EXPERIMENT-6
Active first order LPF, HPF using OP-AMP.

a. Aim: a. To Design a Active first order LPF, HPF using OP-AMP.

b. To Verify the functionality of above circuits.

b. Specification: circuit uses LM741 IC

c. Apparatus

Hardware: a. Resistors (1kΩ)
b. Capacitor (0.1uF)
c. DSO
d. LM 741
e. Signal generator
f. Bread board

d. Theory:

About operational amplifier:

LM741 is an operational amplifier (op-amp). Op-amps are versatile integrated circuits that can be used for a variety of applications including:

- Inverting signals
- Summing multiple inputs
- Filtering signals

Operational Amplifier as a Low-Pass Filter

An operational amplifier (op-amp) can be configured to function as a low-pass filter, a circuit that allows low-frequency signals to pass through while attenuating high-frequency signals. This configuration is achieved by using a resistor and capacitor in a specific arrangement, typically in the feedback loop of the op-amp.

Operational Amplifier as a High-Pass Filter

An operational amplifier (op-amp) can be configured to function as a high-pass filter, a circuit that allows high-frequency signals to pass through while attenuating signals of lower frequencies. This configuration utilizes the frequency-dependent impedance properties of capacitors and resistors to achieve the desired filtering effect.

e. Procedure:

a. Connect the circuit as per the circuit diagram
b. Apply input as per the requirements and observe the outputs.
c. Observe the outputs of active LPF and HPF using a CRO
d. Note the outputs and compare the theoretical cutoff frequency with the practical values and also note the saturation values of op-amp.

Design:

I. LPF: Resistors (1kΩ),Capacitors (0.1μF) OP-AMP(LM741), DSO, supply voltages, Sig Gen.

II. HPF: Resistors (1kΩ),Capacitors (0.1μF) OP-AMP(LM741), DSO, supply voltagess, Sig Gen.

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

LOW-PASS FILTER
C=0.1μF, R∼=1kΩ, f_c = 1.60 kHz

HIGH-PASS FILTER
C=0.1μF, R∼=1KΩ, f_c = 1.60 kHz

f. Circuit schematic of each application and their responses:

I. LPF:

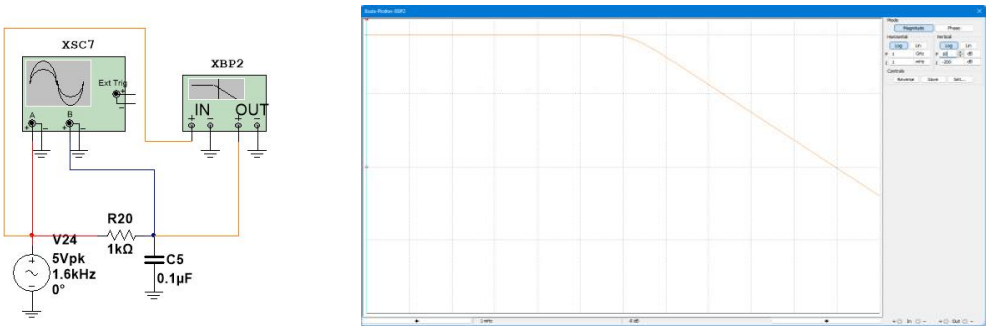

Fig-1: LPF Circuit

CONCLUSION:

From the above response we can conclude that the LPF circuit passes frequencies less than design frequency and attenuates frequencies greater than that.

II. LPF with Direct Load Connection:

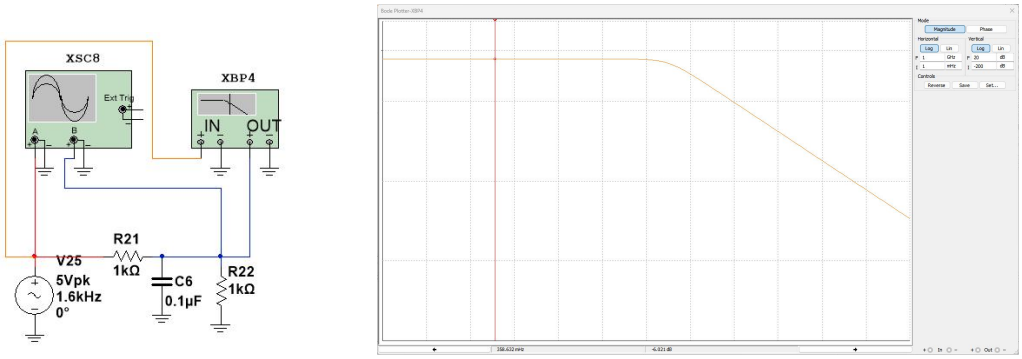

Fig-2: LPF Circuit with direct load connection.

CONCLUSION:

From the above response we can conclude that the LPF circuit passes frequencies less than design frequency and attenuates frequencies greater than that, and due to direct connection b/w capacitor and load resistor there is a burden on capacitor and the gain of the system decreases.

III. Active first order LPF using OPAMP 741 with unity gain:

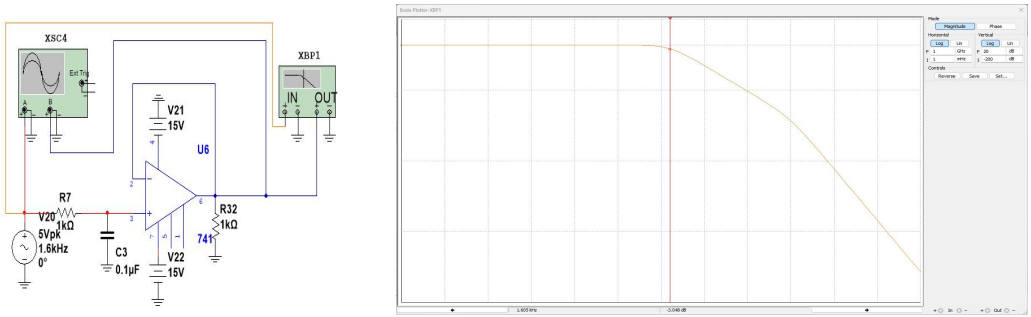

Fig-3: Active first order LPF using OPAMP 741 with unity gain.

CONCLUSION:

From the above response we can conclude that the LPF circuit passes frequencies less than

design frequency and attenuates frequencies greater than that, and due to buffer circuit b/w capacitor and load resistor there is no burden on capacitor and the gain of the system is not disturbed as op-amp consumes zero input current.

IV. HPF:

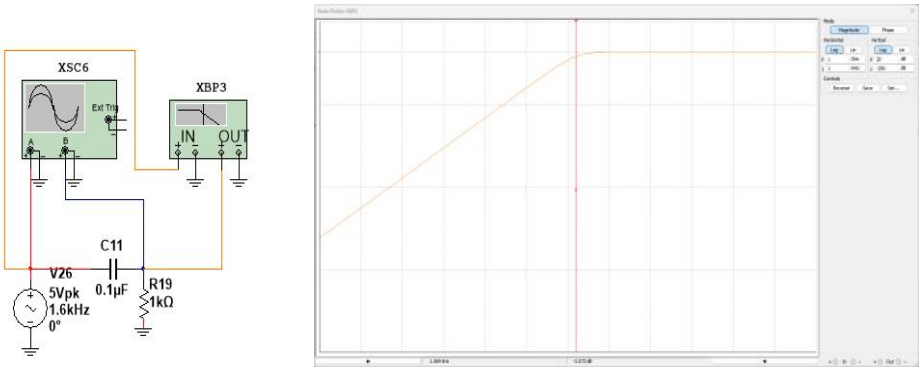

Fig-4: HPF Circuit

CONCLUSION:

From the above response we can conclude that the HPF circuit passes frequencies greater than design frequency and attenuates frequencies lesser than that.

V. HPF with Direct Load Connection:

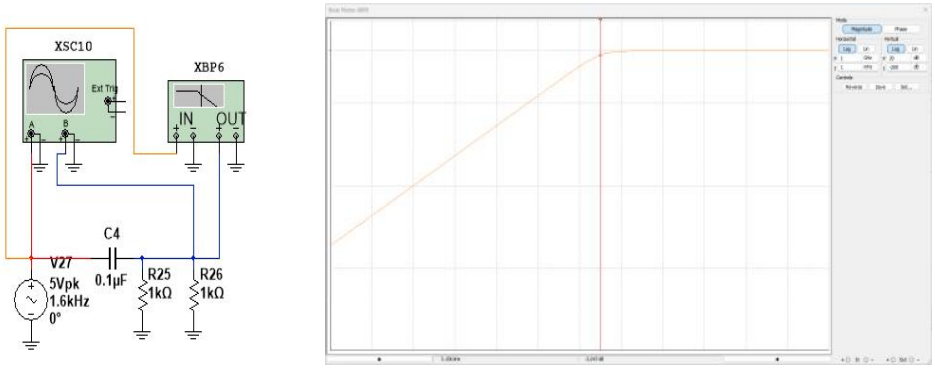

Fig-5: HPF Circuit with direct load connection.

CONCLUSION:

From the above response we can conclude that the HPF circuit passes frequencies greater than design frequency and attenuates frequencies lesser than that, and due to direct connection b/w the two resistors the frequency for which we have designed the circuit is being shifted.

VI. Active first order HPF using OPAMP 741 with unity gain:

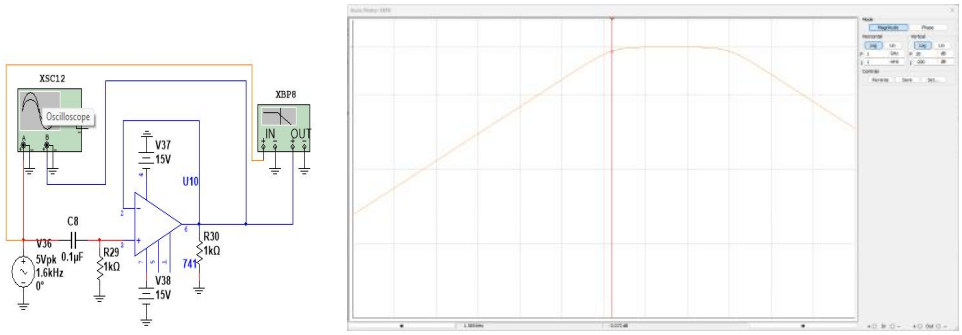

Fig-6: Active first order HPF using OPAMP 741 with unity gain.

CONCLUSION:

From the above response we can conclude that the HPF circuit passes frequencies greater than design frequency and attenuates frequencies lesser than that, and due to buffer circuit b/w two resistors the designed frequency is not affected.

g. **Result:**
We have designed and implemented active LPF and HPF using OP-AMP [LM741].

Signature of the Faculty