EE6402 TRANSMISSION AND DISTRIBUTION
QUESTION BANK

UNIT I STRUCTURE OF POWER SYSTEM

Structure of electric power system: generation, transmission and distribution; Types of AC and DC distributors – distributed and concentrated loads – interconnection – EHVAC and HVDC transmission - Introduction to FACTS.

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. List the advantages of high voltage transmission.
9. State Kelvin's law.
10. What are the limitations of Kelvin's law?
11. Name various types of HVDC links.
12. Why all Transmission and Distribution systems are 3 phase systems?
13. Why all overhead lines use ACSR conductors?
14. Why transmission lines are 3 phase 3 wire circuits while distribution lines are 3 phase 4 wire circuits?
15. Write the difference between EHVAC and HVDC transmission systems.
16. State the advantages of ring main systems.
17. State the advantages of interconnected system.
18. What is a ring distributor?
19. What are the advantages and disadvantages of high voltage ac transmission?
20. Why dc transmission is economical and preferable over ac transmission for long distance only?

PART-B (16 marks)

1. (i) Discuss various types of HVDC links. **(8)**
(ii) List out the main components of a HVDC system. **(8)**
2. (i) Draw and explain the structure of modern power systems with typical voltage levels **(13)**
(ii) What is the highest voltage level available in India? **(3)**
3. (i) Explain the effect of high voltage on volume of copper and on efficiency. **(8)**
(ii) Explain why the transmission lines are 3 phase 3-wire circuits while distribution lines are 3 phase 4-wire circuits. **(8)**
4. (i) Draw the model power system with single line representation. Show its essential constituent sections. **(6)**
(ii) What are the AC transmission and distribution level voltages we have in India? **(4)**
(iii) What are the different kinds of DC links? Draw relevant diagrams. **(6)**
5. (i) Explain why EHV transmission is preferred? What are the problems involved in EHV AC transmission? **(8)**
(ii) With neat schematic, explain the principle of HVDC system operation. **(8)**
6. Explain about FACTS with neat diagram **(16)**
7. Explain TCSC and SVS systems **(16)**
8. Explain with neat diagram about STATCOM and UPFC **(16)**
9. (i) Compare EHVAC and HVDC transmission **(8)**
(ii) Explain the applications of HVDC transmission system **(8)**

10.(i)Write short notes on distributed and concentrated loads?**(8)**
(ii)What are distributors?explain its types in detail**(8)**

UNIT II TRANSMISSION LINE PARAMETERS

Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - application of self and mutual GMD; skin and proximity effects - interference with neighboring communication circuits - Typical configurations, conductor types and electrical parameters of EHV lines, corona discharges

PART-A (2 marks)

1. Define Skin effect.
2. What is meant by proximity effect?
3. Differentiate the stranded conductor and bundled conductor.
4. List out the advantages of double circuit lines.
5. Define - Self and mutual – G.M.D.
6. What is meant by inductive interference?
7. What is transposition of conductors?
8. What is ACSR conductor?
9. What is fictitious conductor radius?
10. Define unsymmetrical and symmetrical spacing.
11. What is meant by corona discharge?
12. Why skin effect is absent in dc system?
13. On what factors skin effect depends?
14. What is a bundle conductor?What are its advantages?
15. What are composite conductors? What are the main disadvantages of corona?
16. What is local corona? What are the methods adopted to reduce corona?
17. Define inductance of a line. Mention the factors governing inductance of a line.
18. What is the necessity of a double circuit line?
19. Write an expression for inductance of a single phase transmission system.
20. Define corona and critical disruptive voltage.

PART-B (16 marks)

1. (i)From the fundamentals derive an expression for inductance of a single phase transmission system. **(8)**

(ii) Write short notes on corona discharges**(8)**

2. Derive an expression for capacitances of a single phase transmission system and discuss the effect of earth on capacitance with suitable equation. **(16)**

3. Derive an expression for inductance

i) Of a single-phase overhead line. **(8)**

ii) A conductor is composed of seven identical copper strands each having a radius r. Find the self-GMD of the conductor**. (8)**

4. i) Derive an expression for the capacitance between conductors of a

Single phase overhead line. **(8)**

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. **(8)**

5. i) Derive the expression for inductance of a two wire 1Φ transmission line **(8)**

ii) Derive the expression for capacitance of a 1Φ transmission line **(8)**

6. i) What are the advantages of bundled conductors? **(4)**

ii) Derive the expression for capacitance of a double circuit line for hexagonal spacing. **(8)**

iii) Why is the concept of self GMD is not applicable for capacitance? **(4)**

7. i) Explain clearly the skin effect and the proximity effects when referred to overhead lines. **(8)**

ii) Write a short note on the inductive interference between power and communication lines. **(8)**

8. i) Derive the expression for the capacitance per phase of the 3 Φ double circuit line flat vertical spacing with transposition. **(8)**

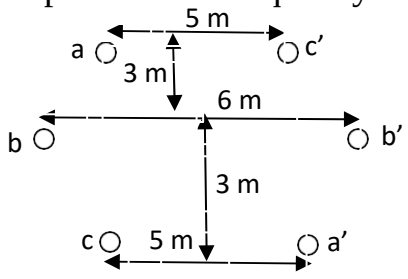
ii) A 3 Φ overhead transmission line has its conductors arranged at the corners of an equilateral triangle of 2m side. Calculate the capacitance of each line conductor per km. Given the diameter of each conductor is 1.25cm. **(8)**

9. i)Find the capacitance per km per phase of a 3Φ line arrangement in a horizontal plane spaced 8 metres apart. The height of all conductors above the earth is 13 metres. The diameter of each conductor is 2.6 cm. the line is completely transposed and takes the effect of ground into account. **(8)**

ii). Discuss the concept of GMR and GMD in the calculation of transmission line inductance. **(8)**

10. Find the inductance /phase /km of doublecircuit 3phase line shown in fig. the line is completely

Transposed and operates at a frequency of 50Hz. Radius r = 6mm **(16)**



UNIT III MODELLING AND PERFORMANCE OF TRANSMISSION LINES

Classification of lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance; transmission efficiency and voltage regulation, real and reactive power flow in lines, Power - circle diagrams, surge impedance loading, methods of voltage control; Ferranti effect.

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 Ferranti effect? What is the cause of Ferranti effect?
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?

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. **(16)**

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, regulationand efficiency of the transmission line. **(16)**

3. Derive the expressions for sending end voltage in nominal T method and end Condenser method. **(16)**

4. What is an equivalent circuit of long line? Derive expression for parameters of this circuit in terms of line parameters. (**16)**

5. i) Define regulation of a transmission line and derive the approximate expression for the regulation of a short transmission line. **(8)**

ii) What is corona loss? How do you determine this loss? **(8)**

6. A 220kV, 3Φ transmission line has an 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. **(16)**

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 0.1 Ω/km, and 1.5cm outside dia, spaced equilaterally 2m between centres. Neglect leakage reactance and use nominal T and π methods. **(16)**

8. i) Explain the Ferranti effect with a phasor diagram and its causes. **(16)**

9. A 50Hz transmission line 300 km long total series impedance of 40+j25 Ω and total shunt admittance of 10-3 mho. The 220 Kv with 0.8 lagging power factor. Find the sending end voltage, current, power and power factor using nominal pi method.(**16)**

10.i) Explain the classification of lines based on their length of transmission**. (6)**
ii) What are ABCD constants. (**10)**

UNIT IV INSULATORS AND CABLES

Insulators - Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators. Underground cables - Types of cables, Capacitance of Single-core cable, Grading of cables, Power factor and heating of cables, Capacitance of 3- core belted cable, D.C cables

PART-A (2 MARKS)

1. What is the purpose of insulator?
2. What is the main purpose of armouring?
3. What is meant by efficiency of an insulator string?
4. List out various types of insulators used for overhead transmission lines.
5. Mention the advantages of the pin type insulator.
6. What are the main causes for failure of insulators?
7. What are the different tests that are conducted on an insulator?
8 What are the methods for improving string efficiency?
9. Write short notes on puncture test.
10. Define impulse ratio.
11.Mention 3 parts of cable.
12.What is the function of sheath in a cables.
13.State the properties of insulating materials.
14.Mention the commonly used power cables.
15. Mention the advantages of pvc over paper insuated cables.
16.In what way AI sheaths are superior to lead sheaths?
17.Why protective covering is done in cables?
18. What is meant by serving of a cable?
19. Where CSA sheath is used in cables?Why is it used?

20. State the advantages of polythene insulators.

PART-B (16 marks)

1. Discuss any two methods to increase the value of string efficiency, with suitable sketches. **(16)**

2. Explain any two methods of grading of cables with necessary diagrams. **(16)**

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

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. **(8)**

4. i) Derive the expression for insulator resistance, capacitance and electric stress in a single core cable.Where is the stress maximum and minimum?**(8)**

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 **(8)**

5. i) Draw the schematic diagram of a pin type insulator and explain its function. **(8)**

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 **(4)**

b) Line Voltage **(2)**

c) String Efficiency **(2)**

6. i) Describe with the neat sketch, the construction of a 3 core belted type cable**. (8)**

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. **(8)**

7. i) What are the various properties of insulators? Also briefly explain about suspension type insulators. **(8)**

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. **(8)**

8. i) Briefly explain about various types of cables used in underground system.**(8)**

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 **(8)**

9. i) Give any six properties of a good insulator. **(4)**

ii) With a neat diagram, explain the strain and stay insulators. **(4)**

iii) 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. **(8)**

10. i) Explain the constructional features of one LT and HT cable **(8)**

ii) Compare and contrast overhead lines and underground cables. **(8)**

UNIT V MECHANICAL DESIGN OF LINES AND GROUNDING

Mechanical design of transmission line – sag and tension calculations for different weather conditions, Tower spotting, Types of towers, Substation Layout (AIS, GIS), Methods of grounding.

PART-A (2 MARKS)

1. What is AIS?
2. What is earth resistance?
3. What are the classifications of substation according to service?
4. What are the types of transformer substations? What are the equipments used in a transformer substation?

5. What are the factors to be considered for busbar design?
6. What is neutral grounding or neutral earthing?
7. What is GIS?
8. What are the different types of bus bar arrangements in substations?
9. What is bus bar?
10. What are the materials mainly used in busbars?
11.Define sag.
12. What is the reason for sag in transmission line?
13.Name the types of towers.
14.Mention the factors that affect sag in the transmission line.
15.Define coefficient of earthing.
16.Mention two disadvantages of ungrounded neutral.
17.Name the various types of grounding.
18.How the capacitance effect is taken into account in a long line?
19.What is substation?
20.What is meant by tower spotting?

PART-B

1. Explain the following:
   (i) Neutral grounding
   (ii) Resistance grounding. **(16)**
2.Write short notes on AIS. **(16)**
3.Write short notes on GIS. **(16)**
4.Explain various methods of grounding. **(16)**
5. An overhead line has a span of 336 m. The line is supported ,at a 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. **(16)**

6. 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**.(8)**
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**.(8)**

7. 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. **(16)**

8. Derive the expressions for sag and conductor length under bad weather conditions. Assume Shape of overhead line is a parabola. **(16)**

9. Write short notes on

i. Explain the design principles of substation grounding system **(8)**

ii. Grounding grids **(8)**

10. With the neat layout explain the design of modern substation with all protecting devices. **(16)**