CSE 251-Project

Course Name: Electronics Circuits
Course Code: CSE 251
Section No: 04

Name of the Project: Design a 5V DC Power Supply using Diode for a specified input.

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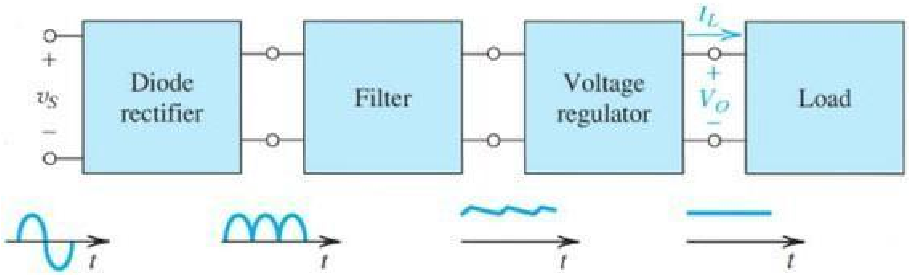
Problem Statement

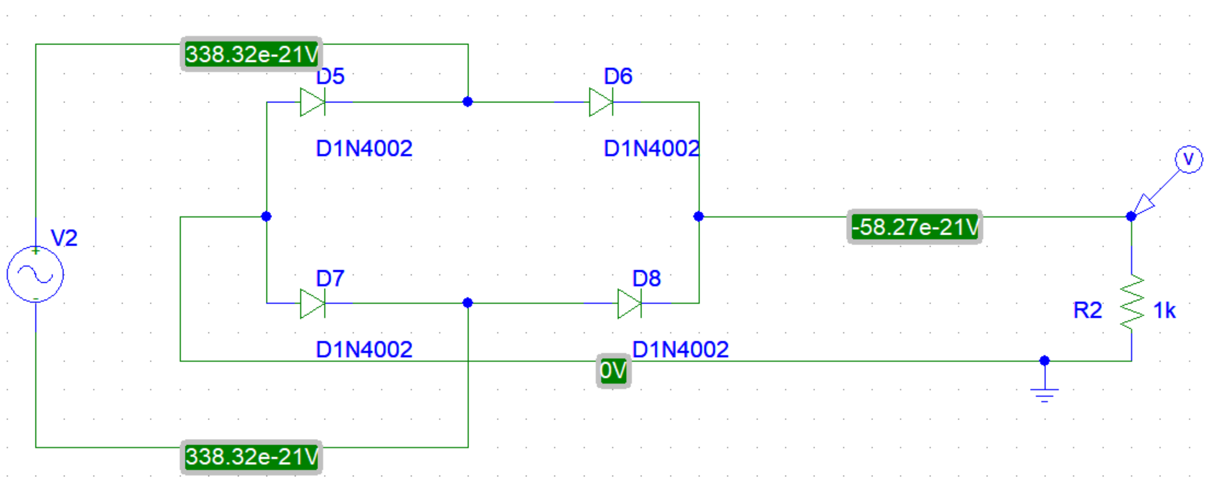


The figure above shows the block diagram of a dc power supply design process. The design process includes three design segments: a diode rectifier, a filter, and a voltage regulator to get the final output Vo. The diode rectifier converts the input sinusoid Vs to a unipolar output, which can have the pulsating waveform indicated in Fig. 3. The variations in the magnitude of the rectifier output are considerably reduced by the filter block. The output of the rectifier filter contains a time-dependent component, known as ripple. To reduce the ripple and to stabilize the magnitude of the dc output voltage against variations caused by changes in load current, a Zener shunt voltage regulator can be implemented. Design the circuit components, and finally simulate to test the circuit. Use sine wave (24Vp-p) as input signal, and capacitor, resistors, and Zener diode of suitable value for the design. Note that, for design purpose, the values of the resistors should not exceed more than 10kΩ.

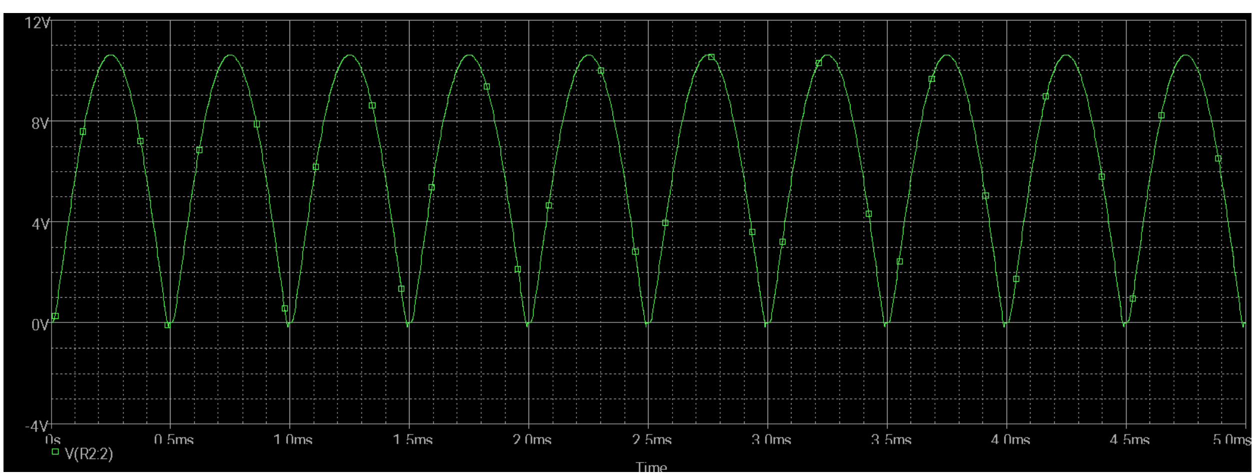
Design Details

Diode Rectifier:

A full bridge rectifier was used for this block. Diodes of model 1N4002 were used in simulations and 1N4007 were used in the practical circuit.



With 24Vp-p 1khz sine wave as input, the output is given below.



Filter :

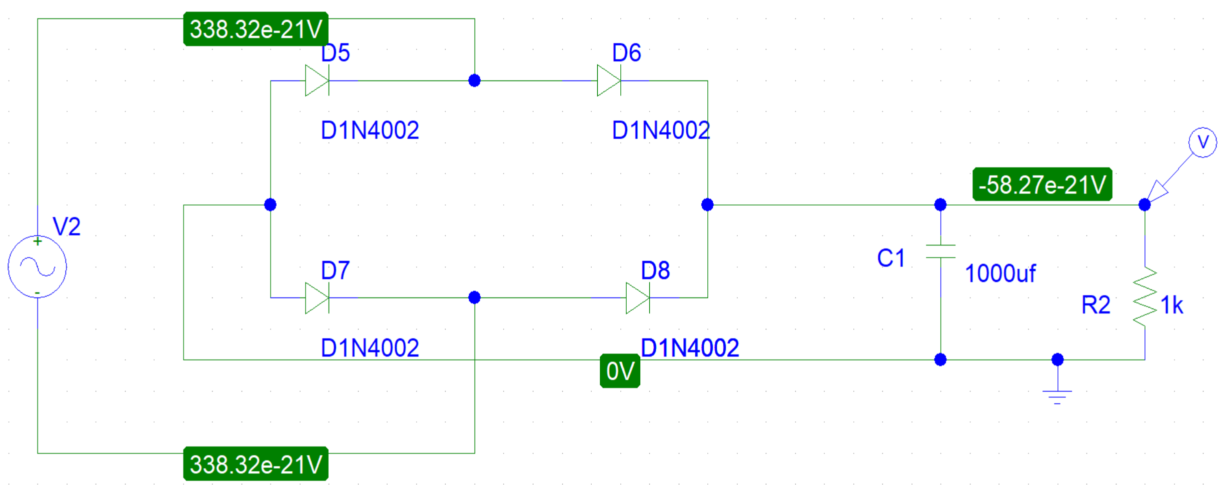
We are targeting a peak-to-peak ripple of around 100mV, considering maximum load current of 10mA, and a minimum frequency of 60Hz to a maximum input frequency of 1kHz.

$$V_{rp-p} = \frac{I_L}{2 * f * C}$$

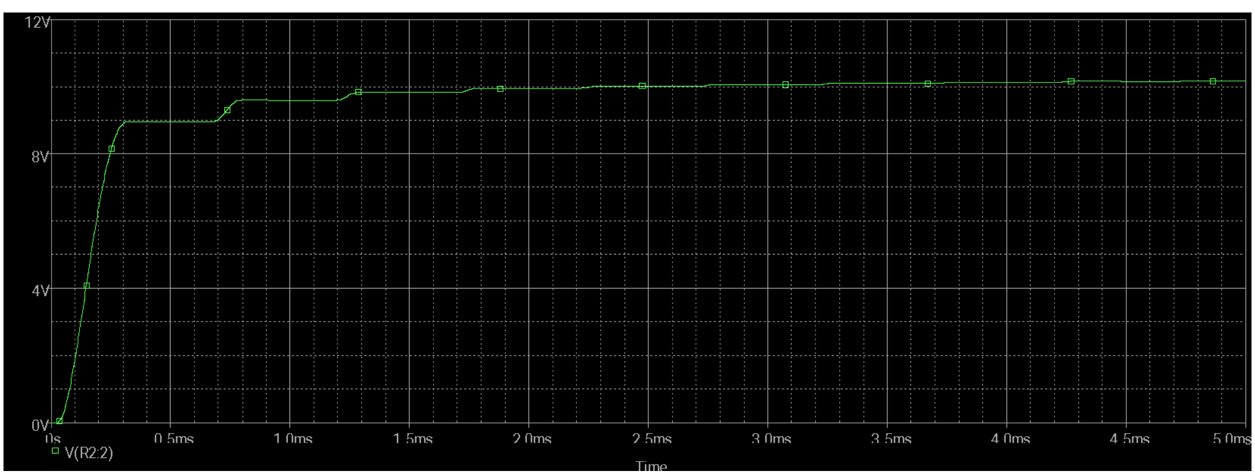
Therefore,
$$100 * 10^{-3} = \frac{10m}{2 * 60 * C}$$

Therefore, C = 833.3µF

Rounding that off to 1000µF capacitor, and for practical build, a 1000µF 50V capacitor.



Simulation result:



Voltage Regulator:

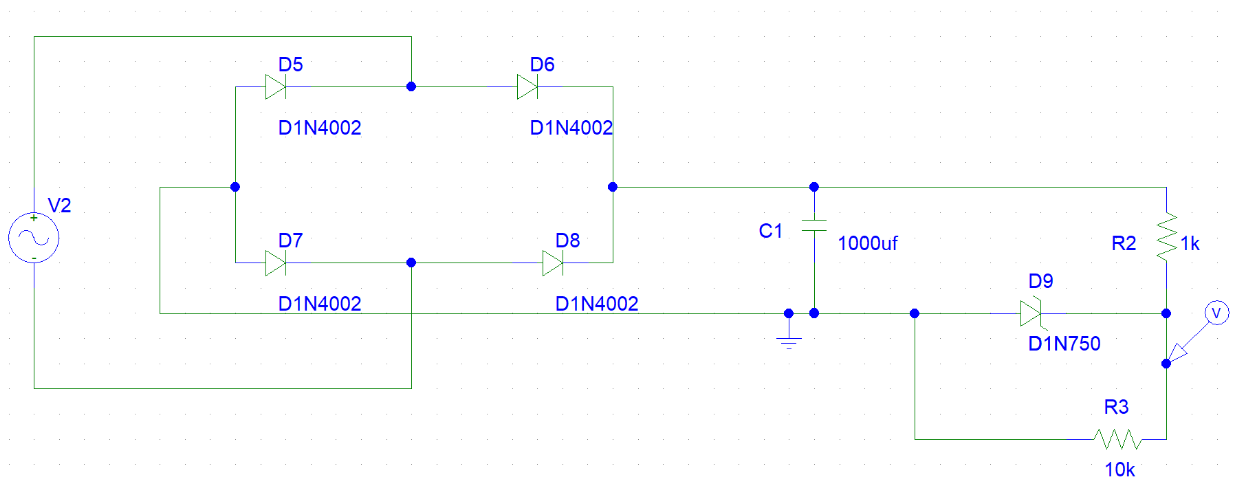
We are using a 5.1V Zener shunt voltage regulator rated at 0.25W.
Therefore, maximum current flowing through the Zener may be

$$I_{Zmax} = \frac{0.25W}{5.1V} = 49.02mA$$

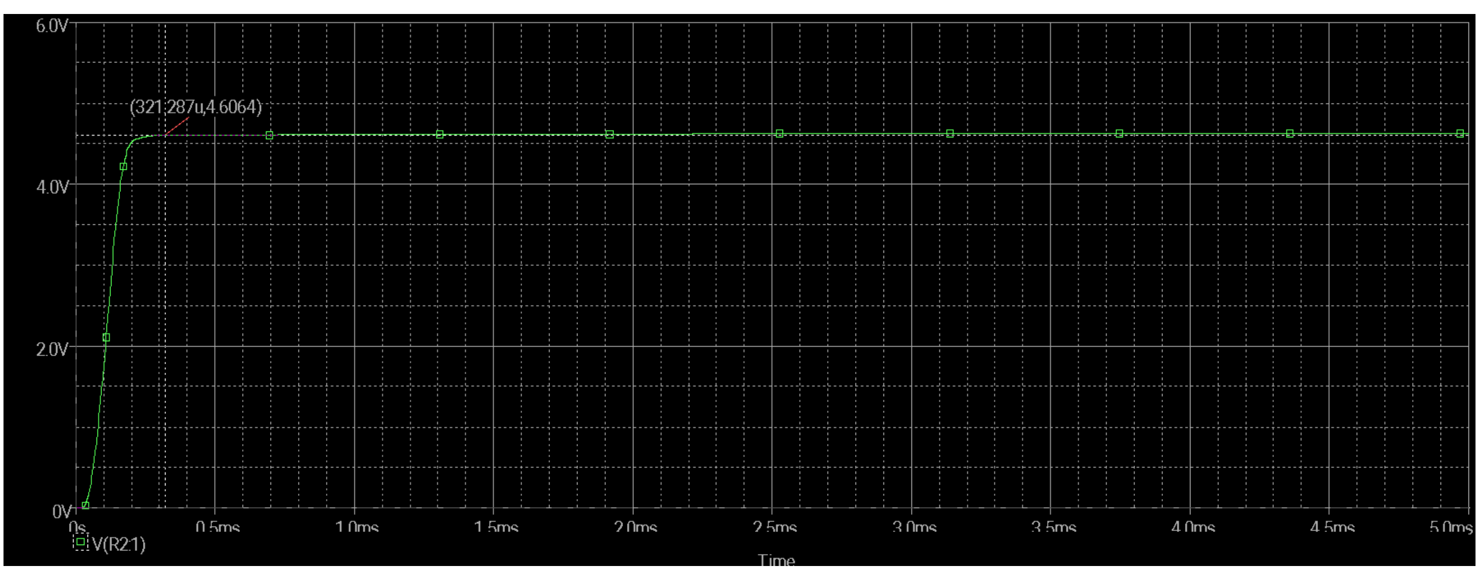
Minimum value for the series resistor Rs is,

$$R_S = \frac{12 - 5.1}{49.02m} = 140.76\Omega$$

After using 1k resistor,



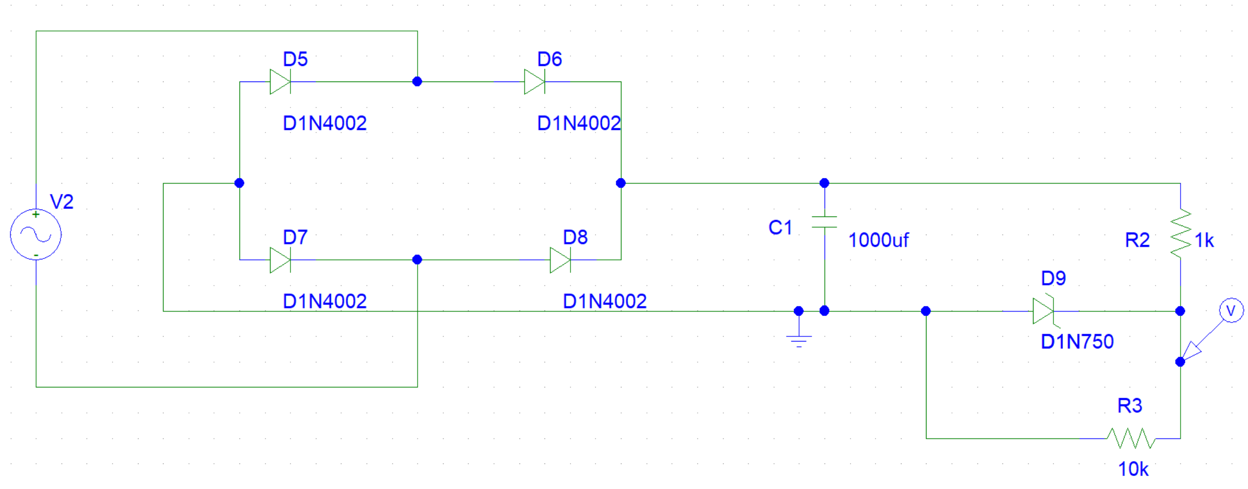
Simulation:



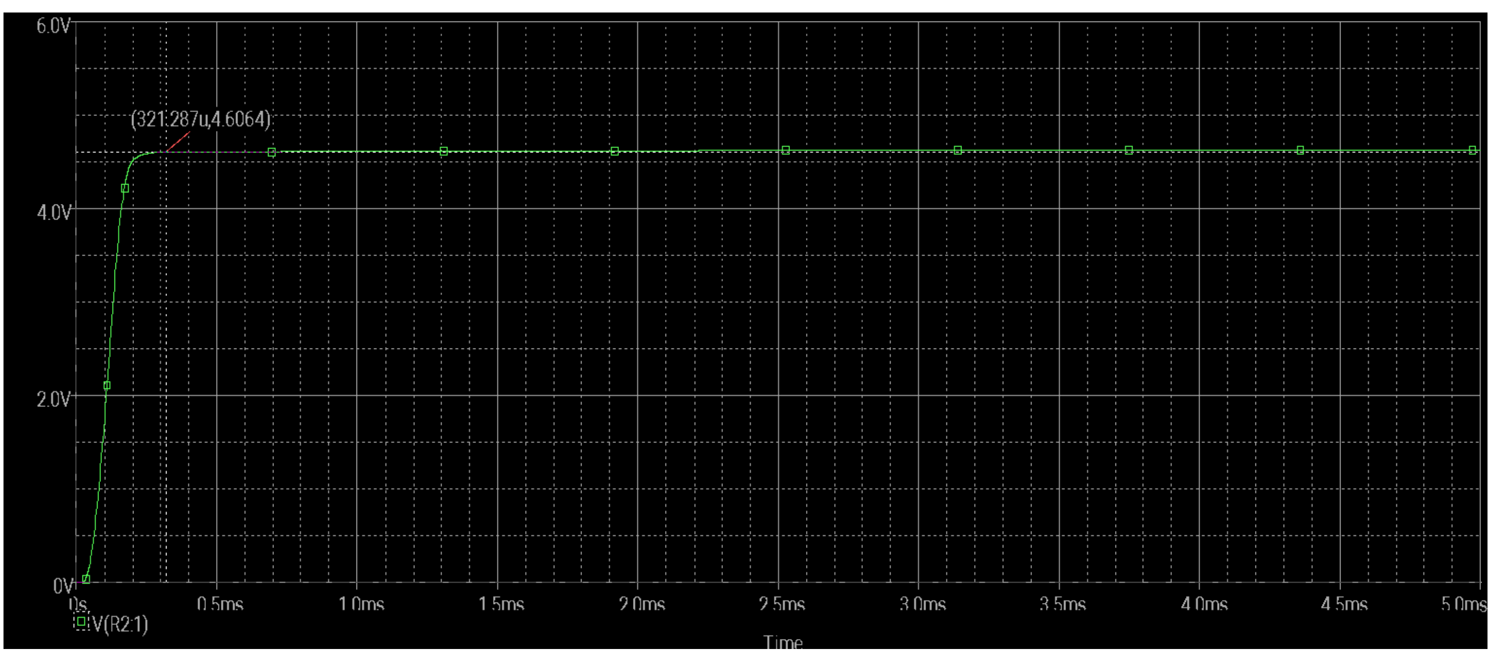
Load:

We are using **Load** of 10k resistor, for small current flow. We can also use less resistance but as in the question it is mentioned that we can't exceed 10k resistance that is why we are using 10k.

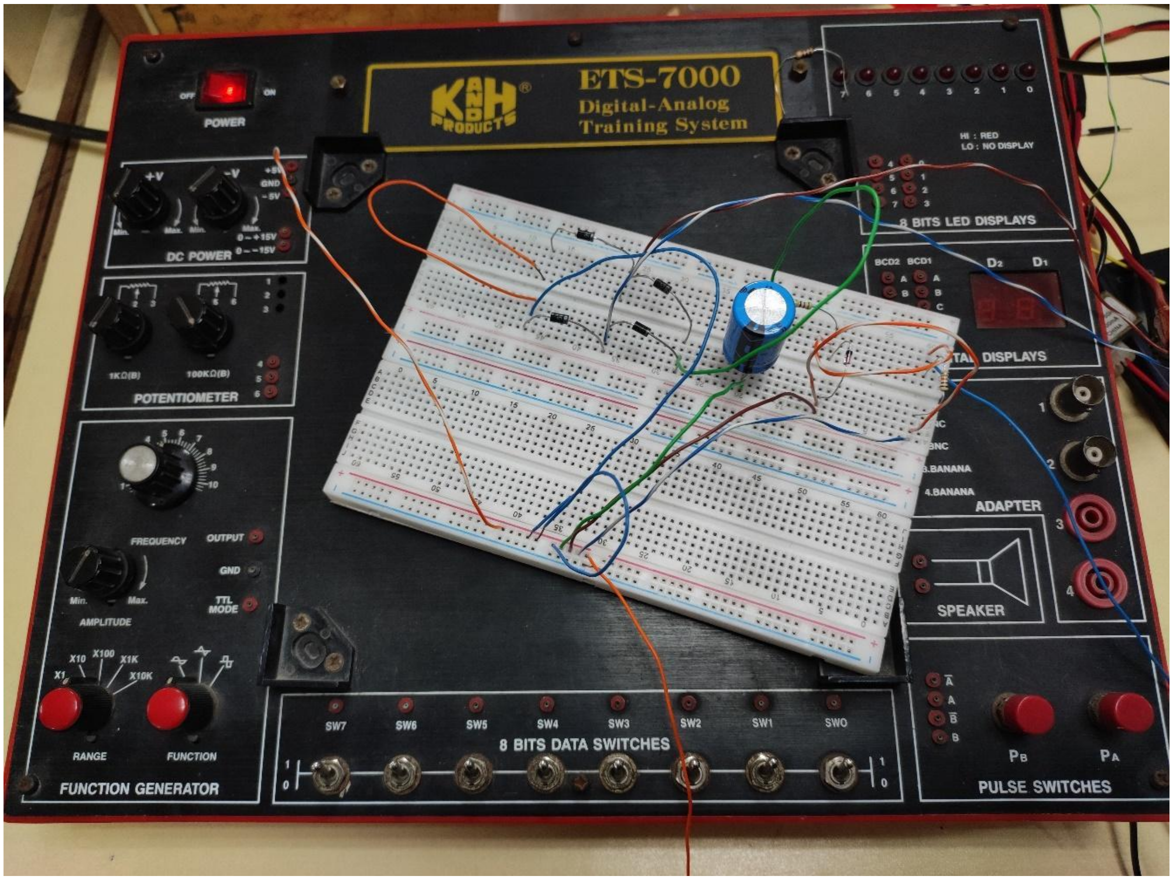
Circuit Diagram:



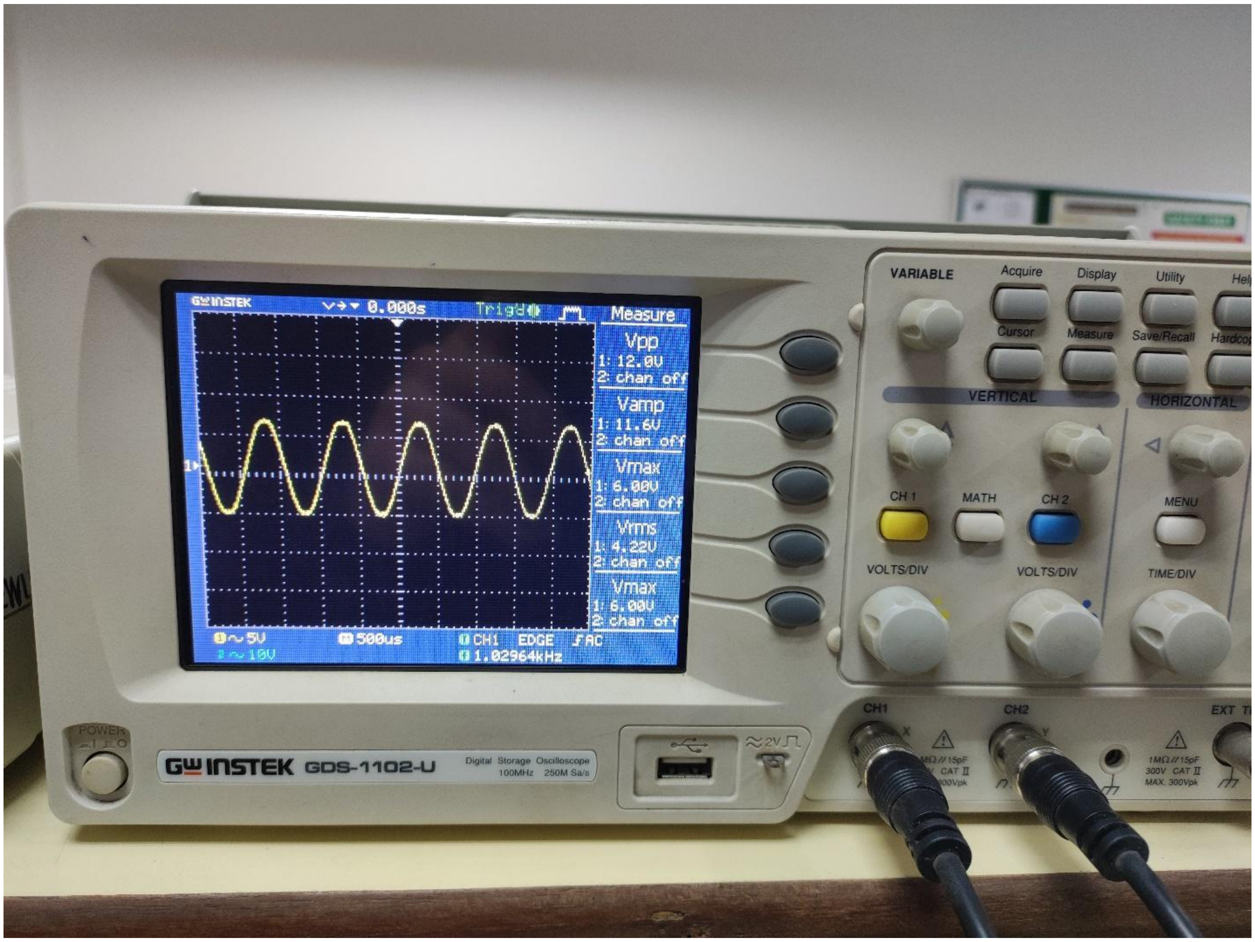
Simulation:

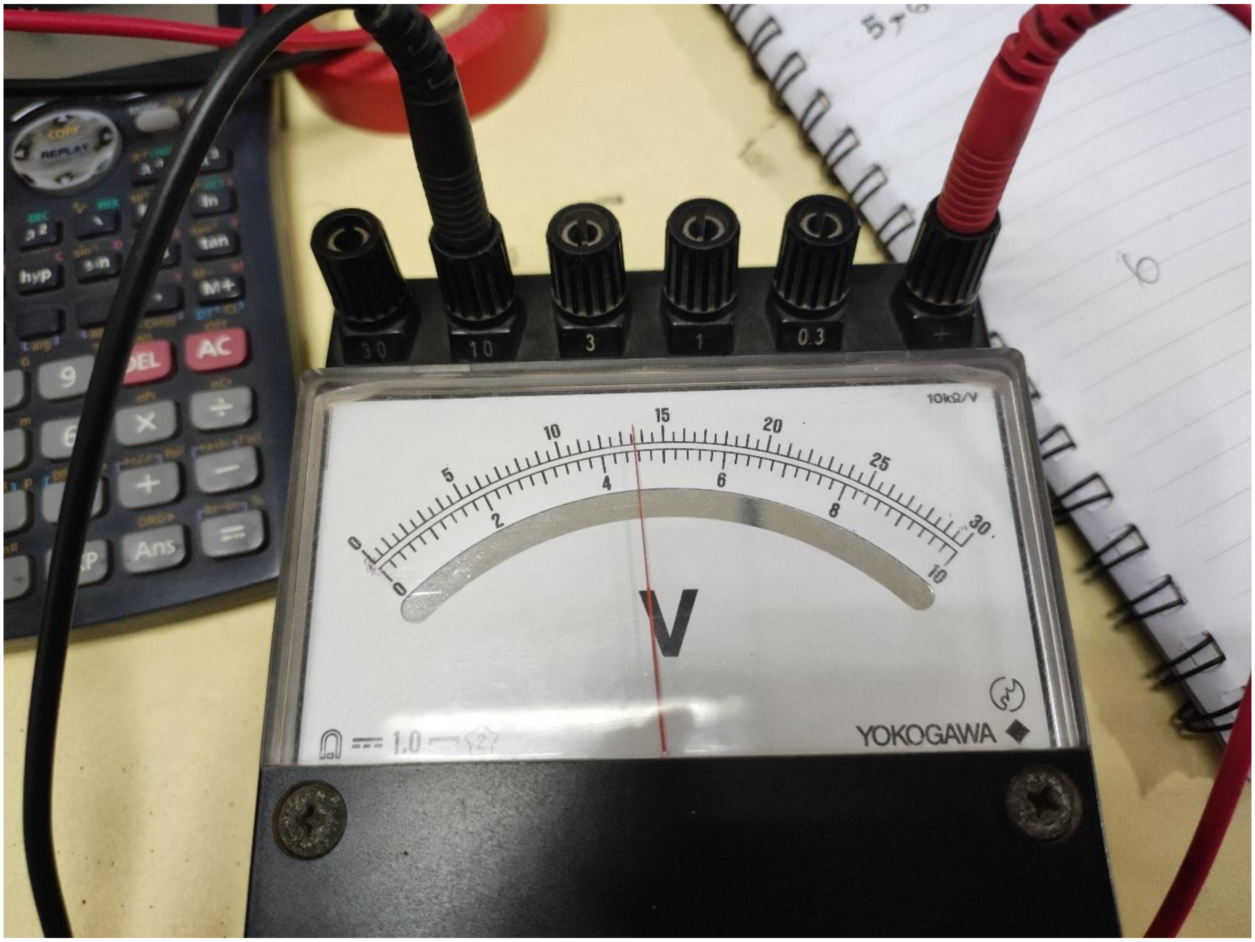


Practical Circuit:



1.0296
k
Hz
1M
100K
10K
1K
100
10
1
GATE
ATT −20dB
FREQUENCY
SWEEP/TIME
SWEEP/RATE
DUTY
CMOS
OFFSET
AMPL
OUTPUT
50 Ω
POWER
FAST
MAX
LIN
SWEEP ON
SWEEP OFF
CMOS ADJ
TTL
MIN
GW INSTEK
GFG-8217A


GW INSTEK
0.000s
Trig'd
Measure
Vpp
1: 12.0V
2: chan off
Vamp
1: 11.6V
2: chan off
Vmax
1: 6.00V
2: chan off
Vrms
1: 4.22V
2: chan off
Vmax
1: 6.00V
2: chan off
~5V
500us
CH1 EDGE
AC
1.02964kHz
VARIABLE
Acquire
Display
Utility
Cursor
Measure
Save/Recall
VERTICAL
HORIZONTAL
CH 1
MATH
CH 2
MENU
VOLTS/DIV
VOLTS/DIV
TIME/DIV
POWER
GW INSTEK GDS-1102-U
Digital Storage Oscilloscope
100MHz 250M Sa/s
CH1
CH2


30
10
3
1
0.3
+
10kΩ/V
0
5
10
15
20
25
30
0
2
4
6
8
10
V
YOKOGAWA
1.0