Lab Report 4

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AIM :

To build 1 HZ oscillator with op-Amp

MATERIALS USED :

S.no.	Name of apparatus	Range	Quantity
1	LM358 ic	-	1
2	Resistors	1K	2
3	Resistors	45.82K	1
4	Breadboard	-	1
5	Connecting wires	-	according to the user
5	Capacitor	$10\mu F$	1
6	Power supply	-15 to 15V	1
7	Oscilloscope or DSO	-	1

THEORY :

IC LM358 :

It is a low-powered dual op-amp ic. Operates in a voltage range of -12 to 12 V. (image source:**https://in.pinterest.com/pin/429812358158504204/**)

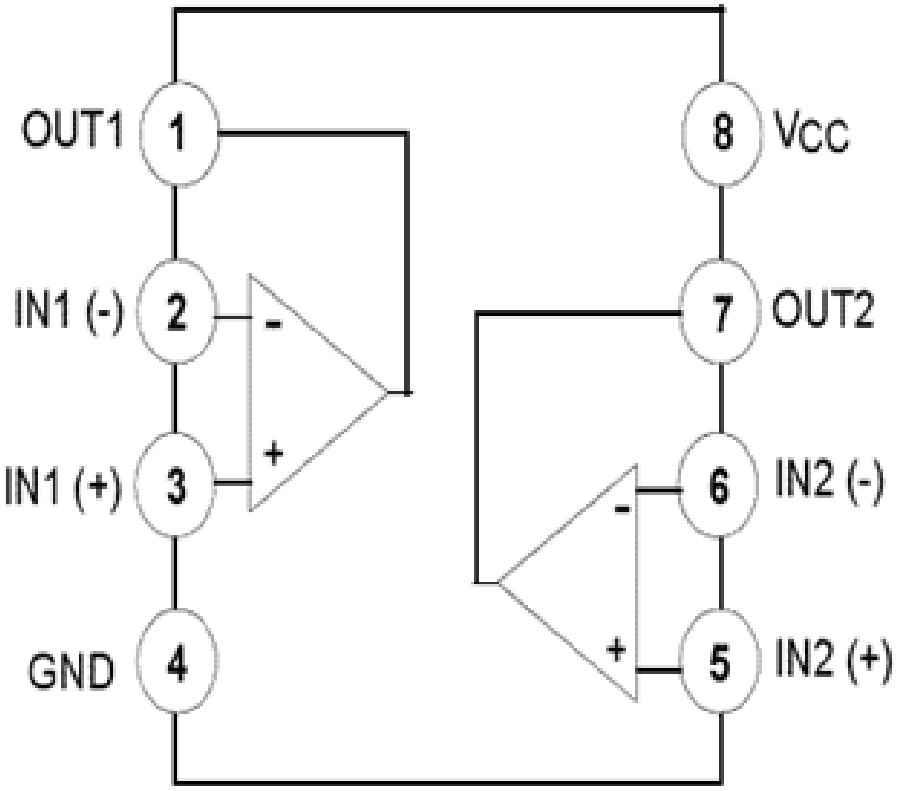

Fig. 0: Pinout

Relaxation oscillator:

A relaxation oscillator generates a non-sinusoidal waveform (like a square or triangular wave) by charging and discharging a capacitor through a resistor. We have used LM358 ic in an astable configuration, where the circuit continuously switches between two states, creating oscillations.

Schmitt Trigger Operation:

The LM358 is configured as a comparator with hysteresis. The inverting input $()$ and non-inverting input $(+)$ receive different voltages, and the output switches between two levels (high and low) depending on the difference.

The Schmitt trigger introduces hysteresis, which means it has two threshold voltages. When the input voltage goes above the upper threshold, the output switches to low, and when the input goes below the lower threshold, the output switches to high. This prevents the output from oscillating due to noise and creates a clean square wave.

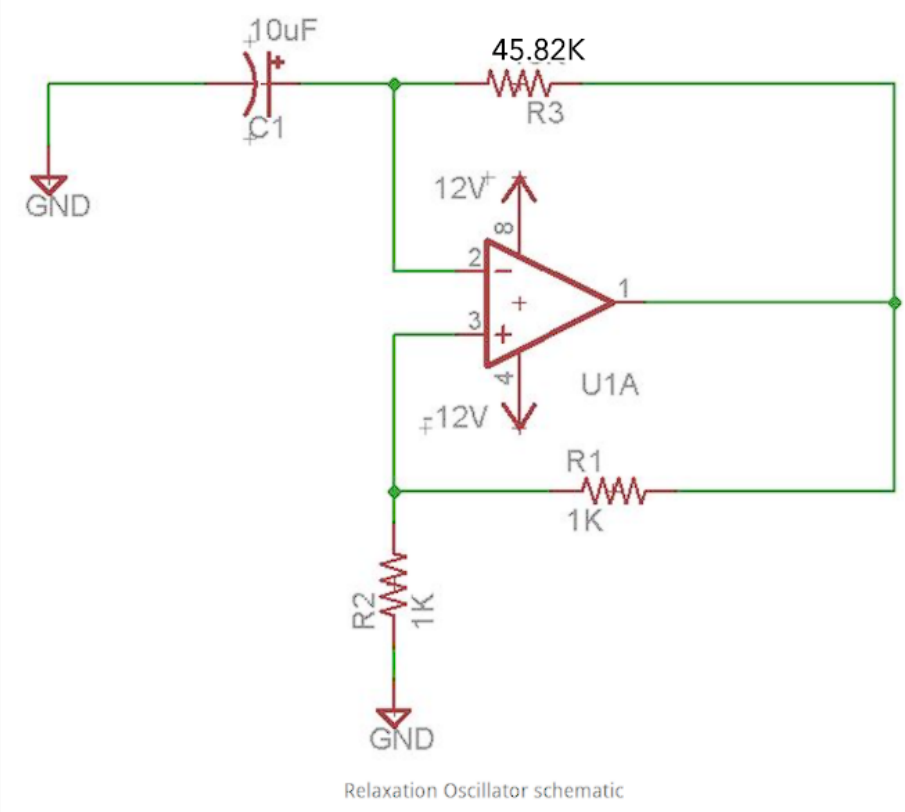

Fig. 0: Pinout

RC Charging/Discharging:

A resistor and capacitor (RC network) are used to set the time constant, which determines the frequency of the square wave output.

Initially, the capacitor charges through the resistor, and its voltage increases over time. The charging continues until the voltage across the capacitor reaches the upper threshold set by the Schmitt trigger.

Once this happens, the output of the op-amp switches states, causing the capacitor to discharge.

When the capacitor discharges below the lower threshold, the output switches again, repeating the cycle. The capacitor begins charging again, producing continuous oscillations.

CALCULATION:

$$f_0 = \frac{1}{T}$$

$$f_0 = \frac{1}{2 \times R_3 C ln\left(\frac{2R_1+R_2}{R_2}\right)}$$

Given that R_1=R_2=1K, f_0=1Hz and R_3 is unknown
After substituting and calculation:

$$R_3 = 45.5K$$

I. PROCEDURE :

1) Connect the om-amp to the breadboard.
2) Connect R_1 between pins 1 and 3 of the op-amp. Then connect R_2 between pins 3 and GND.
3) Connect R_3 between pins 1 and 2 of the op-amp. Then connect the capacitor between pins 2 and GND.
4) Connect the two grounds to a common ground for easy connections.
5) Connect V_{cc} of 12V to pin 8 and -12V to pin 4. Connect the COM of the power supply to pin 4 of op-amp(GND).
6) Note the observations.

II. OBSERVATION :

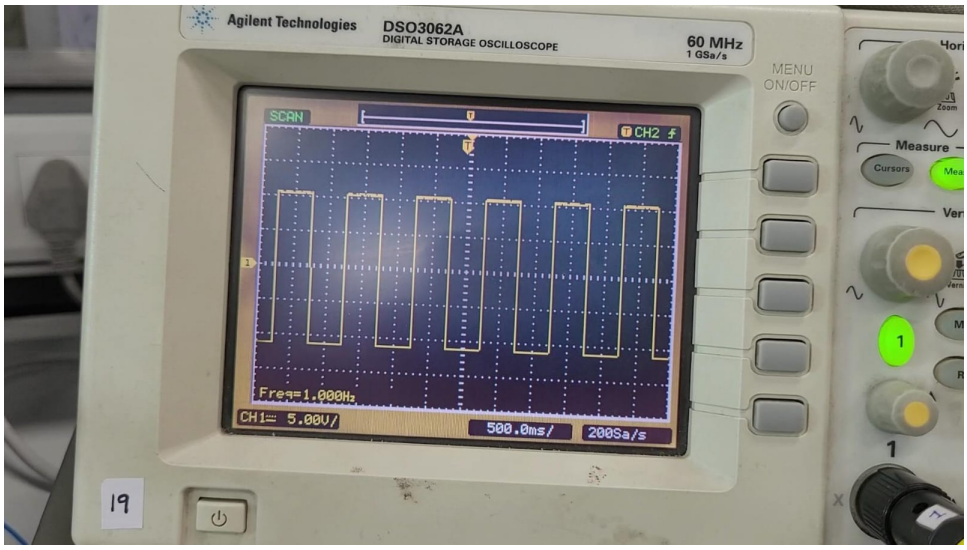

Fig. 6: Output square wave

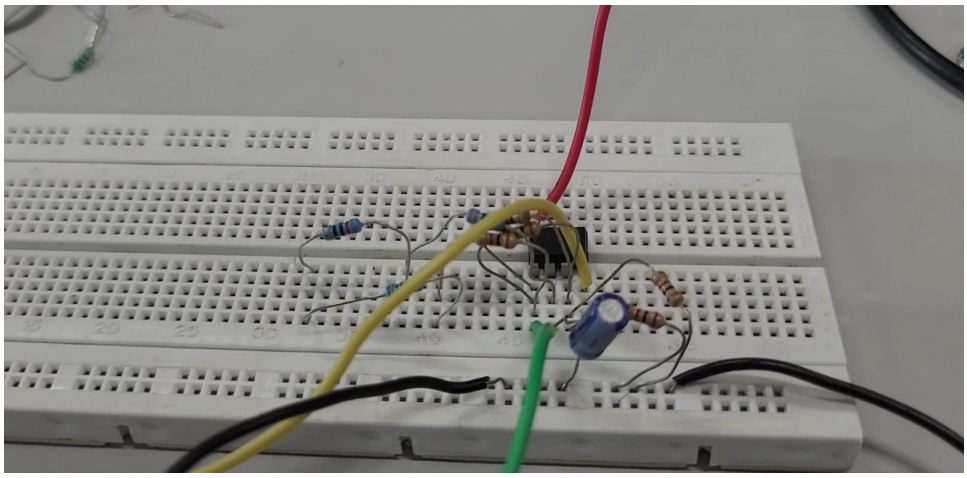

Fig. 6: circuit

III. CONCLUSION :

A square of frequency 1Hz has been made using the following oscillator.