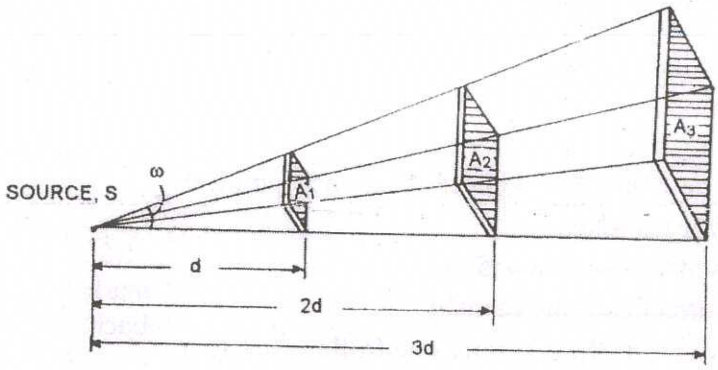
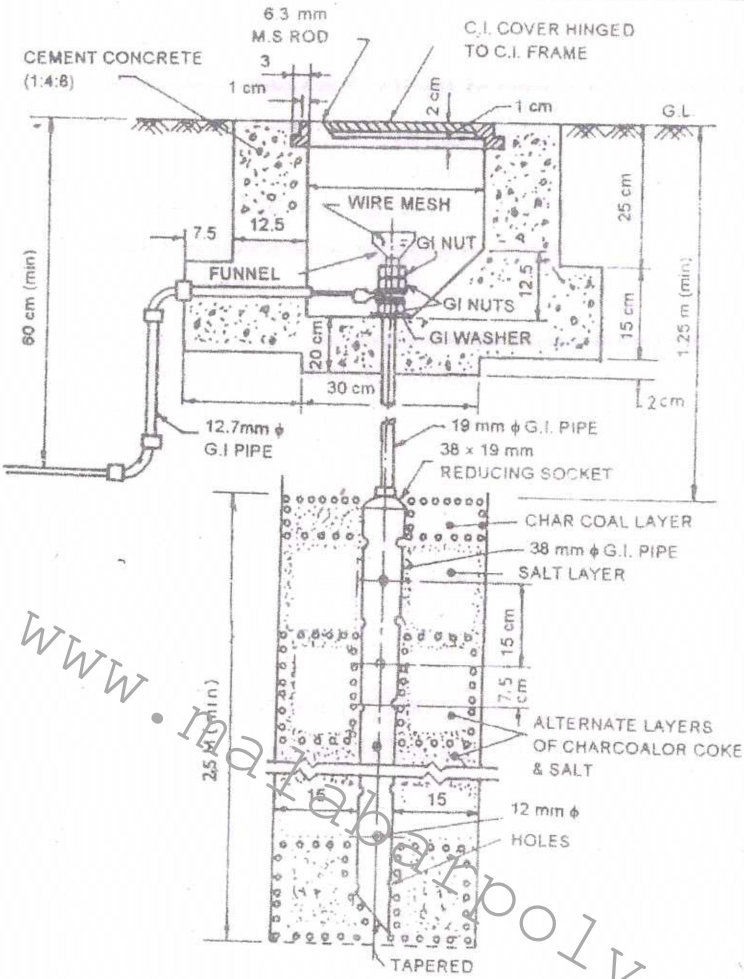
Revision:15

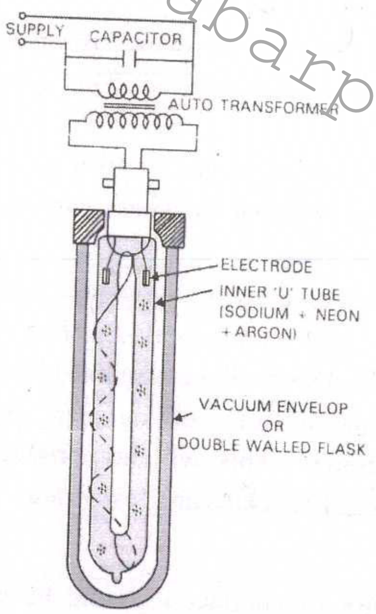
Course Title: Electrical Estimating and Costing **Course Code: 4033**

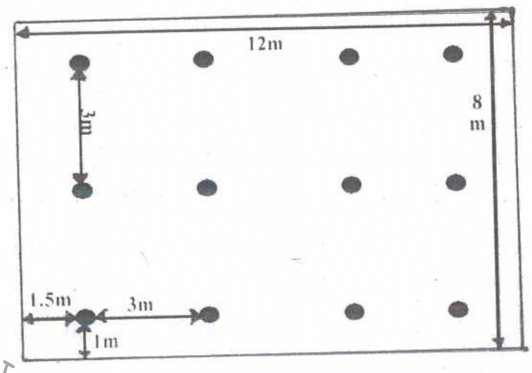
Qn No	Scoring Indicator	Split up Score	Sub Total	Total
I	**Part A**			
1	It is the luminous flux received by the surface per unit area. It is represented by E. The unit of illumination is lux Illumination, E = $\frac{flux}{area}$lux	2	2	
2	1) Surface conduit or open conduit 2). Recessed or concealed conduit	1 Each	2	
3	Nature of soil condition, Moisture content, Temperature of the soil, Depth of the electrode embedded below the ground level, size of earth electrode, Material of the electrode (any two)	1 Each	2	
4	Pin insulator, Suspension, disc, shackle, Guy (any two)	1 Each	2	10
5	11kV for industrial and 230V for domestic	2	2	
II	**Part B**			
6	It states that the illumination of a surface is inversely proportional to the square of the distance between the square and the light source.  Let S= point source A_1, A_2, A_3 = 3 parallel surface areas in m^2 d, 2d,3d = distance of A_1, A_2, A_3 in m ω = solid angleI = luminous intensity For area A1 solid angle $\omega = \frac{A_1}{d^2}$ ………………………………….(1)	1 Fig 1		6

	Flux φ_1 on area A_1 = luminous intensity x solid angle $= I\omega$ ……………………………………..(2) Substitute the equation (1) in (2) $\varphi_1 = I\frac{A_1}{d^2}$ $= \frac{IA_1}{d^2}$ ……………………..(3) Illumination E on area $A_1 = \frac{flux}{area} = \frac{\varphi_1}{A_1}$ …………………………..(4) Substitute the equation (3) in (4) $= \frac{IA_1}{d^2} \times \frac{1}{A_1}$ $= \frac{IA_1}{d^2 A_1}$ $E_1 = \frac{I}{d^2}$ lux Similarly illumination on A_2, $E_2 = \frac{I}{(2d)^2}$ lux Illumination on A_3, $E_3 = \frac{I}{(3d)^2}$ lux From this we can see that the illumination of surface is inversely proportional to the square of the distance between source and the object. Thus inverse square law is proved.	4		
7	$E = \frac{I}{d^2}$ $20 = \frac{60}{d^2}$ $d = \sqrt{\frac{60}{20}} = \sqrt{3}$ d=1.73m	6	6	
8	1.Every guard wire shall be connected with earth at each point at which its electrical continuity is broken 2. Breaking strength shall not be less than 635kg 3. Should have sufficient current carrying capacity 4. Lines crossing trolley wires:- if there is only one trolley wire two guard wires should be provided with a distance of 40 cm, guard books shall be provide for preventing the sliding of broken lines	1.5 mark Each	6	

9			6	6
10	Incoming Service wires, Energy meter, Voltmeter, Ammeter, Bus-bars, Pilot lamps, IC main switch/ circuit breakers, Sub circuit cutout or MCB'S, Interconnecting wires, Closed Container, Danger plate, Nails and Screws, Insulation tape, Wooden gutties, Sand, cement... etc (any 6)	1 Mark Each	6	
11	Insulators, Cross arms and clamps, Conductors, Guys and Stays, Lightning Arrestors, Fuses and Isolators, Earth wires, Vee Guards. (any 6)	1 Mark Each	6	

12	**Indoor substation:-**in such substation the apparatus is installed within the substations building. Such substations are usually for voltages up to 11kV but can be erected for the 33kV and 66kV and the surrounding atmosphere is contaminated with impurities such as metal corroding gases and fumes, conductive dust etc	3	6	
	Outdoor substation:-Such substation is erected for distribution of power in localities. They are installed in open air with fencing. These are further sub divided into; a) Pole mounted substations Such substation is erected for distribution of power in localities. Single strut pole or H- type pole or 4 pole structures with suitable platforms are employed for transformer's of capacity up to 25kVA, 100kVA respectively. b) Foundation mounted substations (Plinth) The capacity above 250 kVA, the foundation is used.	3		
	Part C			
III a	Total illumination at ground, just below 500 CP lamp post = Illumination due to 500CP lamp and Illumination due to 800CP Lamp $E_A = E_{500} + E_{800} = \frac{I_{500}}{h^2} + \frac{I_{800}}{d^2}\cos\theta_2 =$ $\frac{500}{10^2} + \frac{800}{\left[\sqrt{10^2+20^2}\right]^2} \times \frac{10}{\left[\sqrt{10^2+20^2}\right]} = 5 + 0.716$ $=5.716$ lux	2	8	
	$E_B = E_{800} + E_{500}$ $= \frac{800}{10^2} + \frac{500}{\left[\sqrt{10^2+20^2}\right]^2} \times \frac{10}{\left[\sqrt{10^2+20^2}\right]} = 8 + 0.447$ $= 8.447\,lux$	3		
	Illumination at the centre of the posts on the ground $E_c = E_{c800} + E_{c500}$ $= \frac{I_{500}}{d^2}\cos\theta + \frac{I_{800}}{d^2}\cos\theta$ $= \frac{500}{\left(\sqrt{10^2+10^2}\right)^2} \times \frac{10}{\left[\sqrt{10^2+10^2}\right]} + \frac{800}{\left(\sqrt{10^2+10^2}\right)^2} \times \frac{10}{\left[\sqrt{10^2+10^2}\right]}$ $= 1.77 + 2.82 = 4.59\,lux$	3		

III b	This lamp consists of an inner U tube which can withstand high temperature of the electrical discharge. Is has two sets of electrodes connected to a pin type base. In the inner U tube there is a combination of sodium, neon and argon gases. The neon gas serves to start the discharge and develop enough heat to vapourise the sodium. Below 60^0 Csodium is in solid state. The lamp operates at about 300^0 C. The tungsten coated electrodes are connected across auto transformer having relatively high leakage reactance. The secondary voltage is about 450 to 470 V. this voltage initiate a discharge through neon gas. When the supply is switched ON the high voltage of the auto transformer initiates the electric discharge through the neon gas and gives red-orange colour glow. The metallic sodium which is on the walls of the inner tube gradually vapourises and discharge takes place through the sodium vapour. The lamp will take 15 – 20 minutes to attain its full brightness. The luminous efficiency of the lamp is about 40 – 50 lumen/watt. The life span is approximately 3000hrs. 	3 Fig 4		
IV a	Hall area =12x8=96m^2 Total flux required to illuminate the area , 160 x 96 = 15360 lumen Actual flux produced by the source $= \frac{Total\ flux}{UF \times DF} = \frac{15360}{0.8 \times 0.5} = 38400\,lumen$	1 2		

	Total wattage required to produce 38400 lumen, $\frac{Total\ flux}{\eta} = \frac{38400}{40} = 960\,w$ Total no of 80 w lamps required, $\frac{960}{80} = 12$ 	1 1 fig 3	8	
IV b	Direct fitting: - 90-100% directed towards 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 other direction. Translucent reflectors can be used. This type also produces shadows General fitting: - 40-60% on the working plane, 60-40% goes other direction. Translucent reflectors of different thickness can be used. This fitting produce almost uniform light Semi-indirect fitting: - 10-40% light on the working plane, remaining light goes to 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	1.5 1.5 1 2 1	7	
Va	1. The current rating of the cable or conductor should be slightly greater (at least 1.5 times) than the load current. 2. Every live wire line should be protected by a fuse of suitable rating as per load requirements. 3. Every sub-circuit should be connected with fuse on distribution board.	1		

	4. All metal coverings used for the protection of earth must be connected to earth. 5. No switch or fuse is used in earth or neutral conductor. 6. Every apparatus should be provided with a separate switch. 7. No additional load should be connected to the existing installation until it has been satisfied that the installation can safely carry the additional load. 8. All the switches and starters should be accessible to the operator. 9. A caution notice should be fixed on all equipment. 10. In any building light wiring and power wiring should be kept separately. 11. When the installation has been completed it should be tested before giving the supply and the leakage in the wiring should not exceed 1/5000 of the maximum current of the load. 12. In three phase 4 wire installation the load should be distributed almost equally on the all phases 13. In case of three phase 4 wire system, on the main board, indication of 3 phases should be done in **Red, Yellow and Blue**. **Neutral** should be indicated by **Black**. (any 8 points)	Mark each	8	
V b	$60\times 20 = 1200w$ $60\times 15 = 900w$ $60\times 14 = 840w$ $500\times 1 = 500w$ $1000\times 3 = 3000w$ Total load =6440w Total current $= \frac{Total\ load}{supply\ voltage} = \frac{6440}{230} = 28A$ Light and fan sub circuit $= \frac{1200+900+840}{800} = \frac{2940}{800} = 3.67 \approx 4$ sub circuit Power sub circuit$= \frac{3000+500}{3000} = \frac{3500}{3000} = 1.16 \approx 2$ sub circuit	2 1 2 2	7	
VI	1) No of sub circuits 3 2) Size of Cable:- The cable for sub circuit 1 and 2 should be the minimum size ie, 1	1 1		

mm^2 coper cable. For power subcircuit 31/1.8 mm aluminium core cable can be used. A 15 A , 250 V flush type DP main switch can be used — 3

3) Length of PVC conduit= 62m
4) Length of Cable:- — 3
   Power circuit = 30m
   Light and fan circuit = 174m
5) Labour cost — 1
   Meter board = 2 points
   Distribution board = 2 points
   Light and Fan = 17 points
   Power point = 2 points
   Total points = 23

Labour cost @ 300 per point =300x23=6900

Sl No,	Material	Qty	Cost
1	DP 15A, 250 V Main switch	1	500
2	IC cutout 15 A 250 V	1	50
3	Flush type fuse unit 15 A	1	50
4	Flush type fuse unit 5 A	2	50
5	PVC conduit 12mm	62 m	930
6	1 mm2 cable	174 m	2000
7	Switches 5A , 250 V one way	17	340
8	2 pin sockets 5 A 250 V	4	100
9	3 pin sockets 15 A, 250 V	2	100
10	Lamp holders	8	120
11	Saddles	Lumpsum	200
12	Screws	Lumpsum	200
13	PVC junction boxes, bends, round blocks	Lumpsum	300
14	Eartg wire , 16 SWG	2 kg	600
15	Earth set	1	5000
16	Labour cost		
	Grand Total		10540

— 6

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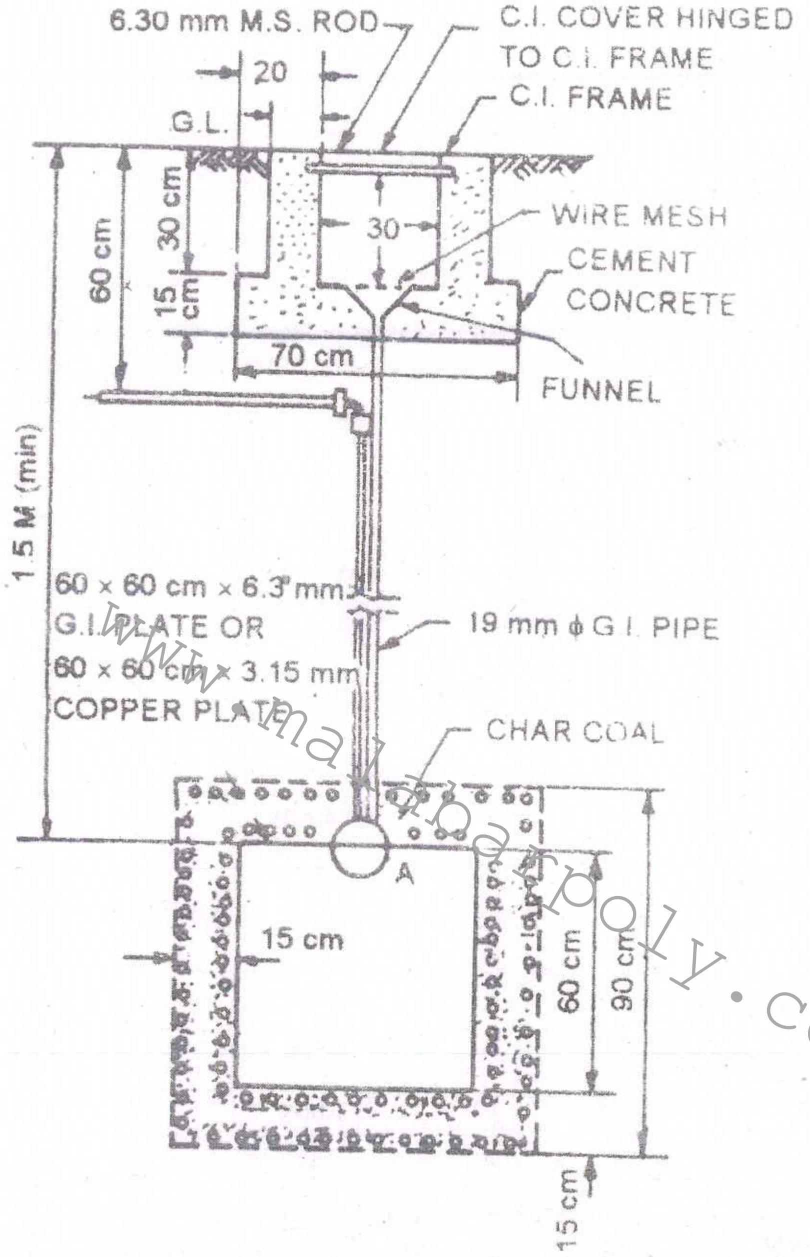
<tr><td>VII</td><td>
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<tr><td></td><td>Material</td><td></td><td></td><td></td></tr>
<tr><td></td><td>GI plate 60cmX60cmX6.3mm
GI wire (8SWG)</td><td></td><td></td><td></td></tr>
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12.7mm GI pipe
19mm GI pipe
GI nut,bolt, washers, checknut
GI bend 12.7mm
GI lugs
Cast iron frame with hinges
Cast iron cover 30cmX30cm
Funnel with wire mesh
Charcol or cock
Salt
Cement
Caution plate

7

VII
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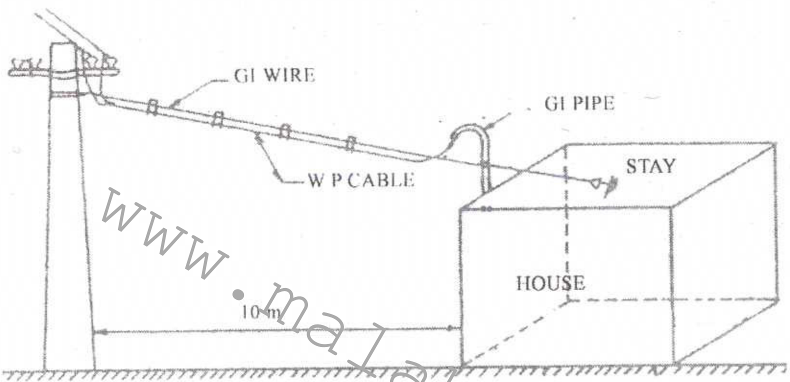

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Material	Quantity
1 phase energy meter	1
16 A fuse unit	1
7/20 WP twin core cable	15m
GI wire for supporting cable	15m
Link clips	1 box
Insulation tape	1
GI Pipe 18mm dia	1
Neutral link	1
Cement	1sack
Sand	LS
Wooden board 10" X 10"	1
Nails and Screws	2kg
Wooden gutties	LS

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IX

Number of poles $= \frac{1600}{100} = 16$

Length of conductor = 2 X 1600 + 5% sag and wastage = 3360 m

Insulators Pintype = 15x2=30, 7

disc type = 2x2=4

Cross arms 16+1 = 17

Material	Qty	cost
PSCC 9 m long poles	16	32000
AAC conductor	3360m	63000
Pin insulators	30	3000
Disc insulators	4	1000
MS cross arm	6	540
Earth set	2	1000
Stay set	3	3600
Danger plates	16	320
Cement	20 bag	7000
Concrete	20 bags	1200
Sand	2 tons	1400
Binding wire	6kg	700
MS flat for cross arm fixing	17	3400
Nut and bolts	50kg	2500

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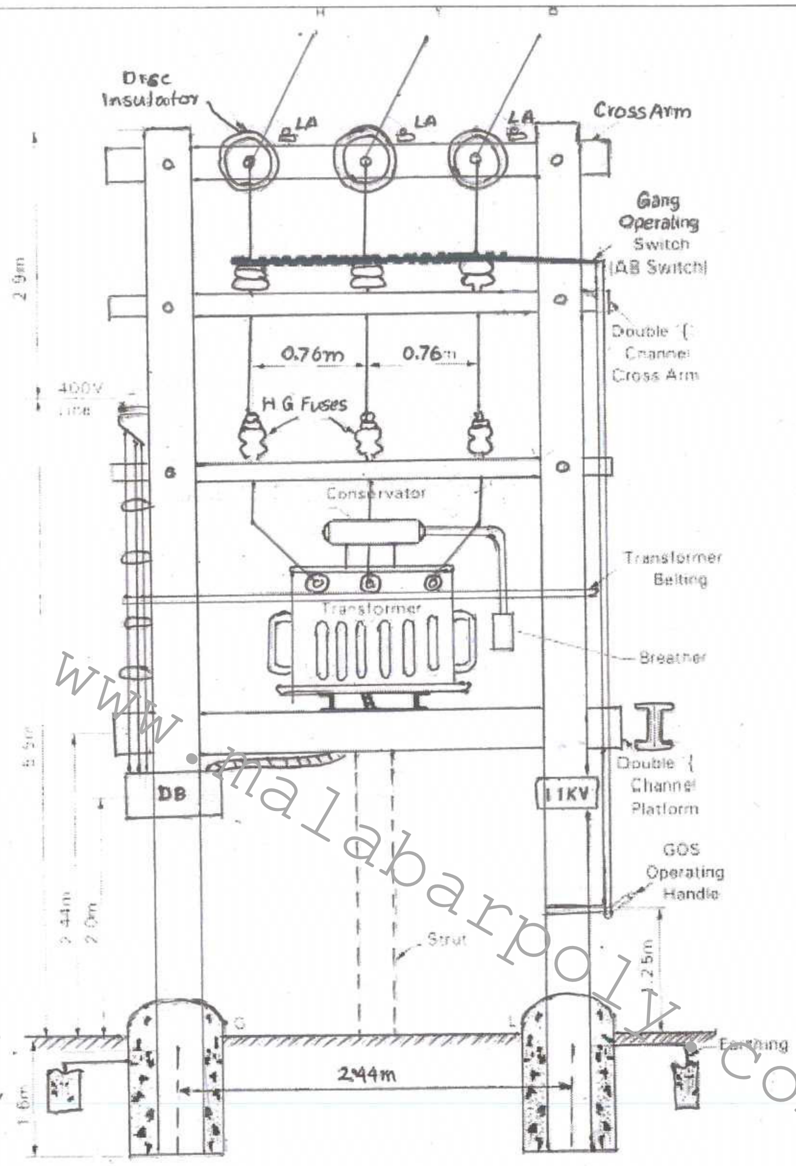

b. Pole-Mounted Sub Station (11 KV/400 V)
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Description of material with specification	Quantity Required		Rate		Total
	Qty	unit			
PCC poles 11 m long	2	No	2000	each	
11 kV disc insulators	3	No	200	,,	600
Lightning arrestor (1 set of 3)	1	Set	2500	,,	2500
Gang operating switch	1	Set	10000	Set	10000
11 kV DO fuse unit(Drop out)	1	,,	2300	,,	2300
100 kVA, 11/440 V 3 phase 4 wire 50 Hz outdoor type T/F with complete accessories and oil filled	1	No	300000	,,	300000
MS angle iron 50mmX50mmX6mm	6	No	500		3000
MS channel iron 100mm X 50mm X 6 mm	2	No	1000	,,	2000
400A, 500 V, ICTPN switch with rewirable type porcelain Fuses (complete set)	1	No	5000	,,	5000
ACSR conductor 7/2.11 mm	15	M	100	M	1500
Single core VIR cable 95mm^2	20	M	50	M	1000
19/ 1.63 mm single core VIR cable	7	M	30	M	210
Clamps	6	No	60	Each	360
Earthing set	4	No	2000	,,	8000
Stay set with insulation	2	No	1000	,,	2000
Barbed wire	10	Kg	50	Kg	500
Danger plates with clamps	2	No	100	Each	200
Nuts and bolts	Lump sum				1000
Cement	4	Sack	350	Sack	1400
Sand	4	,,	100	,,	400
Pebbles	4	,,	200	,,	800

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