Lab Manual

for

EEE 1232

Electronic Devices and Circuits Lab

Department of Computer Science and Engineering

Varendra University

Rajshahi, Bangladesh

VARENDRA UNIVERSITY

Department of Computer Science and Engineering

EEE 1232

Electronic Devices and Circuits Lab

Student Information	
Student ID	
Student Name	
Semester	
Section	
Batch	

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INSTRUCTIONS FOR LABORATORY

1. Students should sign in the log registers as soon as they enter in the lab and strictly observe the lab timings.

2. Students have to strictly follow the written and verbal instructions given by the teacher. If they do not understand the instructions, the handouts and the procedures, they can ask the instructor or teacher.

3. Students should have to accompany by their laboratory partner and the instructors all the time.

4. It is mandatory for the students to come to lab in a proper dress and have to wear their ID cards.

5. Mobile phones should be switched off in the lab and the bags should keep in proper place.

6. Students should keep the lab clean all times, no food and drinks are allowed inside the lab.

7. Intentional misconduct will lead to expulsion from the lab.

8. Students should not handle any equipment without reading the safety instructions. They should read the handout and procedures in the Lab Manual before starting the equipment's.

9. Students should do their writing, setup and a careful circuit checkout before applying power. They should not make circuit changes or perform any writing when power is on.

10. Student should avoid contact with energized electrical circuits.

11. Students should not insert connectors forcefully into the sockets.

12. Students should immediately report dangerous or exceptional conditions to the Lab instructors. Equipment that is not working as expected, wires or connectors are broken, the equipment that smells or smokes. If a student is not sure what the problem is or what is going on they should switch off the Emergency Shutdown.

13. Students should never use the damage instruments, wires or connectors. They should handover the parts to the Lab Instructor.

14. After completion of Experiment, students should return the equipment to lab staff. They are not allowed to take any item from the lab without permission.

15. Observation book and lab record should be carried to each lab. Readings of current lab experiment are to be entered in Observation book and previous lab experiment should be written in Lab record book. Both the books should be corrected by the faculty in each lab.

16. Handling of Semiconductor Components: Sensitive electronic circuits and electronic components have to be handled with great care. The inappropriate handling of electronic component can damage or destroy the devices. The devices can be destroyed by driving to high currents through the device, by overheating the device, by mixing up the polarity, or by electrostatic discharge (ESD). Therefore, always handle the electronic devices as indicated by the handout, the specifications in the data sheet or other documentation.

Varendra University

COURSE SYLLABUS

1.	**Faculty**	Faculty of Science and Engineering
2.	**Department**	Department of CSE
3.	**Program**	B.Sc. in Computer Science and Engineering
4.	**Name of Course**	Electronic Devices and Circuits Lab
5.	**Course Code**	EEE 1232
6.	**Bi-semester and Year**	Summer 2023
7.	**Pre - requisites**	CSE 122
8.	**Status**	Core Course
9.	**Course Credit**	1.5
10.	**Section**	A,B,C
11.	**Class Hours**	2 Hours
12.	**Class Location**	Digital Electronics Lab
13.	**Names of Academic Instructors**	Arifa Ferdousi Ipshita Tasnim Raha Moloy Kumar Ghosh
14.	**Office**	CSE Office room, Permanent Campus, VU
16.	**Counseling Hours**	Monday 10:10 – 12:30 (Sec: A), Thursday 10:10 – 12:30, 12:30 – 3:40 (Sec: B,C)
17.	**Text Books**	1. Electronic Devices and Circuit Theory, Robert L. Boylestad, Louis

		Nashelsky 2. Microelectronics Circuits, Sedra / Smith 3. Principles of Electronics, *S. Chand Group*, Mehta, Rohit, V K Mehta
18.	**Equipment's**	1. Lab Sheet 2. Resistors 3. Project Board 4. Ammeter 5. Multimeter 6. Diode 7. Zener Diode 8. Voltage Regulator 9. Connecting Wires 10. Capacitor 11. Signal Generator 12. DC Voltage Supply 13. Oscilloscope
19.	**Course Description**	In this course students will perform experiments to verify practically the Theories and concepts learned in CSE 223.
20.	**Course Objectives**	The course is designed to provide the background of the following topics: a) Perform the experiment with different types of diode. b) Perform the use of oscilloscope and signal generator in circuit operation. c) Demonstrate the functions of rectifier.
21.	**Learning Outcomes**	After the successful completion of this course, students will be able, i. To plot electronic circuits. ii. To measure values from electronic circuits. iii. To use electronic equipment's properly. iv. To know the use of semiconductor devices. v. To use signal in circuits and display the output.
22.	**Teaching Methods**	Lecture

23.	Topic Outline				
	Class	**Topics**	**Class**	**Reading Reference**	**Activities**
	1	Introduction, identification, gathering knowledge and the usages of instruments	1		Implementation, Question Answer
	2	Forward Bias	1		Implementation, Question Answer
	3	Reverse Bias	1		Implementation, Question Answer
	4	Voltage Regulation using Zener Diode while Load Resistor is constant	1		Implementation, Question Answer
	5	Voltage Regulation using Zener Diode while Input Voltage is constant	1		Implementation, Question Answer
	6	Half Wave Rectifier	1		Implementation, Question Answer
	7	Full Wave Rectifier	1		Implementation, Question Answer
	8	Positive and Negative Clipper Circuit	1		Implementation, Question Answer
	9	Positive and Negative Clamper Circuit	1		Implementation, Question Answer
	10	Lab Quiz and Lab Viva	1		Problem Solving, Question Answer
	11	Lab Final and Lab Report Final Submission	1		Implementation, Question Answer

24.	**Assessment Methods**	(see table below)

Assessment Type	**Marks**
Attendance	10%
Continuous Assessment (Experiment, Report, Viva)	40%
Final Examination (Lab Test, Quiz, Viva, Project)	50%
Total	**100%**

25.	**Grading Policy**	(see table below)

Numerical Grade	**Letter Grade**	**Grade Point**
80% and above	A+ 4.00	75%
to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	D	2.00
Less than 40%	F	0.00

26.	**Additional Course Policies**	**1. Lab Reports** Report on previous Experiment must be submitted before the beginning of new experiment. A bonus may be obtained if a student submits a neat,

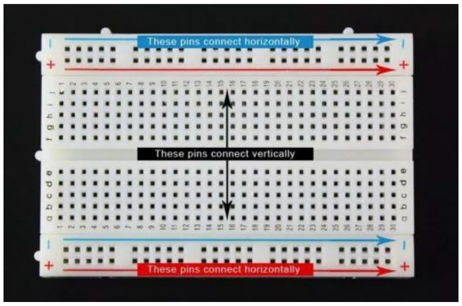
		Clean and complete lab report. **2. Examination** There will be a lab exam at the end of the semester that will be closed book. **3. Unfair means policy** In case of copying/plagiarism in any of the assessments, the students involved will receive zero marks. Zero tolerance will be shown in this regard. In case of severe offences, actions will be taken as per University rule. **4. Counseling** Students are expected to follow the counseling hours posted. In case of emergency/unavoidable situations, students can e-mail me to make an appointment. Students are regularly advised to check the course materials. **5. Policy for Absence in Class/Exam** If a student is absent in the class for anything other than medical reasons, he or she will not receive attendance. If a student misses a class for genuine medical reasons, he or she must apply with the supporting documents (prescription/medical report). He or she will then have to follow the instructions given by the instructions given by the instructor for makeup. In case of absence in the mid/final exam for medical grounds, the student must also get his or her application forwarded by the head of the department before a make-up exam can be taken. It is recommended that the students inform the instructor beforehand through mail if they feel that they will miss a class or evaluation due to Medical reasons.
27.	**Additional Information**	a. Academic Calendar Summer 2023. b. Academic information and policies. c. Grading and performance Evaluation. d. Proctorial Rules.

Experiment No.: 01

Experiment Name: Introduction, identification, gathering knowledge and usages of lab instruments.

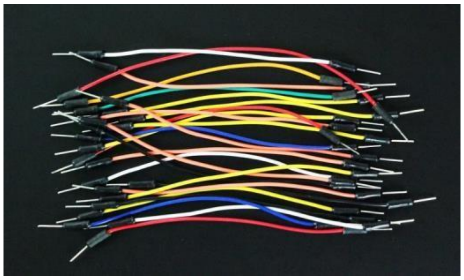
Theory: There are many equipments in electronic lab. It is most important to know about the equipments, identify them and know the process of use of the equipments before starting experiment. Introduction of some of the electronic lab equipments are described below with diagram.

Breadboard: Breadboards are an essential tool for prototyping and building temporary circuits. These boards contain holes for inserting wire and components. Because of their temporary nature, they allow you to create circuits without soldering. The holes in a breadboard are connected in rows both horizontally and vertically as shown below.

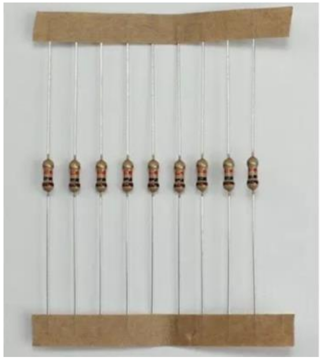


Digital Multimeter: A multimeter is a device that's used to measure electric current (amps), voltage (volts) and resistance (ohms). It's a great for troubleshooting circuits and is capable of measuring both AC and DC voltage. Check out this post for more info on how to use a multimeter.

Jumper Wire: These wires are used with breadboard and development boards and are generally 22-28 AWG solid core wire. Jumper wires can have male or female ends depending on how they need to be used.



Resistor: Resistors are used to resist the flow of current or to control the voltage in a circuit. The amount of resistance that a resistor offers is measured in Ohms. Most resistors have colored stripes on the outside and this code will tell you it's value of resistance. You can use a multimeter or Digikey's resistor color code calculator to determine the value of a resistor.

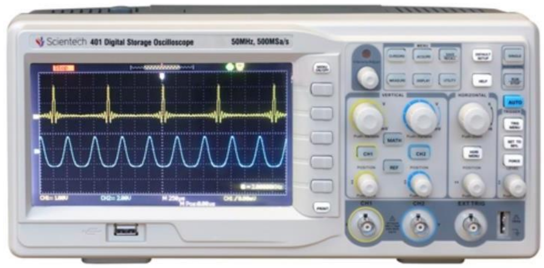


Variable Resistor (Potentiometer): A variable resistor is also known as a potentiometer. These components can be found in devices such as a light dimmer or volume control for a radio. When you turn the shaft of a potentiometer the resistance changes in the circuit.

Capacitor: Capacitors store electricity and then discharges it back into the circuit when there is a drop in voltage. A capacitor is like a rechargeable battery and can be charged and then discharged. The value is measured in F (Farad), nano Farad (nF) or pico Farad (pF) range.

Diode: A diode allows electricity to flow in one direction and blocks it from flowing the opposite way. The diode's primary role is to route electricity from taking an unwanted path within the circuit.

Oscilloscope: Electronics are all about the signals and the oscilloscope is the primary measurement tool to observe the shape of signals. Oscilloscopes, often called oscopes or just scopes, display signals in a graphical format on a pair of axes, generally with Y as the voltage and X as the time. This is a very powerful way to quickly see the shape of a signal, determine what is going on in an electronic circuit and monitor performance or track down problems. Oscilloscopes are available in digital and analog variants, starting at a few hundred dollars and running into the tens of thousands for the top of the line models. Digital scopes have several measurements and trigger options built into the system which make measurements of peak-to-peak voltage, frequency, pulse width, rise time, signal comparisons, and recording waveforms simple tasks.



Ammeter: A measuring instrument which is used to measure the electric current in a circuit is known as an ammeter. The units of measurement for electric current is amperes (A) Earlier ammeters were laboratory instruments which depend on the earth’s magnetic field for operation. In an era of the 19th century, improved instruments were designed which could be placed in any position and allows accurate measurements in electric power systems. The smaller currents can be measured by using milli ammeters or micro ammeters, units of measuring the smaller current are in the milli ampere or micro-ampere range. There are different types of ammeters such as moving-coil, moving magnet and moving-iron, etc.

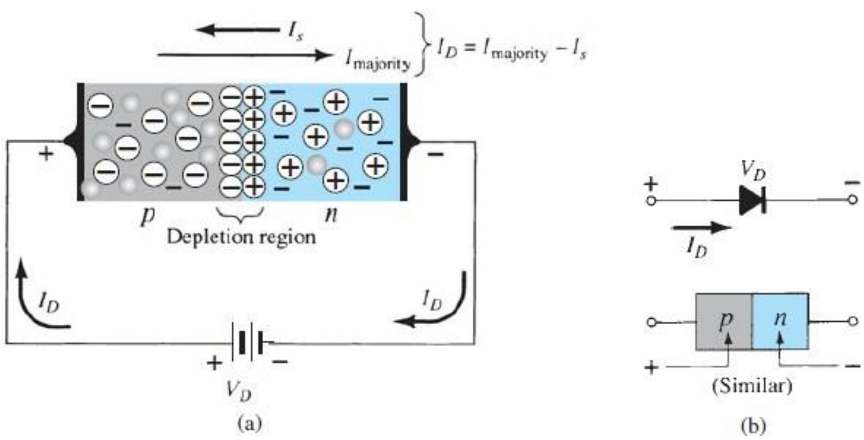
Signal Generator: A signal generator is also named as pitch generator, function generator or frequency generator is an electronic device used for generating electronic signals either in the analog or digital domains (repeating or non-repeating signals). Signal generators are used in testing, designing and repairing electro acoustic or electronic devices. In general no electronic device is suitable for all applications. There are various types of signal generators with different applications and purposes. During the development in technology, compared to signal generators there are flexible and programmable software tone generators with embedded hardware units are made available in the market.

Signature of the Teacher
Date:

Experiment Number: 02

Experiment Name: To study the operation of Forward Bias.

Theory: A forward-bias or "on" condition is established by applying the positive potential to the p -type material and the negative potential to the n -type material. The application of a forward-bias potential V_D will "pressure" electrons in the n -type material and holes in the p -type material to recombine with the ions near the boundary and reduce the width of the depletion. The resulting minority-carrier flow of electrons from the p -type material to the n -type material and of holes from the n -type material to the p -type material has not changed in magnitude since the conduction level is controlled primarily by the limited number of impurities in the material, but the reduction in the width of the depletion region has resulted in a heavy majority flow across the junction.



Required Equipments:

1. Bread Board
2. DC Voltage Supplier
3. Resistor (1 kΩ, 1 piece)
4. Diode (1 piece)
5. Ammeter (1 piece)
6. Digital Multimeter (1 piece)
7. Connecting Wires

Circuit Diagram:

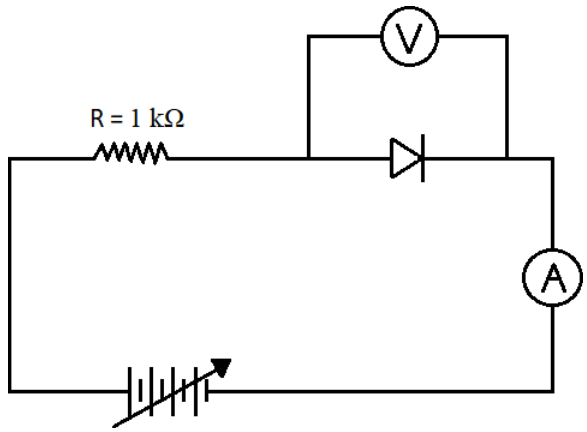


Figure: Circuit Diagram of Forward Bias

Data Table:

No. of Observation	**Supply Voltage V_s ( )**	**Resistor R ( )**	**Voltage Across Diode V_D ( )**	**Current Across Diode I_D ( )**
01				
02				
03				
04				
05				
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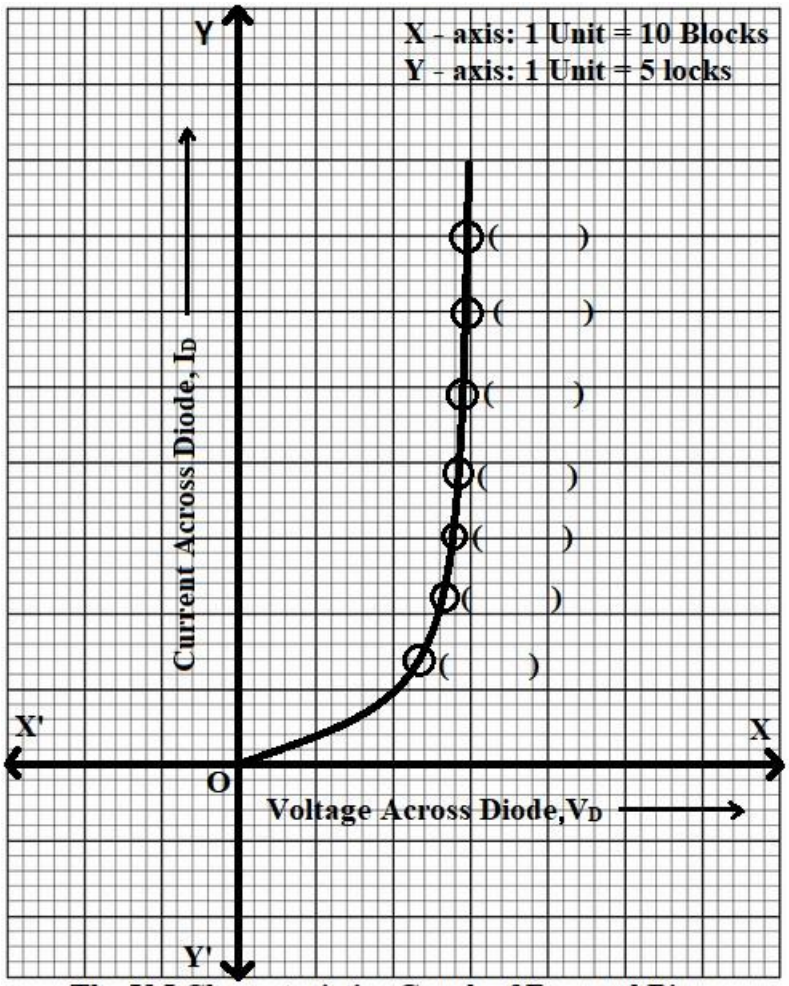
11				
12				
13				
14				
15				

Graph:



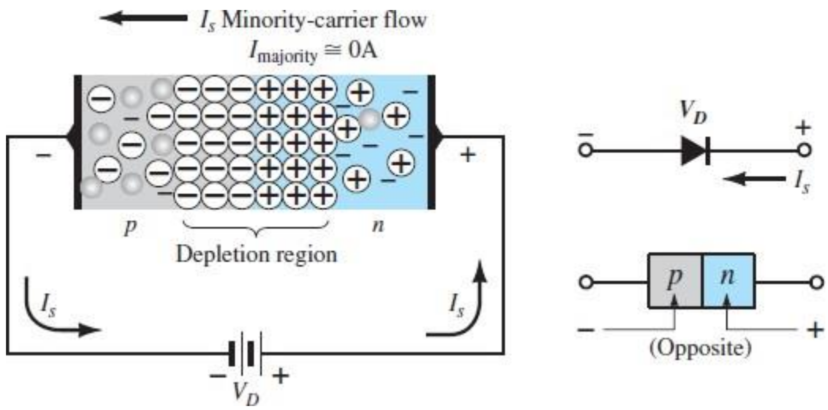
The V-I Characteristics Graph of Forward Bias

Signature of the Teacher
Date:

Experiment Number: 03

Experiment Name: To study the operation of Reverse Bias

Theory: If an external potential of V volts is applied across the p – n junction such that the positive terminal is connected to the n -type material and the negative terminal is connected to the p -type material, the number of uncovered positive ions in the depletion region of the n -type material will increase due to the large number of free electrons drawn to the positive potential of the applied voltage. For similar reasons, the number of uncovered negative ions will increase in the p-type material. The net effect, therefore, is a widening of the depletion region. This widening of the depletion region will establish too great a barrier for the majority carriers to overcome, effectively reducing the majority carrier flow to zero. The current that exists under reverse-bias conditions is called the reverse saturation current and is represented by Is.



Required Equipments:

1. Bread Board
2. DC Voltage Supplier
3. Resistor (1 kΩ, 1 piece)
4. Zener Diode (1 piece)
5. Ammeter (1 piece)
6. Digital Multimeter (1 piece)
7. Connecting Wires

Circuit Diagram:

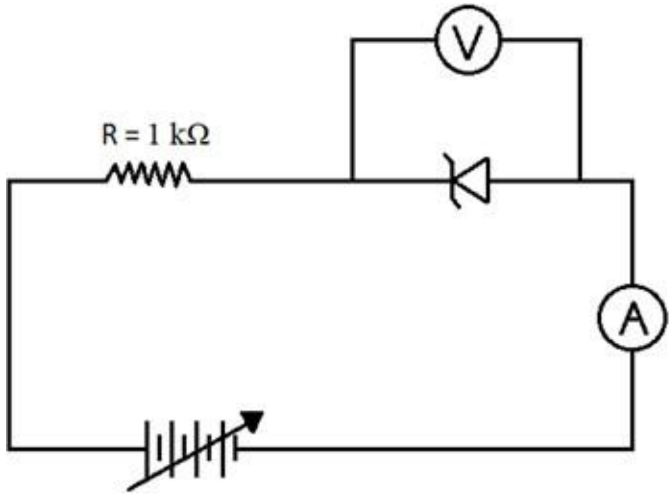
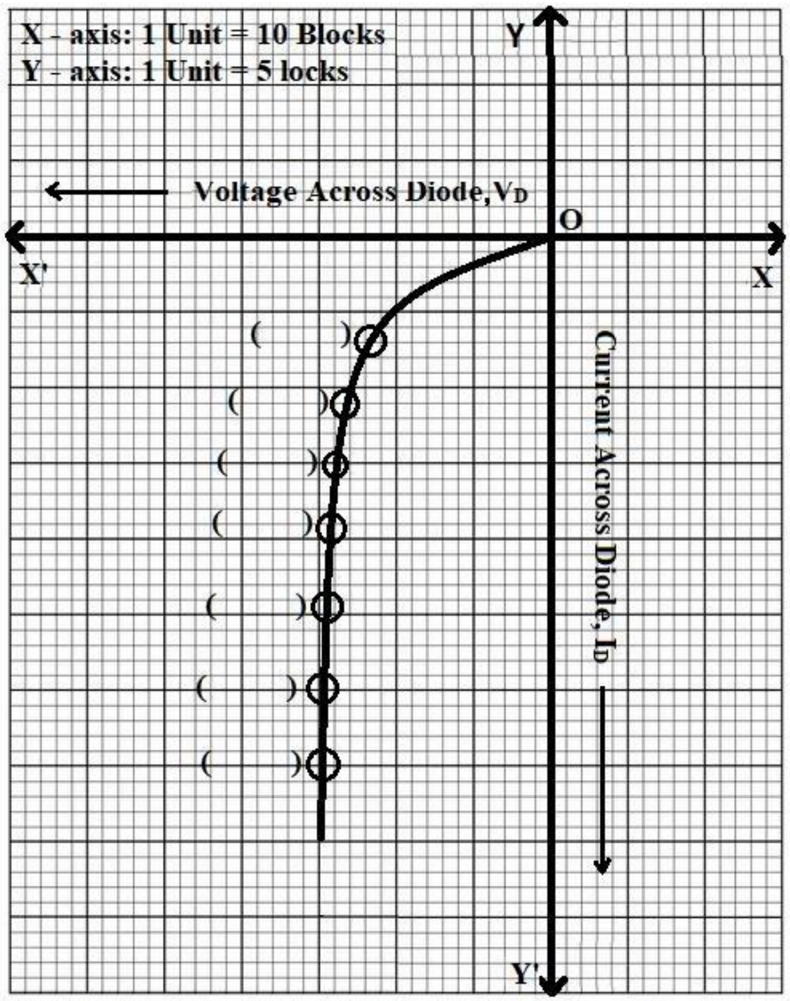


Figure: Circuit Diagram of Reverse Bias

Data Table:

No. of Observation	Supply Voltage V_s ( )	Resistor R ( )	Voltage Across Diode V_D ( )	Current Across Diode I_D ( )
01				
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				
13				
14				
15				

Graph:



The V-I Characteristics Graph of Reverse Bias

Signature of the Teacher
Date:

Experiment No.: 04

Experiment Name: To study the operation of Voltage Regulation using Zener Diode while Load Resistor is Constant.

Theory: The use of the Zener diode as a regulator is so common that three conditions surrounding the analysis of the basic Zener regulator are considered. The analysis provides an excellent opportunity to become better acquainted with the response of the Zener diode to different operating conditions. The purpose of a voltage regulator is to maintain a constant voltage across a load regardless of variations in the applied input voltage and variations in the load current. The resistor is selected so that when the input voltage is at $V_{i(min)}$ and the load current is at $I_{L(max)}$ that the current through the Zener diode is at least $I_{z(min)}$. Then for all other combinations of input voltage and load current the Zener diode conducts the excess current thus maintaining a constant voltage across the load. The Zener conducts the least current when the load current is the highest and it conducts the most current when the load current is the lowest.

Required Equipments:

1. Bread Board
2. DC Voltage Supplier
3. Resistor (1 kΩ 1 piece, 4.7 kΩ 1 piece)
4. Zener Diode (1 piece)
5. Digital Multimeter (1 piece)
6. Connecting Wires

Circuit Diagram:

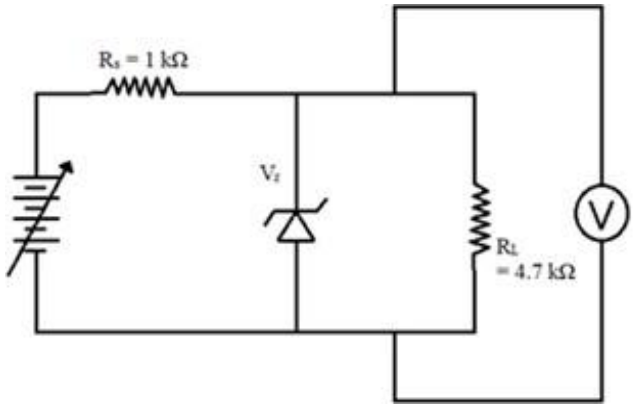


Figure: Circuit Diagram of Voltage Regulation while Input Voltage is Variable and Load Resistance Constant

Data Table:

No. of Observation	Input Voltage V_{in} ( )	Load Resistor R_L ( )	Output Voltage V_{out} ( )
01			
02			
03			
04			
05			
06			
07			
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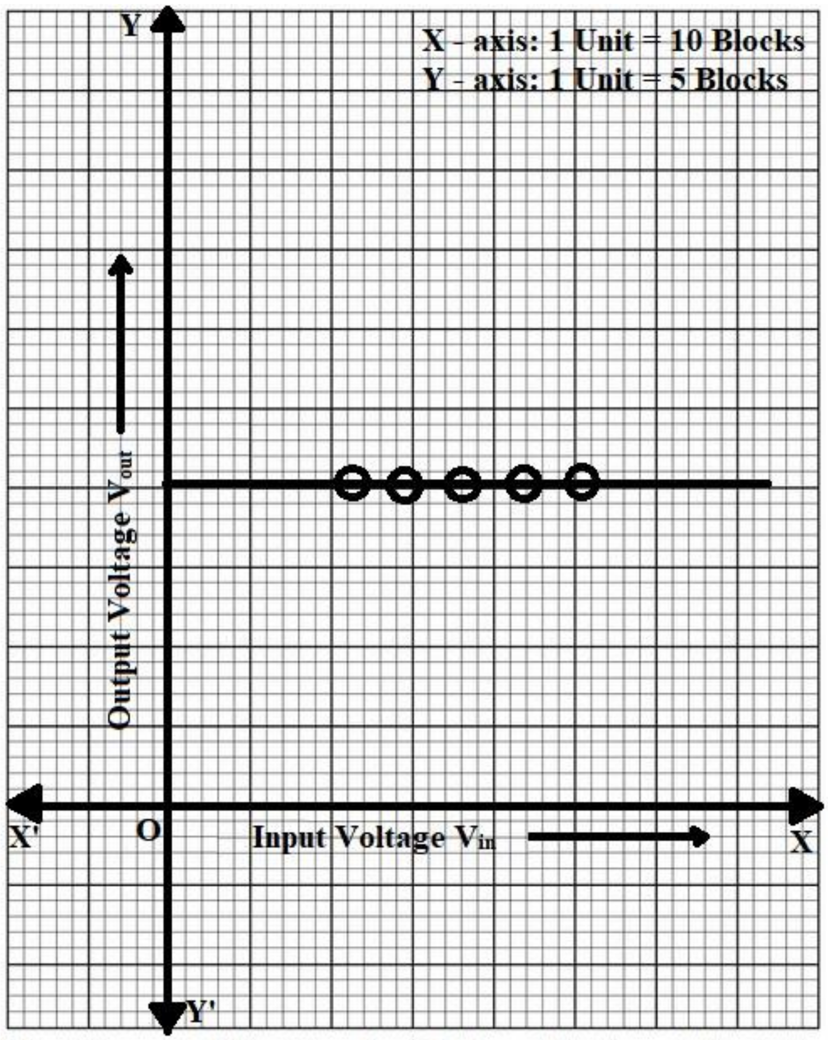
10			
11			
12			

Graph:



The Characteristics Graph while Input Voltage is Variable

Signature of the Teacher
Date:

Experiment No.: 05

Experiment Name: To study the operation of Voltage Regulation using Zener Diode while Input Voltage is Constant.

Theory: The use of the Zener diode as a regulator is so common that three conditions surrounding the analysis of the basic Zener regulator are considered. The analysis provides an excellent opportunity to become better acquainted with the response of the Zener diode to different operating conditions. The purpose of a voltage regulator is to maintain a constant voltage across a load regardless of variations in the applied input voltage and variations in the load current. The resistor is selected so that when the input voltage is at $V_{i(min)}$ and the load current is at $I_{L(max)}$ that the current through the Zener diode is at least $I_{z(min)}$. Then for all other combinations of input voltage and load current the Zener diode conducts the excess current thus maintaining a constant voltage across the load. The Zener conducts the least current when the load current is the highest and it conducts the most current when the load current is the lowest.

Required Equipments:

1. Bread Board
2. DC Voltage Supplier
3. Resistor (1 kΩ, 1 piece)
4. Variable Resistor
5. Zener Diode (1 piece)
6. Digital Multimeter (1 piece)
7. Connecting Wires

Circuit Diagram:

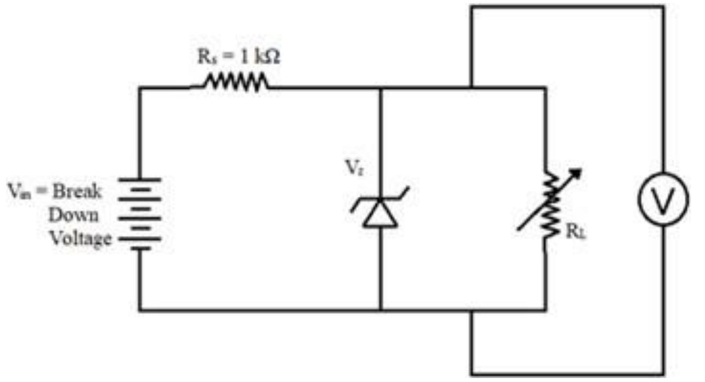
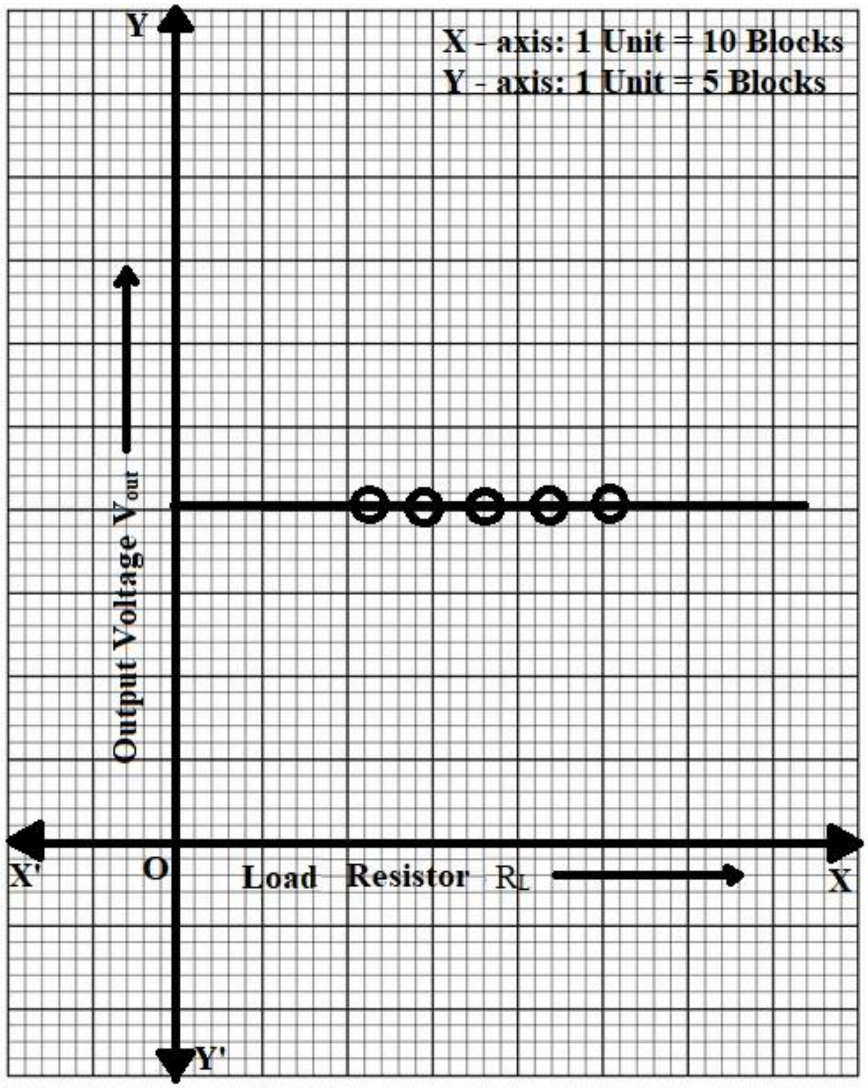


Figure: Circuit Diagram of Voltage Regulation while Input Voltage is Constant and Load Resistance Variable

Data Table:

No. of Observation	Input Voltage V_{in} ( )	Load Resistor R_L ( )	Output Voltage V_{out} ( )
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			

Graph:



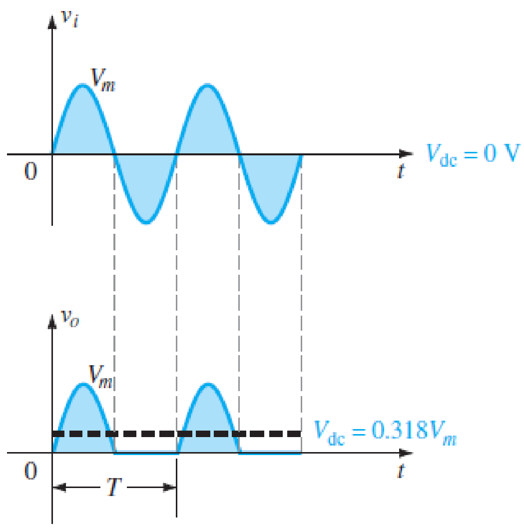
The Characteristics Graph while Load Resistor is variable

Signature of the Teacher
Date:

Experiment No.: 06

Experiment Name: To study the operation of Half Wave Rectifier

Theory: In half-wave rectification, the rectifier conducts current only during the positive half-cycles of input A.C. supply. The negative half-cycles of A.C. supply are suppressed that is, during negative half-cycles, no current is conducted and hence no voltage appears across the load. Therefore, current always flows in one direction (D.C.) through the load though after every half-cycle.



Required Equipments:

1. Bread Board
2. Signal Generator
3. Resistor (1 kΩ 1 piece)
4. Diode (1 piece)
5. Oscilloscope
6. Connecting Wires

Circuit Diagram:

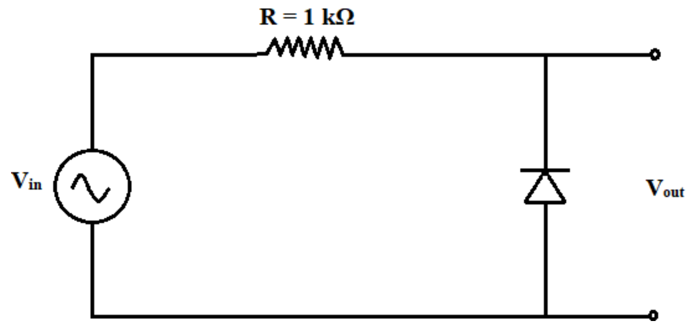
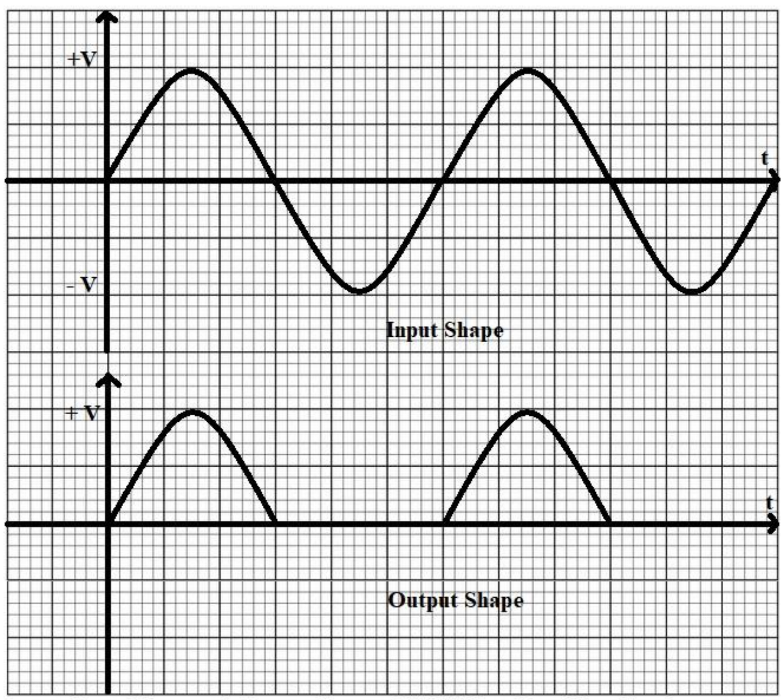


Figure: Half Wave Rectifier Circuit

Data Table:

Input Voltage V_{in} ( )	Input Frequency f_{in} ( )	Output Voltage V_{out} ( )	Output Frequency f_{out} ( )

Graph:



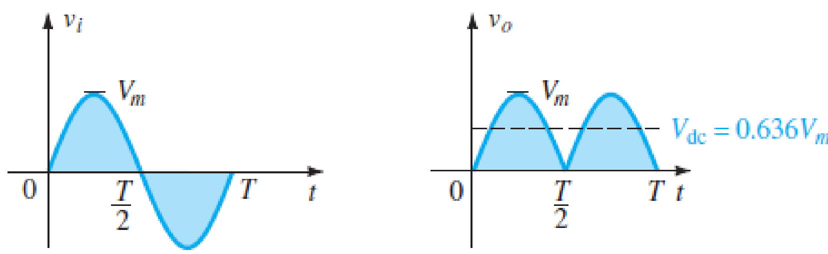
Input Shape and Output Shape of Half Wave Rectifier Circuit

Signature of the Teacher
Date:

Experiment No.: 07

Experiment Name: To study the operation of Full Wave Rectifier

Theory: In full-wave rectification, current flows through the load in the same direction for both half-cycles of input A.C. voltage. This can be achieved with two diodes working alternately. For the positive half cycle of input voltage, one diode supplies current to the load and for the negative half-cycle, the other diode does so. Current being always in the same direction through the load. Therefore, a full-wave rectifier utilizes both half-cycles of input A.C. voltage to produce the D.C. output. The dc level obtained from a sinusoidal input can be improved 100% using a process called full-wave rectification. The most familiar network for performing such a function has four diodes in a bridge configuration. The input output shape for Full Wave Rectifier is,



Required Equipments:

1. Bread Board
2. Signal Generator
3. Resistor (1.5 kΩ 1 piece)
4. Diode (4 piece)
5. Oscilloscope
6. Connecting Wires

Circuit Diagram:

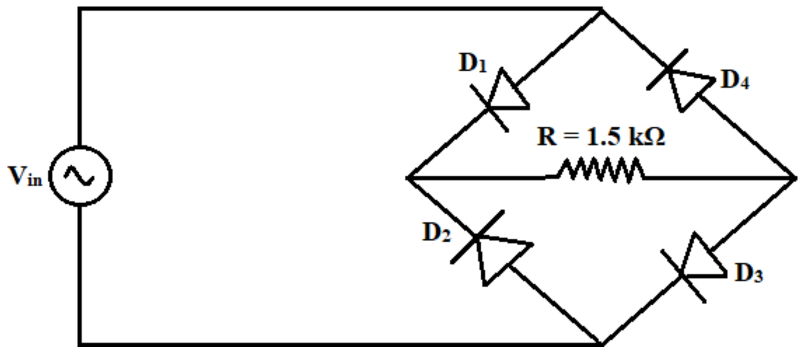
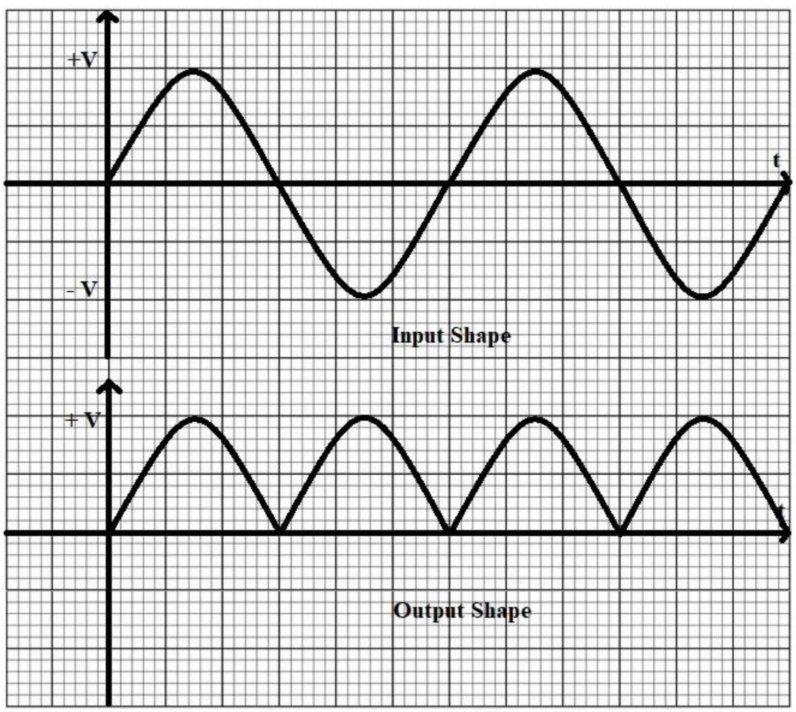


Figure: Full Wave Rectifier Circuit

Data Table:

Input Voltage V_{in} ( )	Input Frequency f_{in} ( )	Output Voltage V_{out} ( )	Output Frequency f_{out} ( )

Graph:



Input Shape and Output Shape of Full Wave Rectifier Circuit

Signature of the Teacher
Date:

Experiment No.: 08

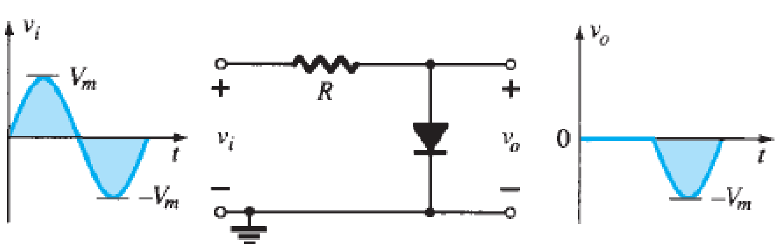
Experiment Name: To study the operation of Positive Clipping Circuit and Negative Clipping Circuit.

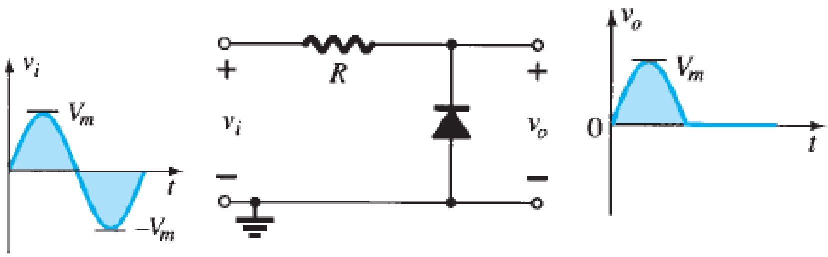
Theory: Clippers are networks that employ diodes to clip away a portion of an input signal without distorting the remaining part of the applied waveform. The half-wave rectifier is an example of the simplest form of diode clipper. Depending on the orientation of the diode, the positive or negative region of the applied signal is "clipped" off. According to this concept, Clipping circuit are two types. Positive clipping circuit and negative clipping circuit.

In positive diode clipping circuit, the diode is forward biased during the positive half cycle of the sinusoidal input waveform. For the diode to become forward biased the diodes begins to conduct and become short circuit. So the current pass through it and the output voltage is become zero. During the negative half cycle, the diode is reverse biased blocking current flow through itself and as a result has no effect on the negative half of the sinusoidal voltage which passes to the load unaltered. Then the diode limits the positive half of the input waveform and is known as a positive clipper circuit.

In negative clipping circuit, the diode is forward biased during the negative half cycle of the sinusoidal waveform and short it while allowing the positive half cycle to pass unaltered when reverse biased. As the diode limits the negative half cycle of the input voltage it is therefore called a negative clipper circuit.

The input output shape for both positive and negative clipping circuit is given below,





Required Equipments:

1. Bread Board
2. Signal Generator
3. Resistor (1.5 kΩ 1 piece, 4.7 kΩ 1 piece)
4. Diode (1 piece)
5. Oscilloscope
6. Connecting Wires

Circuit Diagram:

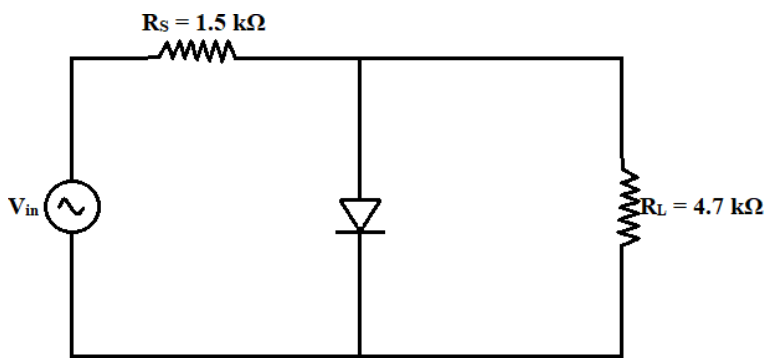


Figure 1: Positive Clipping Circuit

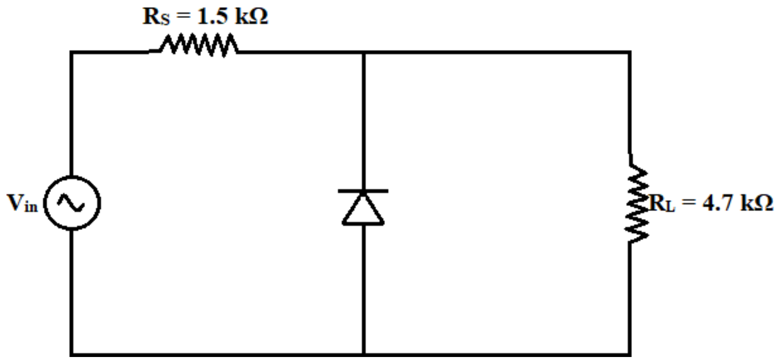


Figure 2: Negative Clipping Circuit

Data Table:

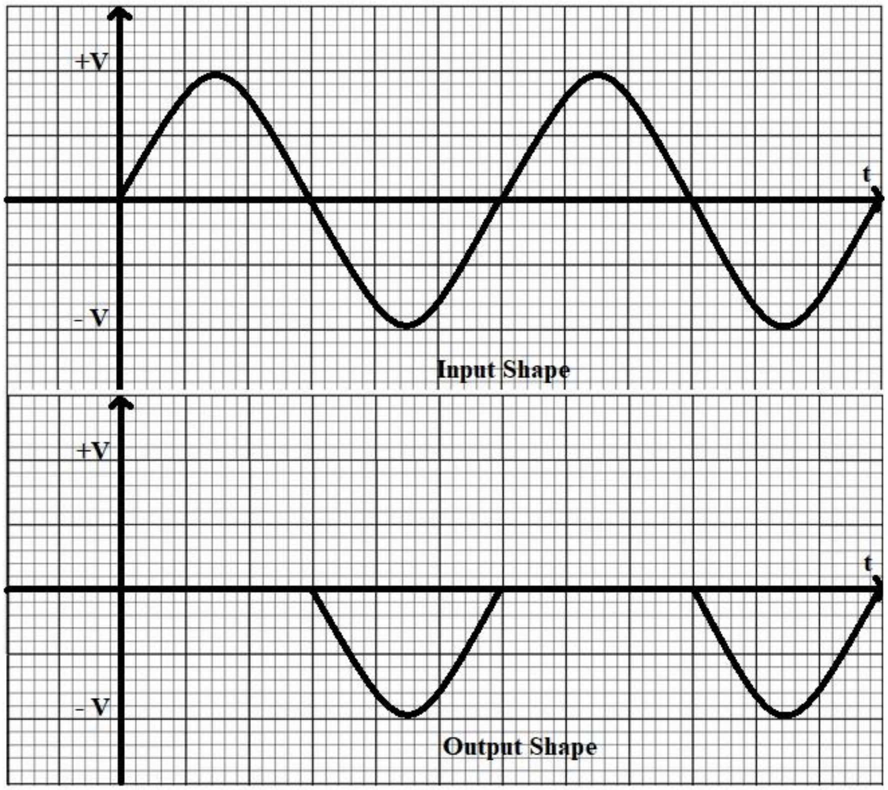
Input Voltage V_{in} ( )	**Input Frequency** f_{in} ( )	**Output Voltage** V_{out} ( )	**Output Frequency** f_{out} ( )

Table 1: Data Table for Positive Clipping Circuit

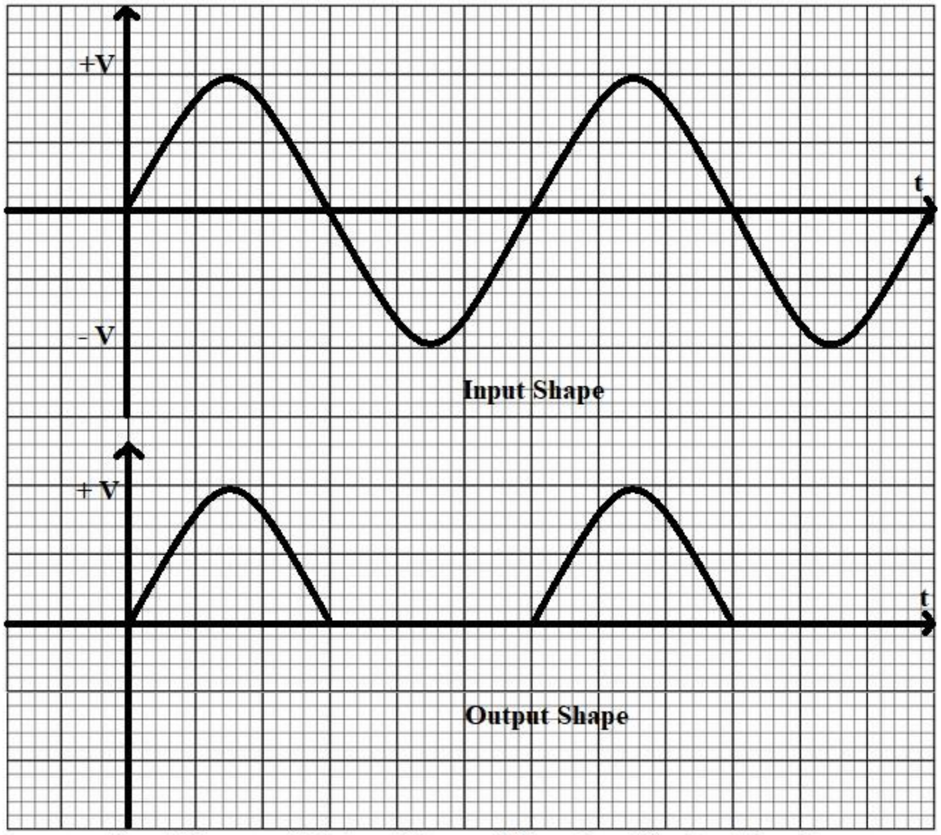
Input Voltage V_{in} ( )	**Input Frequency** f_{in} ( )	**Output Voltage** V_{out} ( )	**Output Frequency** f_{out} ( )

Table 2: Data Table for Negative Clipping Circuit

Graph:



Input shape and Output shape of Positive Clipping Circuit



Input Shape and Output Shape of Negative Clipping Circuit

Signature of the Teacher
Date:

Experiment No.: 09

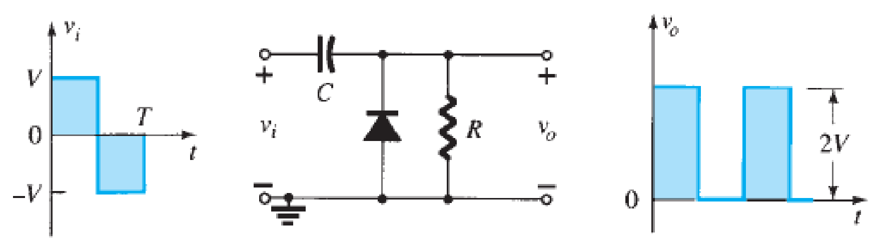
Experiment Name: To study the operation of Clamping Circuit

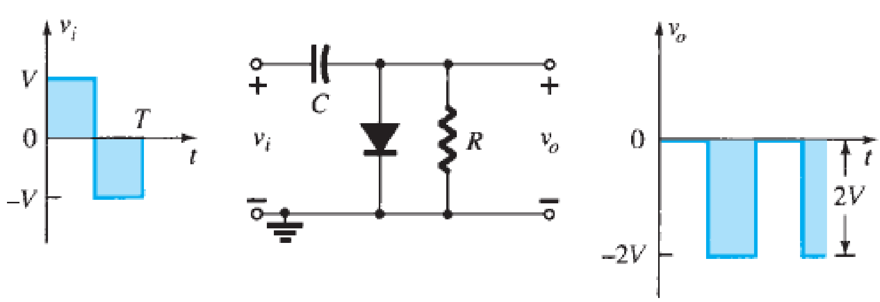
Theory: A clamper is a network constructed of a diode, a resistor and a capacitor that shifts a waveform to a different dc level without changing the appearance of the applied signal. Additional shifts can also be obtained by introducing a dc supply to the basic structure.

The chosen resistor and capacitor of the network must be chosen such that the time constant determined by $t = RC$ is sufficiently large to ensure that the voltage across the capacitor does not discharge significantly during the interval the diode is non conducting.

If the clamping circuit shifts the waveform in the positive portion then it is called positive clamping circuit. If the clamping circuit shifts the waveform in the negative portion then it is called negative clamping circuit.

The input output shape for both positive and negative clamping circuit is given below,





Required Equipments:

1. Bread Board
2. Signal Generator
3. Resistor (1.5 kΩ 1 piece)
4. Capacitor (1 μF 1 piece)
5. Diode (1 piece)
6. Oscilloscope
7. Connecting Wires

Circuit Diagram:

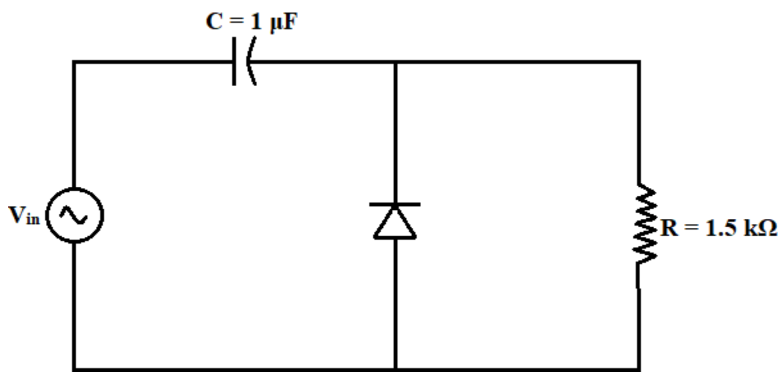


Figure 1: Positive Clamping Circuit

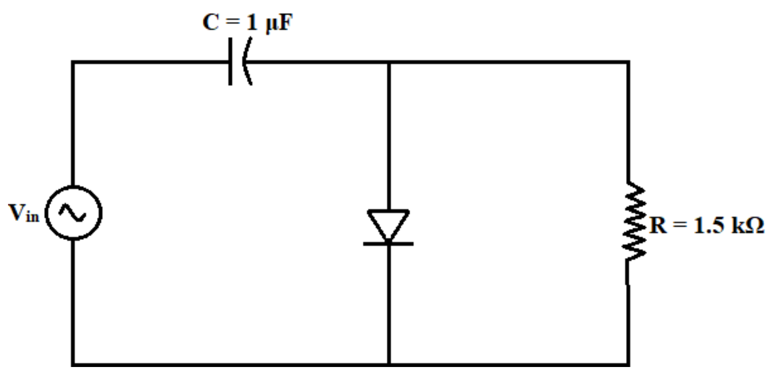


Figure 2: Negative Clamping Circuit

Data Table:

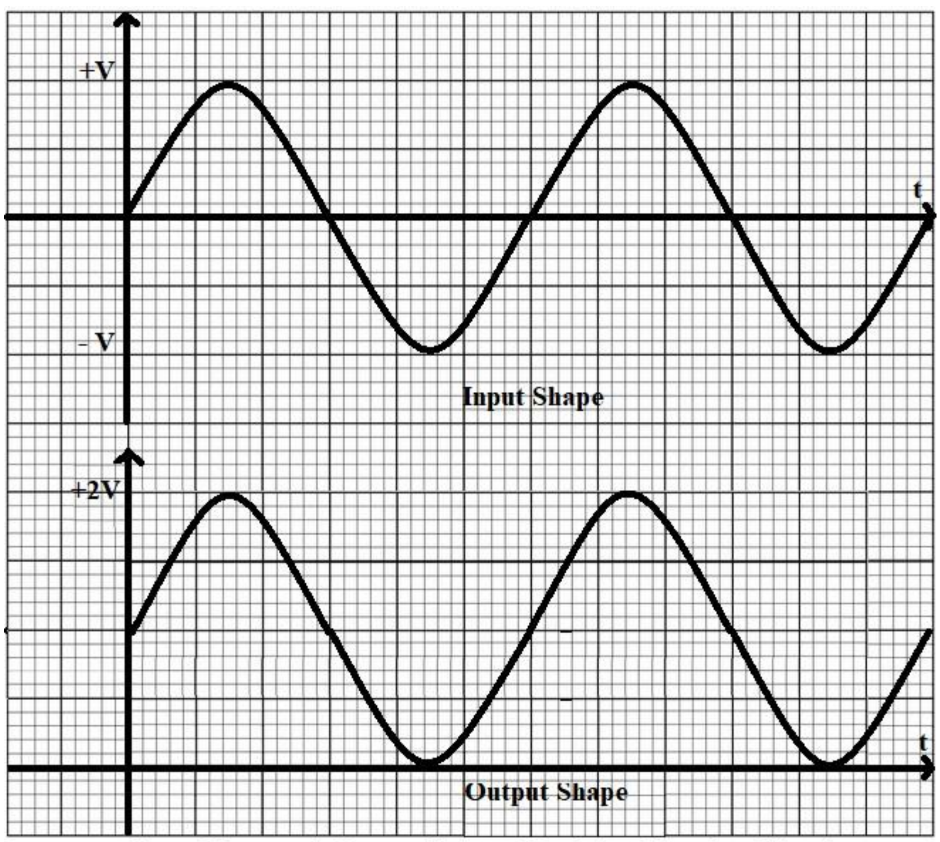
Input Voltage V_{in} ( )	Input Frequency f_{in} ( )	Output Voltage V_{out} ( )	Output Frequency f_{out} ( )

Table 1: Data Table for Positive Clamping Circuit

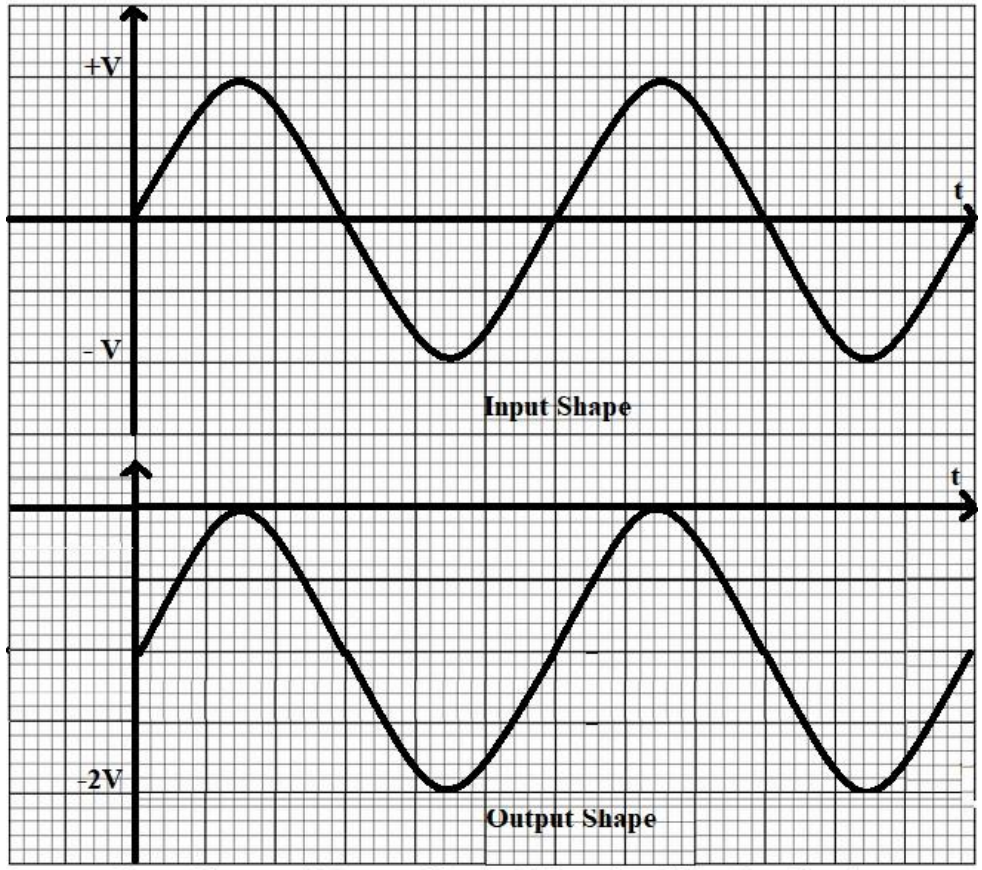
Input Voltage V_{in} ( )	Input Frequency f_{in} ( )	Output Voltage V_{out} ( )	Output Frequency f_{out} ( )

Table 2: Data Table for Negative Clamping Circuit

Graph:



Input Shape and Output Shape of Positive Clamping Circuit



Input Shape and Output Shape of Negative Clamping Circuit

Signature of the Teacher
Date:

Lab 41

FINAL LAB QUIZ

Task 1: Lab Quiz.

Task 2: Viva Voce.

Lab 42

FINAL LAB EXAMINATION

Task 1: Final Lab Examination.

Task 2: Final Lab Report Submission.