

CHAPTER 1

Knowledge about Metric and English system of measurement.

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1. Convert 100 degree centigrade to Fahrenheit

Ans) formula is $^{\circ}\text{F} = 9/5 \text{ }^{\circ}\text{C} + 32$

$$\begin{aligned} &= 9/5 \times 100 + 32 \\ &= 180 + 32 \\ &= 212 \text{ }^{\circ}\text{F} \\ \therefore 100 \text{ }^{\circ}\text{C} &= 212 \text{ }^{\circ}\text{F} \end{aligned}$$

2. Convert - 40 degree centigrade to Fahrenheit.

Ans) formula is $^{\circ}\text{F} = 9/5 \text{ }^{\circ}\text{C} + 32$

$$\begin{aligned} &= 9/5 \times -40 + 32 \\ &= -72 + 32 \\ &= -40 \text{ }^{\circ}\text{F} \\ \therefore -40 \text{ }^{\circ}\text{C} &= -40 \end{aligned}$$

3. Convert 150 degree Fahrenheit to centigrade .

Ans) formula is $^{\circ}\text{C} = 5/9 (\text{ }^{\circ}\text{F} - 32)$

$$\begin{aligned} &= 5/9 \times (150 - 32) = 5/9 \times (118) \\ &= 65.56 \text{ }^{\circ}\text{C} \\ \therefore 150 \text{ }^{\circ}\text{F} &= 65.56 \text{ }^{\circ}\text{C} \end{aligned}$$

4. Convert 10kg/cm2 to PSI.

$$\begin{aligned} 1 \text{ kg/cm}^2 &= 14.2 \text{ PSI} \\ 10 \text{ kg/cm}^2 &= 14.2 \times 10 = 142 \text{ PSI} \end{aligned}$$

CHAPTER 2

Reading and making simple Electrical Drawings.

1. Draw the circuit diagram of one lamp controlled by a switch
2. Draw the circuit diagram of simple electrical circuit consists of a battery, fuse, switch, ammeter, voltmeter and load.
3. Draw the circuit diagram of a staircase wiring.
4. Draw the circuit diagram of a fluorescent lamp.
5. Draw the circuit diagram of a ceiling fan.
6. Draw the circuit diagram of a godown wiring.
7. Draw the circuit diagram of a HPSV/MH lamp.
8. Draw the power and control circuit diagram of a DOL starter.
9. Draw the power and control circuit diagram of a star and delata starter.

CHAPTER III

Identification and usage of Electrical Hand tools.

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1. What are the items should contain in the tool bag of a technician while attending the failure in a crane.

Ans) 1. Double test lamp 2. screw drivers 3. spanner set 4. connector 5. combination pliers 6. insulation tape 7. fuse wires of sorts 8. HRC fuses 9. Emery paper 10. Clip on ammeter 11. Allen keys

2. As per safety aspect, how to maintain the tools?

1. The handles of the pliers should have insulation sleeves in good condition.
2. The screw driver should have insulation handle. Do not use screw driver as chisel.
3. The condition of the double test lamp has to be checked often. Before testing supply, the working of the test lamp should be ensured with the near by live supply.
4. The ropes, slings, rubber gloves , ladders should be checked periodically.

3. What the sizes of spanners available in a spanner set.

Sl no	SIZE	Sl no	SIZE
1	6-7mm	7	18-19mm
2	8-9mm	8	20-22mm
3	10-11mm	9	21-23mm
4	12-13mm	10	24-26mm
5	14-15mm	11	25-28mm
6	16-17mm	12	27-32mm

CHAPTER IV

Knowledge about Electrical Measurements and measuring instruments.

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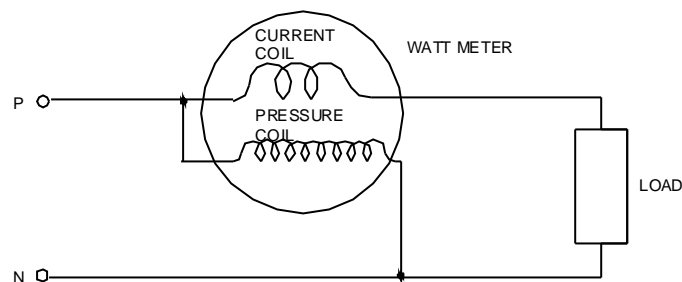
Descriptive questions

1. Explain the procedure of measure the insulation resistance of a 3 phase 415 v motor.

Ans)

1. The insulation resistance of a motor can be checked with a 500v insulation megger.
2. Check the megger by shorting both terminals. It should show 0 ohms.
3. Remove a small portion of paint from the motor body to get good contact of the megger terminal.
4. Keep one terminal of the megger on the body and other terminal to any one of the motor terminal.
5. Rotate the megger at constant speed for a period of 1 minute. The value should be more than 1 mega ohms.
6. Repeat this for the other terminals.
7. If the value is 0 ohms , the motor is said to be earthed.
8. If the value is below 1 mega ohms it is said be poor insulation.
9. Now check the insulation value between windings. The insulation value should be more than 1 mega ohms.

2. Draw the circuit diagram and explain the method of measuring the power of a single phase load with watt meter.



The circuit diagram for measuring the power of a single phase load with watt meter is shown above. The watt meter has got 4 terminals . Two terminals for current coil and two terminals for pressure coil. One CC terminal and one PC terminal is shorted and given phase supply. Other end CC terminal series to the load and PC terminal given neutral . Now the watt meter read the load power.

CHAPTER V

Outline knowledge about Battery and series parallel connections.

Descriptive questions

1. What will be the voltage and AH capacity of 7 lead acid cells of 120 AH connected in series.

Ans)

- When cells are conned in series the total voltage will be addition of all cell voltages . so the total voltage = $7 \times 2v = 14$ volts.
- The AH capacity will be 120 AH.

2. What will be the voltage and AH capacity of 8 lead acid cells of 120 AH connected in parallel.

Ans)

- When cells are conned in parallel the total voltage will be same as each cells. So the terminal volage will be 2 volts.
- The AH capacity will be $120 \text{ AH} \times 8 = 960 \text{ AH}$

3. Explain the chemical action taking place in a lead acid cell.

The total chemical reaction in side a lead acid cell during charge and discharge is given below.



Sl no	Fully charged condition	Fully discharged condition
1.	+ ve plate : Pb O ₂ (lead peroxide)	+ ve plate : Pb SO ₄ (lead suplhate)
2.	- ve plate : Pb (Spongy lead)	- ve plate : Pb SO ₄ (lead suplhate)
3.	Electrolyte : Diluted sulphuric acid	Electrolyte : Diluted sulphuric acid
4.	Specific gravity 1.210- 1.220	Specific gravity 1.180
5.	Voltage : 2.2.Volts	Voltage : 1.8Volts

4. List out various defects of a lead acid cell.

Ans) The various defects of a lead acid cell is

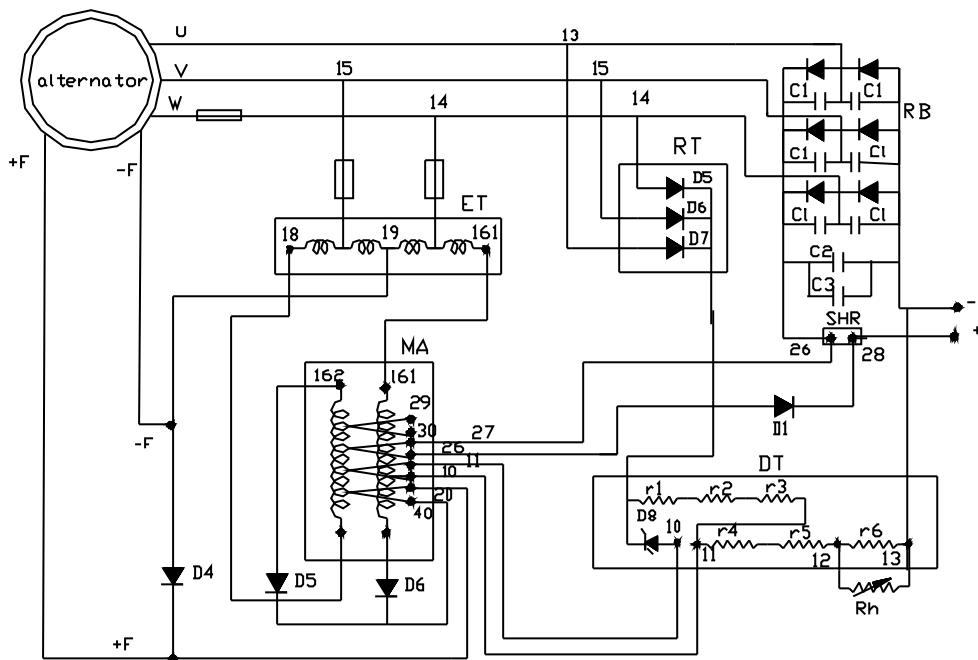
1. sulphation (Hard sulphation, soft sulphation)
2. Buckling
3. Reversal of cells
4. Shedding of active materials
5. sedimentation

CHAPTER VI

- General Knowledge about TL alternators and Regulators and wiring in coaches.
- Simple knowledge about Train Lighting services.

Descriptive questions

1. Draw the circuit diagram of a 110 V MA type regulator and explain.



The regulator-rectifier unit has the following functions

- Rectifying 3 phase AC output of alternator to DC using full wave rectifier bridge
- Regulating the voltage generated by alternator at set value. 124V 4.5, 127V 25KW
- Regulating the output current at set value. 37.5A, 4.5 kw, 135A 25KW.
- Over voltage protection.

To achieve the above functions the RRU uses the following components.

1. Power rectifier
2. Magnetic Amplifier (MA)
3. Excitation transformer (ET)
4. Voltage detector(DT)
5. OVPR

2. Write down the fire prevention measures adopted in TL coaches.

1. In order to minimize the risk of electrical fires on coaches the following actions are recommended.
2. Use of P V C cables for coaches wiring
3. Fuse of proper rating should be provided
4. Fan, light leads should be provided with terminal strip connector
5. Crossing of +ve and -ve wires are eliminated by segregation of +ve and -ve wiring on both sides of the coaches
6. All the wires should be properly of +ve and -ve wires should be eliminated.,
7. The wires should be passed through metallic holes by using rubber bush
8. Insulation resistance of coaches wiring should be checked time to time on all nase depots.
9. No loose joints should be allowed to continue in coaches wiring.
10. Bare ends and joints should be covered with proper insulation.
11. All protective sheets of cables provided on under frame should be cleaned which gets during the run of train.
12. Leakage of the roof should be pointed out to the mechanical branch to avoid short circuit of wiring due to entry of rain water or water feeding up pipes of the over head tank.

3. Write the anti theft measures adopted in coaches

In order to avoid theft, the 17th electrical standard committee meeting has recommended the provision of the following antitheft measures.

1. Wiring of under frame cables in conduit.
2. Provision of antitheft rod in battery boxes.
3. Provision of 'L' type bolts with nuts diagonly on battery boxes.
4. The chain of alternator provided for tensioning arrangement should be welded with it's body at one end for preventing it form falling down
5. Two number of safety chairs are provided with alternator to prevent it from falling down when the alternator suspension bracket arrangement is damaged.
6. 'V' belt are provided in place of flat belts.
7. Screw type holder for lamps are provided in place of BC lamp and holder.
8. Special key for light fitting cover should be provided
9. Special key for rotary type switches.
10. Cheating of roof wires at every 9" distances to make it difficult to pull out the cable after cutting.
11. The inspection cover of the fan shall be provided with locking arrangements.
12. Fix split pin by passing through the hub of the blade and armature shall to prevent easy removal of armature
13. Use aluminum field coils instead of copper field coils.

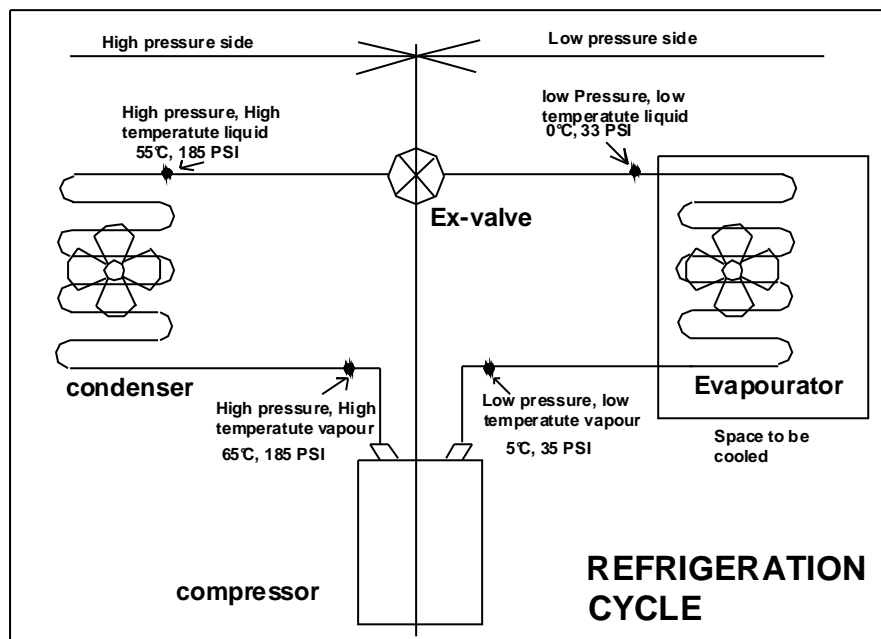
4. Draw the coach wiring diagram of a TL coach showing various sizes of Cables used, fuses and other protective devises.

CHAPTER VII

14. Outline knowledge about Electrical Equipment and Refrigeration equipment in AC coaches.
15. Outline knowledge about working of Air-conditioners, Refrigerators, water coolers etc.,

Descriptive questions

1. Explain the cycle of refrigeration with a neat drawing.



Refrigeration cycle

In the refrigeration cycle the low pressure low temperature refrigerant vapour is converted into high pressure high temperature refrigerant vapour by the compressor.

This high pressure high temperature refrigerant vapour is converted into high pressure low temperature refrigerant liquid in the condenser section.

This high pressure low temperature refrigerant liquid is converted into low pressure low temperature refrigerant liquid in the expansion device.

Then this low pressure low temperature refrigerant liquid is converted into low pressure low temperature refrigerant vapour by absorbing heat in the evaporator. Then the vapour will enter into the compressor, the cycle going on repeats. The expansion device and compressor which divide the system into low side and high side of the system.

2. What are the desirable properties of a refrigerant.

1. Its boiling point should be low.
2. Its freezing points should be low.
3. Its critical temperature should be high.
4. Its critical pressure should be low.
5. Evaporator and condenser pressure should be positive.
6. It should have high latent heat of vapourisation.
7. It should be non-corrosive.
8. It should be non-inflammable.
9. It should be non-toxic and non-irritating.
10. It should be non-poisonous.
11. It should be non-explosive.
12. It should have high dielectric strength
13. It should freely mix with lubricating oil
14. It should not have any effect on precious materials
15. Leak detection should be easy
16. It should be cheap and easily available in market

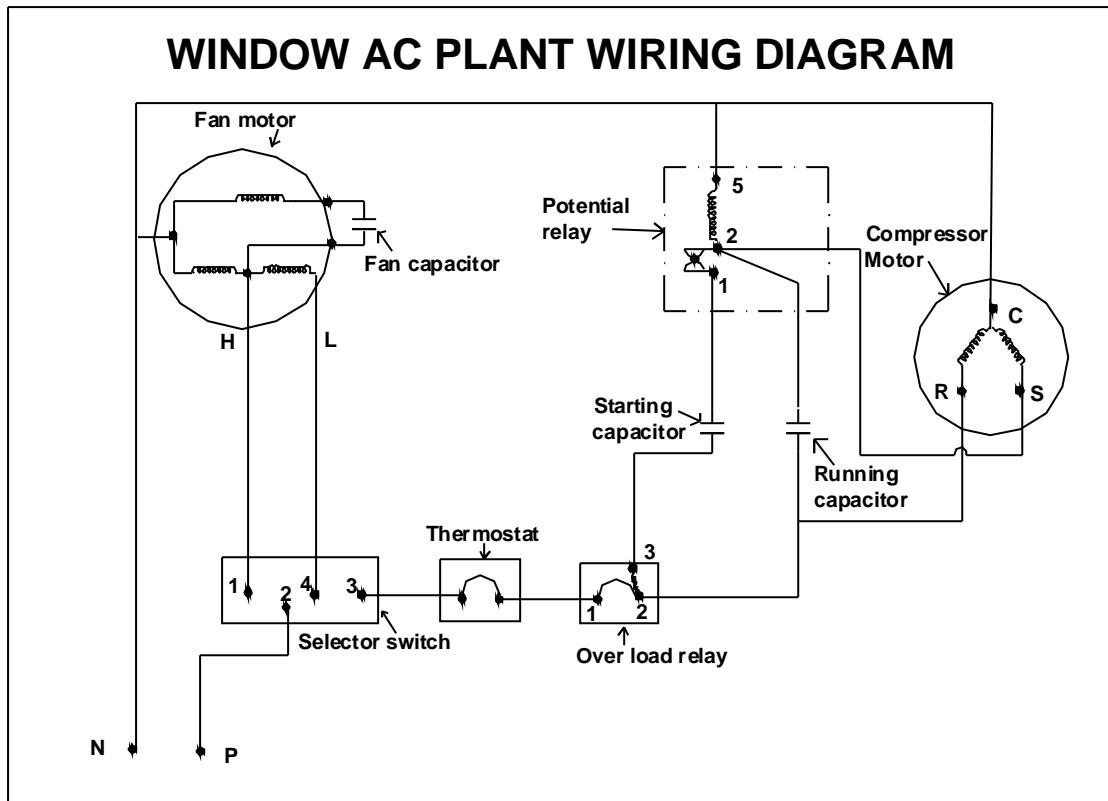
3. List out various AC equipments and power equipments used in an RMPU coach.

- RRU : 2 nos
- Battery 1100 AH : 1 set
- Pre-cooling transformer and rectifier.: 1 no
- Inverter 25KVA : 2 nos
- WRA : 2 nos
- Power panel : 1 no
- Control panel : 2 nos
- Alternator (25 kw) : 2 nos

4. Write 10 advantages of RMPU coach over US coach.

DESCRIPTION	RMPU	US
Weight	1400 kgs	2700 kgs
Installation time	4 hrs	4 days
Refrigerant	R22	R12
Quantity of refrigerant	3 kgs	12-15 kgs
Compressor	Hermetically sealed	Open type
Leak potential	Nil	Enormous
Maintenance	Little	Heavy
Dust collection	Little	heavy
Damage due to cattle run, flash flood	Nil	Heavy
Performance	Excellent	Deteriorate due to dust collection
Water drop on passenger	Nil	Some times
Fresh air	From roof	From side, takes toilet smell
Capacity control	25% to 100 %	50% to 100%
Down time for repair	4 hrs	Very long
Inverter	Required	Not required
WRA	Required	Not required
POH time	Less	more

5. Draw the circuit diagram of a Window air-conditioned.



CHAPTER VIII

16. Basic Electricity, Knowledge about AC/DC motors, Windings.

Descriptive questions

1. A house is having following loads.
 - a. 6 nos of FL lamp working 8 hours per day.
 - b. 5 nos of ceiling fan working 10 hrs per day.
 - c. 1 hp pump motor working 1 hour per day.
 - d. 15W CFL working 5 hors per day.
 - e. 750w electric iron 2 hrs per week.

Calculate the electricity charges for a month having 30 days at the rate of Rs3/- per unit.

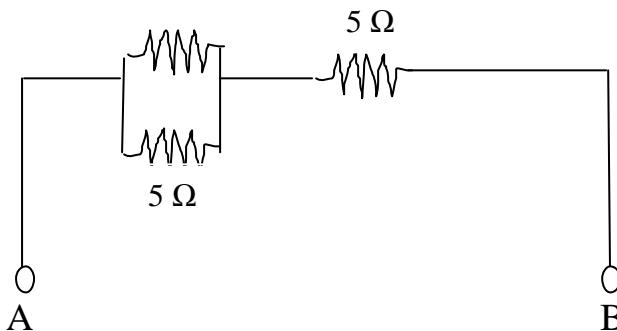
6 nos of FL lamp working 8 hours per day =	6x 40 x 8	=	1920	wh
5 nos of ceiling fan working 10 hrs per day =	5x60x10	=	3000	wh
1 hp pump motor working 1 hour per day =	1 x 746 x 1	=	746	wh
15W CFL working 5 hors per day	= 1 x 15 x 5	=	75	wh
750w electric iron 2 hrs per week				
therefore per day = 0.285 hrs	= 750 x .285	=	214	wh

total energy consumption	=		5955	wh
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or 5.955 Kwh

electricity charge for a month of 30 days at the rate of Rs.3/- unit = 5.955 x 3 x 30 = 535.95

2.



Calculate the total resistance across terminal A and B.

a. $R_{eq} = R_1 \cdot R_2$

----- if the resistance are connected in parallel.

$$\frac{R_1 + R_2}{5 \times 5} = 25$$

----- = ----- = 2.5 ohms

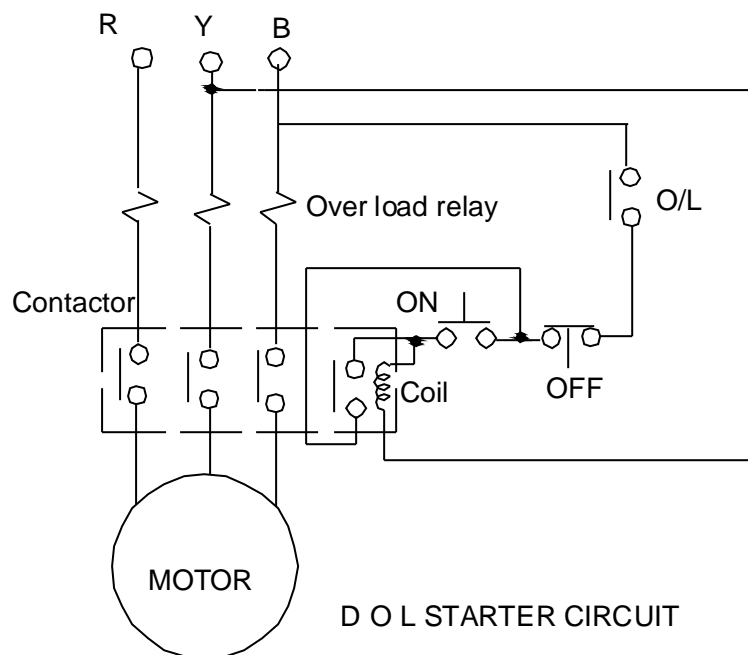
$$5 + 5 = 10$$

$R_{eq} = R_1 + R_2$ if the resistance are connected in series.

$$2.5 + 5 = 7.5 \text{ ohms}$$

therefore total resistance $R_T = 7.5 \text{ ohms}$

3. Draw the DOL starter and explain.



- DOL starter is used up to 5HP motors.
- It has got one contactor, Over load relay, ON and OFF push button and wiring.
- It has got low voltage and over load protection.
- Motor will trip when the running current is more than the current setting of the OLP.

CHAPTER IX

17. Outline knowledge about transformers OH lines, cables, wiring control equipments.

Descriptive questions

1. Write down the conditions for paralleling of transformers.

- Polarity of the two transformers must be same
- Two transformers must have same voltage ratio
- Both the transformers must have same percentage impedance
- In poly phase, phase rotation must be same and the transformers must have same phase displacement or vector grouping.

2. Write down the maintenance schedule of a 750 kVA transformer.

s.no	Hourly	Inspection notes	Action
1	Load	Check against rated figure	Reduce the load if higher
2	Temperature	Check oil temperature	Switch off if the oil temperature is high
3	Voltage	Check against rated figure	Take corrective action
s.no	Daily	Inspection notes	Action
1	Dehydrating breather	Check the colour of silica gel	If silica gel is pink change it. If it is in pale blue, then it is in good condition
s.no	Monthly	Inspection notes	Action
1	Oil level in transformer	Examine the oil level and dirt deposits	Clean or replace
s.no	Half yearly	Inspection notes	Action
1	Oil conservation	Check the moisture	Improve ventilation
2	Cable boxes	Inspect for leaks, cracks etc.,	Attend defects if any
s.no	Yearly	Inspection notes	Action
1	Transformer oil	Check the dielectric strength	Take suitable action to restore the quality of oil
2	Earth resistance	Check values of earth resistance	Take suitable action if earth resistance is high
3	Relay alarms and their circuits	Examine relay and alarm contacts, their operation fuses etc. check relay accuracy	Clean the component and replace the contact and fuses
s.no	5 Yearly	Inspection notes	Action
1	Core and winding	Overall inspection including lifting of core and coils	Wash with clean dry oil

These are the schedule maintenance for the transformer of capacities less than 1000 KVA

3. Write down the advantages of UG cables over OH cables.

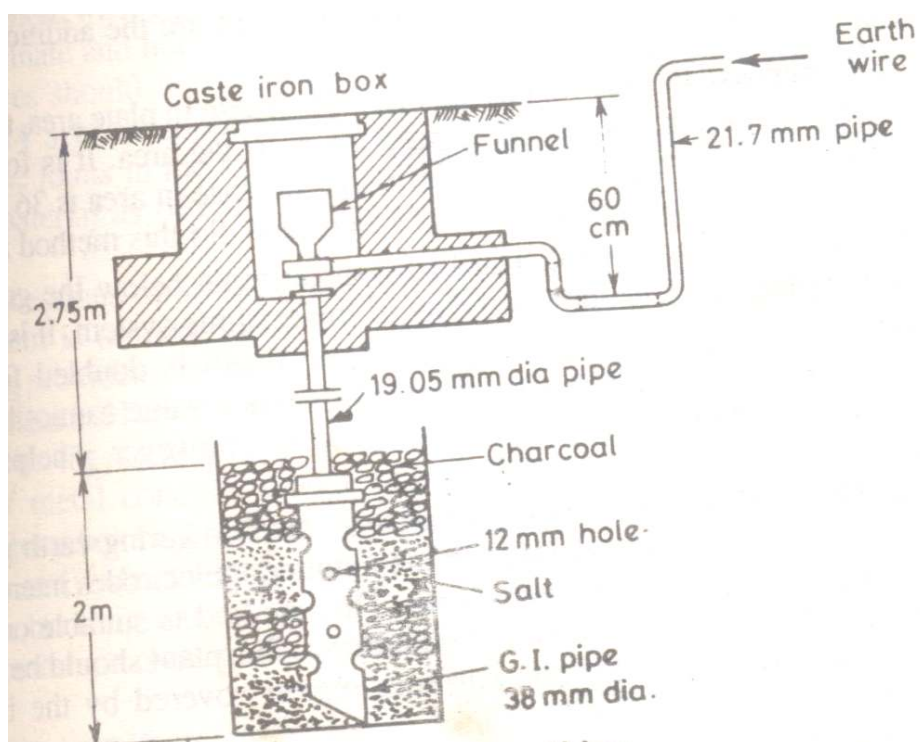
	Description	Overhead line	Underground(UG cable)
1	General appearance	Not good	Good appearance
2	Installation cost	normal	More
3	Maintenance cost	more	less
4	Chances of fault	more	Less
5	Fault finding	Easy	Not so easy
6	Periodic maintenance	required	Not required
7	safety	less	More
8	Type of conductor	Aluminium	3 core(or) 3 ½ core LT UG cable
9	Calculation of sag	Essential	Nil
10	Application	No limitation	Limited to 132 v only

CHAPTER X

18.Importance of earthing and earthing practice.

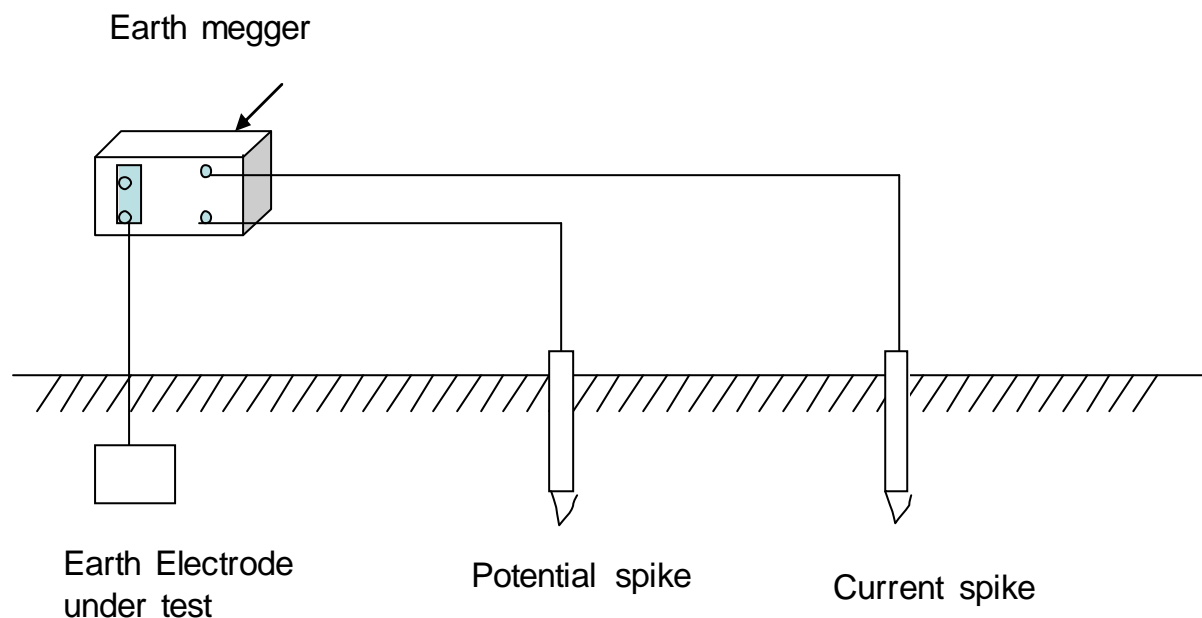
Descriptive questions

1. Explain with a drawing the laying of a pipe earth.



- Earthing is done to protect human being and equipment from leakage current.
- 38 mm dia GI pipe is used with 12mm hole around.
- The length of the pipe is 2 meters
- 19mm dia GI pipe is coupled with 38mm GI pipe.
- .Charcoal and salt filled alternatively filled to retain moisture and conductivity.

2. Write down the procedure of testing an earth with an earth megger.



The resistance of the earth electrode can be measured by using an earth megger. The C1 & P1 of the earth megger is shorted and connected to the earth electrode under test. A potential spike is driven in to the ground at 75 feet from the earth electrode under test and connected to P2 of the megger. A current spike is driven in to the ground at 150 feet from the earth electrode under test and connected to C2 of the megger. By rotating the megger, the earth resistance value can be directly read from the scale of the megger.

Measurement of Earth Resistance

The earth resistance can be measured by using earth megger during the test earth connection to the electrode under test should be disconnected from system earth. The terminal of C1 and P1 of earth megger has to be sorted and connected to the earth electrode by using shortest lead which is under test. C2 terminal of megger has to be connected to current electrode spike at a distance of 50 to 70 feet. The P2 terminal of the megger has to be connected potential electrode spike at a distance of 50 to 70 ft. from the current electrode. The angle of direction between the spike should be at least 90 degree apart. The reading of the megger to be recorded duly moving the current electrode until to get same value for the three consecutive readings. Similarly the potential electrode also to be moved and reading to be taken until to get same value for the three consecutive readings. The final value of the resistance will be taken as average of the above readings.

CHAPTER XI

- Safe working on Electrical installations, overhead lines, shutdown procedure
- Safety practices- General and First Aid.

Descriptive questions

1. Write 10 safety points you will follow while working in electricity.

- a) Before start a work in electrical installation it should be switched off and earthed.
- b) The procedure for effective power shutdown and resuming supply should be clear cut and fool proof
- c) As far as possible repair work should be carried out during day light hours only.
- d) If the work has to be done during night hours sufficient artificial lighting should be provided.
- e) Staff working on OH lines should use proper ladders, safety belts etc to ensure they won't fall down.
- f) Always test the supply system with double test lamp, only not use tester to confirm the power supply.
- g) Always treat the spare wire has the live wire and ensure the wire is live or not live.
- h) IE rules to be followed strictly that whenever any authorizes person goes for any sort of work in the LT transmission live.

2. Write 10 energy conservation points adopted in workshop.

- a) Providing capacitor bank to improve power factor and better system voltage for motors and other equipments.
- b) Switch off standby transformers to reduce no load losses.
- c) Switch off lights and fans when not in use.
- d) Using natural lighting by providing translucent sheets.
- e) Using timer switch in street light.
- f) Using automatic float switches in water tank to control the pump motor.
- g) Replacing FL with CFL, metal halide and HPSV fittings.
- h) Replacing choke into electronic ballast.
- i) Painting of walls with light colour of good reflecting property.
- j) Using solar water heater for service building, hospitals etc.

3. Write down the shut down procedure.

- Person need shut down has to give requisition on the proforma EE 243 asking for power shutdown in particular circuit.
- Authorized person will give permit to work proforma EE 244 after switching off the power supply.
- On completion of work authorized persons has to give proforma EE 245 saying that all works completed and all persons and tools are removed from the equipment and equipment can be re energized.
- Whenever more than one group is working on the same distribution circuit a senior most person should be incharge for both the group.
- Whenever more than one group is working the earthing of equipment shall be done either side of the section
- Before commencement of work on any electrical equipment after taking shutdown. Following works are to be done.
 - (i) Identify the electrical equipment.
 - (ii) Switch Off
 - (iii) Isolate
 - (iv) Discharge.
 - (v) Earth it.
 - (vi) Provide caution / danger notice on particular equipment ie. men working
 - (vii) The person who is possessing competency certificate only to be allowed to undertake any work on Electrical equipments.

Self Shut Down

Where an Electrical Department official himself has to work on an individual item of electric equipment, which is directly under his control, such as on a motor or crane supply lines in a workshop, it is not necessary to use forms prescribed in the above procedure but in all such cases an authorized person will be continuously present at site when work is in progress. The prescribed forms will however be required if any of his staff belonging to other departments are required to work on or near the wires.

4. Explain the method of administrating mouth to mouth respiration.

1. Place the patient so as to lie on his back. If there is some foreign matter like tobacco, chocolate etc in the mouth remove it. This will make the air passage clear.
 2. open the airway of the patient by lifting his neck with one hand while your other hand tilts his head back and down as far r as possible such that the chin points upwards.
 3. Pinch the nostrils to prevent air leakage. Maintain the open air way by keeping the neck elevated.
 4. Seal your mouth tightly around the victim's mouth and blow the air in. The patient chest should rise.
 5. Remove your mouth. Release the patient's nostrils listen for air escaping from the patient's lungs, watch for the patient's chest to fall.
- Repeat the steps at 12 to 15 times a minute continuously until medical help arrives or breathing in the victim is restored.