KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
DEPARTMENT OF ELECTRICAL ENGINEERING
Electronic Circuits II – EE303

Experiment # 7
Active Filters

OBJECTIVE

To measure the transfer functions of several active filters and to determine their corner frequencies, or center frequency and to determine their roll-off rates from the frequency responses.

PRELAB WORK

Students must perform the following calculations and PSPICE before coming to the lab.

1. For the different active-filter configurations shown in Figure 1 and 2 perform an approximate hand calculation assuming that the operational amplifiers are ideal. In each case sketch the expected transfer function and calculate the corner frequency, or the center frequency, the gain of the filter configuration and its pass band, or bandwidth.

2. Using SPICE, simulate the different configurations and from SPICE output file calculate the corner frequency, or the center frequency, the gain of the filter configuration and its pass band, or bandwidth. The second model for simulation op-amps is shown in Figure 3. This model is more sophisticated than the first model presented in Experiment 3, as it models the finite input resistance, the finite differential gain, the finite output resistance, the frequency dependence of the differential gain and the limiting characteristics of the op-amp. Figure 3 also shows an example of how to call the op-amp SUBCIRCUIT. Try to use the SUBCIRCUIT concept in your simulation.
   For the SPICE simulations take the input voltages of the order of 1V amplitude and obtain the frequency range from your hand calculations in step 1.

You must have your SPICE output file with your hand calculations ready before you come to the lab.

EXPERIMENTAL WORK

1. Construct the circuits shown in Figure 1 and 2. Apply sinusoidal input voltage with constant amplitude, of the order of 1V, and vary the frequency within the range decided by your hand calculations of the prelab. In each case monitor the input and output voltages on a dual trace oscilloscope. Measure the ratio between output and input voltages and plot your results on the same sheet obtained from SPICE output.

2. From your measurements obtain the corner frequency, or the center frequency, the gain of the filter in the pass band and its band, or bandwidth.

3. Compare your hand calculations, SPICE simulations and experimental measurements and tabulate them in Table I.

4. Comment on your results.

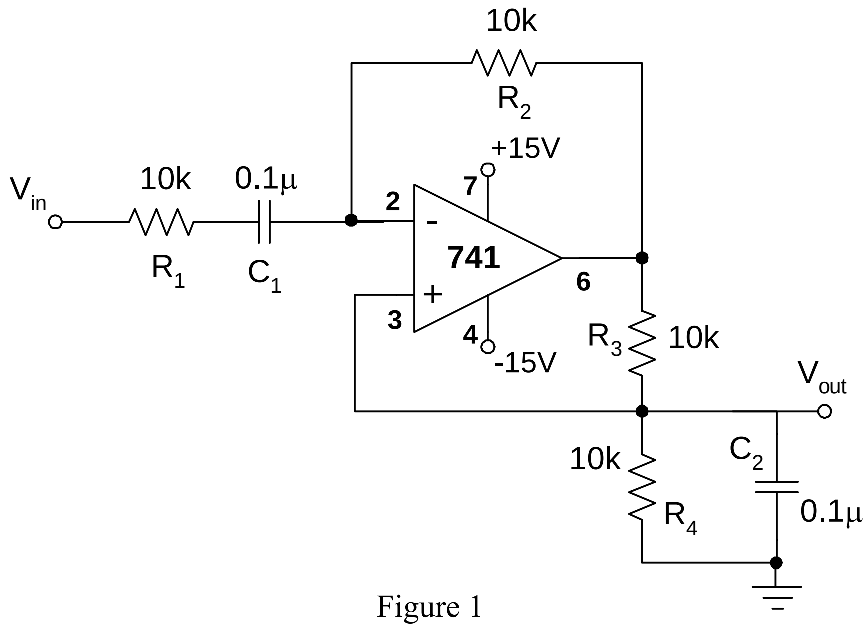


Figure 1

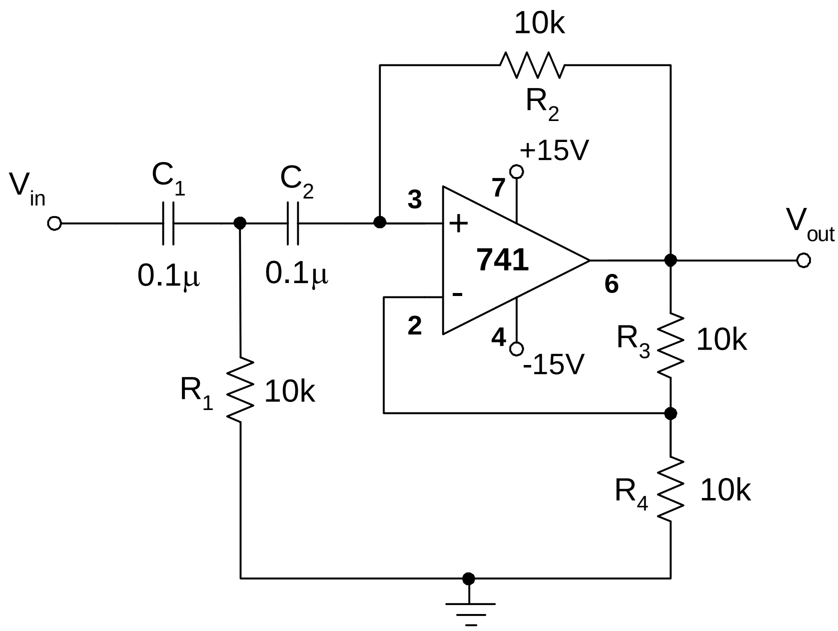
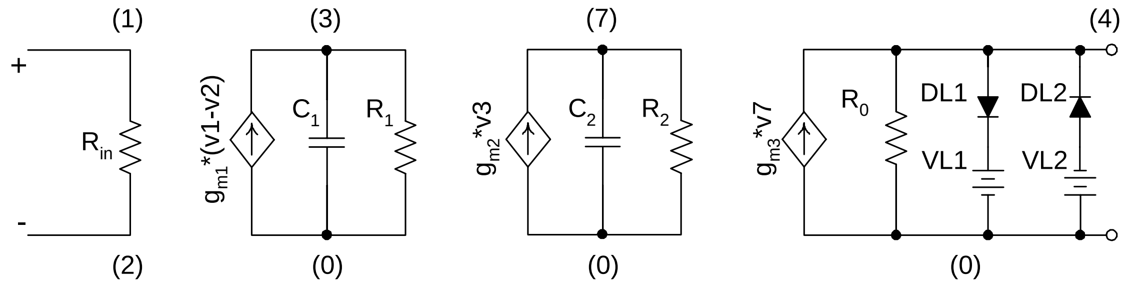


Figure 2




```
.SUBCKT OPAMP     1    2    4
RIN     1    2    400K
GM1     3    0    1    2    200m
R1      3    0    1MEG
C1      3    0    0.0159uF
GM2     0    7    3    0    1m
R2      7    0    1K
C2      7    0    39.8pF
GM3     0    4    7    0    5m
R0      4    0    200K
DL1     4    5    DIODE
DL2     6    4    DIODE
VL1     5    0    DC   13V
VL2     0    6    DC   13V
.MODEL       DIODE     D
.ENDS
```

A SUBCKT call for an op-amp connected between points 11, 17, 30 where 11 is the positive input, 17 is the negative input and 30 is the output is:

```
x…..   11   17   30   OPAMP
```

Figure 3. SPICE model for operational amplifier

Table I: Summary of hand calculations, SPICE simulation and experiment

Circuit		Hand Calculation	SPICE Simulation	Experimental Result
Figure 1	MF Gain			
	Center Frequency			
	Bandwidth			
Figure 2	MF Gain			
	Center Frequency			
	Bandwidth			