Shri Guru Gobind Singhji Institute of Engineering and Technology
Vishnupuri, Nanded (Maharashtra State) INDIA PIN 431606
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Vision Statement: Education of Human Power for Technological Excellence

Circuit Simulation Project

LOW PASS FILTER USING OP-AMP

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Title of the circuit: Low Pass Filter Using OP - Amp

Theory/Description:

The op-amp low pass filter is an active filter circuit that allows low-frequency signals to pass through while attenuating high-frequency signals beyond a certain cutoff frequency. It is widely used in signal conditioning, noise reduction, and audio processing applications.

In this circuit, the LM741 operational amplifier is configured in an **in**verting mode, with a resistor at the input and a capacitor placed in the feedback path. The combination of the resistor and capacitor forms an RC frequency-selective network, which determines the filtering action of the circuit.

At low frequencies, the capacitive reactance is high, and the capacitor behaves almost like an open circuit. Hence, the amplifier provides a constant gain.
At high frequencies, the capacitive reactance decreases, causing the capacitor to short the feedback path and reduce the gain significantly, thereby attenuating high-frequency components.

The cutoff frequency (also called the corner frequency) of the low pass filter is the frequency at which the output voltage drops to **0.707 times** (−3 dB) of the maximum value.

The cutoff frequency is given by:

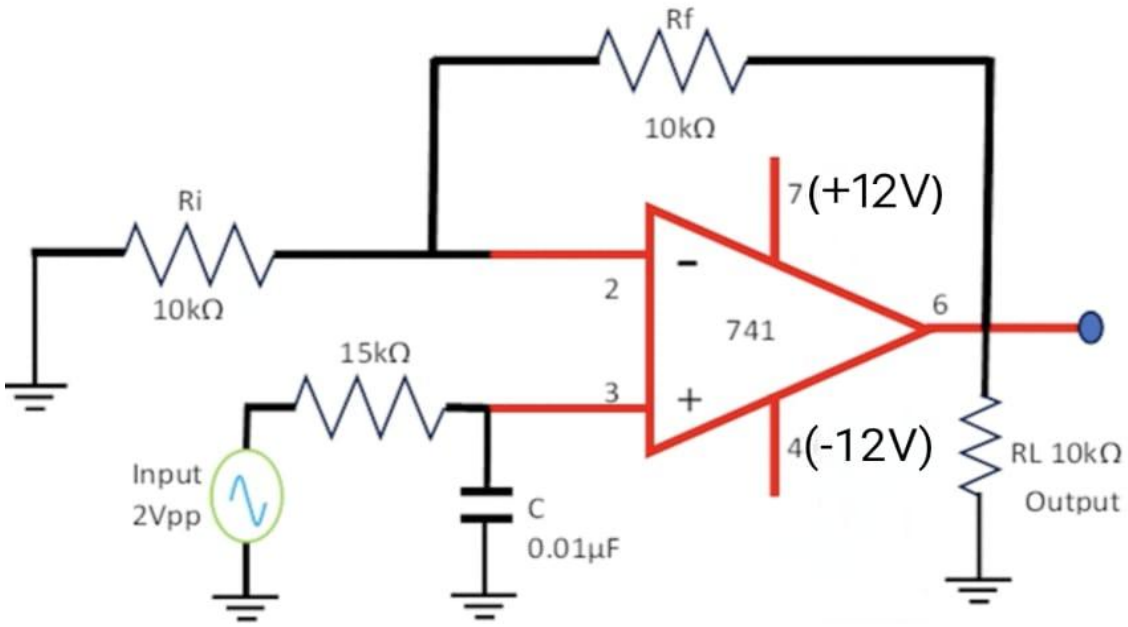
$$f_c = \frac{1}{2\pi RC}$$

Where:

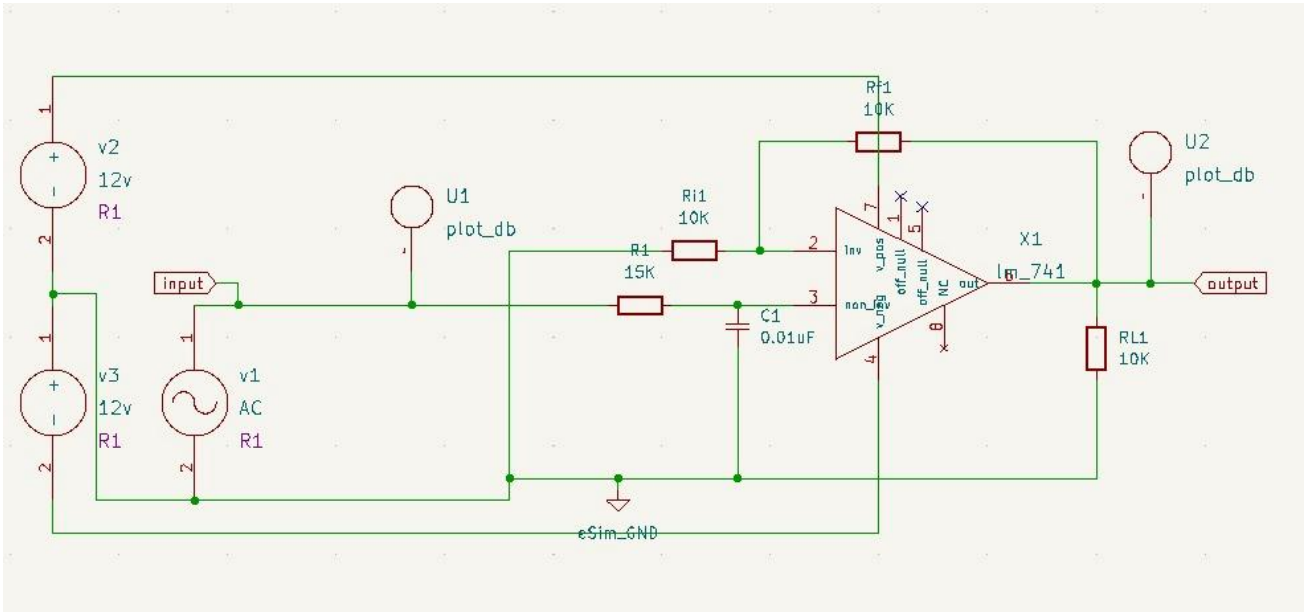
- R= Resistance in ohms (Ω)
- C= Capacitance in farads (F)
- f_c= Cutoff frequency in hertz (Hz)

Thus, the low pass filter using LM741 effectively passes signals below the cutoff frequency while suppressing unwanted high-frequency noise.

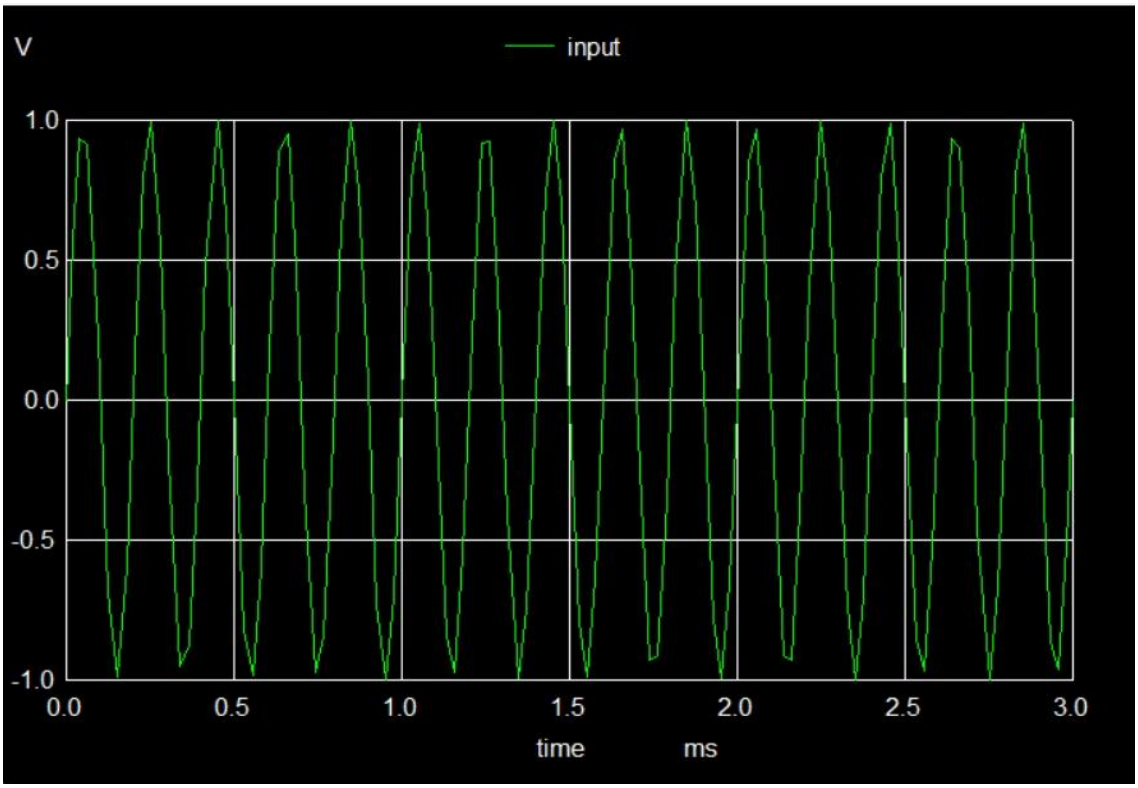
Circuit Diagram :



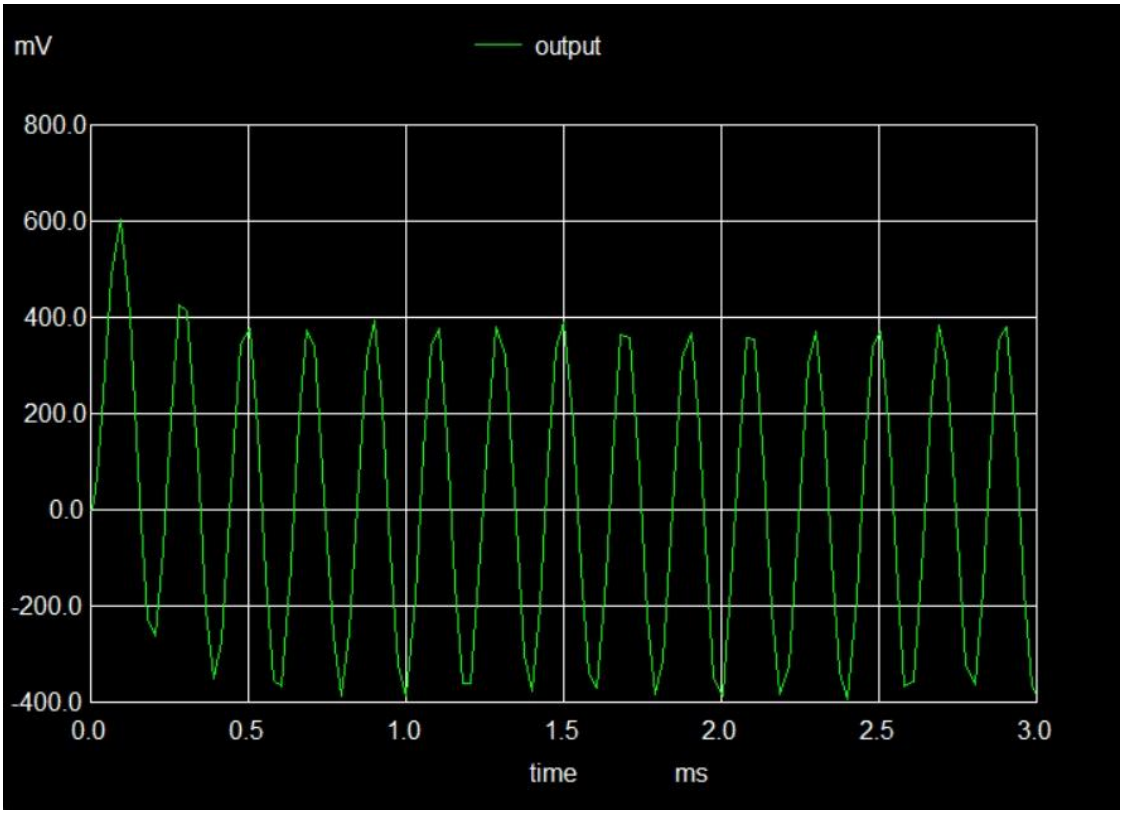
Schematic Sketch :



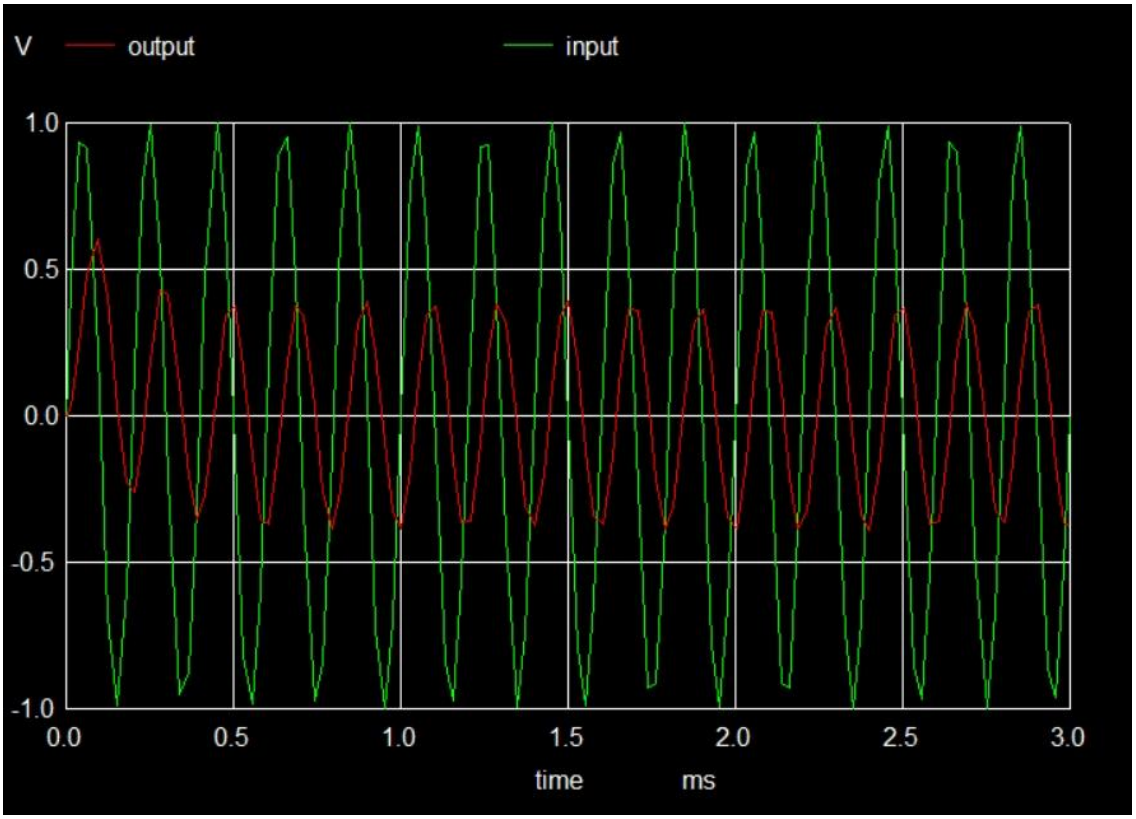
INPUT WAVEFORM:



OUTPUT WAVEFORM :



INPUT – OUTPUT WAVEFORM :



RESULT :

$f_c = \frac{1}{2\pi RC}$	$\tau = RC$	$A_v = 1 + \frac{R_f}{R_1}$
$f_c = \frac{1}{2\pi \times 10\,k\Omega \times 0.01\,\mu F}$	$\tau = 10\,k\Omega \times 0.01\,\mu F$	$A_v = 1 + \frac{10\,k\Omega}{10\,k\Omega}$
$f_c = 1591\,\text{Hz}$	$\tau = 0.0001\,\text{s} = 0.1\,\text{ms}$	$A_v = 2$

Conclusion:

Hence, Low Pass Filter Using OP-Amp has been designed and simulated using eSim software.

Source/Reference(s):

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