Department of Electronic Engineering

NED University of Engineering & Technology

PRACTICAL WORKBOOK

For the course of

Basic Electronics (EL-106)

For F.E (EL)

Instructor's Name: _____

Student's Name: _____

Roll No.: _____ Batch: _____

Semester: _____ Year: _____

Department: _____

LABORATORY WORKBOOK FOR THE COURSE

Basic Electronics (EL-106)

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Reviewed By:

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Approved By:

The Board of Studies

Department of Electronic Engineering

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Lab Experiment # 01

Objective:

To PRACTICE about the Electronic Laboratory Equipment.

Theory:

The most important debugging tool in any Electronic Lab is a millimeter. A millimeter can measure continuity, resistance, voltage and sometimes even current, capacitance, temperature, etc. You should go through all of these sections in order, as they build on each other.

1. Continuity measurements How to tell if two points are electrically connected
2. Resistance measurements How to measure resistance - resistors, potentiometers and sensors
3. Voltage measurements How to measure voltage - battery testing, wall adaptor testing, and mixed AC/DC measurements.

What is continuity?

Continuity means are two things electrically connected. So if two electronic parts are connected with a wire, they are continuous. If they are connected with cotton string, they are not: while they are connected, the cotton string is not conductive. You can always use a resistance-tester (ohmmeter) to figure out if something is connected because the resistance of wires is very small, less than 100 ohms, usually. However, continuity testers usually have a piezo buzzer which beeps. This makes them very useful when you want to poke at a circuit and need to focus on where the probes are instead of staring at the meter display.

Remember!

You can only test continuity when the device you're testing is not powered.

Always test to make sure your meter is working before starting the test by brushing the two tips together, and verifying you hear the beep. Maybe the battery is low or it’s not in the right mode.

Continuity is non-directional; you can switch probes and it will be the same.

If you are testing two points in a circuit and there is a (big) capacitor between those points **you may hear a quick beep and then quiet**. That's because the voltage the meter is applying to the circuit is charging up the capacitor and during that time the meter 'thinks' its continuous (essentially).

Small resistors (under 100 ohms or so) and also all inductors will seem like short circuits to a millimeter because they are very much like wires.

Likewise, continuity doesn't mean "short" it just means very very low resistance. For example, if you have a circuit that draws an Amp from a 5V supply, it will appear to be a 5Ω

resistor. If you measure that with your meter it will think its a short circuit, but really its just a high-drain circuit.

Example 1

This meter is very simple. When the probes are not touching, the display shows "1". When you touch the tips together, the display changes to a three digit mode (it's displaying resistance, which we will cover later) It also emits a beep.

Example 2

This meter is dual-mode but still very easy to use. Turn the dial to the symbol. When the probes are not touching the display shows "OL" which stands for Open Loop. (Open loop is another way of saying there is no continuity) When you touch the probes, the sound wave icon shows up in the display (upper right) and it also shows a number. The number is not the resistance, actually...it is the voltage (look for the V in the right hand side for Volts). This is because this mode is also a Diode Test (which will be discussed later).

What is resistance? Resistance is just what it sounds like, it is the characteristic that makes a component fight current flow. The bigger the resistance value (in ohms Ω) the more it fights. Most resistors you'll see range between 1 ohm and 1 mega ohm (1.0 MΩ) they often have 5% tolerance but you can buy 1% or even 0.1% accuracy resistors.

In general, resistance testing is best for measuring resistors, but you may find yourself measuring the resistance of other things, such as sensors and speakers.

Resistor coding

Resistors are color coded, at first it seems like a bad way to print the values but with a little time it becomes faster because you dont have to read any numbers and the stripes are visible no matter how it is rotated.

This image shows a 1.0 kΩ 5% resistor (brown black red gold)

Remember!

You can only test resistance when the device you're testing is not powered. Resistance testing works by poking a little voltage into the circuit and seeing how much current flow, it is perfectly safe for any component but if it is powered there is already voltage in the circuit, and you will get incorrect readings

You can only test a resistor before it has been soldered/inserted into a circuit. If you measure it in the circuit you will also be measuring everything connected to it. In some instances this is OK but I would say that in the vast majority it is not. If you try, you will get incorrect readings and that's worse than no reading at all.

Resistance is non-directional, you can switch probes and the reading will be the same.

If you have a ranging meter (as most inexpensive ones are), you'll need to keep track of what range you are in. Otherwise, you will get strange readings, like OL or similar, or you

may think you're in KΩ when really you're in MΩ. This is a big problem for beginners so be careful!

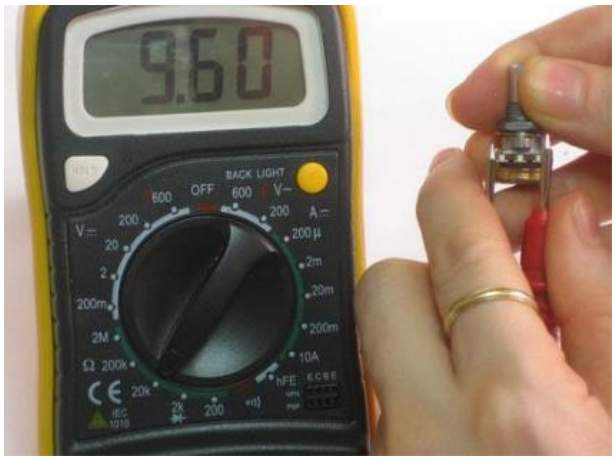
Look for an ohm (Ω) symbol, if its a ranging meter there will be a bunch of subdivided modes. If its auto-ranging there will be only one. This meter has the Ω symbol and then 7 submodes, ranging from 200Ω to 2000MΩ.

Example1. Testing a resistor

With an auto-ranging meter, just put the two probes across the resistor and read the number. For example, this 1KΩ 5% resistor is actually 0.988 K ohm. And this 10KΩ is really 9.80KΩ. Note that the numbers look similar but the decimal point has moved.

Example 2. Testing a potentiometer

You can test the max-value of a potentiometer by measuring across the two 'ends' as shown here with a rotational 10KΩ pot. To find the 'range' look at the dial.

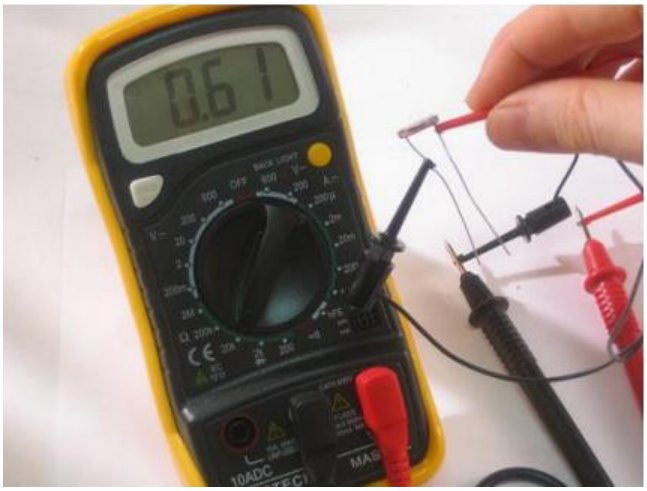


You can also use a multimeter to tell whether the potentiometer is a linear or logarithmic (audio) pot. When the pot is centered, if the resistance between the wiper and one end is half of the total value, its linear.

Example 3. Testing a sensor

Potentiometers are resistors that change value when they are moved. A Light Dependent Resistor (LDR) is a resistor that changes value with the amount of light it receives. This one has a range of about 20K max.

First, set the range, in this case 20KΩ seems pretty good. In bright light, it measures about 610 Ω Slightly shaded it's 5.84KΩ (remember this is still a well-lit photo)



There are often two separate modes for AC and DC voltage. Both will have a V but one will have two lines, one dashed and one solid (DC) and one with have a wave next to it (AC). This meter has the double line for DC voltage, and 5 ranges, from 200mV to 600V.

This ranged meter has 5 ranges, the top range is 750 VAC or 1000 VDC, to switch between DC and AC you need to press the DC/AC button on the upper right.

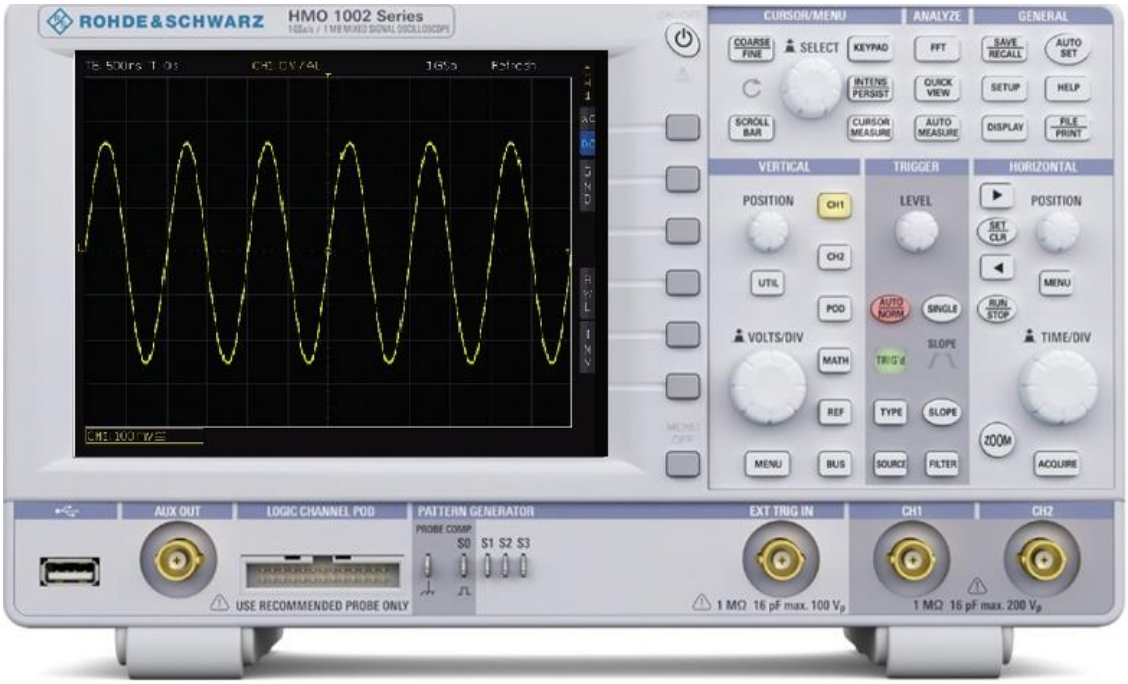
When the probes are not connected to anything, they should display 0V. They might flicker a bit if they pick up ambient voltage (your home is a big radiator of 60Hz voltage which can couple into your meter probes)

Example 1: Testing batteries

Testing batteries is a super useful skill and is one of the best ways to practice with your multimeter. The first battery we'll test is a new 1.5V alkaline. This one is a AAA but a AA, C or D cell will be the same voltage. Set the range to 2V DC.

Oscilloscope:

The front panel of R&S HMO 1002 Max Oscilloscope is presented here:



This lesson teaches you how to turn on the oscilloscope and display a simple signal. To perform the Getting Started lesson, follow these steps:

1. Plug in the oscilloscope and apply power by pressing the POWER button on the top of the case. Notice that when you apply power, the oscilloscope immediately performs a self-test.
2. CH1 and CH2 are inputs for the channels to be displayed. This oscilloscope has dual channel and is able to display two signals at the same time.
3. The Autoset function obtains a stable waveform display for you. It automatically adjusts the vertical and horizontal scaling, as well as the trigger coupling, type, and position, slope, level and mode settings.
4. The Quick View function displays all the important parameters of the actual signal displayed.
5. The Auto Measure for the automatic measurement of parameters.
6. The knob of 'Volts/Div' Alters the gain of the amplifier that controls the size of the signal in the vertical axis. It is normally set so the waveform fills the vertical plane as best as possible.
7. The knob of 'Time/Div' sets the speed at which the screen is scanned, calibrated in terms of a certain time for each centimetre calibration on the screen.
8. Run/Stop allows the selection of the Run and Stop mode. When the stop mode is selected, the key will light up in red colour.

Function Generator

The waveform function generator is a 2-channel function generator based on DDS (Direct Digital Synthesis) technology providing flexible performance and system features for basic scientific and industrial requirements. With over voltage, over current, short circuit and reverse voltage protections.

This lesson teaches you how to turn on the function generator and use 2 independent output channels at same frequency range for main waveforms, follow these steps:

1. Turn it on.
2. Select the output waveform i.e. sine, triangle, square, positive and negative pulse, positive and negative ramp.
3. Set the parameters like frequency (1u Hz to 5 MHz), amplitude (1mVp-p to 20Vp-p), phase etc.
4. Connect the probe to the output and turn the output ON.

Observations:

Using function generator & oscilloscope, generate & observe following waveforms. Also note down all parameters in following chart:

1. A pulse train with 50% duty cycle.
2. A waveform similar to the supply which comes in our wall socket.
3. A triangular wave with 50% duty cycle.

	V(peak to peak)	**V(RMS)**	**Frequency**	**Average value**
Pulse Train				
Wall Supply				
Triangular				

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Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
Equipment Use Sensory skills to ***demonstrate*** the use of the equipment for the lab work.	Doesn't demonstrate the use of equipment.	Slightly demonstrates the use of equipment.	Somewhat demonstrates the use of equipment.	Moderately demon strates the use of equipment.	Fully demonstrates the use of equipment.
Procedural Skills ***Displays*** skills to act upon sequence of steps in lab work.	Not able to either learn or perform lab work procedure.	Able to slightly understand lab work procedure and perform lab work.	Able to somewhat understand lab work procedure and perform lab work.	Able to moderately understand lab work procedure and perform lab work.	Able to fully understand lab work procedure and perform lab work.
Response Ability to ***imitate*** the lab work on his/her own.	Not able to imitate the lab work.	Able to slightly imitate the lab work.	Able to somewhat imitate the lab work.	Able to moderately imitate the lab work.	Able to fully imitate the lab work.
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Equipment Handling ***Equipment care*** during the use.	Doesn't handle equipment with required care.	Rarely handles equipment with required care.	Occasionally handles equipment with required care.	Often handles equipment with required care.	Handles equipment with required care.
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Laboratory Session No. _____ Date: _____

Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

Lab Experiment # 02

Objective:

To PRACTICE the half-wave rectifier.

Equipment:

- Bread board
- Step down transformer
- Oscilloscope
- Multimeter
- Diode (1N4007)
- Resistors

Theory:

A diode is a unidirectional conducting device, it conducts only when its anode is at higher voltage with respect to its cathode in a half wave rectifier circuit. During positive half cycle of the input, the diode gets forward biased and it conducts, current flows through the load resistor RL and voltage is developed across it. During the negative half cycle of the input, the diode gets reversed biased. Now no current (except the leakage current which is very small) flows. The voltage across the load resistance during this period of input cycle is zero. Thus, the diode conducts only for half cycle and a pure ac signal is converted into a unidirectional signal.

Circuit Diagram:

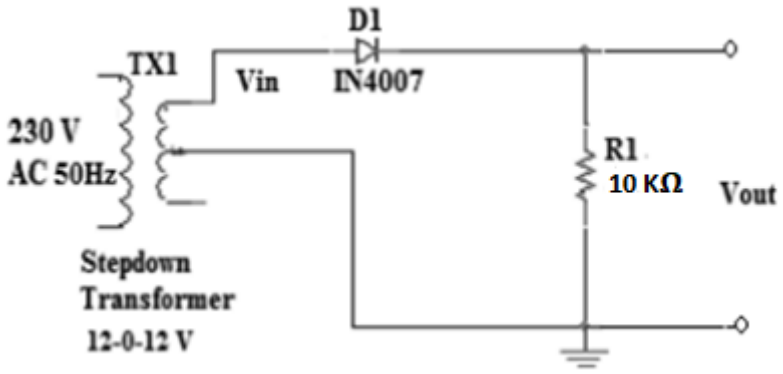

Figure 1 Half Wave Rectifier

Observations:

Readings	$V_{peak\text{-}peak}$	Frequency	RMS Value	Average Value
Transformer output				
Circuit output				

Calculations:

Show calculations for the observations by using their formulas and draw the voltage waveforms.

F/OBEM 01/05/00

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nstructor's Signature with Date:	

Lab Experiment # 03

Objective:

To PRACTICE the Centre Tapped Full-wave Rectifier.

Equipment:

- Bread board
- Step down transformer
- Oscilloscope
- Multimeter
- Diode (1N4007)
- Resistors

Theory:

In a full-wave rectifier circuit there are two diodes, a transformer and a load resistor. The transformer has a center-tap in its secondary winding. It provides out of the phase voltage to the two diodes. During the positive half-cycle of the input, diode D2 is reverse biased and it does not conduct but D1 is forward biased and it conducts. The current flowing through diode D1 also passed through the load resistor R_L and a voltage is developed across it. During the negative half-cycle of the input, diode D1 is reverse biased and it does not conduct but now D2 is forward biased and it conducts. Now current is flowing through diode D2 and the load resistor R_L. The current flowing through the load resistor passed in the same direction in both the half cycles and the DC voltage is obtained at the output.

Circuit Diagram:

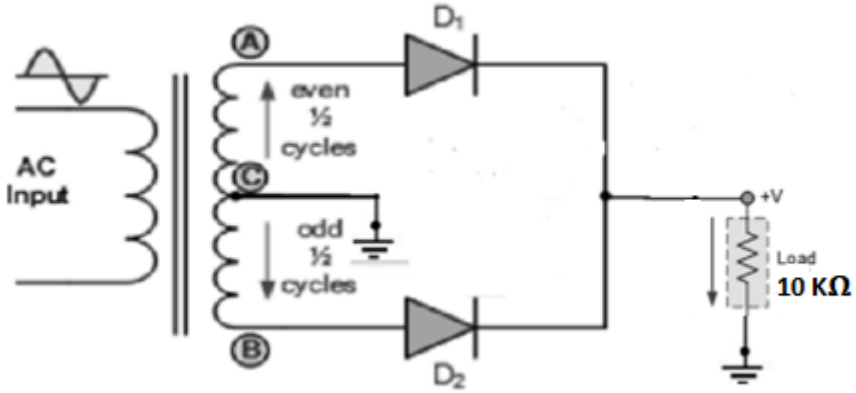

Figure 1 Full Wave Rectifier

Observations:

Readings	$V_{peak\text{-}peak}$	Frequency	RMS Value	Average Value
Transformer output				
Circuit output				

Calculations:

Show calculations for the observations by using their formulas and draw the voltage waveforms.

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Remarks	
Instructor's Signature with Date:	

Lab Experiment # 04

Objective:

To PRACTICE the Bridge Rectifier with and without Filter.

Equipment:

- Bread board
- Step down transformer
- Oscilloscope
- Multimeter
- Diode (1N4007)
- Resistors
- Capacitors

Theory:

In a bridge rectifier circuit there are four diodes, a transformer and a load resistor. When the input voltage is positive at point A, diodes D1 and D2 conduct. The current passes through the Load resistor. During the other half of the input signal, the point A is negative with respect to the point B. The diodes D3 and D4 conducts. The current passes through the load resistor in the same direction as during the positive half-cycle. DC voltage is developed across the load.

A filter ideally eliminates the fluctuations in the output voltage of a half- wave or full-wave rectifier and produces a constant-level dc voltage. Filtering is necessary because electronic circuits require a constant source of dc voltage and current to provide power and biasing for proper operation. Filters are implemented with capacitors, as you will see in this section. Voltage regulation in power supplies is usually done with integrated circuit voltage regulators. A voltage regulator prevents changes in the filtered dc voltage due to variations in input voltage or load.

Circuit Diagram:

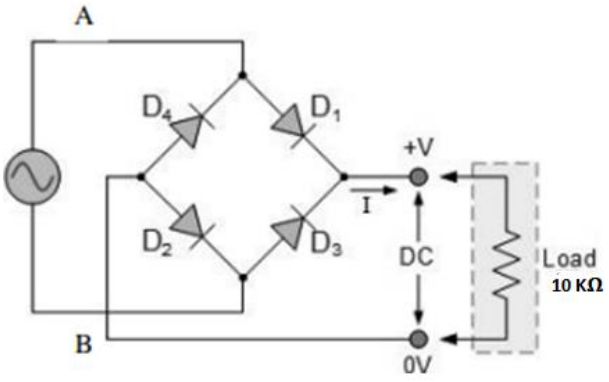

Figure 1 Bridge Rectifier without Filter

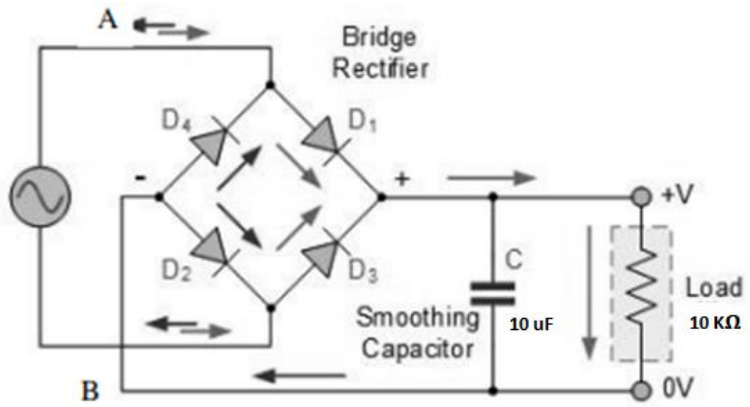

Figure 2 Bridge Rectifier with Filter

Observations:

Readings	$V_{peak\text{-}peak}$	Frequency	RMS Value	Average Value
Transformer Output				
Circuit Output without Filter				

Circuit Output with Filter		Ripple Voltage
R= 10KΩ	**C= 10µF**	
R= 100KΩ	**C= 10µF**	
R= 10KΩ	**C= 100µF**	

Calculations:

Show calculations for the observations by using their formulas and draw the voltage waveforms.

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Remarks	
Instructor's Signature with Date:	

Lab Experiment # 05

Objective:

To PRACTICE the Diode Limiters.

Equipment:

- Bread board
- Function Generator
- Oscilloscope
- Multimeter
- Diode (1N4007)
- Resistors
- DC voltage supply

Theory:

Clipping circuits are used in applications where an input voltage should not be allowed to exceed a maximum value, and also in wave shaping of signal. A Clipper circuit in which the diode is connected in shunt to the input signal and that attenuates the positive portions of the waveform, is termed as Positive Shunt Clipper. When the input voltage is applied, the positive cycle of the input makes the point A in the circuit positive with respect to the point B. This makes the diode forward biased and hence it conducts like a closed switch. Thus, the voltage across the load resistor becomes zero as no current flows through it and hence Vo will be zero. The negative cycle of the input makes the point A in the circuit negative with respect to the point B. This makes the diode reverse biased and hence it behaves like an open switch. Thus, the voltage across the load resistor will be equal to the applied input voltage as it completely appears at the output Vo.

A Clipper circuit in which the diode is connected in shunt to the input signal and that attenuates the negative portions of the waveform, is termed as Negative Shunt Clipper. When the input voltage is applied, the positive cycle of the input makes the point A in the circuit positive with respect to the point B. This makes the diode reverse biased and hence it behaves like an open switch. Thus, the voltage across the load resistor equals the applied input voltage as it completely appears at the output Vo. The negative cycle of the input makes the point A in the circuit negative with respect to the point B. This makes the diode forward biased and hence it conducts like a closed switch. Thus, the voltage across the load resistor becomes zero as no current flows through it.

Circuit Diagrams:

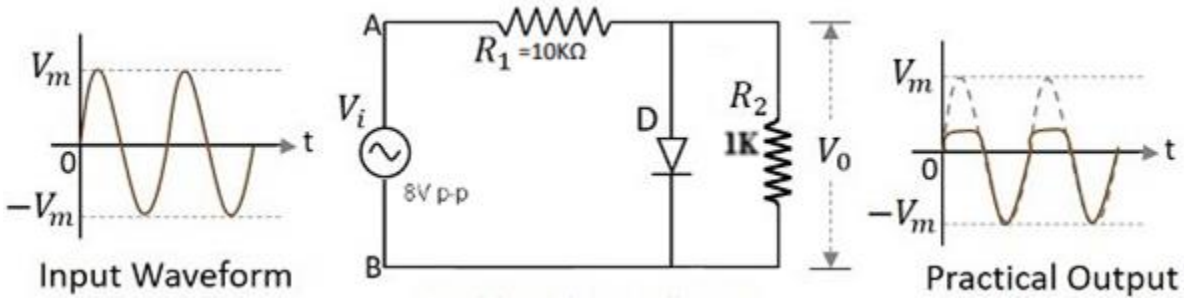

Figure 1 Positive Clipper

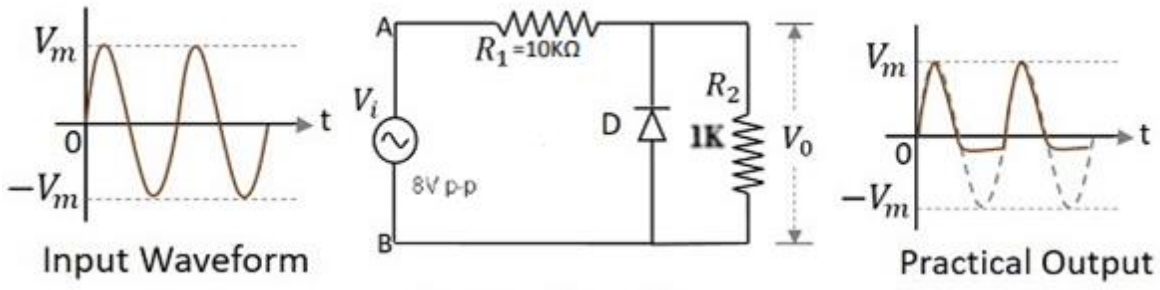

Figure 2 Negative Clipper

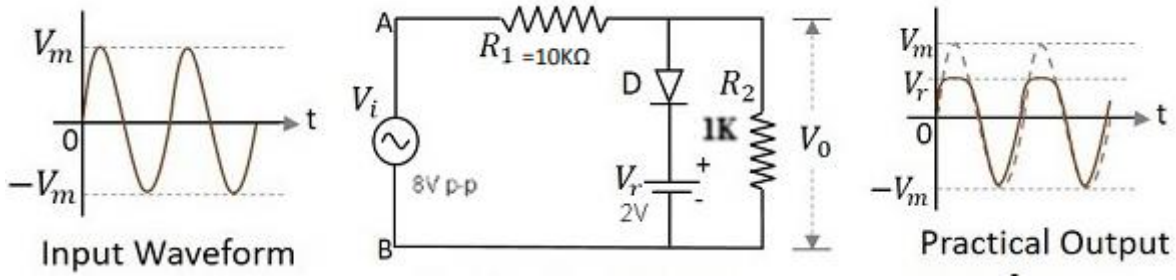

Figure 3 Positive Biased Clipper

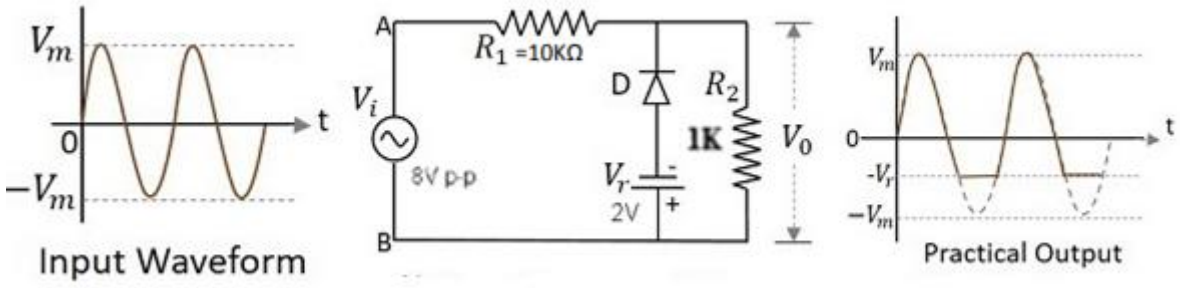

Figure 4 Negative Biased Clipper

Observations:

Readings	Output Voltage	
	For Positive Clipper	**For Negative Clipper**
For Unbiased Clipper		
For Biased Clipper		

Waveforms:

Draw and Label output voltage waveforms.

For Unbiased Clipper

For Biased Clipper

NED University of Engineering & Technology
Department of _____ Engineering
Course Code and Title: _____

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
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Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
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Laboratory Session No. _____ Date: _____

Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

Lab Experiment # 06

Objective:

To PRACTICE the Diode Clampers.

Equipment:

- Bread board
- Function Generator
- Oscilloscope
- Multimeter
- Diode (1N4007)
- Resistors
- Capacitors

Theory:

The clamping circuit is a DC level restorer and changes the DC level of an arbitrary waveform, to a predetermined DC level. The network must have a capacitor, a diode, and a resistive element, but it can also employ an independent dc supply to introduce an additional shift. The magnitude of R and C must be chosen such that the time constant $\tau = RC$is large enough to ensure that the voltage across the capacitor does not discharge significantly during the interval the diode is non-conducting. Throughout the analysis we will assume that for all practical purposes the capacitor will fully charge or discharge in five-time constants.

Positive clamping occurs when negative peaks raised or clamped to ground or on the zero level. In other words, it pushes the signal upwards so that negative peaks fall on the zero level.

Negative clamping occurs when positive peaks raised or clamped to ground or on the zero level. In other words, it pushes the signal downwards so that the positive peaks fall on the zero level.

Circuit Diagram:

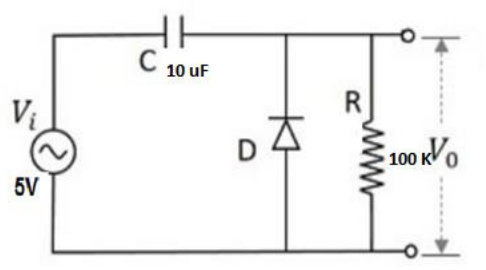


Figure 1 Positive Clamper

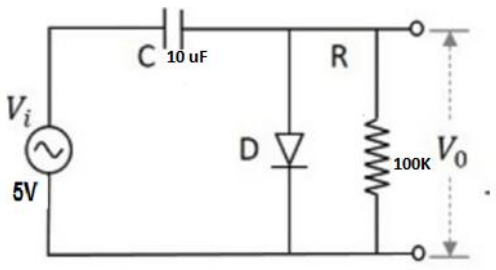


Figure 2 Negative Clamper

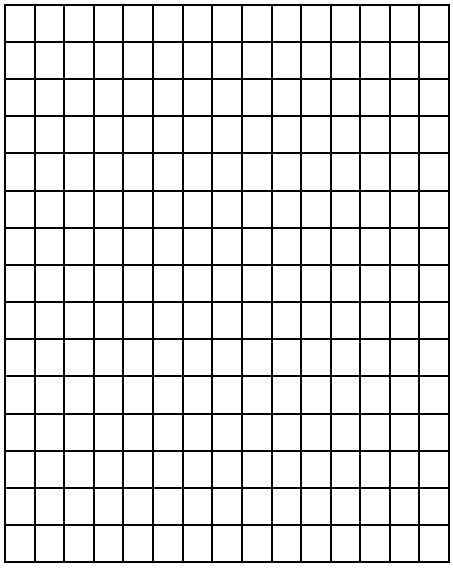
Observations:

Readings	Output Voltage	
	For Positive Clamper	For Negative Clamper
For Positive Clamper Circuit		
For Negative Clamper Circuit		

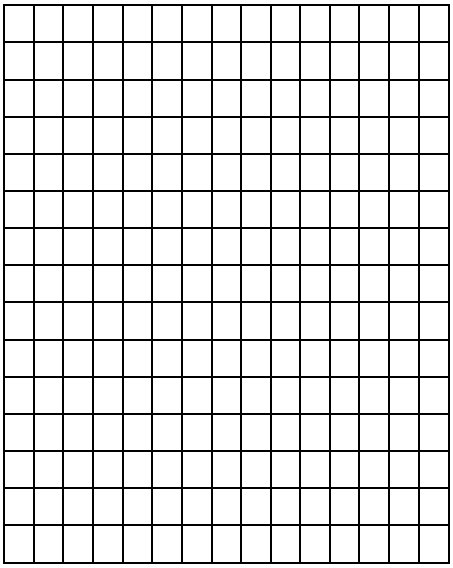
Waveforms:

Draw and Label output voltage waveforms.

For Positive Clamper



For Negative Clamper



NED University of Engineering & Technology
Department of _____ Engineering
Course Code and Title: _____

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Laboratory Session No. _____ Date: _____

Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

Lab Experiment # 07

Objective:

To PRACTICE Zener Diode as a Voltage Regulator.

Equipment:

- Bread board
- Multimeter
- Zener diode (1N4737A)
- Resistors
- DC voltage supply

Theory:

Zener diode is a heavily doped PN junction diode. Due to heavily doped, its depletion layer is very thin and is order of micrometer. The forward bias characteristic of Zener diode is same as the normal PN junction diode but in reverse bias it has different characteristic.

Basically, Zener Diode is constructed for operation in the reverse breakdown region. The relation between current and voltage is almost linear in this case $V_Z = V_{ZO} + I_Z r_Z$, where r_Z is the dynamic resistance of the Zener at the operating point. V_{ZO} is the voltage at which the straight-line approximation of the I-V characteristic intersects the horizontal axis. After reaching a certain voltage, called the breakdown voltage, the current increases widely even for a small change in voltage. However, there is no appreciable change in voltage. So, when we plot the graph, we should get a curve very near to x-axis and almost parallel to it for quite some time. After the Zener potential V_Z there will be a sudden change and the graph will become exponential.

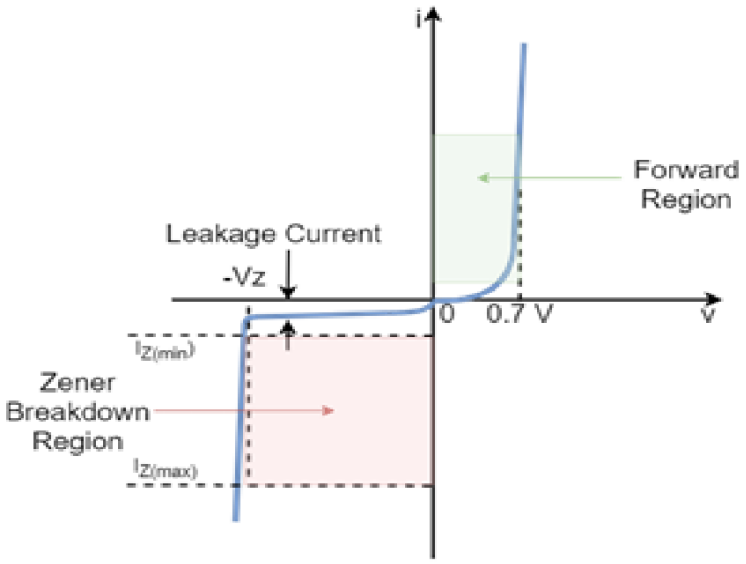

Figure 1 Zener Diode Curve

Circuit Diagram:

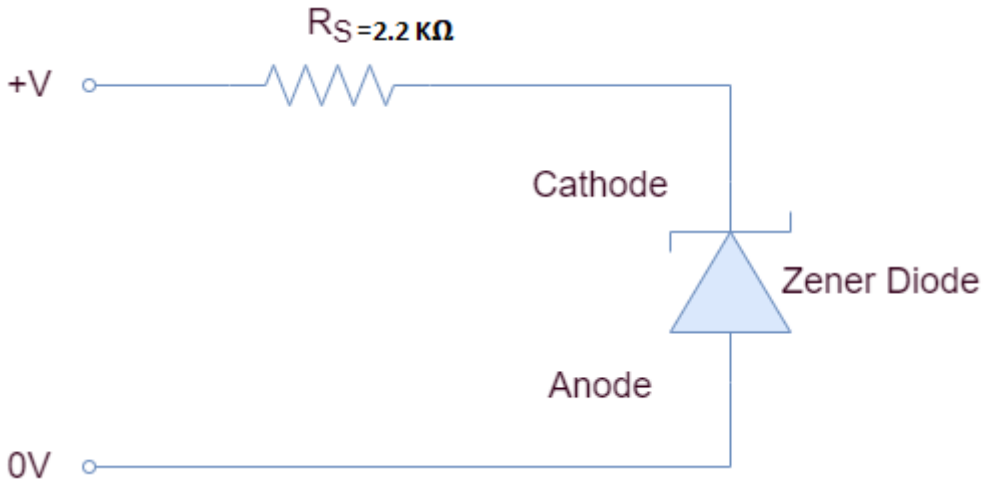

Figure 2 Zener Diode Circuit

Observations:

Reverse Bias Mode

S. No.	Voltage (V)	Zener Voltage (Vz)	Zener Current (mA)
1.	5		
2.	6		
3.	7		
4.	8		
5.	9		
6.	10		
7.	11		
8.	12		
9.	13		
10.	14		

NED University of Engineering & Technology
Department of _____ Engineering
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Laboratory Session No. _____ Date: _____

Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

Lab Experiment # 08

Objective:

To PRACTICE the Inverting and Non-Inverting Amplifiers.

Equipment:

- Bread board
- Multimeter
- Function Generator
- Oscilloscope
- Opamp (LM-741)
- Resistors
- DC voltage supply

Theory:

An opamp is a high gain differential amplifier with very high gain input impedance. This very high open loop gain allows for creating amplifiers with stable gain using feedback. Opamps are capable of amplify, controlling, generating sinusoidal or non-sinusoidal waveforms over frequencies from dc to MHz and computing operations such as (addition, subtraction, multiplication, integration, differentiation).

The inverting voltage amplifier is based on parallel-parallel negative feedback. This amplifier exhibits modest input impedance, low output impedance, and stable inverting voltage gain. The input signal is applied to the inverting pin of opamp and there is a phase inversion of 180^{O}. The voltage gain is set by the two feedback resistors, Ri and Rf.

The non-inverting voltage amplifier is based on series-parallel negative feedback. As the ideal voltage-controlled voltage source, this amplifier exhibits high input impedance, low output impedance, and stable voltage gain. The input signal is applied to the non-inverting pin of opamp and there is no phase inversion. The voltage gain is set by the two feedback resistors, Ri and Rf.

Circuit Diagram:

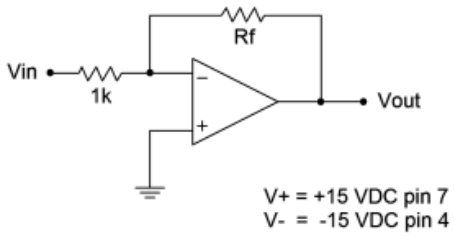

Figure 1 Inverting Amplifier

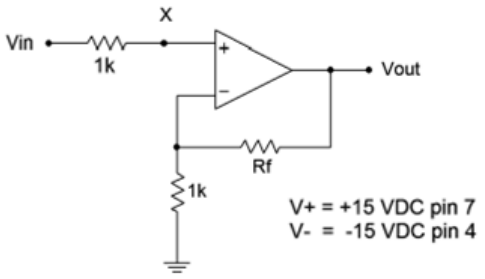

Figure 2 Non-inverting Amplifier

Observations:

S. No.	Frequency	Amplitude	Ri	Rf	Inverting Amplifier		Non-Inverting Amplifier	
					Vo	Voltage Gain	Vo	Voltage Gain
1.	1KHz	200mV	1KΩ	1KΩ				
2.	1KHz	200mV	1KΩ	5KΩ				
3.	1KHz	200mV	1KΩ	10KΩ				
4.	1KHz	200mV	1KΩ	20KΩ				
5.	1KHz	200mV	1KΩ	50KΩ				

Calculations:

Show calculations for the observations by using their formulas and draw the observed waveforms.

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Course Code and Title: _____

Psychomotor Domain Assessment Rubric-Level P3					
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Laboratory Session No. _____ Date: _____

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Remarks	
Instructor's Signature with Date:	

Lab Experiment # 09

Objective:

To PRACTICE the Summing Amplifier.

Equipment:

- Bread board
- Multimeter
- Function Generator
- Oscilloscope
- Opamp (LM-741)
- Resistors
- DC voltage supply

Theory:

The summing amplifier is an application of the inverting op-amp configuration. The summing amplifier has two or more inputs, and its output age is proportional to the algebraic sum of its input voltages. It can be used for combining multiple inputs. It is capable of adding all DC inputs, All AC inputs and DC +AC inputs. The inverting summing amplifier circuit inverts the input signals.

Circuit Diagram:

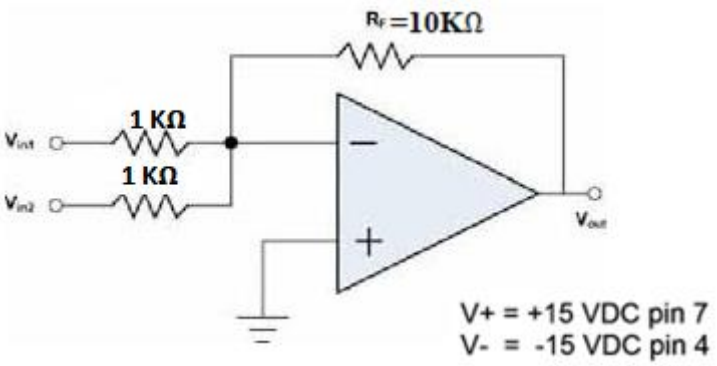

Figure 1 Summing Amplifier

Observations:

S. No.	Input Signal Vin1	Input Signal Vin2	Output Signal
1.	5V DC	5V DC	
2.	5V DC	1Vp-p AC	

Calculations:

Show calculations for the observations by using their formulas also draw the observed waveform.

NED University of Engineering & Technology
Department of _____ Engineering
Course Code and Title: _____

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Laboratory Session No. _____ Date: _____

Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

Lab Experiment # 10

Objective:

To PRACTICE the Integrator and Differentiator Circuits.

Equipment:

- Bread board
- Multimeter
- Function Generator
- Oscilloscope
- Opamp (LM-741)
- Resistors
- DC voltage supply

Theory:

The concept of integration is usually described as “finding the area under the curve”. There are many uses for this function, including wave shaping and analog computing. An ordinary amplifier ideally changes only the amplitude of the input signal. An integrator can change the waveform of the input signal, for example, turning a square wave into a triangle wave. A practical integrator cannot be used at just any frequency. There exists a useful range of integration, outside of which the circuit does not produce the desired effect. By adding a capacitor in parallel with the feedback resistor R2 in an inverting amplifier, the op-amp can be used to perform integration.

The concept of differentiation is usually described as “finding the slope of the curve.” An ordinary amplifier ideally changes only the amplitude of the input signal. A differentiator can change the waveform of the input signal, for example, turning a triangle wave into a square wave. A practical differentiator cannot be used at just any frequency. There exists a useful range of differentiation, outside of which the circuit does not produce the desired effect. By adding a capacitor in series with the input resistor R1 in an inverting amplifier, the op-amp can be used to perform differentiation.

Circuit Diagram:

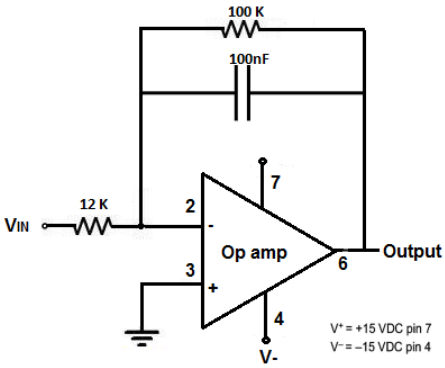

Figure 1 Integrator

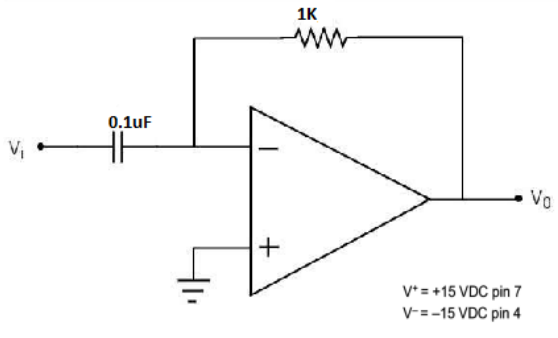

Figure 2 Differentiator

Observations:

S. No	Integrator			Differentiator		
	Vin	Frequency	Vout	Vin	Frequency	Vout
1.	2 Vp-p	50 HZ		2 Vp-p	1 KHz	
2.	2 Vp-p	200 Hz		2 Vp-p	5 KHz	

Waveforms:

Draw and Label output voltage waveforms.

F/OBEM 01/05/00

NED University of Engineering & Technology
Department of _____ Engineering
Course Code and Title: _____

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Laboratory Session No. _____ Date: _____

Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

Lab Experiment # 11

Objective:

To TRY Voltage Divider Bias based Common Source Amplifier Circuit and perform its DC Analysis.

Equipment:

- Bread board
- Multimeter
- Function Generator
- MOSFET (2N7000)
- Resistors
- DC voltage supply

Theory:

FET is a voltage-controlled device with three terminals -source, drain, and gate. Based on these terminals, FET is divided into 3 amplifier configurations. They are common-source, common drain (source-follower), and common-gate amplifier circuits. The common – source amplifier circuit is most widely used than any other amplifier circuits. When the input signal is applied at the gate terminal, then the output voltage is amplified and obtained at the load in the drain terminal. Here source acts as a common terminal between the input and output. It is also known as a voltage amplifier or a trans conductance1 amplifier.

Circuit Diagram:

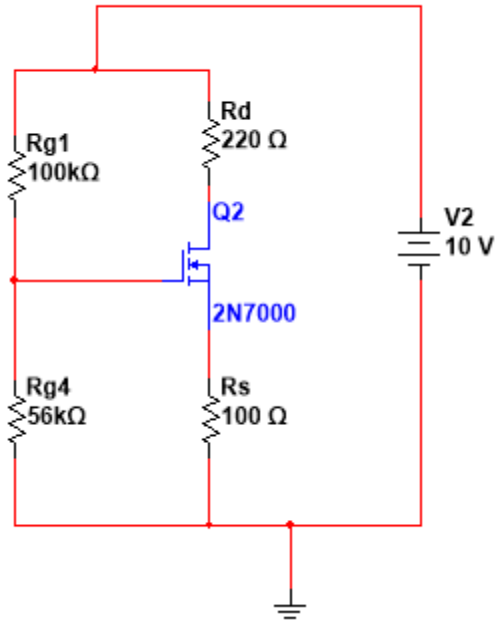

Figure 1 Voltage Divider Biased Common Source Amplifier

Observations:

S. No.	Parameters	Values
1.	V_D	
2.	V_G	
3.	V_S	
4.	I_D	

Mode of Operation is _____

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Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
Equipment Use Sensory skills to ***demonstrate*** the use of the equipment for the lab work.	Doesn't demonstrate the use of equipment.	Slightly demonstrates the use of equipment.	Somewhat demonstrates the use of equipment.	Moderately demon strates the use of equipment.	Fully demonstrates the use of equipment.
Procedural Skills ***Displays*** skills to act upon sequence of steps in lab work.	Not able to either learn or perform lab work procedure.	Able to slightly understand lab work procedure and perform lab work.	Able to somewhat understand lab work procedure and perform lab work.	Able to moderately understand lab work procedure and perform lab work.	Able to fully understand lab work procedure and perform lab work.
Response Ability to ***imitate*** the lab work on his/her own.	Not able to imitate the lab work.	Able to slightly imitate the lab work.	Able to somewhat imitate the lab work.	Able to moderately imitate the lab work.	Able to fully imitate the lab work.
Observation's Use ***Displays*** skills to use the observations from lab work for experimental verifications and illustrations.	Not able to use the observations from lab work for experimental verifications and illustrations.	Slightly able to use the observations from lab work for experimental verifications and illustrations.	Somewhat able to use the observations from lab work for experimental verifications and illustrations.	Moderately able to use the observations from lab work for experimental verifications and illustrations.	Fully able to use the observations from lab work for experimental verifications and illustrations.
Safety Adherence Adherence to ***safety*** procedures.	Doesn't adhere to safety procedures.	Slightly adheres to safety procedures.	Somewhat adheres to safety procedures.	Moderately adheres to safety procedures.	Fully adheres to safety procedures.
Equipment Handling ***Equipment care*** during the use.	Doesn't handle equipment with required care.	Rarely handles equipment with required care.	Occasionally handles equipment with required care.	Often handles equipment with required care.	Handles equipment with required care.
Group Work ***Contributes*** in a group based lab work.	Doesn't participate and contribute.	Slightly participates and contributes.	Somewhat participates and contributes.	Moderately participates and contributes.	Fully participates and contributes.

Laboratory Session No. _____ Date: _____

Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

Lab Experiment # 12

Objective:

To TRY the operation of Common Source Amplifier Circuit to perform its AC Analysis.

Equipment:

- Bread board
- Multimeter
- Function Generator
- Oscilloscope
- MOSFET (2N7000)
- Resistors
- DC voltage supply
- Capacitors

Theory:

The MOS transistor common source amplifier is a circuit that amplify a small signal into large signal. The common – source amplifier circuit is most widely used than any other amplifier circuits because it can produce high input and output impedance, and also its performance is high. Here is a complete description of the common-source amplifier using FET. High input impedance is desirable to keep the amplifier from loading the signal source. This high input impedance is controlled by the bias resistors R1 and R2). Normally the value of the bias resistors is chosen as high as possible. However, too big a value can cause a significant voltage drop due to the gate leakage current. A large voltage drop is undesirable because it can disturb the bias point. For amplifier operation the MOSFET should be biased in the active region of the characteristics.

Circuit Diagram:

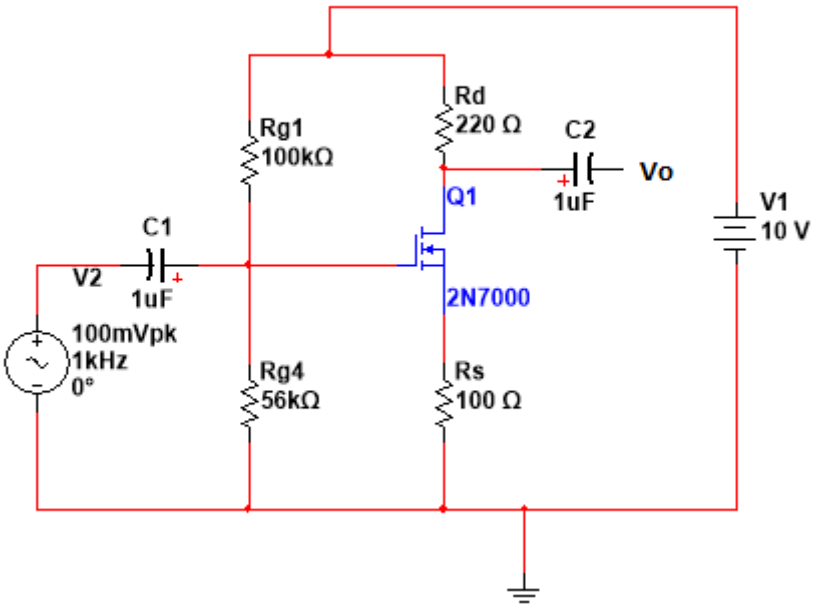

Figure 1 Voltage Divider Biased Common Source Amplifier

Observations:

S. No.	Vin	Vout	Gain
1.			
2.			
3.			

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Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
Equipment Use Sensory skills to ***demonstrate*** the use of the equipment for the lab work.	Doesn't demonstrate the use of equipment.	Slightly demonstrates the use of equipment.	Somewhat demonstrates the use of equipment.	Moderately demon strates the use of equipment.	Fully demonstrates the use of equipment.
Procedural Skills ***Displays*** skills to act upon sequence of steps in lab work.	Not able to either learn or perform lab work procedure.	Able to slightly understand lab work procedure and perform lab work.	Able to somewhat understand lab work procedure and perform lab work.	Able to moderately understand lab work procedure and perform lab work.	Able to fully understand lab work procedure and perform lab work.
Response Ability to ***imitate*** the lab work on his/her own.	Not able to imitate the lab work.	Able to slightly imitate the lab work.	Able to somewhat imitate the lab work.	Able to moderately imitate the lab work.	Able to fully imitate the lab work.
Observation's Use ***Displays*** skills to use the observations from lab work for experimental verifications and illustrations.	Not able to use the observations from lab work for experimental verifications and illustrations.	Slightly able to use the observations from lab work for experimental verifications and illustrations.	Somewhat able to use the observations from lab work for experimental verifications and illustrations.	Moderately able to use the observations from lab work for experimental verifications and illustrations.	Fully able to use the observations from lab work for experimental verifications and illustrations.
Safety Adherence Adherence to ***safety*** procedures.	Doesn't adhere to safety procedures.	Slightly adheres to safety procedures.	Somewhat adheres to safety procedures.	Moderately adheres to safety procedures.	Fully adheres to safety procedures.
Equipment Handling ***Equipment care*** during the use.	Doesn't handle equipment with required care.	Rarely handles equipment with required care.	Occasionally handles equipment with required care.	Often handles equipment with required care.	Handles equipment with required care.
Group Work ***Contributes*** in a group based lab work.	Doesn't participate and contribute.	Slightly participates and contributes.	Somewhat participates and contributes.	Moderately participates and contributes.	Fully participates and contributes.

Laboratory Session No. _____ Date: _____

Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

Lab Experiment # 13

Objective:

To TRY to design a MOSFET Amplifier to obtain the Frequency Response from 100Hz to 1MHz.

1. Use common source amplifier to achieve gain.
2. Select appropriate components and transistor.
3. Bias the circuit to operate in desired mode.
4. Perform AC analysis.
5. Observe voltage gain.
6. Obtain bandwidth.

Deliverables:

1. A step-by-step designing procedure and descriptive analysis of circuit.
2. Mathematical model that characterizes the behavior of a transistor.
3. A simulation of a suitable amplifier design that exactly meets the specified criteria.
4. Observe the gain for given range of frequency.
5. Please make sure to submit the properly formatted hand written report in a tidy handwriting and readable format.

Observations:

S. No.	Frequency	Vo
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

Calculations:

Show calculations for the observations by using their formulas and draw the input and output waveform.

CLO	PLO	Knowledge Profile (WK) (Select appropriate)	CEA Attributes (Select appropriate)
□ CLO 1 □ CLO 2 ✓ CLO 3	□PLO1 □PLO2 □PLO3 ✓PLO4 □PLO5 □PLO6 □PLO7 □PLO8 □PLO9 □PLO10 □PLO11 □PLO12	□WK1: Natural Sciences □WK2: Mathematics and Computing □WK3: Engineering Fundamentals □WK4: Engineering Specializations □WK5: Engineering Design □WK6: Engineering Practices □WK7: Engineering in Society ✓WK8: Research Literature	✓Range of Resources □Level of interaction □Innovation □Consequence to society and the environment ✓Familiarity

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Criterion	Below Average (0)	Average (1)	Good (2)	Very Good (3)	Excellent (4)
Circuit Design	No circuit diagram, no designing	Circuit is designed completely but no proper specifications and no objective achieved.	Circuit is designed completely but no proper specifications and only few objectives achieved.	Circuit is designed completely with proper specifications and only few objectives achieved.	Circuit is designed completely according to the objectives and specifications
Simulation	No simulation performed	Simulation results are not presented properly	Simulation results are presented but no proper justification and analysis	Simulation results are presented with some analysis	Simulation results are clearly presented with proper justification and analysis
Hardware Implementation	Defined objectives are not achieved, hardware is not working	Some of the objectives achieved, hardware is not working and not demonstrated properly	Some of the objectives achieved, hardware working but not demonstrated properly	Some of the objectives achieved, hardware working with proper demonstration	All results are achieved, hardware working well, properly demonstrated
Results	Results are not presented	Results are analyzed bit not presented and no parameters calculated	Results are partially analyzed and presented without parameters calculated	Results are analyzed and well-presented without parameters calculated	Results are analyzed and well presented with all parameters calculated
Report	Report is not well prepared	Many observations are not reported	Some significant observations re not mentioned in the report but presented overall objective	Few observations are missed, but results are discussed clearly	All key concepts and technical aspects of project are clearly described