# Experiment No. 5

## ASTABLE MULTIVIBRATORS USING OP AMP

**Aim:** To design and setup symmetrical and asymmetrical astable multivibrators using Op-amp 741, plot the waveforms and measure the frequency of oscillation

**Objectives**: After completion of this experiment, student will be able to design and setup an astable multivibrators circuit using OP AMP.

**Equipments/Components:**

| Sl. No | Name and Specification | Quantity required |
|---|---|---|
| 1 | Dual power supply +/- 15V | 1 |
| 2 | Function generator (0- 1MHz) | 1 |
| 3 | Oscilloscope | 1 |
| 4 | Bread board | 1 |
| 5 | IC 741C | 1 |
| 6 | Resistor | 5 |
| 7 | Capacitor 0.1μF | 1 |
| 8 | Diode 1N4001 | 2 |
| 9 | Probes and connecting wires | As required. |

**Theory:**

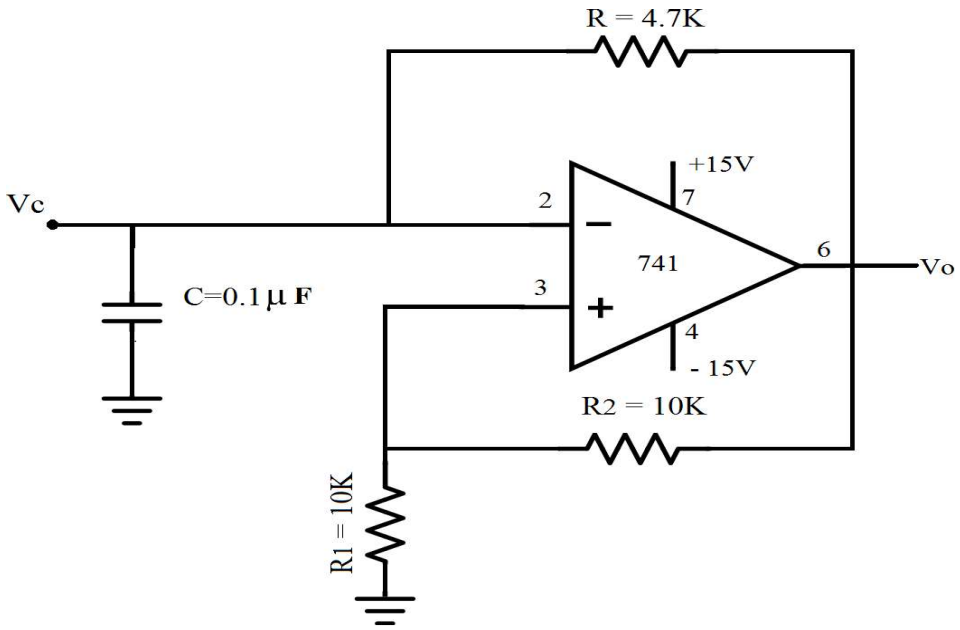
In this circuit, the opamp is operated in saturation mode and the output swings between +Vsat and –Vsat giving square wave output. This circuit is also called free running oscillator or square wave generator . A positive feedback with feedback factor $\beta = R_1 / (R_1+R_2)$ is provided to the non-inverting terminal. When Vo= +Vsat, the capacitor C starts to charge to + Vsat through R. when the capacitor voltage crosses $+\beta$Vsat, output switches from +Vsat to –Vsat. Now the voltage appearing at the non-inverting terminal is $-\beta$Vsat and capacitor discharges through R towards -Vsat. When the capacitor voltage crosses $-\beta$Vsat, the output switches from –Vsat to + Vsat and this process continues to generate square wave output with time period $T=T_{on} + T_{off}= 2RC \ln[(1+\beta)/(1-\beta)]$. In asymmetrical astable multivibrators, the charging and discharging time of capacitor is made unequal to get asymmetrical square wave with different $T_{on}$ and $T_{off}$.

**Procedure:**

1. Check the components.
2. Setup the symmetric astable multivibrator circuit on the breadboard and check the connections.
3. Switch on the power supply.
4. Observe output and capacitor voltage on two channels of the oscilloscope simultaneously.
5. Draw the waveforms on the graph.
6. Measure the frequency of oscillation and duty cycle .
7. Repeat the procedures for asymmetric astable multivibrator.

### a) SYMMETRICAL ASTABLE MULTIVIBRATOR

**Circuit Diagram:**




**SYMMETRICAL ASTABLE MULTIVIBRATOR**

**Design:**

Given $f = 1$ KHz

So $T = 1/f = 1$ms

And $\beta = R_1 / (R_1+R_2)$

Let $R_1 = 10K\Omega$ , and $R_2 = 10K\Omega$

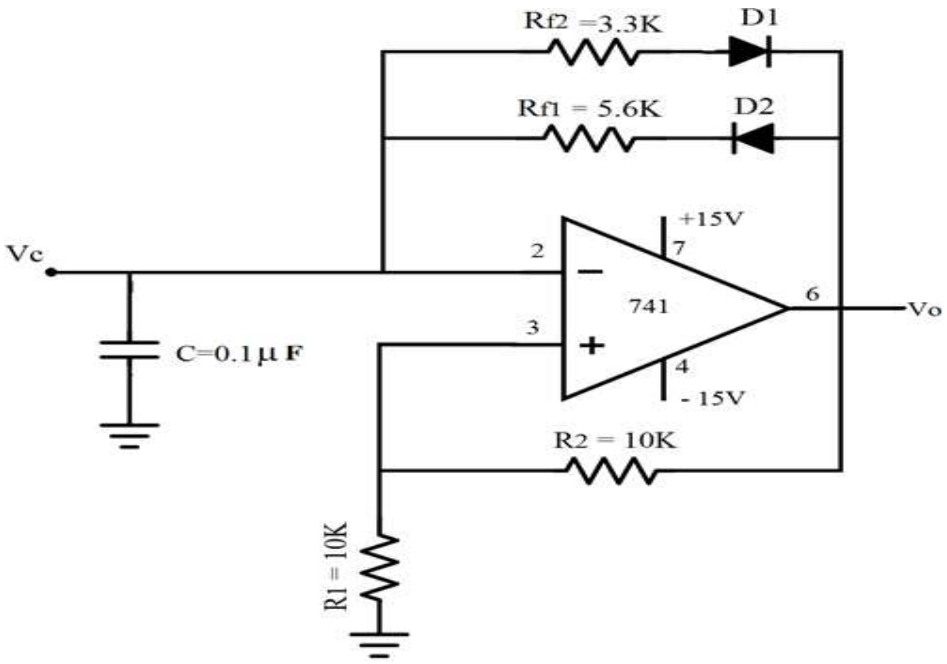
Then $\beta = 0.5$

Therefore $T = 2.2RC$

Let $C = 0.1\mu F$ Then $R =$ $4.7K\Omega$

## b) ASYMMETRCAL ASTABLE MULTIVIBRATOR

**Circuit Diagram:**




ASYMMETRICAL ASTABLE MULTIVIBRATOR

**Design:**

Given f = 1 KHz

So $T = T_{on} + T_{off} = 1/f = 1ms$

Also Duty cycle $= T_{on}/(T_{on}+T_{off}) = 0.66$ or 66% Solving above two equations, $T_{on} = 0.66ms$ $T_{off} = 0.33ms$

For $\beta=0.5$,

$T_{on} = 1.1R_{f1}C = 0.66ms$

Let $C = 0.1\mu F$

Then $R_{f1} = 6.2K\Omega = 5.6K\Omega$ (Std)

Similarly $T_{off} = 1.1R_{f2}C = 0.33ms$

Then $R_{f2} = 3K\Omega = 3.3\ K\Omega$ (Std)

**bservation:**

a) **Symmetrical astable multivibrators**

$V_o$(p-p)= ?

f = ?

Duty cycle = ?

b) **Asymmetrical astable multivibrators**

$V_o$(p-p)= ?

f = ?

Duty cycle = ?

**Graph:**

a) **Symmetrical astable multivibrators**

b) **Asymmetrical astable multivibrators**

**Result:**

## MONOSTABLE MULTIVIBRATOR USING OP AMP

**Aim:** To design and setup a monostable multivibrator using Op-amp 741 and

(i) Plot the waveforms (ii) Measure the time delay

**Objectives**: After completion of this experiment the students are able to design and set up the monostable multivibrator circuit and delay circuits.

**Equipments/Components**

| Sl. No. | Name and spification | Quantity |
|---|---|---|
| 1 | Dual Power Supply +/-15V | 1 |
| 2 | Resistors | 4 |
| 3 | Capacitor 0.1μF;0.01μF | 1 each |
| 4 | IC μA 741 | 1 |
| 5 | Function generator (0-1)MHz | 1 |
| 6. | Oscilloscope | 1 |
| 7. | Diode 1N 4001 | 2 |
| 8 | Bread board | 1 |
| 9 | Connecting wires and probes | As required |

**Theory:**

The monostable multivibrator is also called as one shot multivibrator. The circuit produces a single pulse of specified duration in response to each external trigger pulse. It always has one stable state (+Vsat). When an external trigger is applied, the output state changes and the new state is called quasi stable state (-Vsat). The circuit remains in this state for a fixed interval of time and then it returns to the original state after this interval. This time interval is determined discharging of the capacitor from 0.7V to -βVsat.The time period of quasi stable state or the delay is given by

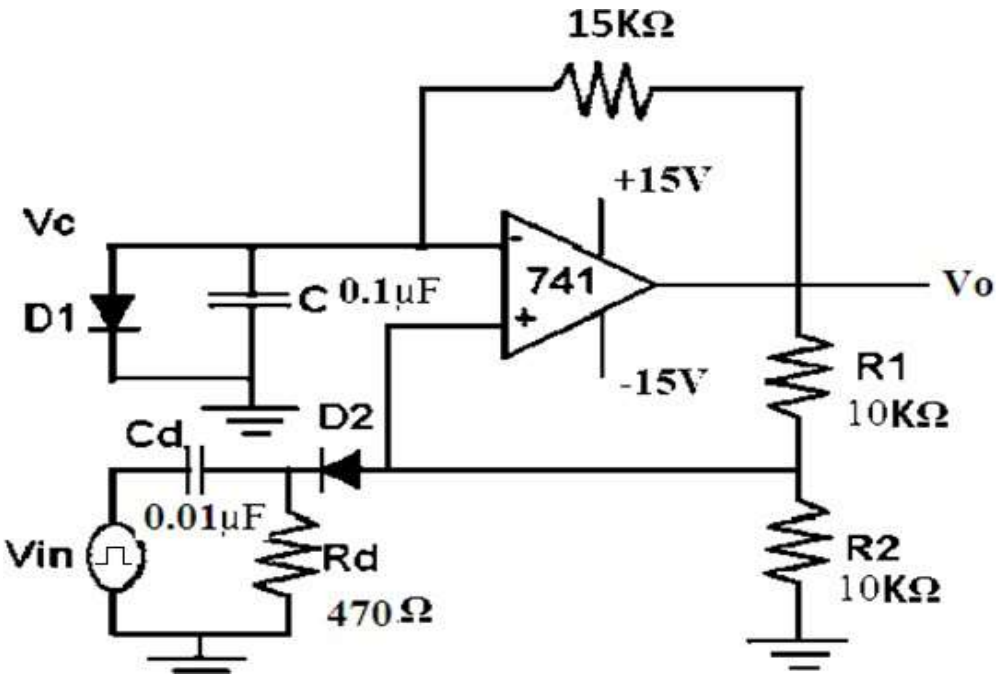
$$T = 0.69RC$$

**Procedure:**

1. Check the components.
2. Setup the monostable multivibrator circuit on the breadboard and check the connections.
3. Switch on the power supply.

4. Put the function generator output to square wave mode. Adjust the amplitude to 5V.
5. Observe trigger input , output and capacitor voltage on different channels of the oscilloscope simultaneously.
6. Draw the waveforms on the graph.
7. Measure the time delay .

**Circuit Diagram:**




**Design:**

Time Period T= 0.69RC

Let T = 1ms; and C = 0.1μF.

Then R = 15KΩFeedback factor

$\beta = R_2/(R_1+R_2)$ Let $\beta = 0.5$ or 1/2

$R_2/(R_1+R_2) = 1/2$

If $R_1$=10KΩ ; $R_2$ =10KΩ

**For triggering circuit**

$R_dC_d = 0.0016t$

Let $t = 3ms$ and $C_d = 0.01\ \mu F$; then $Rd =$ $470\Omega$ $D_1$ & $D_2$ are diodes 1N 4001

**Observations:**

Measured time period or delay =?

**Graph:**

**Result:**