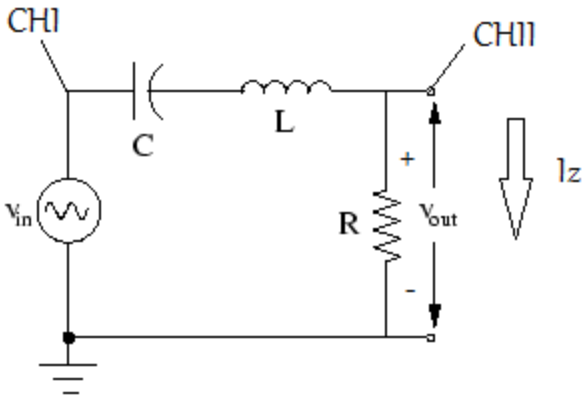
Ece 232 - Advanced Electrical Circuit Analysis Lab Manual 4



$L = 0.1\ H, C = 10\mu F, R = 1k\Omega$

$V_{in}(t) = 1 \sin 2\pi ft$

$f = 2500Hz$

CHI ➔ *The voltage observed over the Z* (V_Z) *where* $Z = sL + \frac{1}{sC} + R$

[Since all components are in series]

CHII ➔ $V_{out} = RI_Z$ ➔ $I_Z(in\ mA)$ [I_Z is the total current over the impedance Z]

- ✓ V_Z *is shown by CHI in Volts.*
- ✓ I_Z *is shown by CHII in mAmpers.*

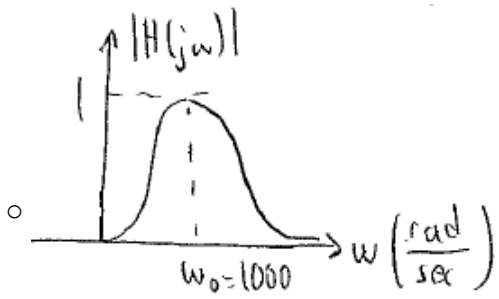
Hence the CHI vs. CHII will show the voltage/current relation for Z.

$$|H(jw)| = \frac{1000\text{jw}}{\sqrt{(10^5 - 0.1\text{w}^2)^2 + (1000\text{w})^2}}$$

$$H(jw) = \frac{V_{out}(jw)}{V_{in}(jw)} = \frac{1000\text{jw}}{(10^5 - 0.1\text{w}^2) + (1000\text{jw})}$$

- ✓ Resonant frequency equate real part of the denominator of H(jw) to 0.

Hence $10^5 - 0.1\text{w}^2 = 0$ ➔ $w_o = 1000\text{rad/sec}$ {resonant freq.}

- 

- If f=2500Hz and w=15700rad/sec

$$H(jw) = \frac{1000\text{jw}}{(10^5 - 0.1\text{w}^2) + (1000\text{jw})}$$

$$\angle H(jw) = \angle V_{out}(jw) - \angle V_{in}(jw) = 90 - \tan^{-1}\frac{1000\text{w}}{(10^5 - 0.1\text{w}^2)}$$

$w = 0$ ➔ $\angle H(jw) = 90$

$w = w_0 = 1000 rad/sec$ ➔ $\angle H(jw) = 0$

$w = 15700 rad/sec$ ➔ $90 - \tan^{-1}\frac{1000\text{w}}{(10^5 - 0.1*(15700)^2)} = 90 - \tan^{-1}\frac{157}{-245.49}$

$$\angle H(jw) = 90 - 148 = -58$$

$$\angle H(jw) = \angle V_{out}(jw) - \angle V_{in}(jw) = \angle I_Z - \angle V_Z = -58$$

$V_{in}(V_Z) is\ leading\ V_{out}(I_Z) by\ 58^0$. ➔The impedance is inductive.

$$T = \frac{1}{f} = \frac{1}{2500Hz} = 0.4msec$$

d: phase distance

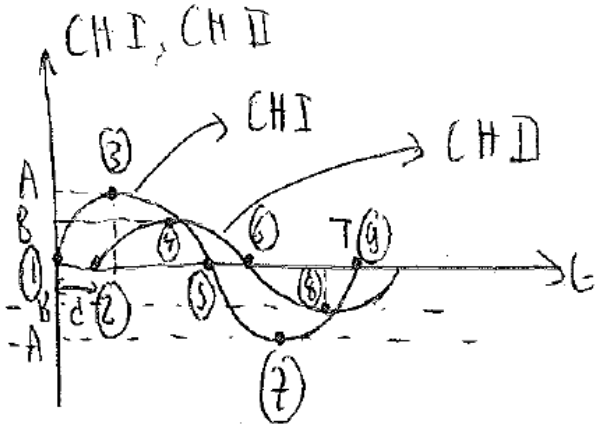
θ: phase difference $= \frac{d}{T} * 360$

$$\angle H(jw) = -\angle Z(jw) = -58$$

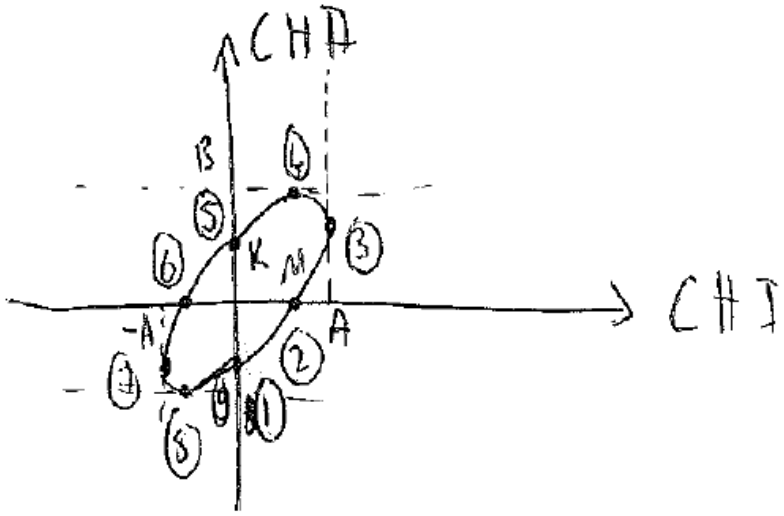
$$\angle Z(jw) = 58\ \{V_Z is\ leading\ I_Z,\ I_Z\ is\ lagging\ V_Z\}$$

$|\angle Z(jw)| = \frac{A}{B}$ $when\ w = 15700 rad/sec$

- Y-T mode [CHI and CHII are drawn w.r.t time t]



- Corresponding X-Y mode



$|\angle Z(jw)| = \frac{A}{B}$

$\angle Z(jw) = \arcsin\frac{K}{B} = \arcsin\frac{M}{A}$

Although we can find the phase by $\angle Z(jw) = \arcsin\frac{K}{B} = \arcsin\frac{M}{A}$ we cannot identify precisely whether the phase is lagging or leading (we cannot say CHI is leading or lagging)