Linear Integrated Circuits

ECE-3013

TASK-2

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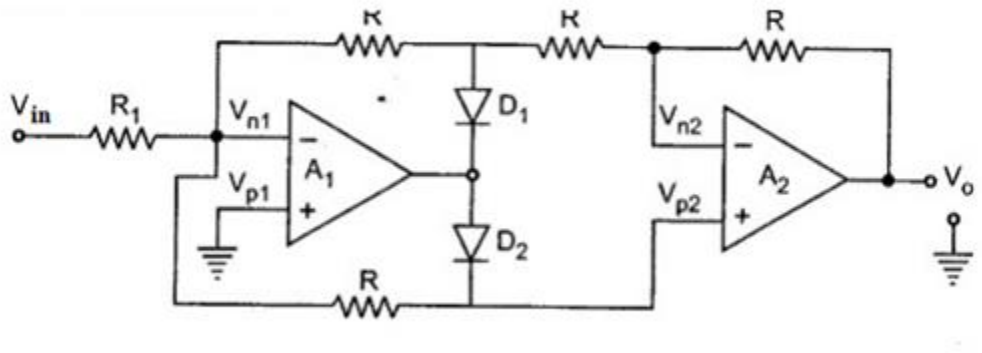
SLOT-L45-46

1. Design a full-wave rectifier circuit using op-amp, diode and other required components. Analyze the output for the input voltage (positive half cycle, negative half cycle) and present your findings.

AIM:

To design a full-wave rectifier circuit using op-amp, diode and other required components.

CIRCUIT DIAGRAM



Components Required

Op amp 741

10 kilo ohms resistors

A pair of 1N4001 diodes

Bread board

Supply Voltage for Op amp

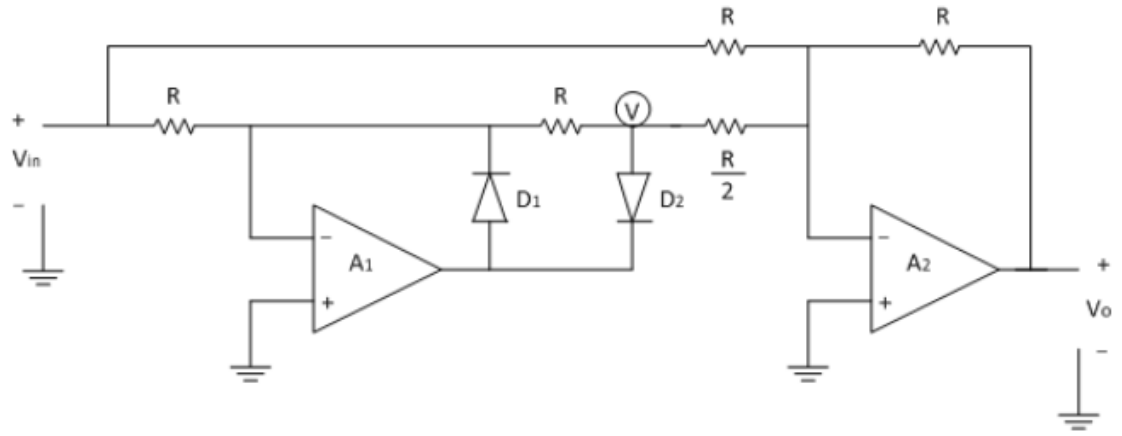
Function generator

Digital oscilloscope

Connecting wires

THEORETICAL EXPLANATION

In PFWR, for both the half cycles output is produced & in one direction only. The diagram below shows an inverting type of Precision FWR with positive output. It is also called as absolute value circuit because output signal swing is only in positive direction. So we get absolute value of input signal.



In positive half cycle of applied ac input signal, output of first op-amp (A1) is Negative. Therefore diode D2 is forward biased & diode D1 is reverse biased. Here op-amp A1 works as an inverting amplifier with gain =(-R/R)=-1

Therefore output of op-amp A1 is ,V=(-1) Vin=-Vin

Op-amp A2 works as an inverting adder. The two inputs to the op-amp A2 are voltage V (output of A1) and input voltage Vin. Thus output of op-amp A2i.e. Output voltage is given as

∴Vo=-[R/R Vin+R/(R/2) V]

∴Vo=-[Vin+2V]

Substituting V=-V_in

∴Vo=Vin

In negative half cycle of applied ac input signal, output of first op-amp (A1) is positive. Therefore diode D2 is reversed biased & diode D1 is forward biased.

Due to virtual ground concept output of op-amp A1is zero. (∴V=0)

Thus output of op-amp A2, i.e. Output voltage is given as

∴Vo=-[R/R Vin+R/(R/2) V]

∴Vo=-[R/R Vin+R/(R/2) (0)]

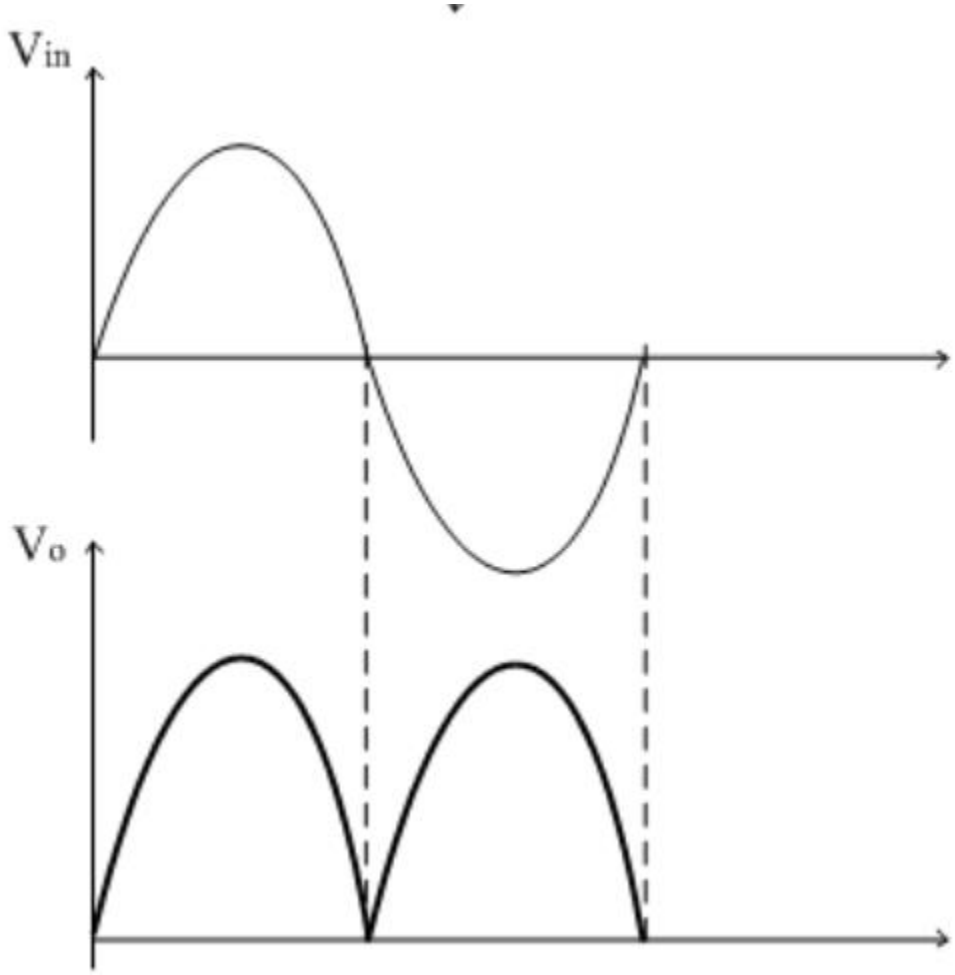
But in negative half cycle input magnitude is negative therefore we get,

∴Vo=-[R/R (-Vin)]

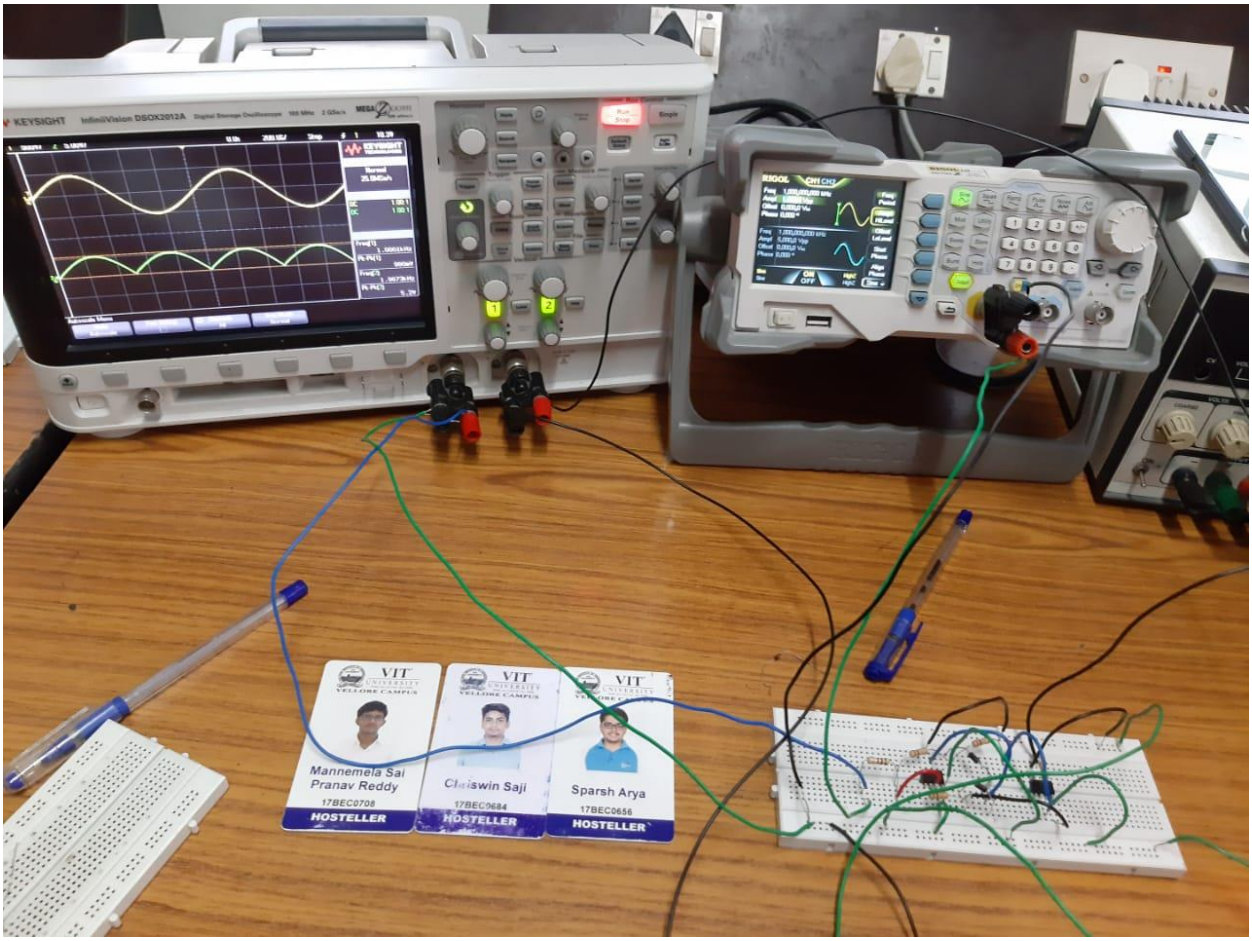
∴Vo=Vin

Thus in both the half cycles output is positive & in one direction & also have same magnitude. Thus it is also called as non-saturating type of PFWR because op-amp A1 is not going in saturation.

The transfer characteristics and input-output waveforms of PFWR are shown below,



OUTPUT



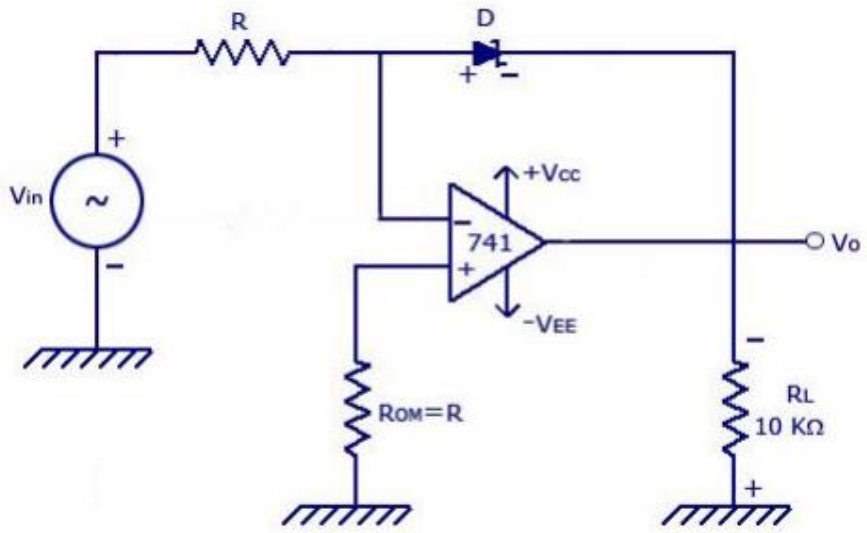
RESULTS

Thus, the results for the experiment have been successfully verified with proper waveform at the output.

2.

a.

(i) Analyze the circuit function shown in Figure 2 based on the Zener diode and output and present your findings



(ii) Reverse the direction of zener diode and analyse the circuit operation for Figure 2

AIM:

(i)

To analyze the circuit shown above with Zener diode.

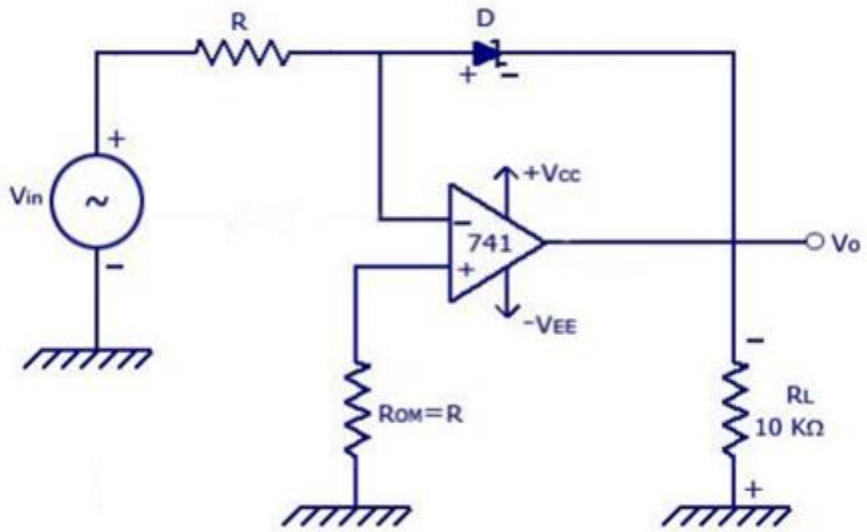
To plot the waveform observed at output.

(ii)

To analyze the same circuit by reversing the Zener diode.

To plot the waveform observed at output.

CIRCUIT DIAGRAM



COMPONENTS REQUIRED

Op amp 741

10 Kilo ohms Resistor

Zener Diode

Function generator

Digital oscilloscope

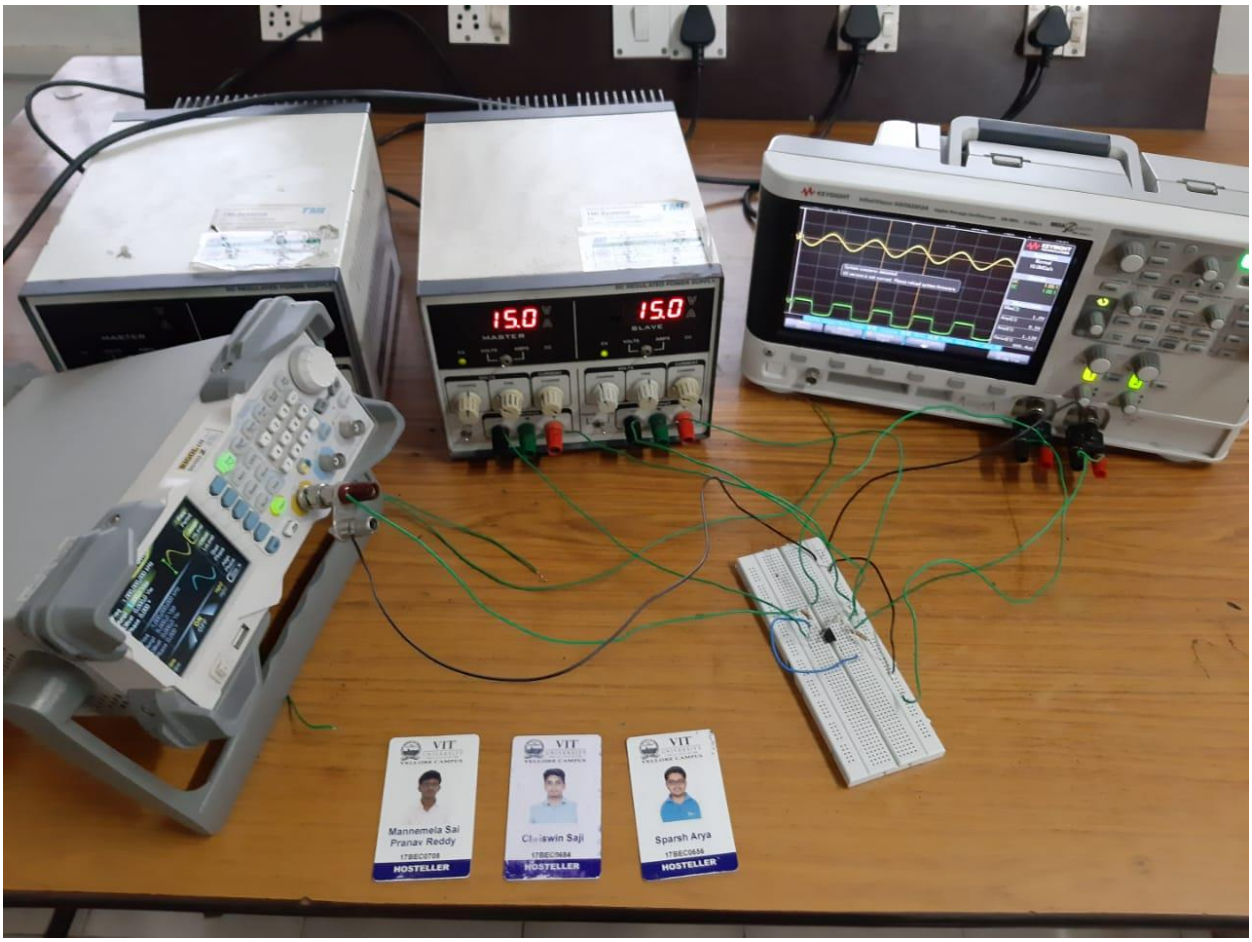
Power supply for Op amps

THEORETICAL EXPLANATION

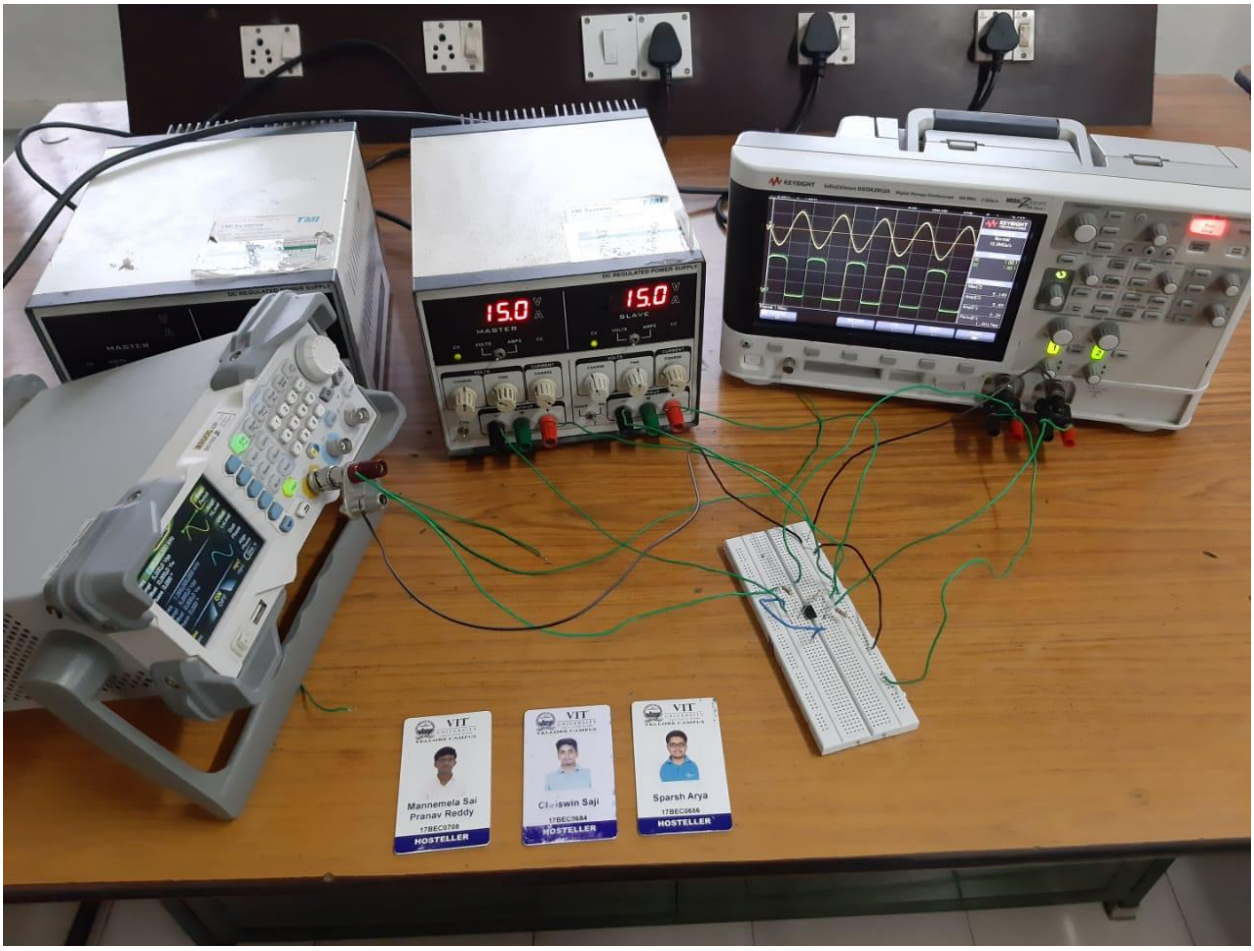
The offset problems can also be reduced by adding a voltage compensating network and a offset reducing resistor. Since the op-amp is originally designed to act as an amplifier, its output will not act linearly with logic families like TTL. A TTL requires input voltages which range between (0-5) volts. Thus, to keep the op-amp's output voltage swing between these ranges, other components like zener diodes are added onto the circuit. Such circuits with specified output swing are called voltage limiters.

In the figure shown below, the zener diode that is connected in the feedback path of the op-amp circuit. This design helps in keeping the voltage limit between the positive value of output voltage for the first case and negative values of the output voltage for the second case**.**

OUPUT


15.0
MASTER
15.0
SLAVE
Mannemela Sai Pranav Reddy
HOSTELLER
HOSTELLER
Sparsh Arya
HOSTELLER

Part (i)

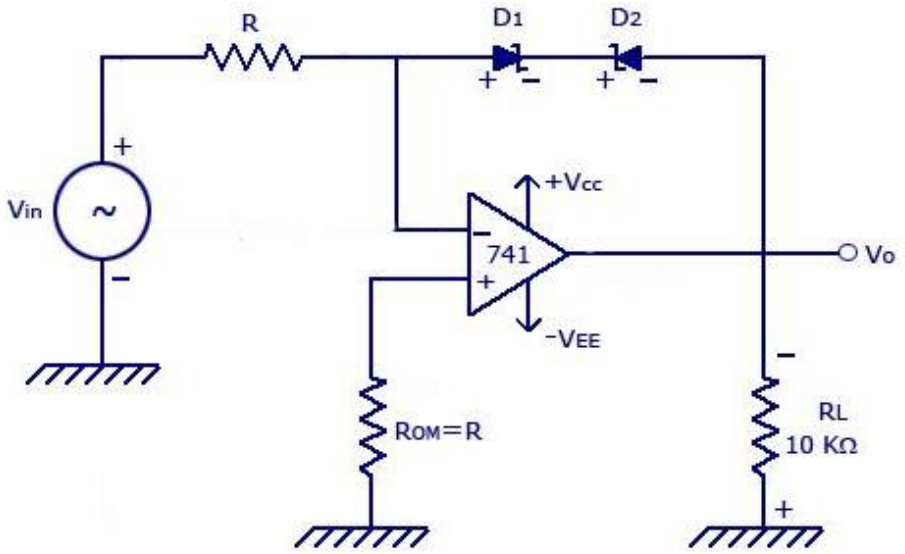


Part (ii)

RESULTS

Thus, the results for the experiment have been successfully verified with proper waveform at the output.

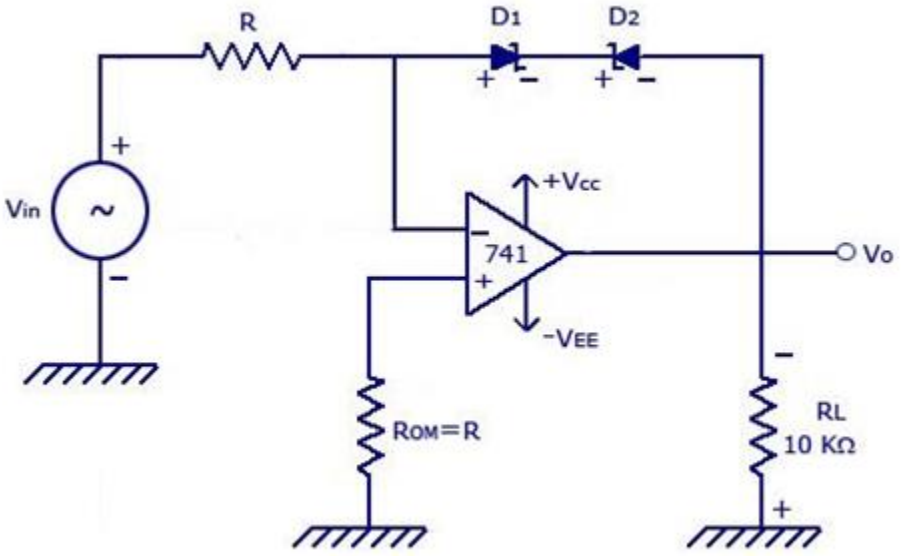
2b. Analyze the circuit function shown in Figure 3 based on the Zener diode and output and present your findings. Where this circuit can be used?



AIM:

To analyze the circuit shown above with 2 Zener diodes and to plot the output waveform.

CIRCUIT DAIGRAM



COMPONENTS REQUIRED

Op amp 741

10 Kilo ohms Resistor

Zener Diode

Function generator

Digital oscilloscope

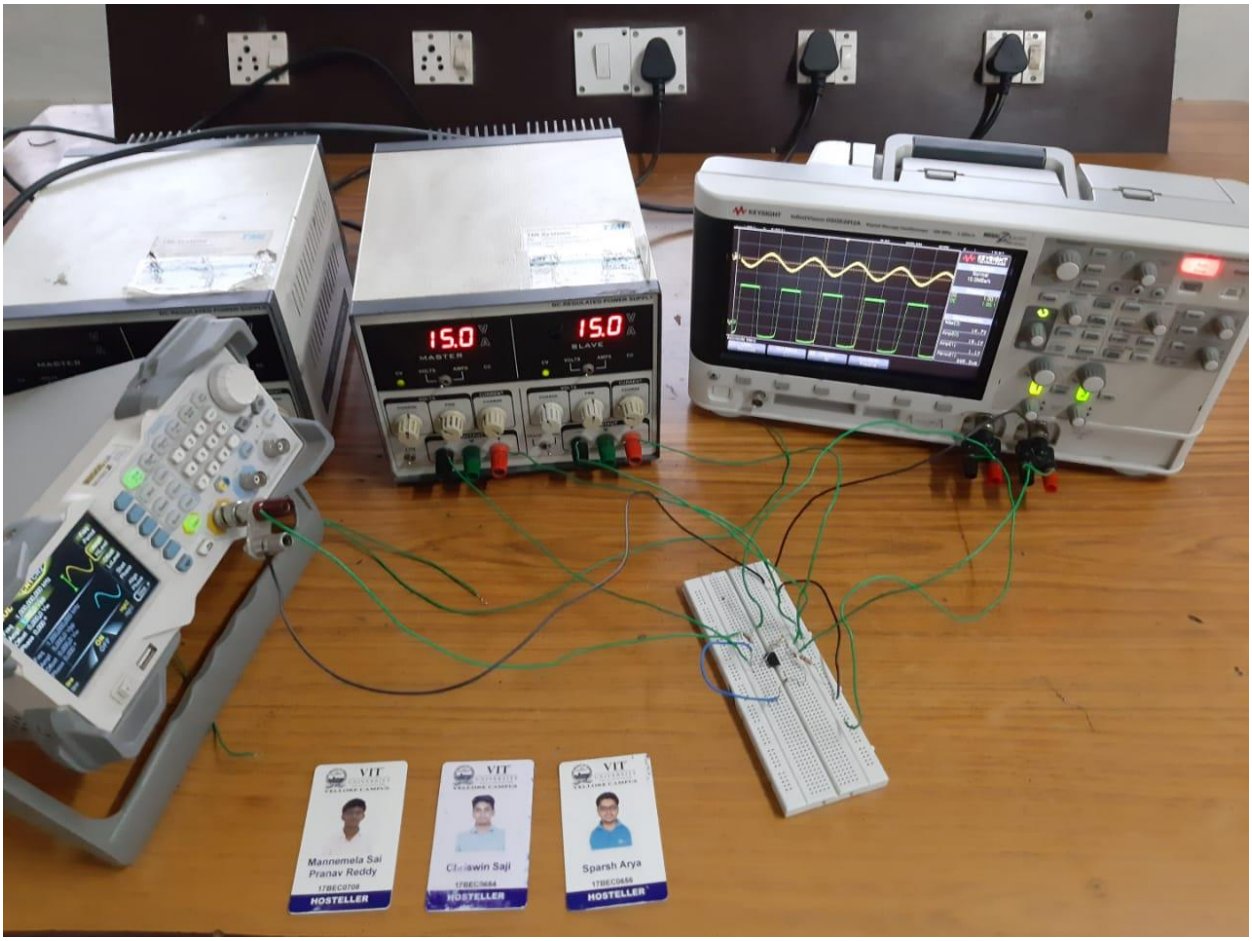
Power supply for Op amps

Theoretical Explanation

The offset problems can also be reduced by adding a voltage compensating network and a offset reducing resistor. Since the op-amp is originally designed to act as an amplifier, its output will not act linearly with logic families like TTL. A TTL requires input voltages which range between (0-5) volts. Thus, to keep the op-amp's output voltage swing between these ranges, other components like zener diodes are added onto the circuit. Such circuits with specified output swing are called voltage limiters.

In the figure shown below, there are two zener diodes that are connected in the feedback path of the op-amp circuit. This design helps in keeping the voltage limit between the positive and negative values of the output voltage, V_0. As shown in the waveform, as the voltage Vin increases from 0 to positive voltage, the value of V0 increases in the opposite direction (negative). This goes on until the diode D1 becomes forward biased and D2 goes into avalanche breakdown.

OUTPUT



RESULTS

Thus, the results for the experiment have been successfully verified with proper waveform at the output.

TASK-2

FULLWAVE RECTIFIER

(1) o/p → 5.2V

fq → 1.9874 KHz

i/p → 1V

fq → 999.44 Hz.

ZENER DIODE (1)

(2) ii) i/p → 1V

fq → 1KHz

o/p → 5.5V

fq → 1KHz.

ZENER DIODE (flipped)

(3) a) i) i/p → 5V

~~fq~~ Time → 1ms.

o/p → 5.6V

Time → 1ms

2 ZENER DIODE

b) i/p → 1V

TP → 1ms.

o/p → 1.9V

REFERENCES

https://electronics.stackexchange.com/questions/202349/opamp-oscillator-amplitude-stabilization-with-zener-diodes

https://www.electronics-tutorials.ws/opamp/op-amp-comparator.html

https://electronics.stackexchange.com/questions/195479/zener-diode-in-comparator