Name : Naeem Ullah Khan

ID : 6873

~~S~~-program : BE(E)

subject : power Transmission and Distribution

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Q No 1:-
(A) Explain classification of overhead Transmission line:

Ans:- The overhead transmission line classify into three types according to the manner in which capacitance is taken into acount.

*) Short transmission line
*) Medium transmission line
*) Long transmission line

1) Short Transmission line:-
when the length of the line is up to about 50 Km, the line consider as short transmission line. the line voltage is completly low <20 KV. the capacitance effect in short overhead line is neglected. because due to small length and low voltage, the capacitance effect is very small. Hence in short, overhead transmission line, the capacitance effect is neglect. therefore, while designing modeling and studying the performence

of the short line. only Resistance and inductance are taken into account.

a) Medium Transmission line:-

When the length of the b/w ~~rote~~ 50 km to 150 km and the line voltage is b/w 20 kV to 100 kV, this type of overhead line consider as a medium transmission line. in this types of line, the capacitance effect cannot be neglect. Hence, while studying the performence of the line, the capacitance effect must include.

According to the distribution of the effect of capacitance, the medium Transmission line is further divides in to three parts: End condenser methed, Nominal T method and Nominal PI method.

(a) End condenser method:- In this method, the capacitance of line is lumped and concentrated at the Recieving end or load end of the Transmission line.

(b) Nominal T method:- in this method, the capacitance of the line assumes to be concentrate at the middle point of the line. Half of the Resistance and inductance are lumped on either side.

(c) Nominal PI method:- in this method, the capacitance of each conductor divides in to two Halves. one half is Lump at the sending end and the second half lump at the receiving end.

(3) Long Transmission lines:-

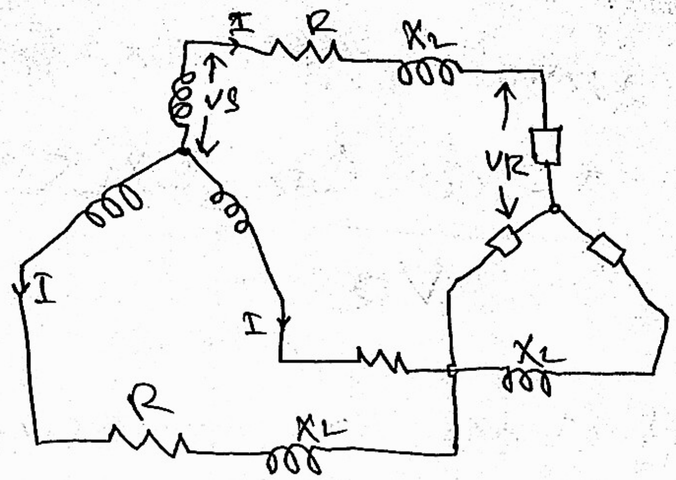
when the length of the ~~Transmi~~ Transmission line is more than 150km, the line consider as long Transmission line. in this type of transmission line, the voltage is more than 100KV. for the modeling and designing of the long overhead Transmission line, the capacitance effect is taken as uniformaly distribute over the entire length of the line. the rigorous method use to solve the mathematical model of long

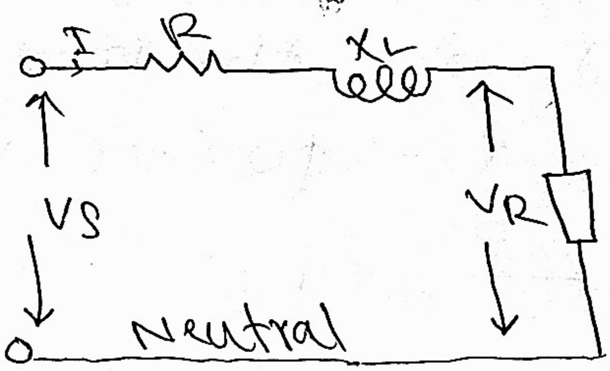
Transmission line.

QNo18-

(B) Explain three phase short Transmission line:-

Ans:. Three phase short transmission line: for Reason associated with economy, transmission of electric power is done by 3 phase system. this system may be regarded as consisting of three single phase unit, each wire transmitting one-third of the total power. As a matter of convenience, we generally analyze 3-phase system by considering one phase only.
therefore, expression for regulation, efficiency etc. derived for a single phase line can also be applied to a 3-phase system. since only one phase is considered, phase values of 3-phase system should be taken. thus, VS and VR are the phase voltage and inductive reactance per phase respectively.





=> effect of load p.f on Regulation and efficiency:

the Regulation and efficiency and of a transmission line depand to a considerable extent upon the power. 1) factor of the load factor of the load.

1) effect on Regulation:- the effect on a short transmission

the expression for a short transmi-on-ssion line is given below

%age voltage regulation =

$$= \frac{IR\cos\phi_R + IX_L\sin\phi_R}{V_R} \times 100$$

%age voltage regulation =

$$= \frac{IR\cos\phi_R - IX_L\sin\phi_R}{V_R} \times 100$$

(for leading P.f)

=) effect on transmission efficiency:-
the power delivered to the load depand upon the power factor.

$P = V_R \times I\cos\phi_R$ (for single phase line)

$$I = \frac{P}{V_R\cos\phi_R}$$

$P = 3V_R I\cos\phi_R$ (for 3-Phase line)

$$I = \frac{P}{3V_R\cos\phi_R}$$

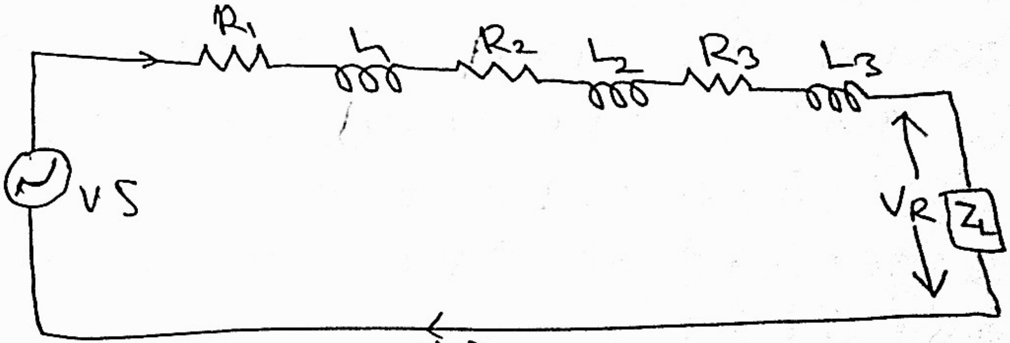
it is clear that in each case, for a given amount of power to be transmitted (P) and Receiving end voltage (V_R), the load current I is inversely proportional to the load P.f $\cos\phi_R$. consequently with the decrea in load P.f, the load current and hence the line losses are increased.

Q No 2:-

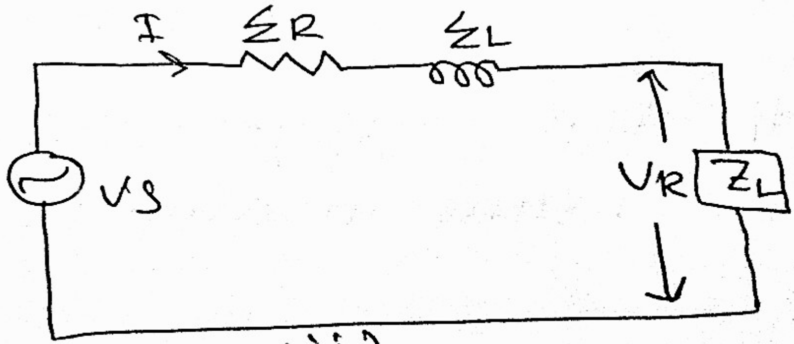
(A) Explain briefly constant of ~~the~~ Transmission line:-

Ans:- Constant of a transmission line:-

A transmission line has resistance, inductance and capacitance uniformly distributed along the whole length of line. before we pass on to the methods of finding these constants for a transmission line, it is profitable to understand them thoroughly.



(i)



(ii)

(i) Resistance :- it is opposition of line conductor to current flow. the resistance is distributed uniformly along the whole length of the line as shown in fig(i). However, the performance of a transmission line can be analyzed conveniently if distributed resistance is considered as lumped as shown in Fig.(ii)

(ii) Inductance :- when an alternating current flow through a conductor, a changing flux is set up which links the conductor. due to this flux linkages, the conductor possesses inductance. mathematically, inductance is defined as the flux linkage per ampere i.e.,

$$\text{inductance, } L = \frac{\Psi}{I} \text{ henry}$$

where Ψ = flux linkages in weber-turns
I = current in amperes.

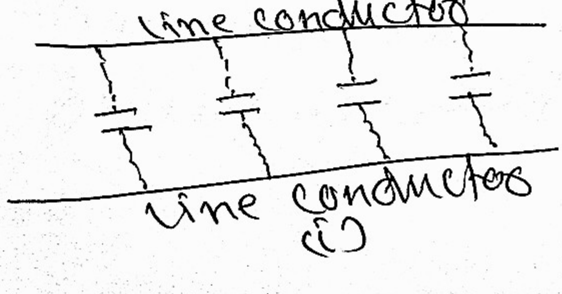
The inductance is also uniformly distributed along the length of the line as shown in fig. (i). again for the convenience of analysis, it can be taken to be lumped as shown in Fig. (ii)

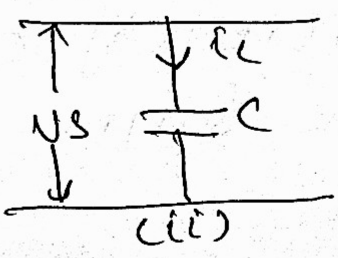
(iii) capacitance. we know that any two conductor separated by an insulating material constitute a capacitor. As any two conductor of an overhead transmission line are separated by air which acts as an insulation, therefore, capacitance exist b/w any two overhead line conductor. the capacitance b/w the conductor is the charge per unit potential difference

i.e., capacitance, $C = \frac{q}{V}$ Farad

were q = charge on the line in coulomb

V = P.d b/w the conductor in volts.



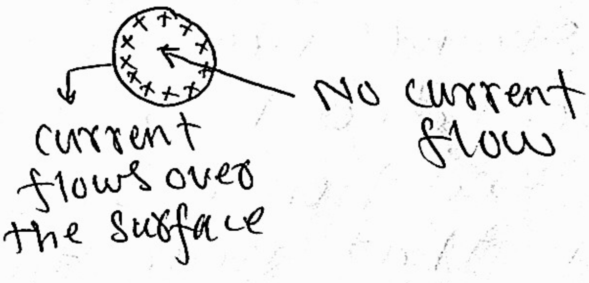


the capacitance is uniformly distributed along the whole length of the line and may be regarded as a uniform series of a capacitor connected b/w the conductor as shown in line conductor fig.(i). when an alternating voltage is impressed on a transmission line, the charge on the conductor at any point increases and decreases with the increase and decrease of the instantaneous value of the voltage, b/w conductor at that point. the result is that a current (known as charging current) flows b/w the conductor [see line conductor fig.(ii)]. this charging current flow in the line even when it is open circuit i.e., supplying no load. it affects the voltage drop along the line as well as the efficiency and power factor of the line.

Q No2 :-

(B) What do you know about Skin effect ?

Ans:- Skin effect :- When a conductor is carrying steady direct current (d.c) this current is uniformly distributed over the whole x-section of the conductor. Howere the alternating current flowing through the conductor does not distribute uniformly, rather it has the tendency to concentrate near the surface of the conductor as shown in figure. this is known as skin effect.



the tendency of alternating current to concentrate near the surface of a conductor is known as skin effect.

Due to skin effect, the effective area of cross section of the conductor through which current flow, is reduced. consequently, the resistance of the conductor is slightly increased when carrying an alternating current. the cause of skin effect can be easily explained. A solid conductor may be thought to be consisting of a larg number of strands, each carrying a small part of the current. the inductance of each strands near the centre are surrounded by a greater magnetic flux and hence have larger inductance than that near the surface.
the high reactance of inner strands causing the alternating current to flow near the surface

of conductor. this crowding of current near the conductor surface is the skin effect. the skin effect depands upon the following factor.

(i) Nature of material

(ii) Diameter of wire - increase with the diameter of wire

(iii) frequency - increase with the increase in frequency.

(iv) shape of wire - less for standed conductor than the solid conductor.

it may be noted that skin effect is negligible when the supply frequency is low (<50Hz) and conductor diameter is small (<1cm)

QNo 3:-

(A) Types of Line support:-

(1) Wooden Poles
(2) RCC Poles
(3) Steel tubular poles
(4) Steel towers.

(1) Wooden Poles:-

*) made of chemically treated woods.
*) used for distribution lines especially in areas, where good quality woods
*) are available.
*) very echonomical but capable to decay.
*) To protect from decay, poles have Zinc or aluminium cap at the top and Bitumen coating at the bottom.

(2) RCC Poles:-

*) made of reinforced concrete cement.
*) stronger than wood Poles but more costly.

*) very long life and need little maintenance
*) Bulky and heavy
*) widely used for distribution lines upto 33KV.
*) can be manofactured at site.

(3) Steel tubular poles :-

*) stepped pole manufactured from a single tube, the diameter being reduced in parallel steps.
*) more costly than RCC and wood poles.
*) Have light weight, High strength to weight ratio and long life.
*) widely used for lines up to 33KV.

(4) Steel towers :-

*) used for lines of 66KV and above
*) very long life and high degree of reliability.
*) can withstand very severe weather condition.

*) overhead HV, EHV, and UHV lines mostly use self supporting steel towers.

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Q No 3:-

(B) Types of insulator:-

Ans!. (1) Pin type insulators
(2) Suspention type insulator
(3) post type insulator
(4) strain insulator

(1) Pin type insulator:-

*) Small, simple in construction and cheap.
*) used on lines upto and including 33KV.
*) for higher voltage they tends to be more heavy and costly.

(2) Suspension type insulators:-

*) Used for lines above 33KV.

*) Also known as disc or string insulator

*) consist of Porcelian discs mounted one above the other.

*) The conductor is suspended below the point of support by an insulator string.

*) mechanical stresses are reduced.

(3) Post insulators:-

*) used for supporting bus bars and disconnecting switches in sub-station.

*) in extra high voltage sub-station, Polycon post insulator are used.

*) similar to pin insulator but has a metal base and metal cap so that more than one unit can be mounted in series.

(4) Strain insulator :-

*) spacial mechanically strong suspensi insulator.

*) Similar to suspension type insulators.

*) used to take the tension of the conductor at the line termination and at portions where there is a change in direction of line.

End