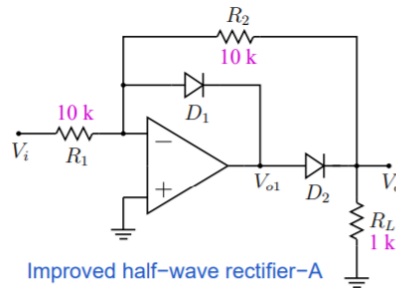


Sheel Shah

19D070052

Expt8

Q1. Improved half wave rectifier A



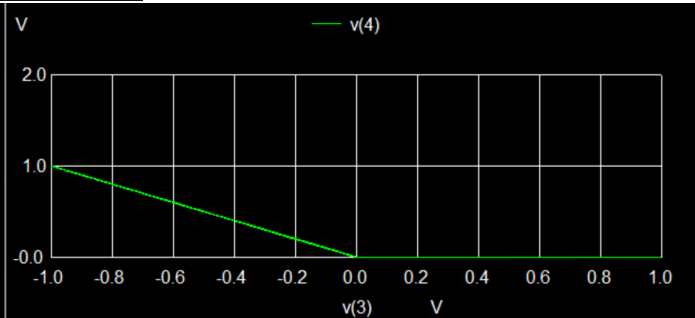
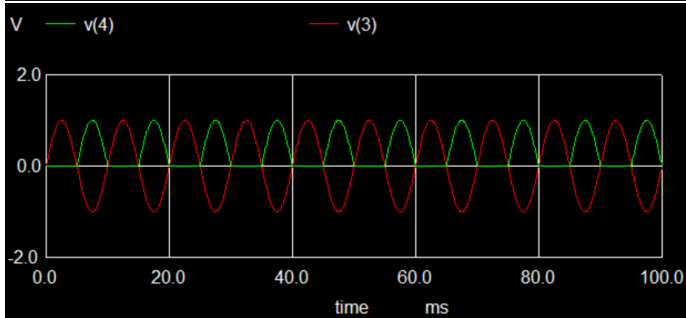
19D070052, Sheel Shah, improved half wave rectifier A

```
.include all_model_files/Diode_1N914.txt
.include all_model_files/ua741.txt
```

```
** nodes:
** 1: opamp -, 2: vo1
** 3: vi, 4 vo
x1 0 1 10 11 2 ua741
v_i 3 0 sin(0 1 100 0 0)
r1 1 3 10k
r2 1 4 10k
d1 1 2 1N914
d2 2 4 1N914
r_l 4 0 1k
```

```
v_cc1 10 0 12
v_cc2 11 0 -12
```

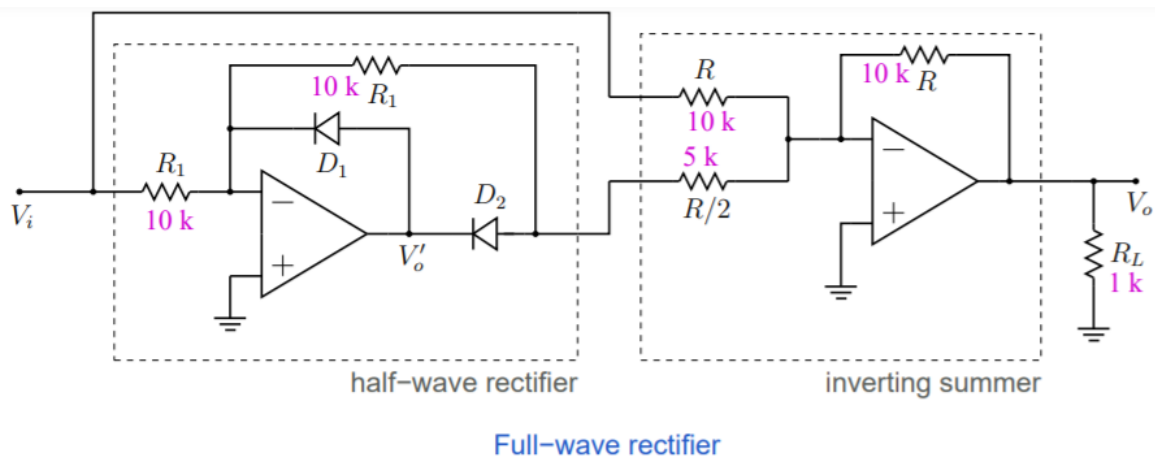
```
.tran 100u 100m
.control
run
plot v(4) v(3)
plot v(4) vs v(3)
.endc
.end
```



Learnings:

- The improved circuit has a better response and there is no delay when input switches from negative, as op amp is never saturated.

Q2. Full wave rectifier

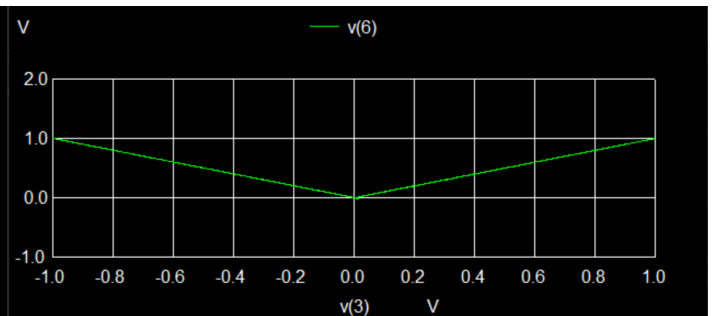
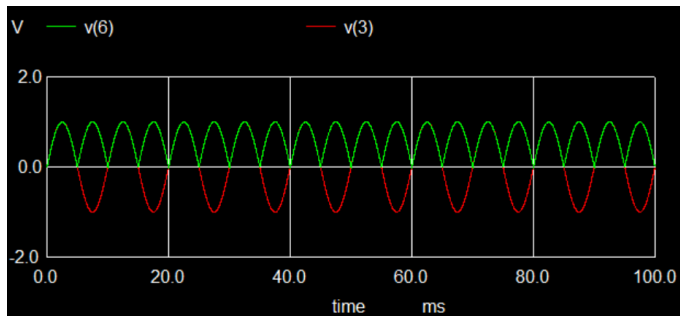


19D070052, Sheel Shah, full wave rectifier

```
.include all_model_files/Diode_1N914.txt
.include all_model_files/ua741.txt
```

```
** nodes:
** 1: opamp1 -, 5: opamp2 -, 2: vo'
** 3: vi, 4 vo1, 6: vo
x1 0 1 10 11 2 ua741
x2 0 5 12 13 6 ua741
v_i 3 0 sin(0 1 100 0 0)
r1 1 3 10k
r2 1 4 10k
d1 2 1 1N914
d2 4 2 1N914
r_r 3 5 10k
r_half 4 5 5k
r_f 5 6 10k
r_l 6 0 1k
v_cc1 10 0 12
v_cc2 11 0 -12
v_cc3 12 0 12
v_cc4 13 0 -12
```

```
.tran 10u 100m
.control
run
plot v(6) v(3)
plot v(6) vs v(3)
.endc
.end
```



Learnings:

- There is no saturation and the output is very good.

Q3. Single pole high pass filter

$$F_c = 1 / (2 \cdot \pi \cdot R_A \cdot C_A) = 338.6 \text{ Hz}$$

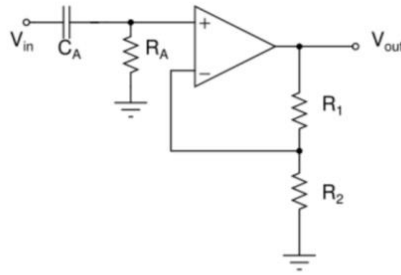


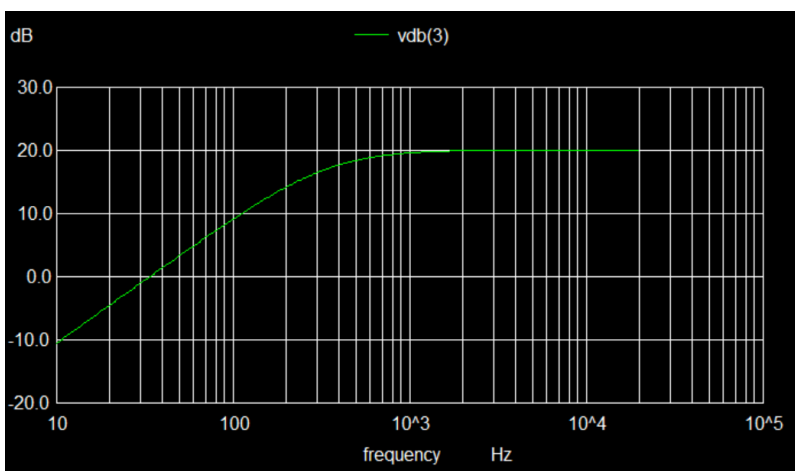
Fig. 2 Single-pole active high-pass filter

```
19D070052, Sheel Shah, single pole high pass filter

.include all_model_files/Diode_1N914.txt
.include all_model_files/ua741.txt

** nodes:
** 1: opamp1 +, 2: opamp1 -, 3: vo
x1 1 2 10 11 3 ua741
v_i 4 0 dc 0 ac 1
c_a 1 4 0.1u
r_a 1 0 4.7k
r1 3 2 9.1k
r2 2 0 1k
v_cc1 10 0 12
v_cc2 11 0 -12

.ac dec 100 10 20k
.control
run
plot vdb(3)
.endc
.end
```



Learnings:

- Expected plot from analysis matches with the simulated plot.

Q4. Sallen Key low pass filter

$$F_c = 1 / (2 * \pi * \sqrt{r_a * r_b * c_a * c_b}) = 338.6 \text{ Hz}$$

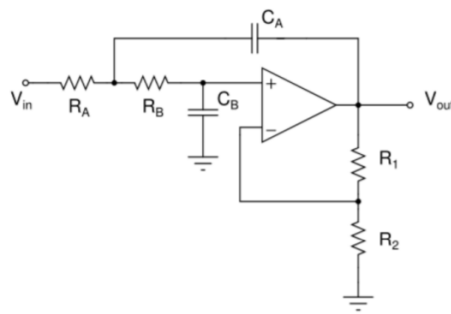


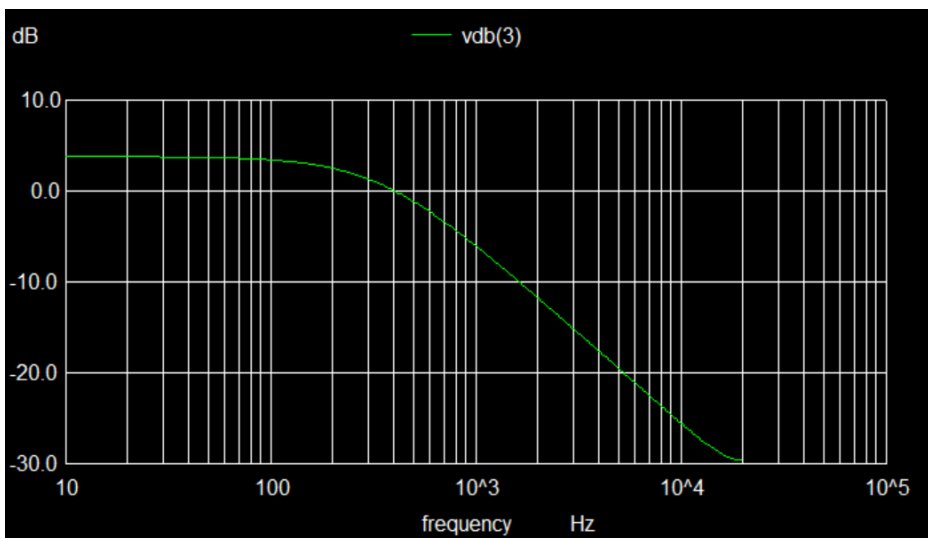
Fig. 3 Sallen-Key (2-pole) active low-pass filter

19D070052, Sheel Shah, , Sallen-Key (2-pole) Active Low-pass Filter

```
.include all_model_files/Diode_1N914.txt
.include all_model_files/ua741.txt

** nodes:
** 1: opamp1 +, 2: opamp1 -, 3: vo
x1 1 2 10 11 3 ua741
c_b 1 0 0.1u
r_b 1 4 4.7k
r_a 4 5 4.7k
c_a 4 3 0.1u
v_i 4 0 dc 0 ac 1
r1 3 2 1.8k
r2 2 0 3.3k
v_cc1 10 0 12
v_cc2 11 0 -12

.ac dec 100 10 20k
.control
run
plot vdb(3)
.endc
.end
```



Learnings:

- Expected plot from analysis matches with the simulated plot.