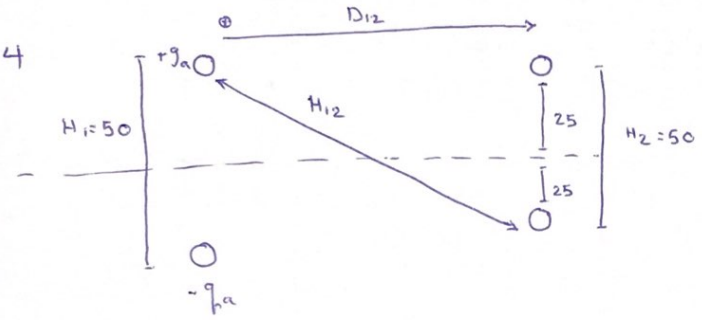
یا طیب

رضا دیندار
۹۸۱۴۳۰۳
تمرین سری 4 تحلیل سیم

#4



$$V_{ab} = \frac{q_a}{2\pi\varepsilon_0}\ln\frac{D_{12}}{r} + \frac{q_b}{2\pi\varepsilon_0}\ln\frac{r}{D_{12}} - \frac{q_a}{2\pi\varepsilon_0}\ln\frac{H_{12}}{H_1} - \frac{q_b}{2\pi\varepsilon_0}\ln\frac{H_2}{H_{12}} \xrightarrow{q_a = -q_b}$$

$$V_{ab} = \frac{1}{2\pi\varepsilon_0}\left(q_a\ln\frac{D_{12}}{r} + \underbrace{q_b}_{=-q_a}\ln\frac{r}{D_{12}}\right) - \frac{1}{2\pi\varepsilon_0}\left(q_a\ln\frac{H_{12}}{H_1} + \underbrace{q_b}_{=-q_a}\ln\frac{H_2}{H_{12}}\right)$$

$$= \frac{1}{2\pi\varepsilon_0}q_a\ln\frac{D_{12}^2}{r^2} - \frac{1}{2\pi\varepsilon_0}q_a\ln\frac{H_{12}^2}{H_1H_2} = \frac{q_a}{2\pi\varepsilon_0}\left(\ln\frac{D_{12}^2}{r^2} - \ln\frac{H_{12}^2}{H_1H_2}\right) \xrightarrow{V_{ab} = 0.5V_{ab}}$$

$$= \frac{q_a}{2\pi\varepsilon_0}\left[\ln\frac{D_{12}}{r} - \ln\frac{H_{12}}{\sqrt{H_1H_2}}\right] \Rightarrow C_{an} = \frac{q_a}{V_{an}} = 2C_{ab} = \frac{2\pi\varepsilon_0}{\ln\frac{D_{12}}{r} - \ln\frac{H_{12}}{\sqrt{H_1H_2}}} \quad \left(\frac{F}{m}\right)$$

ب) قطر = 0.229 in =

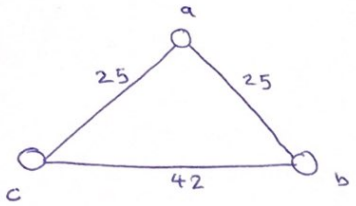
$$C_{an} = \frac{2\pi\varepsilon_0}{\ln\frac{D_{12}}{r}} = \frac{2\pi * 8.85 * 10^{-12}}{\ln\left(\frac{10*12}{\frac{0.229}{2}}\right)} = 7.996 * 10^{-12} \left(\frac{F}{m}\right)$$

$$C_{an} = \frac{2\pi\varepsilon_0}{\ln\left(\frac{D_{12}}{r}\right) - \ln\frac{H_{12}}{\sqrt{H_1H_2}}} = \frac{2\pi * 8.85 * 10^{-12}}{\ln\frac{10*12}{\frac{0.229}{2}} - \ln\frac{\sqrt{10^2+50^2}}{\sqrt{50*50}}} = 8.018 * 10^{-12} \left(\frac{F}{m}\right)$$

#5

متقارنین : $d = 0.879$ inch $\rightarrow r = \frac{0.879}{2}$ inch

$D_{eq} = \sqrt[3]{25 * 25 * 42} = 29.72$ ft



$$C_{an} = \frac{2\pi\varepsilon_0}{\ln \frac{D_{eq}}{r}} = \frac{2\pi * 8.85 * 10^{-12}}{\ln \frac{29.72 * 12}{\frac{0.879}{2}}} = 8.301 \times 10^{-12} \left(\frac{F}{m}\right)$$

$$= 8.301 \times 10^{-6} \times 1.609 = 0.01336 * \left(\frac{\mu F}{m}\right)$$

$$\rightarrow X_c = \frac{1}{\omega C_{an}} = \frac{1 \times 10^6}{337 \times 0.0136} = 0.1985 \times 10^6$$

مقدار $X'_a = 0.0981$

for 29.72 ft : $X'_d \simeq 0.0999 \Rightarrow X_c = X'_a + X'_d = 0.198 \times 10^6$ $\Omega . m$

for 150 mil : $C_{an} = 150 \times 0.01336 = 2.004$ $\mu F \Rightarrow X_c = \frac{0.198}{150} \times 10^6 = 1325\ \Omega$

#6

$D_{12} = 12$

$D_{23} = 12$

$D_{13} = 24$

$D_{eq} = \sqrt[3]{12 \times 12 \times 24} = 15.12^m$

$r = \frac{0.0328}{2} = 0.0164$

$$\Rightarrow X_c = \frac{2.862}{60} \ln \frac{15.12}{0.0164} \times 10^9 = 3.256 \times 10^8$$

for 125 mil: $X_c = \frac{3.256 \times 10^8}{125 \times 1609} = 1619\ \Omega$

7

$D_{eq} = \sqrt[3]{11 \times 11 \times 22} = 13.86^m$

$r_{blue\text{-}jay} = \frac{(1.259 \times 2.542)}{2} \times 10^{-2} = 0.016^m$

$\Rightarrow X_c = 4.77 \times 10^4 \ln \frac{13.86}{0.016} = 322650$ $\Omega . km$

$r_{oove} = \frac{(0.927 \times 2.54)}{2} \times 10^{-2} = 0.01177$ m $\quad r'_{11} = \sqrt{r_d} \rightarrow = \sqrt{0.0177 \times 0.4} = 0.0842$

$X_c = 4.77 \times 10^4 \ln \frac{13.86}{0.0842} = 243440\ \Omega . km$

#8

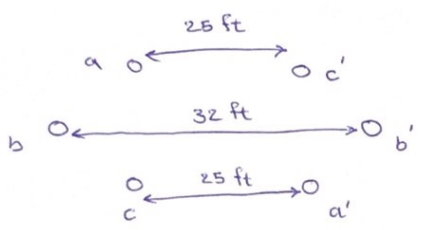
$D_{eq} = \sqrt[3]{9 \times 9 \times 18} = 11.34$ m , $d_{1,Rail} = 1.165$ inch $\longrightarrow r_{Rail} = \frac{1.165 \times 2.54}{2} \times 10^{-2}$

$= 0.0148$

$r' = \sqrt[3]{r d^2} = \sqrt[3]{0.0148 \times 45^2} = 0.1442$ m $\Rightarrow X_c = 4.77 \times 10^{-4} \ln \frac{11.34}{0.1442} = 208205$ Ω.km

---

#9



$D_{ab} = D_{a'b'} = \sqrt{14^2 + (3.5)^2} = 14.43$

$D_{ab'} = D_{a'b} = \sqrt{14^2 + (28.5)^2} = 31.75$

$D_{aa',bb'} = \left[(D_{ab} \cdot D_{ab'})(D_{a'b} \cdot D_{a'b'}) \right]^{1/4} = (14.43 \times 31.75)^{1/2} = 21.04$

$D_{cb} = D_{c'b'} = \sqrt{14^2 + 3.5^2} = 14.43$, $D_{cb'} = D_{c'b} = \sqrt{14^2 + 28.5^2} = 31.75$

$D_{bb',cc'} = \left((D_{bc} \times D_{bc'}) \cdot (D_{b'c} \cdot D_{c'b'}) \right)^{1/4} = 21.04$

$D_{ac} = D_{a'c'} = 28$, $D_{ac'} = D_{ca'} = 25 \Rightarrow D_{aa',cc'} = \left((D_{ac} \cdot D_{ac'})(D_{a'c} D_{a'c'}) \right)^{1/4}$

$= (28^2 \times 25^2)^{1/4} = 26.46$

$\Rightarrow D_{eq} = \left(D_{aa',bb'} \times D_{aa',cc'} \times D_{bb',cc'} \right)^{1/3} = 22.71$ ft

$D_{aa'} = \sqrt{25^2 + 28^2} = 37.54$ ft , $D_{bb'} = 32$ ft , $D_{cc'} = D_{aa'} = 37.54$ ft

$r_{Drake} = \frac{1.108}{2 \times 12} = 0.0462$ ft , $R_{aa'} = \sqrt[2]{r_a \cdot D_{aa'}} = \sqrt[2]{0.0462 \times 37.54} \xrightarrow{R_{cc'} = R_{aa'}}$

$R_{bb'} = \sqrt[2]{r_b \cdot D_{bb'}} = \sqrt[2]{0.0462 \times 32} \Rightarrow R = (R_{aa'} \cdot R_{bb'} \cdot R_{cc'})^{1/3} = \left[(\sqrt{0.0462 \times 37.54})^2 (\sqrt{0.0462 \times 32}) \right]^{1/3}$

$= 1.282$ ft

$X_c = 2.965 \times 10^{-4} \ln \frac{22.71}{1.282} = 85225$ Ω.mi , $I_{chg} = \frac{\frac{138000}{\sqrt{3}}}{85225} = 0.935$ A/mi/phase

$= 0.467$ A/mi/conductor