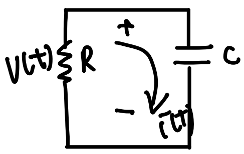
lect11 Part 1 Reasonance → interpret

Mechanical Reasonance → 机械上的共振

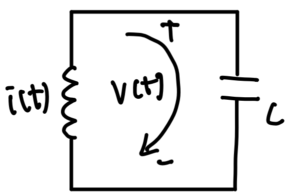


source free

free running

$(R+\frac{1}{j\omega C})I=0$ ← complex number

KVL to loop. ⇒ $I=0$ 稳态



$(j\omega L+\frac{1}{j\omega C})\cdot I=0$

⇓

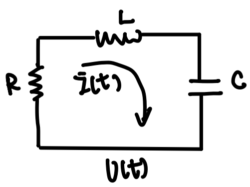
$j\omega L+\frac{1}{j\omega C}=0$ ⇒ $j\omega L=-\frac{1}{j\omega C}$

⇒ $\omega=\frac{1}{\sqrt{LC}}$

$\omega_0$ ~ Reasonance Resonant freq.

$i(t)=Re\{Ie^{j\omega_0 t}\}=|I|\cos(\omega_0 t+\theta)$

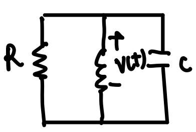
$v(t)=Re\{\frac{I}{j\omega_0 C}e^{j\omega_0 t}\}=\frac{|I|}{\omega_0 C}\sin(\omega_0 t+\theta)$



$Z_s\cdot I=0$ KVL apply to loop.

$Z_s=R+\frac{1}{j\omega C}+j\omega L$

⇒ only $I=0$



$\frac{V}{R}+\frac{V}{j\omega L}+\frac{V}{\frac{1}{j\omega C}}=\frac{V}{Z_p}=0$ ⇒ $\frac{1}{\frac{1}{R}+j(\omega C-\frac{1}{\omega L})}$

$R\neq0$ $Z_p\neq0$

$Z_p\cdot I=0$ → $I=0$ 纯RLC不可能共振/谐振.

$\omega=\frac{1}{\sqrt{LC}}$ can cancel the tune.

## Freq. domain response of LTI system.

dissipate LTI system with a co-sinsoidal source

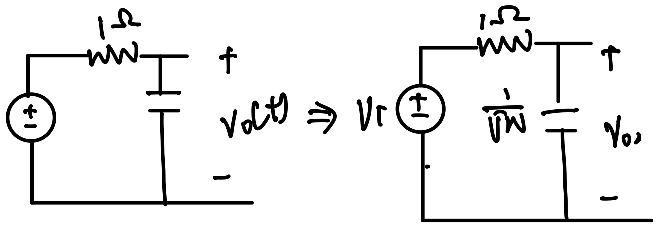
$f(t)=Re\{Fe^{j\omega t}\}=|F|\cos(\omega t+\angle F)$

$f(t)\to\boxed{LTI}\to y(t)$

$y(t)=Re\{Ye^{j\omega t}\}=|Y|\cos(\omega t+\angle Y)$

$Y=H(\omega)F$ Y is propotional to F through $H(\omega)$

↳ freq response of ckt.




freq response.

$F = V_i$

$Y = V_o$

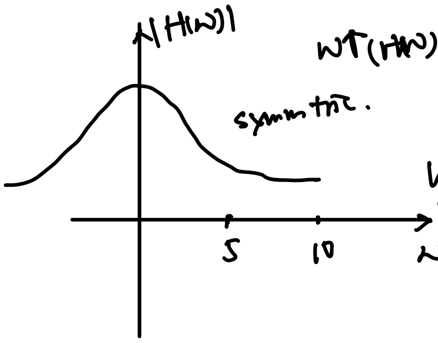
$\frac{V_o}{V_i} = H(w)$

$V_o = \frac{\frac{1}{jw}}{1+\frac{1}{jw}} V_i \rightarrow \frac{V_o}{V_i} = \frac{1}{1+jw}$

$w\uparrow (|H(w)|)\downarrow$

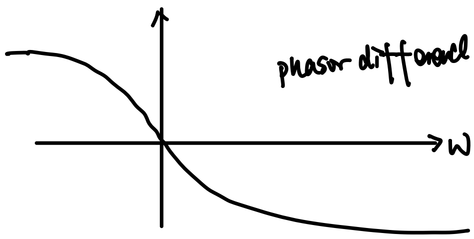
$|H(w)| = \frac{1}{\sqrt{1+w^2}}$

$\angle H(w) = \tan^{-1}\left(\frac{1-jw}{1+w^2}\right)$




symmetric.

low pass response.

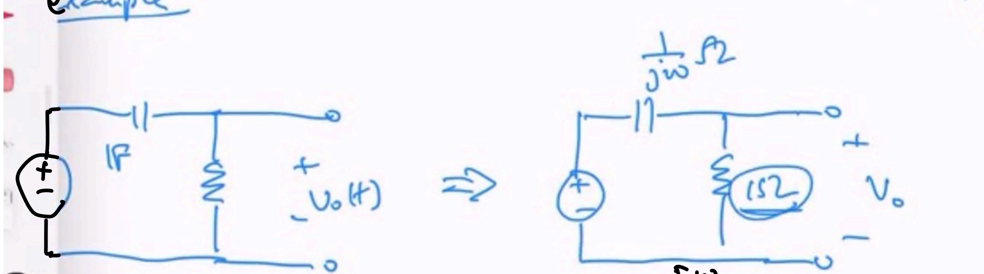



phasor difference

Comments

1. An input signal with freq. near zero pass with nearly unity scaling at the amplitude.
   Input at higher freqs. will be attenuated
2. low-pass filter of lowest order.
3. H(w) phase of H(w) depends on frequency.
   phase of output is retarded by 90° at high enough freq.

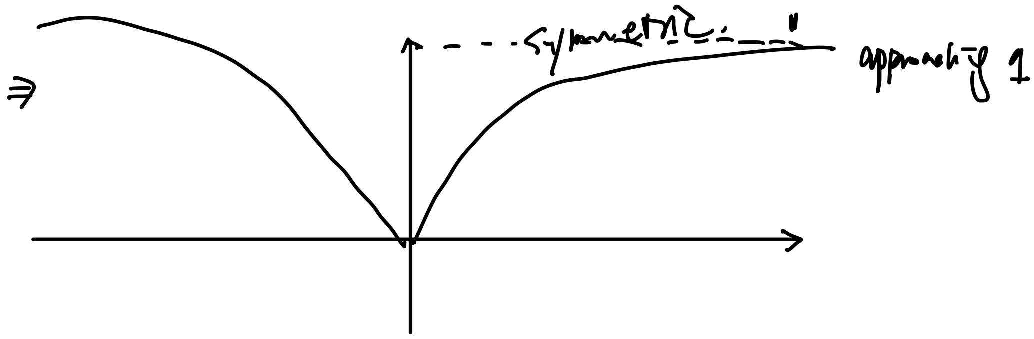
example

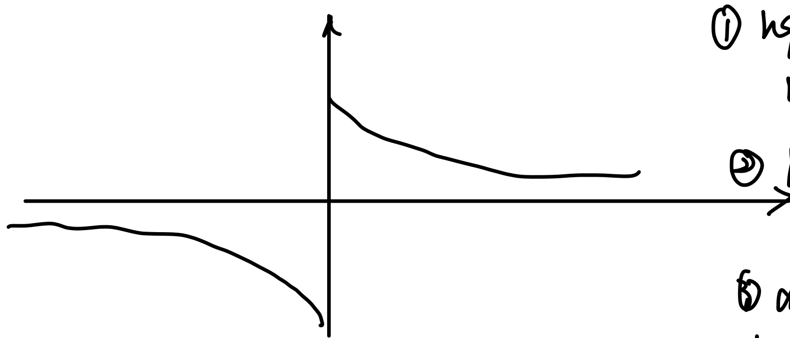



$V_o = \frac{1}{1+\frac{1}{jw}} V_i \Rightarrow \frac{V_o}{V_i} = H(w) = \frac{jw}{1+jw}$

$|H(w)| = \frac{|w|}{\sqrt{1+w^2}}$ $\angle H(w) = \tan^{-1}\frac{1}{w}$

$\Rightarrow$

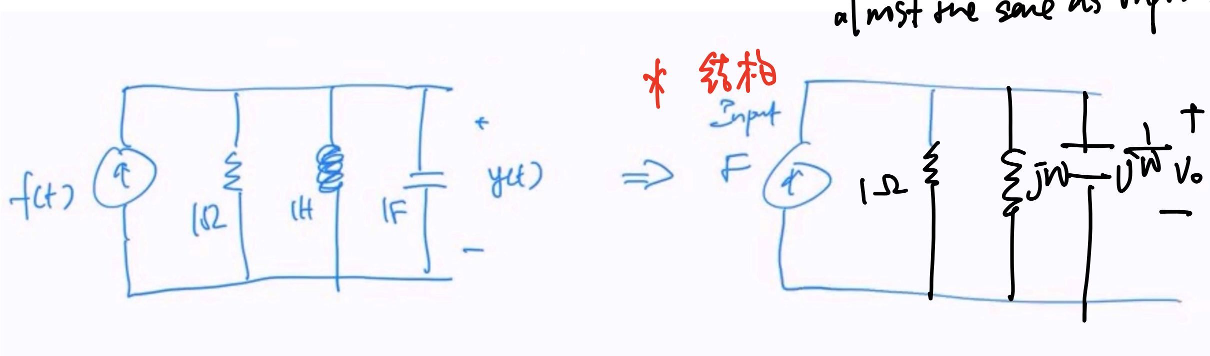


① high pass filter of lowest order.

② phase of output advance by $90°$.

③ at very high freq output almost the same as input.




$$Y = Z_p F$$

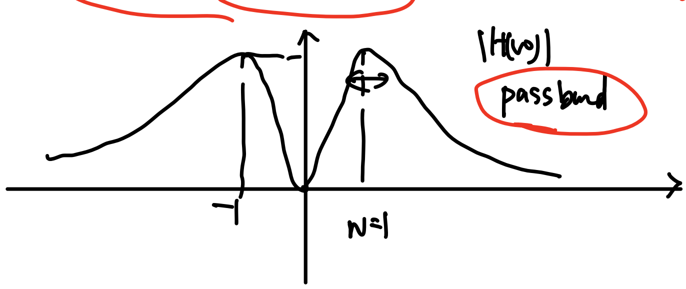
$$F = \frac{1}{1+\frac{1}{jw}+jw} = \frac{jw}{jw+1-w^2} \qquad H(w) = \frac{Y}{F} = \frac{jw}{1-w^2+jw}\ \Omega$$

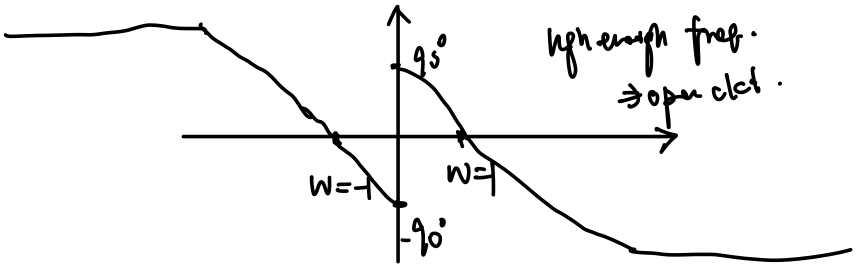
$$|H(w)| = \frac{|jw|}{|1-w^2+jw|} = \frac{w}{\sqrt{(1-w^2)^2+w^2}}$$

$$\angle H(w) = \tan^{-1}\frac{1-w^2}{w}$$

band pass filter.

$\Rightarrow$






high enough freq.

⇒ open ckt.