ECE 232 – Lab 5

Laboratory Study (25.03.2016)

In your laboratory work, you have to find corner frequency of the high pass circuit. In laboratory suppelementary notes, corner frequency was found as 483 Hz. (see **supplimentary notes for Lab5** in course webpage)

In that note:

$$frequency\ response:\ \ H(jw) = \frac{Vout\ (jw)}{Vin\ (jw)}$$

$$H(jw) = \frac{Vout\ (jw)}{Vin\ (jw)} = \frac{I\ x\ R}{I\ x\ (R + \frac{1}{jwc})}$$

$$H(jw) = \frac{I\ x\ R}{I\ x\ (R + \frac{\mathbf{1}}{\boldsymbol{jwc}})} = \frac{R}{R - \frac{\boldsymbol{j}}{\boldsymbol{wc}}} = \frac{w * 33 * 10^3}{w * 33 * 10^3 - 10^8 j}, \boldsymbol{we\ multiply\ \frac{1}{jwc}\ with\ j}$$

$$|H(jw)| = \frac{w * 33 * 10^3}{\sqrt{(w * 33 * 10^3)^2 + (-10^8)^2}}$$

How do we find this equation? We know that if we want to compute magnitude of the complex number then;

$$Z = a + bj$$

$$|Z| = \sqrt{a^2 + b^2}$$

So in our equation ;

$$|H(jw)| = \frac{w * 33 * 10^3}{\sqrt{(w * 33 * 10^3)^2 + (-10^8)^2}}\ ,\qquad w * 33 * 10^3 = a, and\ -10^8 = b$$

$$|Z| = \sqrt{(w * 33 * 10^3)^2 + (-10^8)^2}$$

$$|Z| = \sqrt{(w * 33 * 10^3)^2 + 10^{16}}$$

Thus,

$$|H(jw)| = \frac{w * 33 * 10^3}{\sqrt{(w * 33 * 10^3)^2 + 10^{16}}}$$

And our corner frequency is

$$\frac{w * 33 * 10^3}{\sqrt{(w * 33 * 10^3)^2 + 10^{16}}} = \frac{1}{\sqrt{2}}$$

$$\frac{w^2 * 33^2 * 10^6}{(w * 33 * 10^3)^2 + 10^{16}} = \frac{1}{2}$$

$$2 * w^2 * 33^2 * 10^6 = (w * 33 * 10^3)^2 + 10^{16}$$

$$2 * w^2 * 33^2 * 10^6 - (w * 33 * 10^3)^2 = 10^{16}$$

$$w^2 * 33^2 * 10^6 = 10^{16}$$

$$w^2 = \frac{10^{10}}{33^2} \Rightarrow w = \frac{10^5}{33} \Rightarrow f \cong 483\ Hz$$

But what we did in laboratory (Section 4) is :

$$H(jw) = \frac{Vout\ (jw)}{Vin\ (jw)} = \frac{I\ x\ R}{I\ x\ (R + \frac{1}{jwc})} = \frac{R}{R + \mathbf{\frac{1}{jwc}}}$$

$$|H(jw)| = \frac{R}{\sqrt{(R)^2 + (\mathbf{\frac{1}{jwc}})^2}}$$

From this equation we found that

$$w^2 = -\frac{10^4}{33}\ which\ is\ incorrect!$$

If our number is complex number $Z = a + bj$, then we use $|Z| = \sqrt{a^2 + b^2}$ equation to find magnitude. So, in our equation

$$H(jw) = \frac{R}{(R + \frac{1}{jwc})}$$

$$|H(jw)| = \frac{R}{\sqrt{(R)^2 + (\mathbf{\frac{1}{wc}})^2}}$$

$$\frac{33 * 10^3}{\sqrt{(33 * 10^3)^2 + (\frac{1}{w * 10^{-8}})^2}} = \frac{1}{\sqrt{2}}$$

$$\frac{33^2 * 10^6}{(33 * 10^3)^2 + (\frac{1}{w * 10^{-8}})^2} = \frac{1}{2}$$

$$33^2 * 10^6 * 2 = (33 * 10^3)^2 + (\frac{1}{w * 10^{-8}})^2$$

$$33^2 * 10^6 * 2 - (33 * 10^3)^2 = (\frac{1}{w * 10^{-8}})^2$$

$$33^2 * 10^6 = (\frac{1}{w * 10^{-8}})^2$$

$$w^2 * 10^{-16} = \frac{1}{33^2 * 10^6} \Rightarrow w^2 = \frac{1}{33^2 * 10^{-10}}$$

$$w = \frac{10^5}{33} = \Rightarrow f \cong 483\ Hz$$

Calculation problem in laboratory is that we didn't ignore "j" even if magnitude of the complex number is $|Z| = \sqrt{a^2 + b^2}$.