Lab Session 2 – Hardware
Passive Filters

Objectives:

Upon completion of this experiment, the student will be able to:

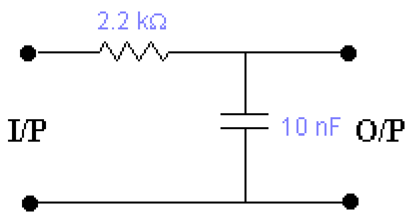
1. Analyze passive filter design
2. Understand the complementary nature of HPF, LPF and BPF, BSF

Equipment and Components Required:

- NI-ELVIS II+ Kit
- NI Prototyping Board
- Resistors (0.33 k, 1 k, 2.2 k, 3.3 k).
- Capacitors (10 nF, 100 nF).
- Diodes.

A: Low Pass Filter:

1. Adjust the function generator module in the NI software interface to generate a sinusoidal wave of frequency 500 Hz.
2. Connect the input wave produced by the generator to channel(0) of the oscilloscope (You can do this by connecting FGEN node which is the output of the function generator to any of AI0+,AI1+,AI2+…..AI7+. Then **if** you chose AI0+ then you should connect AI0- to ground. Afterwards, set channel (0) source to AI0 in the software interface) and run its software interface.
3. Measure the amplitude and frequency of the sinusoidal wave in step 2.
4. Now, connect the (FGEN) node to the input node (ground is common) of the shown circuit which you are supposed to build on the bread-board:



5. Connect the output node of the circuit to channel (1) (You can use the same procedure as in step 2 with a different AI of course) of the oscilloscope.
6. Measure the amplitude of the output signal in volts.
7. Change the frequency of the input signal from the function generator software interface to (1KHz, 5KHz, 10KHz, 15KHz and 20KHz) and measure the output voltage in each case and fill in table(1) in your answer sheet.

8. Draw the output voltage amplitude against the input frequency in your answer sheet (figure (1)).
9. Repeat the steps (1 -to- 7) for an input square wave and fill in the table in your answer sheet (table (1)).

Q1: What happens at low frequencies and high frequency?
Q2: Why does the output waveform differ for different frequencies?
Q3: Draw the voltage waveform on R & C at frequencies 1KHz and 20KHz for the same input signal.

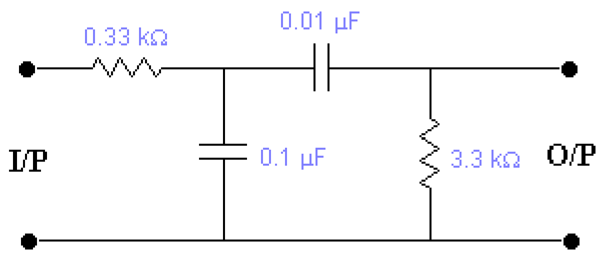
B: High Pass Filter:

1. Reverse the positions of the capacitor and the resistor.
2. Repeat the steps of the Low Pass Filter, fill in the table (table (2)) and draw the required wave forms (figure (2)).

Q4: What happens at low frequencies and high frequency?
Q5: Why does the output waveform differ for different frequencies?
Q6: Draw the voltage waveform on R & C at frequencies 1KHZ and 20KHZ for the same input signal.
Q7: What is your conclusion by comparing results from low pass and high pass?

C: Band Pass Filter:

1. Connect the shown circuit:



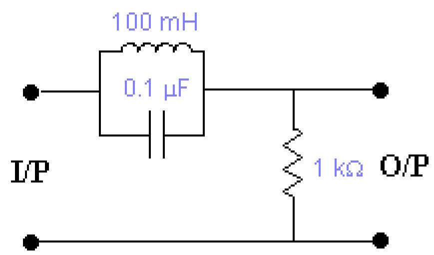
2. Connect a sinusoidal input wave of frequency 500HZ from the frequency generator to the input terminals of this circuit.
3. Measure the output voltage amplitude and fill in the table (table (3)) in your answer sheet.
4. Repeat for different frequencies and fill in the same table.
5. Plot the output voltage against input frequency in figure (3) in your answer sheet.
6. Repeat using a square wave as an input and fill in the same table.

Q8: What is the frequency corresponding to maximum output?
Q9: What is the 3dBs point of the filter?
Q10: What is the Band width of this filter?

Q11: Why does the waveform of the output signal in case of square wave input signal -at the center frequency- take that shape?

D: Band Stop Filter:

1. Connect the shown circuit on the NI kit bread-board:
2. Apply a sinusoidal input wave of frequency 500Hz to the circuit input.
3. Measure the output voltage amplitude and fill in the table (table (4)) in your answer sheet.
4. Use a sinusoidal input signal of different frequencies and fill in the same table.
5. Plot the output voltage amplitude against frequency in figure (4) in your answer sheet.
6. Repeat for an input square wave and fill in the same table.



Q12: What is the center frequency of this filter?
Q13: What is the Band width of this filter?

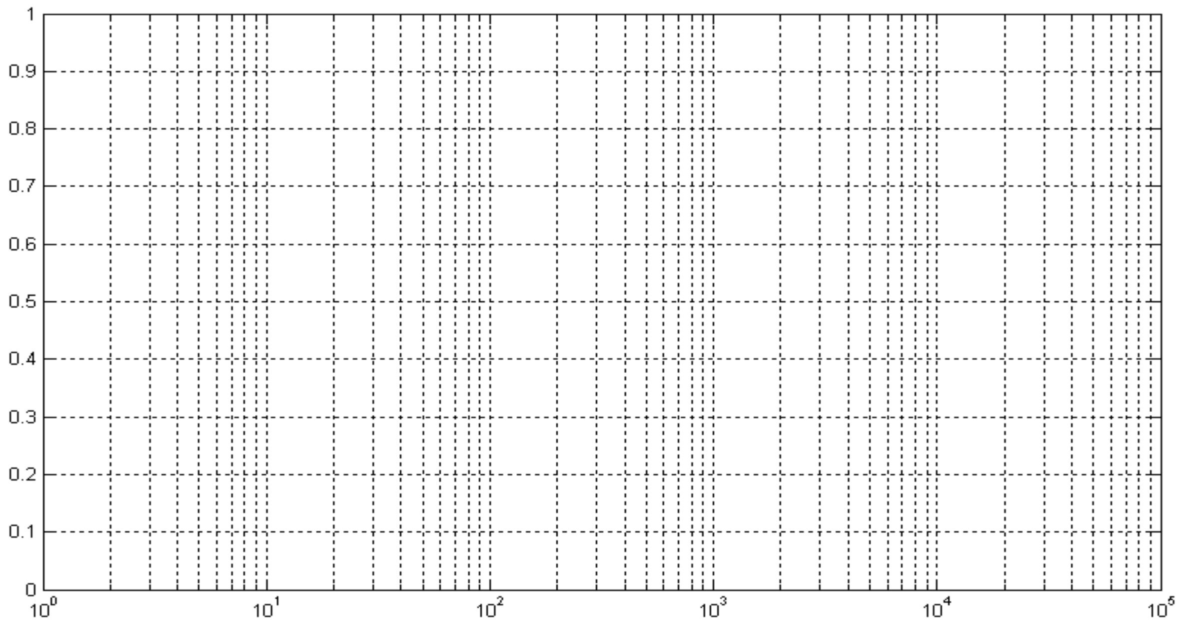
Lab Session 2 – Hardware – Answer Sheet

Name:

Table (1):

Frequency (HZ)	500	1000	5000	10000	15000	20000
Vout [Sin.] (volt)						
Vout [SQW.] (volt)						

Figure (1):



Answer to Q1:

- At low frequencies:...
  ....
- At high frequencies:...
  ....

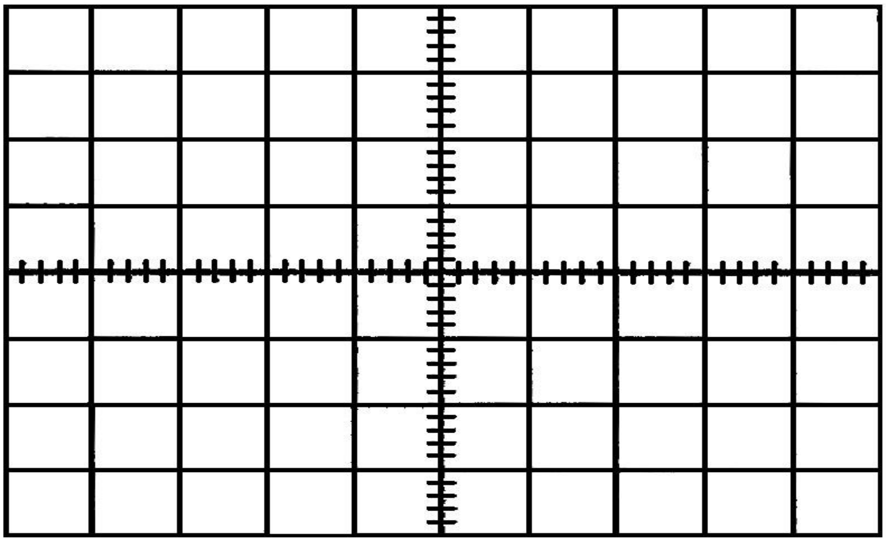
Answer to Q2:

The output waveform differs for different frequencies because: ....

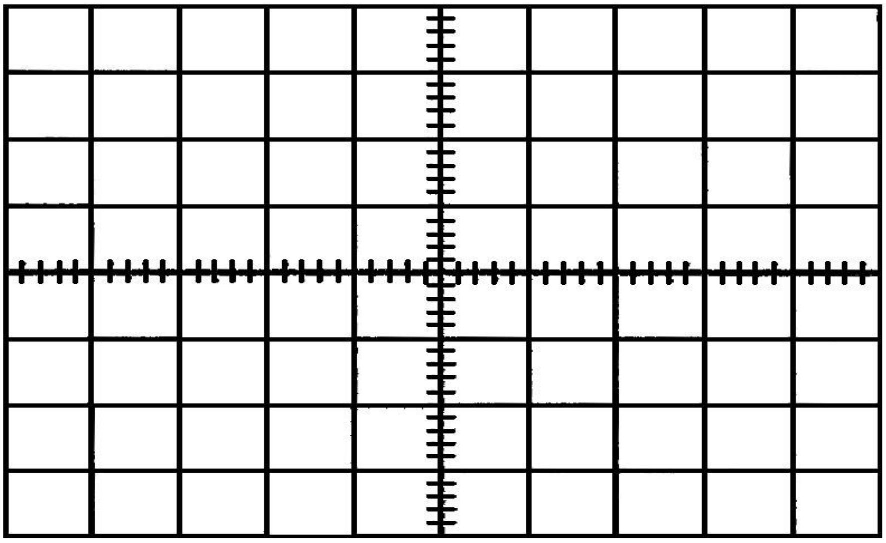
....

<u>Answer to Q3:</u>

Voltage on R:



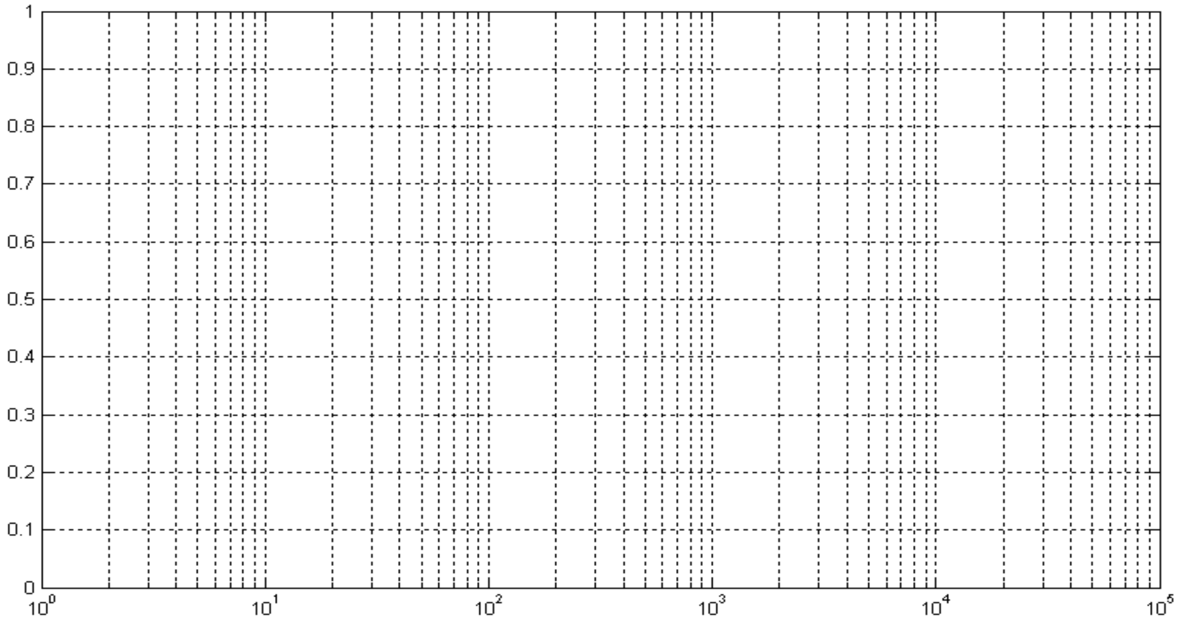
Voltage on C:



<u>Table (2):</u>

Frequency (HZ)	500	1000	5000	10000	15000	20000
Vout [Sin.] (volt)						
Vout [SQW.] (volt)						

Figure (2):



Answer to Q4:

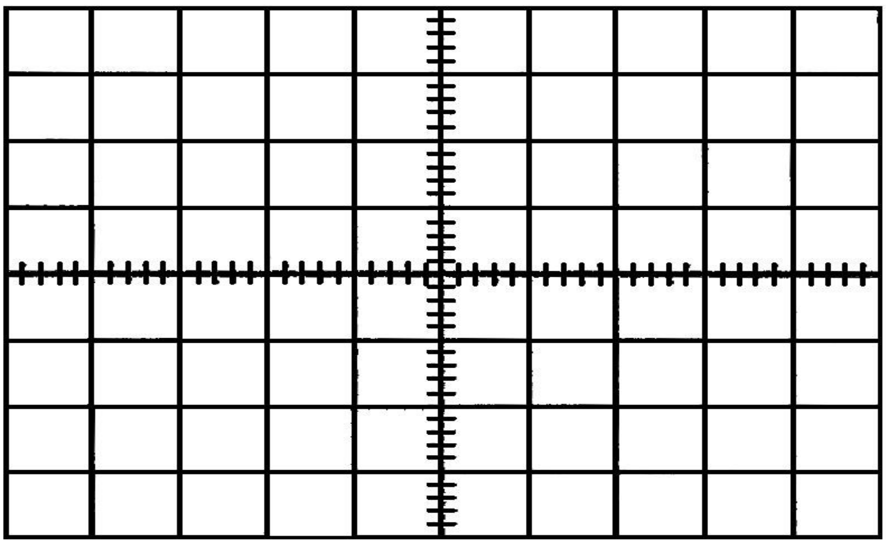
- At low frequencies:..
  ....
- At high frequencies:..
  ....

Answer to Q5:

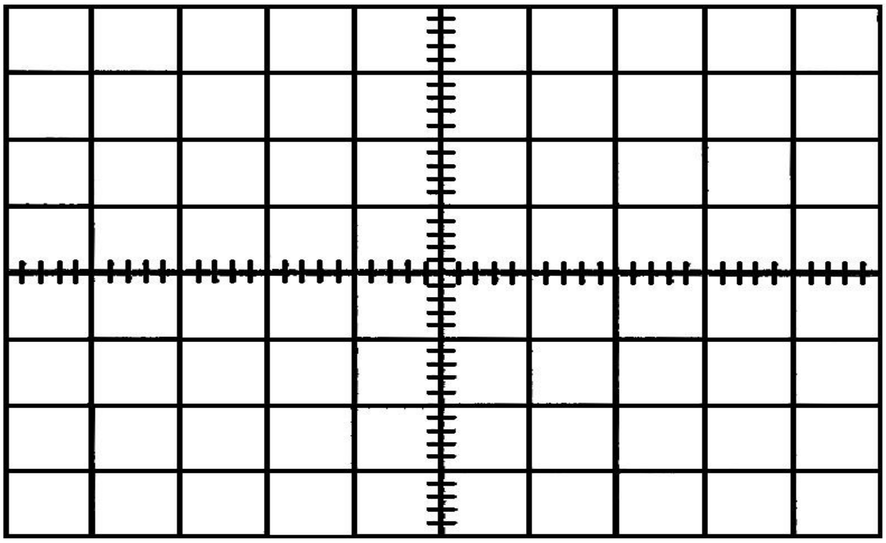
The output waveform differs for different frequencies because: ....
....

Answer to Q6:

Voltage on R:



Voltage on C:



Answer to Q7:

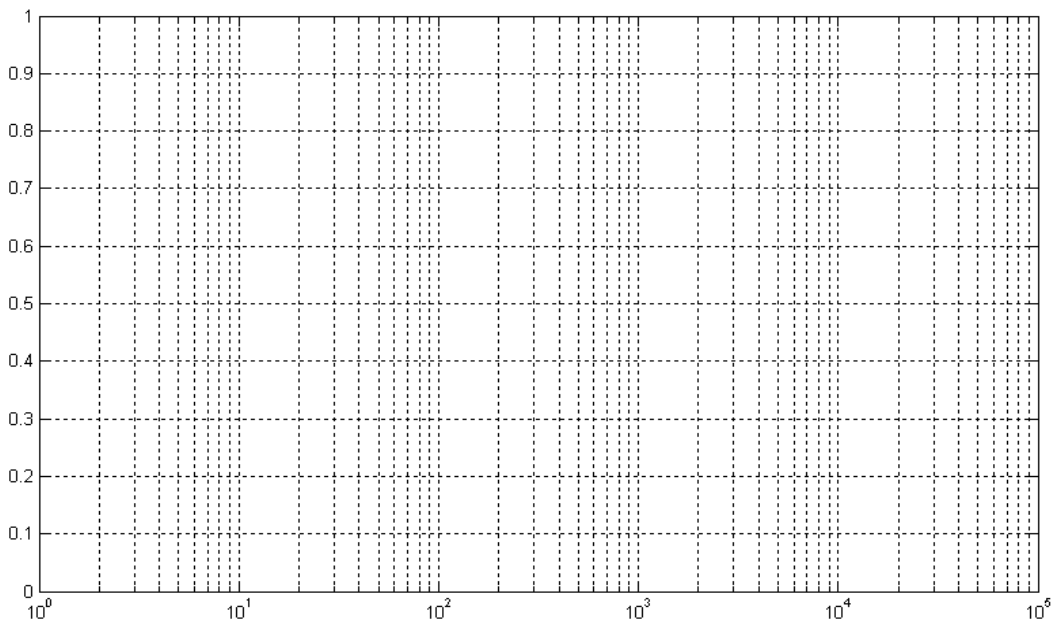
I conclude that: ……………………………………………………………………………………………

……………………………………………………………………………………………

Table (3):

Frequency (HZ)	500	1000	5000	10000	15000	20000
Vout [Sin.] (volt)						
Vout [SQW.] (volt)						

Figure (3):



Answer to Q8:

The frequency corresponding to maximum output is: .... HZ

Answer to Q9:

The 3dBs point of the filter is: ....

Answer to Q10:

The Band width of this filter is: .... HZ

Answer to Q11:

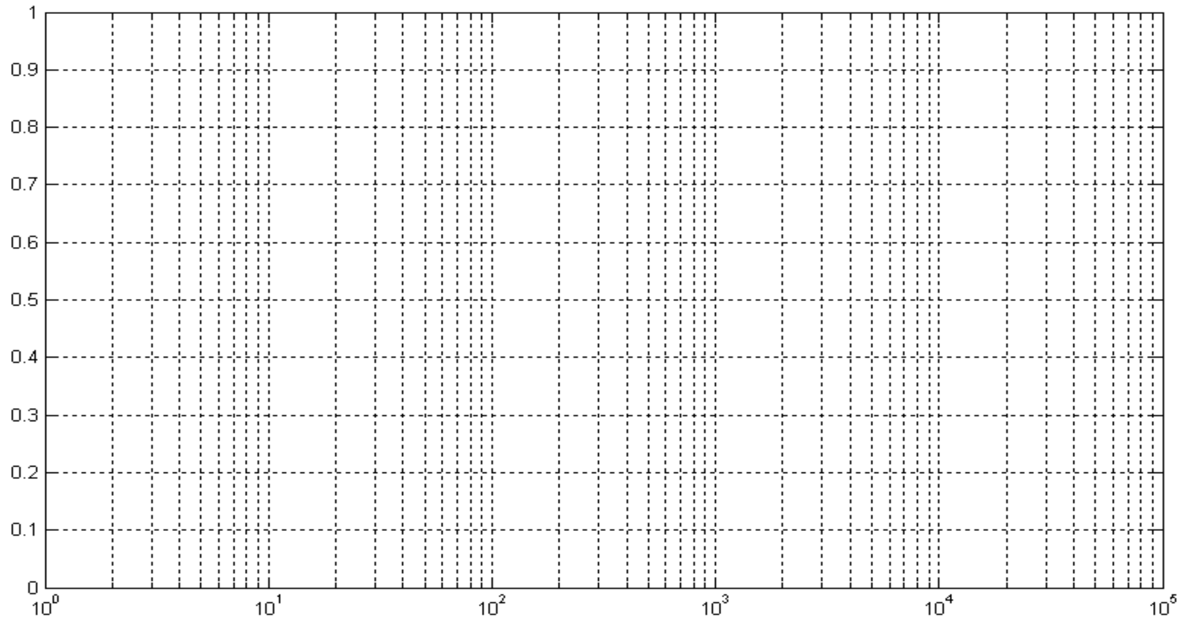
The waveform of the output signal in case of square wave input signal -at the center frequency- take that shape because: ....

....

Table (4):

Frequency (HZ)	500	1000	5000	10000	15000	20000
Vout [Sin.] (volt)						
Vout [SQW.] (volt)						

Figure (4):



Answer to Q12:

The center frequency of this filter is: .... HZ.

Answer to Q13:

The Band width of this filter is: ……………………. HZ.