Name : Abid Khan
ID : 11445
Paper : Power Transmission and Distribution
Sir : Engr Sanaullah Ahmad
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Question no : 1

a part

Solution.

Spacing of conductors, d=2m=200cm

Radius of conductor, r= 1.2/2=0.6 cm

Loop inductance per meter length of the line.

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

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

$= 24.23\times10^{-7}H$

⇒ Loop inductance per km of the line

$= 24.23\times10^{-7}\times1000 = 24.23\times10^{-4}H = 2.423mH$

= **2.423 mH** Answer.

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Question no = 1

B Part.

Solution:

Load power factor, $\cos\theta_R$

= 0.8 Lagging

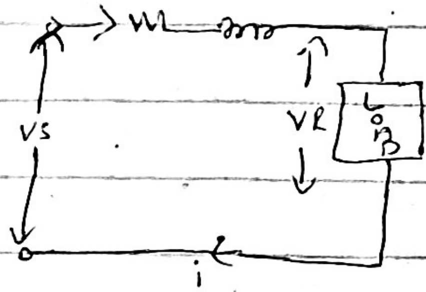
Total line impedence, $\vec{Z} = R + jX_L = 10+j15$

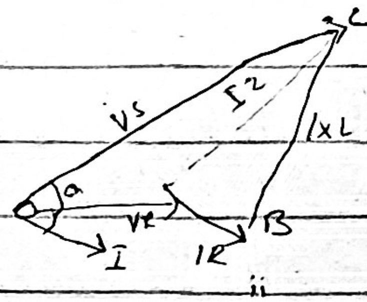
$I_R = I_S = I$

⇒ Recivingend Voltage, V_R = 33 kv = 33,000 v

∴ Line current, $I = \frac{kW \times 10^3}{\sqrt{} V_R \cos\phi_R} = \frac{1100 \times 10^3}{33000 \times 0.8} = 41.67A$

As $\cos\theta_R = 0.8$ ∴ $\sin\theta_R = 0.6$





The equivalent circuit and phasor diagram of the line are shown in fig (i) and (ii)

Taking reciving voltage $\vec{VR}$ as the Refrence Phasor

$\vec{VR} = VR + j0 = 33000V$

$\vec{I} = I(\cos\theta R - j\sin\theta R)$

$= 41.67(0.8 - j0.6) = 33.33 - j25$

(i) Sending end voltage

$\vec{VS} = \vec{VR} + \vec{I}\,\vec{Z}$

$= 33,000 + (33.33 - j25.0)(10 + j15)$

$= 33000 + 333.3 - j250 + j500 + 375$

$= 33,708.3 + j250$

∴ Magnitude of $Vs = \sqrt{(33,708.3)^2 + (250)^2}$

$= 33,709V$

(ii) Angle b/w $\vec{VS}$ and $\vec{VR}$ is $\alpha = \tan^{-1}\frac{250}{33708.3} = \tan^{-1}$

$0.0074 = 0.42^\circ$

∴ Sending end power factor angle is

$\phi_S = \phi_R + \alpha = 36.87^\circ + 0.42 = 37.29^\circ$

∴ Sending end P.F

$\cos\phi_S = \cos 37.29^\circ = 0.7956$ Lagging

(iii) Line losses = $I^2R = (41.61)^2 \times 10 = 17364W = 17.364\ kW$

output delivered = 1100kw

Power Sent = 1100 + 17.364 = 1117.36kw

∴ Transmission Effeciency =

$$\frac{\text{Power deliverd}}{\text{Power Sent}} \times 100$$

$$= \frac{1100}{1117.364} \times 100 = 98.44\%$$

Note VS and ϕ_S can also be calculated as follow

$VS = VR + IR\cos\phi_R + IX_L\sin\phi_R$

$= 33000 + 41.67 \times 10 \times 0.8 + 41.67 \times 15 \times 0.6$

$33000 + 333.36 + 375.03$

$= 33708.39V$ which is the same approximatly as above.

$$\cos\phi_S = \frac{VR\cos\phi_R + IR}{VS}$$

$$\frac{33000 \times 0.8 + 41.67 \times 10}{33,708.39}$$

$$\frac{26,816.7}{33,708.39}$$

$= \boxed{0.7958}$ Answer.

— x — x — x x —

Question no = 2

a part

Tariff:

The amount of money frame by the suppler for the supply of electrical energy to various types of consumers is known as electricity tariff the tariff covers the total cost of producing and suppling electric energy plus a reasonable cost

Tariff for Electic Energy:

The electicity genarated is to be supplied to the consumers the total cost of genration and profit as to be recoverd from the consumers the rate of energy sold to the consumers as domestic commerial or industrial.

=> The rati depend upon the total energy consumed and the load factor of the consumer.

=> The tariff energy should recover the fixed cost operating cost and profit etc

Types of tariff

=> Tariff may be a plain, two or three parts

=> Two and three part tariff consist of two components.

=> Variable component based on the actual unit being consumed.

=> Fixed component- base on installed capacity or maximum demand

=> In a plain tariff it is the cost of electricity unit in terms of kwh (1unit = 1kwh) actually used by consumers are chared in bill

=> The unit in terms of kwh are registered by kwh and registered by energy ~~matter~~ meter.

Two part tariff

⇒ Cost of the electricity supplied to consumers may be divided into fixed cost and runing cost.

⇒ Two part tariff consist of fixed cost and running cost for larg power consumer two part tariff is imposed Fixed cost may very from consumer to consumer and may based on appliances connected to supply Thus two part tariff usally have KVA or kw and variable portion based on the amount of electricity units consumed (ie)

∴ Tariff = Rs Per kVA (kw) + Rs Per kwH

Three part tariff:

⇒ Three part tariff consist of fixed part based on KVA or kw variable portion based of kwH and maximum demand which varies depending on habit of use of appliances.

⇒ Maximum demand can be obtained from maximum demand indicator installed on distribution transformer.

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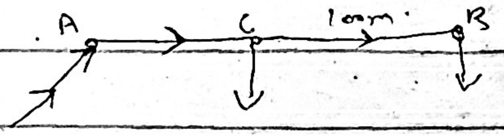
Question no 2
B Part

Solution:

Fig show the single line diagram of distributer.

=> Impedence of distributer/Km

$= (0.2 + j0.1)\,\Omega$



$(I_1 = 100A)$ $(I_2 = 200)$

$(\cos\phi_1 = 0.707\ \text{lag})$ $(\cos\phi_2 = 0.8\ \text{Lag})$

Impedence of Sec AC, $\vec{Z}_{AC} = (0.2 + j0.1) \times 200 \times /1000$

$= (0.04 + j0.02)\,\Omega$

Impedence of sec CB, $\vec{Z}_{CB} = (0.2 + j0.1) \times 100/1000 -$

$= (0.02 + j0.01)\,\Omega$

Taking voltage at the far End Bas refrence vector we have Load current at point B,

$\vec{I_2} = I_2(\cos\phi_2 - j\sin\phi_2) = 200(0.8 - j0.6)$

$= (160 - j120)\,A$

Load current at point C

$\vec{I_1} = I_1(\cos\phi_1 - j\sin\phi_1) = 100(0.707 - j0.707)$

$= (707 - j70.7)\,A$

Current in Section CB

$\vec{I_{CB}} = \vec{I_2} = (160 - j120)\ A$

current in section AC

$\vec{I_{AC}} = \vec{I_1} + \vec{I_2} = (70.7) - j70.7 + (160 - j120)$

$= (236.7 - j190.7)\ A.$

Voltage drop in Section CB

$\vec{V_{CB}} = \vec{I_{CB}}\ \vec{Z_{CB}} = (160 - j120)(6.02 + j0.01)$

$= 4.4 - j0.8$ volts

Voltage drop in Section AC

$\vec{V_{AC}} = \vec{I_{AC}}\ \vec{Z_{AC}} = (230.7 - j190.7)(0.04 + j0.02)$

$= (13.04 - j3.01)$ volts.

Voltage drop in distributor

$= \vec{V_{AC}} + \vec{V_{CB}} = 13.04 - j3.01) + (4.4 - j0.8)$

$= (17.44 - j3.81)$ volts

Magnitude of drop =

$\sqrt{(17.44)^2 + (3.81)^2}$

17.85V Ans

— x — x — x —