

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
EE 6402- TRANSMISSION AND DISTRIBUTION
II YEAR EEE**

UNIT -1 STRUCTURE OF POWER SYSTEM

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

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- 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 midpoint earthed.
- iii. D.C. three wire.

Single phase A.C. system

- i. Single phase two wire
- ii. Single phase two wire with midpoint 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 under^ground system.

S.No	Over head system	Underground system
1	Construction cost is less.	Construction cost is high.
2	To occupy the more spaces in metropolitan area.	To enhance the city beauty
3	It is operated above 66KV.	It is limits upto 66KV.
4	Fault can be easily detected and rectified.	Fault cannot be easily detected.

5	Maintenance cost is high.	Maintenance cost is very less.
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11. List the components of a power system.

The components of a power system are:

- Generating station
- Step up transformer
- Step down transformer
- Transmission line
- Switching station
- Primary distribution line
- Secondary distribution line
- Feeder
- Distributor and
- Consumer

12. How distribution systems are classified?

Distribution systems are classified by,

- Nature of current
- Type of construction
- Scheme of connection
- 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.

15. 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.

16. What is meant by Electrical power system?

The flow of electrical power from the generating station to the consumer is called as an electrical power system

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-II

TRANSMISSION LINE PARAMETERS

1. What are the line parameters in transmission line?

- (i) Resistance
- (ii) Inductance
- (iii) Capacitance

2. What are the factors to be considered while designing the transmission line?

- (i) Type and size of a conductors
- (ii) Line regulation and control of voltage
- (iii) Efficiency of transmission
- (iv) Corona loss
- (v) Power flow capability

3. What are the types of aluminium conductor?

- (i) AAC- All Aluminium Conductor
- (ii) AAAC - All Aluminium Alloy Conductor
- (iii) ACSR - Aluminium Conductor with Steel Reinforcement
- (iv) ACAR - Aluminium Conductor with Alloy Reinforcement

4. What are the advantages of ACSR conductor?

- (i) They have low corona loss
- (ii) Skin effect is to reduced extent
- (iii) Due to high mechanical strength the line span can be increased. This is minimize cost of erection and maintenance.

5. Define inductance?

The flux linkage per ampere is called the inductance.

$$L = \Psi / I$$

6. What is mean by skin effect?

When a conductor is carrying steady direct current this current is uniformly distributed over the whole cross section of the conductor. An alternating current flowing through does not distribute uniformly rather it has the tendency to concentrate near the surface of the conductor. This is known as skin effect.

7. What are the advantages of aluminium conductor?

- (i) They have low cost
- (ii) Less resistance and corona loss
- (iii) Less weight

8. What are the steps for reducing telephone interference?

- (i) The harmonics at the source can be reduced with the use of AC harmonic filters, DC harmonic filters and smoothening reactors.
- (ii) Use greater spacing between power and telephone lines.
- (iii) The parallel run between telephone line and power line is avoided.
- (iv) If the telephone circuit is ground return then replace it with metallic return.

9. What are factors influencing the telephone interference?

- (i) Because of harmonics in power circuit their frequency range and magnitudes.
- (ii) Electromagnetic coupling between power and telephone conductor.
- (iii) Due to unbalance in power circuits and in telephone circuits.
- (iv) Type of return telephone circuit i.e. either metallic or ground return.
- (v) Screening effect.

10. What is mean by telephone interference?

The distortion effect and potential rise effect are disturbance which is produced in the telephone communication because of power lines is called telephone interference.

11. Write down the comparison between single circuit and double circuit.

Sl.No	Single circuit	Double circuit
1.	This type of arrangement is less dangerous during repair work.	This type of arrangement is comparatively dangerous.
2.	From continuity of supply point of view, the circuit is less reliable	With reference to continuity of supply, the circuit is much reliable
3.	It requires lesser foundation and less weight of steel tower member	It requires more foundation as the structure is of heavier. The height of tower is more
4.	The spacing of conductors required is greater	The spacing of conductors required is lesser.

12. Write down the depending factors of electrostatic effects.

The electrostatic effect mainly depends on what is the distance between power and communication circuits and length of the route over which they are parallel.

13. What is mean by proximity effect?

The current distribution may be non uniform because of another effect known as proximity effect. Consider two wire line as shown in fig, let each of the conductor is assumed to be divided into three sections having equal cross sectional area. Three parallel loops are formed by the pairs xx' , yy' and zz' . The flux linking loop xx' is least and it increases for the remaining loops. Thus the inductance of inner loop is less. Thus the current density is highest at inner edges of conductor.

14. Write down the depending factors for skin effect.

- (i) Nature of the material

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- (ii) Diameter of the wire
 - (iii) Frequency of supply
 - (iv) Shape of wire

15. What are the advantages of bundled conductor?

- (i) low radio interference and corona loss
- (ii) reduced voltage gradient at conductor surface
- (iii) increase in capacitance
- (iv) low reactance due to increase in self GMD
- (v) increase in surge impedance loading

16. What is mean by standard conductor?

The standard conductor usually has a central wire which is surrounded by the layers of wires. These layers consists of 6, 12, 18,wires successively. Thus the total strands are 7, 13, 19,.... This type of conductor is called stranded conductor.

17. What is mean by bundled conductor?

The conductors of any one bundle are in parallel and charge per bundle is assumed to divide equally between the conductors of bundle. The composite or stranded conductors touch each other while the bundled conductors are away from each other. This type of conductor is called bundled conductor.

18. What is mean by resistance?

It is defined as the opposition offered by the transmission line conductors to the flow of current.

19. What is mean by symmetrical spacing?

Consider three conductors A, B and C. if the three conductors are placed symmetrically at the corners of an equilateral triangle of sides. Then it is called symmetrical spacing.

20. What is mean by unsymmetrical spacing?

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

21. 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. Write down the classification of overhead transmission line

- Short transmission line
- Medium transmission line
- Long transmission line

2.What is mean by Short transmission line?

If the transmission line length is about 50 km and the line voltage is low i.e. is 20kv or less than that the line is treated as short transmission line.

3. What is mean by medium transmission line?

When the transmission line length is about 50 to 150 km and the line voltage is 20kv to 100kv than that the line is treated as short transmission line.

4. What is mean by long transmission line?

When the transmission line length is about 150 km and the line voltage is Above 100kv than that the line is treated as short transmission line.

5. What are the types of medium transmission line?

- End condenser method
- Nominal T method
- Nominal π method

6. Define voltage regulation.

The difference in voltage at the receiving end of the transmission line at the no load and full load is termed as voltage regulation expressed in terms of percentage of receiving end voltage

$$\% \text{ voltage regulation} = (V_{\text{no load}} - V_{\text{full load}} / V_{\text{full load}}) \times 100$$

7. Define transmission efficiency.

The ratio of power obtained at the receiving end to the power at sending end is called transmission efficiency of the line.

8. What is mean by Surge impedance?

In the power system network the characteristic impedance is sometimes referred as surge impedance. It is defined as square root of Z/Y .

Where,

Z = series impedance of line

Y = Shunt admittance of line.

9. What is mean by Surge impedance loading?

The surge impedance loading of a line is the power delivered by a line to a purely resistive load equal to its surge impedance. The line is assumed to have no resistance.

10. What is mean by Ferranti effect?

At no load condition in transmission line the voltage at receiving end is more than that sending end because of the effect of the line capacitance. This is called Ferranti effect.

11. Write down the line compensation using in transmission line.

- Series compensation
- Shunt compensation

12. What are the advantages of series compensation?

- Increase in power transmission capacity of line
- Improvements in system stability
- Improved voltage regulation
- Load division between parallel circuits
- Damping effect

12. What are the disadvantages of series compensation?

- Reduce the reactance of line and increase the fault current level
- It gives high torsional stresses
- It will increase the hunting
- The series capacitor may cause faulty operation of distance relays of the line protection if the degree of compensation and location of capacitor is not proper.

13. Write down the various factors on which transmission line capability.

- Thermal limits of conductor
- Transient and steady state stability
- Transmission line capability depends on over voltage at the capacitor terminals of series compensated line.

14. Write down the effect of shunt compensation.

- It reduces the line current losses owing to generation of reactive power.
- It reduces the transmission line current to a value less than the current in the load
- It improves the power factor of the transmitted power
- It reduces the voltage drop uniformly along the length of the line

15. Write down the advantages of shunt compensation.

- The kW of alternators, transformers and lines are increased.

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- The line current is reduced
 - The losses in power transformer and cables are reduced which saves the energy
 - It prevents overloading of transformers and switchgears
 - Improved voltage is obtained at the receiving end

16. Write down the disadvantages of shunt compensation.

The only disadvantage with shunt capacitor is that the response to voltage dips is not as rapid as with series capacitor since the switching of the bank is initiated by change in voltage.

17. Write down the comparison between series and shunt capacitors.

- The rise in voltage due to a shunt capacitor is uniformly distributed along the length of the transmission whereas in case of series capacitors the rise in voltage is sudden where the capacitor is installed.
- For the same rise in voltage the reactive power capacity of a shunt capacitor is greater than that of a series capacitor
- The power factor is improved because of a shunt capacitor while the power factor is little effected by series capacitor
- The series capacitors are found to be more effective for improving the system stability

18. What is mean by corona effect?

It can be noticed that near the overhead lines there exists a hissing noise and sometimes a faint violet glow. The effect due to which such phenomenon exists surrounding the overhead lines is called corona effect.

19. What is mean by corona power loss?

The ions produced in the air due to corona are moving. The energy required to keep them moving is derived from the supply system. This additional power required which is dissipated in the form of heat, sound and light in case of corona, is called corona loss.

20. What are the factors affecting corona and corona loss?

- Electrical factors
- Line voltages

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- Size of the conductor
 - Surface conditions
 - Spacing between conductors

21. What are the advantages of corona?

- Due to corona the air surrounding the conductor is ionized and becomes conducting. This increasing the virtual diameter of the corona
- Corona reduces the effect produced by the surges and conductor is saved from possibilities of lightning

22. What are the advantages of corona loss?

- The corona power loss is the biggest disadvantage which reduce the transmission efficiency
- The third harmonic components produced due to corona makes the current nonsinusoidal. This increases the corona loss
- The ozone gas formed due to corona chemically reacts with the conductor and can cause corrosion

23. Write down the methods to reducing corona effect

- Increasing the conductor size
- Increasing the conductor spacing
- Using hollow and bundled conductors

24. Define radio interference.

The corona discharge produces the radiations which may introduce noise signals in the communication lines, carrier signal, radio and television receivers, navigation signals etc.. such noise signals which adversely affect the wireless signals, produced by corona is called radio interference.

25. 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= r/d

Where,

d - Diameter of the conductor.

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

26. 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 IV

INSULATORS AND CABLES

1. What are the properties of insulators?

- (i) High mechanical strength.
- (ii) High electrical resistance
- (iii) High relative permittivity
- (iv) High ratio of puncture strength
- (v) The insulator material should be non porous

2. What are the types of insulators?

- (i) Pin type insulators
- (ii) Suspension insulators
- (iii) Strain insulators
- (iv) Shackle insulators
- (v) Stay insulators

3. What are the advantages of suspension type insulator?

- (i) Suspension type insulators are cheaper than pin type insulators
- (ii) Each unit or disc of suspension type insulator is designed for low voltage
- (iii) If any one disc is damaged the whole string does not affected
- (iv) Greater flexibility the line

4. Define string efficiency?

The ratio of voltage across the whole string to the product of number of discs and the voltage across the disc nearest to the conductor is known as string efficiency.

5. What are the methods of improving string efficiency?

- (i) By using longer cross arms
- (ii) By grading the insulators
- (iii) By using a guard ring

6. What is mean by insulators?

The insulators provide necessary insulation between line conductors and supports and thus prevent any leakage current from conductors to earth.

7. What are the materials using in insulators?

- (i) Porcelain
- (ii) Glass
- (iii) Synthetic resin

8. What is mean by annealing?

The glass also can be used instead of porcelain. The glass is made tough by heat treatment which is called annealing.

9. What are the advantages of glass insulators

- (i) As transparent cracks bubbles and defects in the insulator can be easily detected by inspection
- (ii) The dielectric strength is very high
- (iii) Cheaper than the porcelain

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- (iv) The resistivity is very high

10. What are the disadvantages of glass insulators?

- (i) Chances of moisture condensation on the surface are higher so leakage current is high
- (ii) Less stronger than the porcelain
- (iii) High tension system
- (iv) Cannot be moulded in irregular shape.

11. What are the advantages of synthetic resin?

- (i) High tensile strength
- (ii) The weight is low
- (iii) Cost is low

12. What is mean by self or mutual capacitance?

The porcelain portion which is an insulator is in between the two metal fittings. Thus it forms a capacitor. This is called self or mutual capacitance.

13. What is mean by shunt capacitance?

In transmission line towers in addition to the self capacitance there will be capacitance between each metal fittings and the earth. i.e. tower the air act as a insulating medium such a capacitance is called shunt capacitance.

14. What are the advantages of suspension insulators?

- (i) The voltage distribution is not uniform
- (ii) The charging currents through various mutual capacitors are varied
- (iii) Voltage across bottom insulator is high
- (iv) Electrical stress is high

15. What is mean by guard ring?

The transmission line tower a large metal ring surrounding the line unit and connected to the metal part of the bottom of the line unit is used. Such a ring is called guard ring.

16. What are the requirements of the cables?

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- (i) The size of the conductor used must be such that it should carry the specified load without overheating and keeping the voltage drop well within the permissible limits
 - (ii) At the voltage level for which cables are designed the insulation thickness must be proper so as to provide high degree of safety and the reliability
 - (iii) The materials used in the manufacturing of the cables must be such that there is complete chemical and physical stability throughout.

17. Write down the various parts of cables.

- (i) Core
- (ii) Insulation
- (iii) Metallic sheath
- (iv) Bedding
- (v) Armouring
- (vi) Serving

18. What are the types of cables?

- (i) Low tension cable
- (ii) High tension cable
 - (i) belted cable
 - (ii) super tension cable
 - (iii) extra tension cable

19. What are the advantages of separate lead sheath cables?

- (i) Due to individual lead sheath core to core fault possibility gets minimized
- (ii) The electrical stress are radial in nature
- (iii) Bedding of cable is easy
- (iv) Increases the current carrying capacity

20. What are the types of super tension cable?

- (i) Oil filled cables
- (ii) Gas pressure cables

21. What are the advantages of oil filled cables?

- (i) Thickness of insulation is less
- (ii) The thermal resistance is less
- (iii) The possibility of voids is completely eliminated
- (iv) Reduced earth fault

22. What are the disadvantages of oil filled cables?

- (i) The initial cost is very high
- (ii) The long length is not possible
- (iii) The laying of cable is difficult
- (iv) Maintenance of cable is difficult

23. What are the advantages of gas pressure cables?

- (i) Maintenance cost is small
- (ii) The nitrogen in the steel tube helps in quenching any fire or flame
- (iii) No reservoirs or tanks required
- (iv) The power factor is improved

24. What is mean by grading of cables?

The process of obtaining uniform distribution of stress in the insulation of cables is called grading of cables.

25. What is mean by capacitance grading?

The grading done by using the layers of dielectrics having different permittivity between the core and the sheath is called capacitance grading

26. What are the types of suspension type insulator?

- (i) Cemented cap type
- (ii) Hewlett or inter linking type

27. What are the methods used to secure insulator to the bolt?

- (i) The porcelain insulator has cement threads which are lined with a soft material like lead. The pin is screwed into such cement screw

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- (ii) Solid lead screw is casted on the head of the pin and is screwed directly into the porcelain

28. What are the properties of insulating materials?

- (i) It should be flexible
- (ii) To avoid electrical breakdown
- (iii) It should be non-inflammable
- (iv) It should have high temperature
- (v) To prevent leakage current

29. What are the main insulating materials used?

- (i) Poly vinyl chloride (PVC)
- (ii) Paper
- (iii) Cross linked polythene
- (iv) Vulcanized India rubber

30. What are disadvantages of gas pressure cable?

The only disadvantage of this cable is very high initial cost

UNIT -5 MECHANICAL DESIGN OF LINES AND GROUNDING

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.

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- 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.

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

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.

14. 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

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- 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.





























