POWER SYSTEMS 1

CHAPTERWISE QUESTION BANK

Chapter 1- Electrical Power generation

Refer NOTES :-

1] Explain Basic Structure of AC Power system in Detail by SLD.

2] Draw & Explain Hydroelectric Power plant in Detail. State its Advantages & Disadvantages.

3] Draw & Explain Thermal Power plant in Detail. State its Advantages & Disadvantages.

4] Draw & Explain Nuclear Power plant in Detail. State its Advantages & Disadvantages.

5] Explain Different Types of Nuclear Power Plant in detail

6] Explain Different Types of Hydro Power Plant in detail

7] Draw Single line diagram of Power System[Layout of Power System]

8] Explain Excitation System a] DC Excitation b] Ac Excitation c] Static Excitation

9] Explain Site Selection Criteria for Hydro, Coal & Nuclear Power Plant

Chapter 2- Electrical Design of Overhead Lines

Refer:- V K Mehta Ch 9 Page 202:- Electrical Design of Overhead Lines

1. **List Major Electrical Equipments in substations**
2. **Derive Equation of Inductance of Single Phase Two Wire Line. *[Page No 207]***
3. **Derive Equation for Inductance of a Three Phase Overhead Line for A] General Equation B] Symmetrical Spacing C] Unsymmetrical Spacing *[Page No 209]***
4. **Derive Equations for Self & Mutual GMD . Also List out formulae for Inductance in terms of GMD *[Page No 212]***
5. **define Capacitance. Derive Equation for Capacitance of a Single Phase Two-wire Line *[Page No 222]***
6. **Derive Equation for Capacitance of a Three Phase Overhead Line for**

   A] Symmetrical Spacing B] Unsymmetrical Spacing *[Page No 223]*

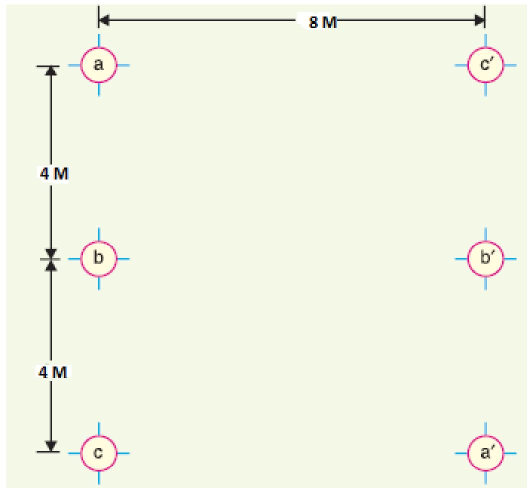
7. **Explain Following Effects:-**
   A]Skin Effect B]Ferranti Effect C]Proximity Effect *[Page No 204]*

8. **What is mean by Corona? Explain following terms**
   A] Visual Critical Voltage B] Critical Disruptive voltage c] Power Loss due to corona *[Page No 182]*

9. **Explain Factors affecting corona *[Page No 182]***

SAMPLE EXAMPLES:- INDUCTANCE

Example Fig ***shows the spacings of a double circuit 3-phase overhead line. The phase sequence is ABC and the line is completely transposed. The conductor radius in 1·8 cm. Find the inductance per phase per kilometre***

1. 

Example The three conductors of a 3-phase line are arranged at the corners of a triangle of sides 4, 5 and 6 metres. Calculate inductance per km of the each conductor when conductors are regularly transposed. The diameter of each line conductor is 1.5 cm

Example The three conductors of a 3-phase line are arranged at the corners of a triangle of all sides of 5 m. Calculate inductance per km of the each conductor when conductors are regularly transposed. The diameter of each line conductor is 1.5 cm

SAMPLE EXAMPLES:- CAPACITANCE

6. **Example The three conductors *A*, *B* and *C* of a 3-φ line are arranged in a horizontal plane with *DAB* = 2 m and *DBC* = 2·5 m. Find line-to-neutral capacitance per km if diameter of each conductor is 1·24 cm. The conductors are transposed at regular intervals.**
7. **A 3-phase, 50 Hz, 132 kV overhead line has conductors placed in a horizontal plane 4·56 m apart. Conductor diameter is 22·4 mm. If the line length is 100 km, Calculate the charging current per phase, assuming complete transposition.**
8. **A single phase transmission line has two parallel conductors 1·5 metres apart, the diameter of each conductor being 0·5 cm. Calculate line to neutral capacitance for a line 80 km long.**

<u>Chapter 3:- Mechanical Design of Overhead Lines</u>

Refer VK Mehta Ch 8:-page no 159

1. **Explain Types of Conductors Material specification *[Page No 160]***
2. **Explain Types of Electrical Conductors *[Page No]***
3. **Explain Different types of Insulators used for power transmission and distribution *[Page No 165]***
4. **Derive equation for Potential distribution over string of insulator *[Page No 168]***
5. **What is String Efficiency? Explain methods to Improve string Efficiency. *[Page No 169]***
6. **What is mean by sag? Derive expression for sag in case of Equal Supports [Page no 187]**
7. **What is mean by sag? Derive expression for sag in case of Un-Equal Supports [Page no 188]**
8. **What is Effect of wind & Ice loading on conductor sag? Write Equations for same. [Page no 189]**

SAMPLE EXAMPLES:- String Efficicency

Example 8.2 *A 3-phase transmission line is being supported by three disc insulators. The potentials across top unit (i.e., near to the tower) and middle unit are 8 kV and 11 kV respectively. Calculate (i) the ratio of capacitance between pin and earth to the self-capacitance of each unit (ii)the line voltage and (iii) string efficiency.*

Example *Each line of a 3-phase system is suspended by a string of 3 similar insulators. If the voltage across the line unit is 17·5 kV, calculate the line to neutral voltage. Assume that the shunt capacitance betwen each insulator and earth is 1/8th of the capacitance of the insulator itself. Also find the string efficiency.*

Example *A string of 4 insulators has a self-capacitance equal to 10 times the pin to earth capacitance. Find (i) the voltage distribution across various units expressed as a percentage of total voltage across the string and (ii) string efficiency.*

SAMPLE EXAMPLES:- Sag Calculations

Examples:-

1]A 3-phase, 220 kV, 50 Hz transmission line consists of 1·5 cm radius conductor spaced 2 metres apart in equilateral triangular formation. If the temperature is 40ºC and atmospheric pressure is 76 cm, calculate the corona loss per km of the line. Take mo = 0·85.

2] transmission line has a span of 150 m between level supports. The conductor has a cross-sectional area of 2 cm2. The tension in the conductor is 2000 kg. If the specific gravity of the conductor material is 9·9 gm/cm3 and wind pressure is 1·5 kg/m length, calculate the sag. What is the vertical sag?

3] A transmission line has a span of 275 m 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 1·27 cm and is subjected to a wind pressure of 3·9 gm/ cm2 of projected area, calculate sag for a safety factor of 2. Weight of 1 c.c. of ice is 0·91 gm.

Chapter 4:- Performance of Transmission Lines:-

Refer VK Mehta Ch 10:-page no 228

1. **What are the types of Transmission lines? Explain each in details *[Page No 229]***
2. **Define % voltage Regulation, Efficiency, Power & Line current of transmission line. *[Page No 229]***
3. **Derive Equation for regulation & transmission efficiency for short transmission line. *[Page No 230]***
4. **Derive Equation for regulation & transmission efficiency for medium transmission line for End Condenser Method *[Page No 240]***
5. **Derive Equation for regulation & transmission efficiency for medium transmission line for Nominal T Method *[Page no 243]***
6. **Derive Equation for regulation & transmission efficiency for medium transmission line for Nominal Pi Method*[Page no 246]***
7. **Determine ABCD Constants for Short Transmission Line *[Page no 256]***
8. **Determine ABCD Constants for Medium Transmission Line for Nominal T Method *[Page no 256]***
9. **Determine ABCD Constants for Medium Transmission Line for Nominal Pi Method *[Page no 257]***

SAMPLE EXAMPLES:-

Examples:-

1. A 3-phase , 50 Hz, overhead transmission line 200km long has the following constants:

Resistance/km/phase = 0.1 ohm
Inductive reactance /km/phase= 0.2 ohm
capacitive suseptance/km/ph= 0.04*10^-4 siemen
Determine
i) The sending end current
ii) Sending end voltage
Transmission efficiency when a balanced load of 12,000 kW at 66 kv , pf is 0.8 lagging. **USE NOMINAL T METHOD**

[refer vk mehta, page 244, values are changed]

2. single phase overhead transmission line delivers 1100 kW at 33 kV at 0·8 p.f. lagging. The total resistance and inductive reactance of the line are 10 Ω and 15 Ω respectively.
Determine : (i) sending end voltage (ii) sending end power factor and (iii) transmission efficiency

<u>Chapter 5 :- AC & DC Distribution</u>

<u>Refer VK Mehta .</u>

1. **Explain the following systems of distribution :** ***[Page No 306]***

(i) Radial system

(ii) Ring main system

(iii)Interconnected System

2. Derive Equation for Voltage in DC Distributor Fed at **one End**— **Concentrated Loading** ***[Page No 313]***
3. Derive Equation for voltage in DC Distributor Fed at **Both Ends** — **Concentrated Loading** for equal & Unequal Voltages ***[Page No 319]***

4. **Derive equation of Voltages for AC distribution line for following case**

1] Power factors referred to receiving end voltage.

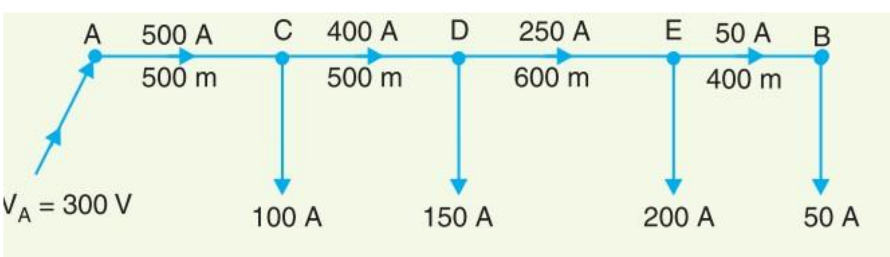
[Page No 357]

2] Power factors referred to respective load voltages.

[Page No 358]

<u>SAMPLE EXAMPLES:- DC DISTRIBUTION</u>

1] Example 13.1. A 2-wire d.c. distributor cable AB is 2 km long and supplies loads of 100A, 150A,200A and 50A situated 500 m, 1000 m, 1600 m and 2000 m from the feeding point A. Each conductor has a resistance of 0·01 Ω per 1000 m. Calculate the p.d. at each load point if a p.d. of 300 V is maintained at point A. [VK mehta Page no 313]



2]

Example 13.11. *A 2-wire d.c. distributor AB is fed from both ends. At feeding point A, the voltage is maintained as at 230 V and at B 235 V. The total length of the distributor is 200 metres and loads are tapped off as under :*

25 A at 50 metres from A ; 50 A at 75 metres from A

30 A at 100 metres from A ; 40 A at 150 metres from A

The resistance per kilometre of one conductor is 0·3 Ω. Calculate :

(*i*) *currents in various sections of the distributor*

(*ii*) *minimum voltage and the point at which it occurs*

Solution. Fig. 13.19 shows the distributor with its tapped currents. Let I_A amperes be the current supplied from the feeding point A. Then currents in the various sections of the distributor are as shown in Fig 13.19.

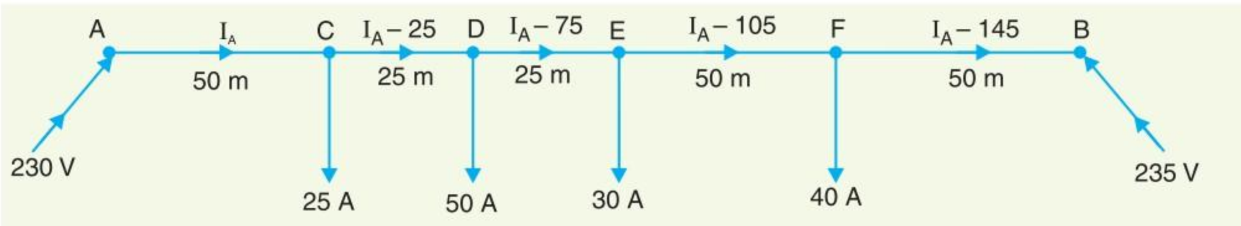


Fig. 13.19

3]

Example 13.12. *A two-wire d.c. distributor AB, 600 metres long is loaded as under :*

Distance from A (metres) :	*150*	*300*	*350*	*450*
Loads in Amperes :	*100*	*200*	*250*	*300*

The feeding point A is maintained at 440 V and that of B at 430 V. If each conductor has a resistance of 0·01 Ω per 100 metres, calculate :

(*i*) *the currents supplied from A to B,* (*ii*) *the power dissipated in the distributor.*

Solution. Fig. 13.21 shows the distributor with its tapped currents. Let I_A amperes be the current supplied from the feeding point A. Then currents in the various sections of the distributor are as shown in Fig.13.21.

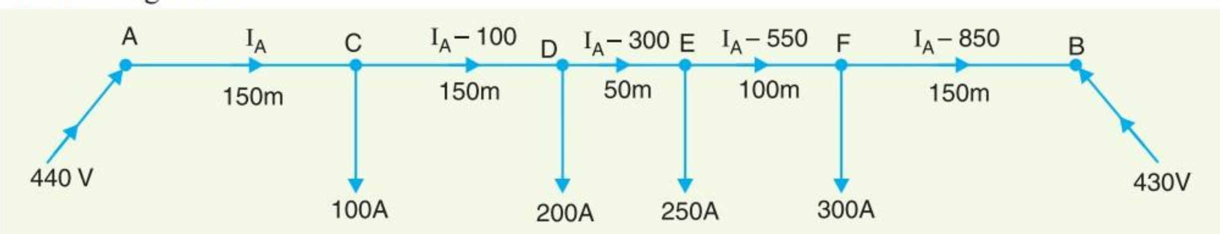


Fig. 13.21

4]

Example 13.23. *A 2-wire d.c. distributor ABCDEA in the form of a ring main is fed at point A at 220 V and is loaded as under :*

10A at B ; 20A at C ; 30A at D and 10 A at E.

The resistances of various sections (go and return) are : AB = 0·1 Ω ; BC = 0·05 Ω ; CD = 0·01 Ω ; DE = 0·025 Ω and EA = 0·075 Ω. Determine :

(*i*) *the point of minimum potential*

(*ii*) *current in each section of distributor*

Solution. Fig. 13.37 (*i*) shows the ring main distributor. Let us suppose that current *I* flows in section *AB* of the distributor. Then currents in the various sections of the distributor are as shown in Fig. 13.37 (*i*).

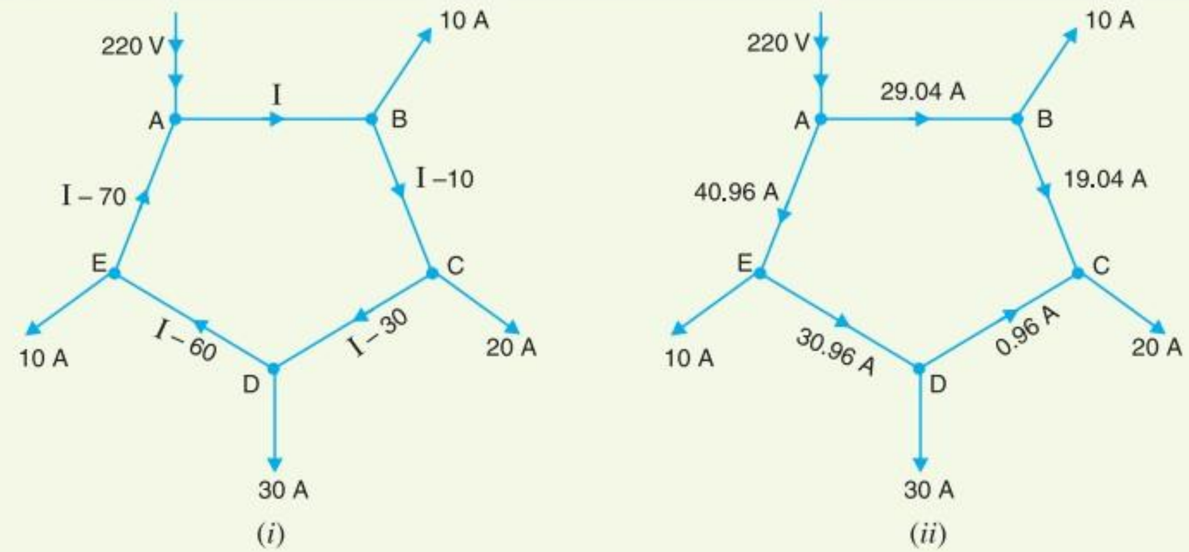


Fig. 13.37

SAMPLE EXAMPLES:- AC DISTRIBUTION

1] VK mehta page no 359

Example 14.1. *A single phase a.c. distributor AB 300 metres long is fed from end A and is loaded as under :*

(*i*) *100 A at 0·707 p.f. lagging 200 m from point A*

(*ii*) *200 A at 0·8 p.f. lagging 300 m from point A*

The load resistance and reactance of the distributor is 0·2 Ω and 0·1 Ω per kilometre. Calculate the total voltage drop in the distributor. The load power factors refer to the voltage at the far end.

Solution. Fig. 14.4 shows the single line diagram of the distributor.

Impedance of distributor/km = $(0{\cdot}2 + j\,0{\cdot}1)\,\Omega$

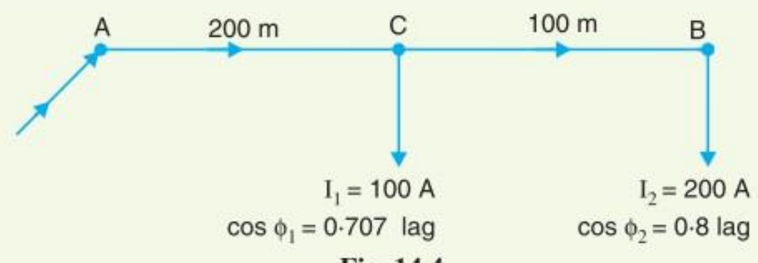


Fig. 14.4

2] Example 14.2. A single phase distributor 2 kilometres long supplies a load of 120 A at 0·8 p.f. lagging at its far end and a load of 80 A at 0·9 p.f. lagging at its mid-point. Both power factors are referred to the voltage at the far end. The resistance and reactance per km (go and return) are 0·05 Ω and 0·1 Ω respectively. If the voltage at the far end is maintained at 230 V, calculate : (i) voltage at the sending end (ii) phase angle between voltages at the two ends

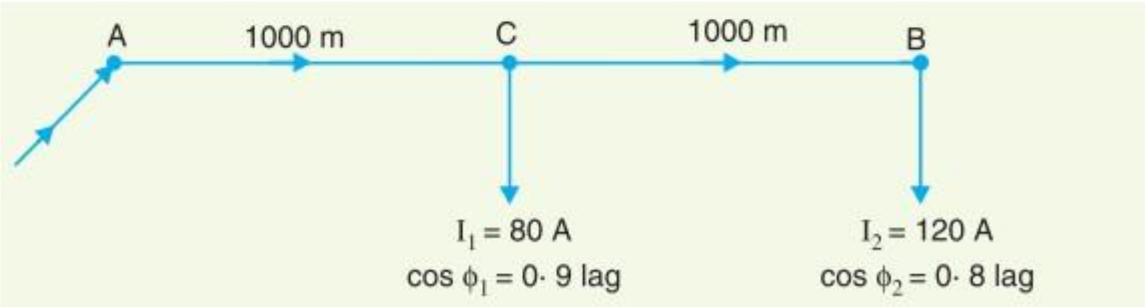


Fig. 14.5

3] Example 14.3. A single phase distributor one km long has resistance and reactance per conductor of 0·1 Ω and 0·15 Ω respectively. At the far end, the voltage VB = 200 V and the current is 100 A at a p.f. of 0·8 lagging. At the mid-point M of the distributor, a current of 100 A is tapped at a p.f. of 0·6 lagging with reference to the voltage VM at the mid-point. Calculate : (i) voltage at mid-point (ii) sending end voltage VA (iii) phase angle between VA and VB

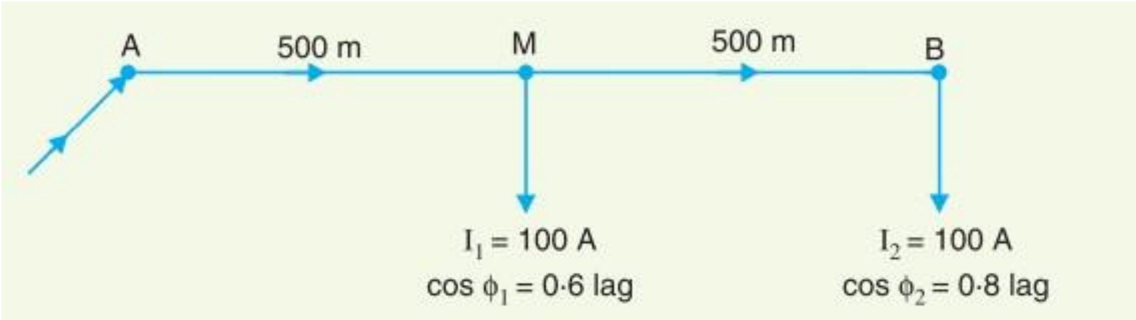


Fig. 14.6