

Transmission and Distribution

Unit1

1. Why all transmission and distribution systems are 3 phase systems?

A 3 phase a.c circuit using the same size conductors as the single phase circuit can carry three times the power which can be carried by a 1 phase circuit and uses 3 conductors for the 2 phases and one conductor for the neutral. Thus a 3 phase circuit is more economical than a 1 phase circuit in terms of initial cost as well as the losses. Therefore all transmission and distribution systems are 3 phase systems.

2. Why the transmission systems are mostly overhead systems?

Because of the cost consideration, the transmission systems are mostly overhead systems.

3. Why all overhead lines use ACSR conductors?

ACSR conductors comprises of hard drawn aluminium wires stranded around a core of single or multiple strand galvanized steel wire. They provides the necessary conductivity while the steel provides the necessary mechanical strength. Has less corona loss. The breaking load is high and has less weight.

4. Why transmission lines are 3 phase 3 wire circuits while distribution lines are 3 phase 4 wire circuits?

A Balanced 3 phase circuit does not require the neutral conductor, as the instantaneous sum of the 3 line currents are zero. Therefore the transmission lines and feeders are 3 phase 3 wire circuits. The distributors are 3 phase 4 wire circuits because a neutral wire is necessary to supply the 1 phase loads of domestic and commercial consumers.

5. Why overhead line conductors are invariably stranded?

They are stranded to make them flexible during erection and while in service.

6. State the advantages of interconnected systems.

Any area fed from one generating station during overload hours can be fed from another power station and thus reserved capacity required is reduced, reliability of supply is increased and efficiency is increased.

7. What is a ring distributor?

A ring distributor is a distributor which is arranged to form a closed circuit and is fed at one or more than one point.

8. State any two advantages of ring main system.

Less voltage fluctuations at consumer's terminals. Less copper is required as each part of the ring carries less current than in radial system.

9. Mention the disadvantages of a 3 wire system

In 3 wire system a third wire is required .The safety is partially reduced .A balancer is required and therefore cost is increased.

10. What are the advantages of a 3 wire dc distribution system over a 2 wire dc distribution system?

If 3 wire system is used to transmit the same amount of power over the same distance with same efficiency with same consumer voltage we require 0.3125 times copper as required in 2 wire system.

11. Mention the differences between 3 wire and 3 phase 4 wire distribution system?

- i)3 phase 3 wire is employed for balanced loads, but 3 phase 4 wire is employed for unbalanced loads.
- ii)3 phase 3 wire is used for transmission but 3 phase 4 wire is used for distribution of power to consumers.

12. State kelvin's law.

The annual expenditure on the variable part of the transmission system should be equal to the annual cost of energy wasted in the conductor used in that system.

13. State any two limitations of kelvin's law.

It is difficult to estimate accurately the annual charge on the capital outlay. It does not give the exact economical size of the conductor.

14. Define resistance of the transmission line.

It is defined as the loop resistance per unit length of the line in a single phase system. In 3 phase system it is defined as the resistance per phase.

15. Mention the demerits of HVDC transmission.

- i. Electric power cannot be generated at high dc voltages.
- ii. The dc voltages cannot be stepped up for transmission of power at high voltages.
- iii. The dc switches and circuit breakers have their own limitations.

16. What are the advantages of high voltage ac transmission.

The power can be generated at high voltages. The maintenance of ac substation is easy and cheaper.

17. Mention the disadvantages of high voltage ac transmission.

An ac line requires more copper than a dc line. The construction of an ac line is more complicated than a dc transmission line. Due to skin effect in the ac system the effective resistance of the line is increased.

18 Mention the limitations of using very high transmission voltage.

The increased cost of insulating the conductor. The increased cost of transformers ,switch gears and other terminal apparatus.

19. Mention the terminal equipments necessary in HVDC system.

Converters, mercury arc valves and thyristors.

20. Why HVDC line do not require any reactive power compensation ?

Due to absence of charging currents .

21. Mention the equipments that supply reactive power in HVDC converter stations ?

AC filters Static shunt capacitors Synchronous condensers Static VAR compensators .

22. Why dc transmission is economical and preferable over ac transmission for large distances only ?

Because with larger distances ,the saving in cost of dc overhead lines become greater than the additional expenditure on terminal equipment .

23. Why is voltage regulation better in case of dc transmission ?

Because of absence of inductance in dc systems .

24. What are the advantages of adopting EHV/UHV for transmission of ac electric power?

Reduced line losses

High transmission efficiency

Improved voltage regulation

Reduced conductor material requirement

Flexibility for future system growth

increase in transmission capacity of the line

increase of SIL .

25. Mention the problems associated with an EHV transmission ?

The problems associated with EHV transmission are corona loss and radio interference , requirements of heavy supporting structures erection difficulties and insulation requirements .

26. What for series and shunt compensation provided in EHV lines ?

Series compensation is provided to reduce the series reactance of the line so as to improve stability, voltage regulation and transmission efficiency. Shunt compensation is provided to reduce the line susceptance so as to improve the voltage regulation under light load condition .

37. Define inductance of a line.

It is defined as the loop inductance per unit length of the line. Its unit is henrys per meter.

38. Define capacitance of a line.

It is defined as shunt capacitance between the two wires per unit line length. Its unit is farads per meter.

39. What is skin effect?

The steady current when flowing through the conductor, does not distribute uniformly, rather it has the tendency to concentrate near the surface of the conductor. This phenomenon is called skin effect.

40. Why skin effect is absent in dc system?

The steady current when flowing through a conductor distributes itself uniformly over the whole cross section of the conductor. That is why skin effect is absent in dc system.

41. What is the effect of skin effect on the resistance of the line?

Due to skin effect the effective area of cross section of the conductor through which current flow is reduced. Hence the resistance of the line is increased when ac current is flowing.

42. On what factors the skin effect depend?

Nature of the material, Diameter of the wire, Frequency and shape of the wire.

43. Define symmetrical spacing.

In 3 phase system when the line conductors are equidistant from each other then it is called symmetrical spacing.

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

To reduce the inductance per phase and to increase the efficiency.

45. Mention the factors governing the inductance of a line.

Radius of the conductor and the spacing between the conductors.

46. Define a neutral plane.

It is a plane where electric field intensity and potential is zero.

47. Define proximity effect.

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

48. What is the effect of proximity effect?

It results in the non uniform distribution of current in the cross section, and the increase of resistance.

49. What is a composite conductor?

A conductor which operates at high voltages and composed of 2 or more subconductors and run electrically in parallel are called composite conductors.

50. What is a bundle conductor?

It is a conductor made up of 2 or more sub conductors and is used as one phase conductors.

51. Mention the advantages of using bundled conductors.

Reduced reactance, reduced voltage gradient , reduced corona loss .reduced interference

52. What is meant by transposition of line conductors?

Transposition means changing the positions of the three phases on the line supports twice over the total length of the line .the line conductors in practice ,are so transposed that each of the three possible arrangements of conductors exist for one-third of the total length of the line .

54. What is skin effect?

The phenomenon of concentration of an ac current near the surface of the conductor is known as skin effect.

55. On what factors does the skin effect depends?

The skin effect depends upon the 1, type of the material 2, frequency of the current 3, diameter of conductor& shape of conductor. It increases with the increase of cross-section, permeability and supply frequency.

56. Define voltage regulation.

Voltage regulation is defined as the change in voltage at the receiving (or load) end when the full-load is thrown off, the sending-end (or supply) voltage and supply frequency remaining unchanged .

% voltage regulation= $((V_s - V_r)/V_r) * 100$
where V_s is the voltage at the sending end
 V_r is the receiving end voltage.

57. Define proximity effect.

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

58. Define transmission efficiency.

Efficiency defined as the ratio of power delivered at the receiving end to the power sent from the sending end .

59. Define Ferranti effect .

The phenomenon of rise in voltage at the receiving end of the open circuited or lightly

loaded line is called the Ferranti effect .

60.What are the units of ABCD (generalised) constants of a transmission line ?

A and D are dimensionless B is in ohms and C is in Siemens (mhos)

61.Mention the range of surge impedance in underground cables .

40-60 ohms

63.What is corona?

The phenomenon of violet glow, hissing noise and production of ozone gas in an overhead line is called corona.

64.Mention the factors affecting corona.

Atmosphere, conductor size, spacing between conductors and line voltage.

65.Define critical disruptive voltage.

It is defined as the minimum phase voltage at which corona occurs.

66.Define visual critical voltage.

It is the minimum phase voltage at which corona appears all along the line conductors .

67.State any two merits of corona.

Reduces the effects of transients produced by surges .System performance is improved.

68.Give the two demerits of corona.

The transmission efficiency is affected. Corrosion occurs.

69.Mention the methods of reducing corona effect.

By increasing the conductor size and conductor spacing.

70.Why ACSR conductors are used in lines?

If the size of the conductor is larger corona effects are reduced and reduces the proximity effect .Hence they are used in lines.

71.Define medium lines.

Lines having length between 60 and 150 km and line voltages between 20 and 100kv are called medium lines.

72.Define short lines.

Lines having lengths below 60km and voltages below 20kv are called short lines.

73.Explain the term voltage stability.

The ability of the system to maintain the voltage level within its acceptable limits is called as voltage stability.

74.Differentiate between voltage stability and rotor angle stability.

Voltage stability: -It means load stability. -It is mainly related to reactive power transfer.

-Here problems arise mainly in the event of faults.

Rotor angle stability: -It means basically generator stability. -It is mainly interlinked to real power transfer. -Here problems arise during and after faults.

76. Define a synchronous compensator (condenser)?

Synchronous compensator is a synchronous motor with no mechanical output. When it is under excited it operates at lagging p.f (ie it delivers vars). Thus it operates both as a shunt capacitor and as a shunt reactor.

77. Mention any two advantages of series compensation

improves system stability.

are generally self regulatory and requires little or no control equipment

78. State any two comparisons between series compensation and shunt compensation.

Series compensation is cheaper than SVS.

Losses are lower than in SVS.

79. Why series compensation is used in long series ?

to increase transmission capacity

to improve system stability.

to obtain correct load division between parallel circuits.

80. Mention any two advantages of SVS (Static Var System)

Provides fast control over temporary over voltages. Provides a better control of voltage profile.

81. Mention the components used in series compensation ?

Series capacitors Spark gap protection Metal oxide resistor (for protection) Current limiting reactor Bypass switch Control & protection equipment.

82. Mention the components used in static var compensator.

Saturated reactor Thyristor controlled reactor –fired capacitor (TCR –FC)

Thyristor switched capacitor – thyristor controlled reactor (TSC –TCR)

Harmonic filters.

83. Give any two reasons to minimize the reactive power transfer in lines.

leads to voltage stability.

results in greater real and reactive losses

84. List the four parameters by which the performance of transmission lines are governed.

Series resistance Series inductance Series capacitance Series conductance.

86. Why cables are not used for long distance transmission?

Cables are not used for long distance transmissions due to their large charging currents.

87. Mention the 3 main parts of the cable?

Conductor, dielectric, sheath

88. What is the function of conductor?

Conductor provides the conducting path for the current.

89. What is the purpose of insulation in a cable?

The insulation or dielectric withstands the service voltage and isolates the conductor with other objects.

90. What is the function of sheath in a cables?

The sheath does not allow the moisture to enter and protects the cable from all external influences like chemical or electrochemical attack fire etc.

91. Mention the conductor materials in cables?

Copper , Aluminium