EHVAC & HVDC Transmission System

Unit wise Question Bank

UNIT – I : Power Handeling capacity of EHVAC Transmission Line

1. Prove that the percentage power loss in EHVAC transmission line is independent of its length and it depends on the ratio of conductor resistance to the positive sequence reactance per unit length. 6 w18, 6 s18, 6 w17, 6 s16, 6 w16
2. Explain and derive **cosine law** of variation of surface voltage gradient of bundled conductors. 6 w18, 6 s18,7 w17,7 s17, 6 w16
3. Derive the equations for maximum voltage gradient on the centre and outer phases of 3 conductors in case of EHVAC transmission system. 7 w17
4. Derive an expression for Maxwell's potential coefficient of a 1ϕ line considering the effect of ground. 6 s17
5. Derive the expression for electric field of a line charge of Two-conductor AC line considering the effect of ground. 6 s16
6. A power of 2000mw is to be transmitted from Chandrapur thermal power station to Western part of Maharashtra over a distance of 800km. Use 400kV and 750kV transmission system for it. Calculate number of circuits with 40% series capacitor compensation and also calculate the total power loss. Assume δ=30º and values of 'x' and 'r' as given below: 8 w18

System (kv)	400	750
x Ω/km:	0.327	0.272
r Ω/km	0.031	0.0136

7. A power of 12000 mw is required to be transmitted over a distance of 1000 km at a voltage level of 400 kV and 750 kV determine.

   i) Possible number of circuit required with equal magnitude for sending and receiving end voltages with 30º phase difference.

   ii) Current Transmitted

   iii) Total line loss 8 s18

System (kv)	400	750
Line reactance Ω/km:	0.327	0.272
Line resistance Ω/km	0.031	0.0136

8. Calculate the maximum voltage gradient on the center of outer phases of 3 conductors in case of EHVAC Transmission system of 735 kV line. The line parameter are N = 4, r=0.0176 m, B = 0.4572 m for Bundled conductor of each phase. The line height and phase spacing in Horizontal Configuration are H = 15m & S = 15m use mangoldt formulae. 8 w18, 8 s18, 8 w16, 6 s17
9. A power of 2000 MW is to be transmitted from Chandrapur thermal power station to western part of Maharashtra over a distance of 800 km. Use 400 kV and 750 kV transmission system for it. Calculate number of circuits with 40% series capacitor compensation and also calculate the total power loss per km. Assume δ=30º and values of 'x' and 'r' are as given below: 8 w17

System (kv)	400	750
x Ω/km:	0.327	0.272
r Ω/km	0.031	0.0136

10. A power of 1200 mw is required to be transmitted over a distance of 1000 km at vtg levels of 400 kv and 750 kV. Determine :

    i) Possible No. of ckts required with equal magnitude for sending & receiving end vtg

    with 30° phase difference

    ii) The current to be transmitted

    iii) Total line losses. 7 s17

    The values of r & x are.

System (kv)	400	750
x Ω/km:	0.327	0.272
r Ω/km	0.031	0.0136

11. A power of 3000 mw is to be transmitted from super thermal power station over a distance of 800 km. use 400 kv and 750 kv alternatives. Suggest number of circuits required with 40% series capacitor compensation and calculate the total power loss and loss per Km. Assume δ=30º and values of 'x' and 'r' are specified below. 8 w16

System (kv)	400	750
x Ω/km:	0.327	0.272
r Ω/km	0.031	0.0136

12. A power of 2150 MW is to be transmitted over a distance of 920km on a voltage level of 400kv and 750 kv. line reactance and resistance are as follow.

System (kv)	400	750
Line reactance Ω/km:	0.327	0.272
Line resistance Ω/km	0.031	0.0136

Assume δ = 30ºand series compensation of 50%. Suggest

i) No of ckt ii) Total power loss iii) Power loss per km. 7 s16

13. A single circuit transmission line is placed above ground to study the High voltage effect. The conductors are ASCR with diameter 0.0635m and separated by a distance of 6m. The line height is 21m above ground.

i) Find Maxwell's potential coefficient.

ii) Find Charge coefficient of voltage are ± 400kv.

iii) Check weather corona take place on the surface. 7 s16

UNIT-II ELECTROSTATIC& ELECTROMAGNETIC FIELD OF EHV LINES

14. Describe the difference between primary shock current & secondary shock current. What is the meaning of let go current? 7 W18, 7 S17

15. What is the effect of high electrostatic field on human beings, animal and plants. 6 W18, 6 S18, 7W18, 4 S17

16. Explain the calculation of electrostatic field of single ckt 3-phase line. 5 S17, 7W16

17. Explain charge-voltage diagram with corona.6 W18, 6W17, 5 W16

18. What is critical disruptive voltage? Discuss the factors affecting corona power loss. 6 S18, 7W17

19. What is charge vtg. diagram ? Derive the expression for $P_c = \frac{1}{2} kC(V_m^2 - V_0^2)$for corona a energy loss from a charge vtg diagram. 5 S17

20. What is the procedure for measurement of Electrostatic field also write a note on Radio- Interference due to corona. 7 S18, 6W17, 7W16

21. Find the critical disruptive voltage and critical voltage for local and general corona on a 66kV, 3 phase overhead line consisting of three stranded copper of an equilateral triangle. Air temperature and pressure are 21^0C & 73.6cm of Hg respectively. The conductor diameter is 10.4mm. 7W18

22. Find critical disruptive voltage and critical voltages for local and general corona on 3-phase overhead Transmission line, consisting of three stranded copper conductors spaced 2.5m apart at the corner of a equilateral triangle. Air temperature and pressure are 21^0C and 73.6mm of Hg respectively The conductor diameter irregularity factor and surface factor are 10.4mm, 0.85, 0.7 and 0.8 respectively. 7 S18

23. Find the corona inception voltage for 3Phase, 110V, overhead transmission line consisting of 3 stranded copper conductors spaced 2.5 m apart at the corner of an equilateral triangle air temp. & press are 21°C & 73.6 cm of Hg resp. The conductor diameter is 10.4 mm (Assume $\varepsilon_0 = 8.854 \times 10^{-12}$)

i) Find the effective diameter of the conductor at an overvoltage of 2.5 p.u.

ii) Compare the capacitance in both cases. 8 S17

UNIT -III COMPARISION OF EHVAC AND HVDC SYSTEM

24. Compare EHVAC and HVDC transmission on the following aspects.

i) Bulk Power Transmission 2 S18

ii) Power flow control 2 S18

iii) Skin effect 2 S18

iv) Insulation level 2 S18

v) Technical Performance 3W17

vi) Economical Consideration 3W17

25. State the different kinds of HVDC link along with their advantages and disadvantages and application. 7 S18

26. Explain the function and types of MTDC system. 6 S18

27. What is Earth electrode state the factors to be considered for selection of site for Earth Electrode. 6 S18

28. Describe various configuration of earth electrodes used in HVDC schemes. 6 W18

29. Write short notes on:

i) Parallel MTDC system

ii) Kinds of DC links 7W18

30. Discuss the advantages of higher pulse number HVDC converter. Draw the arrangements for twelve pulse bridge converter.7W18

31. What are the objectives of operating DC link in parallel with AC. Explain how these objectives are achieved. 6 W18

UNIT -IV POWER FLOW CONTROL IN HVDC SYSTEM AND HARMONIC FILTER

32. Explain in detail the working of 3 phase bridge converter circuit. (Graetz Bridge) for HVDC transmission. 7 W18,W17

33. Compare the protection philosophy of EHVAC and HVDC transmission system. 7W18

34. Derive expression for reactive power requirement of HVDC converter. How these requirements are met. 6 S18

35. In the context of converter explain : 8 W17

i) Commutation margin

ii) Ignition angle

iii) Overlap angle

iv) Current margin

36. In context of HVDC converter explain – 8 W17

i) Current margin (ΔI_d)

ii) Min. Extinction angle (δ_0)

37. Explain the effect of delay angle α & extinction angle on reactive power. 6 s17

38. A bridge connected rectifier operates with $\alpha = 30^0$& $y = 15^0$. Determine necessary line secondary voltage of the rectifier transformer which is rated at 220/110 kv, if it is required to obtain a dc output voltage of 100 kv. Also determine the tap-ratio required.

39. A dc link has a loop resistance of 5Ω and is connected to transformer giving a secondary voltage of 110V at each end. The bridge connected converter operates as follows: Rectifier $\alpha = 15^0$, x = 10Ω, $\delta_0 = 10^0$ $y = 15^0$, x = 10 Ω. Allow 5% margin on δ_0 and δ . Determine direct current delivered if inverter operates at constant β control. 7W18

40. A bridge connected converter rectifier is fed from 220 kV/110 kV Transformer with primary connected to 220 kV. Determine the dc output voltage when the commutation angle is 15^0 and delay angle are : a) 0^0 b) 30^0 c) 45^0 7S18

41. Explain combined CEA and CC control used in converter. 6S18

42. Draw and explain complete characteristics of converter. 6S18

43. A DC link has a loop resistance of 10Ω and is connected to transformer giving secondary voltage of 120 kV at each end. The bridge connected converter operates as follows.

Rectifier $\alpha = 15^0$, x = 15Ω,

Inverter $\delta_0 = 10^0$ $y = 15^0$, x = 15 Ω.

Allow 5% margin on δ_0 and δ . Determine direct current delivered if inverter operates at constant β control. 7W18, s17

44. It is required to obtain a direct voltage of 100 kV from a bridge connected rectifier operating with $\alpha = 30^0$ and $y = 15^0$. Calculate the necessary line secondary voltage of the rectifier transformer which is normally rated at 345 kV/150kV. Calculate the tap-ratio required. If the rectifier delivers a current of 500 A. Determine the effective reactance per phase. 7W17

32. Draw single line schematic diagram of AC harmonic filter in a typical HVDC substation. 6W18

33. Explain the configuration of DC harmonic filters in detail. 6W18, 6 W17

34. State the order of harmonics of filter branches & explain. 7W18

35. What are the objectives of operating DC link in Parallel with AC line. Explain how its objectives are achieved. 6 W17

36. Explain in short:

i) Single frequency tuned filter.

ii) Double frequency tuned filter. 6 W18, W17

37. Give single line schematic diagram of AC harmonic filter in a typical HVDC substation. State the order of Harmonics of filter branches. 7 S18

38. Draw single line diagram of DC harmonic filter in a typical HVDC substation state the order of harmonics of filter branches. 6 S18

39. A rectifier side of HVDC substation has a no load ideal DC voltage of 276.75kv The DC current is 1.5kA. The actual DC voltage is 250kv. Calculate the reactive power absorbed by rectifier side. Also the inverter side of same HVDC system is at actual DC voltage of 246.25kv The No load ideal DC voltage is 275.53kv Calculate the Reactive Power absorbed by inverter side. 7 S18

UNIT-V HVDC CIRCUIT BREAKERS

40. Describe the function of MRTB and its applications. 7W18, 6 W17

41. Design function of MRTB and its switching sequence. 7S18,

42. On what factor is the reactive power requirement of a converter station depend. 6 s17

43. Derive the expression for the reactive power requirement of HVDC substations. 7 W17

44. Describe the term switching energy how is the commutation principle is used for HVDC ckt. Breaker. 6 s17

45. Compare the protection philosophy of EHVAC and HVDC transmission. 7 W17

46. Explain HVDC substation protection schemes. 7W18

47. Write short notes on:

i) Insulation coordination of HVDC system with its margin. 5W18, 6s18

ii) Fault clearing in HVDC system. 5W18, 6s18

iii) Surge Protection of HVDC substation. 4W18

iv) Sketch the real power versus reactive power characteristics. 3 W17

v) Over voltage protection of HVDC substation. 3 W17

48. How commutation Principle is used in HVDC circuit Breaker. Explain. 7S18

49. What are the various types of HVDC circuit breaker? Describe the commutation principle in HVDC breaker. 6W18