

EE53-Transmission & Distribution

UNIT-1

INTRODUCTION

1. Mention the location of the HVDC transmission.

The locations of the HVDC transmission are Chandigarh, Delhi, Patiala and Faridabad.

2. What is primary transmission?

The electric power at generating station is stepped up to 132kV (to reduce the transmission loss) and transmitted by three phase, three wire overhead system to the outskirts of the city. This forms the primary transmission.

3. What is secondary transmission?

The primary transmission line continues via transmission towers till the receiving stations. At the receiving stations, the voltage level is reduced to 22kV or 33kV using the step down transformer. There can be more than one receiving stations. Then at reduced voltage level of 22kV or 33kV, the power is transmitted to various substations using overhead three phase three wire system. This is secondary transmission. The conductors used for the secondary transmission are called feeders.

4. Write the advantages of A.C transmission.

The advantages of A.C transmission are:

- i. It can be generate power at very high voltages.
 - ii. The maintenance of A.C. substation is easy and cheaper.
 - iii. A.C. voltage can be stepped up or stepped down with the help of transformer.
 - iv. Construction is simple.
 - v. Fault can be detected very easily.
 - vi. There is no converter device required.
5. Write the disadvantages of A.C transmission.

The disadvantages of A.C transmission are:

- i. More copper is required than D.C.
- ii. Construction is complicated than D.C.
- iii. Presence of skin effect to increase the effective resistance of the line.
- iv. In A.C system due to the presence of capacitance there is continuous loss of power due to charging current even when the line is open.

6. Mention the limitations of high transmission voltage.

The limitations of high transmission voltage are:

The cost of insulating the conductor is very high.

Cost of transformer, switchgear and other terminal apparatus are very high.

7. List the various systems of power transmission in D.C. system.

The various systems of power transmission in D.C. system are:

- i. D.C. two wire system

- ii. D.C. two wire with mid point earthed.
- iii. D.C. three wire.
- Single phase A.C. system
 - i. Single phase two wire
 - ii. Single phase two wire with mid point earthed
 - iii. Single phase three wire.
- Two phase A.C. system
 - i. Two phase four wire
 - ii. Two phase three wire
- Three phase A.C. system
 - i. Three phase three wire(Transmission system)
 - ii. Three phase four wire(Distribution system)

8. What is a feeder?

Feeder is defined as lines, which connect the distribution station and distributor.

9. What is a distributor?

Distributor is defined as a common bus bar, which connect the service main and feeder.

10. Distinguish between over head system and underground system.

Over head system	Under ground system
Construction cost is less.	Construction cost is high.
To occupy the more spaces in metropolitan area.	To enhance the city beauty
It is operated above 66KV.	It is limits upto 66KV.
Fault can be easily detected and rectified.	Fault cannot be easily detected.
Maintenance cost is high.	Maintenance cost is very less.

11. List the components of a power system.

The components of a power system are:

- i. Generating station
- ii. Step up transformer
- iii. Step down transformer
- iv. Transmission line
- v. Switching station
- vi. Primary distribution line
- vii. Secondary distribution line
- viii. Feeder
- ix. Distributor and
- x. Consumer

12. How distribution systems are classified?

Distribution systems are classified by,

- i. Nature of current
- ii. Type of construction
- iii. Scheme of connection
- iv. D.C distribution.

13. What is a service main?

Service main is defined as a small cable or conductor which connects the distributor to the domestic terminal.

14. What is a distribution substation?

Distribution substation is a primary distribution system that delivers power to various substations.

16. Give the types of loading in distribution system.

The types of loading in distribution system are:

Uniform loading

Concentrated loading

Combination of uniform loading and concentrated loading.

17. Define one line diagram.

One line diagram is defined as the way in which all electrical apparatus represented by single line in symbolic form.

18. Which system is adopted for transmission of electric power?

A.C system is suitable for transmission of electric power due to the technical difficulties of D.C system. There is possibility of saving the copper conductor.

UNIT-2

TRANSMISSION LINE PARAMETERS

1. What are line parameters?

The line parameters are resistance, inductance, capacitance and shunt combination of conductance.

2. What is skin effect? Is it applicable to direct current also?

The tendency of alternating current to concentrate near the surface of the conductor is known as skin effect.

Skin effect is not applicable to D.C. because it is absent in the D.C. system. D.C. current when flowing through the conductor is uniformly distributed over the whole cross section of the conductor.

3. What is the effect of skin effect on the resistance of transmission line?

Skin effect increases the resistance of transmission line and decreases the current flowing through the line.

4. Mention the factors that depend on the skin effect.

The factors that depend on the skin effect are:

- i. Nature of material
- ii. Diameter of wire
- iii. Frequency
- iv. Shape of wire

Skin effect is negligible when the frequency is less than 50Hz and conductor diameter is less than 1 cm.

5. What is unsymmetrical spacing?

When three phase line conductors are not equidistant from each other the conductor spacing is said to be unsymmetrical spacing.

6. What is symmetrical spacing?

When three phase line conductors are equidistant from each other the conductor spacing is said to be symmetrical spacing.

7. Define mutual GMD.

Mutual GMD is defined as the distance from one end of the conductor to the other end.

8. Define self GMD.

Self GMD is defined as the limit of geometrical mean of the distance between all the pairs of elements in that area as the number of elements increase without limit.

9. What is the necessity for a double circuit line?

The necessity for a double circuit line in over head transmission system is to reduce the inductance per phase.

10. What is Bundle conductor?

A bundle conductor is a conductor made up of two or more Conductors.

11. Write a short note on proximity effect on conductors.

The alternating magnetic flux in a conductor caused by the current flowing in a neighboring conductor gives rise to circulating current in the former which cause an apparent increase in the resistance of the conductor this phenomenon is called proximity effect.

12. What is ACSR conductor?

ACSR stand for Aluminium Core Steel Reinforced. It combine the lightness, electrical conductivity and restlessness of aluminium with the high tensile strength of steel are now employed as over heat conductors of very long distance transmission lines.

13. What is resistance of a transmission line?

In a single phase, or two wires d.c. line the total resistance is known as loop resistance i.e. double the resistance of either conductor. Unit ohm (Ω). In a three phase, resistance per phase is the resistance of the conductor.

14. What is the need for transpositions of line conductors in a transmission system?

When the three phase line conductors have unsymmetrical spacing the flux linkages and inductances of each phase are not the same which creates unequal voltage drops in three phases even if the current in the conductor are same. To avoid the above action transposition is required.

15. What is transposition of conductors?

The transposition is defined as interchanging of position of the line conductors at regular intervals along the line so that each conductor occupies the original position of every other conductor over at equal distance. Such an exchange of positions is known as transposition.

UNIT-III

MODELLING AND PERFORMANCE OF TRANSMISSION LINES

1. Define regulation of a transmission line.

The difference in voltage at the receiving end of a transmission line from no load to full load is called voltage regulation and is expressed as a percentage of the receiving end voltage.

$$\% \text{ voltage regulation} = (V_S - V_R) / V_R * 100$$

Where, V_S - sending end voltage

V_R - receiving end voltage

2. What are the units for the ABCD constants?

The limits of ABCD constants are:

A and D are dimension less.

B is expressed in ohm and C is expressed in mho.

3. Define ferranti effect.

This phenomenon of rise in voltage at the receiving end of the open circuited or lightly loaded line is called ferranti effect.

$$V_R > V_S$$

Where, V_R - receiving end voltage

V_S - sending end voltage

4. What is attenuation in a transmission line?

Attenuation is the power loss in transmission line. It is also called as transmission loss. The difference between the sending end power and receiving end power.

5. Give the classification of transmission lines in terms of distances.

The classification of transmission lines in terms of distances is given by,

- i. Short transmission lines <20kV upto 50km
- ii. Medium transmission lines >20kV<100kV>50 upto 150km
- iii. Long transmission lines >100kV>150km

7. Mention the methods used to control the voltage of transmission lines.

The methods used to control the voltage of transmission lines are:

- i. By using over compound generator

- ii. By excitation control
- iii. By use of tap changing transformers
- iv. Autotransformer tap changing
- v. Booster transformer
- vi. Induction regulator and by improvement of power factor

8. What is surge impedance loading?

Surge impedance loading of a power transmission line is the power delivered by a line to a pure resistive load equal to its surge impedance.

9. What is transmission efficiency?

The ratio of receiving end power to the sending end power of a transmission line is known as the transmission efficiency of the line.

$$\text{Transmission efficiency} = \frac{\text{Receiving end power}}{\text{Sending end power}}$$

10. List any six voltage regulating equipments used in transmission system.

The six voltage regulating equipments used in transmission system are:

- i. Synchronous motors.
- ii. Tap changing transformer
- iii. Series shunt capacitance
- iv. Booster transformer
- v. Compound generators
- vi. Induction regulator

11. What is a power circle diagram?

A power circle diagram is a diagram drawn for the transmission line network involving the generalized circuit constants, the sending end voltage V_S and the receiving end voltage V_R .

12. State the need for compensation in a transmission line.

The need for compensation in a transmission line are:

- i. Improvement in system power factor which is an important aspect in achieving better
- ii. economy in power distribution.
- iii. Reduction in supply side reactive burden.
- iv. To improve the power transfer capability
- v. Reduction in investment per kW of a load supplied.

13. Give formula for surge impedance.

The formula for surge impedance is given by

$$\text{Surge impedance, } Z_C = \sqrt{L/C}$$

Where, Z_C – Surge impedance

L - Inductance

C – Capacitance.

14. Define corona.

Corona is defined as a self sustained electric discharge in which the field intensified ionization is localized only over a portion of the distance between the electrodes.

Indications of corona are:

- i. Hissing noise
- ii. Ozone gas
- iii. Bluish white glow

15. How is corona loss related with the diameter of the conductor?

Corona loss related with the diameter of the conductor by the following Way,
Corona loss $\propto r/d$

Where, d - Diameter of the conductor.

Hence lower the diameter of the conductor, higher is the loss.

16. What is local corona?

The corona does not start simultaneously on the whole surface, but it takes place at different points of the conductor which are pointed is known as local corona.

UNIT- 4 INSULATORS AND CABLES

1. What is the purpose of insulator?

The insulator provides necessary clearances against the highest voltage in worst atmospheric conditions to which the line is likely to be subjected. The insulators also prevent short circuiting between the different phases of the conductor and provide necessary mechanical support for the line conductors.

2. What are the important properties that an overhead line insulator?

The important properties that an overhead line insulator must possess are:

- i. High mechanical strength
- ii. High relative permittivity
- iii. High insulation resistance

3. What is factor of safety?

The ratio of puncture strength to flash over voltage is termed as factor of safety.

$$\text{Factor of safety} = \frac{\text{Puncture strength}}{\text{Flash over voltage}}$$

4. Mention the main causes for failure of insulators.

The main causes for failure of insulators are:

- i. Cracking of insulators
- ii. Porosity of material
- iii. Improper verification
- iv. Flash-over
- v. Mechanical stress

- vi. Short circuits
- vii. Deposition of dust

5. What is an Insulator?

Insulator is the element which provides necessary insulation between line conductor and support. It prevents any leakage current from conductor to earth.

6. List the characteristics of insulators.

The characteristics of insulators used for overhead transmission are:

- i, They should have high mechanical strength in order to withstand the load due to weight of conductors
- ii, They should have high relative permittivity in order to provide high dielectric strength.

7. Enumerate the different types of insulators used for overhead transmission lines?

The different types of insulators used for overhead transmission lines are:

- i. Pin type insulators
- ii. Suspension type insulator
- iii. Strain insulators
- iv. Shackle insulators

8. What is a strain insulator and where is it used?

When there is a dead end or a corner or a sharper curve, the transmission lines is subjected to a greater tension. The insulators which are used to release the excessive tension of such transmission lines is called as strain insulators.

For high voltage transmission lines the strain insulators consisting of an assembly of suspension type insulators are used.

9. What is a shackle insulator?

When the low voltage transmission line meets a dead end or a corner or a sharper curve it is subjected to a greater tension. The insulators which are used to relieve the low voltage line of excessive tension are called shackle insulators.

10. Define string efficiency.

String efficiency is defined as the voltage across the whole string to the product of number of discs and the voltage across the unit nearest to the conductor.

$$\text{String efficiency} = \frac{\text{Voltage across the whole string}}{\text{Number of discs} * \text{voltage across the unit nearest to the conductor}}$$

11. List the various methods for improving string efficiency.

The various methods for improving string efficiency are:

- i. Longer cross - arms method
- ii. Capacitance grading method
- iii. Static shielding method or guard ring method

12. What is guard ring?

A guard ring is a metal ring electrically connected to the conductor and surrounding the bottom insulator. It is used to equalize the potential distribution across each unit in a string.

13. How will you classify testing of insulators?

Testing of insulators can be classified into three types. They are,

- i. Design tests
- ii. Sample tests and
- iii. Routine tests

14. Distinguish between design and routine tests.

The difference between design and routine tests is that the design test is performed to ascertain the electrical and mechanical performance of a particular type of insulators. Whereas the routine test is performed to weed out the defective insulators.

15. Mention the advantages of suspension type insulators over pin type insulators.

The advantages of suspension type insulators over pin type insulators are:

- i. They are cheaper than pin type insulators beyond 11kV
- ii. In the event of failure of an insulator one unit can be replaced instead of whole string.
- iii. Each unit of suspension type insulators is designed for low voltage usually 11kV. Depending upon the working voltage, the desired number of units can be connected in series.

16. What is a cable?

One or more conductors covered with insulating materials and surrounded by a protective cover is called a cable.

17. Mention the advantages of underground cables over overhead lines.

The advantages of underground cables over overhead lines are

- i. They reduce accidents caused by the breaking of the conductors
- ii. They provide better general appearance
- iii. They have small voltage drop across them.

18. What types of insulating materials are used in cables?

Some of the insulating materials used in the manufacture of cables are

- i. Rubber
- ii. Polyethylene
- iii. Polyvinyl chloride
- iv. Enamel
- v. Gutta-percha
- vi. Vulcanized Indian rubber
- vii. Varnished cambric etc.

UNIT- 5

SUBSTATION, GROUNDING SYSTEM AND DISTRIBUTION SYSTEM

1. What is substation?

Substation is the assembly of apparatus used to change some characteristics of electric supply.

2. Give the conditions of laying out a substation.

The conditions for laying out a substation are:

It should be located at a proper site.

It should provide safe and reliable arrangement.

It should be easily operated and maintained.

It should involve minimum capital cost.

3. Mention the classification of substation according to service.

According to service, substations are classified as,

Transformer substations

Switching substations

Power factor correction substations

Frequency changer substations

Converting substations

Industrial substations

4. List the classification of transformer substations.

Transformer substations are classified as,

Step-up substation

Primary grid substation

Secondary substation

Distribution substation

5. Define busbar.

Busbar is defined as a conductor to which a number of circuits are connected.

6. Give the materials mainly used in busbar?

The materials that are mainly used in busbar are:

Copper

Aluminium

7. What are the factors to be considered for busbar design?

The factors to be considered for busbar design are:

Material

Cross section of conductors

Temperature rise

Distance between phase conductors

Enclosure design

8. Which tests are necessary on station busbars?

The tests conducted on station busbars are:

- Temperature rise test
- Rated short time current test
- Rated momentary current test
- High voltage test

9. What is neutral grounding (or) neutral earthing?

The neutral point of star connected three phase winding of power transformers, generators, motors, earthing transformers are connected to low resistance ground. Such a connection is called neutral grounding (or) neutral earthing.

10. State the advantages of neutral grounding.

The advantages of neutral grounding are:

- Arcing grounds are reduced or eliminated
- The life of insulation is long
- Reduced maintenance, repairs and breakdowns
- Stable neutral point
- Improved service reliability
- Greater safety

11. Define earth resistance.

Earth resistance is defined as the resistance of the earthing electrode to the real earth and is expressed in ohms.

$$\text{Earth resistance } E_R = V/I$$

Where,

V – Voltage between the electrode and the voltage spike

I – Injected current

12. What are the devices that are used for transferring D.C. power at the substation by using converting machinery?

The devices that are used for transferring D.C. power at the substation by using converting machinery are:

- Mercury arc rectifier
- Rotary converters and
- Motor generator set

13. What is an interconnector?

The interconnector or inter connected network is a common development of simple ring system to reduce the power loss and voltage drop.

14. What is an interconnected system?

Interconnected system is a system in which the feeder ring is energized by two or more than two generating stations or substations.

15. Write the methods of earthing.

The methods of earthing are:

pipe earthing
Plate earthing

16. Classify the connection schemes.

Classification of connection schemes are:

Radial system
Ring main system
Interconnected system

17. List the disadvantages of D.C. three wire distribution system.

Disadvantages of D.C. three wire distribution system are:

- i. Three wires are required
- ii. A balancer is required and as such the cost is increased
- iii. The safety is partially reduced

18. Write the advantages of radial system.

The advantages of radial system are

- i. The initial cost is low
- ii. Useful when the generation is at low voltage.
- iii. Preferred when the station is located at the centre of the load.