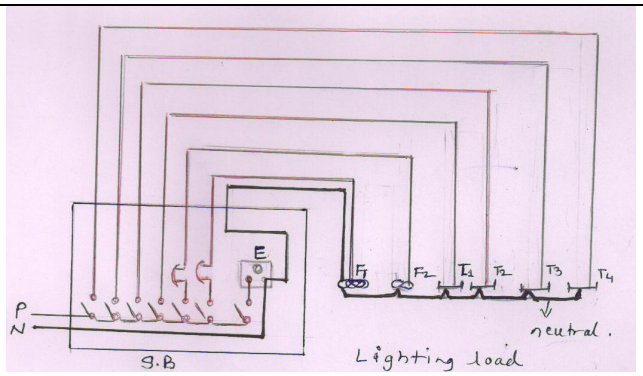
- --- **(1/2 Mark)**

8) Total required voltage : 3- ph, 400 volt ---------- **(1 Mark)**

9) Total No. of Lighting Sub Circuit: 11 No

ii) $Total\ load\ in\ \ = \frac{8320}{800} = 10.40 \cong 11\ \ Nos\ lighting\ sub\ circuit$

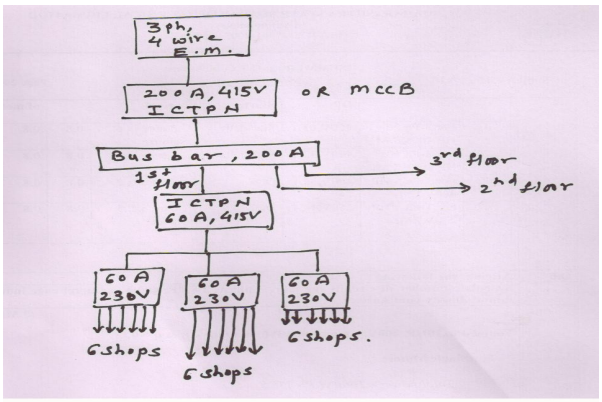
Wiring Diagram for Lighting circuit in one shop:- (Similar to other shop & Building floor) **(1-Marks)**



or equivalent figure

or equivalent figure

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



or equivalent figure

c) **In a workshop, one 15 HP, 400 V, 3(1) 50 Hz motor is to be installed. Draw single line diagram showing arrangement of other equipments. Decide the cable size and rating, fuse rating and motor starter with switch. Assume necessary data.**

Ans: **Four 3-Ph ,15HP, 400V, Assumption P.f. of motor 0.8 & η = 0.8**

For Single Motor:

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

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

$$Rated\ input\ current\ I_L = \frac{15 \times 735.5}{\sqrt{3} \times 400 \times 0.8 \times 0.8}$$

Rated /Full load Current in Motor:- = 24.88 Amp ----------**(1 Marks)**

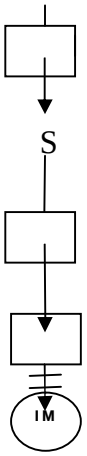
It is assumed that starting current is two times rated input current.

Starting current = 2 x 24.88 = 49.76 Amp---------- **(1 Marks)**

So use, 25 Sqmm , 3 ½ core cable Aluminum 1/ 2.80 mm , 600V grade should be selected rating of SFU, ICTP switch is 63A, 450V grade should be selected. ---------- **(1 Marks)**

Starter Used: Star-Delta Starter

Single Line Diagram: ----------**(2 Marks)**



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

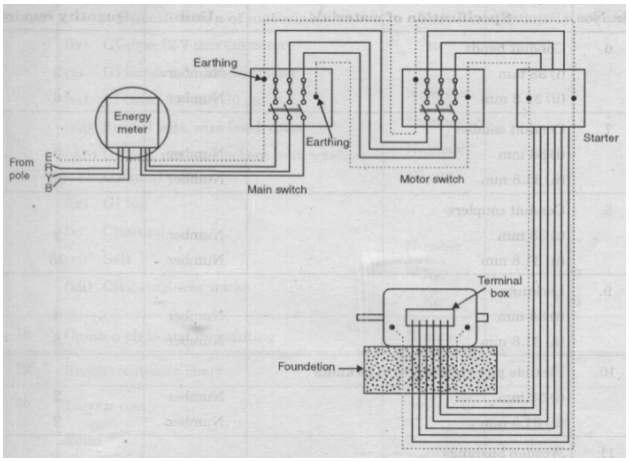
Main Fuse

ICTP

$tar-delta starter

3 Ø Squirrel cage Induction motor **OR**

Wiring diagram – ----------**(2 Marks)**



Or equivalent ckt dia

Q.6	**Attempt the following :** **04 Mark**
a)	**What is industrial load? Write down any four important rules for motor wiring.**
Ans:	**Meaning of Industrial Load:** **(Any Four points expected: 1/2 Mark each)** ➢ In industrial load power load, electrical machines load is more than lighting load. ➢ 3-ph load is more than single phase load. ➢ Power factor of the load is less than unity, it should be improved. ➢ The tariff of industrial load is different. ➢ The all safety precausions e.g. MCB, MCCB, ELCB, Fuses should be installed. ➢ The earthing resistance should be maintained, the size of earth wire is 8SWG copper or 6 SWG GI **Important rules of motor wiring:** **(Any Four points are expected: 1/2 Mark each)** 1. The supply to every motor is controlled by main switch. Main switch may be ICDP for single phase machine and ICTP for 3-ph machine. 2. Starter is required to start the motors, if the capacity of the motor is less than 5 HP then DOL starter can be used and if it is more then star-delta starter, auto transformer starter, or rotor resistance starter etc (depends upon types of motor) can be used. 3. The size and core of cable is also decided Size of the cable is decided by the starting current of every machine, generally starting current is assumed two times of rated input current of every machine 3. Type of the cable is decided by the type of supply of the machine, if the machine is single phase then two core cables is used and if the machine is three phase delta connected then three core cable is selected. If the machine is star connected then 3.5 cores or 4- core cable is selected 4. The path and mounting of cable is selected shortest route and convenience of power machine. 5. Armaoured cable can be selected for indoor power machine and unarmored cables can be selected outdoor power machine. **OR** i) Each motor should be provided with separate cable for distribution board or main board.

ii) Each motor should be individually controlled

iii) Rating of fuse, ICTP or ITDP, & starter should be based on starting current which is assumed two times rated input current.

iv) The motor should be earthed at two distinct terminals by 8 SWG copper wires.

v) The voltage drop in the cable should be with the tolerance limit + or – 5 %

vi) All protective measures should be installed for each motor.

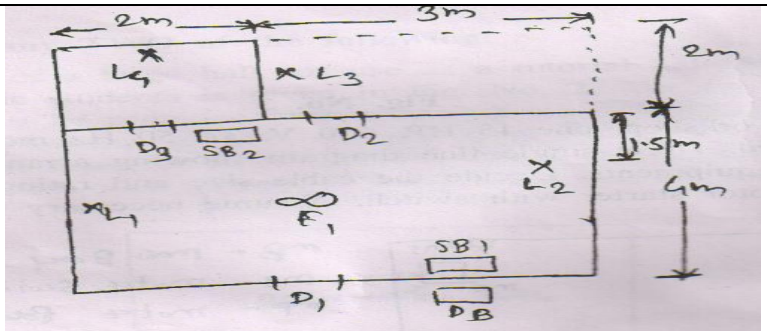
vii) Control unit should be near to motor as far as possible.

viii) Suitable KVAr rating of capacitor should be installed near to motor.

b) Attempt any ONE of the Following 12 Marks

b) i) Fig. No. 5 shows the plan of a small flat. The position of light and fan points and S.B. have been shown in figure:
1) decide the no. of subckts and show these in the plan
2) Calculate length of wire and size of wiring for dia. m. with the list of material and cost of labour.

Ans:



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

$Total\ \ load\ \ for\ small\ \ flat = No.\ of\ Lamps \times watt\ \ = 04 \times 60 = 240\ W$ **--- (1 Mark)**

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

$Total\ load\ in\ \ small\ \ flat = Lamps\ in Watt + Fans\ in\ Watt$

i) $Total\ load\ in\ \ small\ \ flat = 240 + 60 = 300\ watt$ ---------- **(1 Mark)**

$Total\ load\ in\ \ small\ \ flat\ Amps = \frac{300}{230} = 1.30\ Amp\ \ \ assu\min g\ \ p.f. = 1$ ------- **(1 Mark)**

ii) $Total\ No.\ of\ \ sub\ circuit\ = \frac{300}{800} = 0.375 \cong 1\ \ Nos\ lighting\ sub\ circuit$ ---- **(2 Mark)**

iii) Size of is decided by starting Current :

It is assumed that starting current is 1.5 times rated input current.

Starting current = 1.5 x 1.3 = 2.6 Amp---------- **(1 Marks)**

So use, 1.0 Sqmm , 2 core cable Aluminum , 250V grade should be selected rating of ICTP switch is 8A, 250V grade should be selected.

or 1/18 SWG Copper wire are used. ---------- **(2 Marks)**

iv) Calculate the total length of wire: ---------- **(2 Marks)**

Horizontal Run + Vertical Run +10 % of (HR +VR) =

OR

= (1 mtr + 2Mtr +5 Mtr +2 Mtr + 2 Mtr + 2 Mtr +1 Mtr) + (3 -1.2 - 0.3 Mtr + 0.3 + 0.3 + 3 -1.2 -0.3) + 10 %

= 15+ 4.2 + 1.92

Total length of wire = 22 Mtr of 1/18 SWG Copper

Schedule & cost of Material: - **(2 Marks)**

S.No	Material of Material	Quantity	Rate	Total Amount
1	ICDP 250V,8A	01	200.00	200.00
2	Fuses 250V, 8A	02	35.00	70.00
3	PVC conduit (3 Mtr pipe) 1.5mm thickness	20 pipe	15.00	300.00
4	Copper Earthing Plate	01	490.00	490.00
6	DP	01	150.00	150.00
7	Earthing Sundry	lumsump	200.00	200.00
8	6A S.P.S.T.	05	10.00	50.00
10	Ceiling rose	01	10.00	10.00
11	5A, 230V, Angle holder	04	15.00	60.00
11	1.5 Sqmm PVC wire Runing earth	30 Mtr	7.00	210.00
11	1 Sqmm PVC wire (90 Mtr -1 bundle)	01 Bundle	550.00	550.00
12	Labour Charges	05	70.00	350.00
		Total Amount :-		**2640.00**
13	Contingencies+ profit margin	10% Amount:-		264.00
		Total Amount:-		**2904.00**
	iii) Cost of work:	Say Total Amount:		**2910.00**

b) **(ii) A small workshop of size 10 m x 6m x 4m high is under construction. It is required to be provided with the following electrical power connections for motors as in Fig. No.**

6.
1) Draw installation plan showing location of machines, main switch and power D.B.
2) Draw single line dia. starting from energy meter
3) Prepare material table with estimation.

Ans:

1. *For* 5 *HP Machine* : *Rated input current* $I_L = \dfrac{HP \times 735.5}{\sqrt{3}\, V_L \times \eta \times Cos\phi}$ ------- **(1/2 Mark)**

$$Rated\ input\ current\ I_L = \frac{5 \times 735.5}{\sqrt{3} \times 400 \times 0.8 \times 0.8} = \frac{3677.5}{443.392}$$

$Rated\ input\ current\ I_L = 8.29\ Amp$ ---------- **(1/2Mark)**

Starting current : 2 x 8.29 = 16.58 Amp

2. *For* 3 *HP Machine* : *Rated input current* $I_L = \dfrac{HP \times 735.5}{\sqrt{3}\, V_L \times \eta \times Cos\phi}$ ------ **(1/2 Mark)**

$$Rated\ input\ current\ I_L = \frac{3 \times 735.5}{\sqrt{3} \times 400 \times 0.8 \times 0.8} = \frac{2206.5}{443.392}$$

$Rated\ input\ current\ I_L = 4.97\ Amp$ ---------- **(1/2 Mark)**

Starting Current: 2 x 4.97 = 9.94 Amp---------- **(1/2 Mark)**

3. *For* $0.5HP, 1-Ph$ *Machine* : *Rated input current* $I_L = \dfrac{HP \times 735.5}{V_L \times \eta \times Cos\phi}$

$$Rated\ input\ current\ I_L = \frac{0.5 \times 735.5}{230 \times 0.8 \times 0.8} = \frac{367.75}{147.2}$$

$Rated\ input\ current\ I_L = 2.49 Amp$ ---------- **(1/2 Mark)**

Starting Current: 2 x 2.49 = 4.98 Amp---------- **(1/2 Mark)**

4. *For* $1HP, 400V$ *Machine* : *Rated input current* $I_L = \dfrac{HP \times 735.5}{\sqrt{3} \times V_L \times \eta \times Cos\phi}$

$$Rated\ input\ current\ I_L = \frac{1 \times 735.5}{\sqrt{3} \times 400 \times 0.8 \times 0.8} = \frac{735.5}{443.392}$$

$Rated\ input\ current\ I_L = 1.658 \cong 2 Amp$ ---------- **(1 Mark)**

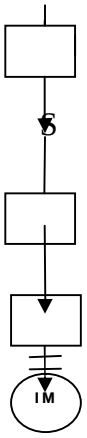
Main Switch for Four Motor = Starting current of highest rated m/c + full load current of reaming all m/c ----------**(1/2 Mark)**
= 16.58 +9.94 +4.98 + 2
= 33.5.21 Amp ---------- **(1 Mark)**

Rating of main switch for all Motors = 40 Amp, 415Volt ---------- **(1 Mark)**

Single Line Diagram : ----------**(2Marks)**

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

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



Energy meter

Main Fuse

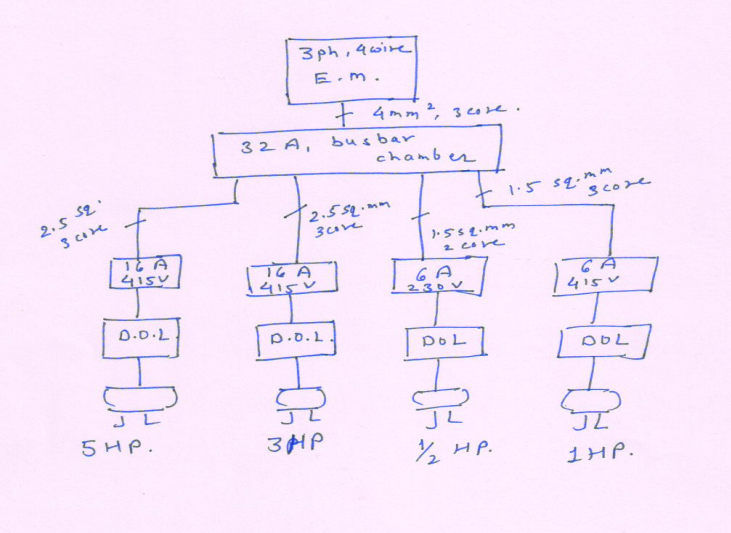
ICTP

$tar-delta starter

3 Ø Squirrel cage Induction motor

OR

Wiring diagram – ----------**(1Marks)**



Or equivalent ckt dia

Schedule of Material: - ----------**(2Marks)**

S.No	Material of Material	Quantity
1	32 A Busbar with Netural link	01
2	3-ph,4 wire 415V, 30-60A, A.C. supply Energy Meter	01
3	ICTP 450V,32A	01
4	ICTP 450V,16A	01
5	ICTP 450V,16A	01
6	ICDP 250V,6A	01

	ICTP 450V, 6A	01
8	DOL Starter	04
9	8 SWG Earthing Wire	50 Mtr
10	60 cm x 60cm x6.36 mm Copper Earthing Plate	01
11	Earthing nut-board	04
12	Earthing Sundry	lumsump
13	36 x36 Wooden Board for SDB	03
14	24 x 24 Wooden board	03
15	Screw 3 inch length	30 No
16	Screw 1 inch length	50 No
17	R,Y,B Indication Lamp	03
18	PVC Tape	04
19	Saddles	1 box
20	25 PVC conduit (3 Mtr pipe) 1.5mm thickness	20 pipe
21	2.5 Sqmm x 3.5 or 3Al. core aramoured cable	15 Mtr
22	2.5 Sqmm x 3.5 or 3 Al.core aramoured cable	22 Mtr
23	1.5 Sqmm x 3.5 or 3 Al. core aramoured cable	30 Mtr
24	1.5 Sqmm x 2 Al.core armoured cable	37 Mtr
25	Steel angle for SDB (2 Mtr length)	06
26	Nut board required for wooden board fitting	16
27	Junction Box	20 approx.
28	4 x 6 Switch board with cutting	03
29	10 x 12 Switch board with cutting	01
30	Main Switch Board	01
31	Labour Charges	At actual
		Total Amount :-
32	Contingencies+ profit margin	10% Amount:-
		Total Amount:-
	iii) Cost of work:	Say Total Amount:

----------**END**----------