

**Electrical Engineering Department
Prelab10**

Student Name: abed.hmeadan Id:1161306

Instructor: Dr. Mohammed jubran section:1

T.A :Eng dalal hamdan

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1- Calculate the cut-off frequencies for the low pass and high pass filter circuits shown in Figure 10.5, 10.6, 10.7, and 10.8.

Part A: First order active low-pass filter

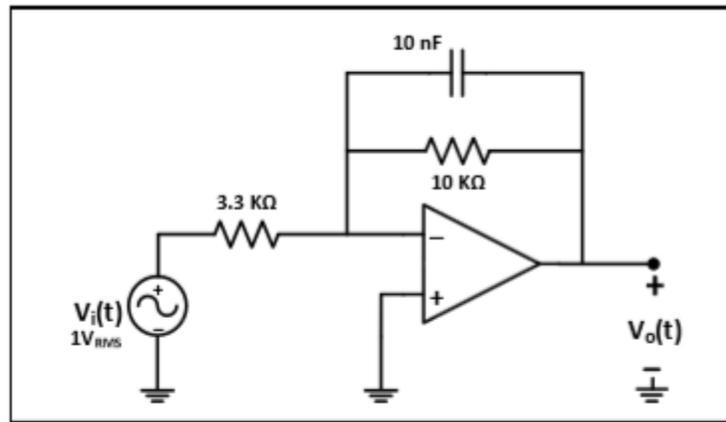


Figure 10.5: First order Active Low Pass Filter

$$f_c = \frac{1}{2 \pi RC} = 1591.5 \text{ Hz}$$

Part B: Second Order Low Pass Butterworth Filter

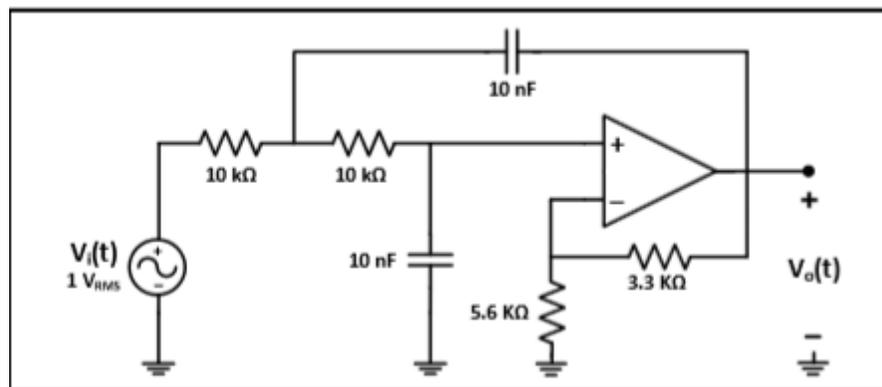


Figure 10.6: Second Order Low Pass Butterworth Filter

$$f_c = \frac{1}{2 \pi RC} = 1591.5 \text{ Hz}$$

Part C: First order active high-pass filter

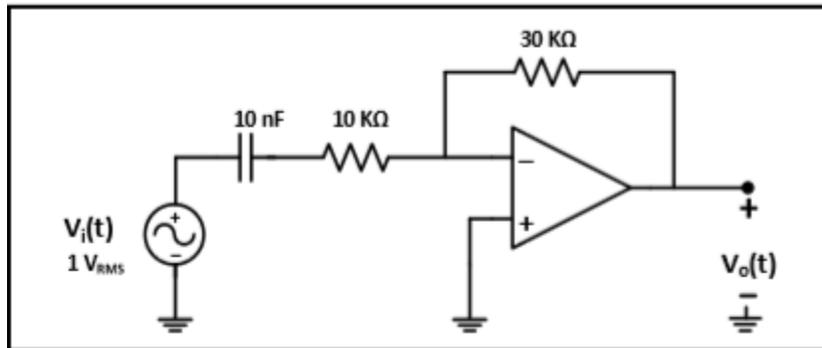


Figure 10.7: First Order Active High-Pass Filter

$$f_c = \frac{1}{2 \pi RC} = 1591.5 \text{ Hz}$$

Part D: Second Order High Pass Butterworth Filter

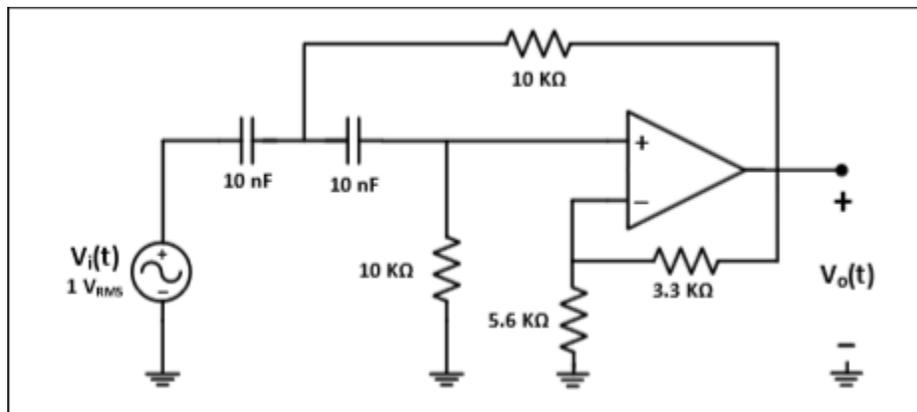
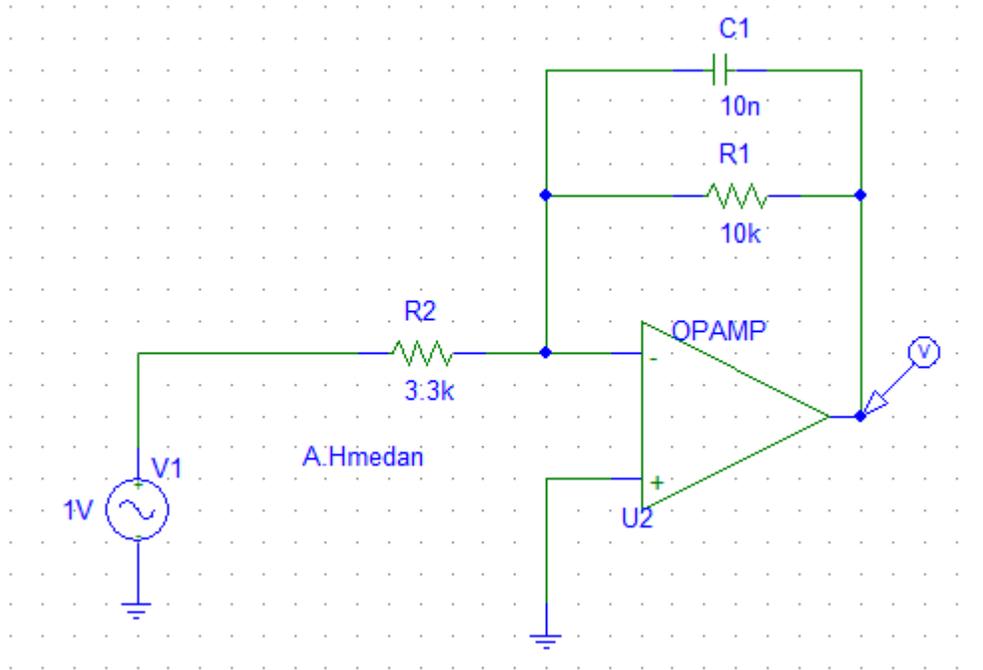


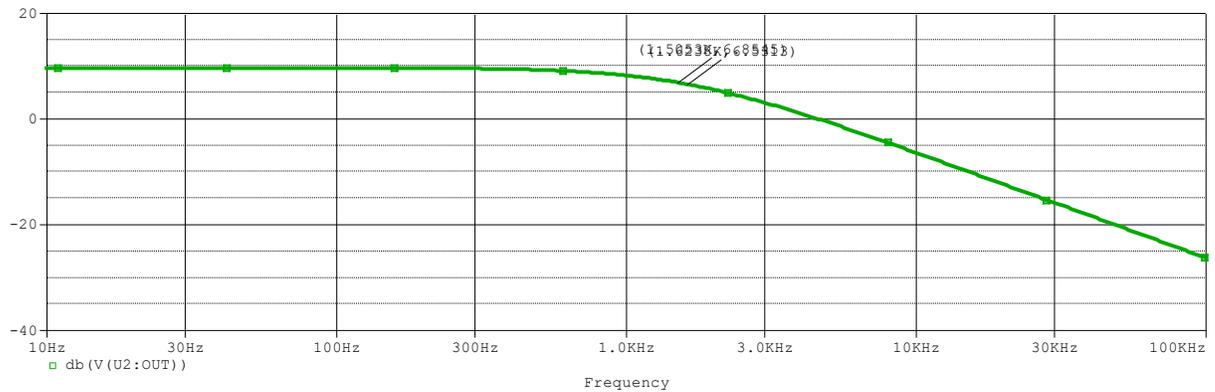
Figure 10.8: Second Order High Pass Butterworth Filter

$$f_c = \frac{1}{2 \pi RC} = 1591.5 \text{ Hz}$$

2- Simulate the circuits in step 1 using ac sweep, use Vac source with 1 V amplitude, and use UA741 Op-amp with +/-15V bias

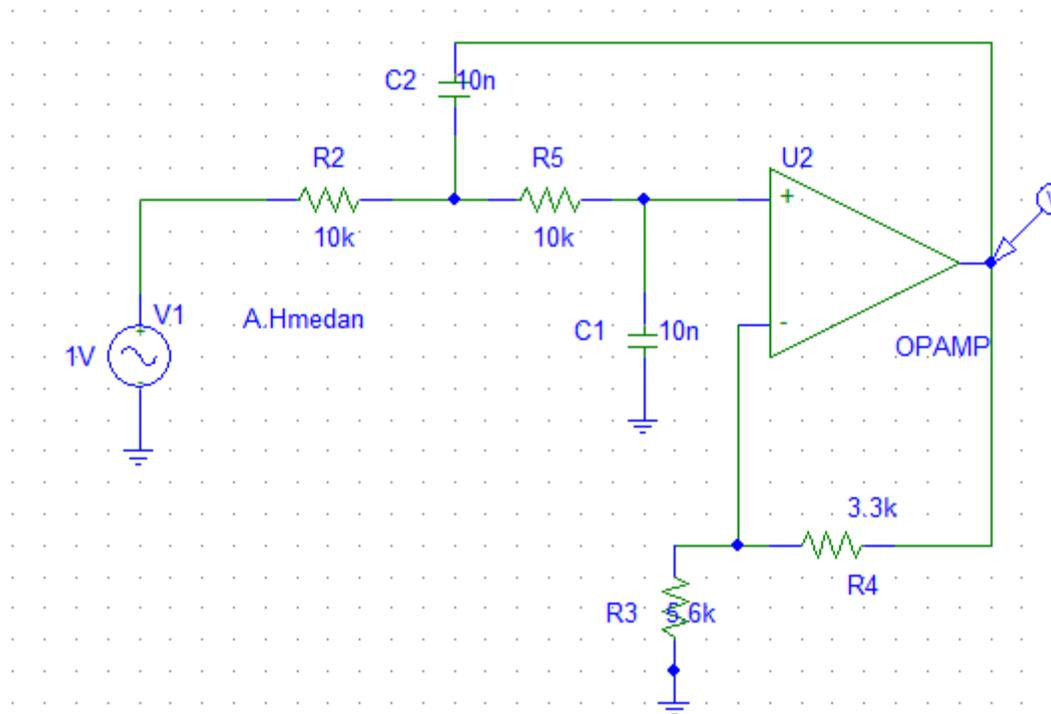
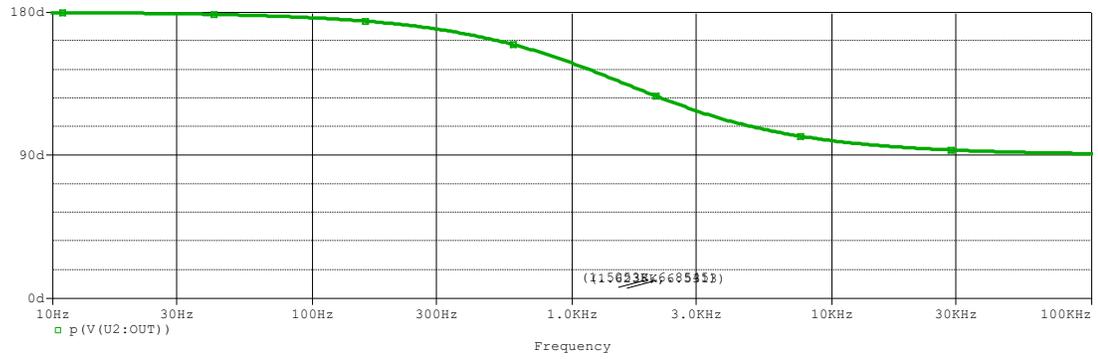


Magnitude

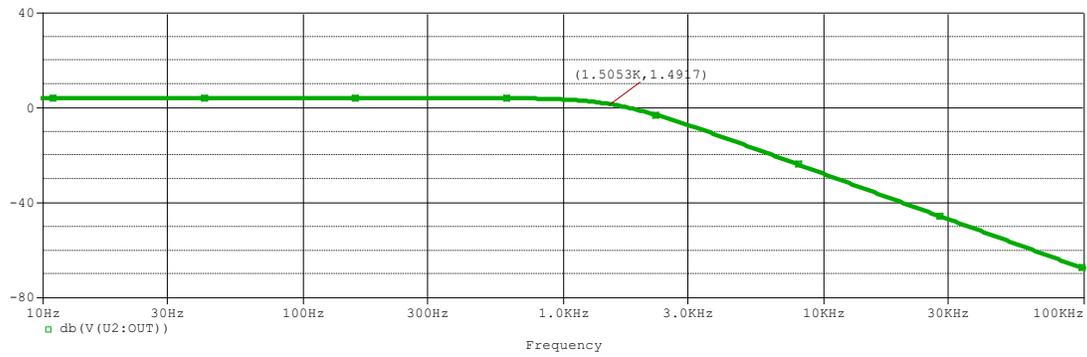


$$f_{-3dB} = 1600 \text{ Hz}$$

Phase

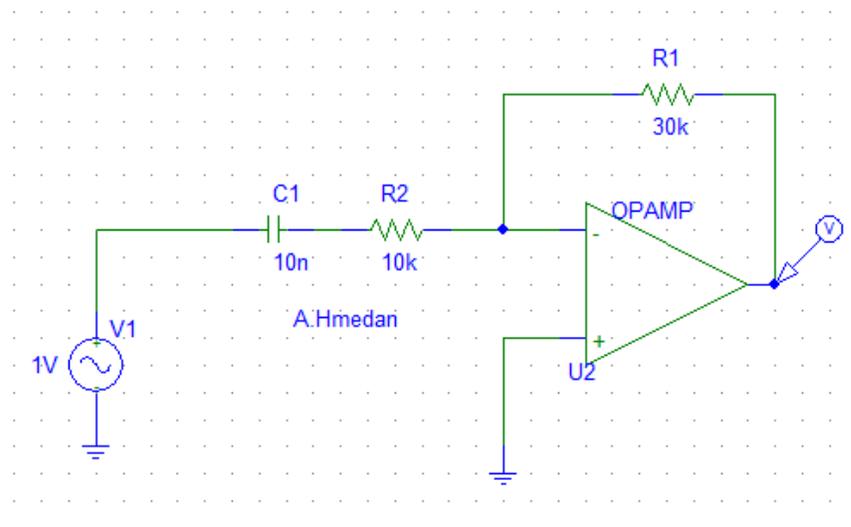
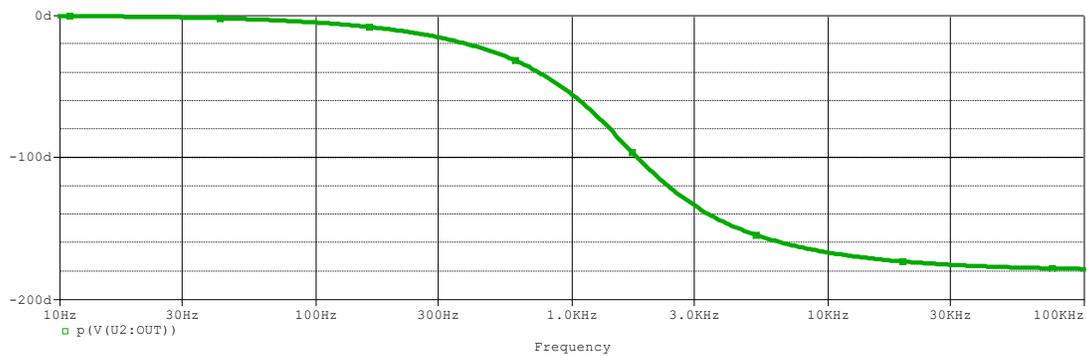


Magnitude

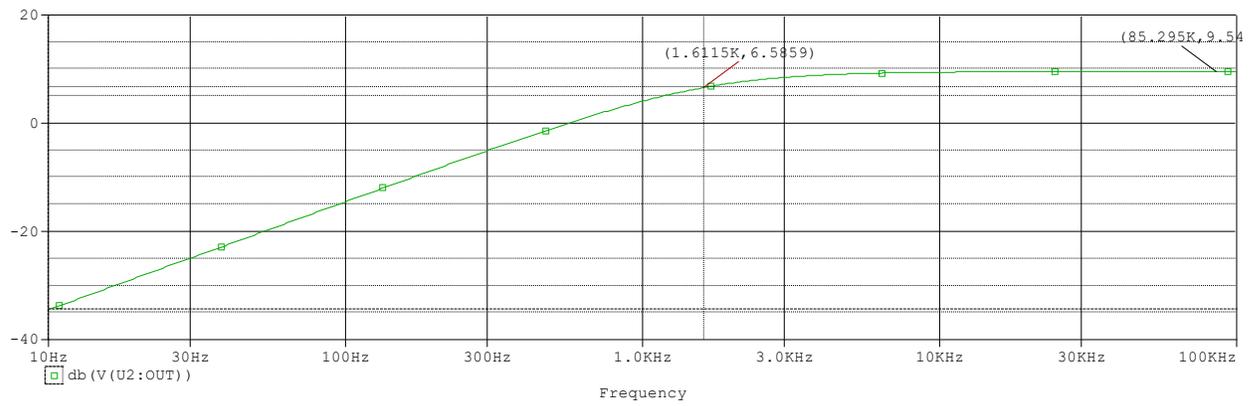


$f_{-3dB} = 1500 \text{ Hz}$

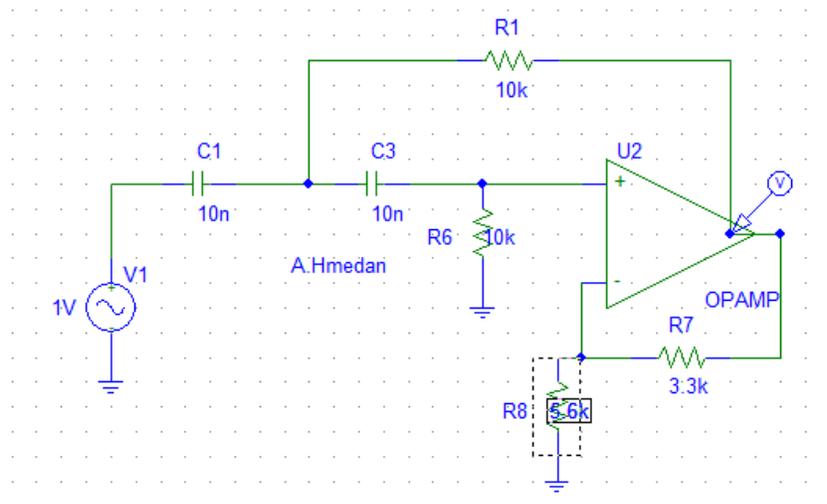
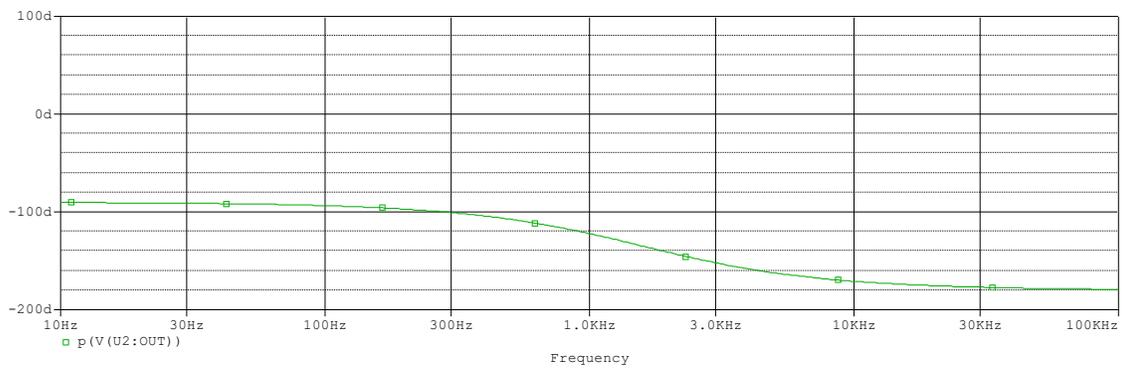
Phase



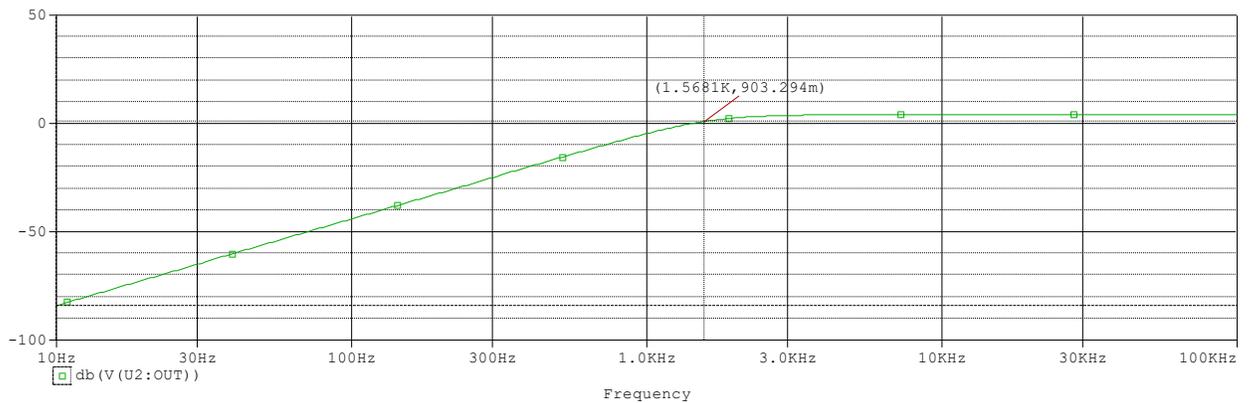
Magnitude



$f_{-3dB} = 1600 \text{ Hz}$

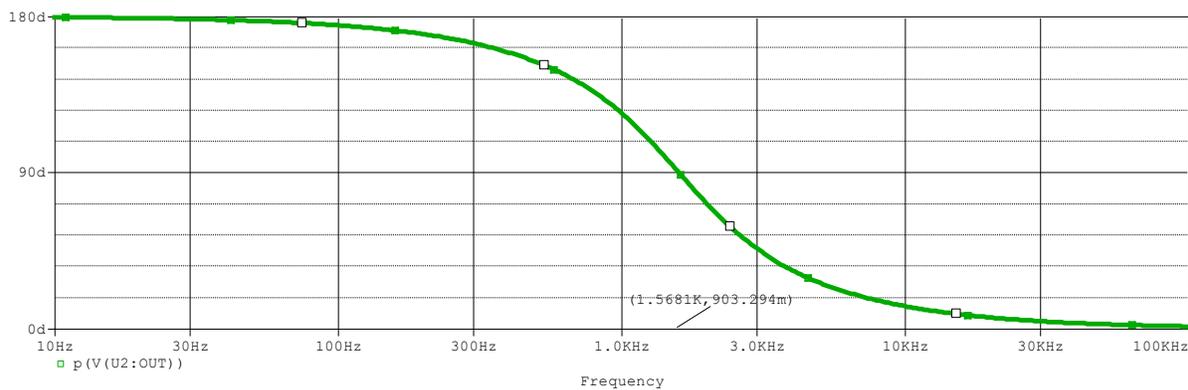


Magnitude



$$f_{-3dB} = 1500 \text{ Hz}$$

Phase



4. Calculate the resonant/center frequency and the two cut-off frequencies for the band-pass and band-reject filter circuits given in Figure 10.9 and Figure 10.10.

Part E: Active band-pass filter

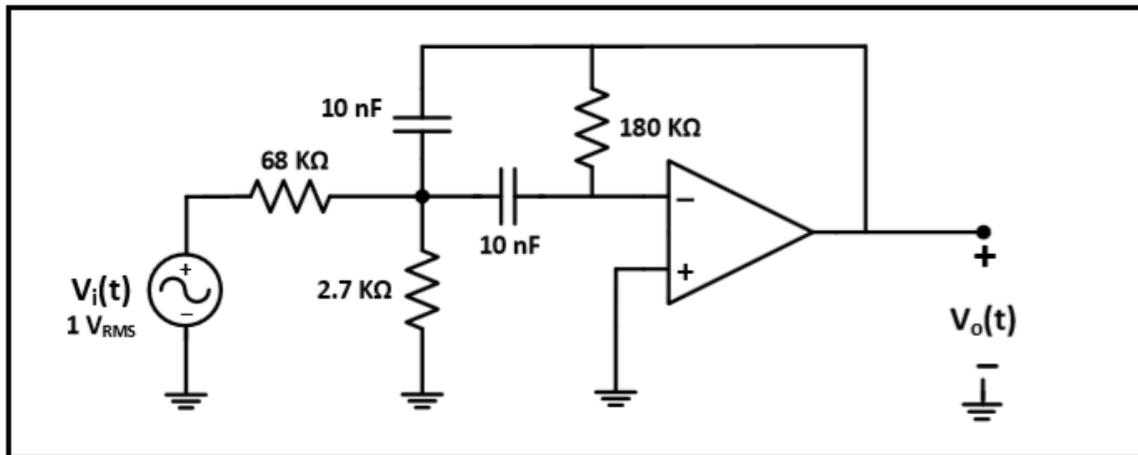


Figure 10.9: Active band pass filter

$$R_{eq} = R_1 \parallel R_2 = \frac{R_1 R_2}{R_1 + R_2}, \quad \beta = \frac{2}{R_3 C}; \quad \omega_o^2 = \frac{1}{R_{eq} R_3 C^2}.$$

$$R_{eq} = 2.6 \text{ K}\Omega$$

$$f_0 = 736 \text{ Hz}$$

$$\beta = 1111$$

$$f_{c1} = f_0 - \beta/2 = 180.5 \text{ Hz}$$

$$f_{c2} = f_0 + \beta/2 = 1291.5 \text{ Hz}$$

Part F: Active band-reject filter

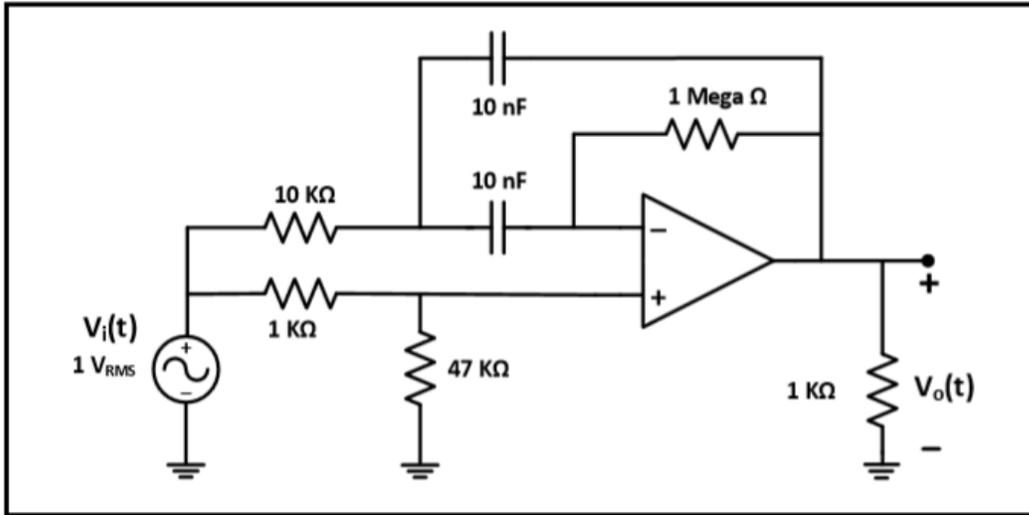
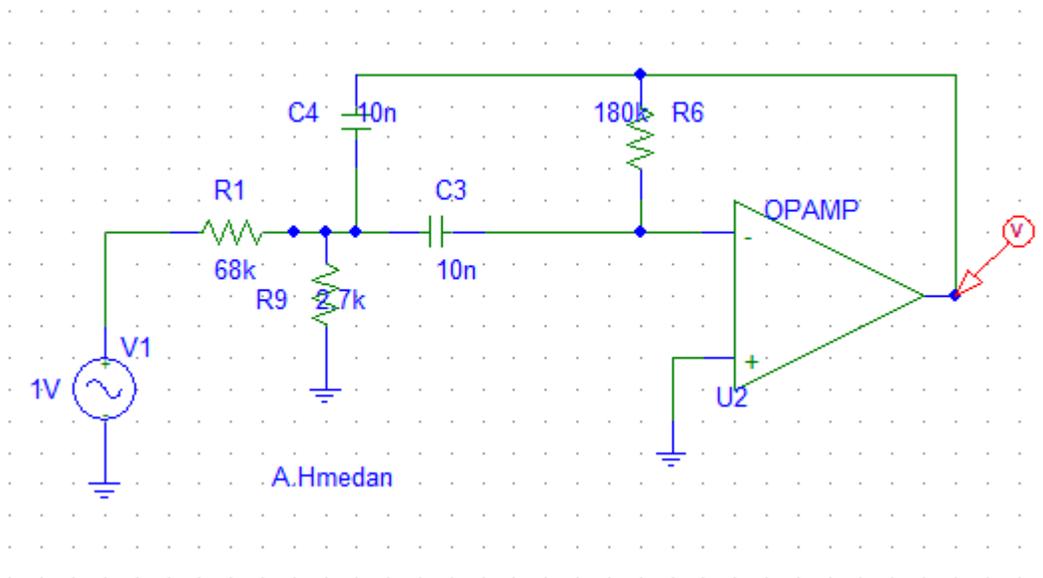
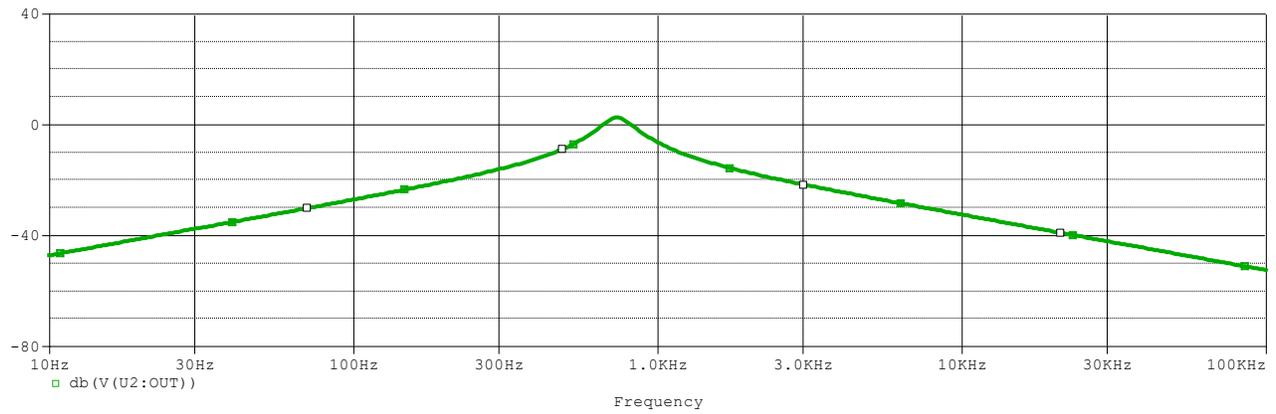


Figure 10.10: Active band reject filter

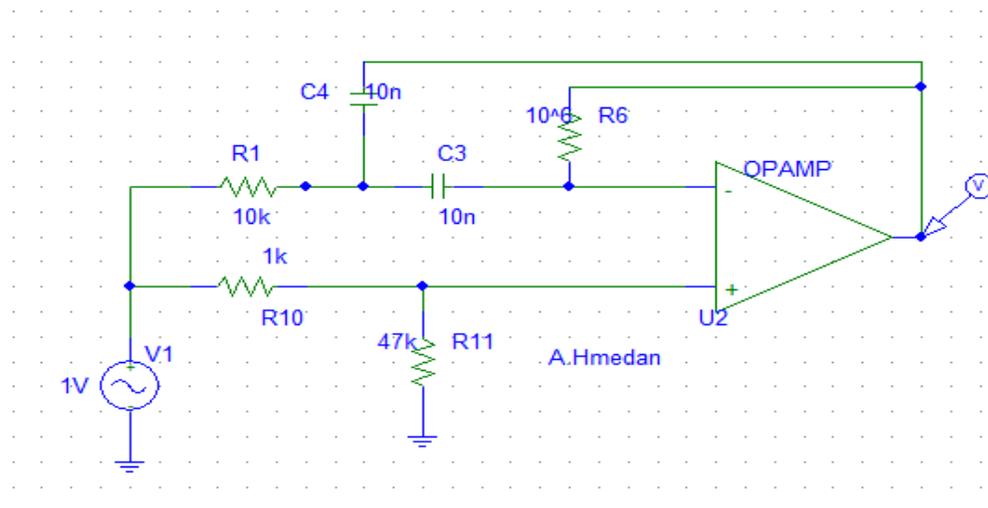
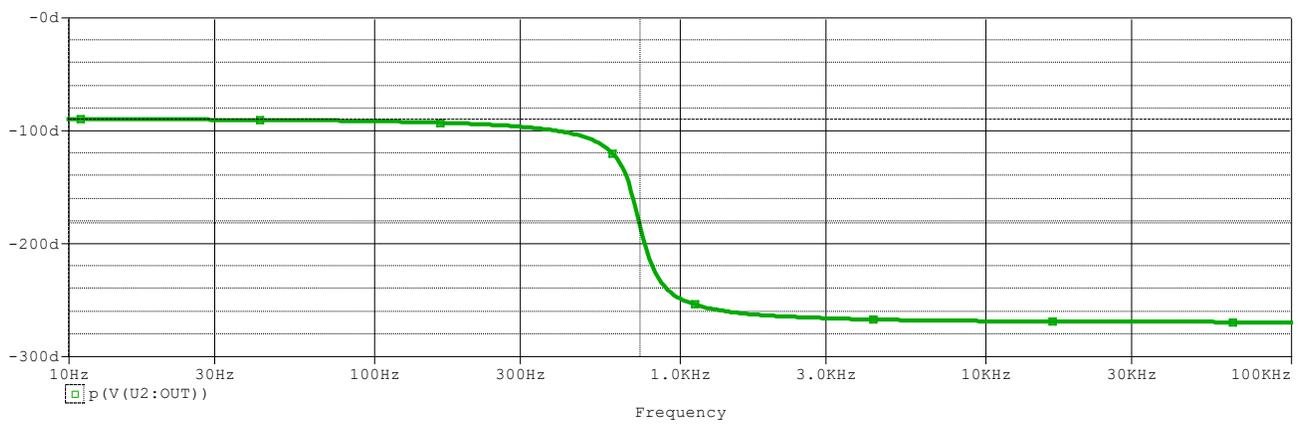
4- Repeat steps 2, 3 for circuits in step 4.



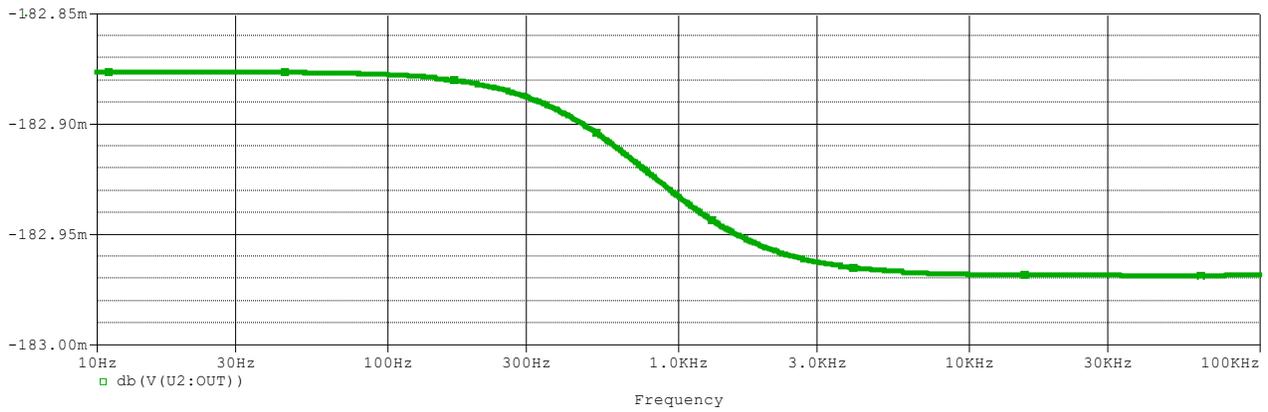
Magnitude



Phase



Magnitude



Phase

