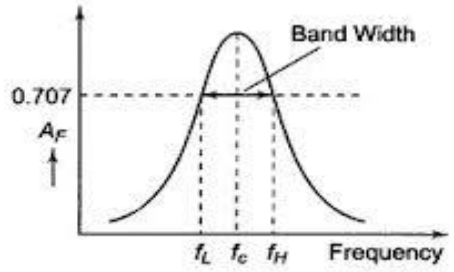
Circuit Simulation Project

Name of the participant : Nadeem Sharief B.

Title of the circuit : Narrow Band Pass Filter using Op-Amp 741.

Theory / Description : The principal of the Active Band Pass filters is to allow/pass signals of particular frequency or band. The frequencies out of the center frequency will be attenuated. If the value of quality factor is greater than ten then the pass band is narrow and bandwidth of the pass band is also less. This band pass filter is called as Narrow Band Pass Filter. It uses only one active component (op-amp) rather than two as wide band pass filter. High pass and low pass filter are combined to form the band pass filter. In the circuit diagram, two RC networks are utilized each to form high pass and low pass filters. The filter is used in inverting mode to set the amplification if required in the circuit.



These Band pass filters are used widely in wireless transmission of signals. The device captures signals of certain frequency and ignores the other frequencies. In communication systems, like radio, walkie-talkie etc there might be interference of multiple frequencies, thus a band pass filter can be used to eliminate unwanted frequencies.

The harmonics present in the transmission lines tends to create unwanted humming noise. A band pass filter with 50Hz/60Hz as its center frequency can rectify the problem of humming.

Design :

The simulation circuit was designed based on the consideration of the below parameters. The center frequency was chosen to be 1KHz and quality factor to be 13, and the subsequent resistance values were calculated by formula.

Capacitance value was chosen to be <1uF for better performance. The resistance values were rounded off to its nearest standard values.

Center frequency	1 kHz
Pass Band gain (A_f)	10
R_1	$Q/[2\pi fcC*A_f] = 20K\Omega$
R_2	$Q/\pi fc*C = 620\Omega$
$R_3 = R_4$	$Q/[2\pi fc*C\ (2Q^2 - A_f)] = 430K\Omega$
$C_1 = C_2$	0.01uF
Af in dB	$40\log(A_f) = 40$

Circuit Diagram(s) :

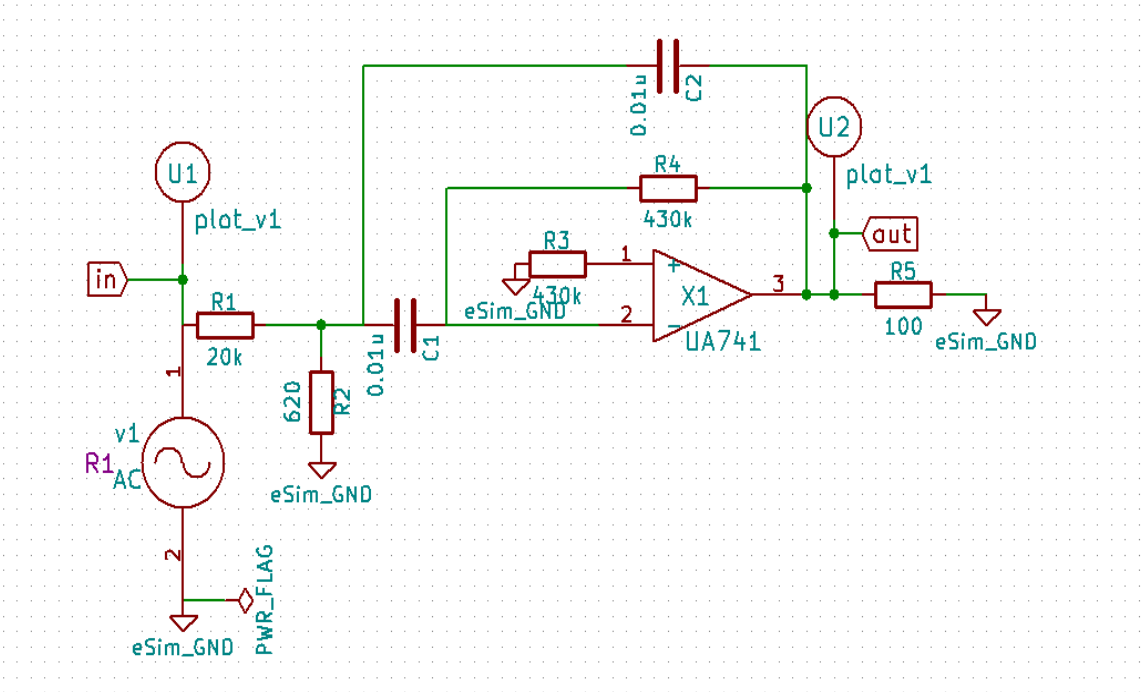


Fig.1 Narrow Band Pass Filter Using Op-Amp 741

Results (Input, Output waveforms) :

1. NGSPICE plot at Input terminal:

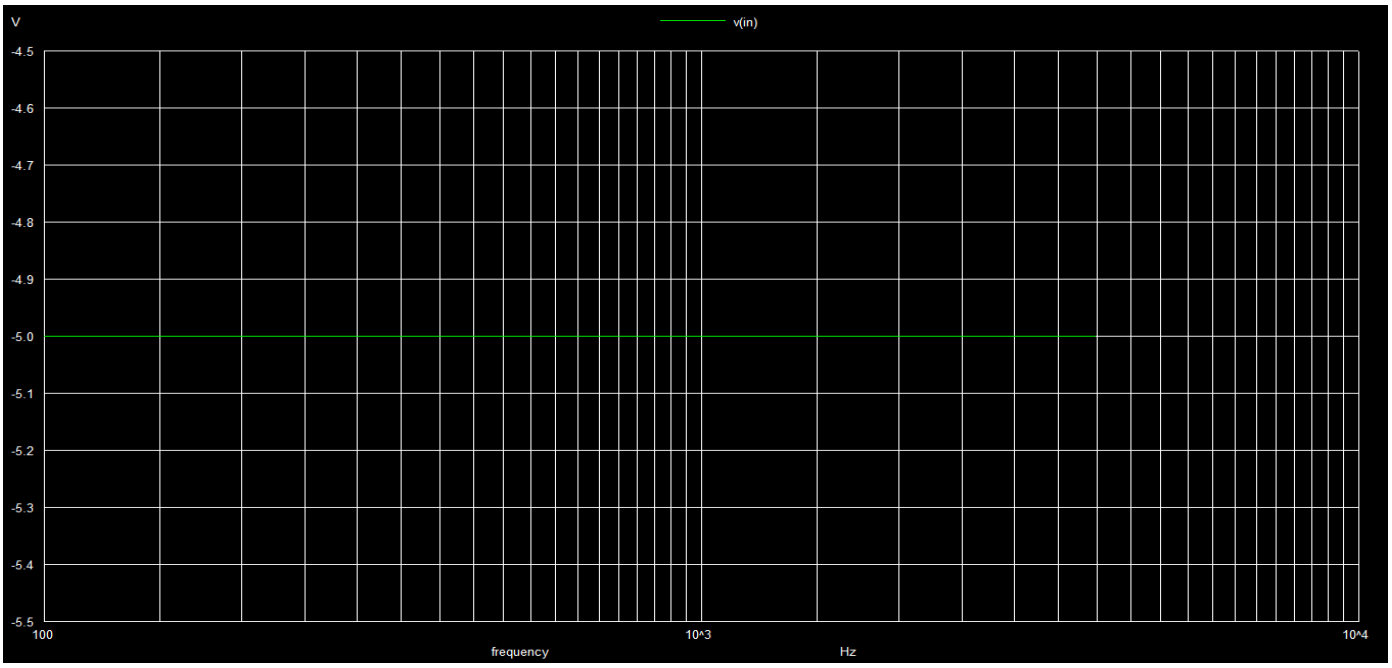


Fig.2 NGSPICE Input Voltage of the Narrow Band Pass Filter

2. NGSPICE plot at Output terminal :

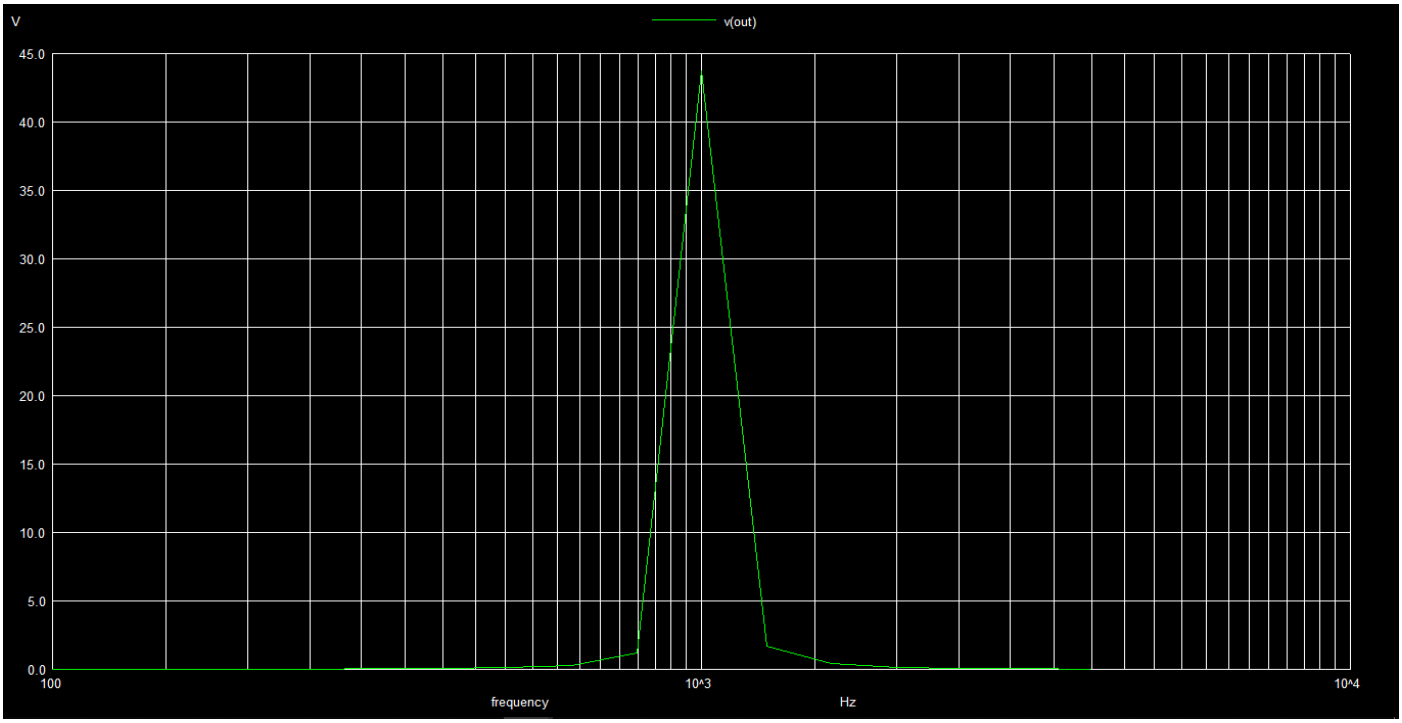


Fig.3 NGSPICE Output of Narrow Band Pass Filter representing center frequency of 1KHz

3. Python plot at Input terminal:

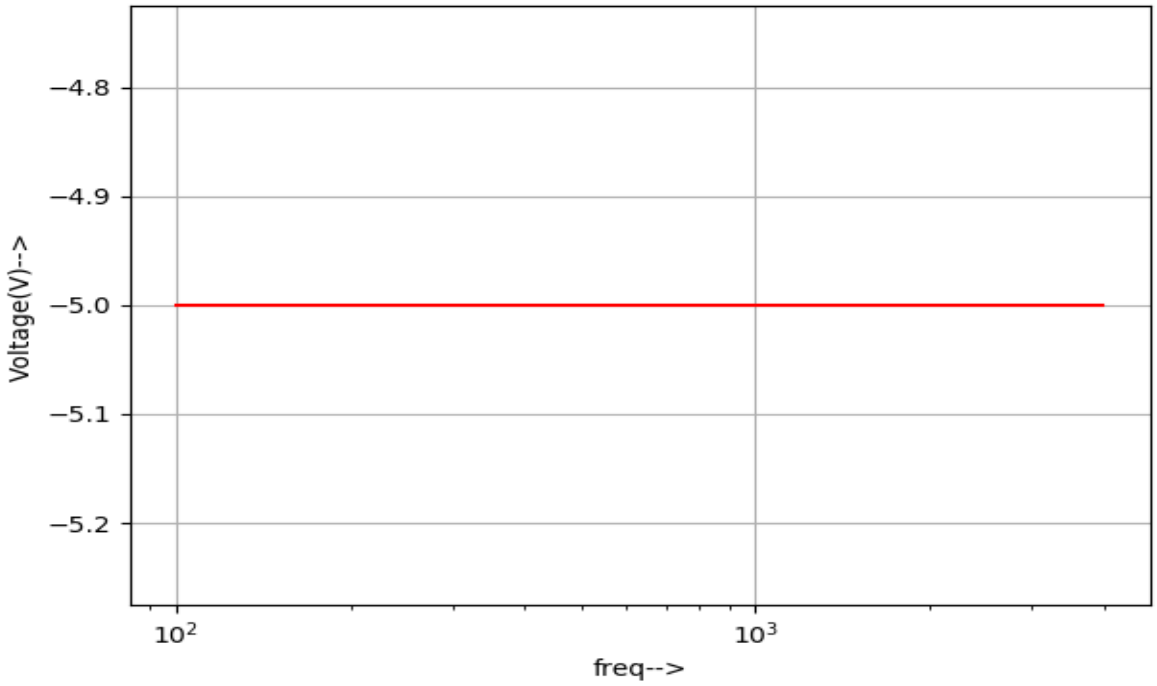


Fig.4 Python Plot Input Voltage of the Narrow Band Pass Filter

4. Python plot at Output terminal:

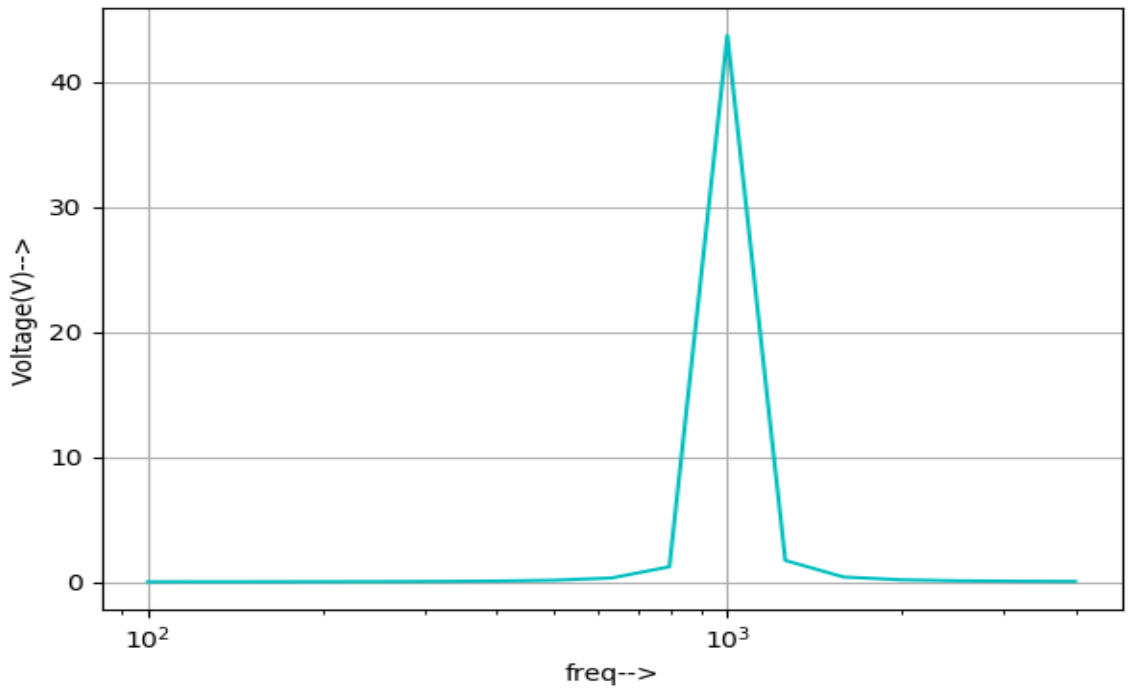


Fig.5 Python Plot Output of Narrow Band Pass Filter representing center frequency of 1KHz

Observation : The calculated gain and center frequency of the filter and the simulation are equal. The filter rolls off approximately at 40dB/decade as it is an band pass filter.

Conclusion : The Narrow Band Pass filter for 1kHz center frequency was designed and realized successfully using the eSim software and the simulated results were verified.

Source/Reference(s) :

1. Op-amps and Linear Integrated Circuits by Ramakant Gayakwad.
2. https://www.eeeguide.com/band-pass-filter-circuit-diagram/