CMR INSTITUTE OF TECHNOLOGY

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Internal Assesment Test - III

Sub:	Electrical design estimation and costing							Code:	10EE81
Date:	26/05/2017	Duration:	90 mins	Max Marks:	50	Sem:	VIII	Branch:	EEE

Answer any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1 (a)	List out the guidelines for inviting tenders.	[5]	C801.1	L2

Guidelines For Inviting Tenders:

1. Whenever practicable and advantageous the contract is executed only after tenders have been invited. In regard to contract for "work" or "repairs" tenders are always invited, except when some exemptions have been granted by the competent authority.
2. Tenders are ordinarily invited on tender forms prescribed for the purpose. If any alteration is to be made, it should be done after taking prior sanction of the competent authority.
3. Tenders, which are always sealed, are invariably invited in the most open and public manner, e.g. by advertisement in the Government Gazette or local papers or by notice in English, Hindi, or Vernacular pasted in public places and by circular communications to the reputed dealers and contractors. All tenderers have free access to the contract documents.
4. The tender notice always states :
   (*i*) The place where and the time when, the contract documents can be seen, and the blank forms of tender obtained; also the amount, if any, to be paid for such forms of tender.
   (*ii*) The place where, the date on which, and the time when the tenders are to be submitted and are to be opened.
   (*iii*) The amount of earnest money to be deposited and the amount and the nature of the security deposit required in the case of the accepted tenders.
   (*iv*) With whom or what authority the acceptance of the tender will rest.
5. In the case of large contracts at least one month's time from the date of advertisement or notice is allowed for receiving all tenders. Authority is always reserved to reject any or all of the tenders so received without giving any reason and this is clearly stated in the advertisements.
6. All tenders received for the same contract are, opened by the competent authority in person at the advertised time and place in the presence of such of the intending contractors or their agents as they may choose to attend.
7. The earnest money of unsuccessful tenders is refunded to the tenderers as soon as possible after the disposal of tenders.
8. Usually the lowest tender is accepted, unless there is some objection to the capability of the contractor, the security deposited by him, or his execution of former work. In all cases where the lowest tender is rejected, reason is, however, recorded confidentially. In selecting the tender to be accepted, the financial status of the individuals and firms, who have tendered, is taken into consideration in addition to other relevant factors.

(b)	Explain the following: i. Comparative statement ii. Market survey and source selection	[5]	C801.1	L2

1.15. COMPARATIVE STATEMENT

This is an important document to evaluate the offers received against an Enquiry. Utmost care must be exercised while preparing the comparative statement (comparative price statement) of tenders. Any deviation from the tendered specifications, delivery conditions, assistance etc., stipulated by the tenderers should be highlighted. A sample of format (Format-II) of comparative price statement (CPS) is given on next page:

1.5. MARKET SURVEY AND SOURCE SELECTION

Good estimating is possible only with an update knowledge of

(*i*) availability of products
(*ii*) sources for production, vendor selection
(*iii*) new products and their quality
(*iv*) prices of products, discounts etc.

A market survey for collection of the above information and retention of the same in a library helps in easier estimation, and decision making for selection of materials and vendors. The surveys carry greater importance to ensure timely availability of materials essential for completion of projects with in stipulated time requirements. Non-receipt of materials in time may result in production/job hold-ups and receipt of materials ahead of time would be a burden on the cash flow of the organisation/company and add to inventory carrying costs. Consequently delay will occur in other activities which may be depending on the particular delayed activity.

It is a healthy engineering practice to conduct a market survey of the availability of products and also to obtain necessary approvals of approved suppliers/vendors to avoid poor quality of products being used at any stage. For early reference the estimator should preferably

(*i*) retain a list of approved suppliers/vendors both in alphabetical order and also product wise, and
(*ii*) retain a list of approved standard products.

In addition to the market survey of materials, sources advantage/assistance can be taken of the similar surveys being conducted by the state or central PWDs or MES standard Schedules of Rates/Specifications.

In order to make a survey easily accessible categorisation/classification of products can be made in a format as given below:

2 Draw the single line diagram and estimate the quantity of **PVC casing capping, conductor used and earth wire** in a house, the plan of which is shown in fig 2.1. Assume the height of ceiling as 3.6 meter. Only one plug point is to be provided only in hall. [10] | C801.2 | L3

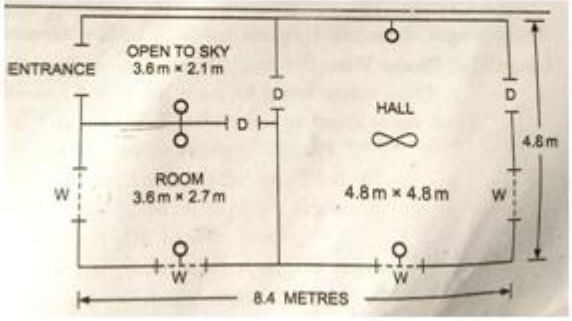


Fig 2.1

Draw the electrical circuit and estimate the quantity of materials and their cost required for PVC casing-capping used in a house, the plan of which is shown in Fig. 8.5. Assume the height of ceiling as 3.6 metres and one plug point is to be provided in each room.

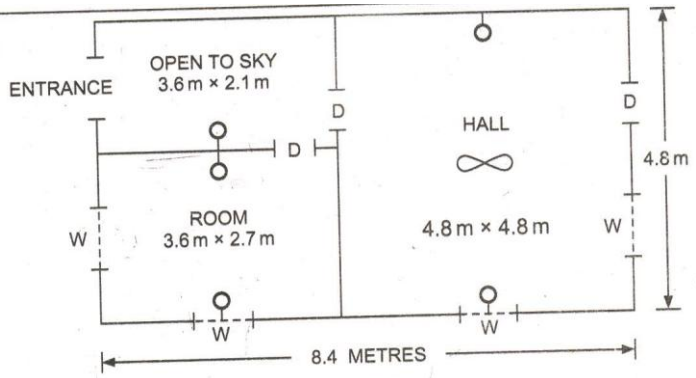


Fig. 8.5

Solution : Given :

No. of light points = 5

No. of fan points = 1

No. of plug points = 2

As per recommendation of ISI the wattage of each light, fan and plug socket (other than power sockets) may be taken as 60 watts for the purpose of load estimation.

$\therefore$ Connected load = 8 × 60 = 480 watts

Since number of points to be connected is 8 (less than 10) and load is 480 watts (less than 800 watts), one circuit is used and distribution board is not required.

Full-load current, $I = \frac{480}{240} = 2$ A.

Hence 240 V, 16A, DPIC switch fuse of any standard make may be used as a main switch and 1/1.40 mm, aluminium conductor, single core, 650 V grade, PVC cable having current carrying capacity of 10 amperes may be used for phase and neutral connections.

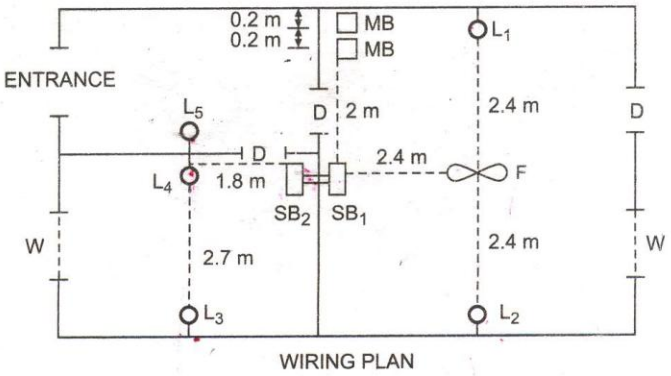


Fig. 8.6

Assumptions :

Assume the height of main board and switchboard = 1.5 metres

Height of casing-capping run = 3.0 metres

Height of bracket light points = 2.4 metres

The distance of meter board (MB) from the front wall (in hall) = 0.2 metre

The wiring plan is shown in Fig. 8.6.

Length of PVC Casing-Capping

From meter board to main board = 0.2 m

From meter board to switch board SB_1 = 1.5 + 2 + 1.5 = 5 m

Vertical run to ceiling in hall (above SB_1) = 3.6 – 3.0 = 0.6 m

Run along ceiling in hall = 2.4 + 2.4 + 2.4 = 7.2 metres

Drop from ceiling to L_1 = 3.6 – 2.4 = 1.2 metres

Drop from ceiling to L_2 = 3.6 –2.4 = 1.2 metres

From switchboard SB_2 to L_4 = 1.5 + 0.3 + 1.8 + 0.6 = 4.2 m

Vertical run to ceiling in room = 0.6 metre

Run along ceiling in room = 2.7 metres

Drop from ceiling to lamp L_3 = 3.6 – 2.4 = 1.2 metres

Total length of casing-capping = 0.2 + 5 + 0.6 + 7.2 + 1.2 + 1.2 + 4.2 + 0.6 + 2.7 + 1.2 = 24.1 metres

Wastage and length used in joints (15%) = 3.6 metres (say)

Total = 27.7 m = 28 m (say)

Length of Conduit of 19 mm Size

Connections are taken from SB_1 to SB_2 and from light point L_4 to L_5 through 19 mm conduit. Hence length of conduit required = 0.25 + 0.25 = 0.5 metre

Length of Phase Wire [1.5 mm^2 aluminium conductor, single core, 650 V grade PVC cable]

From meter board to main board = 0.2 metre

From main board to switchboard SB_1 = 1.5 + 2 + 1.5 = 5 metres

From SB_1 to fan point = 2.1 + 2.4 = 4.5 metres

From SB_1 to light point L_1 = 2.1 + 2.4 + 2.4 + 1.2 = 8.1 m

From SB_1 to light point L_2 = 2.1 + 2.4 + 2.4 + 1.2 = 8.1 m

From SB_1 to SB_2 = 0.25 m

From SB_2 to light point L_4 = 1.5 + 0.3 + 1.8 + 0.6 = 4.2 m

From SB_2 to light point L_5 = 1.5 + 0.3 + 1.8 + 0.6 + 0.25 = 4.45 m

From SB_2 to light point L_3 = 1.5 + 0.3 + 1.8 + 0.6 + 2.7 + 1.2 = 8.1 m

Total length = 0.2 + 5 + 4.5 + 8.1 + 8.1 + 0.25 + 4.2 + 4.45 + 8.1
= 42.9 metres

Wastage and extra wire at distribution boards 8.6 metres

Total length = 51.5 metres

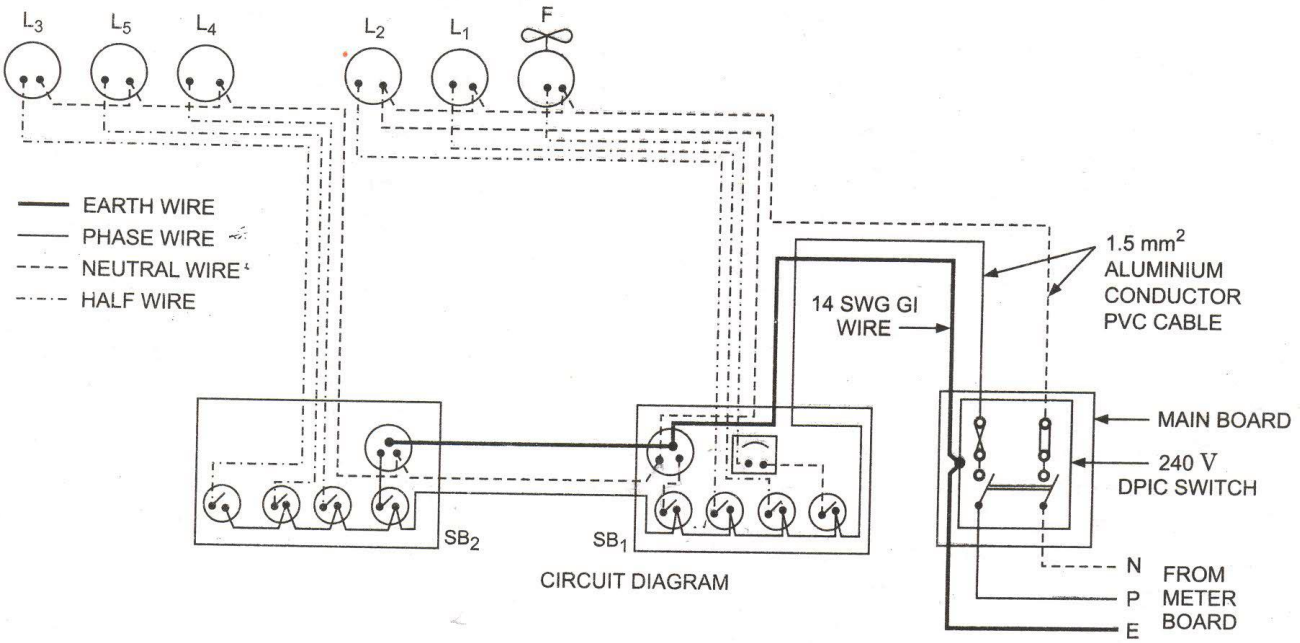


Fig. 8.7

Length of Neutral Wire [1.5 mm^2, aluminium conductor, single core 650 V grade PVC cable]

From meter board to main board = 0.2 m

From main board to fan point F = 1.5 + 2 + 0.6 + 2.4 = 6.5 m

From fan point F to light point L_1 = 2.4 + 1.2 = 3.6 m

From light point L_1 to light point L_2 = 1.2 + 4.8 + 1.2 = 7.2 m

From light point L_2 to switchboard SB_1 = 1.2 + 2.4 + 2.4 + 2.1 = 8.1 m

From SB_1 to SB_2 = 0.25 m

From SB_2 to light point L_4 = 1.5 + 0.3 + 1.8 + 0.6 = 4.2 m

From light point L_4 to L_5 = 0.25 m

From light point L_5 to L_3 = 0.25 + 1.2 + 2.7 + 1.2 = 5.35 m

Total length of neutral wire = 0.2 + 6.5 + 3.6 + 7.2 + 8.1 + 0.25 + 4.2 + 0.25 + 5.35
= 35.65 metres

Wastage and length used in connections (10%) = 3.6 m

Total length of neutral wire required = 39.25 metres

Total length of aluminium conductor single core PVC cable of size 1.5 mm^2 required (Phase + neutral) = 51.5 + 39.25 = 90.75 metres = 90 metres (say)

Length of Earth Wire required (14 SWG GI wire)

From meter board to main board = 0.2 metre

From main board to switchboard SB_1 = 1.5 + 2 + 1.5 = 5 m

From switch board SB_1 to switchboard SB_2 = 0.25 m

Total length required including wastage = 6 m = 0.2 kg (say)

3 List and explain the design considerations of electrical installation in commercial buildings [10] | C801.3 | L2

The fundamental objective of commercial building design is to provide a safe, comfortable, energy-efficient, and attractive environment for living, working, and enjoyment. The electrical design must

satisfy these criteria if it is to be successful.

Today's commercial buildings, because of their increasing size and complexity, have become more and more dependent upon adequate and reliable electric systems.

One can better understand the complex nature of modern commercial buildings by examining the Electrical System requirements systems.

The systems, equipment, and facilities that must be provided to satisfy functional requirements will vary with the type of facility, but will generally include some or all of the following:

1. Building electric service.
2. Power distribution system.
3. Lighting Interior and exterior, both utilitarian and decorative; task and general lighting.
4. Communications Telephone, facsimile, telegraph, satellite link, building-to-building communications (including microwave, computer link, radio, closed-circuit television, code call, public address, paging, fiber optic and electronic intercommunication, pneumatic tube, doctors' and nurses' call, teleconferencing), and a variety of other signal systems.
5. Fire alarm systems Fire pumps and sprinklers, smoke and Fire detection, alarm systems, and emergency public address systems.
6. Transportation: Elevators, moving stairways, dumbwaiters, and moving walkways.
7. Space conditioning: Heating, ventilation, and air conditioning.
8. Sanitation: Garbage and rubbish storage, recycling, compaction, and removal; incinerators; sewage handling; and document shredders and pulpers.
9. Plumbing: Hot and cold water systems and water treatment facilities.
10. Security watchmen, burglar alarms, electronic access systems, and closed-circuit surveillance television.
11. Business machines: Typewriters, computers, calculators, reproduction machines, and word processors.
12. Refrigeration equipment.
13. Food handling, catering, dining facilities, and food preparation facilities.
14. Maintenance facilities.
15. Lightning protection.
16. Automated building control systems.
17. Entertainment facilities and specialized audiovisual systems.
18. Medical facilities.
19. Recreational facilities.
20. Legally required and optional standby/emergency power and peak-shaving systems.
21. Signing, signaling, and traffic control systems; parking control systems including automated parking systems.

4	List out the material required for 1-phase overhead service line of a house located 10m away from the service pole, with following loads: Lighting= 300W, heating = 2500 W, assume safety factor =2	[10]	C801.4	L3

3.8 (a) Size of Service Main for Domestic Installation for a Given Load in Overhead System

Example : The figure shows a low income group Govt. quarters with AEH connection. The total load is 3.3 kW (300W lighting and 2.5 kW heating)

Select the size and service main for the load.

Material Calculation

$$\text{Load Current} = \frac{3300}{230} = 14.35 \text{ A}$$

F.S - 2, current rating is = 14.35 x 2 = 28.7 A.

Size of aluminium wire required = 10 sq. mm (From wire table).

Length of wire = (10 + 10) x 2 = 40 m.

6 sq. mm double sheathed PVC cable = 12 m for connection to overhead line.

Cost of Estimation

Sl. No.	Particulars	Unit	Quantity	Rate Rs. Ps.	Cost Rs. Ps.
1.	10 sq.mm PVC UG cable Aluminium 2 core 1.1 KV class, GI steel tape armoured, 250 V grade.	m	18m	40.00/m	720.00
2.	Stone ware Pipes	No	18	22.00	396.00
3.	38 mm diameter, 3mm thick GI pipe for laying cable	m	5m	165.00/m	825.00
4.	Earthing set	Set	1	1603.00	1603.00
5.	Iron pot 50 A, 250 V grade with two terminals.	No	1	168.00	168.00
6.	PVC cable, 6 sq. mm double sheathed	m	12	7.65/m	91.80
7.	Porcelain fuse units 15A, 250 V grade	No	2	40.00	80.00
8.	38 mm dia, 3 mm thick GI bends	No	3	21.00	63.00
9.	300 mm x 250 mm x 45 mm VTWB	No	1	50.00	50.00
10.	Clamp for fixing pipe pole and on meter side	No	1	18.00	18.00
11.	Clamps for fixing GI pipe with pole and on meterside	No	4	18.00	72.00
12.	Miscellaneous materials like screws, gutties, Rawl plugs and bituminous compound		LS		50.00
		Total Material cost			3950.80
13.	Labour charges @ Rs. 10.00/m	18.00 x 10			180.00
		Total			4130.00
14.	Add 5% for contigency, unfore seen and variation on material cost of Rs. 3950.00				197.50
		Grand Total			4327.50
		Say			Rs. 4328.00

5 Two ac, 3-phase, 415 V, 50 Hz squirrel cage motors are to be installed in a workshop. The rated outputs of the motors and their locations are shown in fig 5.1. Star-delta starters with each motor are to be installed on the wall. The supply company's meter will be located at the position marked. The wiring of the machines is to be carried out according to IE rules. **Make a neat sketch** of the wiring scheme with the help of a single line diagram indicating on the wiring diagram the **number and size of cables and conduit** used. [10] C801.5 L3

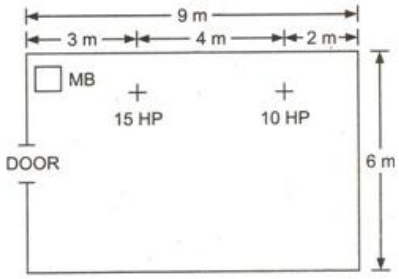


Fig 5.1

Solution : Assuming efficiency of motor 85% and power factor 0.8, we have full load currents of motors

$$I_1 = \frac{15 \times 735.5}{\sqrt{3} \times 415 \times 0.85 \times 0.8} = 22.5 \text{ A for 15 hp motor}$$

$$I_2 = \frac{10 \times 735.5}{\sqrt{3} \times 415 \times 0.85 \times 0.8} = 15.0 \text{ A for 10 hp motor}$$

Full-load current of two motors = 22.5 + 15 = 37.5 A

Hence 3-core, PVC, 1100 V grade, 25 mm^2* aluminium conductor cable having current carrying capacity of 54 A will be used from meter board to main board.

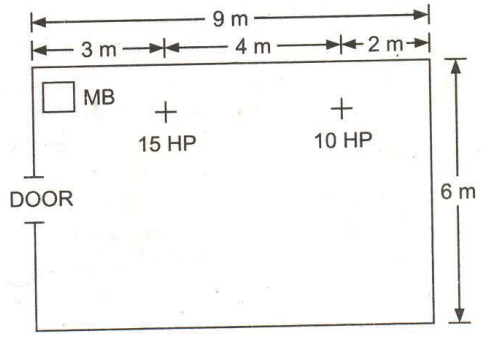


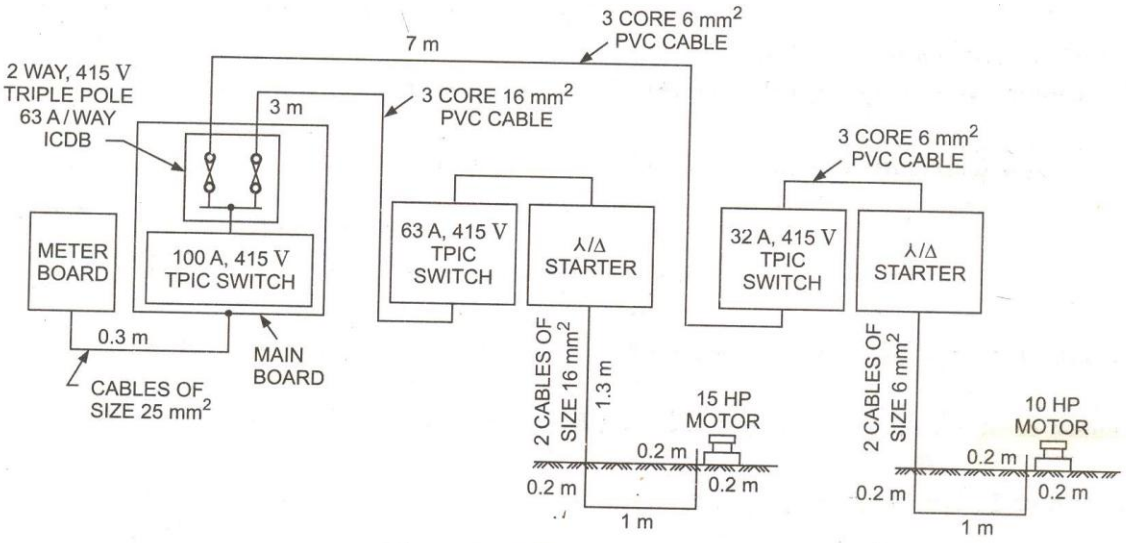
Fig. 9.5

The main switch and main distribution board will be mounted on main board of size 45 cm × 60 cm at a height of 1.3 metres form the floor level and 0.25 m from the supply main board.

The main switch used should be capable of handling starting current of one motor (of highest rating, plus full-load current of the other motor i.e. 22.5 × 2 + 15.0 = 60 A

Hence 100 A, 415 V grade TPIC switch shall be used as main switch.

As there are two circuits and starting current of one circuit (of highest rating) is 45 A, therefore, 2-way, 415 V, 63 A/way ICDB shall be used.



Single Line Wiring Diagram

6 Estimate the quantity of material required and cost of 1km of overhead 11kV 50Hz line using steel pole of 11 meter height and ACSR conductor of 6/1 x 2.59 mm with an average span of 120m [10]

C801.6 | L3

Solution :

Length of line = 1 km

Average span = 120 m

$$\text{Number of spans} = \frac{1{,}000}{120} = 8$$

Length of 6/1 × 2.59 mm conductor required = 3 × length of line + 2% for sag

(as 3 conductors run in 3-phase 11 kV line)

$$= 3 \times 1{,}000 \times \frac{102}{100} = 3{,}060 \text{ metres}$$

$$\text{Weight of ACSR conductor } 6/1 \times 2.59 \text{ mm} = \text{Length of conductor} \times \frac{128}{1{,}000}$$

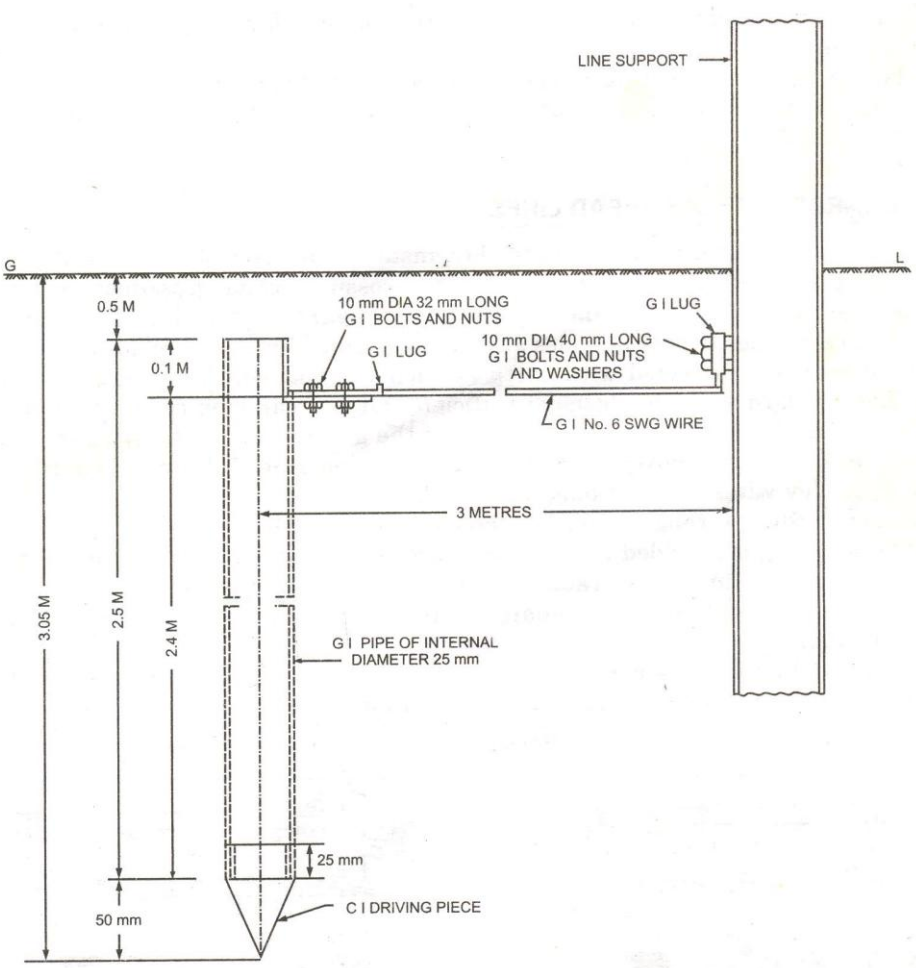
$\because$ 1 km weighs 128 kg

$$= 3{,}060 \times \frac{128}{1{,}000} = 391.68 \text{ kg say } 390 \text{ kg}$$

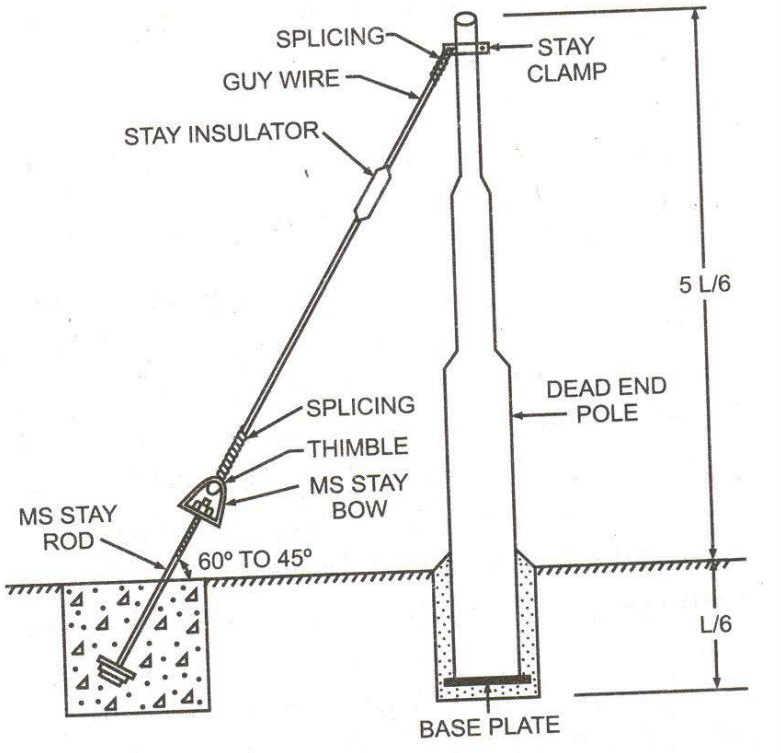
List of material required and cost is given below :

S. No.	*Description of Material With Complete Specifications*	*Quantity Required*	
		Quantity	*Unit*
1.	Steel poles, 11 m long	8	nos
2.	Teak wood cross arms 100 mm × 100 mm × 1.5 m long	8	do
3.	Top insulator brackets	8	do
4.	Earth wire clamps	8	do
5.	11 kV pin insulators complete with pins	24	do
6.	6/1 × 2.59 mm ACSR conductor	390	kg
7.	GI wire 8 SWG	1020 (102)	m (kg)
8.	Binding wire of aluminium for fixing conductors over insulators @ 200 gms at each insulator for 24 insulators	4.8	kg
9.	11 kV lightning arresters complete	1	set
10.	Earthing sets complete	3	do
11.	Danger plates 11 kV with clamps	8	nos
12.	Barbed wire (anticlimbing devices)	15	kg
13.	Pole foundation (muffs)	8	no
14.	Knee bracing sets	8	sets
15.	Guards (GSL No 4)	8	nos.
16.	CI reels to support the continuous earth wire	8	do
17.	Sundries to complete the job such as bolts, nuts, washers, thimbles, painting of iron parts, soldering etc		

7	A pole for an overhead 11 kV, 3-phase, 50Hz line is required to be earthed (pipe) and stay is to be provided. Make a neat sketch showing how it should be done.	[10]	C801.6	L3



Earthing of Transmission Line Supports (Pipe Earthing)



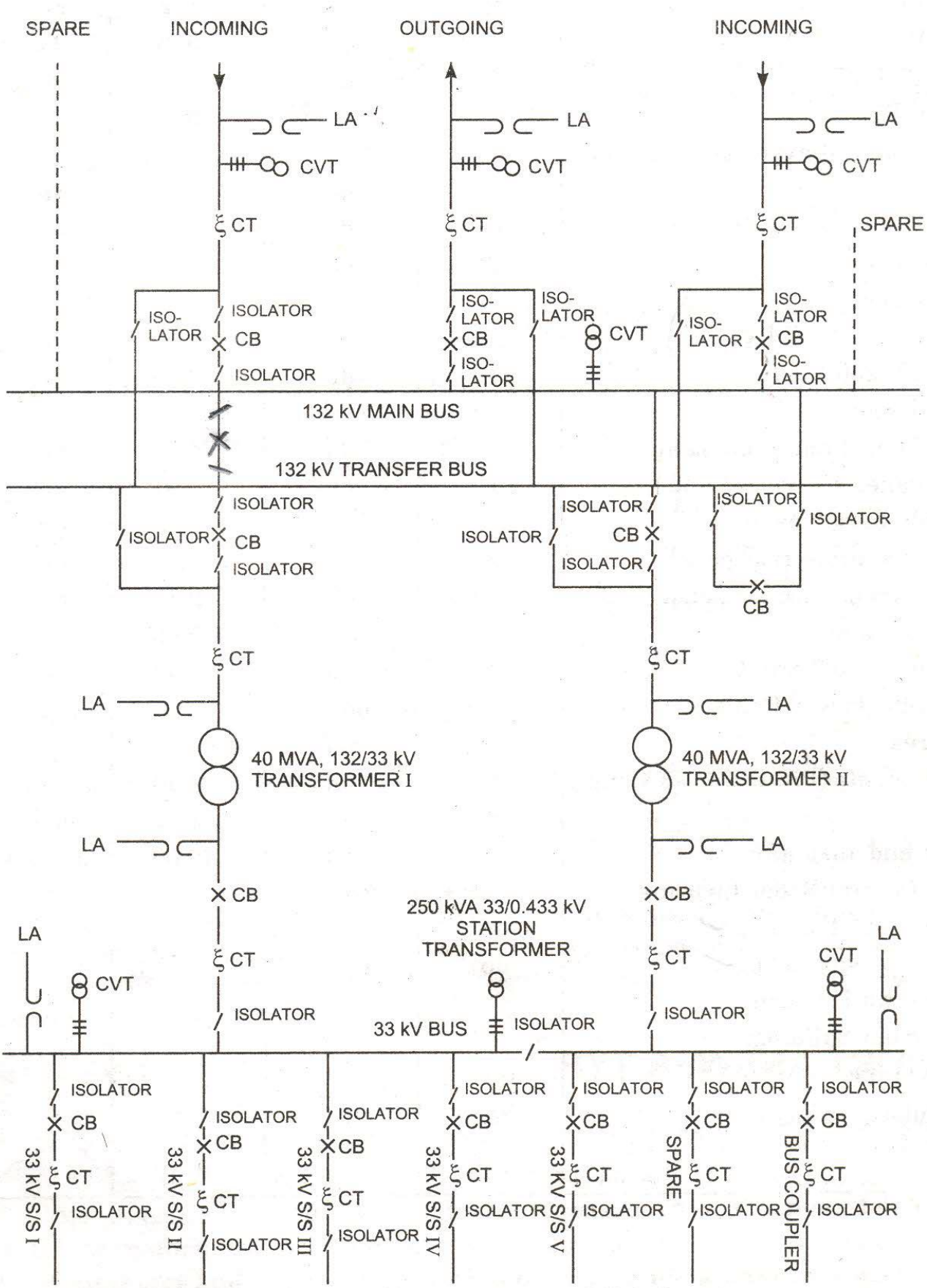
and estimate the cost. [*B.T.E. U.P Electrical Design, Drawing and*

Solution : The earthing and staying neat sketches are given is Figs. 10.63 and 10.19 respectively.

The list of materials with complete specifications and cost thereof for, both earthing and staying an 11 kV 3-phase overhead line, are detailed on next page :

S. No.	*Description of Material With Complete Specifications*	*Quantity Required*	
		Quantity	*Uni*
A	**EARTHING (Pipe Earthing)**		
1.	25 mm diameter GI pipe	2.5	m
2.	19 mm diameter GI pipe	1.5	do
3.	12 mm diameter GI pipe	4.0	do
4.	GI wire 6 SWG	12 (1.2)	do kg
5.	GI lugs	2	nos
6.	10 mm diameter, 32 mm long GI bolts and nuts	2	nos
7.	16 mm diameter, 40 mm long GI bolts, nuts and washers	2	do
8.	12 mm diameter GI bends	1	do
9.	30 cm square cast iron frame	1	no
10.	30 cm square cast iron cover	1	do
11.	Funnel with wire mesh	1	do
12.	Charcoal	10	kg
13.	Common salt	10	do
14.	Cement concrete 1 : 4 : 8	0.15	m^3
B.	**STAYING**		
1.	MS anchor plate 45 cm × 45 cm × 6.0 cm (not galvanised)	1	no
2.	MS stay rod 16 mm diameter and 2.42 m long	1	do
3.	Stay bow made of MS rod 12 mm diameter	1	do
4.	Stay insulator	1	do
5.	Stay wire (7/8 SWG GI wire)	7.5 (4.5)	m kg
6.	Stay clamp	1	no
7.	16 mm diameter, 76 mm long bolts and nuts for fixing	2	do
8.	MS thimbles	2	do
9.	Cement concrete 1 : 4 : 8	0.2	m^3

8 Draw the single line diagram of 132/33 KV substation with main and transfer bus scheme having 2 x 40 MVA transformers. [10] | C801.4 | L3



Single Line Diagram For 132/33 kV Substation