CMR INSTITUTE OF TECHNOLOGY

USN | | | | | | | | | | |

Internal Assesment Test - III

Sub:	Electrical Estimation and Costing							Code:	17EE553
Date:	18/11/2019	Duration:	90 mins	Max Marks:	50	Sem:	5	Branch:	EEE

Answer Any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1	Define the following i) conductor spacing's ii) ground clearance iii) Span lengths iv) Muffs	[10]	CO4	L1
2	Describe the functions of i) Cross Arms ii) Guys & Stays iii) Anti climbing Devices iv) Erection of Supports	[10]	CO4	L2
3	A pole for an overhead 11KV, 3 phase, 50Hz line is required to be earthed and stay is to be provided, make a neat sketch how it should be done. Prepare a list of materials required.	[10]	CO4	L4
4	Discuss the various points to be considered at the time of erection of overhead lines?	[10]	CO4	L2
5	List the various symbols used for Single line diagram of a substation and also draw the diagram of 33KV substation.	[10]	CO5	L1 & L3
6	Analyze and estimate the quantity of material and cost for erection of a 250KVA pole mounted substation.	[10]	CO5	L4
7	Describe the requirement of auxiliary supply for a substation and earthing necessity.	[10]	CO5	L2

Scheme of Evaluation

1 i) conductor spacing's ---------- 4 marks
ii) ground clearance---------- 2 marks
iii) Span length---------- 2 marks
iv) Muffs---------- 2 marks

2 i) Cross Arms ----------2 marks
ii) Guys & Stays ---------- 2 marks
iii) Anti climbing Devices ---------- 2 marks
iv) Erection of Supports---------- 4 marks

3 Sketches---------- 5 marks
List of materials & cost---------- 5 marks

4 10 points to be considered at the time of erection of overhead lines------ 10 marks

5 List of Symbols---------- 4 marks
Diagram---------- 6 marks

6 List of material----------4 marks
Cost estimation----------6 marks

7 Explanations – Substation---------- 5 marks
Explanations- Earthing---------- 5 marks

1)

Conductor Spacings:

Larger Spacing causes

↓

Increase in inductance of the line and Voltage drop.

Keep closer together - keep in mind of corona.

Based of temp, wind pressure also to see.

$$\text{Spacing} = \sqrt{S} + \frac{V}{150} \text{ metres.}$$

S - Sag in metres, V - Voltages in kV.

Line voltage in kV	0.4	11	33	66	132	220	400	765
Spacing in metres	0.2	1.2	2	2.5	3.5	6	11.5	14

Conductor clearances:

Mini. Vertical clearances b/w the ground and conductors are recommended vide IE rule 77.

Line voltage in kV / Clearance in ground in metres	0.4	11	33	66	132	220	400
Across Street	5.8	5.8	6.1	6.1	6.1	7.0	8.4
Along street	5.5	5.5	5.8	6.1	6.1	7.0	8.4
other Areas	4.6	4.6	5.2	5.5	6.1	7.0	8.4

SPAN lengths:

↳ based on roads, canals, railways

↳ ↑ → requirement of material decreases but cost of supports and other expert increases.

For planning both we have see:

a) with wooden poles : 40-50m
b) with Steel tubular poles : 50-80m
c) with RCC poles : 80-200m
d) with Steel towers: 200-400m and above.

Muffs:

↳ muffs are made of 3mm thick sheet in two pieces, detachable 46cm x 46cm at the bottom
30.5cm x 30.5cm at the top
overall length 1.8 metres

Tubular poles → 25.4cm diameter throughout and of length 1.8 metres

Used concreting the poles (or) towers.

2)

CROSS ARMS:

- To support the line conductors at a safe distance from ground
- To keep the conductors at a safe distance from each other and from the pole.

- cross arm is a cross piece fitted to the pole top and position by means of brackets called pole brackets.

MS channel - angle iron (or) wood

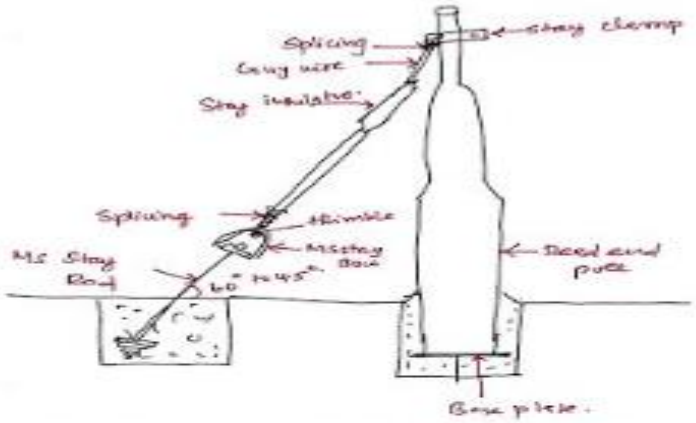
Straight, U-shaped, V-shaped and Zig-Zag

Sal wood material can be employed on 11 KV and 33 KV. to avoid flashover

1.5 m x 125 mm x 125 mm — 11 KV lines
2.1 m x 125 mm x 125 mm - 33 KV lines.

Steel cross arms are generally strong used on steel poles.

GUYS & STAYS ②



=> Essential to stay over dead lines supports at angle and terminal positions as the poles take the pull due to conductors.

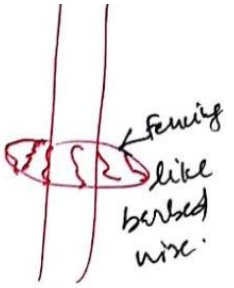
=> angle b/w pole and stay should be 45°.

↓
practice not possible → mini. 30° is maintained

Stay set => MS rod 19mm diameter
+
Stay bow + checknut, thimble +
Stay wire 7/8 (or) 7/10 SWG GI wire
+
Stay clamp

=> Stay arrangement are planned in PPI.

Anticlimbing devices:-



↳ Safeguard against the climbing by unauthorised persons.

↳ GI barbed wire is placed at height of

pole ← 2.5 metres from ground

tower ← 3 metres to 4.5 metres.

Muffs:

↳ muffs are made of 3mm thick sheet in two pieces, detachable 46cm x 46cm at the bottom

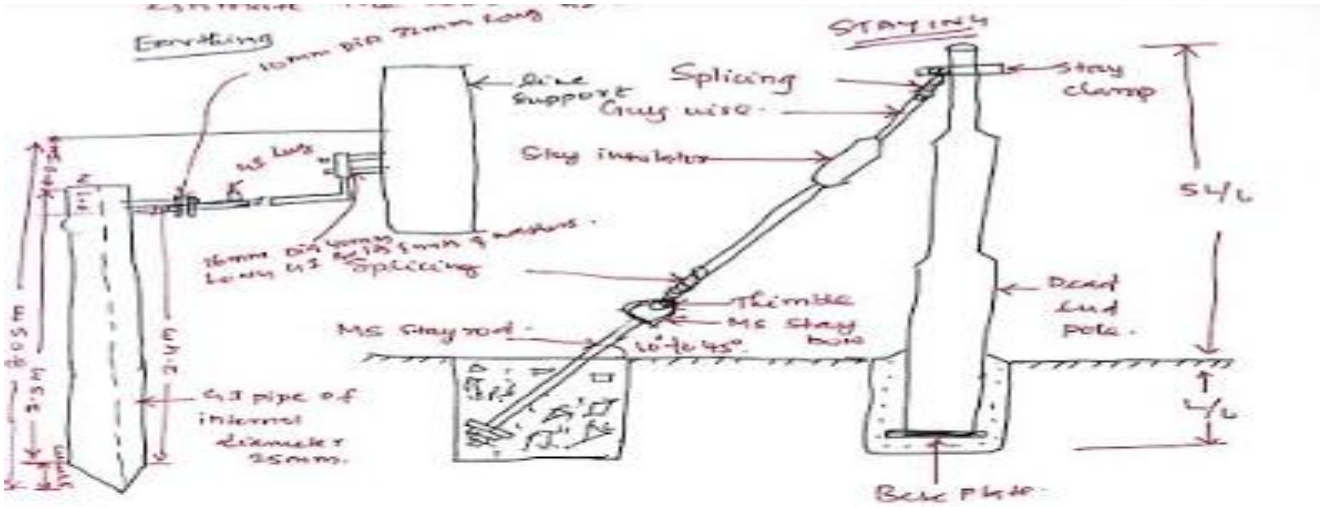
30.5 cm x 30.5 cm at the top

overall length 1.8 metres

Tubular poles → 25.4cm diameter throughout and of length 1.8 metres

used concreting the poles (or) towers.

3)



S.No	Description of with complete	Material Specifications	Qty Required Qty	unit	Rate	Amount
	Earthing					
1.	25 mm dia.	GI pipe	2.5	m	120	300
2.	19 mm dia	GI pipe	1.5	m	90	135
3.	12 mm dia	GI pipe.	4.0	m	75	300
4.	GI wire 6 SWG		12 (1.2)	kg	27/kg	$2.40.
5.	GI lugs		2	Nos.	15	30.00
6.	10mm dia 32 mm long GI bolts and nuts		2	Nos	15	30.00
7.	16mm dia 40mm long GI bolts nuts and washers		2	Nos	18	36.00

S. NO	Material description	Qty Req	Unit	Rate	Amount
8.	12 mm dia GI bends	1	No.	15	15.00
9.	30cm Square cast Iron frame	1	No.	150	150.00
10.	30cm Square cast Iron cover	1	No.	75	75.00
11.	Funnel with wire mesh	1	No.	75	75.00
12.	charcoal	10	kg	15	150.00
13	Common salt	10	kg	5	50.00
14.	Cement Concrete 1:4:8	0.15	m^3	1500/m^3	225.00
	Staying:				
1.	M.S. Anchor plate 45cm x 45cm x 6.0 cm	1	No.	675	675.00.
2.	MS stay rod 16mm diameter and 2.42 m long	1	do	675	675.00
3.	Stay bow made up of MS rod 12mm diameter	1	do	450	450.00
4.	Stay insulators 45 use.	1	do	150	150.00
5.	Stay wire (7/8 SWG)	7.5 (4.5 kg)	m kg	270	1215.00
6	Stay clamp.	1	No.	80	80.00
7.	16mm diameter, 75 mm long bolts and nuts for fixing	2	do	50	100.00
8	M.S. Thimbles	2	do	15	30.00
9	Cement Concrete 1:4:8	0.2	m^3	1500/m^3	300.00
				Total :	5278.00
				Storage & Transportation 5% charges	263.92
				Labour charges 20%	1055.65
				Contingencies : 10%	527.84
					7125.84
				Say : Rs 7200/-	

4)

POINTS to be considered at the time of Erection of Overhead lines:

1. Continuous ground wire earthed at the substation should be provided. Every 4th span of the pole and first and last pole should be properly earthed and wire should be joined properly to the continuous earth wire.

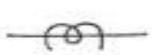
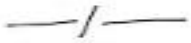
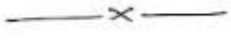
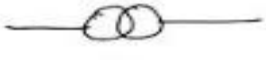
2. The clearance of conductor from the ground and adjoining should be according to IER 77, 78, 79, 80.
3. All metallic parts, line ampoments [except line conductors] should be earthed properly according to IER 90.
4. Permissible spacing b/w the conductors should be maintained throughout the lines.
5. Anti climbing device and danger plate [or caution notice] should be fixed on each pole.
6. One-Sixth of pole length should be properly buried and rammed with the soil.
7. The joints of the conductor should be mechanically strong and in proper sleeves.
8. The conductor should be tightened on the insulator properly with binding wires.
9. Guard wires should be provided wherever essential.
10. Pole steps should be provided in the towers for the lineman to climb the pole.
11. Proper jumper should be used wherever required.

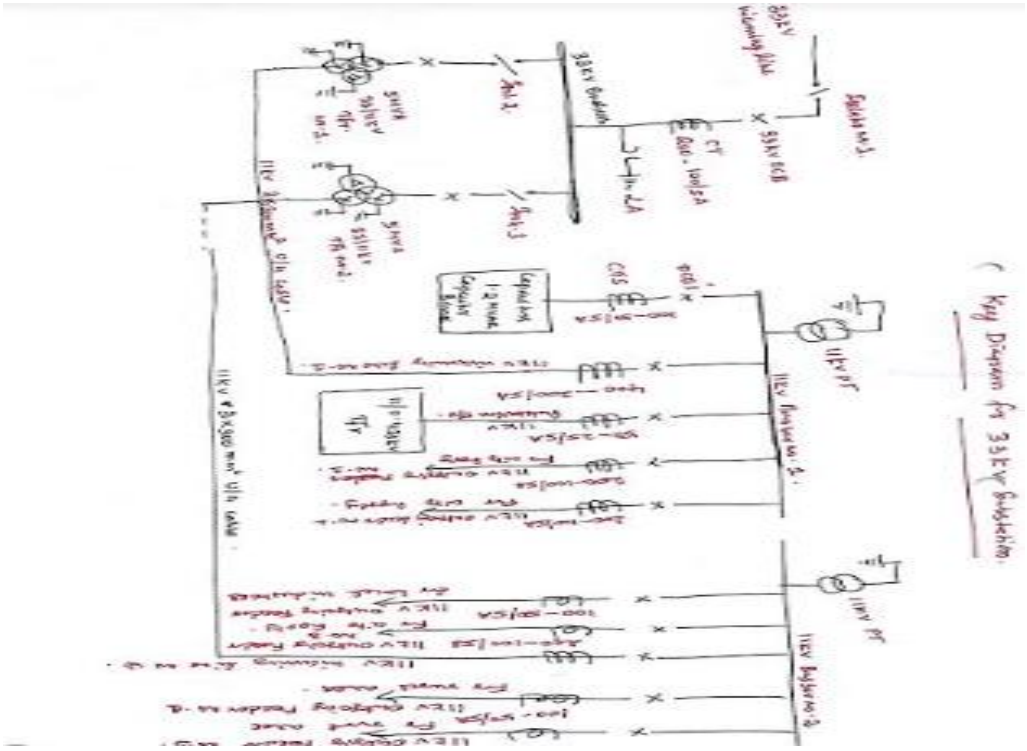
The points to be kept in view in the design of an overhead line are:

1. The line should be able to meet the desired load demands efficiently.
2. The line should be able to withstand adverse atmospheric conditions.
3. The voltage drop along the line should be within prescribed limits (IER 54).
4. The cost of the overhead line should be reasonable.

5)

Graphical symbols for various types of apparatus and circuit elements on substation main connection diagram.

Circuit Elements	Symbols
Earthing	
Current Tfr	
Potential Tfr	
Fuse	
Isolator	
Tandom Isolator	
Circuit Breaker	
Busbar	
Lightning Arrester	
Transformer	
Autotransformer	



(Key Diagram for 33KV Substation.

6)

Estimate the Qty of material and cost for erection of a 250KVA pole-mounted substation.

Primary current $I_1 = \frac{250 \times 1000}{\sqrt{3} \times 11,000} = 13.12A$

(Assuming primary voltage to be 11KV).

Secondary current $I_2 = \frac{250 \times 1,000}{\sqrt{3} \times 415} = 348A$

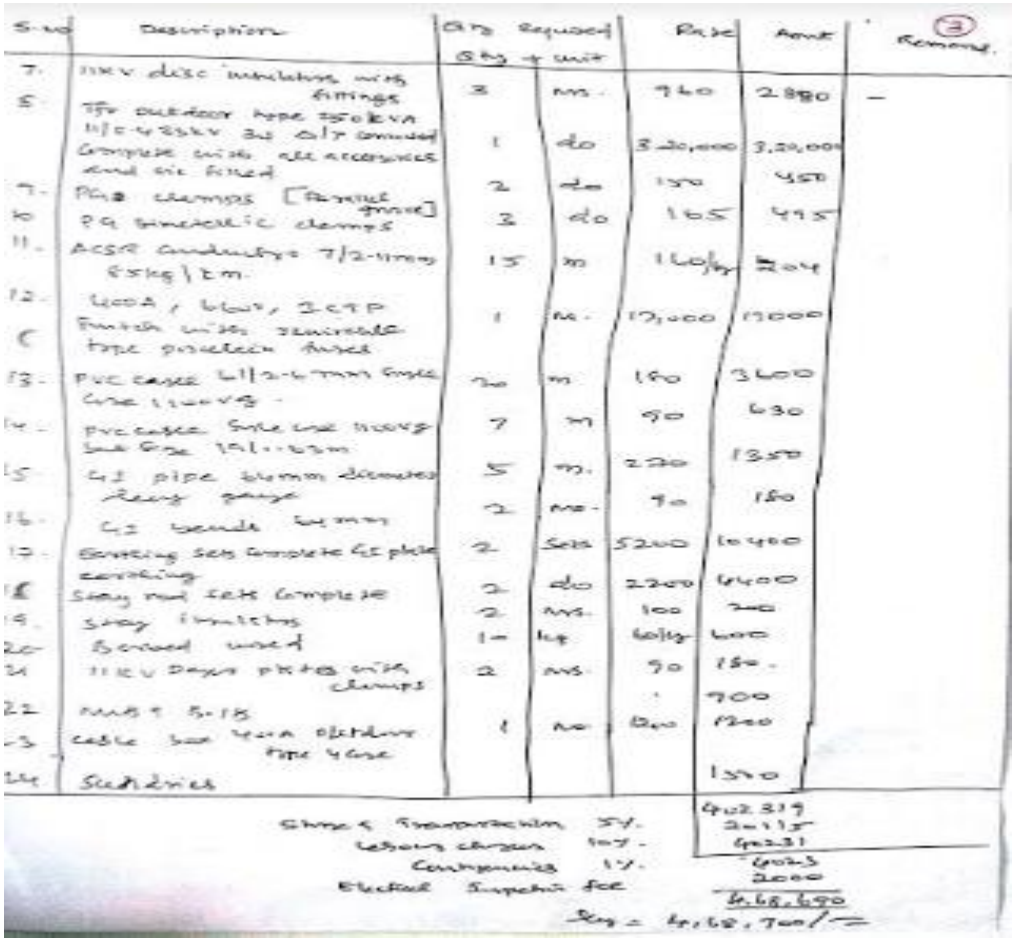
(Assuming Secondary voltage to be 415V).

ACSR conductor, 7/2.11mm will be used for the connection b/w overhead conductors and transformer.

6 1/2.6mm, 1100V grade Single Core PVC cable will be used for connecting switch to transformer (Phase Conductor)

19/1.63mm, 1100V grade Single core PVC cable will be used for connecting switch to transformer (Neutral Conductor).

S.no	Description	Qty Req	Unit	Rate	Amount	Remarks
1.	RCC poles 11m long	2	No.	7900	15800	For H pole structure
2.	11KV GO Switch (ac)-brake, triple pole) complete with fixing arms and 25mm diameter, 4m long operating pipe, lock & handle	1	No	8000	8000	
3	Expulsion type fuse units 11KV (mounted on structures	1	Set of 3	800	2400	
	Fuse	1	"	1000	3000	
	Spare HS					For fixing fuses
4.	MS angle iron 50mm x 50mm x 6.0mm	6	m	75	450	
5.	11KV lightning arrester expulsion type complete with all fittings transmission class discharge capacity 65KA	1	Set	3500	3500	
6.	MS channel iron 100mm x 50mm 6.0mm x 2m long	2	No.	900	1800	For supporting TPs



S.no	Description	Qty required		Rate	Amt	Remarks
		Qty	unit			
7.	11KV disc insulators with fittings	3	nos.	960	2880	—
8.	TPF outdoor type 750 kVA 11/0.433kV 3ϕ D/Y connected complete with all accessories and oil filled	1	do	3,20,000	3,20,000	
9.	PG3 clamps [Aerial grade]	2	do	150	450	
10.	PG bimetallic clamps	3	do	165	495	
11.	ACSR conductor 7/2.11mm 85kg/km.	15	m	160/km	204	
12.	400A, 660V, 3 CTP Switch with removable type protection fuses	1	No.	12,000	12000	
13.	PVC cable 4 1/2.6 mm single core 1100V	20	m	180	3600	
14.	PVC cable single core 1100V 50 sq mm 191.63m	7	m	90	630	
15.	GI pipe 40mm diameter Reey gauge	5	m.	270	1350	
16.	GI bends 40mm	2	No.	90	180	
17.	Earthing sets complete GI plate earthing	2	Sets	5200	10400	
18.	Stay rod set complete	2	do	2200	6400	
19.	Stay insulators	2	Nos.	100	200	
20.	Sleeved wire	1	kg	60/kg	600	
21.	11KV Danger plates with clamps	2	Nos.	90	180	
22.	Nuts & Bolts				700	
23.	cable box 400A distribution type 4 core	1	No.	800	1200	
24.	Sundries				1500	
					4,02,819	
	Stores & transportation 5%.				2,011	
	Labour charges 1%.				4,031	
	Contingencies 1%.				4023	
	Electrical Supervision fee				2000	
					4,68,690	
				Say =	4,68,700/=	

7) **Auxiliary Supply**

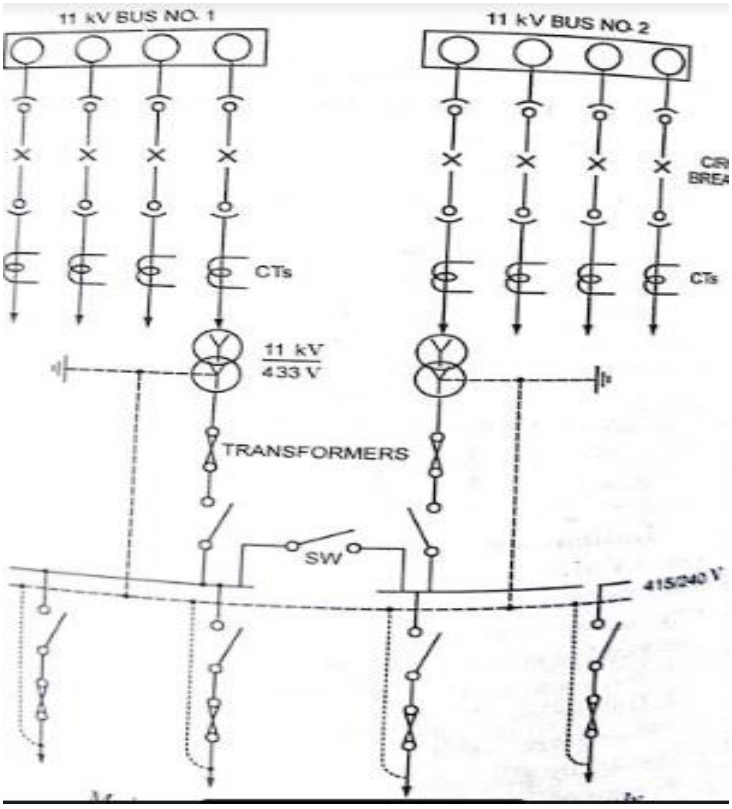
The purpose of auxiliary power supply systems is to cater for the necessary energy for the operation of primary and secondary devices at the substation. The auxiliary power systems are normally divided in two categories, namely the AC system and the DC system(s).The AC system normally operates with the country's standardized utility low voltage level, for example 400 V 50 Hz**.**

These loads would typically include the following:

- Substation building(s) climate control and lighting
- Outdoor equipment and indoor panels desiccation heaters
- Power transformer cooling fans
- Driving motor for on-load tap changer of a power transformer
- Station battery (DC system) charger(s)
- Normal wall socket outlets

The main components of AC auxiliary supply system are:

- Station auxiliary transformer(s),
- AC main distribution switchgear,
- AC sub-distribution board(s) and
- The cable network



Auxiliary Power Supply Diagram

Necessity of Substation Earthing:

The grounding system in substation is very important. The functions of grounding systems or earth mat in include:

- To ensure safety to personnel in substations against electrical shocks.
- To provide the ground connection for connecting the neutrals of stat connected transformer winding to earth (neutral earthing).
- To discharge the over voltages from overhead ground wires or the lightning masts to earth. To provide ground path for surge arresters.
- To provide a path for discharging the charge between phase and ground by means of earthing switches.
- To provide earth connections to structures and other non-current carrying metallic objects in the sub-station (equipment earthing).

In addition to such a grid below ground level, earthing spikes (electrodes) are driven into the ground and are connected electrically to the earth grid, equipment bodies, structures, neutrals etc. are connected to the station earthing system by earthing strips.

If the switchyards have a soil of low resistivity, earth resistance of the earthing system would be low. If the soil resistivity is high, the mesh rods are laid at closer spacing. More electrodes are inserted in the ground.