SL NO. 2/Sem 4/I

Model Question Paper- I

ELECTRICAL INSTALLATION DESIGN AND ESTIMATION

Time : 3 Hours *Max.Marks : 75*

PART A

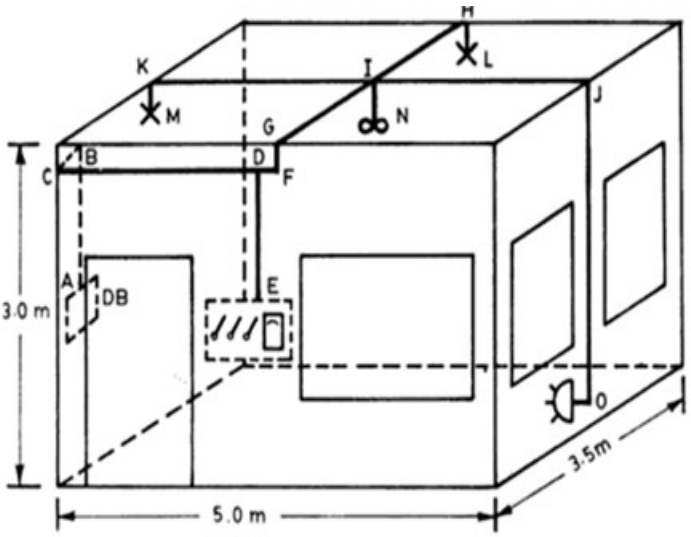
I.*Answer any 5 questions. Each question carries 3 marks* ***(5 x 3 = 15 Marks)***

1	Draw the graphical symbols of the followings: a) Lamp b) Single pole switch c) 6 or 5A Socket outlet	M1.02	R
2	Compare open and concealed conduit wiring systems and list any three differences between them?	M1.01	U
3	Define the following with respect to illumination a) Space Height ratio b) Depreciation Factor	M2.02	R
4	Illustrate direct and indirect lighting schemes	M2.01	U
5	List any three purposes of earthing?	M3.01	R
6	Summarize the necessity of a starter for a motor?	M3.02	U
7	List any three points to be taken into consideration while erecting overhead line?	M4.01	R

PART B

Answer ONE question from each set. Each question carries 15 marks

(4 x 15 = 60 Marks)

II	With neat sketches explain the following wiring systems and mention any three advantages and disadvantages of each.		M1.01	**U**
	a Cleat wiring	**(7.5)**		
	b Wooden Casing and capping wiring	**(7.5)**		
	OR			
III	Given the isometric view of the wiring installation of a room. 		**M1.02**	**A**
	a Draw the schematic representation of the wiring installation	**(3)**		
	b Draw the multiline wiring diagram of the wiring installation	**(5)**		
	c With proper justification find the number of sub-circuits required	**(3)**		
	d With proper justification select suitable size of aluminium conductor for sub-circuits	**(4)**		
IV	**a** Two sources of candle power or luminous intensity 200	**(8)**	**M2.01**	**A**

		candela and 250 candela are mounted at 8 and 10 m, respectively. The horizontal distance between the lamp posts is 40 m, calculate the illumination in the middle of the posts			
	b	State and prove inverse square law?	**(7)**	**M2.01**	**U**
		OR			
V		A small assembly shop 15 m long, 9 m wide, and 3 m up to trusses is to be illuminated to a level of 200 lux. The coefficient of utilisation is 0.75 and maintenance factor is 0.8.		**M2.03**	**A**
	a	Calculate the number of 40 W Fluorescent lamps required to illuminate the whole area if the lumen output of the lamp selected is 3000 lumens	**(3)**		
	b	Calculate the no of lamps fitted along length wise and breadth wise and draw the layout of light fittings. Take a space height ratio as 1.5 and lamp mounting height as 2m	**(9)**		
	c	Determine the number of sub circuits required for electrification	**(3)**		
VI		It is proposed to install a power connection of 3 phase 5 HP		**M3.03**	**A**

	induction motor for an agriculture tube-well in the room of size 3m x 3m x 3m high. The motor is one metre away from two nearest walls. Prepare the estimate in the following order.			
	a Develop installation plan showing location of Main Board and motor etc. Also mark the path of wiring by a thick line.	**(3)**		
	b Develop the single line diagram? Show earth wires also	**(5)**		
	c Select the rating and specification of important material and Calculate the length of wire, conduit, earth wire etc. and prepare a complete list of material required for wiring the room with complete specification of each item. Also calculate the approximate cost for power wiring (excluding earthing)	**(7)**		
	OR			
VII	A newly constructed single storey house is to be provided with single phase 230 V 50 Hz supply having a load of 5kW (light/fan/socket). Supply is to be given from overhead line 20m away from the building. A GI pipe is to be raised along the roof to receive the bare conductors on its cross arm fitted with insulators		**M3.04**	**A**
	a Construct the sketch of service connection?	**(5)**		
	b Prepare a list of material, for giving service connection and also estimate the cost of service connection.	**(10)**		
VIII	An overhead line of 1Km is tapped from the existing 11KV line to feed a particular locality. The particulars of important material to be used for the line to be erected are as follows.		**M4.02**	**A**

	i.Size of conductor : ACSR 6/1 x 2,59 mm ii.Tubular pole or supports of 11 metres length. iii.Size of earth wire: G.S. (Galvanized steel) 8 SWG. iv.Average span : 100 m v. No. of earthing sets to be installed : 3 Nos			
a	Construct the single line diagram of the line	**(3)**		
b	Construct the pictorial representation of the overhead line including the last three post	**(4)**		
c	Prepare the estimation table for the overhead line erection.	**(8)**		
	OR			
IX	A pole mounted substation of capacity 50kVA transformer of rating 11/0.4 kV has to be erected. The HT line is available about 50 metres from the proposed site		**M4.04**	**A**
a	Select a suitable structure for this transformer and Construct a neat sketch of the arrangement and label all the items pole mounted substation satisfying above conditions	**(7)**		
b	Prepare a list of materials for erecting this transformer.	**(8)**		

*******************************END*******************************

BLUE PRINT

Mark Distribution

Module	Hr / Module	(hi / ∑Hi) * 141	TYPE OF QUESTIONS					
			PART A		PART B		TOTAL	
			No of Questions	Marks	No of Questions	Marks	No of Questions	Marks
I	15		2		2		**4**	
		36.47		6		30		**36**
II	15		2		2		**4**	
		36.47		6		30		**36**
III	14		2		2		**4**	
		34.03		6		30		**36**
IV	14		1		2		**3**	
		34.03		3		30		**33**
Total	**58**		**7**		**8**		**15**	
		141		**21**		**120**		**141**

Cognitive Level Wise Question Analysis:

Mark Distribution

Cognitive Level	% Marks	Marks	TYPE OF QUESTIONS					
			PART A		PART B		TOTAL	
			No of Questions	Marks	No of Questions	Marks	No of Questions	Marks
R	30		4		0		**4**	
		42.3		12		0		**12**
U	50		3		2		**5**	
		70.5		9		30		**39**
A	20		0		6		**6**	
		28.2		0		90		**90**
Total	**100**		7		8		**15**	
		141		**21**		**120**		**141**

Question Wise Analysis:

Q.No	Module Outcome	Cognitive Level	Marks	Time (minutes)
I.1	M1.02	R	3	7
I.2	M1.01	U	3	7
I.3	M2.02	R	3	7
I.4	M2.01	U	3	7
I.5	M3.01	R	3	7
I.6	M3.02	U	3	7
I.7	M4.01	R	3	7
II.	M1.01	U	15	36
III.	M1.02	A	15	40
IV.a	M2.01	A	8	23
IV.b	M2.01	U	7	10
V.	M2.03	A	15	40
VI.	M3.03	A	15	35
VII.	M3.04	A	15	35
VIII.	M4.02	A	15	35
IX.	M4.04	A	15	35
Total			141	338

SL NO. 2/Sem 4/II

Model Question Paper- II

ELECTRICAL INSTALLATION DESIGN AND ESTIMATION

Time : 3 Hours *Max.Marks : 75*

PART A

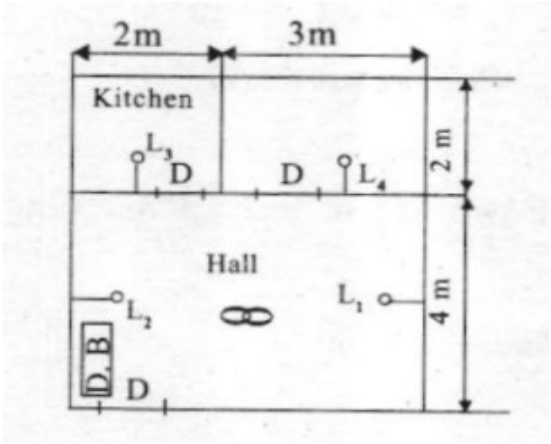
I.***Answer any 5 questions. Each question carries 3 marks*** ***(5 x 3 = 15 Marks)***

1	List out any six internal wiring rules?	M1.01	R
2	List the selection criteria of cables?	M1.02	R
3	Define illumination and mention its unit?	M2.02	R
4	State laws of illumination	M2.02	U
5	List any six materials and their specifications for standard plate earthing?	M3.01	R
6	Calculate the current drawn by a 10HP motor, assuming a supply voltage of 415 V, pf = 0.8 and the efficiency of the load is 80%?	M3.03	A
7	List out any six components of 11KV pole mounted substation.	M4.04	R

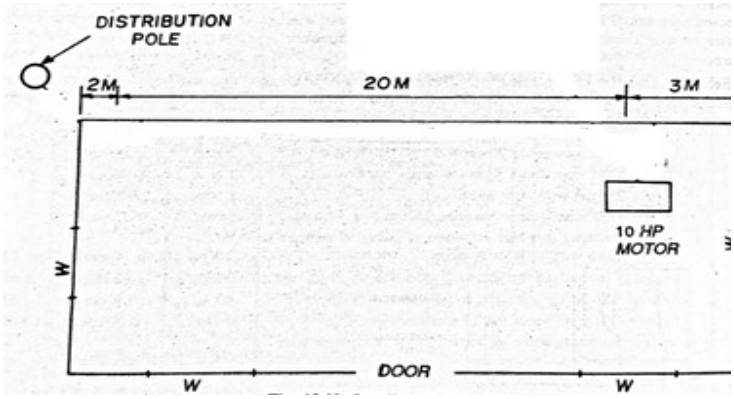
PART B

Answer ONE question from each set. Each question carries 15 marks

(4 x 15 = 60 Marks)

II	With neat sketches explain the following wiring systems and mention any three advantages and disadvantages of each.	M1.01	**U**
(a)	Conduit wiring **(7.5)**		
(b)	PVC Casing and capping wiring **(7.5)**		
	OR		
III	Surface conduit system of wiring in a house as per the given plan is to be implemented. Provide one socket in the kitchen and hall. Wall thickness is 300mm and ceiling height is 3.5 m. Assume missing data if any.	M1.02	**A**
			
(a)	Calculate the number of sub-circuits. **(2)**		
(b)	Calculate the size and length of wire required for the wiring installation. **(5)**		
(c)	Prepare the estimation table for the house. **(8)**		
IV (a)	A small factory 12m x 8m x 4m is to be illuminated with **(8)**	**M2.03**	**A**

		an average illumination of 80 lux on the working plane. Coefficient of utilisation is 0.5 and maintenance factor 0.8. Find the number of lamps required. Lamp efficiency is 40 lumen per watt.			
	(b)	Illustrate different lighting schemes?	**(7)**	**M2.02**	**U**
		OR			
V		A drawing Hall 30m x 13m with ceiling height of 5m is to be provided with general illumination of 120 lux. Taking coefficient of utilization is 0.5 and depreciation factor =0.7143, assume Mounting Height = 2m and space height ratio = 1.5 . Luminous efficiency of 80W fluorescent lamp is 40 lm/watts.		**M2.03**	**A**
	(a)	Determine the number of fluorescent lamps required.	**(5)**		
	(b)	Show the disposition of lamps with sketch.	**(7)**		
	(c)	Calculate the no of sub circuits required for electrification.	**(3)**		
VI		Draw a neat diagram of standard pipe earthing and also prepare an estimate including the list of items for this	**15**	**M3.01**	**A**

	earthing			
	OR			
VII	In a workshop of size 25m x 10 m, the plan of which is given below, a 10 BHP, 400 V, Three phase induction motor is to be installed for a wood cutting machine. The service connections are received in one corner of the workshop from nearest distribution pole.		**M3.02**	**A**
				
(a)	Construct the installation plan showing location of main control equipment, motor and motor control equipment.	**(3)**		
(b)	Construct single line diagram.	**(5)**		
(c)	Construct the wiring diagram.	**(7)**		
VIII	A factory has 75 HP power load for motors and 10 kW light and fan. The supply is to be given from a nearby 3 phase 4 wire distribution line which is at a distance of 200		**M4.02**	**A**

	m from the factory. Separate energy meter for power and lighting loads is to be provided in the factory main board. The line is crossing a 10 m wide road. The connection to the factory is given through underground cable service connection.			
a	Prepare the installation plan.	**(3)**		
b	Construct the pictorial representation of line including the pole near the factory.	**(5)**		
c	Prepare an estimation table for the installation of distribution line.	**(7)**		
	OR			
IX	An indoor type 11/0.4 kV substation is to be erected. The capacity of substation is 1000 kVA and the maximum demand is 800 kVA which has to be distributed in four circuits		**M4.04**	**A**
a	Construct the connection diagram of the substation.	**(6)**		
b	Prepare an estimation table for the substation including all the components.	**(9)**		

BLUE PRINT

Mark Distribution

Module	Hr / Module	(hi / ∑Hi) * 141	TYPE OF QUESTIONS					
			PART A		PART B		TOTAL	
			No of Questions	Marks	No of Questions	Marks	No of Questions	Marks
I	15	36.47	2	6	2	30	**4**	**36**
II	15	36.47	2	6	2	30	**4**	**36**
III	14	34.03	2	6	2	30	**4**	**36**
IV	14	34.03	1	3	2	30	**3**	**33**
Total	**58**	**141**	**7**	**21**	**8**	**120**	**15**	**141**

Cognitive Level Wise Question Analysis:

Mark Distribution

Cognitive Level	% Marks	Marks	TYPE OF QUESTIONS					
			PART A		PART B		TOTAL	
			No of Questions	Marks	No of Questions	Marks	No of Questions	Marks
R	30	42.3	5	15	0	0	**5**	**15**
U	50	70.5	1	3	2	30	**3**	**33**
A	20	28.2	1	3	6	90	**7**	**93**
Total	**100**	**141**	7	**21**	8	**120**	**15**	**141**

Question Wise Analysis:

Q.No	Module Outcome	Cognitive Level	Marks	Time (minutes)
I.1	M1.01	R	3	7
I.2	M1.02	R	3	7
I.3	M2.02	R	3	7
I.4	M2.02	U	3	7
I.5	M3.01	R	3	7
I.6	M3.03	A	3	7
I.7	M4.04	R	3	7
II.	M1.01	U	15	36
III.	M1.02	A	15	36
IV.	M2.03	A	15	36
V.	M2.03	A	15	36
VI.	M3.01	A	15	36
VII.	M3.02	A	15	36
VIII.	M4.02	A	15	26
IX.	M4.04	A	15	36
Total			141	338

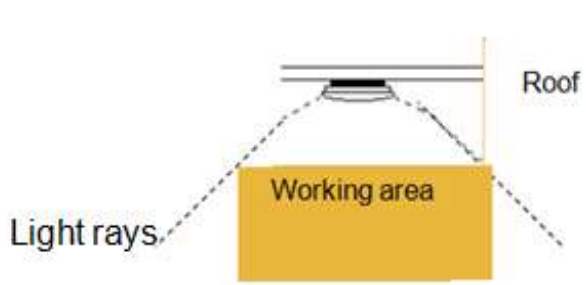
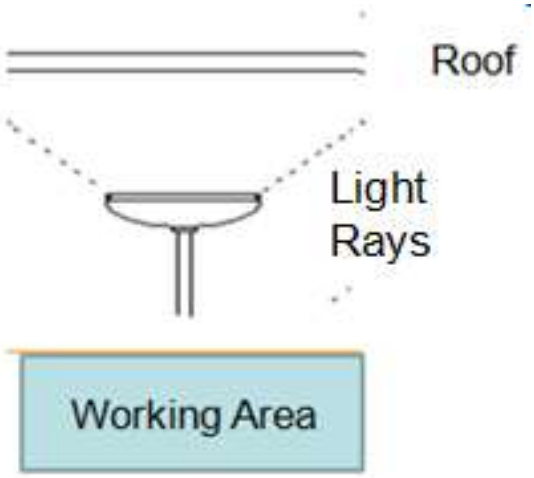
SL NO. 2/Sem 4/I

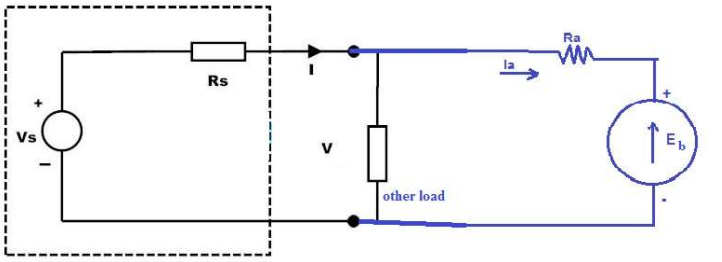
Scoring Indicators

Model Question Paper- I

ELECTRICAL INSTALLATION DESIGN AND ESTIMATION

Q No	Scoring Indicators	Split score	Sub Total	Total Score
	PART A			
I. 1	Lamp or Lamp outlet  Single pole switch  Socket outlet 6 or 5 Amperes 	**3x1**	**3**	**21**
I. 2	**Concealed conduit Wiring System** 1. The surface looks neat and clean. 2. This wiring is done inside the floors/walls. 3. There is no risk of mechanical injury. **Open conduit Wiring System** 1. Open wiring system does not give good look 2. It is a wiring method using cleats, knobs and flexible tubing 3. There is a risk of mechanical injury	**6x0.5**	**3**	
I.3	Space to Height ratio It is defined as the ratio of the horizontal distance between the lamps to the mounting height of the lamp above working plane $Space\ Height\ Ratio = \frac{Space\ between\ Lamps}{Mounting\ Height\ Above\ Working\ Plane}$	**2x1.5**	**3**	

	DepreciationFactor It is defined as the ratio of illumination under normal working condition to the illumination when everything is clean or new $Depreciation\ Factor = \frac{\text{illumination under normal working condition}}{\text{illumination when everything is clean}}$ vv			
I.4	Direct lighting light shines directly on the object from the source of the light About 90-100% of the light falls on the object to be illuminated  2.Indirect lighting - light is reflected to the object to be illuminated About 0-10% of the light falls on the object to be illuminated  	**3x1**	**3**	

I.5	a. To avoid electric shock to human body b. To avoid risk of fire due to earth leakage current through unwanted path c. To ensure that no current carrying conductor rises to a potential with respect to earth than its designed insulation	**3x1**	**3**	
I.6	 At starting N= 0; Eb= ΦNPZ/60 A = 0 • Armature current Ia = (V-Eb)/Ra = V/Ra; Very high • Due to internal resistance drop of power system the terminal voltage decreases (V = Vs - IRs) • This causes voltage dip for other loads • This situation persists until the speed of motor attains the rated speed	**3x1**	**3**	
I.7	a. The voltage at tail end of the line should be within the prescribed limits b. It should be in a position to conduct the desired load efficiently c. The clearance of the conductor from ground and adjoining building should be as per IE rules	**3x1**	**3**	
	PART B			
II.a.	**CLEAT WIRING** Cleat wiring is one of the cheapest wiring systems considering the initial cost and labor and it is most suitable for a temporary basis. This wiring system is quickly installed, easily inspected and altered. In this type of wiring VIR or PVC insulated wire is used as a conductor. This wiring system, All the cables are in open-air therefore fault is very easily found and replaced it very quickly and It is easy to fault detection	**2+ 2.5+ 1.5+ 1.5**	**7.5**	**15**

Cleat wiring is recommended only for temporary installment. The cleat is made in pairs having a bottom and a top half. So, in the bottom, half is grooved to receive the wire and the top half is for cable grip. Initially, the bottom and top cleat are fixed on the wall loosely according to the layout. Then the cable is drawn, tensioned and the cleat is tightened by the screw. The cleat is of the basic three types, having one, two or three grooves, so as to receive one, two or maximum three wires. (2 marks)

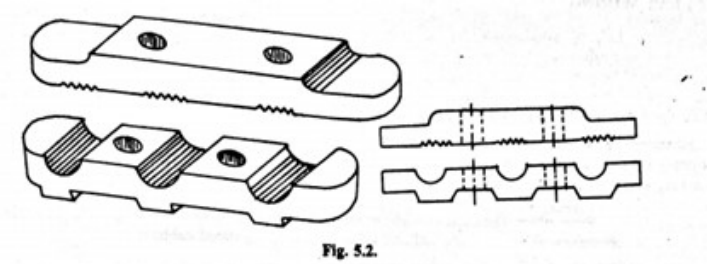
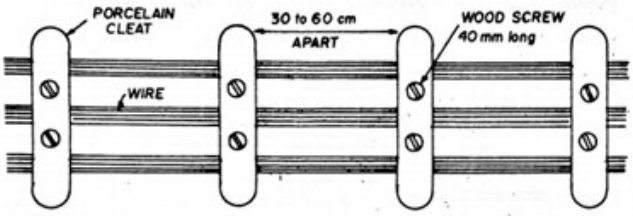


Fig. 5.2.



Wires laid in three groove cleats.

(2.5 marks)

Advantages of cleat wiring:

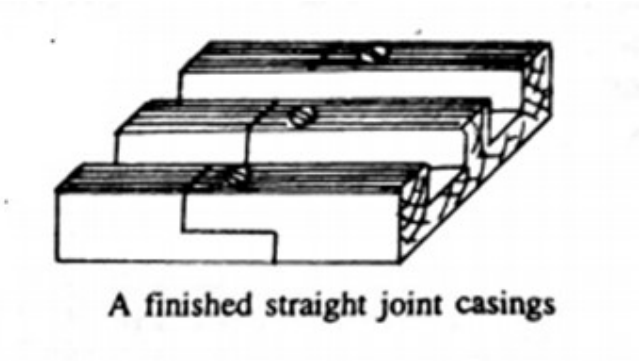
- It is easy to fault detection.
- It is easy to repair.
- This is the temporary wiring system.
- It is the cheapest for internal wiring.

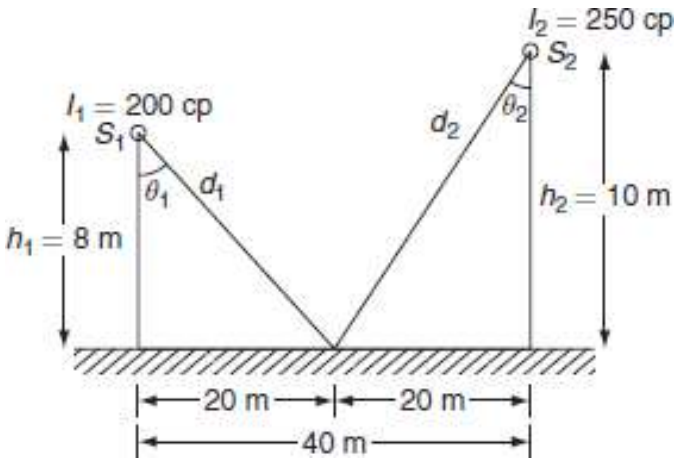
(1.5 marks)

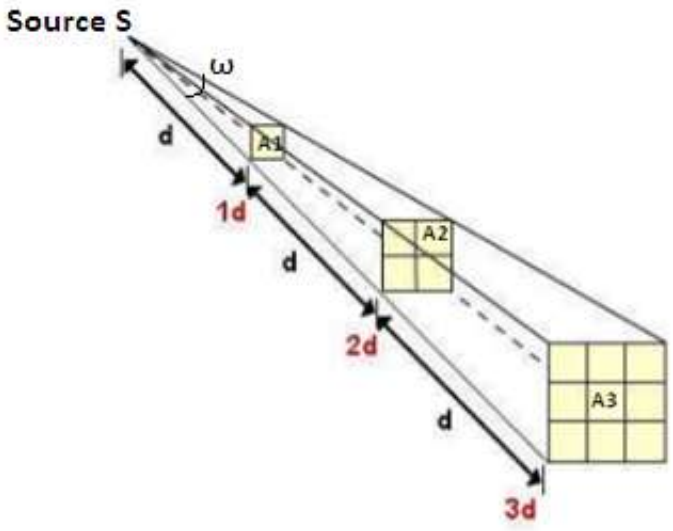
Disadvantages of cleat wiring:

- It has a bad appearance.
- It is not looking good.
- This wiring system is not safe and durable.
- It is a chance to shock or fire.
- It is not a sustainable wiring system.
- It is used only low-temperature places.

(1.5 marks)

II.b.	**WOODEN CASING AND CAPPING** Wooden casing and capping wiring systems are suitable for low voltage domestic installation and here we are using VIR or PVC wires. These wires are laid in grooves and the casing is covered by a rectangular strip of the same width called capping and that is fitted by means of a screw. Well, seasoned teak wood or any approved wood without any defects is used for this type of wiring system. All sides of casing should be plained with smooth finish and the surface should be coated with good quality varnish. (2 marks)  A finished straight joint casings (2.5 marks) **Advantages of Wooden Casing Capping Wiring** • This wiring system is way cheaper than sheathed and conduit wiring systems. • Customized installation can be done in this wiring system. • Reduced risk of electric shock can be expected (1.5 marks) Disadvantages of Wooden Casing Capping Wiring • There is a risk of fire. • This wiring system is not suitable in acidic conditions in industries. • Difficulty in finding any fault caused in the wire. • Highly skilled carpenters are required for installation. (1.5 marks)	**2+ 2.5+ 1.5+ 1.5**	**7.5**	

III.a.	 $d_1 = \sqrt{8^2 + 20^2}$ $= 21.54.$ The illumination of point 'P' due to source 'S1'= 0.159 lux and $d_2 = \sqrt{10^2 + 20^2} = 22.36$ $\cos\theta_2 = \frac{h_2}{d_2} = \frac{10}{22.36} = 0.447.$ $E_2 = \frac{I_2}{d_2^2} \times \cos\theta_2$ $= \frac{250}{(22.36)^2} \times 0.447 = 0.2235$ lux. (5 marks) The illumination at the point '*P*' due to the source '*S*2*'* ∴ The total illumination at *P*' due to both the sources *S*1 and*S*2 = *E*1+ *E*2 = 0.159 + 0.2235= 0.3825 lux. (3 marks)	**5+3**	**8**	**15**
III.b	It states that the illumination of a surface is inversely proportional to the square of the distance between the surface and the light source.	**2+5**	**7**	



(2 marks)

Let S = Point source

A1, A2 and A3 = 3 parallel surface areas in m^2

D, 2d and 3d = Distance of A1, A2 and A3 in m

ω = solid angle

For area A1, solid angle $\omega = A1/d^2$

Flux φ_1 on area A1 = $I\omega = IA1/d^2$

Illumination E_1 on

area A1 = Flux/Area = $\varphi_1/ A1 = (IA1)/ (d^2 A1)$

$$E_1 = I/d^2 \text{ lux}$$

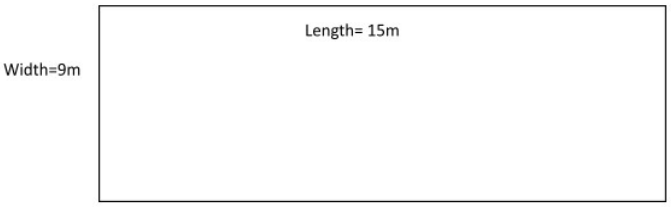
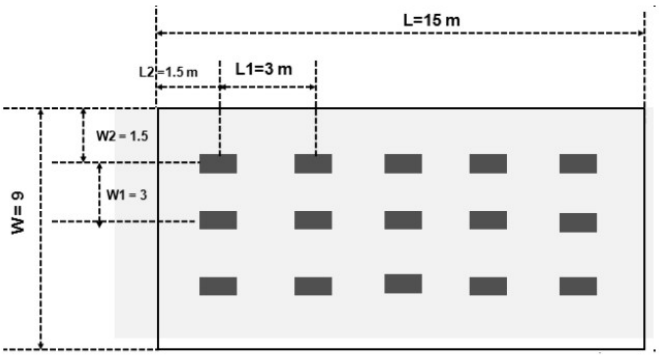
Similarly Illumination E_2 on area A2 = $I/ (2d)^2$ lux

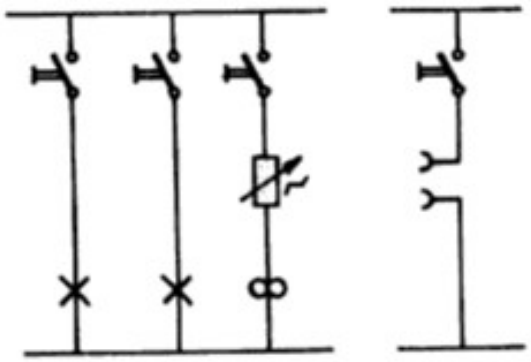
Illumination E_3 on area A3 = $I/ (3d)^2$ lux

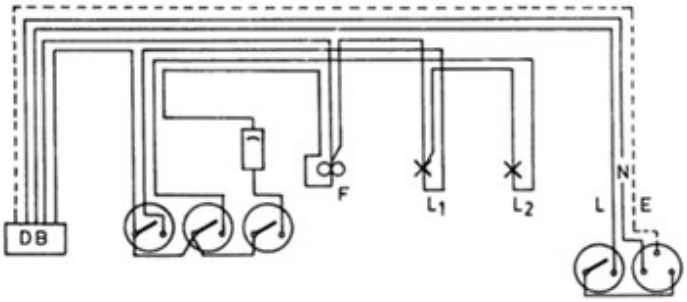
From this we can see that the illumination of the surface is inversely proportional to the square of the distance between source and the object. Thus inverse square law is proved.

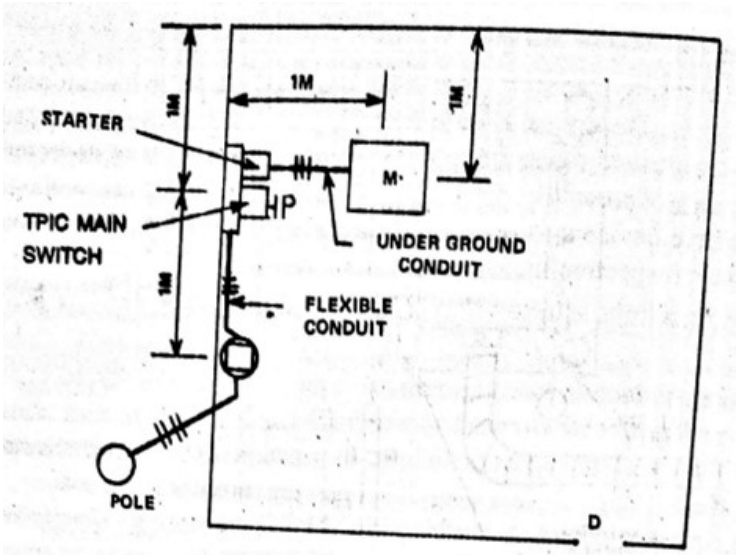
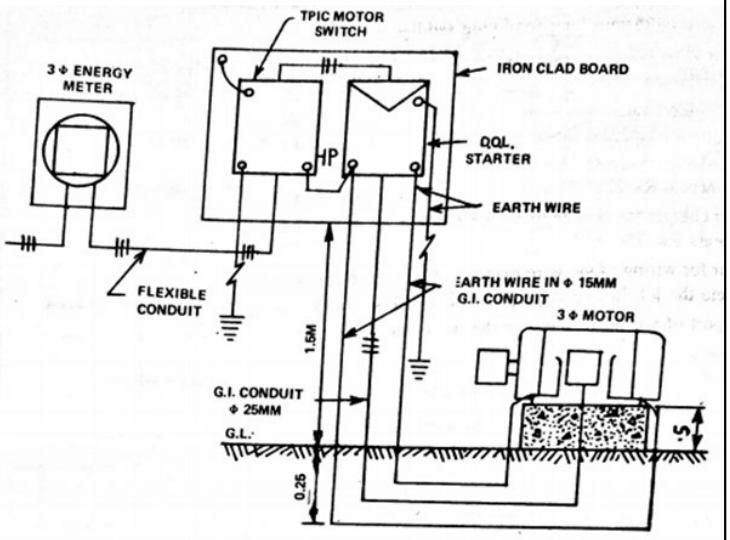
(5 marks)

IV.a.	Number of lamps Total Flux (lumen)=A.E =15 x 9 x 200 = 27000 lumen $Flux\ required = \Phi(lumen)$ $= \frac{Total\ flux}{CU * MF}$ $= \frac{27000}{0.75 * 0.8}$ $= 45000$ lumen $N = \frac{Flux\ Required}{Lumen\ Output\ Of\ 1\ Lamp}$ $= \frac{45000}{3000}$ $= 15$	**3x1**	**3**	**15**

IV.b	layout of light fittings  $Space\ height\ ratio = 1.5$ $mounting\ \ height\ = 2m$ $\frac{Space}{Mounting\ Height} = 1.5$ $Space = 1.5 * mounting\ height$ $= 1.5 * 2$ $= 3\ m$ $No\ of\ lamps\ fitted\ along\ width$ $N_W = \frac{width}{space}$ $= \frac{9}{3} = 3$ $No\ of\ lamps\ fitted\ along\ Length$ $= \frac{9}{3} = 3$ $N_L = \frac{Total\ lamps}{N_w}$ $= \frac{15}{3} = 5$ (4 marks)  	**4+ 5**	**9**	

	$L_1 = \frac{Length}{N_L} = \frac{15}{5} = 3$ $L_2 = \frac{L_1}{2} = \frac{3}{2} = 1.5$ $W_1 = \frac{Width}{N_W} = \frac{9}{3} = 3$ $W_2 = \frac{W_1}{2} = \frac{3}{2} = 1.5$ (5 marks)			
IV.c.	<u>No of sub circuits</u> No of Lamps = N=15 Watt rating of 1 lamp= W = 40 w Total wattage= N*W= 15x40=600 w As per IE rules Load on Each sub circuit is restricted to 800 W 0r 10 outlets $No\ of\ Subcircuits = \frac{Total\ Watts}{800}\ or\ \frac{Total\ points}{10}$ $= \frac{600}{800}\ or\ \frac{15}{10}$ $= 0.75\ or\ 1.5$ $= 1\ or\ 2$ $= 2\ (\ select\ largest)$	**3x1**	**3**	
V.a.		**3x1**	**3**	**15**

V.b.		**5x1**	**5**	
V.c.	No: of light points = 2 Wattage of light points = 2*60 = 120W No: of fan points = 1 Wattage of fan points =1* 100 = 100W No: of socket outlets = 1 (power) Wattage of power socket outlet = 1* 1000 = 1000W No: of Sub-circuits = 2	**3x1**	**3**	
V.d.	**Deciding size of wire** Total current , I = (100+120+1000)/240 = 5A (approx.) Current through Sub-circuit 1 = 1A Current through Sub-circuit 2 = 4A (2 marks) For Sub-circuit 1 - 1/1.40 mm single core Aluminium conductor cable For Sub-circuit 2 - 1/1.80 mm single core Aluminium conductor cable Meter board to distribution box - 1/1.40 mm single core Aluminium conductor cable (2 marks)	**2+2**	**4**	

VI.a	 Installation Plan.	**3x1**	**3**	**15**
VI.b		**5x1**	**5**	
VI.c	Assumptions: 1. Height of Main Board is 1.5 m from floor 2. Two earth wires enclosed in their respective 15mm dia GI pipe installed side by side for earthing the motor 3. The moto with pumping set is installed 0.25 m above floor on suitable foundation Total current I = (5*735.5)/(√ 3*400*0.75*0.85)	**3+4**	**7**	

= 8 A (approx)

Rating of wire = 1/ 2.80 mm

Length of wire = 18 m (approx)

Length of conduit pipe (25 mm) required = 4 m (approx)

Length of conduit pipe (15 mm) required = 7 m (approx)

Length of flexible conduit pipe (25 mm) required = 2.5 m (approx)

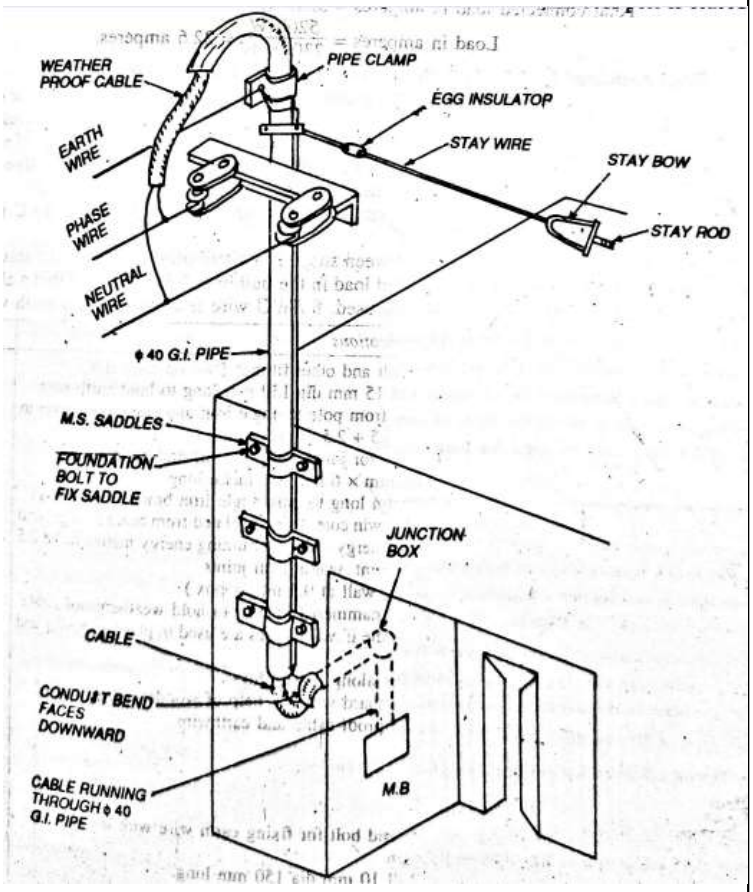
Length of GI (8SWG) earthing wire = 9 m (approx)

(3 marks)

(The length of materials may vary based on different installation plan illustrated by students)

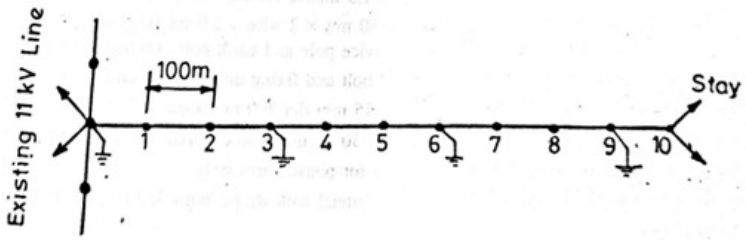
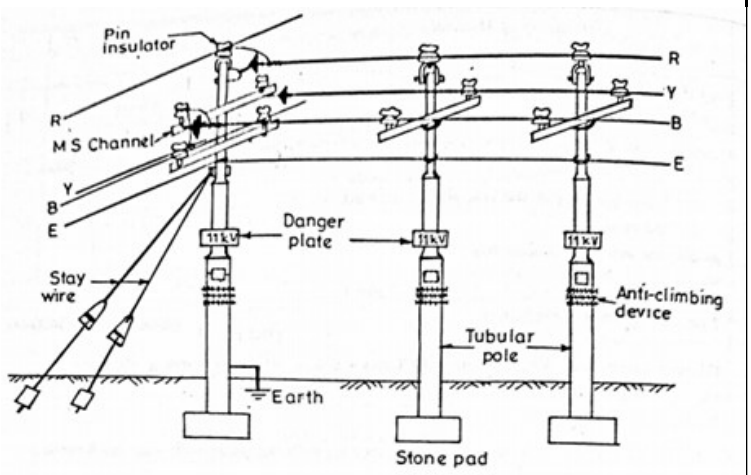
Sl. No:	Material	Quantity	Cost
1	TPIC main switch 32A, 500 V	1	
2	a. GI conduit pipe (25 mm) b. conduit bend c. Saddle	4 m 2 Nos 4 Nos	
3	a.GI conduit pipe (15 mm) b. conduit bend c. Saddle	7 m 4 Nos 8 Nos	
4	flexible conduit pipe (25 mm)	2.5m	
	PVC insulated, aluminium conductor, single core 1/ 2.80 mm dia, 660 V	18m	

	5	GI (8SWG) earthing wire	9m			
	6	Earthing set (Plate earthing) a. GI plate 600mm*600mm*6.36 mm thick b. GI pipe 15 mm dia for enclosing earth wire c. GI pipe 15 mm dia for watering d. Charcoal e. Salt f. Cement , Sand , Concreate	2 Nos 2 Nos 24 m 14 m 15 kg 20 kg --			
		Labour cost				
		Total				
		10% contingency				
		Grand Total				
	(4 marks)					

VII.a		**6x1**	**6**	**15**
VII.b	Assumptions: 1. Height of ground floor is = 3.5 m 2. Service connections received at a height of 6 m from floor 3. Electrical load, 5 sub circuits (given) of 800 W each, with one 15 A socket. Total = 5kW Total load current = 5000/230= 21.7A Total connected load = 21.7 * .6 (60% diversity factor) = 13A (approx) It is therefore suggested that a weather proof cable of size 1/ 3.55 mm, twin core, PVC insulated, 34 A (higher rating about 50%) (3 marks)	**3+6**	**9**	

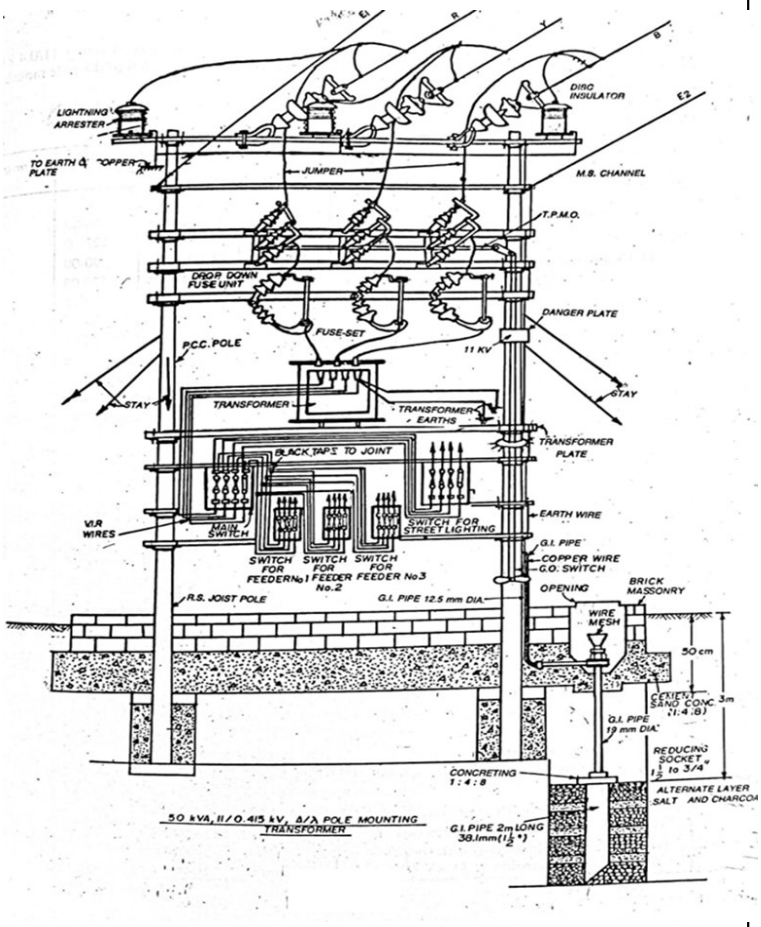
Sl. No:	Material	Quantity	Cost
1	8 SWG GI wire to serve as bare conductor from supply pole to house service connection	63 m	
2	weather proof cable of size 1/ 3.55 mm, twin core, PVC insulated, 34 A	7 m	
3	GI pipe of 50 mm dia	8 m	
4	GI Earth wire 8 SWG	6 m	
5	Pipe bend 50mm dia	3 Nos	
6	Pipe clamp 50mm dia	2 Nos	
7	GI pipe saddle 50mm dia	4 Nos	
8	Hook bolt 15 mm dia , 150 mm long	8 Nos	
9	LT shackle insulators with U clamp and other fittings	4 Nos	
10	Angle Iron service bracket 50mm*50mm*6mm*600 mm long	2 Nos	
11	Stay wire 7/ 10 SWG GI	7 m	
12	Stay bow	1 No	
13	Stay insulator	1 No	
14	Cement, Sand , Concrete	--	
	Labour cost		
	Total		
	10% contingency		
	Grand Total		

(6 marks)

<table>
<tr><td>VIII. a</td><td> 
</td><td>3x1</td><td>3</td><td rowspan="3">15</td></tr>
<tr><td>VIII. b</td><td> 
</td><td>4x1</td><td>4</td></tr>
<tr><td>VIII. c</td><td>
<table>
<tr><th>Sl. No:</th><th>Material</th><th>Quantity</th><th>Cost</th></tr>
<tr><td>1</td><td>Poles 11 m long</td><td>10</td><td></td></tr>
<tr><td>2</td><td>Materials required for connection with existing line of 11 kV
a. MS channel for cross arm 100mm*50mm*1.5 m
b. HT 11 kV disc insulator
c. HT 11 kV pin insulator
d. Stay wire and fittings</td><td>
1 No
3 Nos
2 Nos
2 set</td><td></td></tr>
<tr><td>3</td><td>Fittings for HT straight line Supporters
a. Pole cap of MS
b. Stone pads for poles
c. Angle iron cross arms
d. Cross arm clamp
e. 11kV pin insulator and fittings</td><td>
10 Nos
10 Nos
10 Nos
10 Nos
30 Nos</td><td></td></tr>
<tr><td>4</td><td>No. plate and Danger plate</td><td>10 Nos</td><td></td></tr>
</table>
</td><td>8x1</td><td>8</td></tr>
</table>

	5	ACSR Conductor 6/ 1 , 2.59mm	3030m			
	6	GI earth wire	1020m			
	7	Material for earthing (3 sets) (Plate earthing) a. GI plate 600mm*600mm*6.36 mm thick b. GI pipe 15 mm dia for enclosing earth wire c. GI pipe 15 mm dia for watering d. Charcoal e. Salt f. Cement , Sand , Concreate	 2 Nos 24 m 14 m 15 kg 20 kg --			
	8	Cement, Sand , Concrete	--			
		Labour cost				
		Total				
		10% contingency				
		Grand Total				

IX.a



IX.b

Sl. No:	Material	Quantity	Cost
1	Materials of HT connection with main line a. MS channel 50mm*100mm*1.5 m b. HT 11kV disc insulator c. HT 11kV pin insulator d. Stay set e. Binding wire (Aluminium)	 1 No 3 Nos 3 Nos 2 Nos 500gm	
2	ACSR conductor 6/ 1/ 2.36 mm dia	152 m	
3	GI steel wire 8 SWG	52 m	
4	RS joint 175mm*100mm*10 m long	2 Nos	

7x1	**7**	**15**
8x1	**8**	

	5	Transformer 50kVA 11/0.4kV	1 No			
	6	Fitting on HT double pole structure for pole mounted substation a. MS channel 100mm*50mm*8mm*2.65m long b. Eye bolt c. Doppler angle iron 75mm*75mm*8mm*2 m long d. Stay set e. HT 11kV disc insulator f. HT 11kV pin insulator g. Binding wire (Aluminium) h. No. plate and Danger plate i. fuse sets	 1 No 3 Nos 1 No 2 Nos 3 Nos 3 Nos 500 gm 1 No 1 No			
	7	TPICN 100 A	1 No			
	8	Lightning Arrester one set of three	1 No			
	9	Pipe earthing set	1 set			
	10	Cement, Sand , Concrete	--			
		Labour cost				
		Total				
		10% contingency				
		Grand Total				

SL NO. 2/Sem 4/II

Scoring Indicators

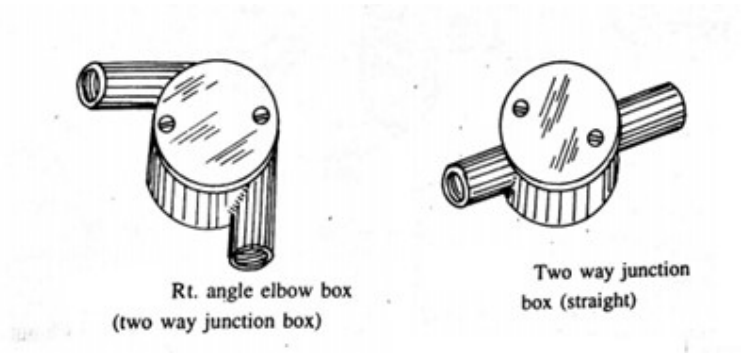
Model Question Paper- II

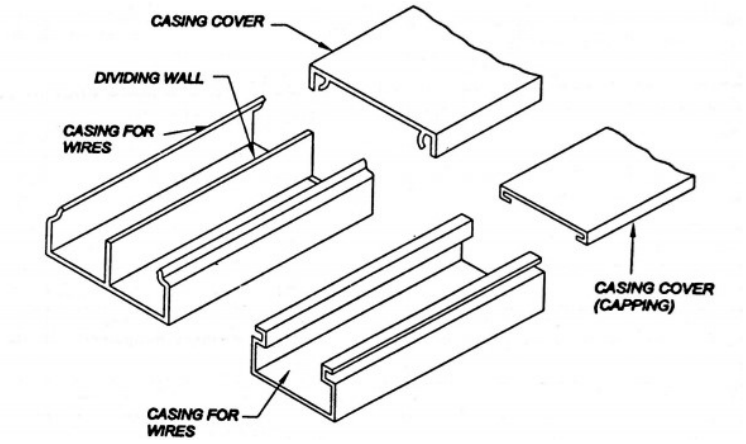
ELECTRICAL INSTALLATION DESIGN AND ESTIMATION

Q No	Scoring Indicators	Split score	Sub Total	Total Score
	PART A			
I. 1	a. 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. b. The conductor used is to be of such a size that it may carry load current safely. c. Separate conduit for light and power wiring. d. Every sub-circuit is to be connected to a distribution fuse board. e. Every line is to be protected by a fuse of suitable rating as per requirements. f. A switch board is to be installed so that its bottom lies 1.25 metres above the floor. g. All plugs and socket-outlets are to be of 3-pin type, the appropriate pin of socket being connected permanently to the earthing system	**6x0.5**	**3**	**21**
I. 2	a. voltage rating b. Current rating c. Conductivity, d. Weight e. Temperature f. Required flexibility g. Tensile strength h. Type of insulation	**6x0.5**	**3**	
I.3	It is the luminous flux received by the surface per unit area. It is represented by E. The unit of illumination is lux. Illumination E = flux / Area	**3x1**	**3**	
I.4	Inverse Square Law This law assumes that the illumination(E) received on a surface from a light source is inversely proportional to the square of it's distance from the source, as long as the source	**2 x 1.5**	**3**	

	remains same $$E = \frac{I}{r^2}$$ Where E = illuminance (lux) I = Luminous intensity(candela) r = distance(metre) **Lambert's Cosine Law** This law states that illumination on a surface is proportional to the cosine of the angle between the normal to the surface and line of flux $$E = \frac{I}{r^2} Cos\theta$$ Where E = illuminance (lux) I = Luminous intensity(candela) r = distance(metre) θ = angle between line of flux and the normal to the illuminated plane			
I.5	a. G.I plate of size 600mm x 600 mm x 83 mm b. G.I wire 8 SWG c. 12.7 mm G.I pipe 2m d. 19.mm G I pipe 1.5 Meters e. G.I nuts bloats check nuts , washers 6 sets f. 12.7 mm G.I bend 2 Nos g. GI earth lugs 3Nos h. 300mmx300mm Cast Iron frame with CI frame 1 set i. Funnel with wire mesh 1 set j. Charcoal 20kg k. common salt 20 kg l. cement concrete 1:4:8 0.1 m²	**6x0.5**	**3**	

I.6	Assuming a supply voltage of 415 V, p.f = 0.8 and the efficiency of the load is 80%. $\text{Current} = (10 \times 735.5) \div (0.8 \times 0.8 \times 400 \times \sqrt{3}) = 16.6$ Amps	**3x1**	**3**	
I.7	a. Pin type insulator b. AB switch c. Lightning Arrester d. Circuit Breaker e. Distribution Transformer f. Earthing g. DO Fuse h. Stay Wire i. MV cable j. LV cable	**6x0.5**	**3**	

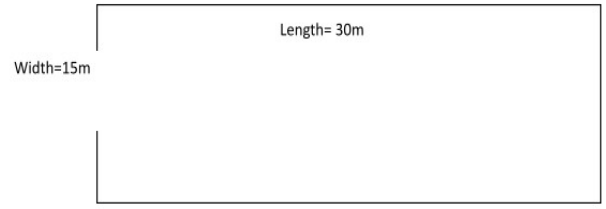
	PART B			
II.a	CONDUIT WIRING Conduit Wiring is the best system of wiring. There are two methods for laying conduits. In one method conduit is laid on the surface of the wall, ceiling etc. This is called surface wiring. The other method is to lay the conduit recessed in wall or ceiling, and this system is known as concealed wiring. Conduit may be rigid or flexible. Rigid conduit is used for general work, while flexible conduit is used for short runs. Various types of fittings are used for jointing and terminating conduit. Conduit and its accessories must be galvanized or enameled in order that these are weather proof and immune to rust. Presently PVC conduit wiring system is most popular. (2 marks)  PVC conduit  (2.5 marks) Advantages of Conduit Wiring ● P.V.C conduits offers a highly resistant against corrosion. ● It is a durable and very popular system. ● It is a water proof wiring system. ● It will not support combustion. (1.5 marks) Disadvantages of Conduit Wiring ● Not suitable for temperature below 5 degree and above 60 degree Celsius ● This is expensive compared to other wiring systems	**2+ 2.5+ 1.5+ 1.5**	**7.5**	**15**

	● Wiring installation is difficult ● Alteration is difficult (1.5 marks)			
II.b	PVC CASING AND CAPPING WIRING This is one of the simple forms of electric wiring systems. As the name referred in this wiring, PVC insulated wires are placed in plastic cashing and covered with cap. The channels and caps are available in the market in standard length. The commonly available standard lengths are 1 meter, 10 feet and 6.5 feet etc. In the casing capping wiring system, we first cut the cashing channels in required length with capping cover. Then we screw these on the wall as per layout planning of our wiring. Normally, we insert screws after each 30 cm in the channel. The After that we place the PVC insulated copper wire in the channel as per our requirement. After all the process we cover the channel by cap. (2 marks)  (2.5 marks) Advantages of PVC casing and capping Wiring ● Cheap in cost as compared to lead sheathed and conduit wiring system. ● Easy to install and rewire. ● It provides good insulation as conductors are good distance apart. (1.5 marks) Disadvantages of PVC casing and capping Wiring ● It cannot be used for damp places for long period of time ● It cannot be concealed, so does not provide a good appearance ● With passage of time, PVC becomes brittle and	**2+ 2.5+ 1.5+ 1.5**	**7.5**	

	rewiring is required. (1.5 marks)			
III.a	Total floor area = 12 x 8 = $96m^2$ Total flux = 80 x 96 = 7680 lumen (2 marks) Total flux required on working plane = total flux/(CU x MF) = 7680/(0.5 x 0.8) = 19200 lumen (2 marks) Total wattage = Flux/η = 19200/40 = 480w (2 marks) No. of lamps required = 480/40 = 12 (2 marks)	**2+2+ 2+2**	**8**	**15**
III.b	Direct fitting: - 90-100% directed towards the working plane, 10% goes to the other direction. The height of the lamp is two thirds of the lamp spacing. Reflectors can be used. This type may produce hard shadows. Semi-direct fitting: - 60-90% on the working plane, 10-40% goes the other direction. Translucent reflectors can be used. This type also produces shadows. General fitting: - 40-60% on the working plane, 60-40% goes the other direction. Translucent reflectors of different thickness can be used. This fitting produces almost uniform light. Semi-indirect fitting: - 10-40% light on the working plane, remaining light goes to the upper hemisphere. Light on the working plane by the reflectivity of the ceiling and walls. This produces faint shadows. Indirect fitting: - 10% of the light on the working plane due the reflectivity of the walls and ceiling. This will not produce any shadows or any glare. These are used for clubs and restaurants.	**7x1**	**7**	
IV.a	Number of sub circuits : Total watts = 520 W, so we need only one sub circuit.	**2x1**	**2**	**15**
IV.b	Size and length of the cable : Current through sub circuit = power / voltage =520 / 230 =2.26A (2 marks) Size of the cable required is 1 mm^2 copper. Length of conduit = 20 m Cable length = Length of conduit X 3 = 60m (3 marks)	**2+3**	**5**	

IV.c		**8x1**	**8**	

Sl. No:	Material	Quantity	Cost
1	DP main switch 15A, 250 V	1	
2	IC cutout 15 A , 250 V	1	
3	Flush type fuse unit 5A,250V	1	
4	PVC conduit 18mm	20m	
5	PVC conduit 12mm	1m	
6	1sq.mm cable	63m	
7	Switches 5 A , 250 V	7	
8	2-pin sockets 5 A , 250 V	2	
9	Ceiling rose	4	
10	Lamp holders	4	
11	Switch boards	5	
12	Wooden gutties	3 box	
13	Saddles	1 box	
14	Nails	2 kg	
15	Cement	5 kg	
16	Earth Wire 16SWG copper	1 kg	
17	Earth set	1 set	
	Labour cost		
	Total		
	10% contingency		
	Grand Total		

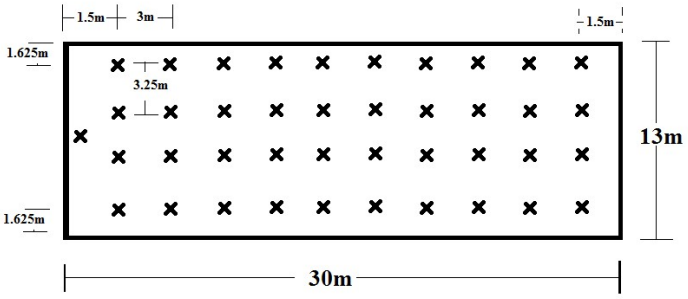
V.a	Luminous efficiency of one lamp =η= 40 lm/watt Lumen output of one lamp = η * watts = 40 X 80=3200 lm Total Flux (lumen)=A.E =(30 x 13) x 120 = 46800 lumen $Flux\ required = \Phi = \frac{Total\ flux}{CU * MF}$ $= \frac{46800}{0.5 * 0.7143}$ = 131037.3739 lumen (3 marks) $N = \frac{Flux\ Required}{Lumen\ Output\ Of\ 1\ Lamp}$ $= \frac{131037.3793}{3200}$ = 40.95. = 41 (2 marks)	**3+2**	**5**	**15**
V.b	**Disposition of Lamps:** 	**4+3**	**7**	

$$Space\ height\ ratio = 1.5$$
$$mounting\ \ height\ = 2m$$
$$\frac{Space}{Mounting\ Height} = 1.5$$
$$Space = 1.5 * mounting\ height$$
$$= 15 * 2 = 3\ m$$
$$No\ of\ lamps\ fitted\ along\ width$$
$$N_W = \frac{width}{space} = \frac{13}{3} = 4.3 = 4$$
$$No\ of\ lamps\ fitted\ along\ Length$$
$$N_L = \frac{Total\ lamps}{N_w}$$
$$= \frac{41}{4} = 10.25 = \ 10$$

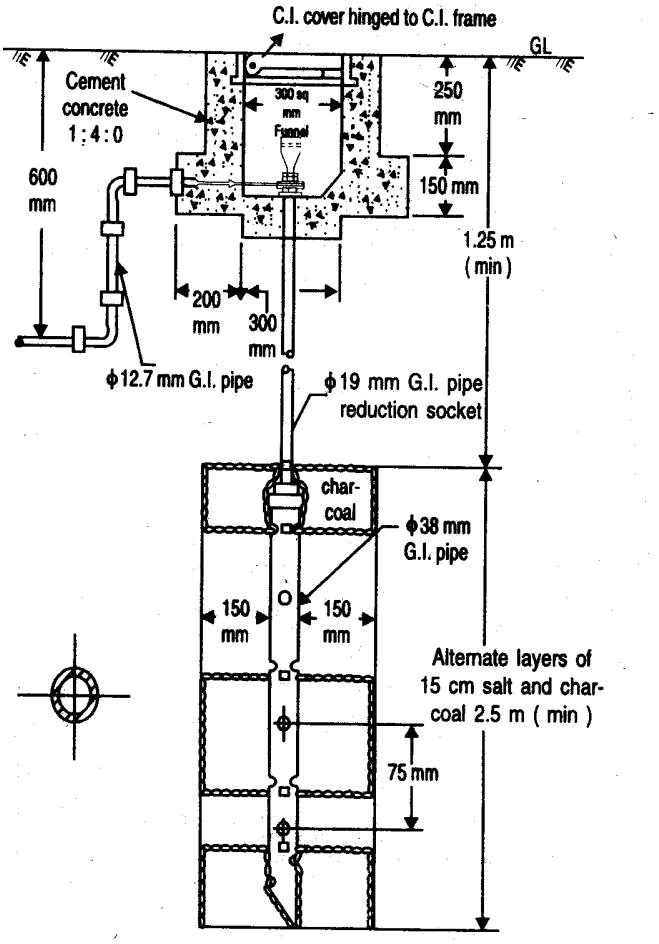
arrange 40 lamps uniformly and 1 lamp separately

$$L_1 = \frac{Length}{N_L} = \frac{30}{10} = 3$$
$$L_2 = \frac{L_1}{2} = \frac{3}{2} = 1.5$$
$$W_1 = \frac{Width}{N_W} = \frac{13}{4} = 3.25$$
$$W_2 = \frac{W_1}{2} = \frac{3.25}{2} = 1.625$$

(4 marks)

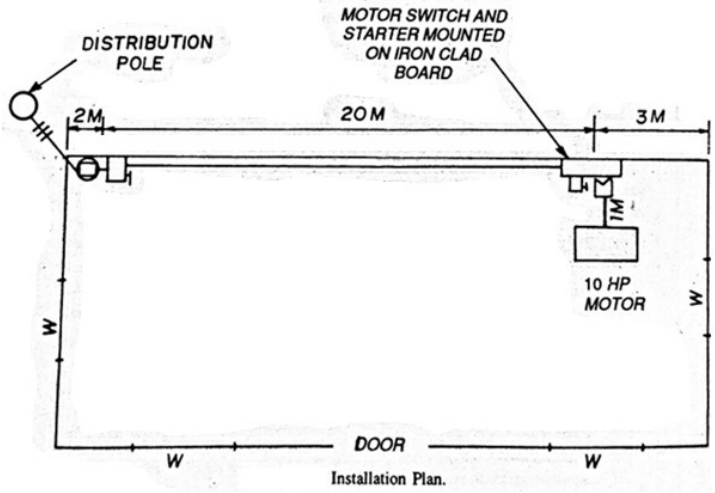
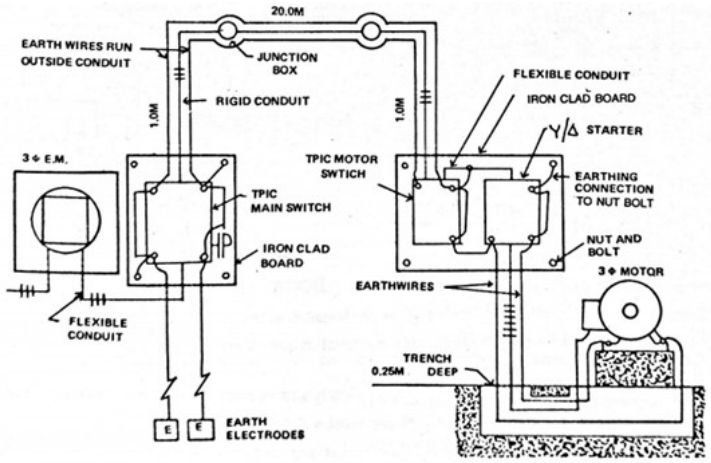
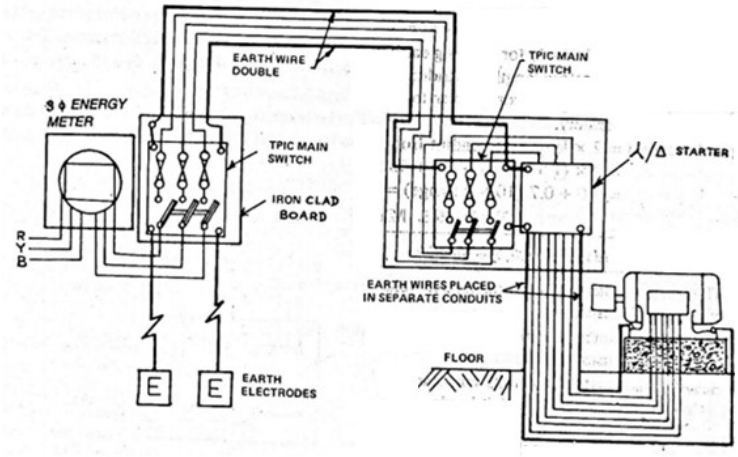


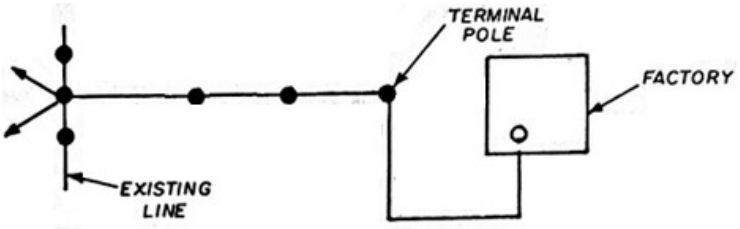
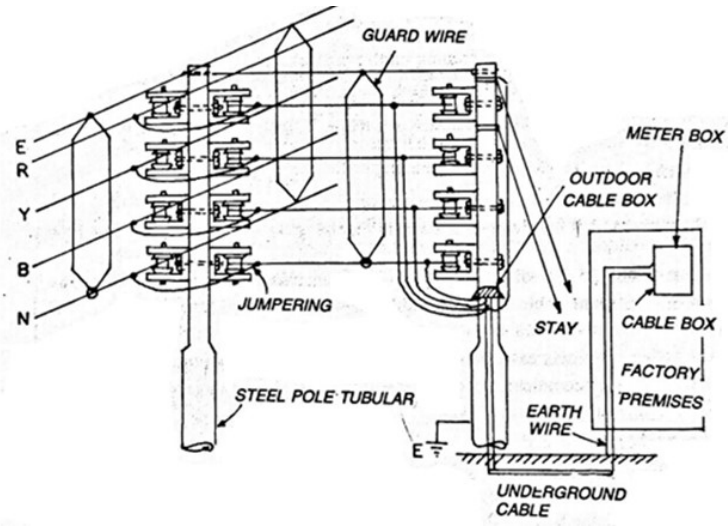
(3 marks)

V.c	**No of sub circuits:** *No of Lamps = N=41* *Watt rating of 1 lamp= W = 80 W* *Total wattage= N*W= 41x80 =3280 W* *As per IE rules Load on Each sub circuit is restricted to 800 W 0r 10 outlets* $No\ of\ Subcircuits = \frac{Total\ Watts}{800}\ or\ \frac{Total\ points}{10}$ $= \frac{3280}{800}\ or\ \frac{41}{10}$ $= 4.1\ or\ 4.1$ $= 5$	**3x1**	**3**	
VI.	 (8 marks)	**8+7**	**15**	**15**

	Estimation **7**	**7**		

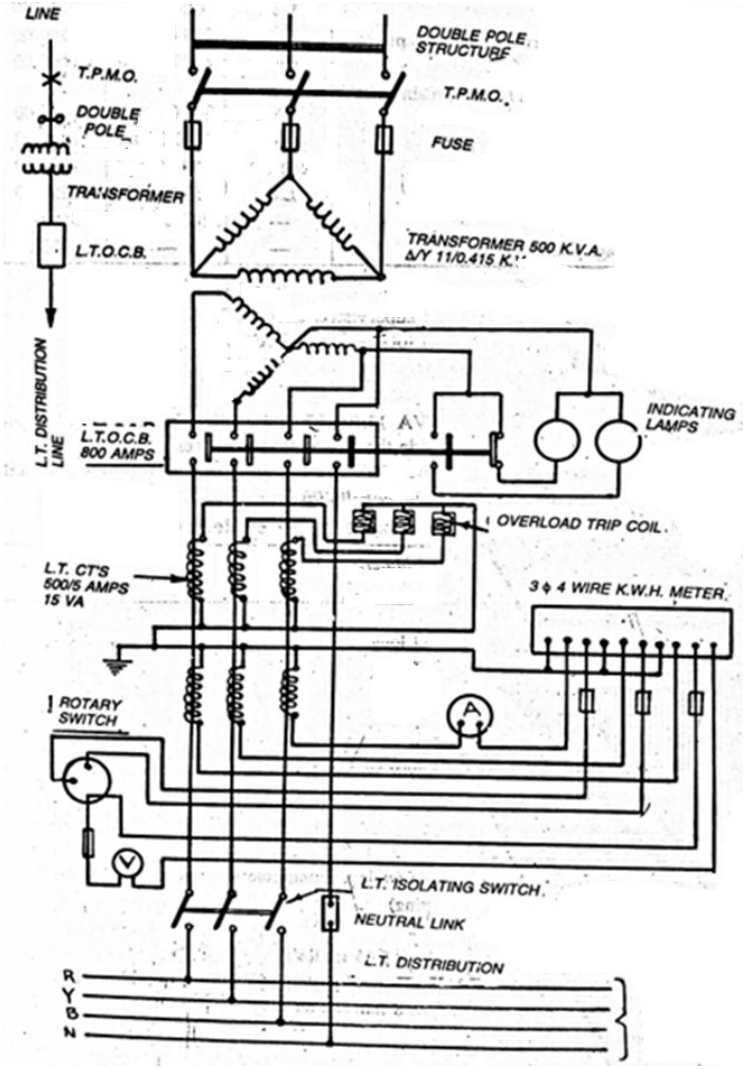
Sl. No:	Material	Quantity	Cost
1	38 mm ϕ,2.5m long GI pipe with 12 mm ϕ holes at an interval of 15 cm threaded one end suitable to hold 38mmX19mm reducer	1	
2	19mm ϕ GI pipe 1 mm threaded both ends	1.5m	
3	12.7mm ϕ GI pipe	4m	
4	38mmX19mm reducer	1	
5	19mm ϕ GI pipe 1 mm threaded both ends	1m	
6	Funnel with wire mesh	1	
7	12.7mm ϕ bend	2 Nos	
8	Cast Iron cover 30cm X 30 cm	1 No	
9	Cast Iron frame 30cm X 30 cm	1 No	
10	GI nuts 19 mm	3	
11	GI wire 8 SWG	1kg	
12	Charcoal	½ gunny bag	
13	salts	20kg	
14	Cement and concrete	LS	
	Labour charges for taking pits size 1m X 1m X 2.5m	LS	
	Labour charges for making earth trough with materials such as bricks, cement etc.	LS	
	Total		
	10% contingency		
	Grand Total		

VII. a	 Installation Plan.	**3x1**	**3**	**15**
VII. b	 Single line diagram	**5x1**	**5**	
VII. c		**7x1**	**7**	

VIII .a		**3x1**	**3**	**15**
VIII .b		**5x1**	**5**	

VIII.c					**7x1**	**7**	

Sl. No:	Material	Quantity	Cost
1	LT shackle insulator with ‘D’ strap bolt and nut	8 Nos	
2	Pin insulator 500V	12 Nos	
3	Stay set complete	2 Nos	
4	Rail pole 10 m long	4 Nos	
5	Cross arms of channel iron of size 75mm*40mm*3mm*0.75 m long	6 Nos	
6	Binding wire Aluminium 14 SWG	1 kg	
7	No: plate with clamp	5 Nos	
8	Eye bolt 15mm dia, 150 mm long for holding earth wire with cross arms	4 Nos	
9	ACSR conductor 6/ 1 *2.59 mm	612 m	
10	7 / 6 SWG GS wire for neutral and earth	420 m	
11	Weather proof cable 19/ 1.80mm paper insulated 1100V grade from outdoor cable box up to meter box	15 m	
12	Cable clamps for holding cable with pole	4 Nos	
13	Ironclad meter board	1 No	
14	Energy meter 3 phase 3 wire 440V 50Hz 200 A	1 No	
15	kit kat 200 A fuse for power loads	3 Nos	
16	kit kat 50 A fuse for power loads	3 Nos	
17	Neutral link	1 No	
18	Earthing set complete	1 No	
	Labour cost		
	Total		
	10% contingency		
	Grand Total		

IX.a		**6x1**	**6**	**15**
IX.b	**Size of LT unit box and cable for each sub-circuit:** The maximum demand is 800 kVA which has to be distributed in four circuits. So each circuit is assumed to be rated 200kVA. The maximum current in LT sub-circuit =(200*1000)/(√3*400)=288 A Therefore 300A unit box, three phase with neutral is selected Cable selected for unit box is 4 core 185 mm (1 mark) **Size of HT cable:** The maximum current in HT sub-circuit =(1000*1000)/(√3*11000)=52.4 A	**1+1+ 1+6**	**9**	

Cable selected is 11kV 3 core HT cable 25mm (1 mark)

Size ofVIR required from transformer to OCB :

VIR cable single core 625 mm capable of handling 1440A current is selected (1 mark)

Sl. No:	Material	Quantity	Cost
1	Switchgear room 6m*6m	1 No	
2	Fittings for existing terminal pole a. MS channel cross arm 100mm*50mm*1.5 m long b. 11kV disc insulator with fittings c. Stay set complete d. HT outdoor cable box set e. GI pipe 75mm dia f. Cable clamps g. GI pipe clamp	 1 No 3 Nos 3 Nos 1 No 3 m 1 No 2 Nos	
3	11kV 3 core HT cable 25mm	30m	
4	11kV panel consisting of TPMO and metering arrangements etc.	1 No	
5	Transformer 11/0.4 kV 1000kVA delta/Star 50 Hz	1 No	
6	Right angle cable box to be fitted in 11kV panel with compound material	1 No	
7	VIR cable single core 625 mm	80 m	
8	Copper lungs 1000A	28 Nos	
9	LT OCB 1600A with all meters, CT,PT etc.	1 No	
10	Earthing of transformer and LT OCB (GI pipe earthing)	3 Nos	
11	LT unit box , 300A, 660V	4 Nos	
	Labour cost		
	Total		
	10% contingency		
	Grand Total		

	(6 marks)			

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