CSMSS
Shahu College of Engineering Chh.Sambhajinagar
Electrical Department

Lab Manual

S.E. (Electrical Engineering)

Academic Year: 2023-24

Name: _____

Class:_____ **Div:**_____ **Roll No.:** _____

Year of the course: _____

Examination No.: _____

CSMSS
Shahu College of Engineering Chh.Sambhajinagar
Electrical Department

CERTIFICATE

This is to certify that _____

Seat Number: _____ Roll No._____ Div_____ from **Second Year Electrical Engineering** has successfully completed his / her Practical work of Subject Power System at Shahu College ofEngineering, Chh.Sambahjinagar in the partial fulfillment of the Bachelor's Degree in Engineering.

(Prof. A. D. Salpe)	(Prof. A. N.Muidraj)	(Dr. U. B. Shinde)
Practical I/C	**Head of the Department**	**Principal**

CSMSS Shahu College of Engineering Chh.Sambhajinagar

Electrical Engineering Department

POWER SYSTEM

INDEX

Sr. No.	Description	Date	Sign
1	To Study the layout of thermal power plant with its Components		
2	To Study the layout, Classification & Components of Hydro power plant.		
3	To Study the alternator excitation system		
4	To Study the types and Properties of various overhead Insulators		
5	To Study the types and Properties of various overhead Conductors		
6	To Study the power cable and its various components and types		
7	To study the layout of Substation along with its Components		

Dos and Don’ts in Laboratory:-

1. Understand the matlab software
2. Understand the all the matlab library.
3. Study the use of all the equipment’s provided in the library of matlab.
4. Study the simulation demos provided by matlab.
5. Develop the program and simulation as per instructions in the manual.
6. Follow all the rules and regulation of the computer lab.
7. Carefully handle the devices in computer lab.
8. Familiarize yourself with the power system equipment, circuit breakers, transformers, meters, and other components before using them.
9. Ensure all power systems and devices are properly grounded to avoid electrical shocks and system failures.
10. Keep the lab clean and free from clutter, especially around high-voltage equipment to reduce risks of fire, shorts, or accidental contact.
11. Never work alone in a lab with high-voltage power systems. Always have a partner or supervisor nearby in case of emergencies.

Experiment No: - 1

Date: _____

Experiment name:

To Study the layout of thermal power plant with its Components.

Apparatus-

Wooden Thermal Plant Model

Objective:

1. Study about the layout of steam power plant.
2. Study about the Rankin cycle and different components steam power plant.

Theory:

1. Steam Power Plant and its Operating Cycle.

The general layout of the modern power plant consists of mainly four circuits which are

- Coal and ash circuit.
- Air and gas circuit.
- Feed water and steam flow circuit.
- Cooling water circuit.

A thermal power station using steam as working fluid works basically on the Rankine Cycle. Steam is generated in a boiler, expanded in a prime mover and condensed in a Condenser and fed into the boiler again with the help of pump. However, in practice, there are numerous modifications and improvements in this cycle with the aim of affecting heat

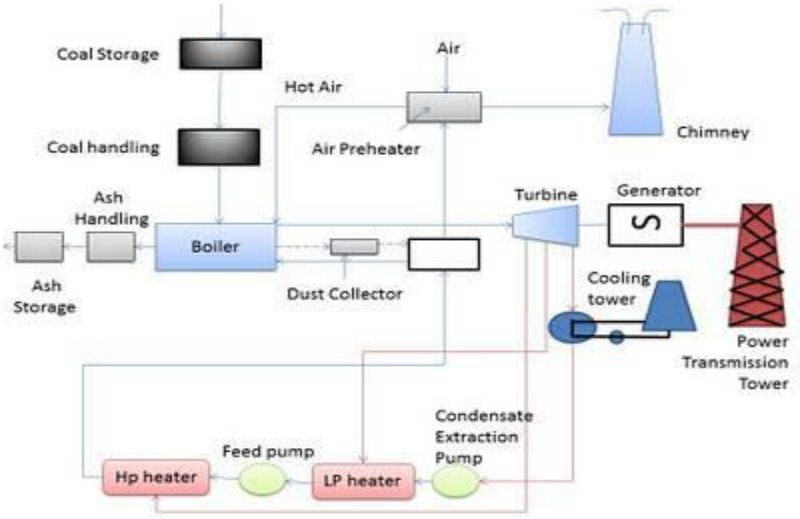


Fig.1Layout of Thermal Power Plant

Conclusion:

- The experiment demonstrates the basic working of a hydropower plant: converting water's kinetic or potential energy into electrical energy using a turbine and generator.

QUESTIONS:

1. Explain different circuits of modern steam power plant.
2. Draw layout of modern thermal power plant.
3. Explain various site selection criteria required to consider for steam power plant.

REFERENCES:

1. Power Plant Engineering by P.K.Nag, TMH Publications.
2. Power Plant Engineering by Domkundwar and Arora, Dhanpatrai Publication

Signature of Teacher

_____

Experiment No-2

Date:-

Experiment name: To Study the layout, Classification & Components of Hydro power plant.

Apparatus-

1. Hydro Power Plant Model

Objective:

To demonstrate how water flowing through a turbine can generate electricity.

THEORY:

The kinetic purposed plant of hydroelectric power plant is to provide power from water flowing under pressure. It has two forms of energy, kinetic energy & potential energy depends upon the mass velocity of flow while the potential energy exists as a result of difference in water level below two points. The turbine converts potential and kinetic energy possessed thus the turbine by water in to mechanical is a prime mover which when coupled to a produces electricity.

Electric Power energy to a generator hydroelectric power can be develop when water continuously flowing under pressure is available Dam is constructed to restrict the river water flow. Essential components of a hydroelectric are as follows Power plant .

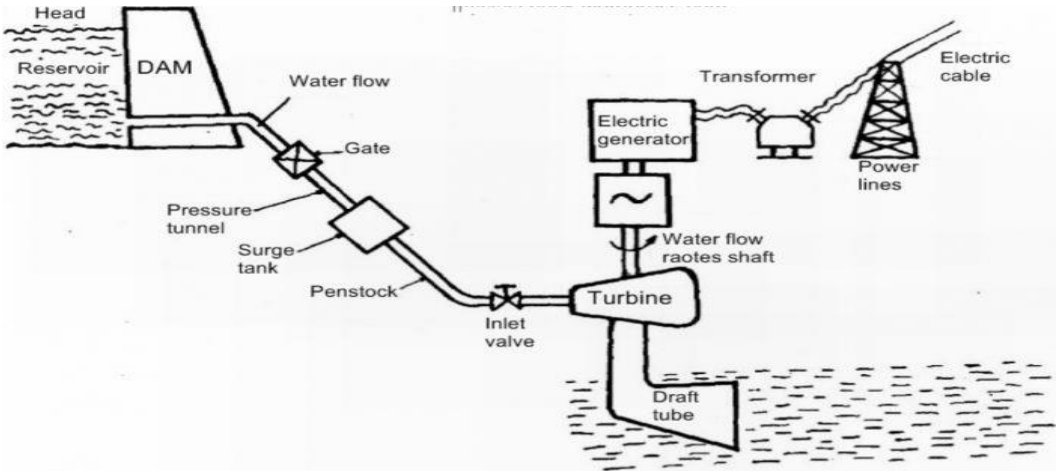


Fig.2.Schematic block diagram of hydroelectric power Plant

1) Storage reservoir; -anThe attachment area is Date: water available from Stored in a reservoir So that it can be utilized to run the turbine for producing power according to requirement.

2) Dam with control works:-of Dam is a structure ejected on a suitable site to provide for the storage water and create head Dam may be built to make an artificial reservoir from valley or it may be created in a river to control the flowing water.

3) Water Ways: - the water carried power house, it force and pipe way Consist Water way is a passes through which from the storage reservoir to the of tunnel control, penstock. Tunnel is water passage made by cutting the mountain to save the distance for bay in an enlarged section of a canel spread out to accommodate the required width of intake. its function is to store temporarily water ejected by plant.

4) Penstock: - It is a pipe of large diameter carrying water under pressure from storage to turbine.

5) Power House:-Is a building to house the turbine, penstock and other for operating the machines?

Rated quantities: - The rated quantities refer to the parameter for which the turbine is designed. Efficiency of hydroelectric power plant: An appraisal of the performance of a

Hydraulic turbine is made by its overall efficiency Overall efficiency - Power available at the shaft Power available at the water jet.

QUESTIONS:

1. Explain different circuits of hydro power plant.
2. Draw layout of hydro power plant.

Conclusion: -

Signature of teacher

_____

Experiment No: - 3

Date: _____

Experiment name:

To Study the alternator excitation system

Theory:

The system which is used for providing the necessary Field current to the rotor winding of the Synchronous machine, such type of system is called an excitation system. In other words, excitation System is defined as the system which is used for the production of the flux by passing current the field winding the main requirement of excitation system is reliability under all conditions simplicity of control, ease of maintenance Stability and fast transient response. Of service at the load current and the power load power an The amount of excitation required depends on factor and speed of the machine. The more excitation is needed in the system. When the load current large, the speed is l…

Types of Excitation system:-

The excitation system is mainly classified into three
Types they are
1) DC Excitation System
2.) AC Excitation system
Rotor excitation system
- Brushless excitation system.
3) Static excitation system.

Their excitation explained below in details

DC Excitation system:-

The DC excitation system has two exciters-the main exciter and A pilot exciter. Exciter output is adjusted by an field current.

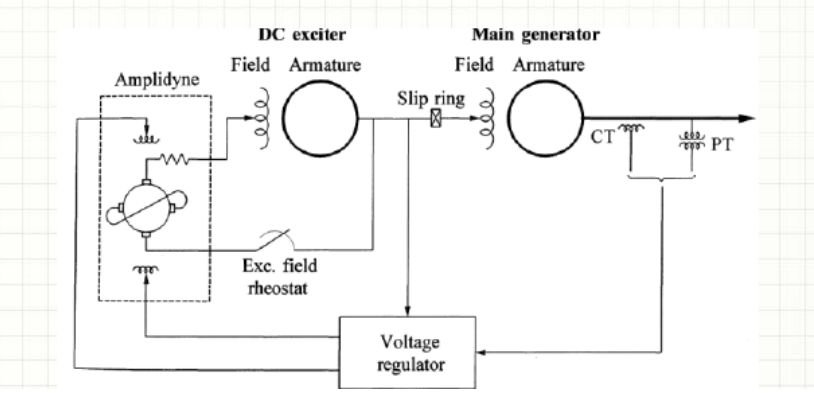


Fig.3 Block Diagram for DC Excitation system

Automatic Voltage regulator:- (AVR) for controlling the output terminal voltage of the alternator transformer input to the AVR ensures limiting of the alternator current during a fault When the field breaker is open, the field discharge resistor is connected across the field winding so as to dissipate the stored energy the field winding which is…

Conclusion:

Signature of Teacher

EXPERIMENT NO:-04

Date:-

Experiment Name: - To Study the types and Properties of various overhead Insulators

Apparatus:-

Pin insulator, Suspension insulator, Stray insulator, Shackle Insulator

Theory:-

Types of insulators

There are mainly three types of insulators

1) Pin insulator
2) Suspension insulator
3) Stray insulator
4) Shackle insulators

In addition to that there are other two types of electrical insulator available mainly for low voltage Application, i.e stay insulator & shackle insulator

1) Pin type insulator:-

As the name suggests, the pin type insulator Upper is secured to the cross-arm on the pole there is a groove on the and end of the insulator for housing the conductor the conductor passes through this groove and is bound by the annealed wire of the Same material as the conductor. Pin type insulators are used for transmission and distribution of electric power at voltage…Causes of insulator failures: Insulators are required to withstand both mechanical & electrical stresses. the latter type is primarily due to line voltage and may cause breakdown of the insulator. the electrical breakdown of the insulator can occur either by flash-over or the puncture puncture In flashover, an arc occurs between the tine conductor and insulator pin & the discharge jumps across the air gaps, following shortest distance In case of flash over, the insulator will continue to act in its proper capacity unless extreme heat produced by the arc destroys the insulator. In case of the discharge occurs from conductor to pin through the body of the insulator when such breakdown is involved, the insulator is permanently destroyed due Excessive had heat. In practice, sufficient thickness porcelain is provided in the insulator to avoid puncture by the line voltage.

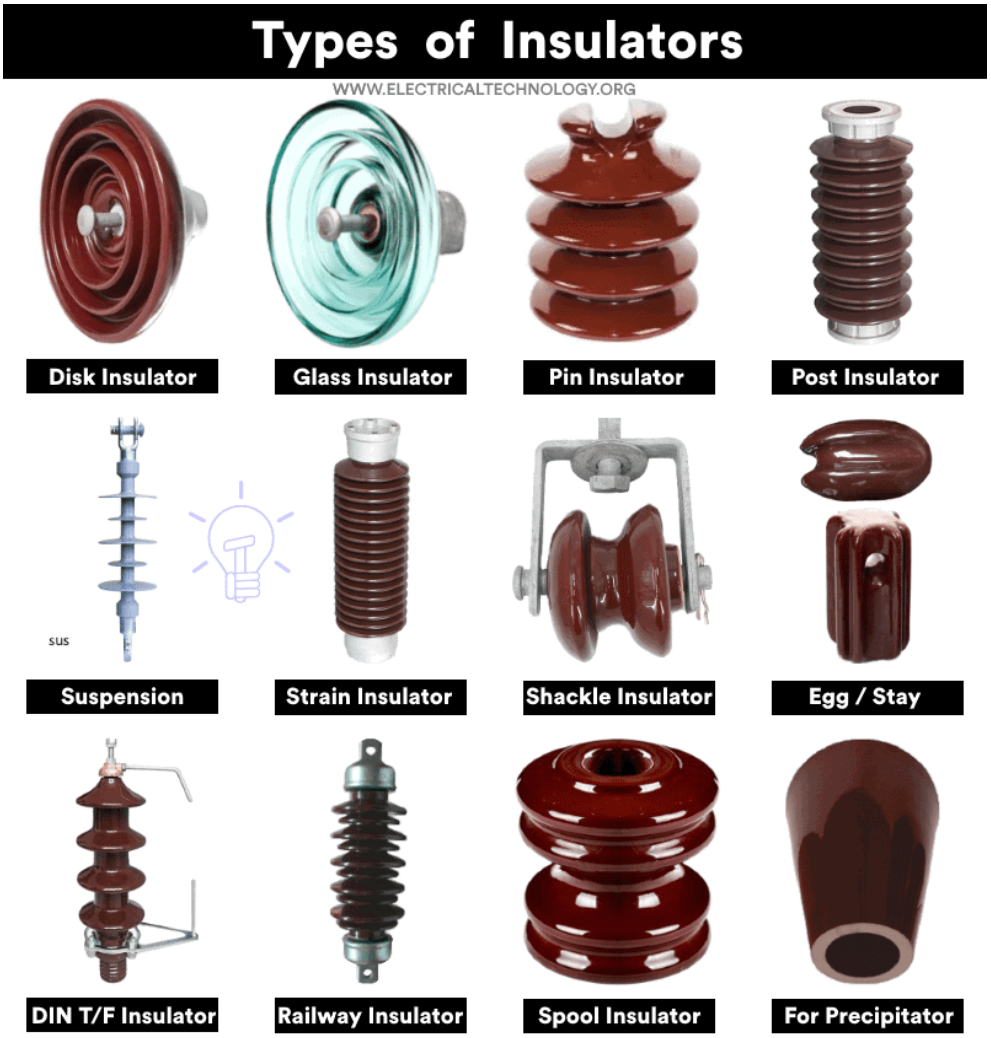
2) Suspension type:-Used for high voltages (> 33 kV), it is a used) practice to use suspension type insulators shown Fig. consist of a number of porcelain discs. Connected in series by metal links in the form the conductor is suspended at the Of a String bottom end of this string while the other ofthe string is secured to the cross-arm of the tower each unit or disc is designed for low Voltage, say 11 KV The number of discs in series would obviously depend upon the working voltage for instance, if the working voltage is os ky, then Six discs in series will be provided on the string**.**

Advantages of suspension type:-

1. Suspension type insulators are cheaper than pin type insulators for voltages beyond 33 KV

2. Each unit or disc of suspension type insulator is designed for low voltage, usually 11 kV

3) Strain insulators:-When there is a dead end of the line or there is corner or sharp curve, the line is subjected to greater tension. In order to relieve the line of



Excessive tension, strain insulators are used for low voltage lines (<11 kV), shackle insulators are as strain insulators. However, for high voltage transmission lines, strain insulator consist of an assembly of suspension insulators. Used The disc of strain insulators are used in the vertical plane when the tension in lines is Exceedingly high, at long river spans, two or Strings are used in parallel more

[4] Shackle insulators:-

In early days, the shackle insulators as strain insulators. But now a were used day, they are frequently used for low voltage distribution lines. Such insulators can be used either in a horizontal position or in a vertical position. They can be directly fixed to the pore with a bolt or to the cross arm.

Conclusion:-

Signature of Teacher

Experiment no:-05

Name of Experiment: - To study the layout of Substation along with its Components

Date: _____

Apparatus:-

Insulator, fuse, Pole, Circuit Breaker, Transformer, Conductor

Theory:-

Conductor: Which Carry electrical power From the Sending and station to the receiving End station.

Properties of Conductor:-

i) High electrical conductivity
ii) High tensile strength in order to withstand Mechanical stress.
iii) Low cost so that it long distance can be used
iv) Low specific gravity so that weight per unit Volume is small.

Types of conductors

1) Copper :-Copper is an ideal material for Overhead lines owing to its high electrical Conductivity and greater tensile strength it is always used in the hard drawn from as stranded conductor. Copper has high current Current carrying capacity of density i..., the copper per unit of x-sectional area is quite large, this leads two advantages The area offered by the conductor to wind loads is reduced Move over, this metal is quite homogeneous, durable and has high scrap value. There is hardly any doubt that copper is an ideal material for transmission and distribution of electric power.

2) Aluminum = Aluminum is cheap and light Compared to Copper as but it has much smaller Conductivity and tensile strength, the relative Comparison of the two materials.

i) The conductivity of aluminum is 60% that the smaller conductivity of aluminum Copper. Means that for any particular transmission efficiency
ii) Aluminum conductor being light, is liable to greater Swing and hence larger cross-Arms are required.

3) Steel cored Aluminum:-Due to the low tensile strength, aluminium Conductors produce greater sag. this prohibit their use for longer spans and makes them unsuitable for long distance transmission The composite conductor thus obtained is known as Steel cored aluminum and is abbreviated as A.C.S.R (Aluminium Conductor steel reinforced.) Steel cord aluminum conductor consist of central core of galvanized Steel wires. Surrounded by a number of aluminum Stands. Usually, diameter of both steel and aluminum wires is the same.

4) Galvanized steel = Can Steel has very high tensile strength. Therefore galvanized steel conductors be used for extremely long spans or for Short line sections exposed to abnormally high stress due to climatic condition They have been found very suitable in rural areas where cheapness in the main consideration.

5) Cadmium Copper:-Copper the conductor material now. Being employed in certain cases. In alloyed with cadmium an addition of 1% or 2% cadmium to copper increases the tensile

Strength by about 50% and the conductivity is only reduce by 15% below that of pare copper therefore, cadmium copper conductor can be useful for exceptionally long span 5. However due to high cost of cadmium used.

Conclusion:

Signature of Teacher

Experiment No: - 6

Date: _____

Experiment name:

Theory:-

Construction of Cables

i) Cores or conductors more than one core or A cable have one (Conductor) depending upon the type of sevice for which it is intended for instance, the 3- conductor cable shown in fig. 6.1 is used for 3-phase service. The conductors are made of tinned copper or aluminum and are usually stranded in order to provide flexibility to the cable.

ii) Insulation: Each core or conductor is provided them with a suitable thickness of insulation thickness of layer depending upon the voltage to be withstood by the cable The commonly used materials for insulation are impregnated paper,Varnished combric or rubber mineral compound.

iii) Metallic sheath: In order to protect the Core

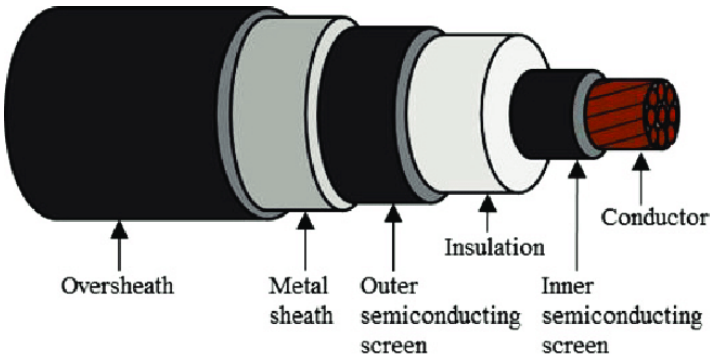


Fig.6.1 Armoring cable

iv) Bedding Over the metallic sheath is applied a layer of bedding which consists of a fibrous materials like jute of hessian tape. The purpose of bedding is to protect the metallic Sheath against corrosion and from mechanical injury due to armouring.of

v) Armouring Over the bedding, armouring is provided which consist one or two layers of galvanised steel wire or steel tape. Its purpose is to protect the cable from mechanical injury while laying it and during the course of handling Armouring may not be done in the case of some cables.from

Vi) Serving = In order to protect armouring atmospheric conditions, a layer of fibrous material (like jute) Similar to bedding is provided over the armouring This is known as serving.

Underground Cables. Consist of An underground cables essentially one Or more conductors with Suitable insulation & surrounded by a protecting

) Single conductor wire
2) Single phase wire
3) bingle standerd wire +
4) Flexible aire =
5 Iron wire
6) Core cable =
(7) Coaxial Cable :
8) Freeze wize

Conclusion:-

Signature of Teacher

Experiment 7 **Date:-**

Aim: To study equipment in a transmission substation

Objective: study the equipment's of in transmission Sub-station

Theory:- The assembly of apparatus used to change Same characteristics of electric supply is called a a sub-station Bus-bar : When a numbers of line operating of the Same voltage have to be directly connected electricity bus-bar are used as the common electrical component Bus- bars are copper or aluminium bars and operate of constant voltage.

i) Single bus-bar arrangement

ii) Double bus - bar arrangement

iii) Single bus-bar sys with sectionlisation

Insulator: the insulator serve two purpose they Support of conductor and confine the current to the conductors are most commonly used material for the insulator precision. Isolating …

ix) Circuit Breaker A circuit breaker is an which can open or close equipment a ckt under normal as well as fault condition it is so designed that it can be operate normally under normal condition automatically under fault conditions.

v) Power Transformer Power transformer is used in a sub-station to step the voltage except at the power station all the substation

Vi) Instrument transformer the line is substations operate to high voltage and current, of thousands of ampere the measuring instruments and protective devices

Designed for low rating and current are

A) Current transformer (C.T)"

B) Potential transformer (P.T)

Vii) Metering and indicating instrument there are several metering and indicating Instrument installed in a sub-stations to maintain watch over the current quantities the instrument transformers are invariable used with then for

Satisfactory operations.

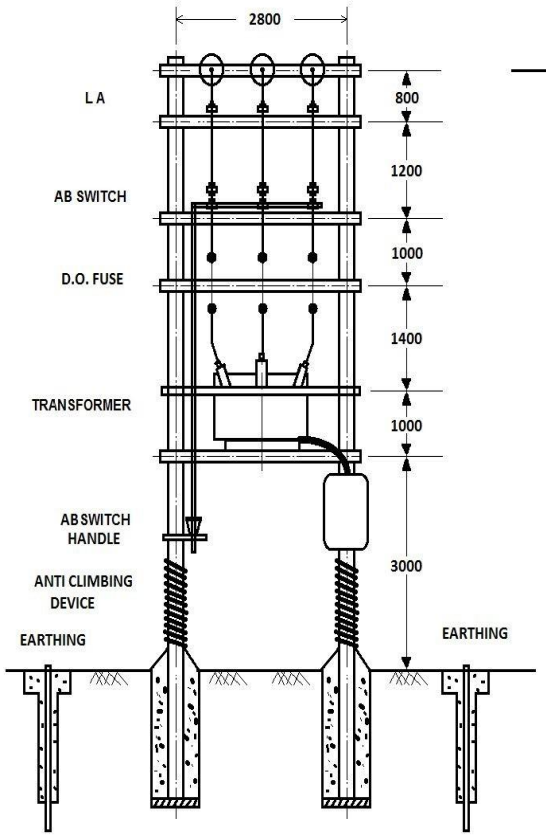
Vii) Miscellaneous equipment. In addition to above there may be following equipment in a substation.

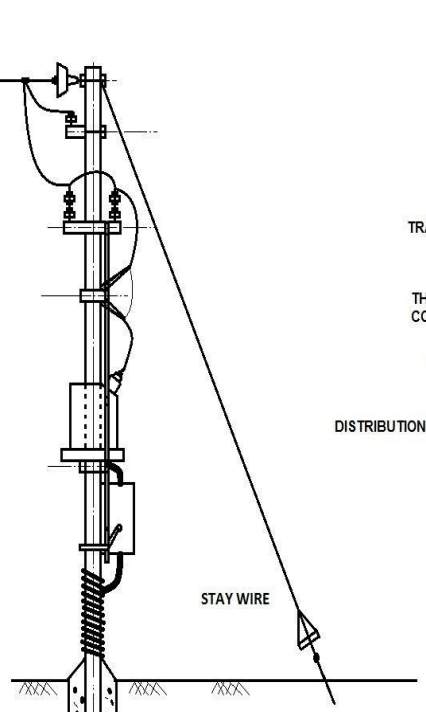
i) Fuses Carrier currents equipment

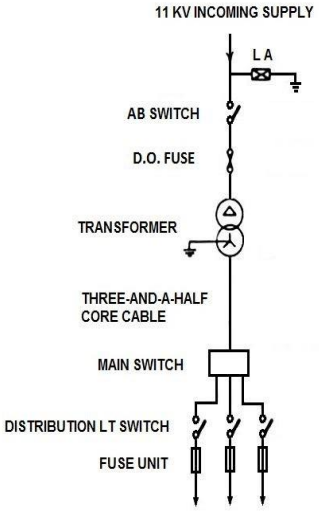
iii) Substations auxiliary supplies

11KV Pole Mounted Substation:

Sr. No.	Description of Technical Parameter	Unit	Primary side	Secondary Side
1	Nominal system voltage	kVrms	11 kV	440 V
2	Maximum system voltage	kVrms	12 kV	400 V
3	Power frequency with stand voltage	kVrms	28 kV	1000 V
4	lightning impulse withstand voltage a) Line to earth	KVp	75 KVp	6 KVp
	b) Across isolating gap	KVp	85 KVp	85 KVp
5	System frequency	Hz	50	50
7	Variation in frequency	%	1.5	0.5
8	Continuous current rating	Amp	1000	800
9	Symmetrical short circuit current	kA	25	25
10	Duration of short circuit fault current	Second	2	2
11	Conductor spacing for AIS a) Phase to ground	meters	3	3
	b) Phase to phase	meters	1	1
12	Design ambient temperatures	Deg	50	50
13	Maximum fault clearing time	ms	<150ms	<150ms







SINGLE LINE DIAGRAM

11 KV POLE MOUNTED SUBSTATION

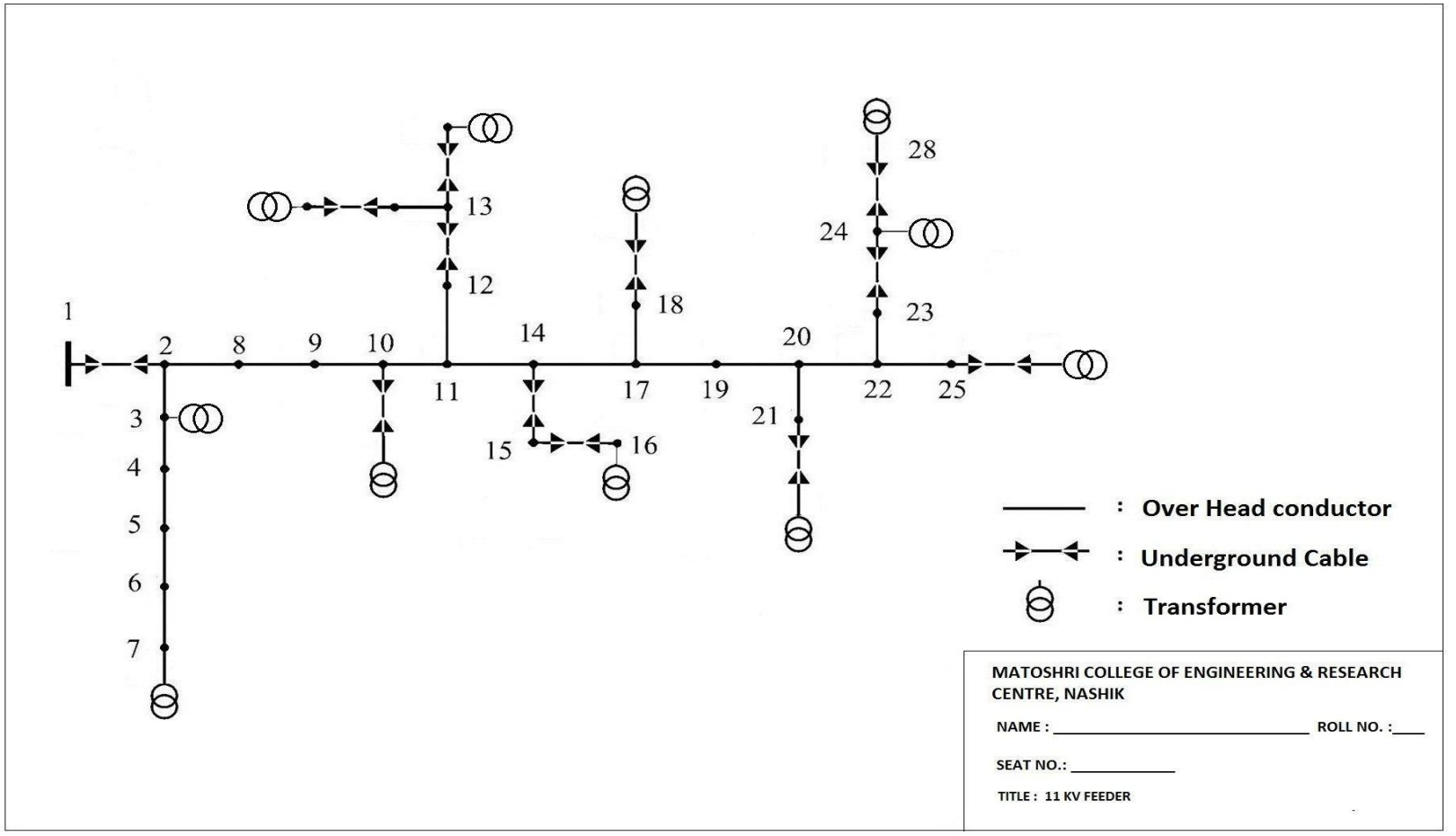
ALL DIMENTION IN MM

MATOSHRI COLLEGE OF ENGINEERING & RESEARCH CENTRE, NASHIK

NAME : _____ ROLL NO. :___

SEAT NO.: _____

TITLE : 11 KV POLE MOUNTED SUBSTATION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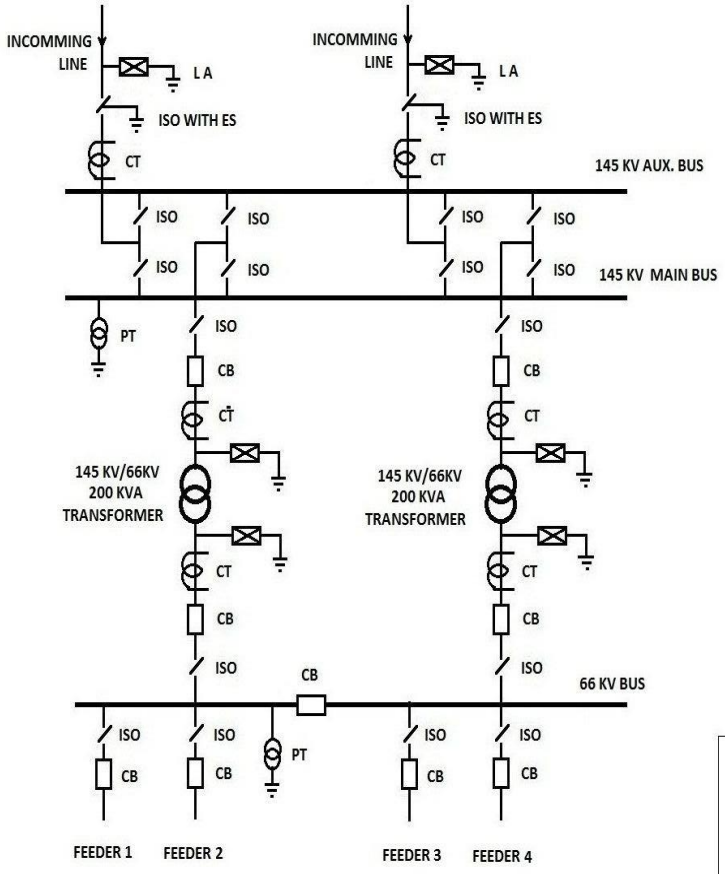
: Over Head conductor
: Underground Cable
: Transformer
MATOSHRI COLLEGE OF ENGINEERING & RESEARCH CENTRE, NASHIK
NAME : _____ ROLL NO. :____
SEAT NO.: _____
TITLE : 11 KV FEEDER

Conclusion:-



SINGLE LINE DIAGRAM OF 145 KV SUBSTATION

SR. NO.	SYMBOL	DISCRIPTION
1		LIGHTING ARRESTER
2		ISOLATOR WITH EARTHING SWITCH
3		CURRENT TRANSFORMER
4		POTENTIAL TRANSFORMER
5		ISOLATOR
6		CIRCUIT BREAKER
7		POWER TRANSFORMER
8		BUS BAR

MATOSHRI COLLEGE OF ENGINEERING & RESEARCH CENTRE, NASHIK

NAME : _____ ROLL NO. :___

SEAT NO.: _____

TITLE : 145 KV SUBSTATION AND SYMBOLS

Signature of Teacher