CMR
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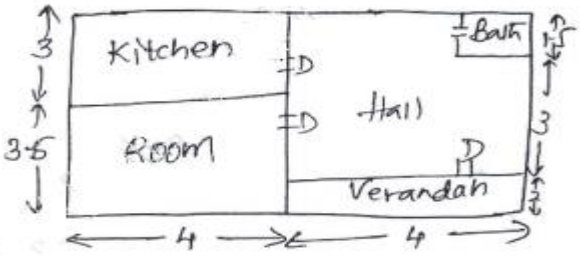
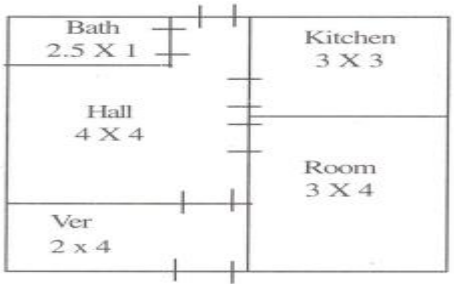
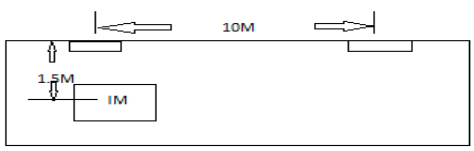
Internal Assesment Test - II

Sub:	Electrical Estimation and Costing							Code:	15EE553
Date:	16/10/2018	Duration:	90 mins	Max Marks:	50	Sem:	5	Branch:	EEE

Answer Any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1	Figure shows the plan of a house which is to be wired in open conduit system for providing lighting outlets only. a) List the Lighting load b) Draw the wiring plan c) Prepare an estimate of cost for the electrification of the lighting outlets. 	[10]	CO2	L4
2	The accompanying sketch shows the plan of a house to be wired in concealed system for providing lighting outlets only. a) Estimate the number and rating of lighting outlets. b) Draw the wiring plan. C) Estimate the required wiring accessories. d) Prepare an Estimate the cost for interior lighting. 	[10]	CO2	L4
3	Describe about Service mains and its methods.	[10]	CO3	L2
4	Prepare a list of material required for 240V, 50Hz street distribution mains for a length of 200m. The load is 8kw. Also workout the cost.	[10]	CO3	L3
5	Describe about power wiring & also determine the load current, fuse rating, cable rating, and size of conduit, main switch and starter.	[10]	CO3	L3
6	List the important consideration for wiring motor installation.	[10]	CO3	L1
7	In a workshop plan shown below, one 15HP, 400Volts, 3-phase, 50Hz induction motor is to be installed. Prepare the estimate of the cost required with a layout of the wiring. The distribution board is placed vertically at height of 1.5m from ground level. 	[10]	CO3	L4

Solution:

1).

a) No. and Rating of lighting outlets:

Sl. No.	Places	Area in Sq.m.	AH 40W	BF 60W	Fan 80W	WP 60W	FL 40W	Total load
1.	Verandah	4x2 = 8	1	1	—	—	—	100 W
2.	Room.	3.5x4 = 14	1	—	1	1	1	220 W
3.	Hall	4x3.5 = 14	—	—	1	1	2	180 W
4.	Kitchen	3.5x3 = 10.5	2	—	—	1	—	140 W
5.	Bath	2.5x1.5 = 3.75	1	—	—	—	—	25 W
	Total.		5		2	3	3	665 W

Since the total load is only 665 WAH, the subcircuit is efficient.

b) Wiring Plan:

c) Material Calculation:

Load current I = W/V = 665/230 = 2.89 A

∴ 30A Flush type D.P is to be used.

3A, 2 pin, MK 13, 230V rating.

375 x 300 x 45 mm Varnished T.W. Board 1 No.

No. of angle holders = 5

No. of Buck lead / Bracket Fitg = 1.

No. of ceiling rose = 5

No. of wall plug socket = 3

No. of Sp. switch = 14

Requirement of Pipe:

Place	Horizontal as in plan	Vertical Drop	Vertical rise	Total Pipe	Elbow	Tee
Verandah	4 * 2	1	—	9	3	2
Hall	(1.75x2)+4+3.5	1	1	13	3	2
Room	4+(1.75x3)	1	1	11.25	3	2
Kitchen	3.5+(1.5x2)	1	—	8.5	2	1
Bath	1.5+1.5+0.75	1	—	4.75	1	1
	Total			46.50	12	8

Adding 5% of wall chasing & wastage

$= 46.50 + 2.325 = 48\ M.$

No of 15mm Hin Saddles $= 48/0.75 = 64$ Nos.

Addig 5% of elbow requirment $= 8 \times 1.05 = 8.4$ Say 9.

1/18 wire requirment $= 48 \times 3 = 144\ M.$

No of round blocks $= 10 + 1$ (for switch of both lights) $= 11$.

No of 250 x 200 x 45 mm TW Board $- 2$ Nos.

No of 150 x 150 x 45 mm TW Board $- 2$ Nos.

No of 1 way PVC [illegible] Box $- 1$ No.

Length of 40mm GI pipe [For Earthing] $= 1.5\ M$.

Requirements of 8 SWG GI wire (for Earthing) $= 1$ Kg.

Miscellaneous materials such as wooden wedges, nut bolts, screws, cement, lock, salt etc.

Estimate of cost for Lighting:

Sl No	Particulars	Unit	Qty	Rate	Cost
1	15mm PVC pipe 2mm thick	length(3M)	48M	20.00	320.00.
2.	15mm PVC Elbows " "	—	13	1.00	13.00.
3.	15mm PVC Tees Suiting for above pipe	—	9	1.50	13.50
4.	1/18 Cu multistrand PVC cable 1.1kvg	Coil(90M)	144	465.00	744.00.
5	Tin Saddles for above pipe	Gross	64	75.00	33.33
6.	5 A SP Flush type Switch 250Vg	—	14	17.00	238.00
7.	5 A, 3/2 pin wall plug Socket Flush type 250Vg	—	3	20.00	60.00
8.	5A, Twopole bakelite ceiling rose 250 Vg	Dz	5	14.00	60.00
9.	Bulkhead fitting with porcelain holder, glass dome mesh complete	No.	1	140	140.00
10.	5A, Bakelite angle holder 250Vg	No.	5	17	85.00.

2)

a) The No. and rating of lighting outlets

Sl. No	Places	Area In SqM	A.H. 40W	B.F. 60 W	Fan. 80W	W.P. 60 W	F.L. 40 W	Total load
1	Verandah	4 X 2 = 8	–	1	–	–	1	100 W
2.	Room	3 X 4 = 12	1	–	1	1	1	220 W
3.	Hall	4 X 4 = 16	1	–	1	1	1	220 W
4.	Kitchen	3 X 3 = 9	1	–	–	–	–	40 W
5.	Passage		1/25W	1	–	–	–	85 W
6.	Bath	2.5 X 1	1/25W	–	–	–	–	25 W
		Total	5	2	2	2	3	690 W

b) Wiring Plan is as shown in fig.5

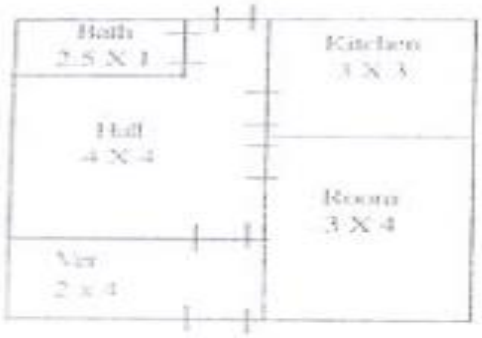


Fig.4 : Plan of the house

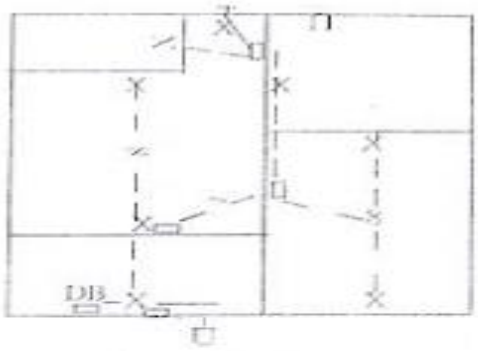


Fig. 5 : Wiring Plan

c) Required wiring accessaries:

Refering above table

No. of S.P. switch = 5 + 2 + 2 + 2 + 3 = 14

No. of 100 x 100 x 45 mm T.W. boards = 5 + 2 + 3 = 10

No. of 100 x 100 x 3 mm Hylem Plate = 10

No. of Angle Holder = 5

No. of Bulk head fittings = 2

No. of wall plug sockets = 2

No. of 150 x 100 x 45mm T.W. Block = 2 (for 3 switches at verandah and 4 switches at the entrance of kitchen)

No. of 150 x 100 x 3 mm Hylem Plate = 2

No. of 200 x 250 x 45mm T.W. Block = 2

No. of 200 x 250 x 3 mm Hylem Plate = 2

No. of 200 x 300 x 45mm T.W. Block = 1

No. of 200 x 300 x 3 mm Hylem Plate = 1

No. of ceiling rose = 2(for fan) + 3(for T.L.) = 5

Pipe Requirement :

Place	Horizontal	Vertital Raise	Vertital Drop	Total	Bends
Verandah	2 + 2	2 + 1 + 1	-	8	4
Room	4 + 2 + 3	2 + 1	2 + 1 +1	15	5
Hall	4 + 2	2 + 1	2 + 1	12	6
Kitchen	--	1	--	1	1
Passage	1 + 1 + 0.5	2 + 2	1 + 1	8.5	4
			Total	44.5	19

Allowing 5% wastage, total pipe requirement = 44.5 + 2.22 = 46.7 or say 48 M

Total no. of bends = 19 + 1 = 20

Wire requirement = 48 x 3 = 144 M

No. of J-hooks = 48/1.5 = 32

Load current = 700/230 = 3.0 A

Rating of flush type main switch = 30 A

Rating of current limiter (with box) = 5 A

No. of 15 A flush type tube unit = 1

1.5 M length, 40 mm G.I. Pipe for earthing.

8 SWG G.I. Wire 1 kg

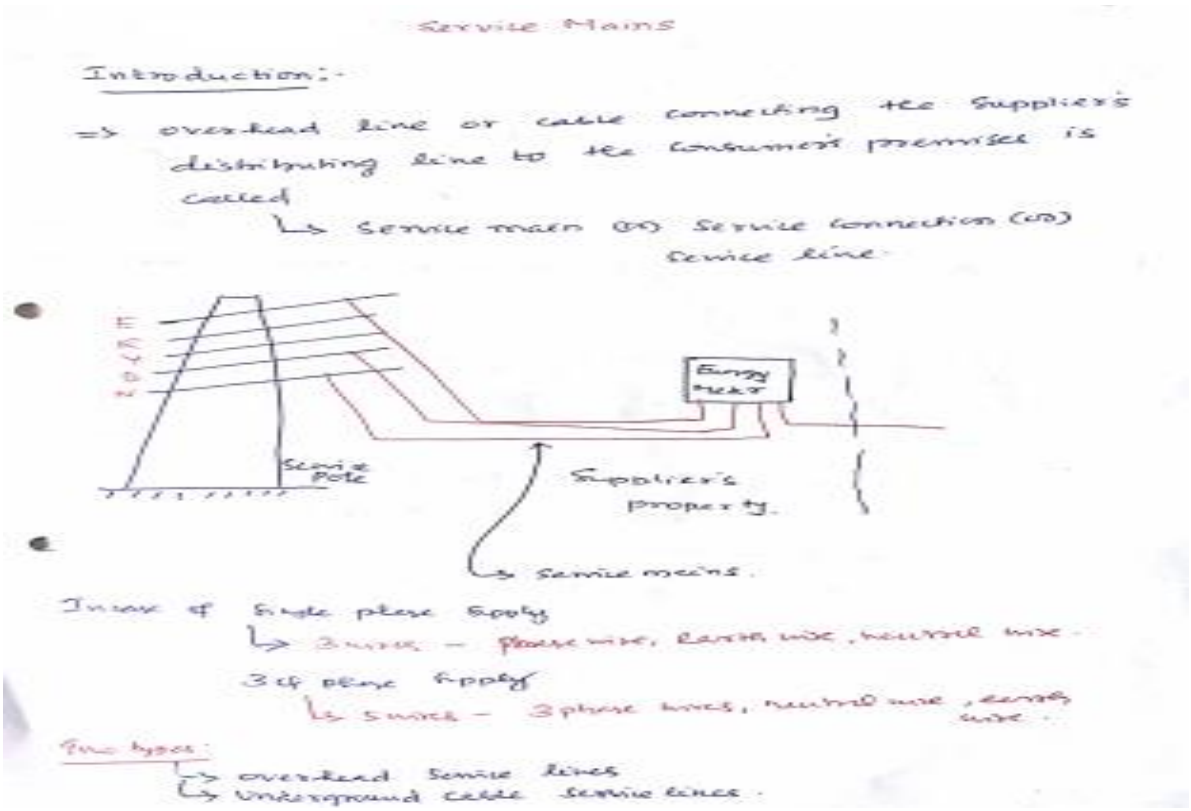
Miscellaneous Materials such as nut, bolts, screws, coal, salt etc.

d) ESTIMATE FOR INTERIOR LIGHTING

Sl. No.	Particulars	Unit	Quantity	Rate Rs.	Cost Rs.
1	30 A Concealed flush type main switch 250 V	No.	1No.	80.00	80.00
2	5 A Current limiter with double box	No.	1No.	105.00	105.00
3	20 mm PVC pipe 2 mm thick	length(3M)	48M	20.00	320.00
4	20 mm PVC Bends 2mm thick	No	20Nos.	1.50	30.00
5	J-hooks for 20 mm PVC pipe	Dozens	32 No.	15.00	40.00
6	1/18 multi strand (34/37) Copper PVC Cable 1.1K Vg	Coil(90M)	144M	465.00	744.00
7	Bakelite angle holder 6A 250Vg.	No	5Nos.	17.00	85.00

8.	Bulk-head fitting complete with porcelain holder, glass doom & mesh	No	2Nos.	140.00	280.00
9.	5A 2 plate bakelite ceiling rose 250Vg.	No	5Nos.	12.00	60.00
10.	5A S.P.flush type decorative switch 250Vg.	No.	14 Nos	25.00	350.00
11.	8 SWG GI wire	Kg.	1Kg.	60.00	60.00
12.	40mm G.i. pipe 3mm thick for earth	Meter	1.5M	140.00	210.50
13.	5A 3/2 pin flush type Wall plug socket 250Vg	No.	2 Nos	20.00	40.00
14.	100X100 X 45 mm T.W concealed block	No.	10Nos.	8.00	80.00
15.	150 X 100 X 45 mm T.W concealed Block	No.	2 No	13.00	26.00
15.	200 X 250 X 45 mm T.W. Concealed Block	No	2 Nos.	40.00	80.00
16.	250 X 300 X 45 mm T.W. Concealed Block	No	1 No	50.00	50.00
17.	15A porcelain Fuse unit 250Vg.	No	2 No	25.00	50.00
18.	100 X 100 X 3 mm hylem sheet	No	10Nos.	10.50	105.00
19.	150 X 100 X 3 mm hylem sheet	No.	2 No	19.50	39.00
20.	200 X 250 X 3 mm hylem sheet	No.	2 Nos.	52.50	105.00
21.	250 X 300 X 3 mm hylem sheet	No.	1 No	75.00	75.00
22.	10A flush type Fuse unit 250Vg.	No.	1 No	25.00	25.00
23.	Misc. Materials such as screws, wedges etc.	Lumpsum			85.50
24.	Labour Charges for a) 14 light points each @ Rs. 55.00 = 770.00 b) Earth work Rs. 50.00 X 1 = 50.00 c) Main Switch & Circuits Rs. 75.00 X 1 = 75.00				895.00
25.	Contingencies @ 5% for the unforseen items and variations in prices				204.75
				Total Rs.	4299.75
				or Say Rs.	4300.00

3).



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For domestic – load of the consumer ≯ 1KW → 16SWG Cu conductor used

domestic / Commercial Boards – load not exceeding 2.5KW

↓

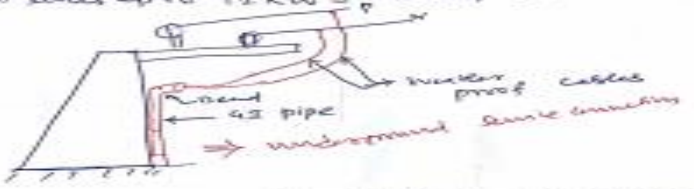
8SWG Cu (or) 13.9mm² AAC (All Aluminium conductor)

(or)

ACSR

Aluminium Conductor Steel reinforced.

Power loads up to 12 KW – 6 SWG Cu (or) 19.4mm² AAC (or) ACSR



⇒ Weather proof Al (or) Cu PVC cables are used.

⇒ low tension 3½ core cable is used for underground service connection.

Methods of Installation of Service lines:

1. Over Head service lines
2. Underground cable service lines.

1 (i) High Roof Building:

⇒ Service bracket [mild steel angle iron piece] is embedded into a wall at suitable height.

⇒ Pin (or) shackle type insulators are fixed in the brackets.

⇒ No of insulators – depends no. of wires.

⇒ Dia. b/w insulators 30cm.

⇒ ECRM is connected to Angle iron.

⇒ GI pipe used – opening face should be down

↓

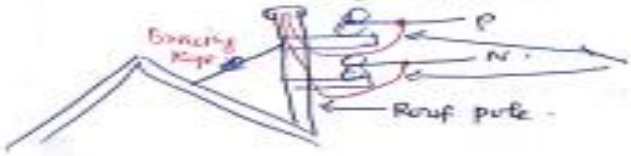
to avoid the entry of rain water.

(ii) Low Roof Building:

Very low light – no need of service bracket

⇒ GI pipe connection is used.

⇒ Roof pole consists of GI strong steel tube (60mm, 80mm, 90mm in dia) Three arms insulator are provide.



⇒ height of roof pole not exceed 3 m else otherwise tensile stress involved will become too high.

⇒ To keep tensile stress less – roof pole is braced by steel rope.

(iii) Weather proof cable method

⇒ 8 SWG GI wire is stretched from service pole to eye bolt.

(iv) Use of Junction (or) Joint Box.

Taking connection from one house to another house joint box is made.

2.) Underground cable service connection:

Lesser currents = 25 KW

MS channel = 16mm x 20mm, bolts & nuts

Stranded -

4).

Connected load, $P = 8$ kW or 8,000 W

Supply voltage, $V = 240$ V

$$\text{Load current, } I = \frac{P}{V} = \frac{8{,}000}{240} = 33.3 \text{ A}$$

Hence 16 mm² aluminium conductor 650 V grade, twin core weatherproof cable having curren rrying capacity of 43 A will be used for street distribution mains. The quantity and cost of materia uired is estimated as below :

No.	Description of Material With Complete Specifications	Quantity Required		Rate			Amount		Remarks
		Quantity	Unit	₹	P	Per	₹	P	
1.	16 mm², 2-core, aluminium conductor, 650 V grade weatherproof cable	204	m	50	00	m	10,200	00	
2.	GI wire 8 SWG	204 (20.4)	do (kg)	270	00	kg	5,508	00	
3.	Clips 31 mm	7	pkts	30	00	pkt	210	00	
4.	Rag eye bolts 16 mm × 225 mm	70	no	15	00	each	1,050	00	
5.	25 mm diameter GI pipe	20	m	75	00	m	1,500	00	
6.	Tee-joints	5	nos	100	00	each	500	00	
7.	Straight through joints	10	do	90	00	do	900	00	
8.	Aerial fuse 32 A	1	do	55	00	do	55	00	
9.	Black tape 19 mm	1	roll	75	00	each roll	75	00	
10.	Sundries to complete the job such as nuts & bolts, cement, sand, wooden bushes, thimbles etc.						500	00	Lump-sum provision
						Total	20,498	00	
						Storage and transportation charges 5%	1,024	90	
						Labour charges 10%	2,049	80	
						Contingencies 1%	204	98	
						Grand total	23,777	68	Say ₹ 23,800.00

5).

Design and Estimation of Power circuits:

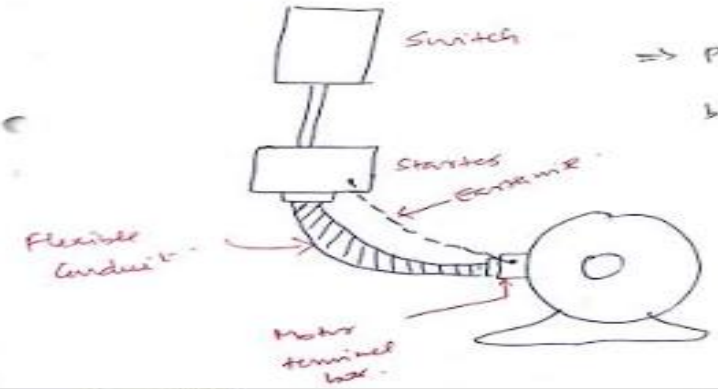
→ two main categories

Power ckt 1
- Heaters
- Coolers
- Refrigerating
- AC
- other similar load

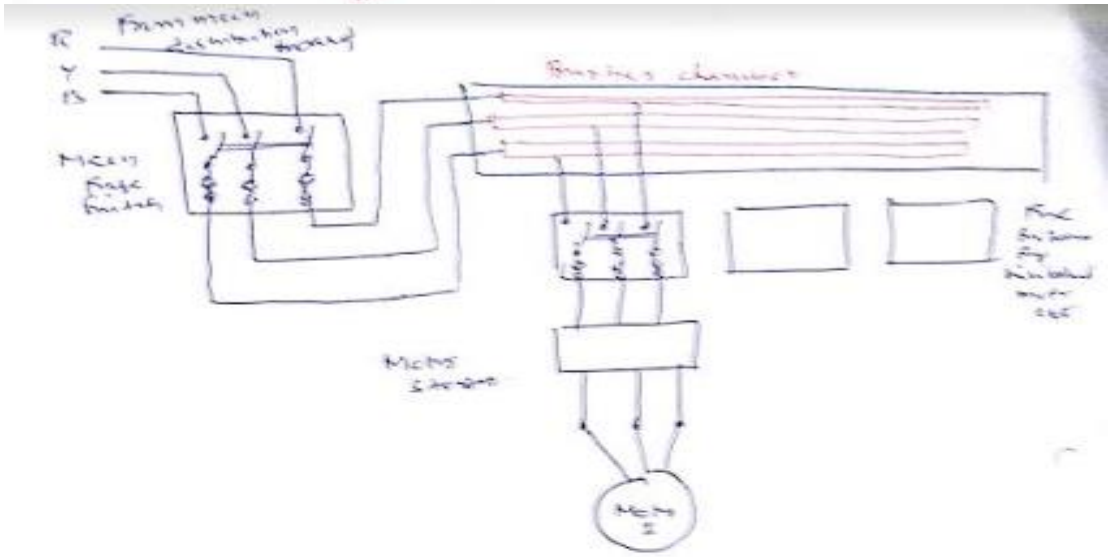
Power ckt 2
- Motors
- Generators
- Air conditioning equipment
- Air ventilation equipment
- Machine tools
- other specific purpose large loads.

=> lighting load => 50 watts for 10 points.

=> Power load => 3000 watts (IS 4648 - 1968).



=> PVC / XLPE
↓
based on load.



Determination of I/p Power:

=> large m/cs loss will be there

=> lower the η we have to calculate.

50% to 60% η — below 1 HP

70% to 75% η — 1 to 2 HP

75% to 80% — 2-5 HP to 5 HP

90% - for large motors.

$$\eta = \frac{o/p}{i/p}$$

$$\text{I/p in watts} = \frac{\text{o/p in watts}}{\text{Motor } \eta} = \frac{\text{Rated HP} \times 746}{\eta_m}$$

Determination of I/P current:

For ex, 500V, 10 HP dc motor at 80% η is

$$\frac{10 \times 746}{500 \times 0.8} = 18.4\,A.$$

In case of 1φ AC motors, Pf usually 0.75 – 0.7 ↓ depends up on type & size of the motor.

$$I = \frac{\text{Rated hp} \times 746}{\eta_m \times V \times \cos\phi}$$

For ex, 2HP, 240V, 70% η, 0.8 Pf,

$$I = \frac{2 \times 746.6}{0.8 \times 240 \times 0.7} \approx 11\,A$$

For 3φ AC motors:

$$I_L = \frac{\text{Rated HP} \times 746}{\sqrt{3} \times \eta_m \times V_L \cos\phi}$$

For ex, 3φ, 415V, 10HP, 80%, 0.85 Pf

$$I_L = \frac{10 \times 746}{\sqrt{3} \times 0.8 \times 415 \times 0.85} \simeq 16\,A.$$

Determination of Rating cables:

As per table after calculating the load current.

Cu/Al

3/20, 7/20, 7/10, 18/20 Cu

4, 6, 10, 25, 35, 30, 45 Sq.mm in case of Al.

Determination of Rating of Fuses:

↳ Fuse – Introduction

Starting current safely but no case

↳ rating of fuse should be greater than twice the rating cables.

Determination of Size of Conduit, distribution board, mainswitch and starter

Ref. table 2.3 ⟹ knowing size of cable & no. of cables ↓ decides conduit size.

Size = 15mm, 20mm, 25mm, 30mm, 40mm.

Thickness = 2mm to 3mm.

Distribution boards

↳ no. of ways

↳ voltage & current rating

↳ S.C circuit level highest current rating

Main Switch:

↳ starting current of one motor [highest rating] + full load current of remaining motors.

Starters Sq. cage IM

DOL — 0.75 kW

Y–Δ – 0.75 – 11 kW

Autotransformer Starter } – above 11 kW.

Rotor Resistance Starter } for slip ring IM.

6).

Important considerations Regarding Motor Installation wiring: (8)

1. All equipment used in power wiring should be of iron clad construction and wiring should be of armoured cable (or) conduit type. (IE Rule 51)
2. Wood work should not be used for mounting of switchgears.
3. Looping of conductors and use of the joints should not be done.
4. The length of flexible conduit used for connecting b/w the terminal boxes of motors and starters, switches and motors should not exceed 1.25 metres.
5. Every motor, regardless of its size should be provided with a switch fuse placed near it. [IE Rule 50 clause(d)]
6. In addition to switch fuse all motors should be provided with suitable means for starting and stopping (starters) placed at convenient places. The starters are used to limit the starting current to desired value. DOL-D, auto-transformer starters, RR starters, used for cc motors 0.75kw, 0.75-11kw, above 11kw etc.
7. The conduit should ~~preferably~~ preferably be layed in covered trenches to facilitate operator movement (safe)
8. Laying of cables must be in seperate conduits for seperate motors
9. Mini. c.s. of conductor that can be used for power wiring is 2.5 mm² for Al conductor & 1.25 mm² for cu conductor cables Hence PVC / XLPE cables of size lower than 3/0.915 mm cu / 1/1.80 mm al cannot be used for power wiring.
10. The current rating of cables for supply to motor may be based normal full load current of the motor but fuse rating should be based on starting current. In no case should the rating of the fuse be greater than the rating of the cable.

11. The conduit used in power wiring shall be electrically continuous throughout and connected to the frame of the motor. The frame of the motor shall be earthed by the owner by two separate and distinct connections of the earth. [IE Rule 61]

12. The wire used to earthing conductor shall be of cu or galvanised iron. The x sectional area of cu earthing wire should not be smaller than half of the largest current carrying conductor used in wiring.
The x sectional area of GI wire, if used as an earthing wire, should be such that its conductivity is not less than the cu conductor.

13. Since supplier provides and maintains only a suitable earthed terminal at or near the point of commencement of supply at the consumer premises, the consumer is required to provide his own earthing system with an independent electrode.

14. While deciding the current rating of a main switch controlling a group of motors. Starting current of one motor (highest) + full load current of remaining motor is considered.

7).

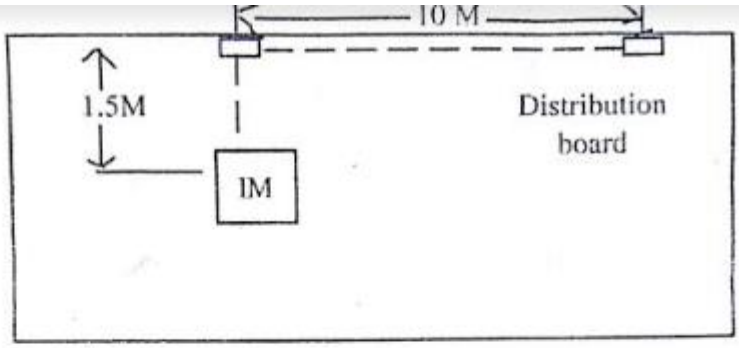


Fig. 14 : wiring plan

Approximate load current = H.P X Current per HP = 15X 1.6 = 24A 16

The size of wire required corresponding to 24A current with a factor of safety of 2 is 7/20 copper (by wire table).

V V H L L

The total requirement of this wire upto starter board = 3 (1 + 1 + 10 + 1 + 1) = 42M (Only 3 leads are required since we don't want neutral)

(In the above V for vertical, H for Horizontal and L for Loose wire required for connection)

H V V

Length of 25mm PVC pipe = 10 + 1 + 1 = 12M

No. of bends = 2

No. of 25mm saddles = 12/0.75 = 16

The approximate current in each lead (of 6 wires) from starter to motor = $24/\sqrt{3}$ = 13.85A.

Therefore 9 to 14 amps fully automatic star-delta starter with voltage coil of 440 is required

The size of wire required corresponding to 13.85A. with a factor of safety of 2 is 7/20 copper (by wire table)

The total requirement of this wire = 6 (2 + 1.5 + 1.5 + 0.5) = 33M

(Assuming the board being placed at a vertical height of 1.5M from ground level, 0.5M vertical raise is taken in the motor side, 'L' being loseness to be kept in the board)

The length 30mm flexible pipe = 1.5 + 1.5 + 0.5 = 3.5M (0.5M raise in the motor side)

No. of 30mm saddles=3.5/0.75=4.66 or say 5

The current rating of I.C.T.P. required = 24 X 2.5 = 60A. (since Market availability is 60A. Factor of safety taken is 2.5)

As we have to provide space in the board for 60A. I.C.T.P., starter & capacitor, the size of board is 750 X 450 X 45mm.

8SWG G.I. wire required = 2 X 2 = 4Kg. → 1 metre = 1kg. Approx. 4kg required

40mm G.I. pipe for 2 earthing each of 2.0M, i.e., totally 4 M

RKVA of capacitor = 15 / 2.5 = 6

9 to 14A Fully automatic Star-Delta starter with coils of 440V range.

Miscellaneous materials such as coal, salt, cement, screws, nuts, bolts, wooden wedges, etc.

ESTIMATE COST

Sl. No.	Particulars	Unit	Quantity	Rate Rs.Ps.	Cost Rs.Ps.
1.	60A I.C.T.P Main switch 500Vg.	No.	1No.	1480.00	1480.00
2.	25mm PVC pipe 2mm thick	Length(3M)	12M	25.00	100.00
3.	25mm PVC Bends	Nos.	2Nos.	3.00	6.00
4.	30mm Flexible pipe 3mm thick	M	3.5M	15.00	52.50
5.	Tin Saddles for 25mm Pipe	Gross	16Nos.	144.00	16.00
6.	Tin Saddle for. 30mm pipe	Gross	5Nos.	200.00	6.94
7.	7/18 copper PVC cable 1.1K Vg.	90M(coil)	42M	2400.00	1120.00
8.	7/20 copper PVC cable 1.1K Vg.	90M(coil)	33M	1850.00	678.33
9.	750X500X45mm Varnished T.W. Board	No.	1 No.	650.00	650.00
10.	8 SWG G.I wire for earthing	Kg	4Kg.	60.00	240.00
11.	40mm G.I. pipe for earthing	M	4M	140.00	560.00
12.	6 RKVA Oil type Power capacitor	No.	1No.	1500.00	1500.00
13.	9 to 14A Fully automatic Star-Delta	No.	1No.	4500.00	4500.00
14.	Contingencies & allowance for variation in prices at 5%				575.00
				Grand Total	**12075.00**

Total Estimate of cost is Rs. Twelve thousand and Seventy five only.