

Worksheet 4.4.1 page 1

ORIGIN:= 1

$$\mu_o := 4 \cdot \pi \cdot 10^{-7} \text{ H/m} \quad \varepsilon_o := 8.854 \cdot 10^{-12} \text{ F/m} \quad \rho := 1.7 \cdot 10^{-8} \text{ } \Omega \text{ m}$$

$$\underline{c} := 2.998 \cdot 10^8 \text{ m/s} \quad l := 10 \text{ m}$$

$$h := 5 \cdot 10^{-3} \text{ m} \quad \underline{s} := 2 \cdot 10^{-3} \text{ m} \quad r := 0.5 \cdot 10^{-3} \text{ m}$$

$$R_{ss1} := \frac{\rho \cdot l}{\pi \cdot r^2} \text{ } \Omega \quad R_{ss2} := R_{ss1} \quad R_{ss3} := 0.005 \text{ } \Omega$$

$$F_x := \frac{4 \cdot \rho}{\mu_o \cdot \pi \cdot r^2} = 6.89 \times 10^4 \text{ Hz}$$

$$L_{c1} := \frac{\mu_o \cdot l}{2 \cdot \pi} \cdot \ln \left(\frac{2 \cdot h \cdot s}{r \cdot \sqrt{s^2 + 4 \cdot h^2}} \right) \text{ H}$$

$$L_{c3} := \frac{\mu_o \cdot l}{2 \cdot \pi} \cdot \ln \left(\frac{\sqrt{s^2 + 4 \cdot h^2}}{s} \right) \text{ H}$$

$$L_{c2} := L_{c1}$$

$$C_c := \frac{1}{L_c} \cdot \left(\frac{l}{c} \right)^2 \text{ F}$$

$$F_q := \frac{1}{4 \cdot \sqrt{L_{c1} \cdot C_{c1}}} = 7.495 \times 10^6 \text{ Hz}$$

printout of calculated values for circuit model :-

$$\frac{R_{ss}}{2} = \begin{pmatrix} 0.108 \\ 0.108 \\ 2.5 \times 10^{-3} \end{pmatrix} \quad \frac{L_c}{2} = \begin{pmatrix} 1.367 \times 10^{-6} \\ 1.367 \times 10^{-6} \\ 1.629 \times 10^{-6} \end{pmatrix} \quad C_c = \begin{pmatrix} 4.07 \times 10^{-10} \\ 4.07 \times 10^{-10} \\ 3.415 \times 10^{-10} \end{pmatrix}$$

definition of impedances and admittances:-

$$Z_n := \begin{pmatrix} 52 \\ 0 \\ 0 \end{pmatrix} \text{ } \Omega \quad Z_f := \begin{pmatrix} 100 \\ 0 \\ 10^7 \end{pmatrix} \text{ } \Omega \quad G_c := \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \text{ mho}$$

Figure 4.3.2 Deriving circuit parameters

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$$\begin{array}{l|l}
 \text{Zbranch}(f) := & \omega \leftarrow 2 \cdot \pi \cdot f \\
 & \text{for } i \in 1 \dots 3 \\
 & \left| \begin{array}{l}
 \text{Rc}_i \leftarrow \text{Rss}_i \cdot \sqrt{1 + \frac{f}{F_x}} \\
 \theta \leftarrow \sqrt{(\text{Rc}_i + j \cdot \omega \cdot \text{Lc}_i) \cdot (\text{Gc}_i + j \cdot \omega \cdot \text{Cc}_i)} \\
 \text{Zo} \leftarrow \sqrt{\frac{\text{Rc}_i + j \cdot \omega \cdot \text{Lc}_i}{\text{Gc}_i + j \cdot \omega \cdot \text{Cc}_i}} \\
 \text{Z}_{1,i} \leftarrow \text{Zo} \cdot \tanh\left(\frac{\theta}{2}\right) \\
 \text{Z}_{2,i} \leftarrow \text{Zo} \cdot \text{csch}(\theta)
 \end{array} \right. \\
 & \text{Z}
 \end{array}
 \begin{array}{l}
 \text{equation (2.5.15)} \\
 \text{equation (4.2.1)} \\
 \text{equation (4.2.2)} \\
 \text{equation (4.2.3)} \\
 \text{equation (4.2.4)}
 \end{array}$$

$$\begin{array}{l|l}
 \text{Zloop}(f, \text{Zf}) := & \text{Z} \leftarrow \text{Zbranch}(f) \\
 & \text{Z}_{11} \leftarrow \text{Zn}_1 + \text{Z}_{1,1} + \text{Z}_{2,1} + \text{Z}_{2,2} + \text{Z}_{1,2} + \text{Zn}_2 \\
 & \text{Z}_{12} \leftarrow -(\text{Z}_{1,2} + \text{Z}_{2,2} + \text{Zn}_2) \\
 & \text{Z}_{13} \leftarrow -(\text{Z}_{2,1} + \text{Z}_{2,2}) \\
 & \text{Z}_{14} \leftarrow \text{Z}_{2,2} \\
 & \text{Z}_{22} \leftarrow \text{Zn}_2 + \text{Z}_{1,2} + \text{Z}_{2,2} + \text{Z}_{2,3} + \text{Z}_{1,3} + \text{Zn}_3 \\
 & \text{Z}_{23} \leftarrow \text{Z}_{2,2} \\
 & \text{Z}_{24} \leftarrow -(\text{Z}_{2,2} + \text{Z}_{2,3}) \\
 & \text{Z}_{33} \leftarrow \text{Zf}_2 + \text{Z}_{1,2} + \text{Z}_{2,2} + \text{Z}_{2,1} + \text{Z}_{1,1} + \text{Zf}_1 \\
 & \text{Z}_{34} \leftarrow -(\text{Z}_{1,2} + \text{Z}_{2,2} + \text{Zf}_2) \\
 & \text{Z}_{44} \leftarrow \text{Zf}_3 + \text{Z}_{1,3} + \text{Z}_{2,3} + \text{Z}_{2,2} + \text{Z}_{1,2} + \text{Zf}_2 \\
 & \begin{pmatrix} \text{Z}_{11} & \text{Z}_{12} & \text{Z}_{13} & \text{Z}_{14} \\ \text{Z}_{12} & \text{Z}_{22} & \text{Z}_{23} & \text{Z}_{24} \\ \text{Z}_{13} & \text{Z}_{23} & \text{Z}_{33} & \text{Z}_{34} \\ \text{Z}_{14} & \text{Z}_{24} & \text{Z}_{34} & \text{Z}_{44} \end{pmatrix}
 \end{array}
 \begin{array}{l}
 \text{equation (4.2.6)}
 \end{array}$$

Figure 4.3.4 Calculating branch impedances and loop impedances

$n := 100$ $s := 1 .. 4 \cdot n$ $F_s := s \cdot \frac{F_q}{n}$ defining the spot frequencies

$V := \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \end{pmatrix} V$ defining the voltage source

$YT_{oc_s} := \begin{cases} f \leftarrow F_s \\ Z \leftarrow Z_{loop}(f, Z_f) \\ I \leftarrow lsolve(Z, V) \\ I_1 \end{cases}$	<p>Main Program</p> <p>Defining the current at the near end of the victim line when the far end is open-circuit. See figure 4.4.5.</p>
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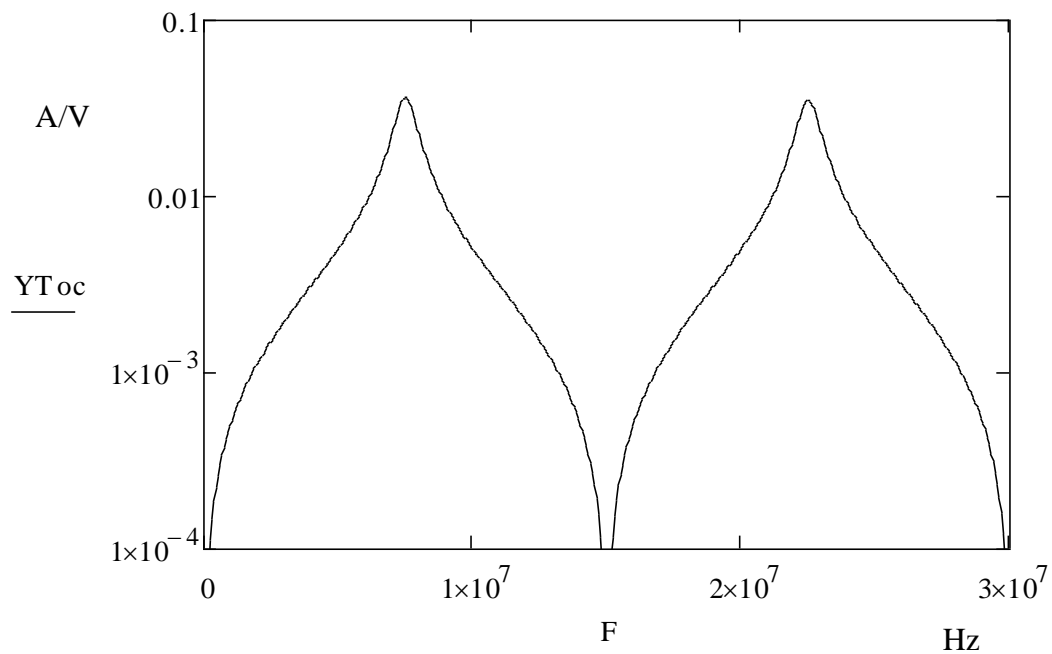


Figure 4.4.6 Transfer admittance of floating configuration