CBCS SCHEME

USN | | | | | | | | | | **17EE553**

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Electrical Estimation and Costing

Time: 3 hrs.   Max. Marks: 100

Note: *Answer FIVE full questions, choosing ONE full question from each module.*

Module-1

1   a.   Define estimating and state its purpose. State the important facts which an estimator should know for preparing an internal wiring estimate.   **(08 Marks)**
    b.   Explain the following : (i) Catalogues (ii) Purchase system   (iii) Contingencies.
                                                                        (06 Marks)
    c.   Mention the different mode of tendering and explain them.   **(06 Marks)**

OR

2   a.   State the purpose of IE rule and regulations. Explain IE rules 29,30 and 55.   **(08 Marks)**
    b.   Write note on the comparative statement.   **(06 Marks)**
    c.   Explain (i) Overhead charges   (ii) Profit   (iii) Payment of bills.   **(06 Marks)**

Module-2

3   a.   List the general rules guidelines for residential installation.   **(04 Marks)**
    b.   Explain the different systems of distribution of energy in a building.   **(04 Marks)**
    c.   Draw the electrical circuit and estimate the quantity of material required for the wiring system. Chosen in a house plan shown in Fig. Q3 (c). The hight of ceiling as 3.6 m and one plug point (60 W) has to be provided in each room.   **(12 Marks)**
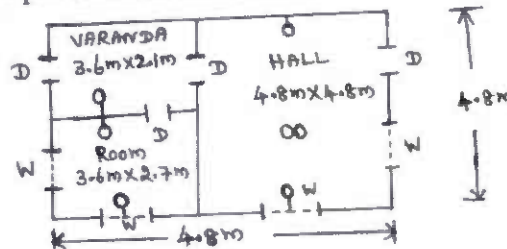

Fig. Q3 (c)

OR

4   a.   Explain the points on which the choice of wiring system can be made. Why fuse is connected in the phase wire?   **(08 Marks)**
    b.   With reference to internal electrification of building, explain how to determine the following: (i) Total load   (ii) Rating of main switch and distribution board (iii) Number of circuits.   **(06 Marks)**
    c.   Determine the size of conductor (copper) for a 2-core cable required to carry a maximum current of 60 A. Length of the cable used is 60 m and declared supply voltage is 240 V AC. (Current ratings of cables shown in table Q4 (c) may be referred)   **(06 Marks)**

| Size of cable | | Current rating in Amps | | Approximate |
No. and dia of wire	Area in mm²	2 Core cable	3 or 4 core cable	Ampere-meter per volt drop
19 / 1.12	19.35	62	50	1050
19 / 1.32	25.80	74	59	1475
19 / 1.626	38.70	97	78	2200

Table Q4 (c)

Module-3

5 a. State the important considerations regarding motor installation wiring. **(06 Marks)**

b. Explain the determination of input power, size of conduit, distribution board, main switch, starter size of the cable and rating of the fuse. **(08 Marks)**

c. Prepare an estimation of materials for providing OH service connection to a single storied building with 240 V, 1ϕ, 50 Hz AC supply. The building has a light and fan load of 5 kW. The supply is to be given from an OH line 20 m away from the building. (assume missing data). **(06 Marks)**

OR

6 a. What do you understand by service line? Write down the various methods of installing service lines. **(04 Marks)**

b. With simple sketches, explain any two methods of installation of OH service lines based on the prevailing conditions of the building. **(06 Marks)**

c. A 10 HP, 415 V, 3 ϕ, 50 Hz induction motor is to be installed in a workshop the plan of which is shown in Fig. Q6 (c). Show the single line diagram and estimate the quantity of material required. **(10 Marks)**
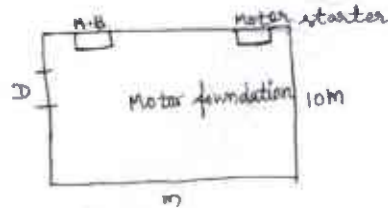
Fig. Q6 (c)

Module-4

7 a. List out the various points to be considered at the time of erection of over head lines. **(06 Marks)**

b. Explain the following : (i) Cross arms   (ii) Guys and stays   (iii) Lightning arrestor. **(06 Marks)**

c. Explain the necessity of earthing of transmission line supports and also show with a neat sketch how earthing of a line support is done using pipe earthing. **(08 Marks)**

OR

8 a. Explain what is meant by repairing and jointing of overhead ACSR transmission conductors. How repairing or jointing is done? **(06 Marks)**

b. Explain the functions of the following in relevance to OH transmission and distribution : (i) Phase plates   (ii) Beads of jumpers. **(06 Marks)**

c. A pole for an overhead 11 KV, 3ϕ, 50 Hz line is required to be earthed and a stay is to be provided make a neat sketch, how it should be done. Prepare a list of materials required. **(08 Marks)**

Module-5

9 a. Describe briefly the equipment that must be available in a substation. **(05 Marks)**

b. Write short notes on substation auxiliary supply. **(05 Marks)**

c. Prepare a list of material required for the installation of a 400 KVA indoor type 11/0.433 KV transformer. **(10 Marks)**

OR

10 a. Explain the functions of the following in a substation : (i) Isolators   (ii) Earthing switch (iii) Batteries. **(06 Marks)**

b. Draw the single line diagram for 132/33 KV substation with main and transfer bus having 2×40 MVA transformers. Prepare on estimation of materials required, with their complete specification. **(08 Marks)**

c. Explain the purposes of substation earthing system. **(06 Marks)**

* * * * *

Modifications in the scheme and solution

1 message

Dr. A.Manjunath <manjuprinci@gmail.com>
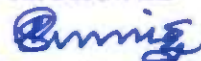To: pmanjunath p <pmanjunathvtu@gmail.com>

Wed, Jan 8, 2020 at 5:05 PM

Modifications in the scheme and solution of subject 17EE553 Electrical Estimation and costing

Q.3.c.Considering length of the building as 8.4mtrs
  as per Scheme and solution

Q.6.c.Considering length of workshop as 30mtrs
  Length of the earth wire required is 70mtrs or 7kg's

Dr.A.Manjunatha

" APPROVED "

Registrar (Evaluation)
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Scheme & Solution

Signature of Evaluator 06/11/19

Subject Title : Electrical Estimation & Costing   Subject Code : 17EE553

Question Number	Solution	Marks Allocated
	Module –1	
1.(a)	<u>Estimating</u> is an act of assessment of quantities of different items and cost thereof to plan the amount required for executing a work before actually carrying out the work.	②m
	<u>purpose of estimating</u> : * It becomes necessary to prepare a complete project for the given programme	
	* It is essential to provide us an accurate assessment of the amount of money required, availability of material etc. * It is used to know about the material required with complete specifications and quantity of each item and the cost to be incurred there on before taking up any new programme in hand.	③m
	The following facts to the estimate should be known to an estimator for preparing an internal wiring estimator :	
	* Complete specifications, giving the general scheme of the installation, type of wiring to be adopted and type and quality of materials to be used it. * Complete schedule of the pts to be wired for with their switches and fittings or alternatively details of whatever else relating to the estimate.	③m
	* Plans & sections marked with details, at least with the positions of main switchgear and distribution boards. →	⑥m
1.(b)	each term × ②m	
(c)	<u>Modes of Tendering</u> open tendering, Global tendering, Limited tendering, Single tendering, proprietary tendering + spot tendering	①m
	Explanation of them	⑤m
2.(a)	<u>purpose of IE rule & regulations</u>	②m
	* safeguard consumers of electrical energy from shock * minimise fire risk * ensure as far as possible, satisfactory operation of equipment and apparatus used	
	IE Rule 29: construction, Installation, Protection, Operation and maintenance of electric supply lines and apparatus	②m
	IE Rule 30: Service lines & apparatus on consumers premises	②m
	IE Rule 55: Declared frequency of supply to consumer	②m

Question Number	Solution	Marks Allocated
2.(b)	Theory explanation of Comparative statement — ②m Format – II – Comparative price statement 1. No of enquiries issued: ——— Enquiry NO: ——— 2. No of tenders received: ——— Date: ——— 3. Date of opening of tender: ——— Due date: ——— Sales Tax Excise Duty Discount Is the offer in conformity with our requirements (Yes/No) Validity for acceptance Prices quoted (Firm/variable) Prices quoted EX-WORKS/F·O·R/FAS/C & FCIF etc condition of the material offered (factory new union surplus etc) Delivery offered weeks/Days/months A·R·D) Terms of Payment L/C/DOCS through Bank/ Advance etc Local candidates if any/agency commission	④m
2.(c)	Explanation of each term × ②m ——→ ⑥m
	Module – 2	
3.(a)	Any 5 general rules guide lines for residential installation — ④m	
3.(b)	different s/ms of distⁿ of energy in an building ↳ Distribution Board s/m & Tree s/m Explanation of each s/m × ②m ——→ ④m	

The comparative price statement table:

Item No.	Description	Quantity Received	Previous purchase			1	2	3	4	5
			order NO.	Date	unit price					

Question Number	Solution	Marks Allocated
3.(C)		

Varanda 3.6m × 2.1m

Room 3.6m × 2.7m

Hall 4.8m × 4.8m

4.8 m

4.8 m

wiring plan

0.2m
0.2m

MB
mB

L5

L4   1.8m

2.7m   SB₁   SB₂

L3

W

2m

2.4m   D

2.4m   F

2.4m   W

L2

circuit diagram

L3 L5 L4

L2 L₁   F

1.5mm² Aluminium single core Conductor, 650V grade PVC cable

① m

② m

Main Board

240V,16A DPIC Switch

SB₂

SB₁

N   } from
P   } Meter
E   } Board

14 SWG GI wire

━━━ Earth wire
──── Phase wire
- - - Neutral wire
-·—·- Half wire

Question Number	Solution	Marks Allocated
	No. of light pts = 5 ; No. of fan pts = 1 ; No. of plug pts = 2 ∴ Connected load = 8 × 60 W = 480 W ; So one ckt used, no distn Board. Full load current, I = $\frac{480}{240}$ = 2 A. Hence 240 V, 16A, DPIC switch fuse used as a main switch & 1/1.40 mm, aluminium cond, Single core, 650 V grade, PVC cable having current carrying capacity of 10A and cond. area 1.5 mm².	①m
	Assumptions: Height of casing-capping run = 3m Height of bracket light pts = 2.4m Height of main board & switch board = 1.5m The distance of meter board (mB) from front wall (in hall) = 0.2m	①m
	Length of PVC casing capping: From meter Board to main board = 0.2m From meter board to switch board SB₁ = 5m Vertical run to ceiling in hall (above SB₁) = 0.6m Run along ceiling in hall = 7.2m Drop from ceiling to L₁ = 1.2m Drop from ceiling to L₂ = 1.2m From switch board SB₂ to L₄ = 4.2m Vertical run to ceiling in room = 0.6m Run along ceiling in room = 2.7m Drop from ceiling to Lamp L₃ = 1.2m Total length of PVC casing capping = 24.1m wastage & length used in joints (15%) = 3.6m (say) ∴ Total = 27.7m ≃ 28m (say)	①m
	Length of Conduit of 19mm size: Connections taken from SB₁ to SB₂ and from light pt L₄ to L₅ through 19mm Conduit. Hence total length of conduit = 0.5m	
	Length of Phase wire: From meter board to main board = 0.2m From main board to switch board SB₁ = 5m From SB₁ to fan pt. = 4.5m ; From SB₁ to SB₂ = 0.25m From SB₁ to L₁ = 8.1m ; From SB₁ to L₂ = 8.1m ; From SB₂ to L₄ = 4.2m ; From SB₂ to L₅ = 4.45m From SB₂ to L₃ = 8.1m ; Total = 42.9m wastage & extra wire at distn board = 8.6m ∴ Total length = 51.5m	①m
	Length of Neutral wire: From meter board to main board = 0.2m From main board to F = 6.5m ; from F to L₁ = 3.6m ; From L₁ to L₂ = 7.2m	
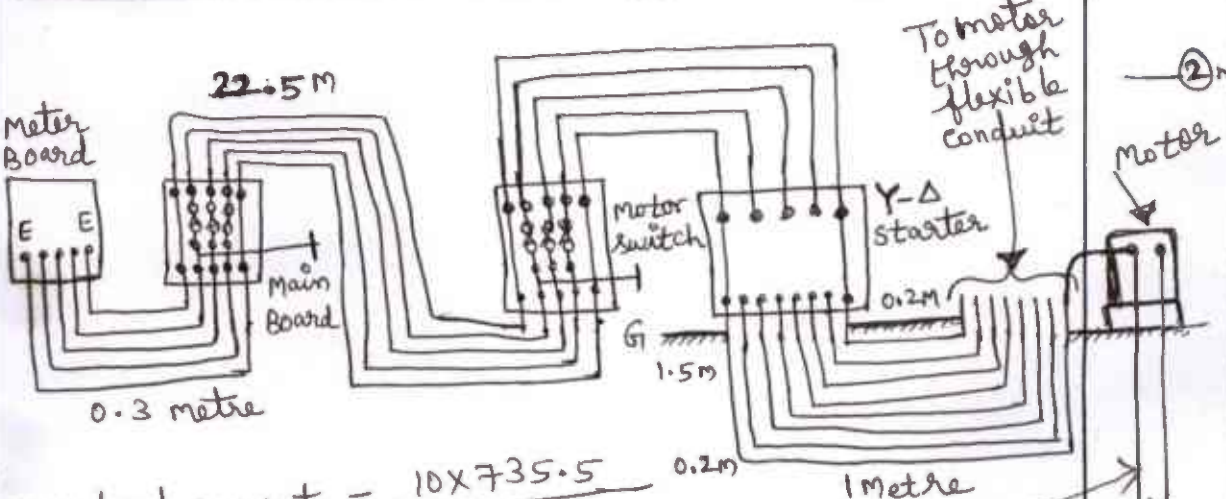
Question Number	Solution	Marks Allocated
	From L_2 to SB_1 = 8.1 m ; From SB_1 to SB_2 = 0.25 m From SB_2 to L_4 = 4.2 m ; From L_4 to L_5 = 0.25 m From L_5 to L_3 = 5.35 ; Total = 35.65 m Wastage & length used in connections (10 %) = 3.6 m Total length = 39.25 m Total length of Al cond, single core, PVC cable of size 1.5 mm^2 (phase + neutral) = 90.75 m = 90 m (say) <u>Length of earth wire : (14 SWG, GI wire)</u> From meter board to main board = 0.2 m From main board to SB_1 = 5 m ; From SB_1 to SB_2 = 0.25 m Total length including wastage = 6 m = 0.2 kg (say) <u>Estimate on the basis of item wise rates :</u>	—①m

| Sl. NO | Description of material with full specifications. | Quantity required ||
		Qty	Unit
1.	240V grade, 16A, DPIC switch with fuse and neutral link	1	NO.
2	PVC casing capping 76mm x 25mm	28	m
3	14 SWG, GI wire (earth wire)	0.2	kg
4	Earthing thimbles with nuts and bolts	3	NOS
5	1.5mm^2 single core 650V grade aluminium conductor PVC cable	90	m
6	piano switches, oneway 5A surface type	8	NOS.
7	Ceiling Rose, two plate PVC type	1	NO.
8	Brass brackets with holders	4	NOS.
9	watertight bracket with holder & globe	1	NO.
10	Plug Sockets 3pin 5A	2	NOS
11	Teak wood boards (double): 25cm x 20cm	2	do
12	Round wooden blocks 20cm x 15cm	1	do
13	Teak wood gutties 10cm x 4cm	6	do
14	wooden screws : 51mm for boards	100	do
	32mm for casing	18	NOS
	13mm for capping	45	do
	19mm for switches	180	do
		32	do
15	Cement, sand, paint, varnish etc →		
	Labour cost @ Rs 60 per point Total →		
	Contingencies 5% →		
	Grand Total →		
	Say →		

The marks notation "—②m" appears at the right side of the table.

Question Number	Solution	Marks Allocated
	Estimate on the basis of supply / fixing rates	

Estimate on the basis of supply / fixing rates

Sl NO	Description of material with full specifications	Qty Required		Marks
		Qty	Unit	
1	Supply & fixing of 240 V, 16A, DPIC switch with fuse & neutral link on board complete in all respects	1	NO.	—②m
	Supply Rates			
	Fixing Rates			
2	Supply & fixing of PVC casing capping 76mm × 25mm	28	m	
3	Wiring of pts in 1.5 mm² PVC insulated single core aluminium cond. cable drawn through casing capping and 5A flush type switches with 3mm bakelite sheet with brass screws & washers.	5	NOS.	
	Supply Rates			
	Fixing Rates			
4	As in item NO. 3 above but for ceiling fans with earth wire of same size	1	NO.	
	Supply Rates			
	Fixing Rates			
5	As in item NO. 4 above but for Plug pts with 5A flush type switches & earth wire of same size	2	Nos	
	Supply Rates			
	Fixing Rates			
6	Water-tight bracket with holder and globe	1	NO.	
	Supply Rates			
	Fixing Rates			
	Total →			
	Contingencies 5% →			
	Grand Total →			
	Say →			

4. (a) choice of wiring sms
└ safety, durability, Appearance, Mechanical Protection, permanency, Accessibility, Initial cost, Maintenance cost ——①m

Explanation of each term ——⑤m

purpose of Fuse connected in Phase wire ——②m

4.(b) For determination of total load → Ratings of light pts, Fan pts, socket outlets, power socket outlets & exhaust fans pt may be assumed or known or specified. ——②m

Question Number	Solution	Marks Allocated
	Determination of no of sub. cpts decided as per no of pts to be wired & total load to be connected to the supply systems. The no of Pts determined as per size of room, illumination level required & luminous efficiency of lamps to be used	(2) m
	Determination of ratings of main switch & distn board	
	The current rating of main switch is decided as per total current of the ckt to be controlled by it.	(1) m
	The current rating of distn board is decided as per no of sub-cpts to be connected to it & current of sub-ckt having highest current rating.	(1) m
4.(c)	Total ampere - metres in the ckt $= $ max. current of the ckt × length of ckt cable (lead & return) $= 60 \times 120 = 7200$ ampere - metre	(1) m
	Permissible v/g drop $= \frac{2}{100} \times 240 + 1 = 5.8$ V	(1) m
	Ampere - metres per volt of permissible drop $= \frac{\text{Total ampere - metres in the ckt}}{\text{Permissible v/g drop}} = \frac{7200}{5.8} = 1240$	(1) m
	From the table, copper cond. cable having v/g drop of fig. next to fig. of ampere-metres per volt drop, determined above, is 19/1.32 mm having current carrying capacity of 74 amperes and giving 1 volt drop per 1475 ampere-metres.	(1½) m
	Since the current carrying capacity of copper cond. cable of size 19/1.32 mm selected is 74 A, more than ckt max. current of 60 A, & v/g drop caused by this cable will be equal to $\frac{7200}{1475} = 4.88$ volts, less than permissible v/g drop of 5.8 volts, hence selected.	(1½) m

Module - 3

5.(a)	Any 6 pts → important considerations regarding motor installation wiring	(6) m
5.(b)	Input to the motor in watts $= \dfrac{\text{o/p in watts}}{\text{Motor efficiency}}$ $= \dfrac{\text{Rated BHP} \times 735.5}{\text{Ƞm}}$ Since 1 Hp (metric) $= 735.5$ watts.	(1) m

Question Number	Solution	Marks Allocated
	The size of conduit is determined from the table of max. capacity of conduits for drawing-in of 1100V grade cables.	—①m
	V/g & current rating of distn board is decided from the no. of ckts to be fed from it, V/g rating of ckt & starting current of sub-ckt having highest current rating respectively.	—①m
	The current rating of main switch is decided as capable of handling starting current of one motor (of highest rating) plus full load current of remaining motors to be controlled from it.	—①m
	For starting of squirrel cage Ims of capacity upto 0.75 KW, b/w 0.7 KW & 11KW & above 11KW, DOL starter, Y-Δ starter and auto T/F starter respectively are used.	—①m
	For starting of slip ring Ims of high ratings, rotor resistance starter is used.	—①m
	The size of cable is determined as per full load current of the motor.	—①m
	The rating of fuse should be based upon the motor starting current & cable current rating should not be lower than half of fuse current rating.	—①m
5.(c)	Taking diversity factor as 1.66 Total load requirement $= \dfrac{5000}{1.66} = 3000W$ Let future load be twice of present load. i.e. $2 \times 3000W = 6000W$ Load current in Amps $= \dfrac{\text{Load in Watts}}{\text{Rated V/g}} = \dfrac{6000}{240} = 25A$ Hence twin core $1/3.55$ mm or $10mm^2$ aluminium cond. weather proof cable having a current carrying capacity of 34A may be employed.	—②m

Sl. NO	Description of materials with complete specifications.	Qty Required	
		Qty	Unit
1.	$10mm^2$, 650V, twin core, aluminium cond. weather proof cable	40	m
2	8 SWG GI wire (earth wire)	4	kg
3	GI pipe 50mm dia	4	m
4	HG conduit 16 SWG 25mm dia	4	do

Question Number	Solution			Marks Allocated
	5 pole clamp	1	NO.	
	6 pipe clamps	2	do	
	7 GI thimbles	3	do	
	8 Wooden bushes for GI pipe	1	do	
	9 Conduit reducers 50mm × 25mm	1	do	
	10 Conduit bend for 25mm Conduit	1	do	
	11 Lock nut for 25mm Conduit	1	do	
	12 Conduit bushing for 25mm Conduit	1	do	
	13 wooden plugs	1	do	
	14 Conduit saddles: 50mm	25	do	
	25mm	4	dO	
	15 IC Main board of size 25cm×30cm	8	do	
	16 Kit-kat 32A capacity	1	NO	
	17 Netural link	1	do	—④m
	18 Aerial fuse 32A capacity	1	do	
	19 stay wire 7/10 SWG	1	do	
	20 stay bow	10	m	
	21 Stay rod with bolts & stay buckle	(1)	(kg)	
	22 Stay insulator	1	NO.	
	23 Cement	1	do.	
	24 Sand	1	do	
	25 Catenary wire	1	bag	
	26 clips 31mm	5	bags	
	27 Sundries to complete the job	3	kg	
		1	packet	

Total →

Storage & transportation charges 5% →

Labour Charges 10% ⟶

Contingencies 1% ⟶

Electrical Inspection fee ⟶

1∅, 25A, 240V, 50HZ Energy meter →

Grand Total →

say →

Question Number	Solution	Marks Allocated
6.(a)	The OH line or cable connecting the supplier's distributing line to the consumer's premises is called service main or service line or service connection.	—①m
	Methods of installation of service lines ↳ OH service lines & UG cable service lines	—①

Question Number	Solution	Marks Allocated
	Various methods used for installation of OH service lines are :	
	→ for high roof building	
	→ for low roof or single storeyed building	—②
	→ weather proof cable method	
	→ use of junction or joint box	
6.(b)	Two methods of installation of OH service lines based on the prevailing conditions of building	
	→ for high roof building ———	③ m
	→ for low roof or single storeyed building —③ m	
6.(c)	Single Line Diagram : Assume $\eta_m = 0.85$ & $pf = 0.8$ lag	

	Full load current $= \dfrac{10 \times 735.5}{\sqrt{3} \times 415 \times 0.8 \times 0.85}$	
	$= 15.05A$	
	Starting current $= 1.5 \times 15.05$	
	$= 22.6A.$	
	Hence 3 core, PVC, 1100V grade, 6mm² aluminium cond. cable of current carrying capacity of 24A may be used.	}—①m
	Length of 25mm HG Rigid Conduit :	
	From meter board to main board $= 0.3m$	
	From main board to motor switch $= 22.5m$ (mounted on control board)	
	Total $= 22.8m$; wastage 10% $= 2.3m$	
	∴ Total $= 25.1m = 25m$ (say)	
	Length of 31mm HG Conduit :	
	From motor starter to ground $= 1.5m$	
	Below ground level $= 0.2m$; Along ground up to foundation $= 1.0 m$	}—①m
	Up to top of motor foundation $= 0.4m$; Total $= 3.1m$	
	wastage 10% $= 0.31m$; ∴ Total $= 3.41m = 3.5m$ (say)	

Question Number	Solution	Marks Allocated
	Length of 25mm flexible conduit required for connecting motor switch to motor starter = 0.25 m Length of 31mm flexible conduit required for connecting heavy gauge conduit to motor = 1m	① m
	Length of 3 core, 1100V grade, 1/2.80 mm (6mm²) aluminium cond PVC cable: 1 length from meter board to main board = 0.3 m 1 length from main board to motor switch = 22.5 m 1 length from motor switch to motor starter = 0.25 m 2 lengths from motor starter to motor terminal box = 8.2 m Total length = 31.25 m ; wastage & for connections 10% = 3.13 m ∴ Total = 34.38 m = 35 m (say)	① m
	Length of Earth wire: According IE Rules, two separate earth electrodes will be provided for earthing purpose. From the table for size of earth wire, for 10Hp motor 8 SWG GI wire will be required as earth wire. Length of earth wire required = 2 × (length of conduit including length of flexible conduit) = 2 × (25 + 3.5 + 0.25 + 1) = 59.5 m = 60m (say) or 6 kg.	① m
	Estimate on the basis of item wise rates ————	③ m
	## Module-4	⑥ m
7.(a)	Write any 7 points ———— * Proper jumper should be used wherever required. * pole steps should be provided in the towers for the lineman to climb the pole * Guard wires should be provided where essential * The cond should be tightened on the insulator properly with binding wires * The joints of the cond should be mechanically strong in proper sleeves * one-sixth of the pole length should be properly buried and rammed in the soil * Anti-climbing device & danger plate or caution notice should be fixed on the each pole. * Permissible spacing b/w the conds should be maintained through out the lines.	

Question Number	Solution	Marks Allocated
	* The clearance of cond from Ground & adjoining should be according to IER 77, 78, 79 & 80. * All metallic parts, line components except main line Cond should be earthed properly according to IER 90.	
7(b)	Explanation of each term × ②m ──────────	⑥ m
7(c)	Earthing of transmission line supports using pipe earthing 10mm dia 40mm long GI Bolts & nuts & washers 10mm dia 32mm long GI Bolts and Nuts Line support GI LUG GI LUG G 0.5m 0.1m GI No. 6 SWG wire 3.05 m 2.5 m 3 m 2.4m GI pipe of Internal Dia 25mm 25mm 50mm ← CI Driving piece L Explanation	③ m ⑤ m

Question Number	Solution	Marks Allocated
8(a)	Repairing of OH ACSR tn Conds → Repair sleeves are employed for repairing of ACSR or All Aluminium Conds which have sustained surface damage causing a few of aluminium strands to be damaged or broken.	─①m
	Joining of OH ACSR tn Conds → The use of mid span tension joints is a subject on which there are different opinions. Some engineers do not use mid-span joints except for repairs while others do use joints on new construction	─①m
	How jointing on repairing is done	②m ④
	↳ splice joints, Britannia joints, married joint, sleeve joint, compression joint	─⑥m
8(b)	Explanation of each term × ③m	
8(c)	Sketch → earthing & staying	

List of materials Required

Sl.no	Description of material with complete specifications	Quantity required Qty unit	
	(A) Earthing (pipe earthing)	2.5	m
1.	25mm dia GI pipe	1.5	m
2.	19 mm dia GI pipe	4.0	m
3.	12 mm dia GI pipe		

Question Number	Solution	Marks Allocated
	4. GI wire 6 SWG → 12 do (1.2) kg	
	5. GI lugs → 2 nos.	
	6. 10mm dia, 32mm long GI bolts & nuts → 2 nos	
	7. 16mm dia, 40mm long GI bolts, nuts & washers → 2 nos	
	8. 12mm dia GI bends → 1 do	
	9. 30cm square cast iron frame → 1 no	3 m
	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 m³	
	(B) Staying	
	1. MS anchor plate 45cm × 45cm × 6.0cm → 1. No (Not galvanised)	
	2. MS stay rod 16mm dia and 2.42m long → 1 dozen	
	3. Stay bow made of MS rod 12mm dia → 1 do	
	4. Stay insular → 1 do	2 m
	5. Stay wire (7/8 SWG GI wire) → 7.5 m (4.5 kg)	
	6. Stay clamp → 1 No	
	7. 16mm dia, 76 mm long bolts, nuts for fixing → 2 do	
	8. MS thimbles → 2 do	
	9. Cement concrete 1:4:8 → 0.2 m³	

Module - 5

Question Number	Solution	Marks Allocated
9(a)	**Equipment available in a SS**	
	→ Main Bus Bars	
	→ Reactors	
	→ Station insulators	
	→ Switch gear ── → Air break switches / oil switches / Isolators / Load interrupter switches / earthing switch	
	→ fuses	5 m
	→ Circuit Breakers	
	→ Power T/Fs	
	→ Protective relays	
	→ Instrument T/Fs ── Current T/Fs (CTs) / Potential T/Fs (PTs)	
9(b)	Substation Auxiliary supply	5 m

Question Number	Solution	Marks Allocated
9(C)	**List of materials required for installation of 400 KVA Indoor type 11/0.433KV T/F**	

Sl.No	Description of material with Complete specifications	Qty	Unit
1)	400 KVA, 11/0.433 KV, 3Φ, 4 wire 50HZ Indoor type T/F complete with all accessories & first filling of oil	1	NO
2)	XLPE insulated aluminium cond 10mm^2 3 core heavy duty 11KV grade cable	30	m
3)	11KV end terminal box complete with jointing materials for XLPE cable (outdoor type)	1	NO
4)	11KV end terminal box complete with jointing materials for XLPE Cable (Indoor type)	1	NO
5)	GI pipe 76mm dia heavy gauge	5	m
6)	clamps for fixing cable pipe (GI) & end boxes	8	NOS
7)	Indoor type oil CB, 11KV with 50/5A CTs for metering arrangement instrumentation protection equipment capacity 400 KVA rupturing capacity 200MVA	1	NO
8)	Earthing for OCB	2	sets
9)	Sand	30	m^3
10)	Bricks (2nd class)	5000	Nos
11)	Cement slabs for covering trenches 33m long	100	do
12)	Empire tape	20	Rolls
13)	HT tape	3	do
14)	Foundation for 400 KVA T/F (cement, sand, mortar etc)	1	NO
15)	Earthing for T/F	2	do
16)	Oil CB, 3Φ, 415V, 800 A, 15mVA rupturing capacity equipped with (i) first filling of oil (ii) 50/5 A, 15VA CTs (iii) overload Trip coils (iv) adjustable dashpot time lags & under volt release	1	do

(5) m

Question Number	Solution	Marks Allocated
	17) LT cubicle board 1·5 m × 1·5 m × 2 m pedestal type with locking arrangement arrangement for bus–bar connection to OCB at item NO 16. → 1 do	
	18) LT Cable, 3½ core, 240 mm² (2 lengths of 15 m each) → 30 m	⑤m
	19) Aluminium lugs assorted for phase conds & neutral conds → 16 Nos	
	20) Earthing of LT panel → 2 do	
	21) Sundries to complete the job such as Bolts & Nuts & other petty items (LS provision. → ⑥m	
10(a)	each term ×②m	
10(b)	132/33 KV substation having 2×40 MVA T/Fs	

		Quantity Required	
Sl·NO	Equipments	Qty	unit
1)	CBs		
	132 KV	5	Nos
	33 KV	11	do
2)	Line isolaters	2	do
	132 KV	10	do
	33 KV	8	do
3)	Bus Isolators	15	do
	132 KV	4	do
	33 KV	12	do
4) Tendom isolators 132 KV		33	do
5)	CTs 132 KV	9	do
	33 KV	6	do
6)	132 KV CVT	12	do
	33 KV PT	12	do
7) LA (Lightning Arrester)		92	do
	132 KV	2	Nos
	33 KV	1	NO
8) Post insulator		2	NO
9) T/Fs 132/33 KV, 40 MVA		1	NO
	33/4 KV, 250 KVA	1	NO
10) Control panel T/F Control & Relay panel			
	B/C panel		
	Double feeder panel	1	NO

②m

Question Number	Solution	Marks Allocated
	Single line diagram of 132/33kv SS	④ m

10) Distance protection panel ——— 3 NOS

33kv tripple feeder panel ——— 3 NOS

11) U/F Relay panel ——— 1 do

12) Energy meter 0.2 acc cls (ABT) ——— 1 do

Question Number	Solution	Marks Allocated
	13) Control & power cable ⟶ LS provision	
	14) structures ⟶ 60 MT	
	15) DC equipments (protection & Conn.) ⟶ 1 set	
	16) ACDB ⟶ 1 NO	
	17) Bus Bar & Insulator ⟶ 1 set	
	18) S/S & control Room Lighting ⟶ LS provision	②m
	19) Earthmat & earthing ⟶ do	
	20) Firefighting equipment ⟶ do	
	21) Boundary wall, fencing, control room building, store shed etc ⟶ do	
	22) Land (subject to actual) ⟶ do	
10 (c)	purposes of substation earthing s/m ⟶ ⑥m	
	↳ safety of operational & maintenance staff.	
	↳ Discharge of electrical charges to ground	
	↳ Grounding of OH shielding wires	
	↳ Electromagnetic Interference.	