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Subject — power Transmision

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Question NO 01

Q: A single phase Line has two parallel Conductor 2 meters apart. The diameter of each Conductor is 1.2cm. Calculated the Loop inductance per km of the Line

Sol

Given data:

Spacing of Conductor $d = 2m = 200cm$

Radius of Conductor, $r = 1.2/2 = 0.6cm$

Loop inductance per meter Length of the

$$\text{Line} = 10^{-7}(1+4\log_e d/r)\,H$$

$$= 10^{-7}(1+4\log_e 200/0.6)\,H$$

$$= 24.23 \times 10^{-7}\,H$$

⇒ Loop inductance per km of the

⇒ Line $= 24.23 \times 10^{-7} \times 1000\, H$

⇒ $= 24.23 \times 10^{-7}\, H$

⇒ $= 2.423\, mH$

Question No 2

Sol

Given data:

Spacing of Conductor $= d = 3m = 300cm$

Radius of Conductor, $= r = 1cm$

Loop inductance $= 10^{-7}(\mu_r + 4\log_e d/r)\, H/m$

(i) with Copper Conductors, $\mu_r = 1$

∴ Loop inductance/m $= 10^{-7}(1+4\log_e d/r)H$

$\Rightarrow 10^{-7}(1+4\log_e 300/1)H = 23.8 = 10-7H$

$\Rightarrow$ Loop inductance/Km $= 23.8 \times 10^{-7} \times 1000$

$\Rightarrow \quad = 2.38 \times 10-3H$

$\Rightarrow \quad = 2.38 mH$

(ii) with Steel Conductor $\mu_r = 100$

∴ Loop inductance/m $= 10^{-7}(100+4\log_e 300/1)H$

$\Rightarrow \quad = 122.8 \times 10^{-7} H$

$\Rightarrow$ Loop inductance/Km

$= 122.8 \times 10^{-7} \times 1000 = 12.28 \times 10-3H$

$\Rightarrow = \quad 12.28 mH$

Question NO 3

Farranti effect :-

The effect in which the voltage at the receiving end of the transmission Line is more then the Sending voltage is Known as the Ferranti effect.

Farranti effect occurs of the transmission line due to the charging current.

Such type of effect mainly occurs because of light Load or open circuit at the receiving end.

A long transmission line can be considered to compose a considerably high amount of capacitance and inductance distributed across the entire length of the line.

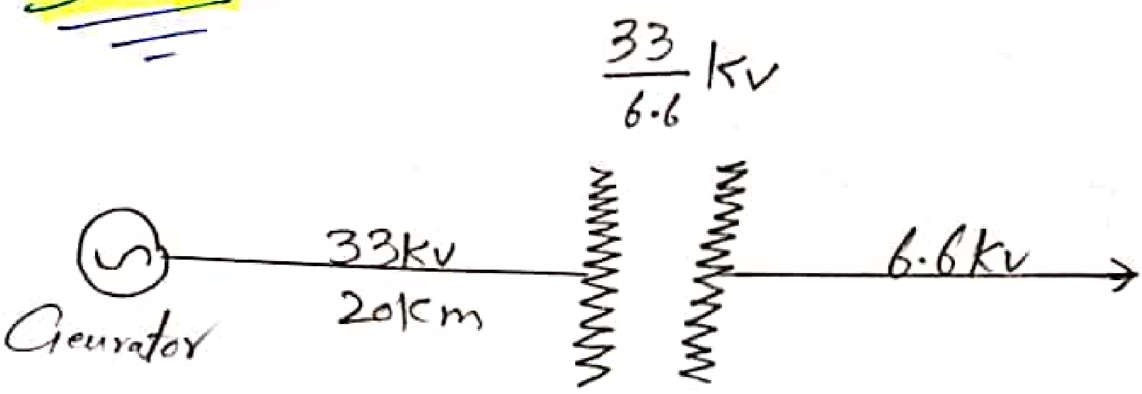
Farranti Effect occurs when current drawn by the distributed capacitance of the line itself is greater then the current associated with the load at the receiving end of the line (during light or no load).

This capacitor charging current leads to a voltage drop across the line inductor of the transmission line system which is in phase with the sending end voltage. This voltage drop keeps on increasing additively as we move towards that load end of the

Line and Subsequently, the Receiving end voltage leading to the phenomena Called Ferranti effect in Power System. Thus both the Capacitance and inductor effect of transmision Line are equally responsible For this Particular phenomena to occurs and hence Farranti effect is negligible in Case of general for a 300 Km Line operating at frequency 50Hz the no Load recieving end voltage has Been found to be 5% higher than the Sending end voltage.

Question NO 4

Sol



The above diagram shows the Single Transmission System. Here the voltage drop will due to impedance of transmission line and also due to the impedance of transformer

⇒ Resistance of each conductor = $20 \times 0.4 = 8\Omega$

⇒ Reactance of each conductor = $20 \times 0.5 = 10\Omega$

Let us transfer the impedance of transformer Secondary to high tension

Side i.e 33 Kv side

Equivalent resistance of transformer refferred to 33K side

$= \text{Primary resistance} + 0.35(33/6.6)^2$

$= 7.5 + 8.75 = 16.25\,\Omega$

= Equivalent reactance of transformer refferred to 33kv side

$= \text{Primary reactance} + 0.65(33/6.6)^2$

$= 13.2 + 16.25 = 29.45\,\Omega$

Total Resistance of Line and transformer is $R = 8 + 16.25 = 24.25\,\Omega$

Total Reactance of Line and transformer

$X_L = 10 + 29.45 = 39.45\,\Omega$

Receiving end voltage per phase is

$= \quad V_R = 33,000/\sqrt{3} = 19052V$

$$I = \frac{2000 \times 10^3}{\sqrt{3} \times 33000} = 35A$$

Using the approximate expression for sending end voltage V_s per phase.

$= \quad V_S = V_R + IR\cos\phi_R + IX_L \sin\phi_R$

$= 19052 + 35 \times 24.25 \times 0.8 + 35 \times 39.45 \times 0.6$

$= 19052 + 679 + 828 = 20559V = 20.559KV$

Sending end line voltage

$= \sqrt{3} \times 20.559kV = 35.6kV$

Sending end P.f $\cos\phi_s$

$$= \frac{V_R \cos\phi_R + IR}{V_S}$$

$$= \frac{19052 \times 0.8 + 35 \times 24.25}{20559} = 0.7826 \text{ Lag}$$

Line Losses $= \frac{3I^2R}{1000}$ kW $= \frac{3 \times (35)^2 \times 24.25}{1000}$

$= 89.12$ kW

output power $= 2000$ KVA $\times 0.8 = 1600$ kW

Transmission efficiency =

$$= \frac{1600}{1600 + 89.12} \times 100$$

$= 94.72\ \%$

Question No 5

Ans:- 5

Sol

First we find 'r'

So. $r = \frac{1.956}{2} = 0.978\,cm$

=> $E_o = \frac{30}{\sqrt{3}} = 21.2$ (r.m.s)

=> $m_o = 1$ (Smooth Conductor)

=> $\delta = 1$ (stander Pressure and temperature)

$V_o = 21.1 m_o \delta r \ln\frac{d}{r}$

Disruptive voltage / Phase $= \frac{210}{\sqrt{3}} = 121.25\,kV$

$\therefore 121.25 = 21.1 \times 1 \times 1 \times 0.978 \times \ln d/r$

$\ln d/r = 5.84 \Rightarrow d = 34/cm$