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Marks	

Experiment # 8

RC Phase Shift Oscillator

Objectives:

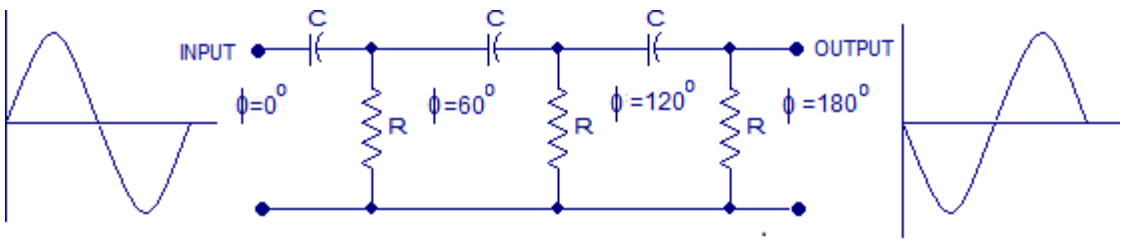
- To study RC phase shift oscillator.
- Design and setup RC phase shift oscillator.

Apparatus:

Op_Amp 741 , Capacitors, Resistors, DMM, CRO, Function Generator, Jumpers, Connecting wires, bread board.

Theory:

RC phase shift oscillator is an oscillator in which resistor and capacitor network is used. This network can be used to give signal desired phase shift. Each RC network produces phase shift of 60° and using three such network in series produces phase shift of 180° as can be seen in Fig.1. Theoretically, oscillations in RC phase shift oscillator are produced as result of charging and discharging of the capacitors attached to the inverting terminal of op-amp through some a RC network. Due to this output of the 741 is out of phase with the input at the inverting terminal.



Three stage RC phase shift network

To have a perfect oscillations of particular frequency Bark son's criteria is followed in which multiplying the feedback gain from output to the input, B, and gain from the inverting configuration, A, becomes equal to unity and with output in phase with the output of op-amp. Due to three RC networks overall phase shift is 360° or 0°. In case of RC phase shift oscillator value of 'B' is -1/29. So, to make AB=1, A should be -29. Due to the inverting configuration R_f =29*R.

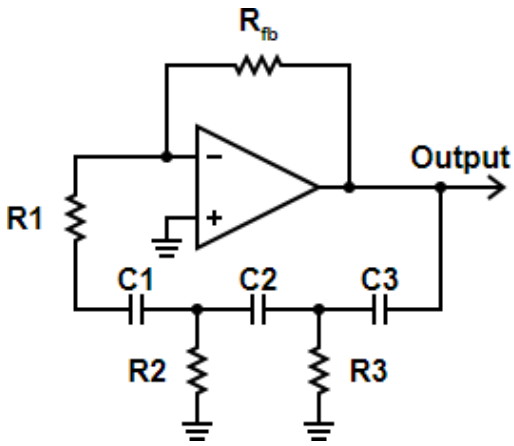


Fig no:2

General procedure:

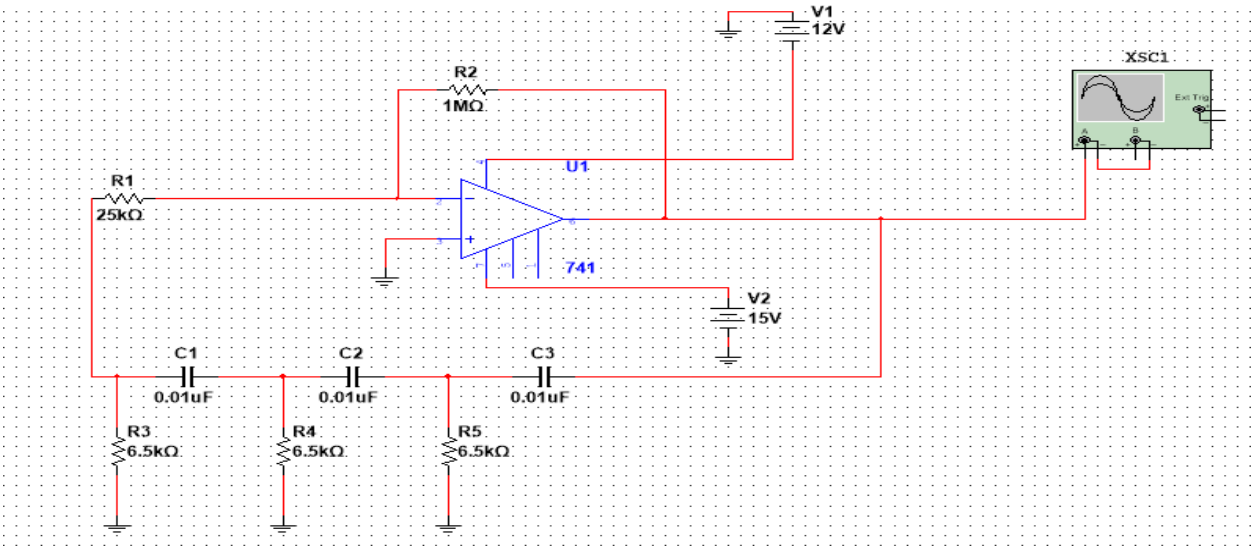
- First of all mount circuit according to the Fig.2.
- Apply supply voltages to the op-amp 741.
- Observe output wave form between the output pin and the ground terminal.
- Now design this circuit for different frequencies and observe the output waveform.

Design:

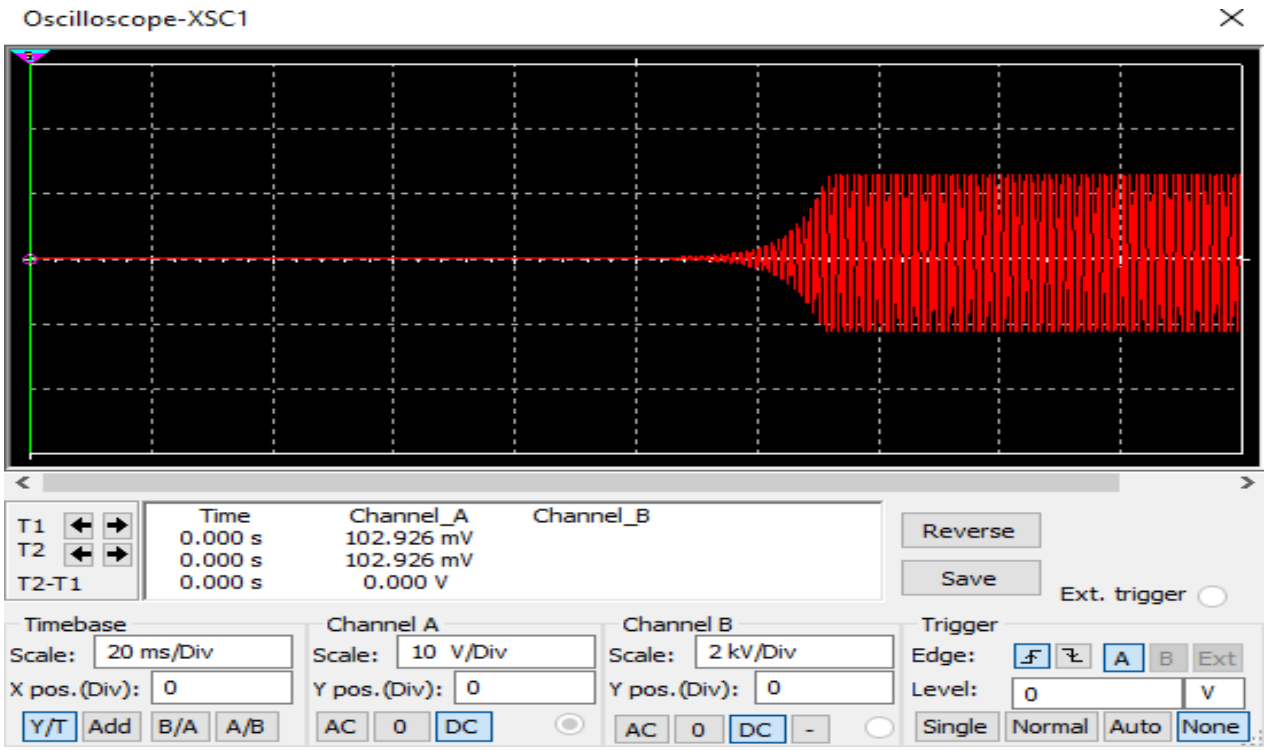
Design the RC phase shift oscillator at different frequencies given in table at last and compare the actual and theoretical values of and resistors using following formula

1) $f = 1/2\ (RC^{*}\ )$

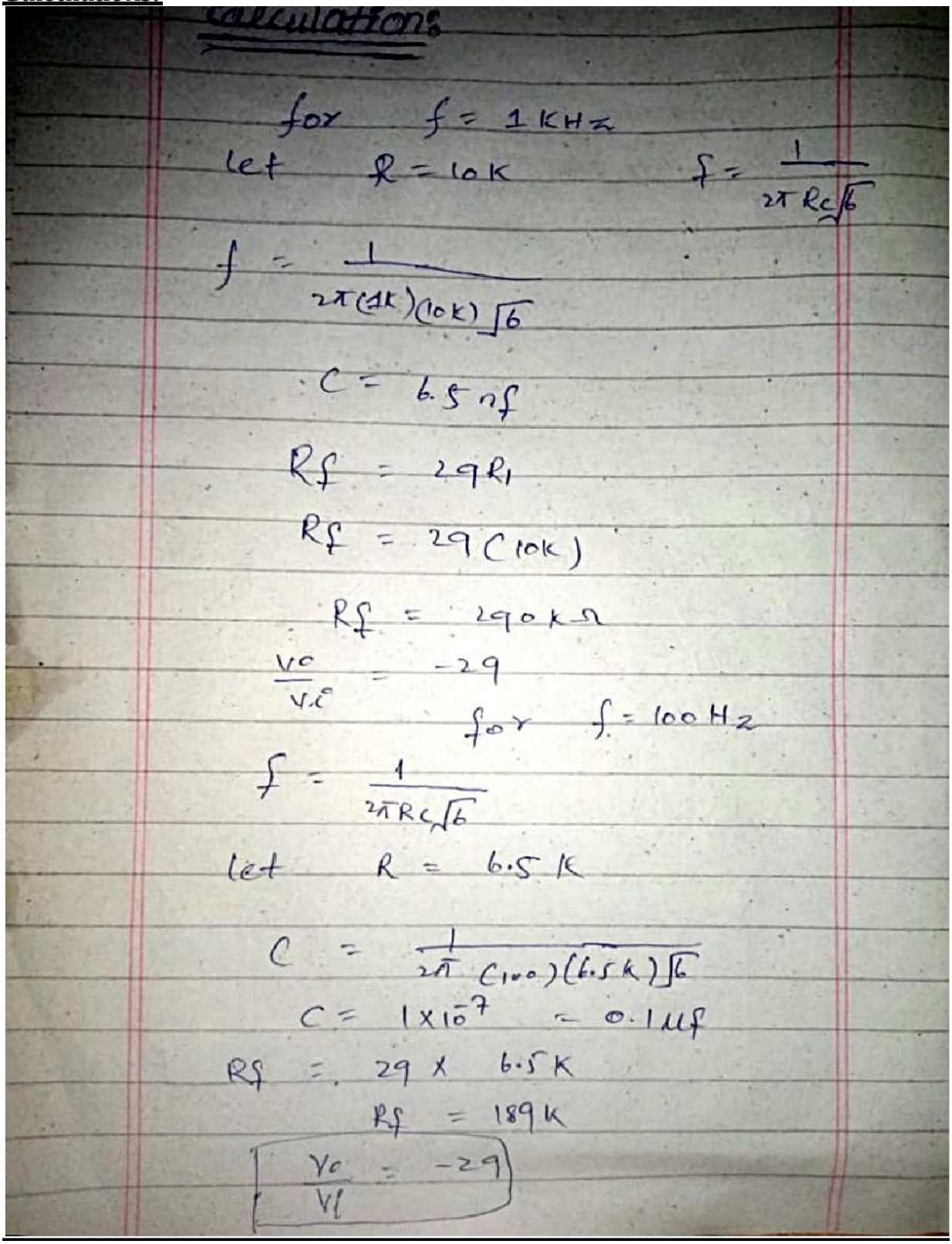
Circuit:



Input and Output Graph:



Calculations:



Calculations:

for $f = 1\,KHz$

let $R = 10K$ $\qquad f = \frac{1}{2\pi RC\sqrt{6}}$

$$f = \frac{1}{2\pi(1K)(10K)\sqrt{6}}$$

$$C = 6.5\,nf$$

$$Rf = 29R_1$$

$$Rf = 29(10K)$$

$$Rf = 290K\Omega$$

$$\frac{Vo}{V_i} = -29$$

for $f = 100\,Hz$

$$f = \frac{1}{2\pi RC\sqrt{6}}$$

let $R = 6.5\,K$

$$C = \frac{1}{2\pi(100)(6.5K)\sqrt{6}}$$

$$C = 1\times10^{-7} = 0.1\mu f$$

$$Rf = 29 \times 6.5K$$

$$Rf = 189K$$

$$\boxed{\frac{Vo}{Vi} = -29}$$

Result:

Sr.#	**Frequencies**	**Capacitor**	**Resistor**	**Amplitude**
01	100 Hz	0.1μF	6.5Kohm	-29
02	1 KHz	6.5nF	10Kohm	-29

Questions:

- **Explain the Barkhausen criteria for sustained oscillations?**
  The Barkhausen criterion states that: • The loop gain is equal to unity in absolute magnitude, that is, | β A | = 1 and Page 2 • The phase shift around the loop is zero or an integer multiple of 2π radian (180°)

- **What is practical applications of a phase shift oscillator?**
  This phase shift oscillator is used to generate the signals over an extensive range of frequency. They used in musical instruments, GPS units, & voice synthesis. The applications of this phase shift oscillator include voice synthesis, musical instruments, and GPS units.
- **What can we get a maximum phase angle of 90 degrees in RC phase shift oscillator? Is it possible?**
  By changing the resistance to zero, we can get a maximum phase angle of 90 degrees. But since we cannot develop voltage across zero resistance, so a 90 degree phase shift is not possible.