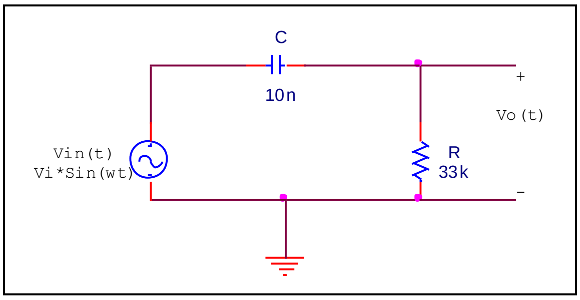
ECE 232-Lab5

Low-pass, High-pass and Band-pass filters

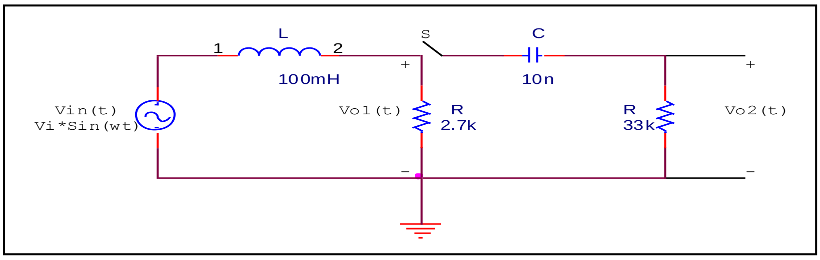
Preliminary Work:

1. Consider the circuit below



Determine the frequency response function H(jw)=Vo(jw)/Vi(jw) and sketch the magnitude and phase characteristics (ie. |H(jw)| and arg(H(jw)) vs w). Indicate the half-power frequency w_c, where $|H(jw_c)|^2$ $|H(jw)|^2_{max}/2$.

2. Consider the circuit below.



a. For S open, determine and sketch the frequency response function H1(jw)=Vo1(jw)/Vin(jw). Indicate the half-power angular frequency.

b. For S closed, determine and sketch the frequency response function H2(jw)=Vo2(jw)/Vi(jw). Indicate the half-power frequencies, wc1, wc2, the resonant angular frequency wo and the angular bandwidth Δw=wc2-wc1. Show that H2(jw)~=H1(jw)*H(jw) where H(jw) is found in part1, since loading is negligible.

3. Propose a method to obtain the frequency response of the circuits experimentally.

Experimental work:

1. Set up the circuit in part 1 of preliminary work. Plot magnitude and phase characteristics of |H(jw)| showing wc. What is the type of this filter?

2.a. Set up the circuit in part 2 of preliminary work. Plot magnitude and phase characteristics of |H1(jw)| showing wc. What is the type of this filter?

2.b Set up the circuit in part 2 of preliminary work. Plot magnitude and phase characteristics of |H2(jw)| showing wc1 and wc2. What is the type of this filter?

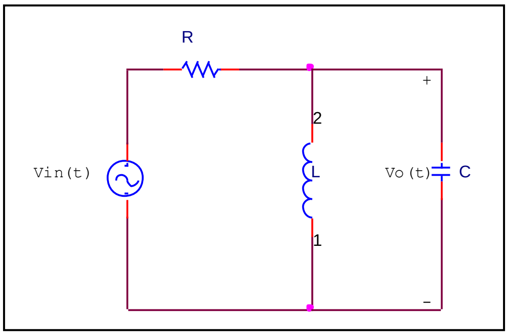
High-pass filter	YT-mode	YT-mode	XY-mode	XY-mode
f(Hz)	$\|H(jw)\|$	$\angle H(jw)$	$\|H(jw)\|$	$\angle H(jw)$
f≈20				
f=200				
$f=f_c$				
f=1000				
f=5000				

Low-pass filter	YT-mode	YT-mode	XY-mode	XY-mode
f(Hz)	$\|H(jw)\|$	$\angle H(jw)$	$\|H(jw)\|$	$\angle H(jw)$
f≈20				
f=2000				
$f=f_c$				
f=6000				
f=20000				

Band-pass filter	YT-mode	YT-mode	XY-mode	XY-mode
f(Hz)	$\|H(jw)\|$	$\angle H(jw)$	$\|H(jw)\|$	$\angle H(jw)$
f≈20				
f=200				
$f=f_c$				
f=1400±100				
f=4800±100				
f=20000				

Preliminary Work: (continuation of preliminary work of lab 6)

3. Consider the circuit below,



L=0.1H
W_0=10 krad/sec
Vin(t)=Vi*Sin(wt)

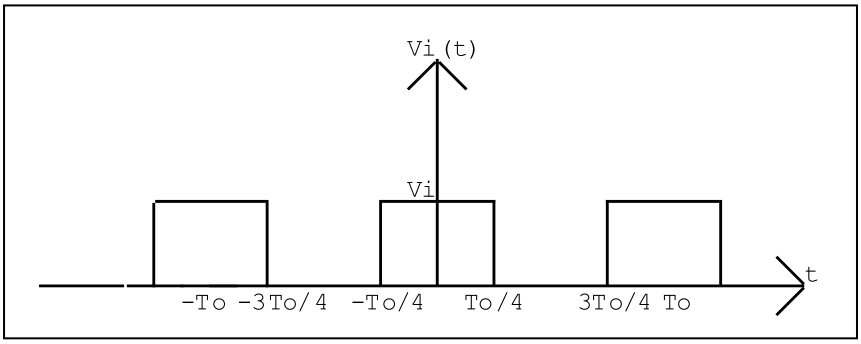
a. For R=3.3kΩ find C, the bandwidth Δw and the quality factor Q=wo/ Δw.

b. For R=10 kΩ find C,Q and bandwidth. Determine and sketch the frequency response function H(jw)=Vo(jw)/Vin(jw). Indicate the half-power angular frequencies and the resonant angular frequency wo

c. A square wave of frequency fo=wo/2π is applied to the circuit of above circuit with element values as in part b. Since the input is periodic with period To=1/fo seconds, it can be represented as a linear combination of sinusoids (Fourier series representation)

Vi(t)=Vi[(1/2)+(2/π)(cos(wot)- (2/3π)(cos(3wot)+ (2/5π)(cos(5wot).....]

Find and sketch Vo(t).

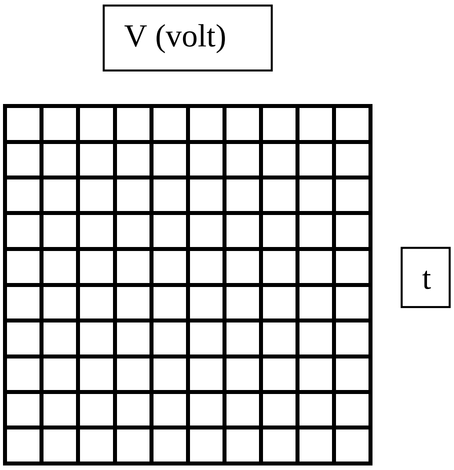


4. Comment on the filtering characteristics of the circuits considered in the preliminary work.

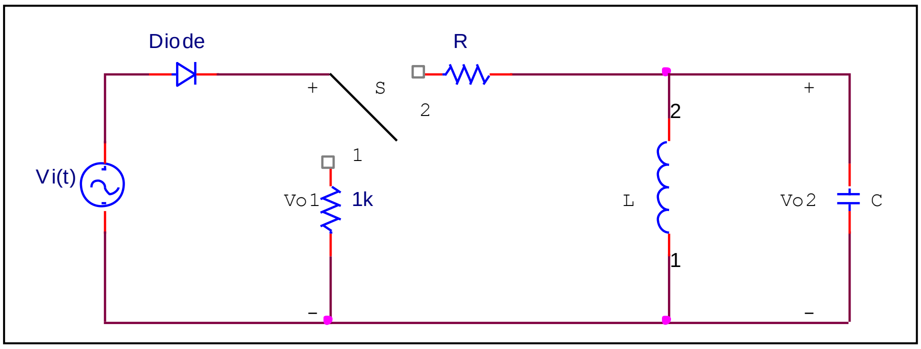
Experimental Work:

1. Set up the circuits in part 3.b of preliminary work determine and sketch the magnitude and phase characteristics of the frequency response function H(jw)=Vo(jw)/Vin(jw). Find the practical wo and compare it with the theoretical one.

2. Set up the circuits in part 3.c of preliminary work, Plot Vi(t) and Vo(t) together. In what way the input and the output are related. Explain.



3. Set up the circuit in figure below using the element values as in the preliminary work part 3.b.



For S in position 1 observe and plot Vo1(t). For S at position 2 observe and plot Vo1(t) and Vo2(t). Comment on the results.