EASWARI ENGINEERING COLLEGE(AUTONOMOUS)
DEPARTMENT OF EEE
EE8402 TRANSMISSION AND DISTRIBUTION
QUESTION BANK

UNIT I TRANSMISSION LINE PARAMETERS

PART-A (2 marks)

1. What is meant by power supply system?
2. What is meant by Transmission and Distribution system?
3. What are the different types of Power supply system?
4. What are the various components of power supply system?
5. What are the different types of power plants?
6. What are the different operating voltages used for generation, primary and secondary transmission in AC power supply systems in India?
7. Define feeder, distributor and service mains.
8. Define Skin effect. Is it applicable to DC current also?
9. What is meant by proximity effect?
10. Differentiate the stranded conductor and bundled conductor.
11. List out the advantages of double circuit lines.
12. Define - Self and mutual – G.M.D.
13. What is meant by inductive interference?
14. What is transposition of conductors?
15. What is ACSR conductor?
16. What is fictitious conductor radius?
17. Define unsymmetrical and symmetrical spacing.
18. Why skin effect is absent in dc system?
19. On what factors skin effect depends?
20. What is a bundle conductor? What are its advantages?
21. Define inductance of a line. Mention the factors governing inductance of a line.
22. What is the necessity of a double circuit line?
23. Write an expression for inductance of a single phase transmission system.
24. A three phase transmission line has its conductor at the corners of an equilateral triangle with side 3m. The diameter of each conductor is 1.63cm. Find the inductance per km per phase of the line.

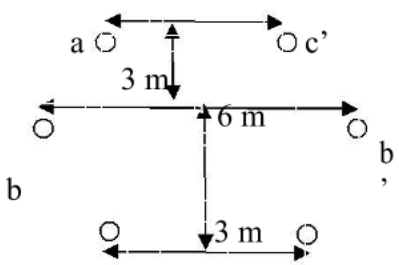
PART-B (16 marks)

1. (i) Draw and explain the structure of modern power systems with typical voltage levels.
   (ii) What is the highest voltage level available in India?

2. (i) Explain the effect of high voltage on volume of copper and on efficiency.
   (ii) Explain why the transmission lines are 3 phase 3-wire circuits while distribution lines are 3 phase 4-wire circuits.
3. From the fundamentals derive an expression for inductance of a single phase transmission system.
4. Derive an expression for capacitances of a single phase transmission system and discuss the effect of earth on capacitance with suitable equation.
5. Derive an expression for inductance
   (ii) Of a single-phase overhead line.
   (iii) A conductor is composed of seven identical copper strands each having a radius r. Find the self-GMD of the conductor.

6.i) Derive an expression for the capacitance between conductors of Single phase overhead line.
ii) Find the capacitance between the conductors of a single-phase 10 km long line. The diameter of each conductor is 1.213cm. The spacing between conductors is 1.25m. Also find the capacitance of each conductor neutral.

7. i) Derive the expression for inductance of a two wire 1Φ transmission line
   ii)Derive the expression for capacitance of a 1Φ transmission line
8. i) What are the advantages of bundled conductors?
   ii)Derive the expression for capacitance of a double circuit line for hexagonal spacing.
   Iii)Why the concept of self GMD is is not applicable for capacitance?
9. Explain clearly the skin effect and the proximity effects when referred to overhead lines.
10. Derive the expression for the capacitance per phase of the 3 Φ double circuit line flat vertical spacing with transposition.
11. A 3 Φ overhead transmission line has its conductors arranged at the corners of an equilateral triangle of 2m side. Calculate the capacitance of each line conductor per km. Given the diameter of each conductor is 1.25cm.
12. i) Find the capacitance per km per phase of a 3Φ line arrangement in a horizontal plane spaced 8 meters apart. The height of all conductors above the earth is 13 meters. The diameter of each conductor is 2.6 cm. the line is Completely transposed and takes the effect of ground into account. ii). Discuss the concept of GMR and GMD in the calculation of transmission line inductance.
13. Find the inductance /phase /km of double circuit 3phase line shown in fig. the line is completely Transposed and operates at $5a_m$frequency of 50Hz. Radius r = 6mm.



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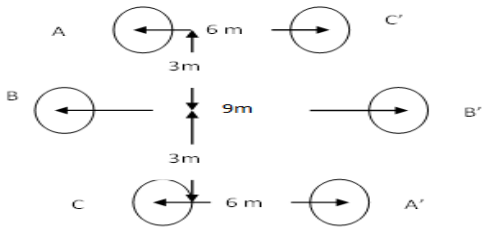
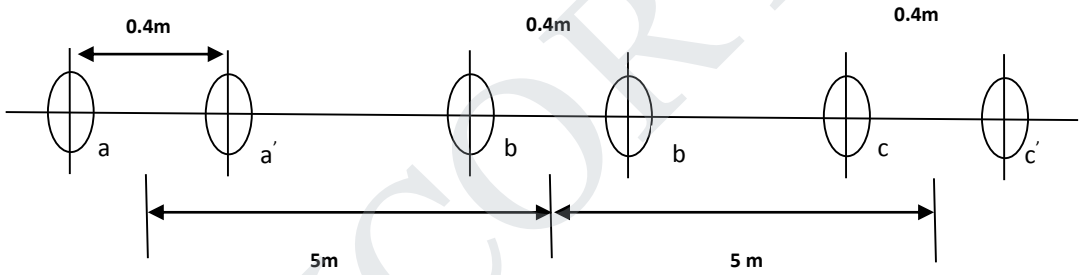
14. A three phase circuit line consists of 7/4.5 mm hard drawn copper conductors. The arrangement of the conductors is shown in figure. The line is completely transposed. Calculate inductive reactance per phase per km of the system.



15. (i) Derive an expression for capacitance of three phases unsymmetrically spaced but completely transposed conductors.
(ii) Determine the capacitance and charging current per unit length of the line when the arrangement of the conductor is shown in below figure. The line is completely transposed and diameter is 15mm and operating voltage is 220 kV.



UNIT II MODELLING AND PERFORMANCE OF TRANSMISSION LINES

PART- A (2 MARKS)

1. Classify overhead transmission lines.
2. Define transmission efficiency.
3. What is a transmission line?
4. List out the common methods of representation of medium transmission lines.
5. Define regulation of power transmission line.
6. What is tuned power line?
7. What is surge impedance loading or natural loading?
8. What are the voltages regulating equipments used in transmission systems?

9. What is attenuation in a power transmission line?
10. What are the units of generalized constants of a transmission line?
11. What is surge impedance loading? What is the range of surge impedance for an overhead transmission line?
12. What is a power circle diagram?
13. What is meant by the receiving end power circle diagram?
14. What is meant by corona discharge?
15. Differentiate between voltage stability and rotor angle stability.
16. What is the use of power circle diagram?
17. What are the causes of voltage drop and line loss in a transmission line?
18. What are the advantages of using series compensation?
19. What is stringing chart? What are the uses of stringing chart?
20. What are the factors which govern the performance of a transmission line?
21. What is the difference between nominal T and nominal Π configuration?
22. What is the range of surge impedance in a underground cable?
23. What is the importance of voltage control?
24. Why the control of reactive power is essential for maintaining a desired voltage profile?
25. What are composite conductors? What are the main disadvantages of corona?
26. What is local corona? What are the methods adopted to reduce corona?

PART-B (16 marks)

1. Determine the efficiency and regulation of a 3phase, 100Km, 50 Hz transmission line delivering 20 MW at a power factor of 0.8 lagging and 66 kV to a balanced load. The conductors are of copper, each having resistance 0.1 Ω / Km, 1.5 cm outside dia, spaced equilaterally 2 metres between centres. Use nominal T method.

2. A three phase 5 km long transmission line, having resistance of 0.5 Ω / km and inductance of 1.76mH/km is delivering power at 0.8 pf lagging. The receiving end voltage is 32kV. If the supply end voltage is 33 kV, 50 Hz, find line current, regulation and efficiency of the transmission line.

3. Derive the expressions for sending end voltage in nominal T method and end Condenser method.

4. What is an equivalent circuit of long line? Derive expression for parameters of this circuit in terms of line parameters.

5. i) Define regulation of a transmission line and derive the approximate expression for the regulation of a short transmission line.

ii) What is corona loss? How do you determine this loss?

6. A 220kV, 3Φ transmission line has impedance per phase of (40+j200) Ω and an admittance of (0+j0.0015) mho. Determine the sending end voltage and sending end current when the receiving end current is 200 A at 0.95 pf lagging. Use nominal method.

7. Determine the efficiency and regulation of a three phase 200 km, 50Hz transmission line delivering 100MW at a pf of 0.8 lagging and 33kV to a balanced load. The conductors are of

copper, each having resistance 0.1Ω/km, and 1.5cm outside dia, spaced equilaterally 2m between centres. Neglect leakage reactance and use nominal T and π methods.

8. Estimate the corona loss for a three-phase, 110KV, 50Hz and 150Km long transmission line consisting of three conductors each of 10mm diameter and spaced 2.5m apart in an equilateral triangle formation. The temperature of air is 30°C and the atmospheric pressure is 750mm of mercury. Assume the irregularity factor as 0.85. Ionization of air may be assumed to take place at a maximum voltage gradient of 30KV/cm.

9. A 50Hz transmission line 300 km long total series impedance of 40+j25 Ω and total shunt admittance of 10-3 mho. The 220Kv with 0.8 lagging power factor. Find the sending end voltage, current, power and power factor using nominal pi method.

10.i) Explain the classification of lines based on their length of transmission.

ii) What are ABCD constants?

11. A balanced three phase load of 30MW is supplied at 132KV, 50Hz and 0.85p.f. lagging by means of a transmission line. The series impedance of a single conductor is (20+j52) Ω and the total phase-neutral admittance is $315x10^{-6}$Siemen.Using nominal T method, Determine i) A, B, C and D constants of the line (ii) sending end voltage (iii) regulation of the line.

12.i) Explain the real and reactive power flow in transmission line.

ii) Explain the flowing with respect to corona (i) corona (ii) effects (iii) disruptive critical voltage (iv)visual critical voltage (v) corona power loss.

13. Perform the analysis of long transmission lines using RIGOROUS method.

14. Explain the method of drawing receiving end power circle diagrams.

15. A 50Hz, three phase transmission line is 250 Km long. It has a total series impedance of (40+j100) ohms and a shunt admittance of 914 x 10^{-6} ohms. It delivers 50MW at 220 KV with a power factor of 0.9 lag. Find the sending end voltage, Voltage Regulation, Transmission efficiency by nominal-T method.

16.A three phase, 50 Hz transmission line, 40 Km long delivers 36 MW at 0.8 power factor lagging at 60KV (phase). The line constants per conductor are, R = 2.5Ω, L = 0.1H, C = 0.25μF. Shunt leakage may be neglected. Determine the voltage, current, power factor, active power and reactive volt-amperes at the sending end. Also determine the efficiency and regulation of the line using nominal π method.

17. (i) Explain the classification of transmission lines with their characteristics

(ii) Define the following

a. Surge impedance.
b. Attenuation constant.
c. Voltage regulation.
d. Transmission efficiency.

18. A 3 phase overhead transmission line has a series impedance of (10+j30) Ω per phase. For receiving and sending end voltages of 132 kV and 140 kV respectively. Draw the receiving and power circle diagram and determine the following:

(i) The maximum real power delivered by the line and load power factor under that condition.

(ii)The capacity of shunt compensation equipment for supplying a load of 150MVA at 0.8 power factor lagging and the power angle under that condition.

(iii)The capacity of shunt compensation equipment to maintain the above voltage under no-load condition.

(iv)The unity power factor load that the line can supply with voltages at above values**.**

UNIT III MECHANICAL DESIGN OF LINES

PART- A (2 MARKS)

1. Define sag.
2. What is the reason for sag in transmission line?
3. Name the types of towers.
4. Mention the factors that affect sag in the transmission line.
5. What is meant by tower spotting?
6. What is the function of isolators?
7. What are the factors on which conductor spacing and ground clearance depend?
8. What is sag template?
9. What is the purpose of insulator?
10. What is the main purpose of armouring?
11. What is meant by efficiency of an insulator string?
12. List out various types of insulators used for overhead transmission lines.
13. Mention the advantages of the pin type insulator.
14. What are the main causes for failure of insulators?
15. What are the different tests that are conducted on an insulator?
16. What are the methods for improving string efficiency?
17. Write short notes on puncture test.
18. Define impulse ratio.
19. What is shackle insulator?
20. Why the insulators are used with overhead lines?
21. State the advantages of polythene insulators.

PART-B (16 marks)

1. An overhead line has a span of 336 m. The line is supported, at water crossing from two towers whose heights are 33.6 m and 29 m above water level. The weight of conductor is 8.33 N/m and tension in the conductor is not to exceed 3.34 × 104 N. Find (i) Clearance between the lowest point on the conductor and water (ii) horizontal distance of this point from the lower support.

2. a)Derive expressions for sag and tension in a power conductor strung between to supports at equal heights taking into account the wind and ice loading also**.**

b) An overhead line has a span of 300m. The conductor diameter is 1.953 cm and the conductor weight is 0.844 kg/m. calculate the vertical sag when a wind pressure is 736

N/sq.m of projected area acts on conductor. The breaking strength of conductor is 77990 N and the conductor should not exceed half the breaking strength**.**

3. A transmission line conductor at a river crossing is supported from two towers at a height of 50 and 80 m above water level. The horizontal distance between the towers is 300 m. if the tension in the conductor is 2000 kg find the clearance between the conductor and water at a point midway between the towers. Weight of conductor/m = 0.844 kg. Derive the formula used.

4. Derive the expressions for sag and conductor length under bad weather conditions. Assume Shape of overhead line is a parabola.

5. Deduce an approximate expression for sag in overhead lines when (i) supports are at equal levels. (ii) Supports are at unequal levels.

6. An overhead line has a span of 160m of stranded copper conductor between level supports. The sag is 3.96m at -5.5°C with 9.53mm thick in ice coating and wind pressure of 40Kgf/m^2 of projected area. Calculate the temperature at which the sag will remain the same under conditions of no ice and no wind. The particulars of the conductor are as follows: Size of the conductor=7/3.45mm, Area of cross section= 64.5 mm^2, weight of conductor =0.594 Kgf/m, Modulus of elasticity = 12700 Kgf/mm^2, Coefficient of linear expansion = 1.7x10^{-5} /°C, Assume 1m^3 of ice to weight of 913.5 Kgf.

7. Discuss any two methods to increase the value of string efficiency, with suitable sketches.

8. i) What are different methods to improve string efficiency of an insulator?

ii) In a 3-unit insulator, the joint to tower capacitance is 20% of the capacitance of each unit. By how much should the capacitance of the lowest unit be increased to get a string efficiency of 90%. The remaining two units are left unchanged.

9. i) Draw the schematic diagram of a pin type insulator and explain its function.

ii) A 3 phase overhead transmission line is being supported by three disc insulators. The potential across top unit (i.e. near the tower) and the middle unit are 8kV and 11kV respectively. Calculate, a) The ratio of capacitance between pin and earth to the self capacitance of each unit b) Line Voltage c) String Efficiency.

10. i)What are the various properties of insulators? Also briefly explain about suspension type insulators.

ii)A string of 4 insulator units has a self capacitance equal to 4 times the pin to earth capacitance. Calculate, a)Voltage distribution as a % of total voltage b) String efficiency

11. i) Give any six properties of a good insulator.

ii)With a neat diagram, explain the strain and stay insulators.

12. (i) Why are insulators used with overhead lines? Discuss the desirable properties of insulators.

(ii) An insulator string for 66KV lines has 4 discs. The shunt capacitance between each joint and metal work is 10% of the capacitance of each disc. Find the voltage across the different disc and string efficiency.

13. What are the properties of insulators? Also briefly explain about pin and suspension type insulators. Draw the schematic diagram.

14. Each line of 3 phase system is suspended by a string of three identical insulators of self –capacitance C Farad. The shunt capacitance of connecting metal work of each insulator

is 0.2 C to earth and 0.1 C to line. Calculate the string efficiency of the system if guard ring increases the capacitance to the line if metal work of the lowest insulators to 0.3 C.

15. In a 3-unit insulator, the joint to tower capacitance is 20% of the capacitance of each unit. By how much should the capacitance of the lowest unit be increased to get a string efficiency of 90%? The remaining two units are left unchanged.

UNIT IV UNDER GROUND CABILITYS

PART-A (2 MARKS)

1. What is the function of sheath in cables?
2. State the properties of insulating materials.
3. Mention the commonly used power cables.
4. Mention 3 parts of cable.
5. Mention the advantages of pvc over paper insulated cables.
6. In what way AI sheaths are superior to lead sheaths?
7. Why protective covering is done in cables?
8. What is meant by serving of a cable?
9. Where CSA sheath is used in cables? Why is it used?
10. Why armoring is done in the cables? And why it is not done in single core cable.
11. What is the purpose of insulation in a cable?
12. Give the relation for the insulation resistance of a cable
13. What is meant by dielectric stress in a cable?
14. How does the grading improve the string efficiency?
15. What are the factors to be considered while selecting a cable for a particular service?

PART-B (16 marks)

1. Explain any two methods of grading of cables with necessary diagrams.
2. i) Derive the expression for insulator resistance, capacitance and electric stress in a single core cable. Where is the stress maximum and minimum?

   ii) A single core 66kv cable working on 3-phase system has a conductor diameter of 2cm and sheath of inside diameter 5.3cm. If two inner sheaths are introduced in such a way that the stress varies between the same maximum and minimum in the three layers find:

   a) position of inner sheaths
   b) voltage on the linear sheaths
   c) maximum and minimum stress

3. i) Describe with the neat sketch, the construction of a 3 core belted type cable**.**

   ii) A conductor of 1cm diameter passes centrally through porcelain cylinder of internal diameter 2 cms and external diameter 7cms. The cylinder is surrounded by a tightly fitting metal sheath. The permittivity of porcelain is 5 and the peak voltage gradient in air must not exceed 34kV/cm. Determine the maximum safe working

voltage.

4. i) Briefly explain about various types of cables used in underground system.

ii) Calculate the most economical diameter of a single core cable to be used on 132kV, 3 phase system. Find also the overall diameter of the insulation; if the peak permissible stress does not exceed 60kV/cm. also derive the formula used here.

5.i) Describe with the neat sketch, the construction of a underground cables.

ii) A cable is graded with three dielectrics of permittivities 4, 3 and 2. The maximum permissible potential gradient for all dielectrics is same and equal to 30 kV/cm. The core diameter is 1.5cm and sheath diameter is 5.5cm.

6. i) Explain the constructional features of one LT and HT cable

ii) Compare and contrast overhead lines and underground cables.

7. (i) Describe on experiment to determine capacitance of belted cable.

(ii) A 33KV single core cable has a conductor diameter of 1cm and a sheath of inside diameter 4 cm. Find the min and max stress in the insulator**.**

8**.**i) Explain the features of Dc cables.

ii) Explain in detail about the power factor and heating of cables.

UNIT V DISTRIBUTION SYSTEMS

PART-A (2 MARKS)

1. List the advantages of high voltage transmission.
2. State Kelvin's law.
3. What are the limitations of Kelvin's law?
4. Name various types of HVDC links.
5. Why all Transmission and Distribution systems are 3 phase systems?
6. Why all overhead lines use ACSR conductors?
7. Why transmission lines are 3 phase 3 wire circuits while distribution lines are 3 phase 4 wire circuits?
8. Write the difference between EHVAC and HVDC transmission systems.
9. State the advantages of ring main systems.
10. State the advantages of interconnected system.
11. What is a ring distributor?
12. What are the advantages and disadvantages of high voltage ac transmission?
13. Why dc transmission is economical and preferable over ac transmission for a long distance only?
14. Distinguish between a feeder and a distributor.
15. How does a.c. distribution differ from d.c. distribution?
16. What is AIS?
17. What is earth resistance?
18. State the various types of substation according to its service requirements.
19. What are the types of transformer substations? What are the equipments used in a transformer substation?

20. What are the factors to be considered for busbar design?
21. What is neutral grounding or neutral earthing?
22. What is GIS?
23. What are the different types of bus bar arrangements in substations?
24. What is bus bar?
25. What are the materials mainly used in busbars?
26. Define coefficient of earthing.
27. Mention two disadvantages of ungrounded neutral.
28. Name the various types of grounding.
29. How the capacitance effect is taken into account in a long line?
30. What is substation?
31. What are the major equipment of a substation?
32. Enumerate the various methods of neutral grounding.
33. Mention two significance of neutral grounding.
34. What is the need of an earthing system?

PART-B (16 MARKS)

1. Explain the following:
   (i) Neutral grounding
   (ii) Resistance grounding.
2. Write short notes on AIS and GIS.
3. Explain various methods of grounding.
4. i)Explain the design principles of substation grounding system
   ii) Grounding grids
   iii) Stepped and tapered mains
   iv) Sub mains
5. With the neat layout explain the design of modern substation with all protecting devices.
6. Explain the classification of substation based on service requirement and constructional feature and Write short notes on substation equipments.
7. Draw the circuit arrangement and explain the various elements of the following bus-bar arrangements. (i) Single bus scheme. (ii) Double bus bar with bypass insulator scheme.
8. What are the different types of bus bar arrangements used in substation? Illustrate your answer with suitable diagram.
9. Explain the following (i) Ring bus (ii) main and transfer bus (iii) double bus with single breaker (iv) double bus with bypass isolators.
10. (i) Discuss various types of HVDC links.
    (ii)List out the main components of a HVDC system.
11. (i) Draw the model power system with single line representation. Show its essential constituent sections.ii)What are the AC transmission and distribution level voltages we have in India? iii) What are the different kinds of DC links? Draw

relevant diagrams.

12. (i) Explain why EHV transmission is preferred? What are the problems involved in EHV AC transmission? (ii)With neat schematic, explain the principle of HVDC system operation.

13. Explain about FACTS with neat diagram .

14. Explain TCSC and SVS systems.

15. Explain with neat diagram about STATCOM and UPFC

16. (i) Compare EHVAC and HVDC transmission. (ii) Explain the applications of HVDC transmission system.

17. (i) Write short notes on distributed and concentrated loads?

(ii)What are distributors? Explain its types in detail

18. Give the advantages, disadvantages and applications of HVDC and HVAC transmission**.**

19. (i) Define FACTS and list and explain its objectives. (ii) Explain the basic types of FACTS controllers.

20. (i) Advantages of EHVAC and HVDC transmission.

(ii) Discuss in detail the problems associated with EHVAC transmission. Also state how these problems are being solved?

21. (i) Describe the basic structure of an AC power system with a single line diagram.

(ii) A transmission line has a span of 275 meters between level supports. The conductor has an effective diameter of 1.96 cm and weighs 0.865 kg/m. its ultimate strength is 8060 kg. If the conductor has ice coating of radial thickness 1.27cm and is subjected to a wind pressure of 39 kg/m2 of projected area. Calculate the maximum sag. Assume that the safety factor is 2 and ice weighs 910kg/m^3.

22.Explain the following system of distribution i) radial system ii) ring main system iii) interconnected system iv) design consideration in distribution system.

23. An electric train taking a constant current of 600A moves on a section of line between two substations 8 km and maintained at 575 and 590 volts respectively. The track resistance is 0.04Ωper Km both go and return. Find the point of minimum potential along the track and currents supplied by two substations at the instant**.**

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