WINTER– 2016 Examinations

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)	**State 1.E Rule No. 90.**
Ans:	**I.E. Rule No.90:** **(2 Mark)** ➢ All metal supports of overhead lines and metallic fittings attached there to, shall be permanently and effectively earthed. ➢ For this purpose, a continuous earth wire shall be provided and securely fastened to each pole and connected with ordinary at 4 points in every 1.6 km spacing between the points is being as nearly equidistant as possible. Alternatively, each support and metallic fittings attached there to shall be efficiently earthed. ➢ Each stay wire shall be similarly earthed unless one insulator has been placed in at a height not less than 3.3 m from the ground.
b)	**Draw the symbols for following:** **(i) Bracket fan (ii) Intermediate switch (iii) Neutral link (iv) Bell**
Ans:	i) **Bracket fan** ii) **Intermediate Switch** iii) **Neutral Link** iv) **Bell** **(Each Symbols: 1/2Mark)**

c)	**Draw wiring diagram for one lamp and two fan.**
Ans:	**Wiring diagram for 1 lamp and 2 fan:** **(2 Marks)** or equivalent figure
d)	**List the name of various components of service connection for underground connection.**
Ans:	**List of Following components of service connection for underground connection:** **(2 Mark)** 1. 2.5 Sqmm, 4 core Armored cable: (Size of cable is depends on load 1.5 KW. & length of cable is depends on service connection premises) 2. Brick, soft sand for protection of cable. 3. If cable is laid across the public road then Cement pipe, DWC pipe or GI pipe is required for better protection of cable 4. Cable lug as per required size. 5. Cable Gland as per required size 6. Feeder piller or cable box or bus bar and cable end box. 7. GI pipe as required size. 8. Cable bushing. 9. 8 SWG Wire 10. Clamps, saddles etc 11. As such all service connection material like main switch, MCB, Energy meter, Neutral link, IC cut out, earthing nut, screws, and wooden board. etc

e)	**State the purpose of following in conduit wiring: (i) Nipple (ii) Bushing**
Ans:	**(i) Purpose of Nipple :** To joint the two separate size (diameter) PVC conduit. **(1 Mark)**
	(i) Purpose of Bushing: **(1 Mark)**
	Bushings are used to protect both wires and Cables and surfaces that they pass through. To protect wires, bushings insulate openings for the wires to pass through so they won't be damaged in any way.
f)	**List the types of internal wiring in residential installations.**
Ans:	**(Any four types are expected: 1/2 Mark each)**
	List the types of Internal wiringin residential installations –
	1) Cleat wiring
	2) Batten wiring
	3) Wooden casing capping wiring
	4) PVC conduit wiring
	5) PVC casing capping wiring
	6) Concealed wiring
g)	**State any two factors on which the size of bus bar chamber depends.**
Ans:	**Following factors the size of bus bar chamber depends:-**
	(Any Two point expected: 1 Mark each point)
	1. Current rating or current carrying capacity :- which decides the cross sectional area of the strips (Copper or Aluminum)
	2. According to voltage level the Clearance between the strips depends:- more voltage more clearance therefore size of bus bar Chamber depends on above two factors
	3. Thermal dissipation conditions.
h)	**Give any four examples of commercial electrical installations.**
Ans:	**(Any four types are expected: 1/2 Mark each)**
	Examples of commercial Installation: (Any four examplesexpected)
	1) Hospital
	2) Schools
	3) Colleges
	4) Banks
	5) Shopping malls
	6) Large temples
	7) Auditorium
	8) Cinema theaters
	9) Show-rooms etc.

i)	**State the function of following in motor wiring circuit:** **(i) Motor switch (ii) Main switch**
Ans:	**i) Motor switch:** To make ON/OFF the motor. **(1 Mark)** **ii) Main switch:** To give the main supply to the motor with fuse protection inside. **(1 Mark)**
j)	**List the types of engineering contracts.**
Ans:	**Different types of Engineering contract:-** **(Any Four types expected 1/2-Mark)** 1) Lump sum contract 2) Item rate contract 3) Cost + % rate contract 4) Target rate contract 5) Material supply contract 6) Labour contract 7) Sub contract 8) All in one contract 9) D.G.S. of 'D' rate contract 10) Cost plus(+) percentage variable rate contract 11) Cost plus(+) fluctuating fees rate contract
k)	**Define the following: (i) Earnest money deposit (ii) Security deposit**
Ans:	**i) Earnest Money deposit (EMD) :-** **(1 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. **ii) Security Deposit (SD):-** **(1 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.
l)	**Name the starters used for following motors:** **(i) 7 H.P. 3-Ph squirrel cage I.M(ii) D.C. shunt motor**
Ans:	**Name the starters used for following motors :** **(Each Name of Starter : 1 Mark)** **i) 7 H.P. 3-Ph squirrel cage I.M:** i) Star-Delta Starterii) Auto transformer starter iii) Soft start starter. **ii) D.C Series Motor :** 1) Armature resistance starter (Two point starter)

Q.2	**Attempt any Four of the following : 16 Marks**
a)	**List any eight rules related to electrification of residential installation.**
Ans:	**(Note: Similar to following rules any eight expected 1/2 Mark each point)**

Following rules related to electrification of residential 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 sizeof 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 $= \dfrac{50 \; M\Omega}{Number \; of \; outlet}$

b)	**Draw a neat 6labeled diagram for overhead service connection to a double storey building.**
Ans:	**Diagram for overhead service connection to a double storey building:-** **(4 Mark)** **or equivalent diagram**
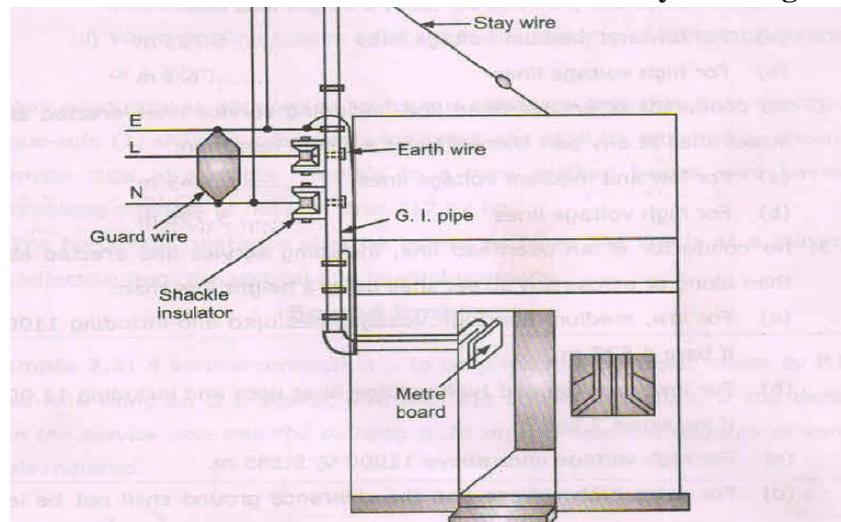
| c)	Compare overhead service connection and underground service connection on the basis of initial cost, identification of fault, appearance and safety.
Ans:	Compare overhead service connection and underground service connection

(Each Point : 1 Mark)

S.No	Basis	Overhead service connection	Underground service connection
1	**Initial cost**	Less	More
2	**Identification of fault**	Easy	Difficult
3	**Appearance**	Appearance is poor. OR not so good	Appearance is good.
4	**Safety**	Less safety	More safety

d)	One light point, one ceiling fan, two 6 Amp socket outlet are to be wired switches are to be provided on a single switch board. Draw the wiring diagram and single line diagram.
Ans:	**i) Wiring diagram for One light point, one ceiling fan, two 6 Amp socket outlet:**

(2 Mark)
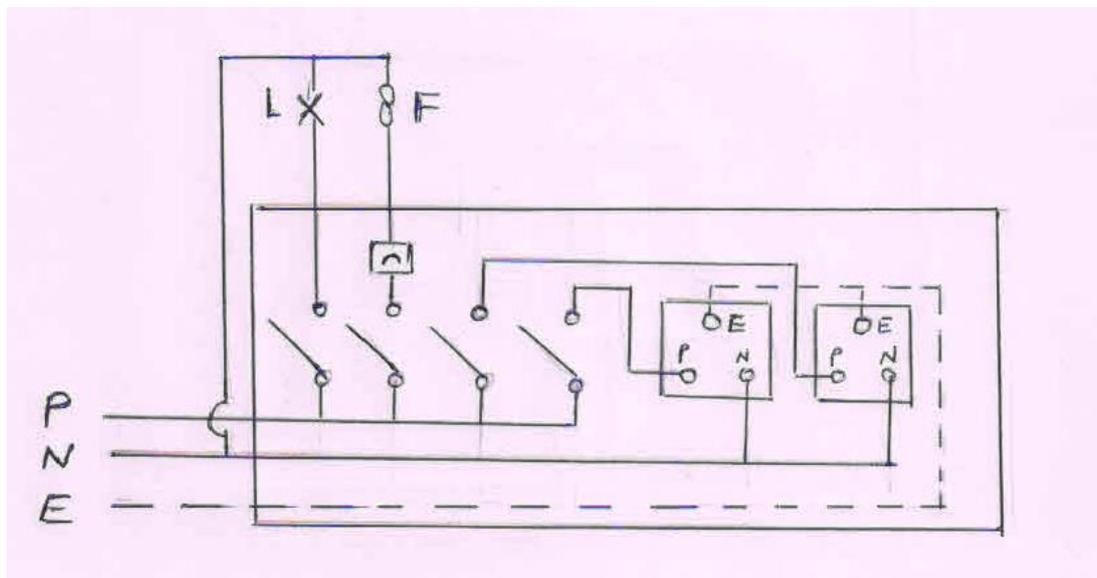
	ii) Single Line diagram: **(2 Mark)** **or equivalent figure**	
e)	**With reference to execution of work explain the meaning of:** **(i) Administrative approval (ii) Technical sanctions**	
Ans:	**(i) Administrative approval:** **(2 Mark)** ➢ When any government department requires executing a project like network addition or extension work or installation of new project. It requires necessary administrative approval from government. ➢ Initially the project is taken up with public works department, the divisional engineer under whom the work lies prepare preliminary report in the form of a proposal. ➢ The proposal is in the form of plan layout drawing at approximate estimation, then the proposal is submitted to the proper authority of the department. ➢ The proposals are approved by competent authority, if PWD recommended that proposal are sound and estimated approximately and reasonably. ➢ This type of formal acceptance that is as good as order to PWD for executing the	
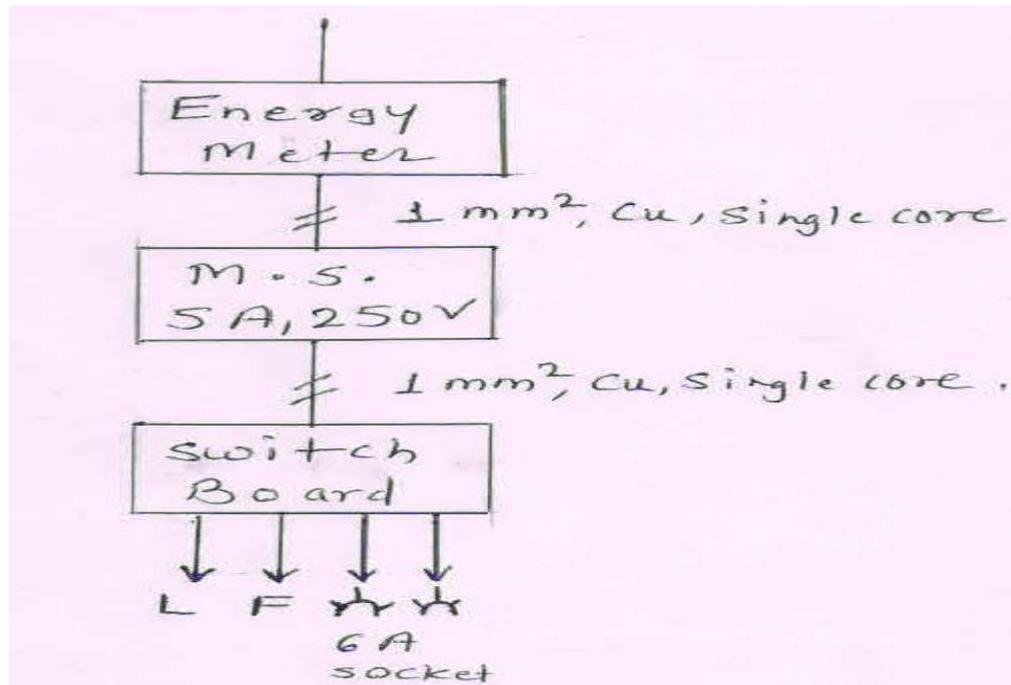
	work is called as **Administrative approval**
	(ii) Technical sanction: **(2 Mark)**
	➢ After the sanction of administration approval by the competent authority, the details drawing of plan and detailed estimate are prepared by PWD engineer.
	➢ If detailed documents are forwarded to the government for sanction or to the officer of the public work department.
	➢ Appointed by government to whom powers are designated by government.
	➢ The sanction given by authority is called **technical sanction**
f)	**State the sequence to be followed to prepare estimate of factory unit.**
Ans:	**(Minimum Eight point expected 1/2 each point)**
	Following the sequence to be followed to prepare estimate of factory unit:-
	1) Find out output power of every machine in watts.
	1) 1 HP = 735.5 w
	2) 1 BHP = 746 w
	3) 1 KVA = 1000 VA. Assume P.f.
	2) Find out Input power of every machine by assuming the efficiency of everymachine.
	$$\text{Input power of machine} = \frac{\text{output power of machine}}{\text{Efficiency of machine}}$$
	3) Find out Input current of every machine for 1-ph machine.
	Input power = $V\, I \cos\phi$
	V = Input voltage = 230V
	Cos ϕ = 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 ϕ = 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 tosustend starting surge, overload momentary short circuit and futureexpansion.

5) Find out total Electrical load of given factory.

6) Determine the Input current required for whole factory.

$$P = \sqrt{3}\ V_L\ I_L \cos \varnothing$$

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

Following the sequence to be followed to prepare estimate of factory unit:-

    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.

Q.3	**Attempt any TWO of the following :** **16 Marks**
a)	**A college canteen hall has 6 m x 4 m size. It provided with the following electric load:** **i) 12 nos. of tube lights 40 watt each.(ii) 6 nos. of fan points of 60 watt each.** **(iii) 4 nos. of plug points of 240 watt each.** **Estimate quantity of material and their cost required for casing capping wiring system.**
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 × watt = 12 × 40 = 480 W* *= Fans × watt = 06 × 60 = 360 W*

$$= Sockets \times watt = 04 \times 240 = 960 \ W$$

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

Total load in Hall $= 480 + 360 + 960 = 1800 \ watt$ ----------------------- **(1 Mark)**

Total load in Amps $= \dfrac{1800}{230} = 7.82 \ A \cong 8 \ Amp \quad assu\min g \ p.f. = 1$

Rating main switch: - since more current is 8 A.

Assumed that Staring current = 1.5 times rated current

So starting current = 1.5x 8 = 12 A

 So Use:-

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

No. of lighting sub circuit $= \dfrac{1800}{800} = 2.25 \cong 3$ ----------- **(1 Mark)**

 Layout Drawing:-   --------- **(2-Marks)**
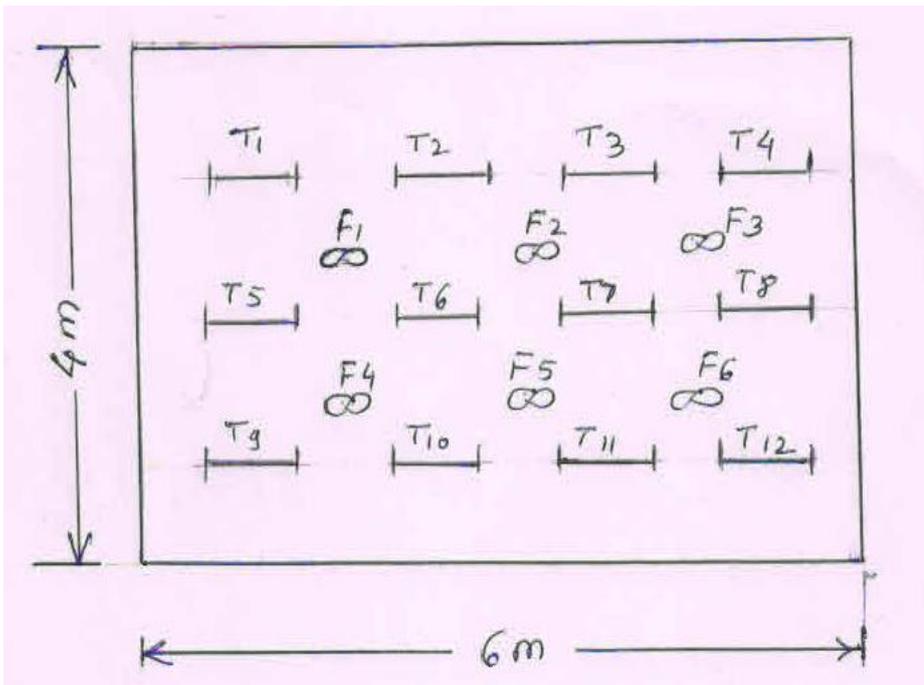
 or equivalent figure

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

ii) Schedule & cost of Material: -   **(4-Mark**

S.No	Material of Material	Quantity	Rate	Total Amount
1	ICDP 250V,16A	01	250.00	250.00
2	Fuses 250V, 16A	02	45.00	90.00
3	PVC Casing Capping (2Mtr pipe) 1.5mm thickness	16 Nos (32 Mtr)	45.00	720.00
4	Copper Earthing Plate	01	490.00	490.00
6	DP	03	150.00	450.00
7	Earthing Sundry	lumsump	200.00	200.00
8	6A S.P.S.T.	22	10.00	220.00
9	6A Three point socket	04	12.00	48.00
10	Ceiling rose	18	10.00	180.00
11	1.5 Sqmm PVC wire (90 Mtr -1 bundle)	01 Bundle	550	550.00
11	1 Sqmm PVC wire Running earth	40 Mtr	7.00	280.00
12	10" x12" Switch Board	02 Nos	25.00	50.00
12	Labour Charges	22	70.00	1540.00
		Total Amount :-		**5068.00**
13	Contingencies+ profit margin	10% Amount:-		507.00
		Total Amount:-		**5575.00**
	iii) Cost of work:	Say Total Amount:		**5575.00**

b) **(i) State the procedure for the selection of rating of main switch and distribution board in residential building installation.**

Ans: **Following the procedure for the selection of rating of main switch and distribution board in residential building installation:**

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)

$$Total \ load \ in \ = tubes \times watt \ = 4 \times 60 + 3 \times 100 = 540 \, W$$

$$= Fans \times watt \ = 4 \times 60 = 240 \, W$$

$$= Sockets \ \times \ watt \ = 6 \times 60 = 360 \ W$$

$i)$ $Total \ connected \ lighting \ load \ in \ a \ house = 540 + 240 + 360 = 1140 \, W \ or \ 1.14 KW$,   **- (1/2 Mark)**

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ii) *Total connected Power load in a house* $= 4 \times 1000 = 4000\,W\ or\ \ 4.0\,KW$,   **(1/2 Mark)**

Total load connected $= 1140 + 4000 = 5140\ or\ \ 5.14\ \ KW$

iii)   Total load in $= \dfrac{1140}{800} = 1.425 \cong 2$ Nos lighting sub circuit

Total load in $= \dfrac{4000}{200} = 2$ Nos Power sub circuit

Distribution Board: So, 4 number of MCB are required   -------------------- **(1 Mark)**

iv) Total Connected load is 5140 watt, so Number of sub circuit = 4 Nos.

v) Current rating of iron clad main switch = since more current is 23 A.

Current rating **Iron clad Main switch** = 32 A   **---------------------------- (1 Mark)**

vi) Value of current rating of iron clad main switch: **------------------------ (1 Mark)**

So Use: - 250V, 32A, ISI mark Main switch of any company

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b) | **ii) State the principles of circuit design in lighting and power circuits.**

Ans: | **The principles of circuit design in lighting and power 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.

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

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

Power Circuit :-   **(2 Mark)**

➤ For power load there should be maximum 3000W for 2 to 3 points.
➤ For power load there should be maximum 1000W for total 1 to 2 points.(old rule)
➤ Make the no. of power sub circuits for power load.

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

OR

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

|	
c)	**Prepare a complete estimate to install a 3-phase, 400 volt, 50 Hz, 3 H.P.induction motor have to be used for grinding purpose in a small workshop having room size of 3 m x 3 m. Assume necessary data required for the estimation. Draw installation plan and wiring diagram.**
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 = 3 x 735.5 = 2206.5 W----------- **(1/2 Mark)** **Step No. 2:-** Input power of I. M = output power of I M / efficiency of IM motor. - **(1 Mark)** Assuming efficiency of I.M is 80 % Input power of induction motor = 2206.5 / 0.8 = 2758.12 W **Step No. 3:-** To determine the rated current for I.M ---------------------------- **(1/2 Mark)** $$P = \sqrt{3}\, V_L\, I_L Cos\phi \qquad\qquad V_L = 400\,V$$ $$I_L = \frac{P}{\sqrt{3}\, V_L Cos\phi}$$ $$I_L = \frac{2758.12}{\sqrt{3} \times 400 \times 0.8} \qquad\qquad Cos\phi = 0.8\ assumption$$ $$I_L = 4.98\ Amp \qquad Rated\ current = 4.98\ Amps \quad ----------- \textbf{(1 Mark)}$$ **Step No. 4:-** To determine the size & core of cable:- ---------------------------------- **(1 Mark)** Starting current is assumed two times rated input current for starting surge, momentary short circuit & overload. Starting current = 2 x 4.98 = 9.96 Amps So use, 2.5 Sqmm 3.5 core cable for the I.M. **Step No. 5:-** Determined the size length & dimensions of ICTP earth wire at input cable:- **(1 Mark)** The rating of main switch is 450 V, 16 Amp ICTP ISI mark Size of earth wire 8 SWG copper or 6 SWG GI Length of earth wire = 2 times length of cable Length of input cable for I .M = 1.2 meter + 0.5 meter +1 meter + 1 mtr (up to motor terminals)

Length of input cable for I .M = 3.7 meter

Total length of cable=3.7+.37=4.07M 3.5core cable , size of 2.5sq.mm --------- (1 Mark)

Step No.6: Installation Plan. --- **(1 Mark)**
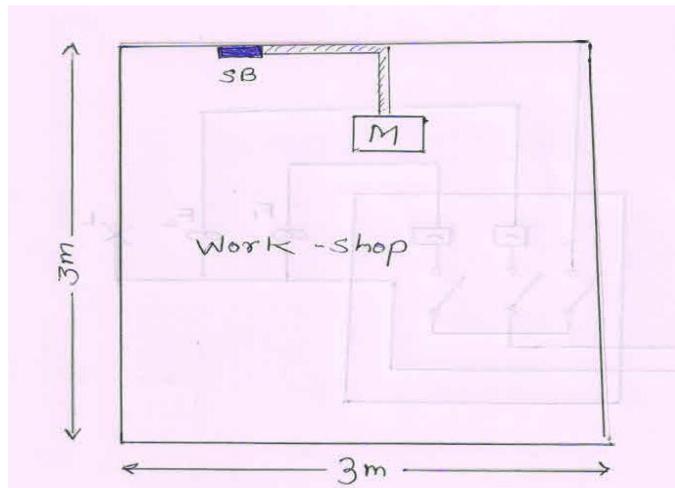
or equivalent diagram

Step 7: Wiring diagram: --- **(1 Mark)**

Material Schedule:

S.No.	Name of Material	Qty
1	16 A Busbar with Netural link	01
2	3-ph,4 wire 415V, 15-30A, A.C. supply Energy Meter	01
3	ICTP 450V,16A	02
4	DOL Starter	01
5	8 SWG Earthing Wire	0.5.kg
6	60 cm x 60 cm x 6.36 mm Copper Earthing Plate	01
7	Earthing Nut-bolt	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	01
14	Saddles	1 box
15	32mm PVC conduit (3 Mtr pipe) 1.5mm thickness	7 pipe
17	2.5 Sqmm x 4 Copper armored cable	10 Mtr
18	Bend	02 approx.
19	Lug & gland	06 approx

Q.4	**Attempt any FOUR of the following :**	**16 Marks**
a)	**Draw the following wiring diagrams:** **(i) One lamp controlled by one switch.(ii) One lamp controlled by two switches.**	
Ans:	**(i) One Lamp controlled by one switch:** **(Figure-2 Marks)** **(ii) One Lamp controlled by two switches:** **(Figure-2 Marks)** **OR**	
b)	**Write necessity of earthing. Draw a neat labelled diagram of pipe type earthing.**	
Ans:	**necessity 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 equipment.	
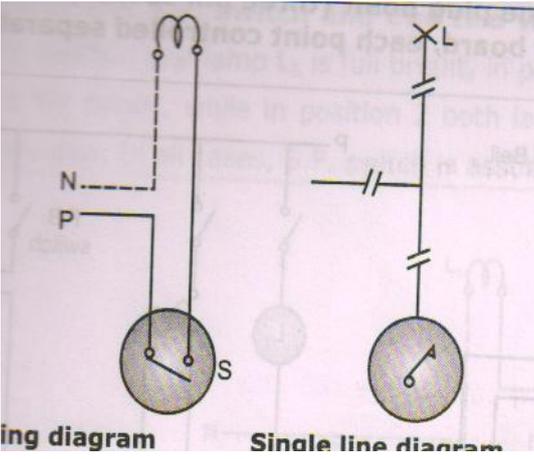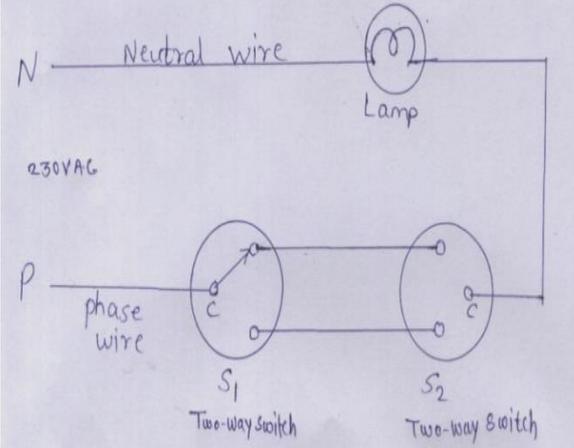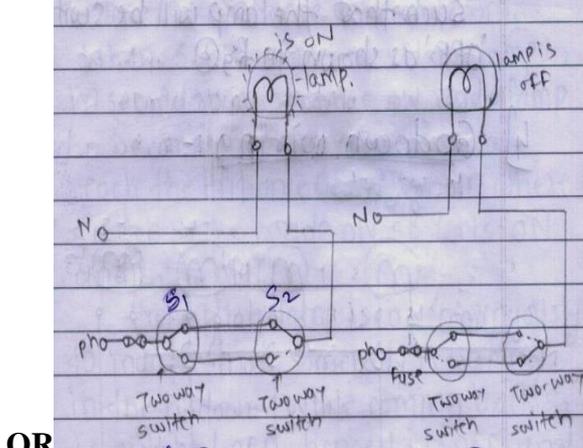
	Diagram for Pipe Type earthing : **(2 Marks)**	
	or equivalent figure	
c)	**Write procedure of submission and opening of a tender.**	
Ans:	**Procedure of submission Procedure of Tender:-** **(2 Marks)** ➢ The tender is submitted from party No.2 (Bidder) to party No.1 (Owner) in sealed envelopes within 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 as **" Envelop No.3"**	
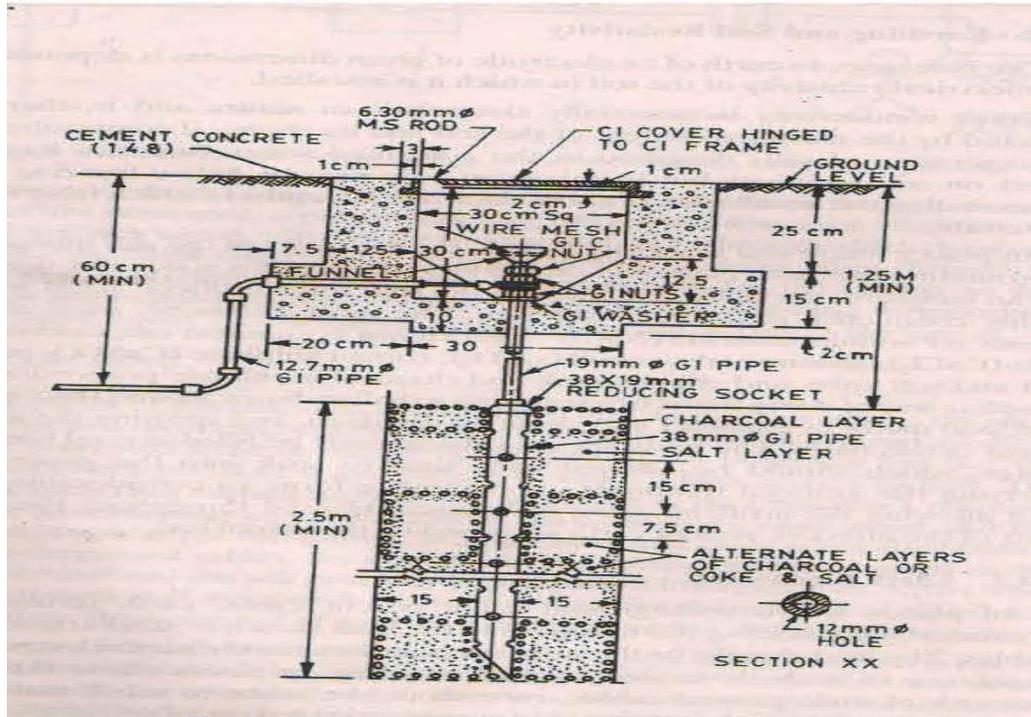
	Procedure of Opening of Tender:- **(2 Marks)** The sealed envelopes are opened in presence of representative of bidders. The procedure is as below ➤ The tenders are always opened at specified date & time in front of representative of every bidder. ➤ Initially envelop No.1 of every party is opened. The 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.	
d)	**State the rating of lamps, fan and socket outlet points used in residential installation.**	
Ans:	**Rating of lamps, fan and socket outlet points used in residential installation:** **(4 Mark)**	

S.No	Points used in residential installation	Rating of Lamp
1	Lamps	40 watt or 60 watt
2	Fan	60 watt or 100 watt
3	Socket outlet	Lighting socket: 100 watt Power socket : 1000 watt

e)	**Write the procedure to prepare a design for commercial electrical installation.**
Ans:	**(Minimum Eight point expected: 1/2 each point)**

The following procedure to prepare a design for 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

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

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

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

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.

$$P = V1\cos\phi \qquad P = \text{Input power for every sub circuit}$$
$$V = \text{voltage} = 230\ V$$
$$I = \text{Input current for every sub circuit}$$

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 battenrequired 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 operated with star delta starter. Draw wiring diagram showing connection of 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.5	**Attempt any FOUR of the following :** **16 Marks**
a)	**A bungalow has a lighting load of 2 kW and power load of 4 kW. It is located 10 mtr away from electric supply pole. Calculate the rating and quantity of service wire required. List the material required to provide O.H. connection.**
Ans:	**(The Assumed data may be vary)** **(Give stepwise Marks as mention below)** *ligthing circuit Load* $= 2000\,W$ *or* $2\,KW$, ---------------- **(1/2Mark)** *Power sub − circuit Load* $= 4000\,W$ *or* $4\,KW$ ---------------- **(1/2 Mark)** *Total load connected* $= 2 + 4 = 6KW$ ------------------------------ **(1/2 Mark)** *Assu* min *g* sup *ply voltage − ph,* $230V$, $50Hz$, *&* $Cos\phi = 1$ *and height of bunglow is* $10\,m$ **(1/2 Mark)**
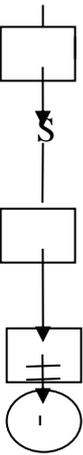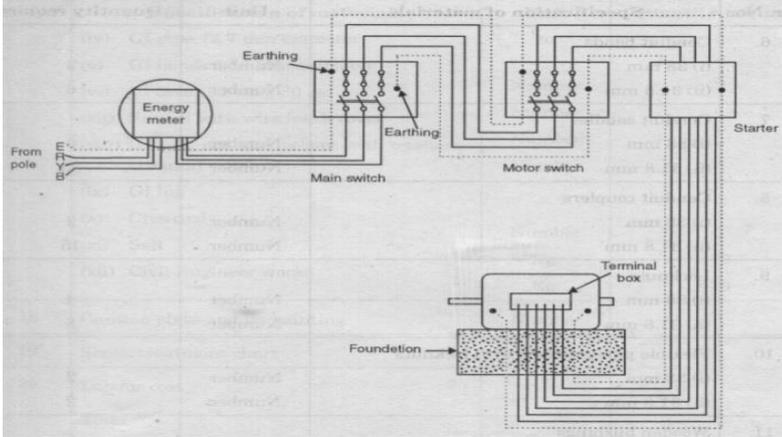
The rated current for service wire or input conductor $= \dfrac{P}{V}$ -------------- **(1/2 Mark)**

The rated current for service wire or input conductor $= \dfrac{6\ KW}{230}$

The rated current for service wire or input conductor $= \dfrac{6000}{230}$

The rated current for service wire or input conductor $= 26.08\ Amps$ ----- **(1/2 Mark)**

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

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

S.No	Schedule of Material	Quantity
1	PVC insulated cable or insulated wire	20Mtr
2	S shaped G I pipe 50 mm diameter	3Mtr
3	Earth wire 8 SWG	20 Mtr
4	Meter board	01 Nos.
5	Stay wire	10 m
6	Stay insulator	01 Nos.
7	Cement	01 Bag
8	Sand	01 Bag
9	Miscellaneous	At actual

b) **The main circuit wire in a house is required to carry a current 45 Amp when connected to single phase a.c. supply. Determine the size of the wire if the length of the circuit is 40 meters.**

Ans: **For Current Rating of 45 Amp when connected to single phase a.c. supply: (4 Mark)**

1. 10 Sqmm, 7/1.4 mm, copper, Single core, PVc insulated, 1.1 KV Grade & 1 volt drop for 5.5 mtr

OR

2. 15 Sqmm, 7/1.63 mm, copper, single core, PVc insulated, 1.1 KV Grade & 1 volt drop for 7 mtr.

   ❖ Note : voltage drop in the cable should be within the permissible limit $\pm 5\%$

c)	**State sequence to be followed for preparing estimate of residential building electrification.**
Ans:	**(Note: Similar to following sequence Any Eight point expected: 1/2 Mark each point)** **Following sequence to be followed for preparing estimate of residential building 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 sizeof 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 $= \dfrac{50\ M\Omega}{Number\ of\ outlet}$
d)		**Define busbar. Draw and label the diagram showing its arrangement.**

	Ans:	**Meaning of Bus-bar**: - Distribute the load on 3-phase four wire systems. **(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
		        OR
		        Incoming and outgoing lines are connected to the element. This element means busbar
		Diagram showing the arrangement of busbar Chember: **(2 Marks)**
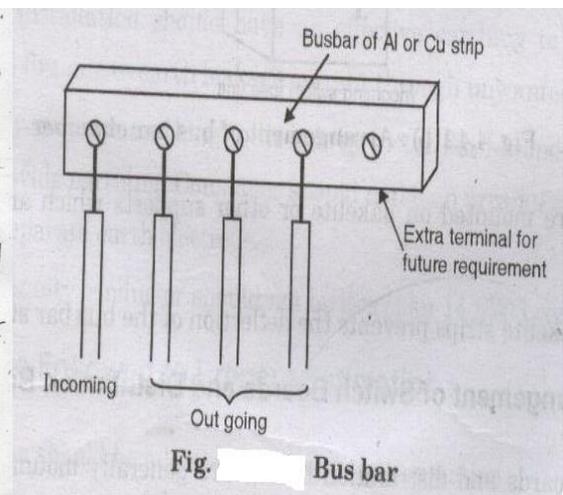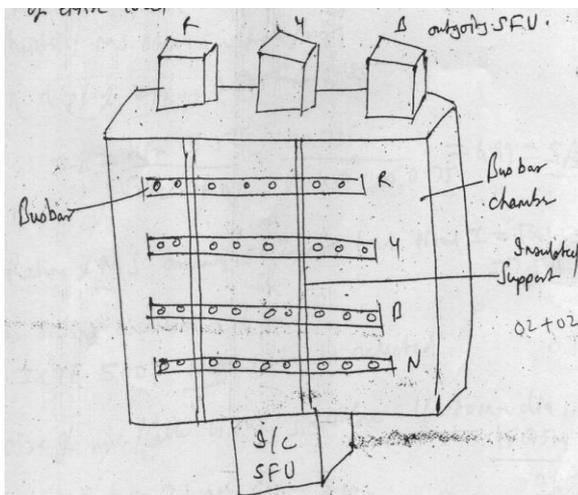		
		or
		 equivalent figure

e)	State commercial rate of any ISI mark company each of following for per unit: (i) Flexible wire bundle (90 mtr)(ii) Three pin power plug (5 A) (iii) Single phase, 15 Amp ICDP(iv) Single phase, 15 Amp MCB
Ans:	**(Each Rate : 1 Mark)** { table below }

S.No	Unit	Rate per unit
i)	Flexible wire bundle (90Mtr)	Rs. 230/- to 700/-
ii)	Three pin power plug (5A).	Rs. 20/- to 45/-
iii)	Single phase, 15 Amp, ICDP	Rs. 250/- to 350/-
iv)	Single phase, 15 Amp, MCB	Rs. 100/- to 200/-

f)	State any four rules and regulations for industrial wiring.
Ans:	**(Any four points expected 1 Mark each)** **Following rules and regulations of industrial wiring:-** 1) Each motor should be provided with separate cable for distribution board or main board. 2) Each motor should be individually controlled 3) Rating of fuse, ICTP or ITDP, & starter should be based on starting current which is assumed two times rated input current. 4) The motor should be earthed at two distinct terminals by 8 SWG copper wires. 5) The voltage drop in the cable should be with the tolerance limit + or – 5 % 6) All protective measures should be installed for each motor. 7) Control unit should be near to motor as far as possible. 8) Suitable KVAr rating of capacitor should be installed near to motor.

Q.6	Attempt any FOUR of the following : 16 Marks
a)	In a factory of area 30 m x 12 m one lathe machine of 1 H.P., 3-phase, 420 volt is to be erected. Estimate the cost for the power wiring.
Ans:	**i) Rating for 1HP, 3-Ph Sq.cage IM, I_{FL} = 5A :-** $Total\ power = Total\ H.P \times 735.5$ $Total\ power = 1\ HP \times 735.5 = 735.5\ watt$ $Total\ power = .735.5\ watt$ $Rated\ input\ current\ I_L = \dfrac{HP \times 735.5}{\sqrt{3}\ V_L \times \eta \times Cos\phi}$

$$Rated\ input\ current\ I_L = \frac{1 \times 735.5}{\sqrt{3} \times 420 \times 0.8 \times 0.8}$$

$$= 1.58\ Amp$$

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

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

S.No	Material of Material	Quantity	Cost of material
1	8 A Busbar with Netural link	01	750.00
2	3-ph,4 wire 415V, 15-30A, A.C. supply Energy Meter	01	500.00
3	ICTP 450V,8A	01	550.00
4	DOL Starter	01	1200.00
5	8 SWG Earthing Wire	0.5.kg	225.00
6	60 cm x 60cm x6.36 mm Copper Earthing Plate	01	490.00
7	Earthing nut-board	02	20.00
8	Earthing Sundry	lumsump	200.00
9	12x12 Wooden Board for SDB	02	50.00
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	01	10.00
14	Saddles	1 box	25.00
15	32mmPVC conduit (3 Mtr pipe) 1.5mm thickness	7 pipe	490.00
17	1.5 Sqmm x 4 Copper aramoured cable	10 Mtr (Assume)	240.00
18	Junction Box	03 approx.	30.00
19	Lug & gland	03 approx	80.00
20	Labour Charges	Lumsum	1500.00
		Total Amount :-	**6465.00**
21	Contingencies+ profit margin	10% Amount:-	646.00
		Total Amount:-	**6871.00**
	iii) Cost of work:	Say Total Amount:	**6870.00**

b)	**State any four rules for motor wiring.**
Ans:	**Important rules of motor wiring:**

<div style="color:red; text-align:right">**(Any Four points are expected: 1/2 Mark each)**</div>

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.

c)	**State the criteria for selection of contractor / supplier (any four).**	
Ans:	**Followingthe criteria for selection of contractor / supplier:**	

(Any Four points are expected: 1 Mark each)

1. Contractor should be well reputed

2. Past experience of the Contractor

3. Contractor licenses should be valid

4. Work in hand of the Contractor.

5. Manpower, Machines, Material availability of the contractor.

6. Tax clearance certificate & financial power of contractor.

d)	**Write any four difference between electrification of residential and industrial installation.**	
Ans:		

(Any Four Point expected : 1 Mark each)

S.No	Basis	Residential installation	Industrial installation. installation
1	Load capacity	Less	High
2	Input Supply	Generally single phase	Generally 3 phase
3	Purpose	Domestic purpose	Commercial purpose
4	Type of Load	Lighting load is more, power load is less.	Power load is more, lighting load is less.
5	Distribution	Bus bar chamber is not required	Bus bar chamber is required
6	Safety precautions	It is not public place so as per our convenience fuse MCB can be used.	It is public place so fuse MCB, MCCB should be compulsory used.
7	Sub-circuit	The lighting sub-circuit and power sub-circuit are separated	The lighting sub-circuit and power sub-circuit are separated
8	Power factor improvement	There is no need of power factor improvement device	If the power factor is poor then there is need of power factor improving device
9	Caution	There is no need of caution notice for residential installation	If supply voltage is equal to or more then 400V then there is need of caution notice

e)	**State the factors governing number of lighting sub-circuits and power sub-circuits in commercial installation.**
Ans:	**The Following factors governing number of lighting sub-circuits and power sub-circuits in commercial installation.**

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.

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

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

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

$$No.\,of\,power\,Sub\,circuits = \frac{Total\,No.of\,power\,po\mathrm{int}s}{2000\,W\,or\,3000\,W}$$

f)	**Give the procedure to calculate motor current in any industrial installation.**
Ans:	**Following the procedure to calculate motor current in any industrial installation:-**

$$Total\,output\,power = Total\,H.P \times 735.5$$ **(1 Mark)**

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

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

$$= \ldots\ldots\ldots\,Amp$$ **(2 Mark)**

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

Starting current = 2 x …….. = …….. Amp by this ampere rating the size and type of cable is decided. The fuses are also selected for this current.   **(1 Mark)**