

ANALOG ELECTRONICS LAB
(EE-222-F)

LAB MANUAL

IV SEMESTER



DRONACHARYA
College of Engineering

Department Of Electronics & Communication Engg
Dronacharya College Of Engineering
Khentawas, Gurgaon – 123506

LIST OF EXPERIMENTS

S.NO.	NAME OF THE EXPERIMENT	Page No.
1.	To get familiar with working knowledge of the following Instruments. (a) CRO (b) Multimeter (c) Function generator (d) Regulated power supply (e) Active passive components (f) Bread Board	3-11
2.	Study of V-I Characteristics of a Diode.	12-14
3(a).	To study and draw the characteristics of half wave and full wave rectifiers.	15-17
3(b).	To study and draw the characteristics of rectifier filter circuit.	18-20
3(c).	Study of Clipping & Clamping circuit.	21-24
4.	To study zener diode characteristics.	25-28
5.	To study zener diode as voltage regulator.	29-30
6(a).	To Study the characteristics of transistor in Common Base configuration.	31-33
6(b).	To plot and study the input and output characteristics of BJT in common-emitter configuration.	34-35
6(c).	Graphical determination of small signal hybrid parameter of BJT.	36-38
7.	To study and draw the characteristics of FET in common source configuration	39-41
8.	Study characteristics of SCR.	42-43
9.	Study of characteristics of DIAC.	44-46
10.	To plot V-I characteristic of TRIAC.	47-49
11.	To study and draw the characteristics of FET in common drain configuration.	50-52
12.	To Study the Series and Shunt Voltage Regulator.	53-54
13.	Study of frequency response of active filters HP, LP & BP.	55-60

EXPERIMENT NO. 1

AIM: To get familiar with working knowledge of the following Instruments.

A.CATHODE RAY OSCILLOSCOPE

The cathode-ray oscilloscope (CRO) is a common laboratory instrument that provides accurate time and amplitude measurements of voltage signals over a wide range of frequencies. Its reliability, stability, and ease of operation make it suitable as a general purpose laboratory instrument. The heart of the CRO is a cathode-ray tube shown schematically in Fig. 1.

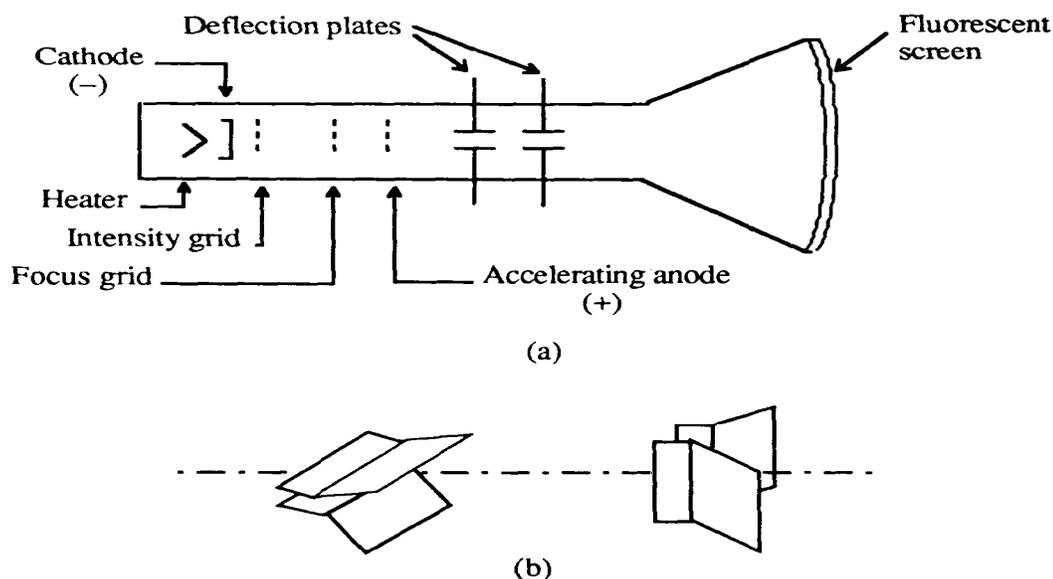


Figure 1. Cathode-ray tube: (a) schematic, (b) detail of the deflection plates.

The cathode ray is a beam of electrons which are emitted by the heated cathode (negative electrode) and accelerated toward the fluorescent screen. The assembly of the cathode, intensity grid, focus grid, and accelerating anode (positive electrode) is called an *electron gun*. Its purpose is to generate the electron beam and control its intensity and focus. Between the electron gun and the fluorescent screen are two pair of metal plates - one oriented to provide horizontal deflection of the beam and one pair oriented to give vertical deflection to the beam. These plates are thus referred to as the *horizontal* and *vertical deflection plates*. The combination of these two deflections allows the beam to reach any portion of the fluorescent screen. Wherever the electron beam hits the screen, the phosphor is excited and light is emitted from that point. This conversion of electron energy into light allows us to write with points or lines of light on an otherwise darkened screen.

In the most common use of the oscilloscope the signal to be studied is first amplified and then applied to the vertical (deflection) plates to deflect the beam vertically and at

ANALOG ELECTRONICS LAB (EE-222-F)

the same time a voltage that increases linearly with time is applied to the horizontal (deflection) plates thus causing the beam to be deflected horizontally at a uniform (constant) rate. The signal applied to the vertical plates is thus displayed on the screen as a function of time. The horizontal axis serves as a uniform time scale.

The linear deflection or sweep of the beam horizontally is accomplished by use of a *sweep generator* that is incorporated in the oscilloscope circuitry. The voltage output of such a generator is that of a saw tooth wave as shown in Fig. 2. Application of one cycle of this voltage difference, which increases linearly with time, to the horizontal plates causes the beam to be deflected linearly with time across the tube face. When the voltage suddenly falls to zero, as at points (a) (b) (c), etc....., the end of each sweep - the beam flies back to its initial position. The horizontal deflection of the beam is repeated periodically, the frequency of this periodicity is adjustable by external controls.

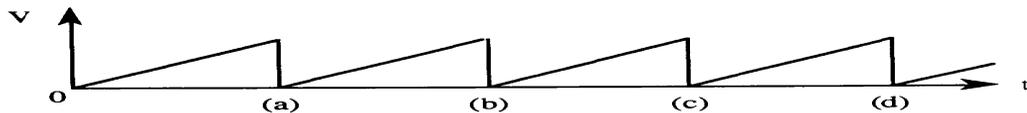
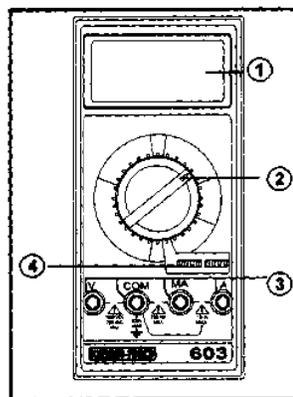


Figure. 2. Voltage difference V between horizontal plates as a function of time t .

To obtain steady traces on the tube face, an internal number of cycles of the unknown signal that is applied to the vertical plates must be associated with each cycle of the sweep generator. Thus, with such a matching of synchronization of the two deflections, the pattern on the tube face repeats itself and hence appears to remain stationary. The persistence of vision in the human eye and of the glow of the fluorescent screen aids in producing a stationary pattern. In addition, the electron beam is cut off (blanked) during flyback so that the retrace sweep is not observed

B. THE MULTIMETER STRUCTURE



A multimeter is used to make various electrical measurements, such as AC and DC voltage, AC and DC current, and resistance. It is called a *multimeter* because it combines the functions of a voltmeter, ammeter, and ohmmeter. Multimeters may also have other functions, such as diode and continuity tests. The descriptions and pictures that follow are specific to the Fluke 73 Series III Multimeter, but other multimeters are similar.

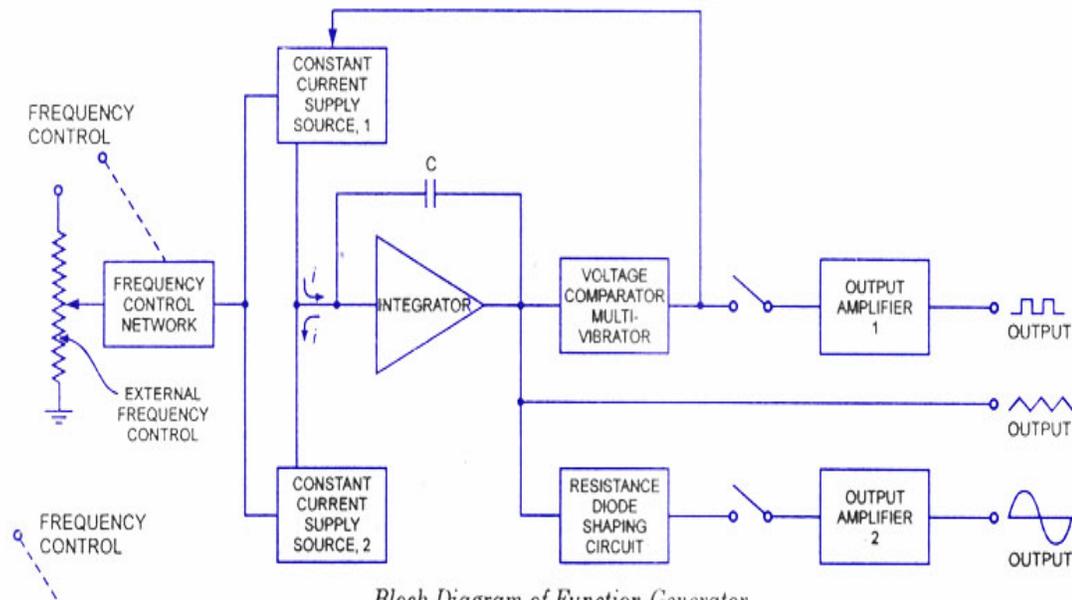
Important note: The most common mistake when using a multimeter is not switching the test leads when switching between current sensing and any other type of sensing (voltage, resistance). It is critical that the test leads be in the proper jacks for the measurement you are making.

Safety Information

- Be sure the test leads and rotary switch are in the correct position for the desired measurement.
- Never use the meter if the meter or the test leads look damaged.
- Never measure resistance in a circuit when power is applied.
- Never touch the probes to a voltage source when a test lead is plugged into the 10 A or 300 mA input jack.
- To avoid damage or injury, never use the meter on circuits that exceed 4800 watts.
- Never apply more than the rated voltage between any input jack and earth ground (600 V for the Fluke 73).
- Be careful when working with voltages above 60 V DC or 30 V AC rms. Such voltages pose a shock hazard.
- Keep your fingers behind the finger guards on the test probes when making measurements.
- To avoid false readings, which could lead to possible electric shock or personal injury, replace the battery as soon as the battery indicator appears.

C. FUNCTION GENERATOR

A **function generator** is a device that can produce various patterns of voltage at a variety of frequencies and amplitudes. It is used to test the response of circuits to common input signals. The electrical leads from the device are attached to the ground and signal input terminals of the device under test.



Features and controls

- Most **function** generators allow the user to choose the shape of the output from a small number of options.

ANALOG ELECTRONICS LAB (EE-222-F)

- -Square wave - The signal goes directly from high to low voltage.
- -Sine wave - The signal curves like a sinusoid from high to low voltage.
- -Triangle wave - The signal goes from high to low voltage at a fixed rate
- The amplitude control on a **function generator** varies the voltage difference between the high and low voltage of the output signal.
- The direct current (DC) offset control on a **function generator** varies the average voltage of a signal relative to the ground.
- The frequency control of a **function generator** controls the rate at which output signal oscillates. On some **function generators**, the frequency control is a combination of different controls.
- One set of controls chooses the broad frequency range (order of magnitude) and the other selects the precise frequency. This allows the **function generator** to handle the enormous variation in frequency scale needed for signals.

How to use a **function generator**?

- After powering on the **function generator**, the output signal needs to be configured to the desired shape. Typically, this means connecting the signal and ground leads to an oscilloscope to check the controls.
- Adjust the **function generator** until the output signal is correct, then attach the signal and ground leads from the **function generator** to the input and ground of the device under test.
- For some applications, the negative lead of the **function generator** should attach to a negative input of the device, but usually attaching to ground is sufficient.

Conclusions

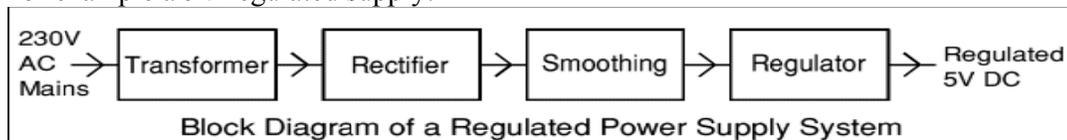
- A **function generator** is a device that can produce various patterns of voltage at a variety of frequencies and amplitudes.

D. REGULATED POWER SUPPLY

Types of Power Supply

There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can be broken down into a series of blocks, each of which performs a particular function.

For example a 5V regulated supply:



Each of the blocks is described in more detail below:

- Transformer - steps down high voltage AC mains to low voltage AC.
- Rectifier - converts AC to DC, but the DC output is varying.

ANALOG ELECTRONICS LAB (EE-222-F)

- Smoothing - smooths the DC from varying greatly to a small ripple.
- Regulator - eliminates ripple by setting DC output to a fixed voltage

POWER:

Push button switch for supplying power to instrument.

OUTPUT ON:

Push button for switching On / Off all the three output voltages.

3 & 6 V/mA (Push button):

For switching the display from voltage to current reading or vice versa. When pushbuttons are pressed, the current supplied from the terminals 12 & 17 is displayed with a resolution of 1mA. In released position voltages across the terminals 12 & 17 are displayed with a resolution of 0.1 V.

4 & 7 DIGITAL DISPLAYS (7-Segment LED):

Dual display with two 3-digit readout for output voltage and current. On the left side of the instrument the voltage and current readings for terminals 3 is indicated. The corresponding values for the terminals 4 are indicated on the right side of the display.

5 & 8 V & mA INDICATORS:

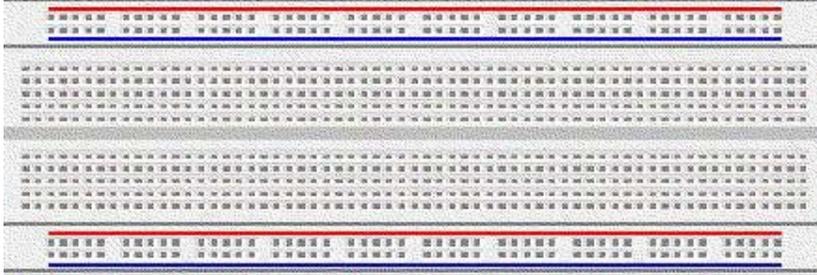
Two LEDs indicate the unit of the display. The mA LED flashes when the 0 – 30VDC output is used in constant current mode, or output current required is in excess of specified value, in CV mode.

E.ACTIVE, PASSIVE COMPONENTS

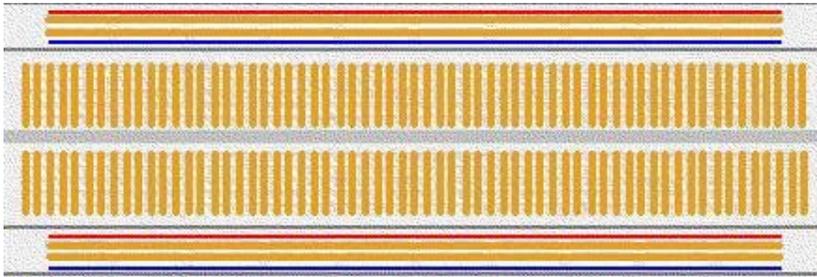
An **electronic component** is a basic electronic element and may be available in a discrete form (a **discrete device** or **discrete component**) having two or more electrical terminals (or *leads*). These are intended to be connected together, usually by soldering to a printed circuit board, in order to create an electronic circuit (a discrete circuit) with a particular function (for example an amplifier, radio receiver, or oscillator). Basic electronic components may be packaged discretely, as arrays or networks of like components, or integrated inside of packages such as semiconductor integrated circuits, hybrid integrated circuits, or thick film devices.

F. BREAD BOARD

A breadboard is used to build and test circuits quickly before finalizing any circuit design. The breadboard has many holes into which circuit components like ICs and resistors can be inserted. A typical breadboard is shown below:



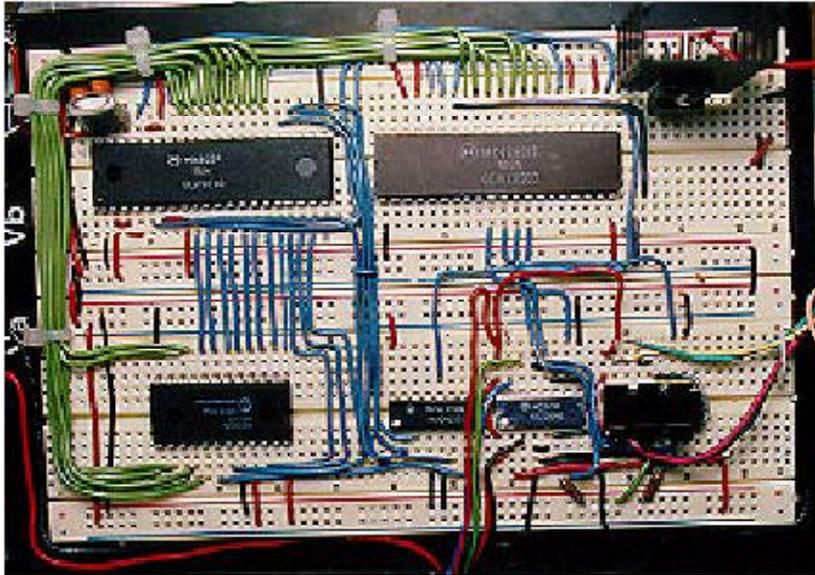
The bread board has strips of metal which run underneath the board and connect the holes on the top of the board. The metal strips are laid out as shown below. Note that the top and bottom rows of holes are connected horizontally while the remaining holes are connected vertically.



To use the bread board, the legs of components are placed in the holes. Each set of holes connected by a metal strip underneath forms a *node*. A node is a point in a circuit where two components are connected. Connections between different components are formed by putting their legs in a common node.

The long top and bottom row of holes are usually used for power supply connections. The rest of the circuit is built by placing components and connecting them together with jumper wires. ICs are placed in the middle of the board so that half of the legs are on one side of the middle line and half on the other.

A completed circuit might look like the following.



Breadboarding tips:

It is important to breadboard a circuit neatly and systematically, so that one can debug it and get it running easily and quickly. It also helps when someone else needs to understand and inspect the circuit. Here are some tips:

1. Always use the side-lines for power supply connections. Power the chips from the side-lines and not directly from the power supply.
2. Use black wires for ground connections (0V), and red for other power connections.
3. Keep the jumper wires on the board flat, so that the board does not look cluttered.
4. Route jumper wires around the chips and not over the chips. This makes changing the chips when needed easier.
5. You could trim the legs of components like resistors, transistors and LEDs, so that they fit in snugly and do not get pulled out by accident.

QUIZ:

Q: What are the uses of CRO?

A: Calibrate an oscillator, Compare two frequency generators, Phase shift determination b/w V and I in any CRT circuit, study Beats phenomenon, study Lisajjous figures

Q: For what electron gun assembly is provided in a CRT?

A: To provide a narrow & sharply focused electron beam

Q: What is meant by deflection sensitivity of a CRO?

A: Vertical deflection of the beam on the screen per unit deflecting voltage

Q: What is the deflection factor of a CRO?

A: Reciprocal of deflection sensitivity.

Q: What is a CRO?

A: Electronic device is an electronic device with a CRT as its main component & other associated circuits consisting of a power supply unit, a saw-tooth wave generator, horizontal & vertical amplifiers.

Q: What is a function generator?

A: It is a signal source that has capability of producing different types of waveforms & frequencies

ANALOG ELECTRONICS LAB (EE-222-F)

Q: How the frequency of a function generator is controlled?

A: By varying the magnitude of current that drives the integrator

Q: What is a regulated power supply?

A: An electronic circuit which provide constant DC voltage of predetermined value across load terminals, which is independent of variations in load current.

Q: What are the basic components of a regulated power supply?

A: A transformer, rectifier circuit, filter, voltage regulator

Q: What is the need of voltage regulators?

A: To keep output voltage constant against variations in load current & in AC mains voltage.

Q. what is breadboard?

A. A breadboard is used to build and test circuits quickly before finalizing any circuit design. The breadboard has many holes into which circuit components like ICs and resistors can be inserted.

Q. What is the difference between active and passive components?

A. Passive elements don't require power from the supply to produce its effect on a signal. They derive the power of the input signal to perform its action. for example, a resistor doesn't require a separate supply to provide its action of resistance in a circuit. Where as in active elements there should be a power source for its working. They require a supply for there working. For instance, transistors - Only after biasing the transistor in required region of operation, its characteristics are applied on the signal. i.e, for amplification, transistor requires a source from where it can work in.

EXPERIMENT NO. 2

AIM: Study of V-I Characteristics of a Diode.

APPARATUS REQUIRED: Diode Characteristics Kit, Power Supply, Ammeter (0-20mA), Voltmeter (0-20V), Connecting Leads.

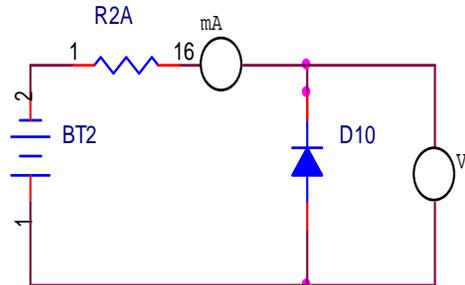
BRIEF THEORY: A P-N junction is known as Semiconductor diode or Crystal diode. It is the combination of P-type & N-type Semiconductor. This offers nearly zero resistance to current on forward biasing & nearly infinite Resistance to the flow of current when in reverse biased.

Forward biasing: When P-type semiconductor is connected to the +ve terminal and N-type to -ve terminal of voltage source. Nearly zero resistance is offered to the flow of current.

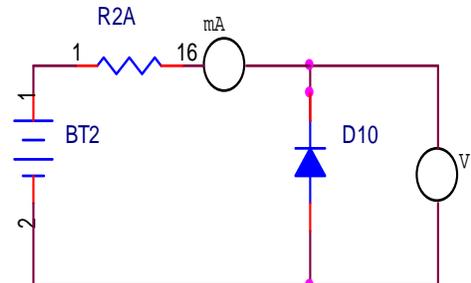
Reverse biasing: When P-type semiconductor is connected to the -ve terminal and N-type to +ve terminal. Nearly zero current flow in this condition.

CIRCUIT DIGRAM:

(1) When diode is forward biased



(2) When diode is reverse biased



PROCEDURE:

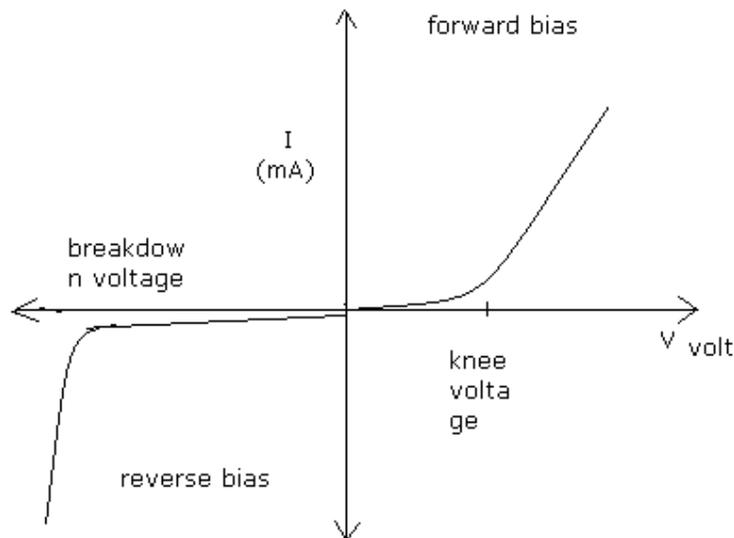
- (1) Connect the circuit as shown in fig.
- (2) Switch on the power supply.
- (3) Vary the value of input dc supply in steps.
- (4) Note down the ammeter & voltmeter readings for each step.
- (5) Plot the graph of Voltage Vs Current.
- (6) Connect the circuit as shown in fig.

ANALOG ELECTRONICS LAB (EE-222-F)

OBSERVATION TABLE:

S.NO	When Diode Is Forward Biased		When Diode Is Reverse Biased	
	Current(mA)	Voltage(V)	Current [μ A)	Voltage(V)
1.				
2.				
3.				

GRAPH:



RESULT: The graph has been plotted between voltage and current.

DISCUSSION: The diode doesn't conduct in RB state and conduct in FB state.

PRECAUTIONS:

- (1) Always connect the voltmeter in parallel & ammeter in series as shown in fig.
- (2) Connection should be proper & tight.
- (3) Switch 'ON' the supply after completing the circuit
- (4) DC supply should be increased slowly in steps
- (5) Reading of voltmeter & Ammeter should be accurate.

QUIZ:

Q.1 Define semiconductor diode?

A. A PN – junction is called semiconductor diode.

Q.2 Define depletion layer?

A. The region having uncompensated acceptor and donor ions.

Q.3 what do you mean by forward biased?

A. When +ve terminal of battery is connected to P side & -ve terminal to N side of diode.

ANALOG ELECTRONICS LAB (EE-222-F)

Q.4 what do you mean by reverse biased?

A. When +ve terminal of battery is connected to N side & -ve terminal to P side of diode.

Q.5 Define Knee voltage?

A. The forward voltage at which current through the junction starts increasing rapidly.

Q.6 Define breakdown voltage?

A. Reverse voltage at which PN junction breaks down with sudden rise in reverse current.

Q.7 Define max. Forward current?

A. It is highest instantaneous forward current that a PN junction can conduct without damage to Junction.

Q.8 Define max. Power rating?

A. Max. Power that can be dissipated at junction without damage to it.

Q.9. What is ideal diode?

A. Diode have been ideal if it acted as perfect conductor (resistance zero) when forward biased and as a perfect insulator (resistance infinite) when reverse biased.

Q10. What are the application of pn diodes?

Ans. As rectifiers in dc power supplies, in demodulation or detector circuits.

EXPERIMENT NO. 3(a)

AIM: To study and draw the characteristics of half wave and full wave rectifiers.

APPARATUS REQUIRED: Power supply, rectifier kit, CRO, Connecting leads.

BRIEF THEORY: Rectification is a process of conversion of AC to DC. In half-wave rectifier, only one diode is used. During +ve half cycle the diode is forward biased & it conducts current through the load resistor R. During -ve half cycle diode is reverse biased

Hence, no current flow through the circuit. Only +ve half cycle appears across the load, whereas, the -ve half cycle is suppressed.

Full Wave Rectifier: In full-wave rectifier, when a.c supplied at the input, both the half cycle current flows through the load in the same direction. The following two circuits are commonly employed.

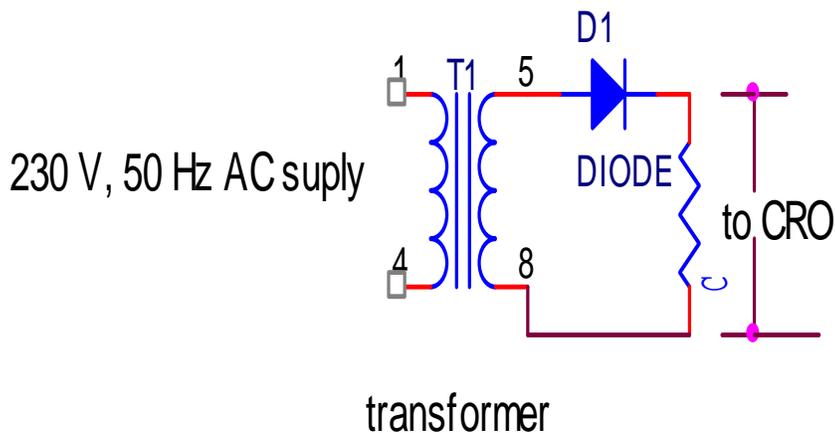
Centre-tap full-wave Rectifier: In this rectifier, two diode & a center-tap transformer is used.

During +ve half cycle the diode D1 is forward biased & D2 is reverse biased. Output will be obtained across load resistor R. During -ve half cycle diode D1 is reverse biased & D2 is forward biased. Output will be obtained across load resistor R & the direction of output is same i.e., DC output is obtained.

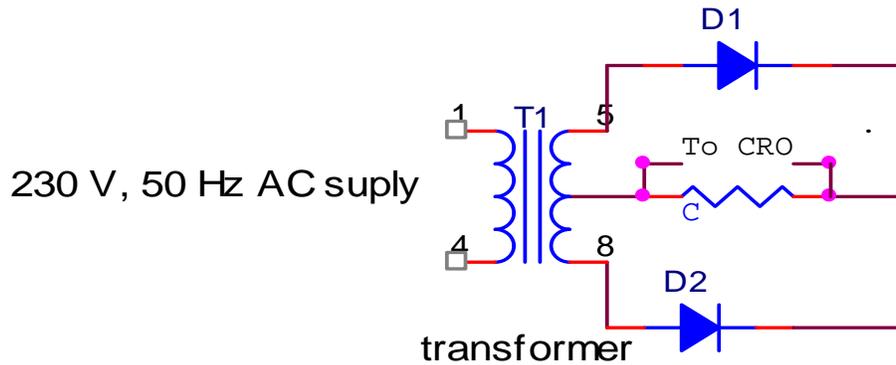
Bridge Rectifier: The circuit Contains four diodes connected to form a bridge. In this an ordinary

transformer is used. During +ve half cycle of secondary voltage, diodes D1 & D3 are forward Biased & diodes D2 & D4 are reverse biased & vice versa.

CIRCUIT DIAGRAM:



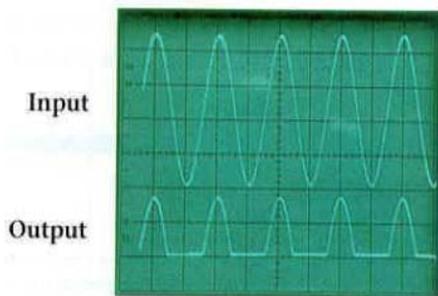
HALF WAVE RECTIFIER



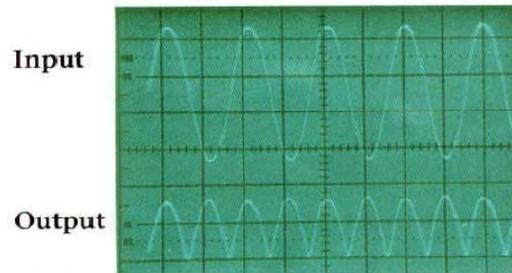
FULL WAVE RECTIFIER

PROCEDURE:

1. Connect the circuit as per the circuit diagram
2. The output is noted down on CRO.
3. Graph is drawn by noting down peak to peak amplitude of input and output voltage



Half Wave Rectifier



Full wave Rectifier

OBSERVATION TABLE:

S. No	RECTIFIERS	INPUT(V)	OUT PUT(V)
1	HALF WAVE		
2	CENTER TAP FULL WAVE		
3	BRIDGE FULL WAVE (FW)		

RESULT: Waveforms of full wave & half wave rectifier have drawn.

PRECAUTIONS:

1. Connections should be tight
2. Handle the equipments with care

ANALOG ELECTRONICS LAB (EE-222-F)

QUIZ:

Q.No.	QUESTION	ANSWERS
1	Define Full wave rectifier?	In both the half cycles current flows through the load in the same direction.
2	Which are different types of Full Wave rectifier?	Different types of full wave rectifier are Centre-Tap full wave rectifier & Bridge rectifier
3	How many no. of diodes are used in full wave rectifier?	4 No. of diodes are used for Bridge rectifier.
4	Give disadvantage of centre-Tap full wave rectifier?	Necessity of transformer with secondary winding.
5	Write ripple factor for FW rectifier?	The ripple factor for Full wave rectifier is 0.48.
6	What is the efficiency of FW rectifier?	Efficiency of full wave rectifier is 81.2%
7	Write advantages of bridge rectifier?	Suitable for high-voltage applications.
8	Write one feature of Full wave rectifier?	The current drawn in both the primary & secondary of the supply transformer is Sinusoidal.
9	Define Transformer Utilization Factor?	Transformer Utilization Factor (TUF) is the ratio of d.c power to be delivered to the load to the a.c rating of the Transformer secondary.
10	Write value for DC current?	DC current is $I_{dc} = I_m / \pi$.

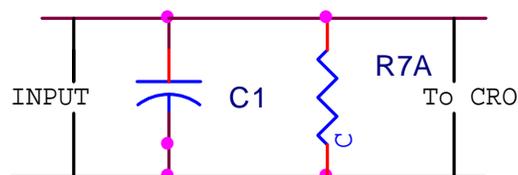
EXPERIMENT NO. 3(b)

AIM: To study and draw the characteristics of rectifier filter circuit.

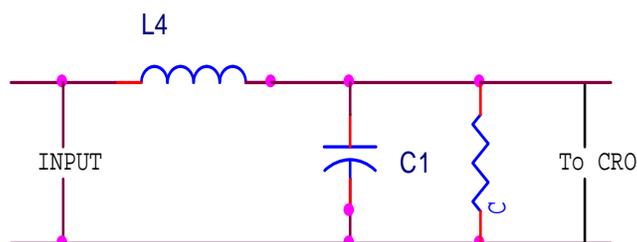
APPARATUS REQUIRED: Power supply, filter kit, CRO, Connecting leads.

BRIEF THEORY: The output from any rectifier is not pure dc but also has some ac components, called ripples along it. It is important to reduce ripples from the pulsating dc supply available from rectifier circuits to the minimum. This is achieved by using a filter circuit which removes the ac components and allows only dc components to reach the load. A filter circuit is a device that converts pulsating output into a steady dc level. A filter circuit is generally a combination of inductors & capacitors. The filtering action of L & C depends upon the facts that an inductor allows dc only & capacitor allows ac only to pass.

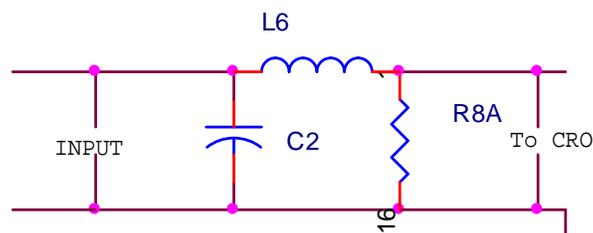
CIRCUIT DIAGRAM:



CAPACITOR FILTER



CHOKE FILTER



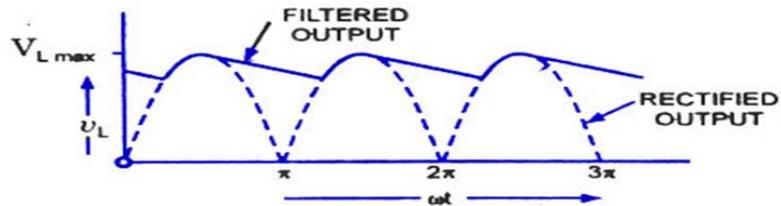
PI FILTER

PROCEDURE:

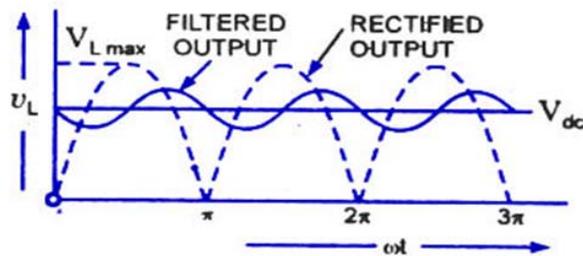
- (a) Connect the circuit as per the circuit diagram
- (b) First introduce capacitor filter and note down the waveforms on CRO
- (c) Then introduce inductor filter and note down the waveforms on CRO

ANALOG ELECTRONICS LAB (EE-222-F)

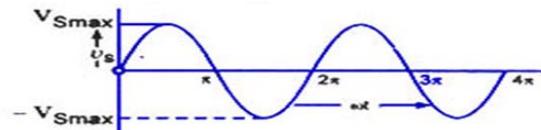
(d) Now introduce Π -filter and note down the waveforms on CRO



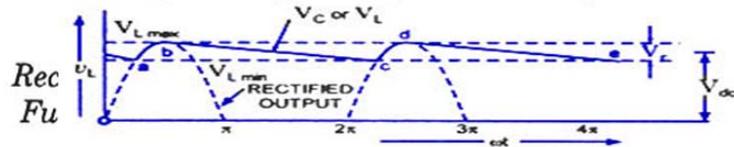
*Rectified and Filtered Output Voltage Waveforms
Full-Wave Rectifier With Capacitor
Input Filter*



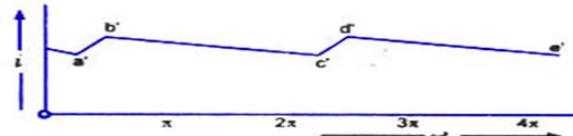
*Rectified and Filtered Output Voltage Waveform
Full-wave Rectifier With Choke-Input Filter*



Input Voltage Waveform To Rectifier



Rectified and Filtered Output Voltage Wavefo



*Load Current Waveform
Half-wave Rectifier With Shunt Capacitor Filter*

PRECAUTIONS:

- (a) Connections should be tight
- (b) Handle the equipments with care

ANALOG ELECTRONICS LAB (EE-222-F)

RESULT: Waveforms of full wave & half wave rectifier is noted down.

QUIZ:

Q. No	QUESTION	ANSWERS
1	What is filter?	The device that converts the pulsating output of a rectifier into a steady dc level is known as filter
2	Give commonly used filters?	Commonly used filters are Series inductor filter Shunt capacitor filter LC filter Π filter
3	Define ripple factor?	Ripple factor is defined as the ratio of rms value of the ac component to the dc value of the wave.
4	What is dc output voltage given by?	The dc output voltage is given by $V_{dc} = I_{dc} R_L$
5	When we can use inductor small?	We can use inductor filter when R_L is consistently small.
6	What happens when the filter capacitor value larger?	When the filter capacitor value larger, larger will be the peak current in the rectifying diode.
7	What is the value of ripple factor for bridge rectifier?	The value of ripple factor for bridge rectifier is 1.21.
8	What is the ripple factor of power supply measured off?	The ripple factor of a power supply is a measure of purity of power output.
9	What happens when form factor of filter is higher?	Greater the form factor of a filter, higher its ripple factor.
10	What is the value of ripple factor for half wave rectifier?	The value of ripple factor for half wave rectifier is 0.48.

EXPERIMENT NO. 3(C)

AIM: Study of Clipping & Clamping circuit.

APPARATUS REQUIRED: Power supply, Clipping & Clamping circuit, Connecting leads, CRO.

BRIEF THEORY:

Clipping: The clippers have the ability to remove signal voltages above or below a specified level & hence change the wave shape of the I/P signal. Most of the clippers employ diodes & are known as diode clippers. Different type of clippers are-

Positive & Negative clipper: A circuit that removes +ve half-cycle of the signal is called +ve clipper. Some times, it is required to remove the -ve half cycle of the I/P signal, the only thing to be done is to reverse the polarity of the diode connected across load, such a clipper is known as a -ve clipper.

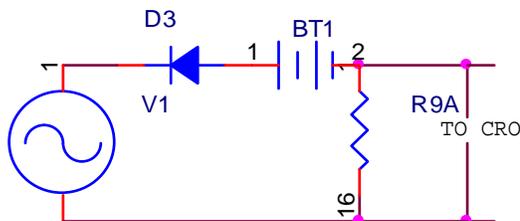
Biased clipper: A clipper used to remove a small portion of +ve or -ve half cycle of the signal

Voltage is called a biased clipper. A diode is employed in series with a battery of different volts depending upon the requirement.

Combination clipper: In this circuit small portion of +ve as well as small portion of -ve half-cycle of the signal voltage is removed.

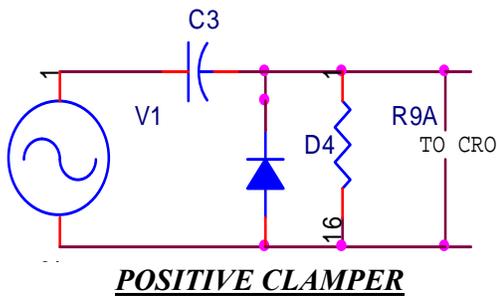
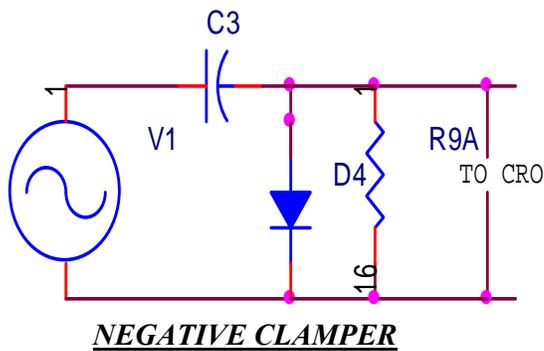
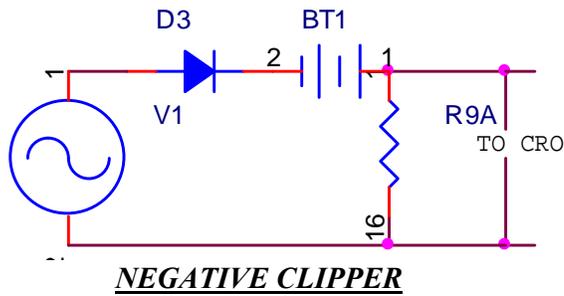
Clamper: A clamping circuit adds d.c component to the signal in such away that it pushes the signal either on the +ve side or on the -ve side. When the circuit pushes the signal on the +ve side then -ve peak of the signal falls on the zero level, this circuit is called a +ve clamper. When the circuit pushes the signal on the -ve side, this is -ve clamper.

CIRCUIT DIAGRAM:



POSITIVE CLIPPER

ANALOG ELECTRONICS LAB (EE-222-F)



PROCEDURE:

CLIPPER

- A. Connect the circuit as shown in the circuit diagram
- B. Observe the output on CRO
- C. Now connect the battery and observe the output.
- D. Repeat the above steps for each type of clipper

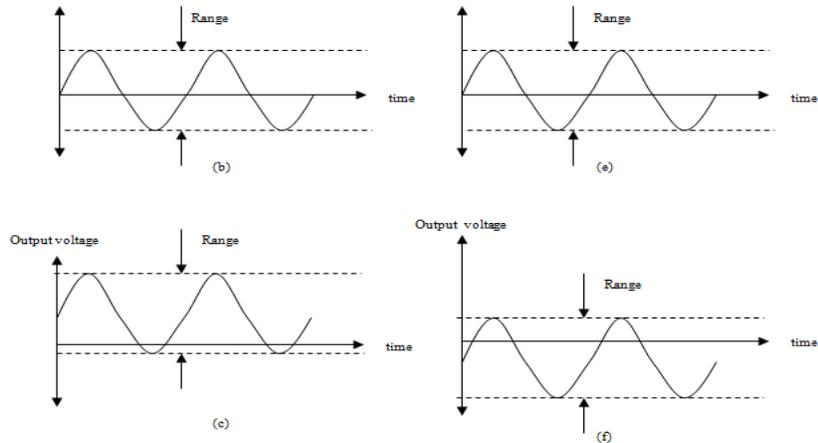
CLAMPER

- A. Connect the circuit as shown in the circuit diagram
- B. Note down the output on CRO
- C. Use dc/ac switch of CRO to calculate the added dc level to the wave

OBSERVATION TABLE:

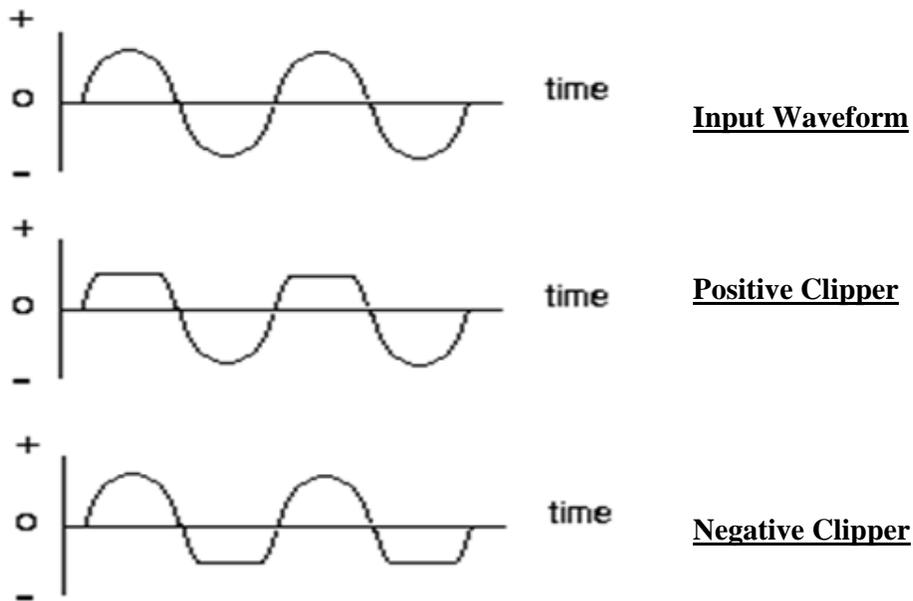
	CLIPPER		CLAMPER	
	I/P(V)	O/P(V)	I/P(V)	O/P(V)
+VE				
-VE				

WAVEFORM:



Positive Clamper

Negative Clamper



PRECAUTIONS:

- A. Connection should be proper & tight.
- B. Switch 'ON' the supply after completing the circuit
- C. Handle the equipments with care

RESULT: Verified the circuit diagram of clipper and clamper and waveforms are drawn.

ANALOG ELECTRONICS LAB (EE-222-F)

QUIZ:

Q. No	QUESTION	ANSWER
1.	What is non-linear wave shaping?	Non linear wave shaping is the process, on applying any wave at input of a non-linear device the shape of the output wave varies non-linearly with the input wave.
2.	Which are the circuits for non-linear wave shaping?	Clipping circuit & Clamping circuits are the circuits for non-linear wave shaping.
3.	What is clipping circuit ?	A wave-shaping circuit which controls the output waveform by removing or clipping a portion of the applied wave is known as clipping circuit.
4.	According to non-linear devices how clippers can be classified?	According to non-linear devices clippers can be classified as diodes clippers & transistor clippers.
5.	According to configuration used classify clippers?	According to configuration used classify clippers can be classified as a) Series diode clipper. b) Parallel or shunt diode clipper. c) Combination clippers.
6.	Classify clippers according to level of clippers?	According to level of clipping the clippers may be a) Positive clippers. b) Negative clippers c) Biased clippers d) Combinational clippers.
7.	What is positive clipper circuit?	Positive clipper is one which removes the positive half cycles of the input voltage
8.	What is negative clipper circuit?	Negative clipper is one which removes the negative half cycles of the input voltage
9.	What is clamping?	A circuit that places either the positive or negative peak of a signal at a desired level is known as Clamping circuit.
10.	How many types of clampers are there?	There are 2 types of clampers a) Positive clamper. b) Negative clamper

EXPERIMENT NO. 4

AIM: To study Zener diode characteristics.

APPARATUS REQUIRED: Regulated DC power supply, Voltmeter, Connecting Wires, kit

Specifications:

Breakdown Voltage = 5.1V

Power dissipation = 0.75W

Max. Forward Current = 1A

THEORY: An ideal P-N Junction diode does not conduct in reverse biased condition. A **zener diode** conducts excellently even in reverse biased condition. These diodes operate at a precise value of voltage called break down voltage. A **zener diode** when forward biased behaves like an ordinary P-N junction diode. A **zener diode** when reverse biased can either undergo *avalanche break down* or *zener break down*.

Avalanche break down:-If both p-side and n-side of the diode are lightly doped, depletion region at the junction widens. Application of a very large electric field at the junction may rupture covalent bonding between electrons. Such rupture leads to the generation of a large number of charge carriers resulting in **avalanche multiplication**.

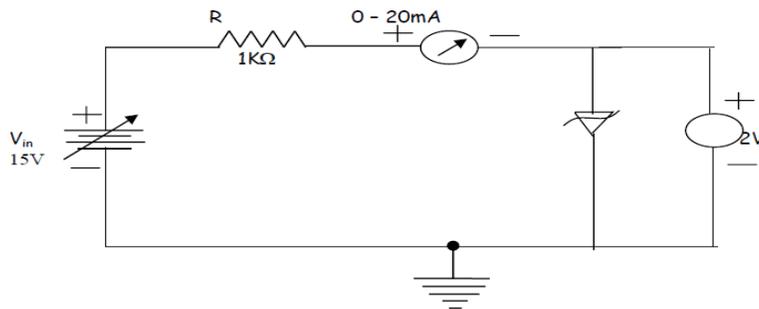
Zener break down:-If both p-side and n-side of the diode are heavily doped, depletion region at the junction reduces. Application of even a small voltage at the junction ruptures covalent bonding and generates large number of charge carriers. Such sudden increase in the number of charge carriers results in **zener mechanism**.

CIRCUIT DIAGRAM:

Fig (1) – Forward Bias Condition:

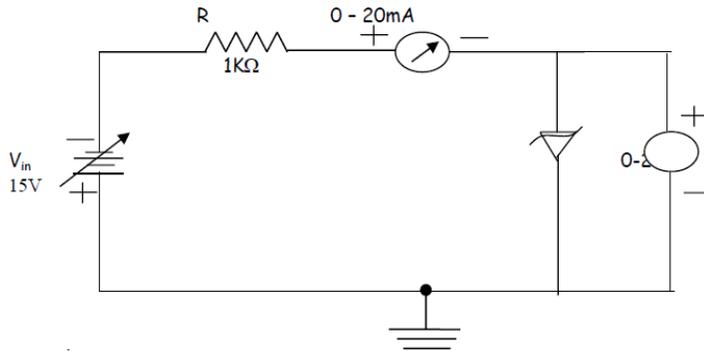
Circuit Diagram:

Fig (1) - Forward Bias Condition:



ANALOG ELECTRONICS LAB (EE-222-F)

Fig (2) - Reverse Bias Condition:



PROCEDURE:

Forward biased condition:

1. Connect the circuit as shown in fig (1).
2. Vary V_{zf} gradually and note down the corresponding readings of I_{zf} .
3. Step Size is not fixed because of non linear curve and vary the X-axis variable (i.e. if output variation is more, decrease input step size and vice versa).
4. Tabulate different forward currents obtained for different forward voltages.

Reverse biased condition:

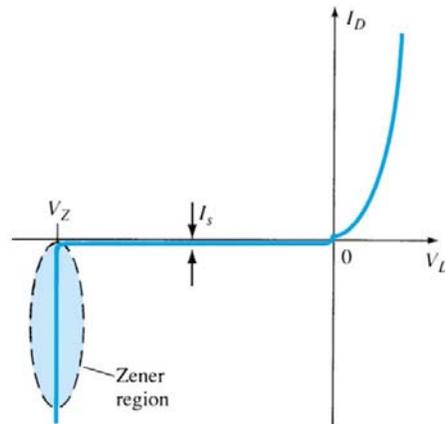
1. Connect the circuit as shown in fig (2).
2. Vary V_{zr} gradually and note down the corresponding readings of I_{zr} .
7. Step Size is not fixed because of non linear curve and vary the X-axis variable (i.e. if output variation is more, decrease input step size and vice versa).
8. Tabulate different reverse currents obtained for different reverse voltages.

OBSERVATIONS:

Zener diode in Forward Zener diode & reverse biased condition should be observed.

Forward Voltage across the diode V_{zf} (volts)	Forward current through the diode I_{zf} (mA)

Reverse Voltage Across diode V_{zr} (volts)	Reverse current through the diode I_{zr} (mA)



CALCULATIONS FROM GRAPH:

Static forward Resistance $R_{dc} = V_f/I_f$

Dynamic forward Resistance $r_{ac} = \Delta V_f/\Delta I_f$

Static Reverse Resistance $R_{dc} = V_r/I_r$

Dynamic Reverse Resistance $r_{ac} = \Delta V_r/\Delta I_r$

PRECAUTIONS:

1. While doing the experiment do not exceed the ratings of the diode. This may lead to damage the diode.
2. Connect voltmeter and Ammeter in correct polarities as shown in the circuit diagram.
3. Do not switch **ON** the power supply unless you have checked the circuit connections as Per the circuit diagram.

RESULT:

1. The zener diode characteristics have been studied.
2. The zener resistance at the breakdown voltage was found to be =

QUIZ:

Q1 Give applications of Zener diode?

A 1: Applications of Zener diode are (a) Voltage regulation (b) Meter protection (c) Zener diode as a peak clipper (d) Zener diode as a reference element

Q2 what is voltage regulation of Zener diode?

A 2: Voltage regulation is a measure of circuit's ability to maintain a constant output voltage even when either input voltage or load current varies.

Q3 what is Zener current?

A 3: The Zener current in the breakdown region of Zener diode is called Zener current.

Q4 Give the equation from which series resistance of Zener diode regulator determined?

A 4: The equation from which series resistance of Zener diode regulator determined is $R_S = V_S - V_{OUT} / I_{ZMAX}$ Where V_S is source voltage, V_{OUT} is output voltage & I_{ZMAX} is maximum current through Zener diode.

ANALOG ELECTRONICS LAB (EE-222-F)

Q5 Give advantages of Zener diode regulator over other regulators?

A 5: Advantages of Zener diode regulator over other regulators are that they are smaller in size, lighter in weight and have longer life.

Q6. What is Zener diode?

A 6: Zener diode, also sometimes called the breakdown diode is a P-N junction diode specially designed for operation in the breakdown region in reverse bias condition.

Q7 Give several methods used to manufacture of Zener diodes?

A 7: several methods used to manufacture of Zener diodes are diffused structure, diffused and passivated structure and alloy diffused structure.

Q8 In passivated structure of a Zener diode by which layer edges of the junction are covered?

A 8: In passivated structure of a Zener diode; Silicon Dioxide layer edges of the junction are covered.

Q9 Give the voltage range availability of Zener diodes?

A 9: The voltage range availability of Zener diodes is 2.4v to 200v.

Q10. What is Zener voltage?

A 10: The voltage at which the Zener diode breaks down is called the Zener voltage.

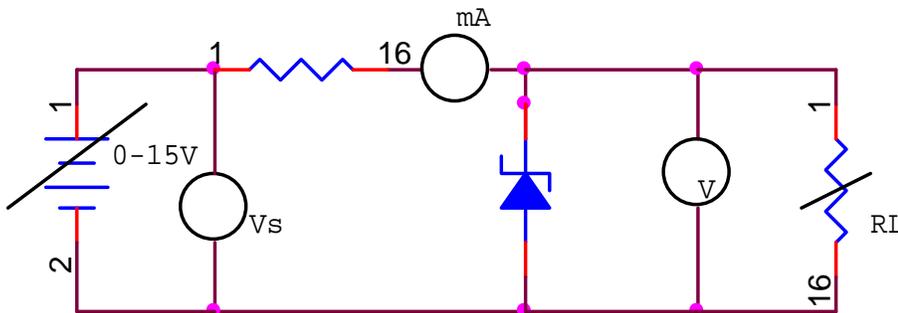
EXPERIMENT NO. 5

AIM: To study zener diode as voltage regulator.

APPARATUS REQUIRED: Power Supply, Zener Diode, Two Voltmeter and connected leads Ammeter.

BRIEF THEORY:- The Zener diode is operated in the breakdown or zener region, the voltage across it is substantially constant for a large current of current through it. This characteristic permits it to be used as a voltage regulator. As the lode Current increases, the Zener current decrease so that current through resistance R_s is constant. As out put voltage = $V_{in} - I_r s$, and I is constant, Therefore, output Voltage remains unchanged. The input voltage V_{in} increase, more current will flow through the zener, the voltage drop across R_s will increase but lode voltage would remain constant.

CIRCUIT DIAGRAM:



PROCEDURE:

- (a) Connect the circuit as per the circuit diagram
- (b) Keep load resistance constant (take maximum value of load resistance)
- (c) Vary input voltage and note down output voltage
- (d) Now keep input voltage constant and vary load resistance and note down corresponding voltmeter reading
- (e) Plot the respective graph

OBSERVATION TABLE:

S. No	Vs (VOLT)	V (VOLT)	RL(E)	V (VOLT)
1				
2				
3				
4				
5				
6				
7				
8				
9				

ANALOG ELECTRONICS LAB (EE-222-F)

PRECAUTIONS:

- (a) Connections should be tight
- (b) Handle the equipments with care

RESULT: Studied how Zener diode is used as a voltage regulator.

QUIZ:

QNo	QUESTION	ANSWERS
1	Give applications of Zener diode?	Applications of Zener diode are (a) Voltage regulation (b) Meter protection (c) Zener diode as a peak clipper (d) Zener diode as a reference element
2	What is voltage regulation of Zener diode?	Voltage regulation is a measure of circuit's ability to maintain a constant output voltage even when either input voltage or load current varies.
3	What is Zener current?	The Zener current in the breakdown region of Zener diode is called Zener current.
4	Give the equation from which series resistance of Zener diode regulator determined?	The equation from which series resistance of Zener diode regulator determined is $R_S = \frac{V_S - V_{OUT}}{I_{ZMAX}}$ Where V_S is source voltage, V_{OUT} is output voltage & I_{ZMAX} is maximum current through Zener diode.
5	Give advantages of Zener diode regulator over other regulators?	Advantages of Zener diode regulator over other regulators are that they are smaller in size, lighter in weight and have longer life.
6	What is Zener diode?	Zener diode, also sometimes called the breakdown diode is a P-N junction diode specially designed for operation in the breakdown region in reverse bias condition.
7	Give several methods used to manufacture of Zener diodes?	several methods used to manufacture of Zener diodes are diffused structure, diffused and passivated structure and alloy diffused structure.
8	In passivated structure of a Zener diode by which layer edges of the junction are covered?	In passivated structure of a Zener diode; Silicon Dioxide layer edges of the junction are covered.
9	Give the voltage range availability of Zener diodes?	The voltage range availability of Zener diodes is 2.4v to 200v.
10	What is Zener voltage?	The voltage at which the Zener diode breaks down is called the Zener voltage.

EXPERIMENT NO: 6(a)

AIM: To Study the characteristics of transistor in Common Base configuration.

APPARATUS REQUIRED : Power supply, Transistor characteristics Kit, Connecting Leads, Voltmeter, Ammeter.

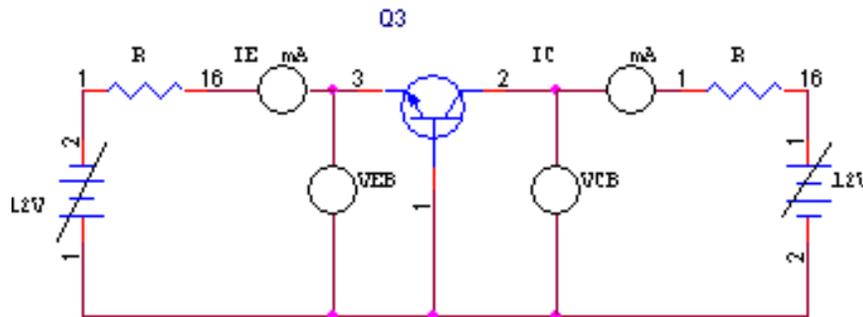
BRIEF THEORY: Transistor is a semiconductor device consist of two p-n junctions. It has three terminals, to handle I/P and O/P four terminals are needed. Therefore, one terminal is made common. A transistor can be connected in three Ways CB, CE, and CC.

Common base: Base is made common. I/P is connected between base & emitter and O/P is taken between base & collector.

Input charact. The curve plotted between emitter current I & the emitter-base voltage constant collector-base voltage V .

Output charact. The curve plotted between collector current I & collector-base voltage V constant emitter current I .

CIRCUIT DIAGRAM :



PROCEDURE:

Input charact.

- Make the connection as per circuit diagram .
- Switch 'ON' the supply & set $V = 0V$
- Vary V in step & note down the emitter current I at each step .
- Set $V = 1V$ & again repeat the same procedure .
- Draw the graph.

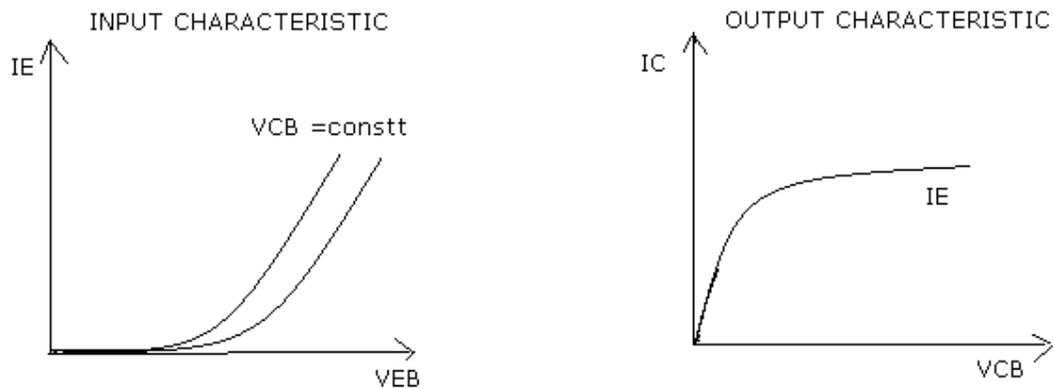
Output charact.

- Make the connection as per circuit diagram.
- Set the value of $I = 1mA$
- Vary V in step & note down the collector current I at each step.
- Set $I = 2mA$ & repeat the same procedure.
- Draw the graph.

OBSERVATION TABLE:

S.No	Input charact.(Vcb=Cons.)		Output charact. (Ie = Const.)	
	Ie(mA)	Veb(Volts)	Ic(mA)	Vcb(Volts)
1.				
2.				
3.				

GRAPH:



RESULT: The input and output characteristics of transformer in CB configuration has been plotted.

DISCUSSION: With the help of output characteristics we can calculate ac & dc current gain in CB configuration.

PRECAUTIONS :

- (1) Always connect the voltmeter in parallel & ammeter in series as shown in fig.
- (2) Connection should be proper & tight.
- (3) Switch 'ON' the supply after completing the ckt.
- (4) DC supply should be increased slowly in steps
- (5) Reading of voltmeter & Ammeter should be accurate.

QUIZ:

Q1: What do you mean by biasing of transistor?

A. When dc voltages are applied across the different terminals of transistor, it is called biasing.

Q2: What is d.c. current gain in common base configuration?

A. It is ratio of collector current(Ic) to emitter current (Ie).

Q3: What is typical value for d.c. current gain ?

A. 0.99

Q4: What is a.c. current gain in CB confifuration?

A. It is ratio of change in collector current to change in emitter current.

Q5: What are input characteristics?

A. These curves relate i/p current & i/p voltage for a given value of o/p voltage.

ANALOG ELECTRONICS LAB (EE-222-F)

Q6: What are output characteristics?

A. These curves relate o/p voltage & o/p current for a given value of input current.

Q7: Which configuration has highest voltage gain?

A. Common Emitter.

Q8: Which configuration is most widely used?

A. Common Emitter.

Q9: What is operating point?

A. The zero signal values of I_c & V_{ce} .

Q10: Which region is heavily doped in Transistor?

A. Emitter

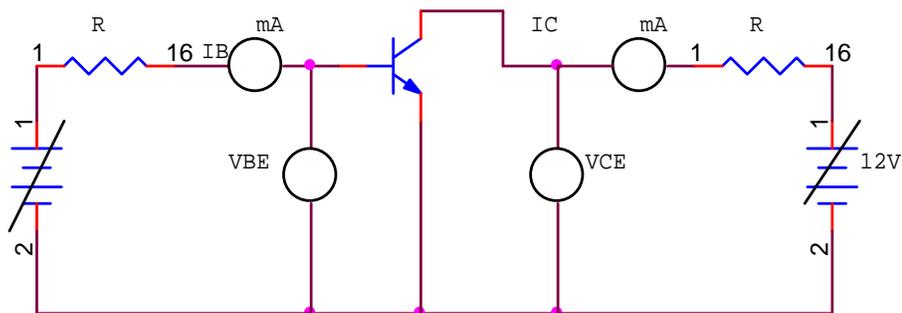
EXPERIMENT NO. 6(b)

AIM: - To plot and study the input and output characteristics of BJT in common-emitter configuration.

APPARATUS REQUIRED: - Transistor Characteristic kit, Multimeter, Connecting leads and Power Supply .

THEORY: - In common Emitter configuration input is applied between base and emitter while the output is taken across emitter and collector. Thus the emitter forms the terminal common to both input and output circuits. The load resistance is connected at collector.

CIRCUIT DIAGRAM:-



PROCEDURE:

(a) Connect the circuit as per the circuit diagram.

Input characteristics

- a) Keep emitter - collector voltage constant.
- b) Vary emitter-base voltage in steps and note down base current reading.
- c) Readings are tabulated and graph is drawn.

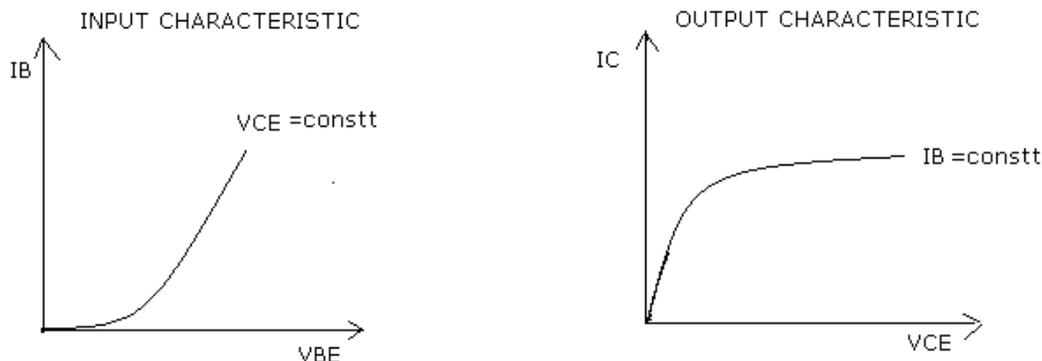
Output characteristics

- a) Keep base current constant.
- b) Vary collector-emitter voltage in steps and note down emitter current.
- c) Readings are tabulated and graph is drawn.

OBSERVATION TABLE:

S.No	Input charact.(Vce=Cons.)		Output charact. (Ib = Const.)	
	Vbe(Volts)	Ib(mA)	Vce(Volts)	Ic(mA)
1.				
2.				
3.				

GRAPH:-



RESULT: The input and output characteristic of transistor in common emitter configuration has been plotted.

DISCUSSION: With the help of output characteristics we can calculate AC & DC current gain in common emitter configuration.

PRECAUTIONS:

- a) Connections should be tight
- b) Handle the equipments with care

QUIZ:

Q1: What do you mean by biasing of transistor?

A. When dc voltages are applied across the different terminals of transistor, it is called biasing.

Q2: What is d.c. current gain in common base configuration?

A. It is ratio of collector current (I_c) to emitter current (I_e).

Q3: What is typical value for d.c. current gain?

A. 0.99

Q4: What is a.c. current gain in CB configuration?

A. It is ratio of change in collector current to change in emitter current.

Q5: What are input characteristics?

A. These curves relate i/p current & i/p voltage for a given value of o/p voltage.

Q6: What are output characteristics?

A. The curves relate o/p voltage & o/p current for a given value of input current.

Q7: Which configuration has highest voltage gain?

A. Common Emitter.

Q8: Which configuration is most widely used?

A. Common Emitter.

Q9: What is operating point?

A. The zero signal values of I_c & V_{ce} .

Q10: Which region is heavily doped in Transistor?

A. Emitter.

EXPERIMENT NO. 6(c)

OBJECTIVE: - Graphical determination of small signal hybrid parameter of bipolar junction transistor.

APPARATUS REQUIRED: - Transistor kit, two voltmeter, two ammeters and connecting leads.

THEORY: - In transistor representation, a mixed type of parameters called the hybrid parameters or h parameters equation are:

$$\begin{aligned}V_1 &= h_{11} I_1 + h_{12} V_2 \\ I_2 &= h_{21} I_1 + h_{22} V_2\end{aligned}$$

Where $h_{11} = V_1/I_1$ $V_2 = 0$; Called input impedance with o/p short circuited.
Its unit is ohm.

$h_{21} = I_2/I_1$ $V_2 = 0$; Called forward transfer current gain with o/p short circuited.

It is dimensionless quantity.

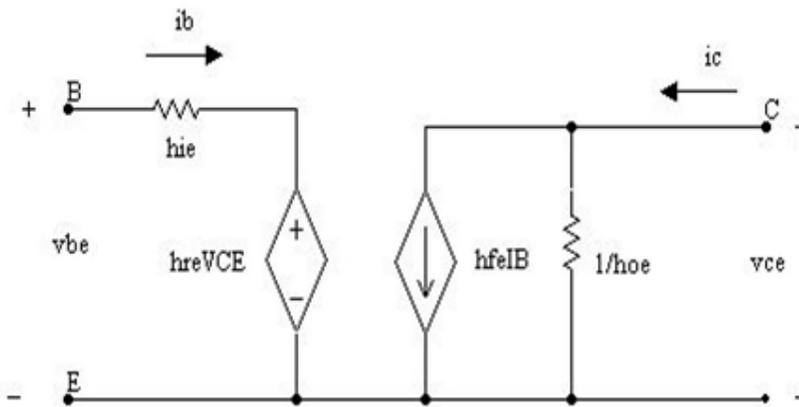
Where $h_{12} = V_1/V_2$ $I_1 = 0$; Called reverse transfer voltage ratio.

$h_{22} = I_2/V_2$ $I_1 = 0$ Called o/p Admittance.

PROCEDURE:

- (1) Connect the circuit as shown in fig. and switch the experiment kit.
- (2) First open the output terminal and supply 5V to input terminal. Measure o/p voltage and i/p current
- (3) Secondly, short the o/p terminal and supply 5V to input terminal. Measure I/P and O/P current using multimeter.
- (4) Calculate h_{11} , h_{12} , h_{21} , h_{22} .

ANALOG ELECTRONICS LAB (EE-222-F)



OBSERVATION TABLE:

S.NO	When o/p is open circuited			When o/p is short circuited		
	V_2	V_1	I_1	V_1	I_2	I_1
1						
2						

RESULT: H- parameters of two port network has been calculated and verified.

PRECAUTIONS:-

- (1) Make the connections according to the circuit diagram. Power supply should be switched off.
- (2) Connections should be tight.
- (3) Note the readings carefully.

QUIZ:

Q1. What are h parameters of a transistor?

A. The h parameter or the hybrid parameters of a transistor helps us to analyze the amplifying action of transistor for small signal .it is necessary for practical purposes. In generally there are four type of h parameter. These are : h_{11} h_{12} h_{21} h_{22}

Q2. What are benefits of H-parameter?

A. Following are the advantages of h-parameters:-

- I. h-parameters are Real Numbers up to radio frequency
- II. They are easy to measure
- III. They can be determined from transistor static characteristic curves
- IV. They are convenient to use in circuit analysis and design
- V. Easily convertible from one configuration to other
- VI. Readily supplied by manufacturers

Q3. H parameter operates in which frequency?

up to radio frequencies i.e 20-20khz

ANALOG ELECTRONICS LAB (EE-222-F)

Q4. Which of the h-parameters corresponds to r_e in a common-base configuration?

A. h_{ib}

Q5. Which of the following is referred to as the reverse transfer voltage ratio?

A. h_r

Q6. What is admittance?

A. In electrical engineering, the **admittance** (Y) is a measure of how easily a circuit or device will allow a current to flow. It is defined as the inverse of the impedance (Z).

The SI unit of admittance is the siemens (symbol S).

Q7. What is conductance?

The **electrical resistance** of an electrical element is the opposition to the passage of an electric current through that element; the inverse quantity is **electrical conductance**, the ease at which an electric current passes. Electrical resistance shares some conceptual parallels with the mechanical notion of friction. The SI unit of electrical resistance is the ohm (Ω), while electrical conductance is measured in siemens (S).

Q8. The lowest output impedance is obtained in case of BJT amplifiers for

Ans CC Configuration

Q9. Which of the following parameters is used for distinguishing between a small signal and a large-signal amplifier?

(A) Voltage gain

(B) Frequency response

(C) Harmonic Distortion

(D) **Input/output impedances**

Q10. Removing bypass capacitor across the emitter-leg resistor in a CE amplifier causes

(A) increase in current gain. (B) decrease in current gain.

(C) increase in voltage gain. (D) **decrease in voltage gain.**

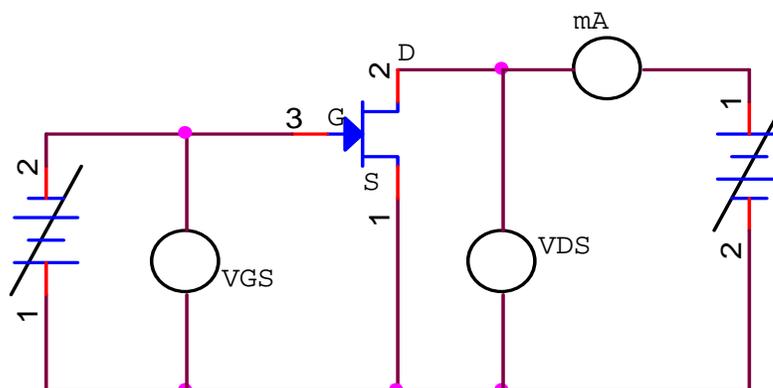
EXPERIMENT NO. 7

AIM: To study and draw the characteristics of FET in common source configuration.

APPARATUS REQUIRED: Power supply, FET characteristic Kit, connecting leads, two Multimeters.

BRIEF THEORY: A FET is a three terminal semiconductor device in which current conduction is by one type of carries & is controlled by the effect of electric field. There are two types of FET namely JFET & MOSFET. Again, a JFET can either have N-channel or P-channel. A N-channel JFET has a N-type semiconductor bar, the two ends of which make the Drain & source terminal. On the two sides of this bar, P-N junction is made. This P region makes gate. Usually, these two gates are connected Together to form a single gate .The gate is given a -ve bias w.r.t source. The Drain is given +ve potential w.r.t source.

CIRCUIT DIAGRAM:



PROCEDURE:

(a) Connect the circuit as per the circuit diagram

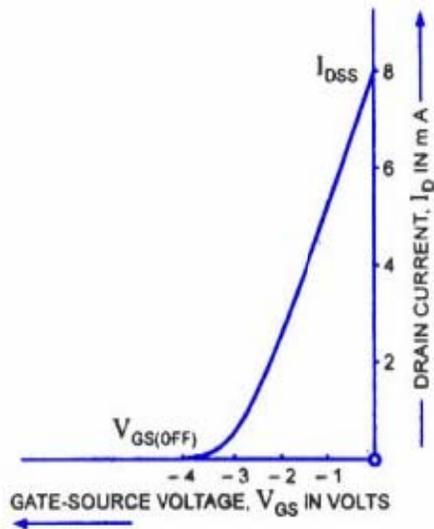
Input characteristics

- Keep drain-source voltage constant
- Vary gate-source voltage in steps and note down drain current
- Readings are tabulated and graph is drawn

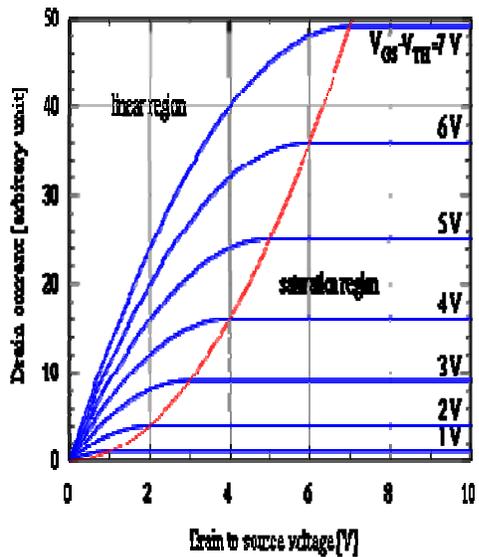
Output characteristics

- Keep gate-source voltage constant
- Vary drain-source voltage in steps and note down drain current.
- Readings are tabulated and graph is drawn

ANALOG ELECTRONICS LAB (EE-222-F)



INPUT CHARACTERISTIC



OUTPUT CHARACTERISTIC

OBSERVATION TABLE:

S. No	I/P at const. VDS		O/P at const. VGS	
	VGS (V)	ID (mA)	VDS (V)	ID (mA)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

PRECAUTIONS:

- (a) Connections should be tight
- (b) Handle the equipments with care

RESULT: Input and output characteristics is obtained.

QUIZ:

Q.No	QUESTION	ANSWERS
1	Define FET?	The field effect transistor is a semi-conductor device which depends for its operation on the control of current by an electric field.
2	How many types of FET's are there?	Two types (a) Junction field effect transistor (JFET). (b) Metal Oxide Semiconductor FET(MOSFET)

ANALOG ELECTRONICS LAB (EE-222-F)

3	Write advantages of FET over conventional Transistor?	Advantages are (a) Thermal stability. (b) Immunity to radiation (c) High input impedance.
4	Write one disadvantage of FET?	Main disadvantage is relatively small 'Gain- Band Width 'product.
5	Define Drain resistance?	Drain resistance can be defined as ratio of drain to source voltage to drain current.
6	Define Tran conductance?	Tran conductance can be defined as ratio of drain current to gate to source voltage.
7	Define transfer characteristic of FET?	The curve drawn between drain current and gate-source voltage for a given value of drain-source voltage.
8	Write applications of a FET?	Applications of FET are (A) Low noise amplifier (B) Buffer amplifier (C) Cascade amplifier (D) Analog switch (E) Chopper
9	How is Drain current controlled in JFET?	In JFET drain current is controlled by controlling the reverse bias given to its base.
10	Define pinch-off voltage?	The value of drain-source voltage at which channel is pinched off (i.e. all the free charges from the channel are removed) is called pinch-off voltage.

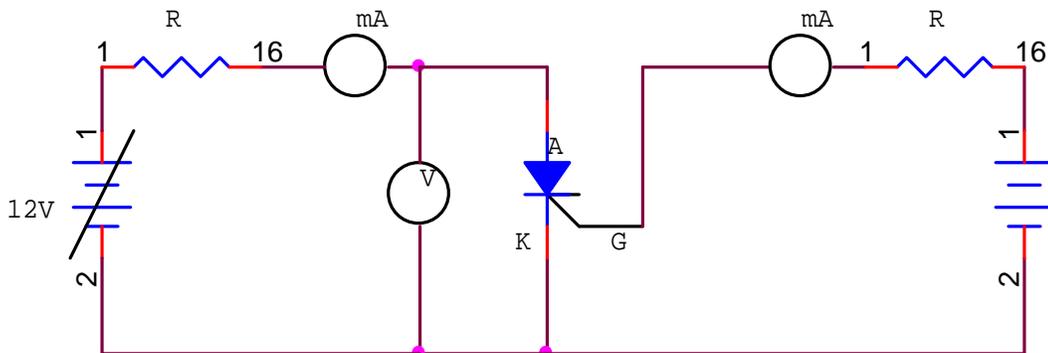
EXPERIMENT NO. 8

AIM: Study characteristics of SCR.

APPARATUS REQUIRED: Power Supply, SCR Kit. , Voltmeter, Ammeter, Connecting Leads.

BRIEF THEORY: Silicon control rectifier (SCR) is a four layer, three terminal semiconductor device, the end 'P' forms the anode & the end 'N' forms the cathode & the gate terminal 'G' is from the 'P' layer next to cathode. It is a unidirectional device. The device can exist upon either ON state or OFF state depending upon the applied voltage . When anode voltage is +ve w.r.t to cathode the SCR start Conducting. If some small gate voltage is applied, the SCR trigger at some low value of anode voltage, but it loses its all control on the SCR Current after triggering. Therefore, in order to turn the SCR to OFF position the anode voltage has to be reduced to zero.

CIRCUIT DIGRAM:



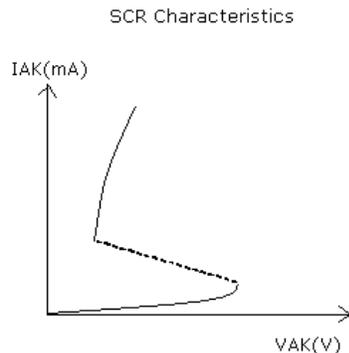
PROCEDURE:

1. Connect the circuit according to the fig.
2. First set $I = 0\text{mA}$, vary input voltage V gradually & measure the current I .
3. Tabulate the readings.
4. Repeat the procedure for different values of I .
5. Draw the graph between V & I .

OBSERVATION TABLE:

S.No	V_{ak} (Volts)	I_{ak} (mA)

GRAPH:



PRECAUTIONS:

1. Always connect the voltmeter in parallel & ammeter in series as shown in fig.
2. Connection should be proper & tight.
3. Switch 'ON' the supply after completing the circuit
4. DC supply should be increased slowly in steps
5. Reading of voltmeter & Ammeter should be accurate.

RESULT: The characteristics of thyristor have been plotted.

DISCUSSION: The SCR will not conduct until it is not triggered by gate voltage.

QUIZ :

- Q.1 Define SCR?
A. It is a controlled rectifier constructed of a silicon material with third terminal for control purpose.
- Q.2 Define Forward Break over Voltage?
A. It is voltage in forward conducting mode after which SCR starts conducting.
- Q.3 Define reverse Break down Voltage?
A. If reverse voltage is increased beyond certain value, SCR will break & this voltage is Called reverse breakdown voltage.
- Q.4 Why it is called controlled rectifier?
A. Because its operation as rectifier can be controlled by using gate terminal.
- Q.5 Define peak forward Voltage?
A. It is limiting positive anode voltage above which SCR get damaged.
- Q.6 Define peak reverse Voltage?
A. Max. reverse voltage that can be applied to SCR without conduction in reverse direction.
- Q.7 Define Holding Current?
A. Min. forward current that must be maintained to keep SCR in conducting state.
- Q.8 Define forward current Rating?
A. The max. Value of anode current that SCR con handle safely.
- Q.9 Define latching current.
A. Min. device current which must be attained by the device before gate drive is removed.
- Q.10 What do you mean by commutation process?
A. Process of turning off the SCR.

EXPERIMENT NO.9

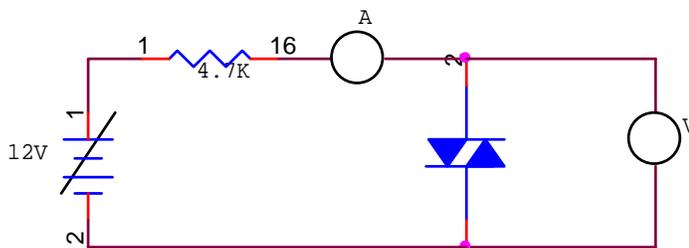
AIM: Study of characteristics of DIAC.

APPARATUS REQUIRED: Power supply, DIAC Characteristic, Connecting Leads, Ammeter, and Voltmeter.

BRIEF THEORY:

Diac: A Diac is a two terminal & four layer bi-directional semiconductor switching device. 'Di' means two (two terminal device) and 'ac' means alternating current hence diac is a switch. In fact, it is a device which can conduct in both the directions. Only when the applied voltage is more than its break over voltage. It is similar as if two latches are connected in parallel. During +ve half-Cycle, the right four layer diode conducts heavily. During -ve half-cycle, the left diode conducts heavily only when the supply voltage exceeds the break over voltage of the Diac.

CIRCUIT DIGRAM:



Circuit for DIAC

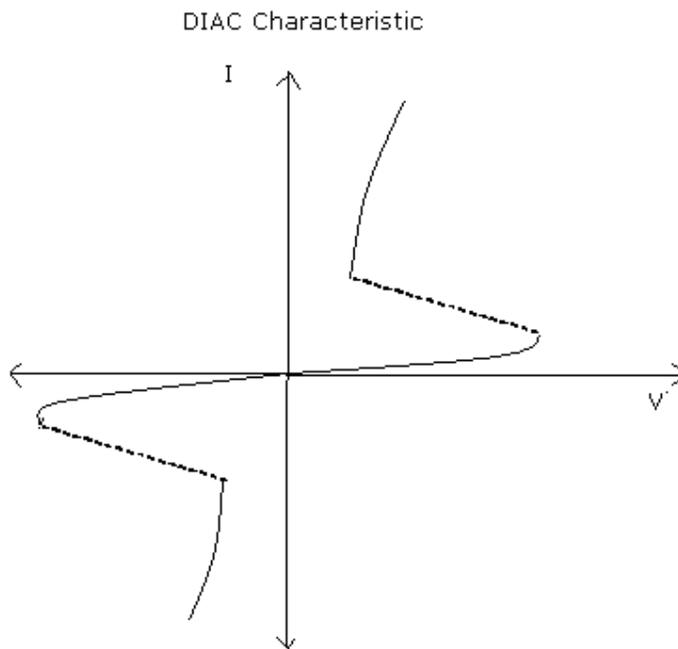
PROCEDURE:

- Make connection as per circuit diagram.
- Apply +ve supply to the circuit.
- Increase the voltage step by step & note down the corresponding current values.
- After a certain voltage, the diac enter in -ve resistance region.
- Now apply reverse polarity & repeat the whole procedure again.

OBSERVATION TABLE:

S.No.	DIAC Characteristics	
	I (mA)	V (Volts)
1.		
2.		
3.		
4.		

GRAPH:
DIAC Characteristic



RESULT: The characteristics of DIAC have been plotted.

PRECAUTION:

1. Always connect the voltmeter in parallel & ammeter in series as shown in fig.
2. Connection should be proper & tight.
3. Switch 'ON' the supply after completing the circuit
4. DC supply should be increased slowly in steps
5. Reading of voltmeter & Ammeter should be accurate.

QUIZ:

- Q.1 Define DIAC?
A. It is a two electrode bidirectional avalanche diode.
- Q.2 Define VBO?
A. The voltage before which DIAC acts as a open switch.
- Q.3 Write application of Diac?
A. Heat control circuit..
- Q.4 Define inter base Resistance?
A. The total resistance of silicon bar from one end to other end.
- Q.5 Define valley Point?
A. Point beyond which if emitter current increases, device enters into saturation region.
- Q.6 Define peak Point Emitter Current?
A.6 Min. current that is required to trigger the device.

ANALOG ELECTRONICS LAB (EE-222-F)

Q7. What is a basic difference between thyristor, triac and a diac?

Ans. Thyristor is semiconductor device convert the stable dc to variable dc which has a three terminals anode, cathode, and gate. The diac is similar to thyristor which is bidirectional without gate terminal work on both ac & dc. The triac is known as diac with gate.

Q8. What are the applications of thyristor?

Ans. It used at mine hauler, press machine, HVDC power supply. In future bracking in automobile, regenerative braking.

Q9.  Identify the symbol:

Ans. SCS (Silicon controlled switch)

Q10. The silicon-controlled switch (SCS) is similar in construction to the

Ans. SCR

EXPERIMENT NO.10

AIM: To plot V-I characteristic of TRIAC.

APPARATUS REQUIRED: Power supply, TRIAC characteristics kit, Connecting leads, Ammeter & Voltmeter.

THEORY: The TRIAC is a three terminal AC switch that is triggered into conduction when a low energy signal is applied to its gate terminal. The TRIAC conducts in either direction when turned on either a positive or negative gate signal triggers it into conduction. Thus, the TRIAC is a three terminals, four layer bidirectional semiconductor device that controls ac power. Because of its bidirectional conduction property, the TRIAC is widely used in the field of power electronics for control purpose.

CIRCUIT DIAGRAM:

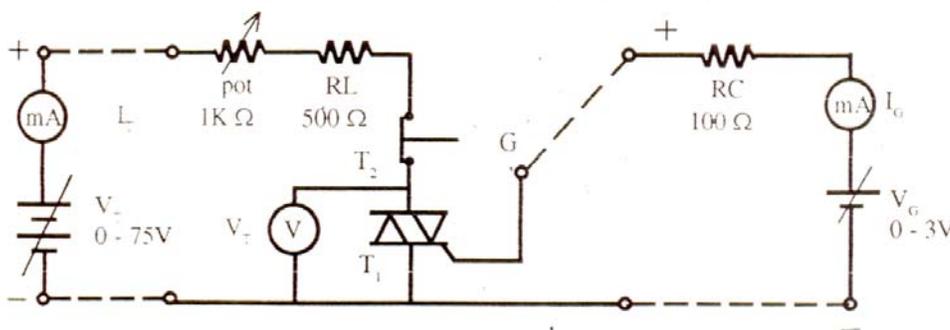


Fig 1.

Circuit diagram for quadrant I. Dashed line connections for I.

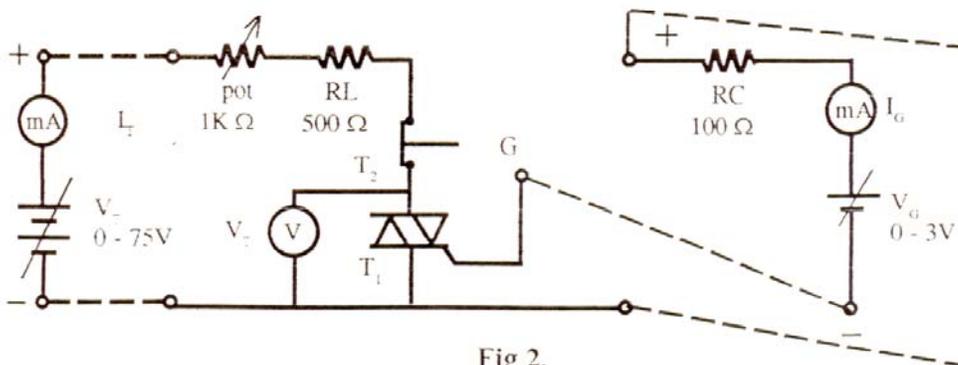


Fig 2.

Circuit diagram for quadrant I. Dashed line connections for I.

PROCEDURE:

- (a) Make connection as per the circuit diagram.
- (b) Apply +ve supply to the circuit.

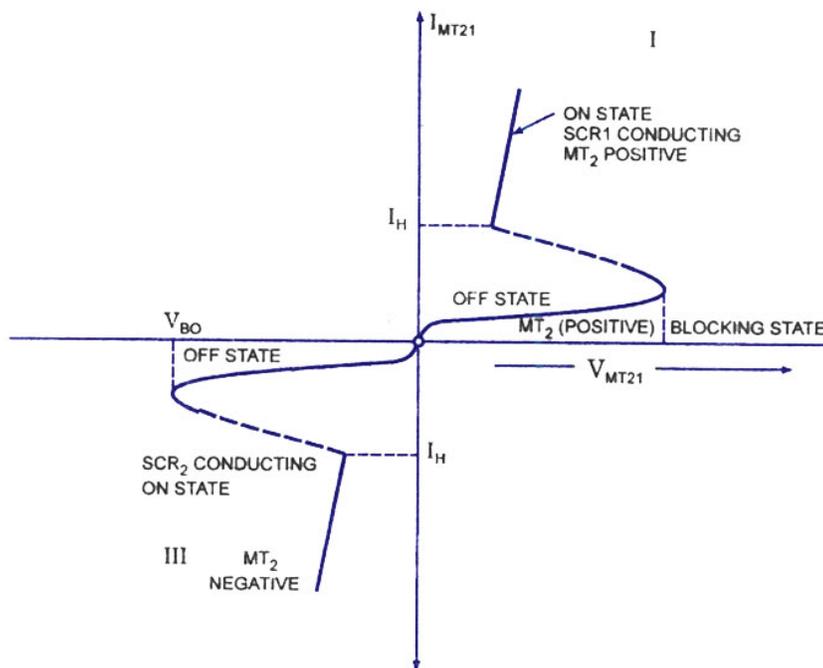
ANALOG ELECTRONICS LAB (EE-222-F)

- (c) Increase the voltage step by step & note down the corresponding current values.
- (d) After a certain voltage, the TRIAC enters into the negative resistance region.
- (e) Now apply reverse polarity & repeat the whole procedure again.

OBSERVATION TABLE:

S.NO	Volts	Current

GRAPH:



V-I Characteristic of a Triac

RESULT: The characteristic of TRIAC have been plotted.

PRECAUTIONS:

- (a) Always connect the voltmeter in parallel & ammeter in series.
- (b) Connection should be proper & tight.
- (c) Switch 'on' the supply after completing the circuit.
- (d) DC supply should be increased slowly in steps.
- (e) Reading of voltmeter & ammeter should be accurate.

ANALOG ELECTRONICS LAB (EE-222-F)

QUIZ/ANSWER:

Q-1 Conduction take place in triac is bidirectional or unidirectional?

Ans: Bidirectional.

Q-2 Expanded form of the word abbreviated TRIAC ?

Ans Triode and AC.

Q-3 Name three terminal of TRIAc?

Ans Main Terminal 1(MT1) ,Main Terminal 2 (MT2) and Gate 'G'.

Q-4 What are the ratings of TRIAC available in market?

Ans Voltage 1200 and Current 300A(rms).

Q-5 Give application of TRIAC?

Ans TRIACS are extensively used in :-

A. Residential lamp –dimmers.

B. Heat control

C. Speed control of small single phase series and induction motor.

Q-6 Is TRIAc have a capability to work in rectifier mode?

Ans: Yes

Q-7 By what manner TRIAC is different from SCR?

Ans 1. bidirectional conduction.

2. TRIAC is a combination of two SCRs connected in anti parallel.

Q-8 How many layers are there in TRIAc?

Ans 5 layers.

Q-9 What is the symbol of TRIAC?



Ans

Q-10 how TRIAC is differ from DIAC?

Ans TRIAC have gate terminal and DIAC didn't.

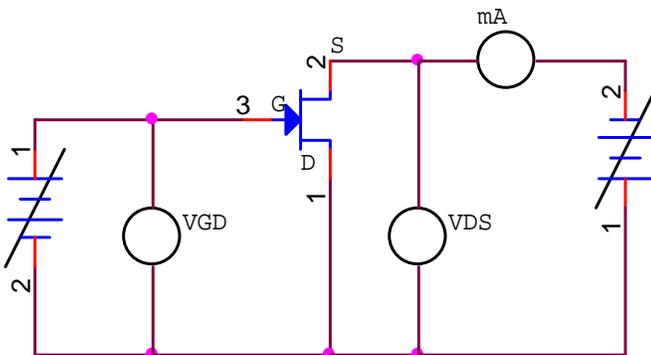
EXPERIMENT NO.11

AIM: To study and draw the characteristics of FET in common drain configuration.

APPARATUS REQUIRED: Power supply, FET charact. Kit, connecting leads, two Multimeters.

BRIEF THEORY: A FET is a three terminal semiconductor device in which current conduction is by one type of carries & is controlled by the effect of electric field. There are two types of FET namely JFET & MOSFET. Again, a JFET can either have N-channel or P-channel. A N-channel JFET has a N-type semiconductor bar, the two ends of which make the Drain & source terminal. On the two sides of this bar, P-N junction is made. This P region makes gate. Usually, these two gates are connected Together to form a single gate .The gate is given a -ve bias w.r.t source. The Drain is given +ve potential w.r.t source. Drain is Common in input and output.

CIRCUIT DIAGRAM:



PROCEDURE:

(a) Connect the circuit as per the circuit diagram

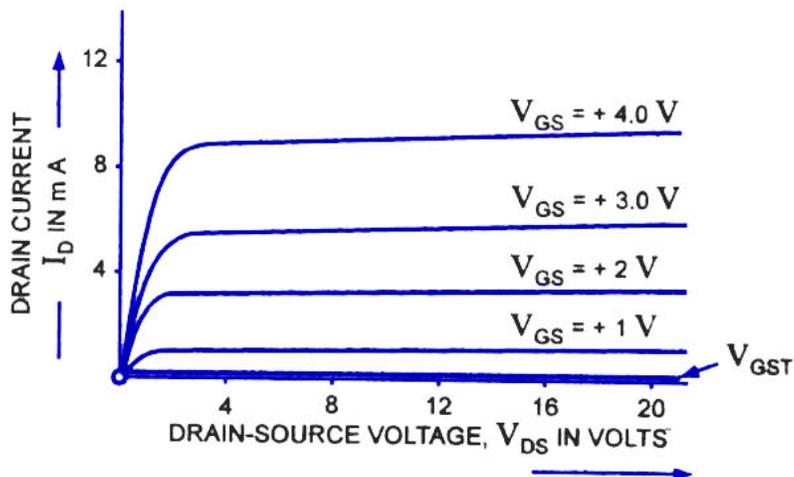
Input characteristics

- (b) Keep drain-source voltage constant
- (c) Vary gate-drain voltage in steps and note down drain current
- (d) Readings are tabulated and graph is drawn

Output characteristics

- (a) Keep gate-drain voltage constant
- (b) Vary drain-source voltage in steps and note down drain current.
- (c) Readings are tabulated and graph is drawn

GRAPH:



OBSERVATION TABLE:

S. No	I/P at const. VDS		O/P at const. VGD	
	VGD (V)	ID (mA)	VDS (V)	ID (mA)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

PRECAUTIONS:

- (a) Connections should be tight
- (b) Handle the equipments with care

RESULT: Input and output characteristics is obtained.

QUIZ:

Q. No	QUESTION	ANSWERS
1	Which is the common log in common drain FET amplifier Between input and output.	Drain leg is common between input and output.
2	Define Pinch off voltage.	The value of drain-source voltage at which

ANALOG ELECTRONICS LAB (EE-222-F)

		channel is pinched off (i.e. all the free charges from the channel are removed) is called pinch-off voltage
3	Write advantages of FET over conventional Transistor.	Advantages are (a) Thermal stability. (b) Immunity to radiation. (c) High input impedance.
4	How much is the gain of common drain FET amplifier?	Gain of common drain amplifier is less than unity.
5	Define Drain resistance.	Drain resistance can be defined as ratio of drain to source voltage to drain current.
6	Define Transconductance.	Transconductance can be defined as ratio of drain current to gate to source voltage
7.	A common-gate amplifier is similar in configuration to which BJT amplifier?	Common base
8.	A common-drain amplifier is similar in configuration to which BJT amplifier?	Common Collector
9.	What is (are) the function(s) of the coupling capacitors C_1 and C_2 in an FET circuit?	<ul style="list-style-type: none"> • to create an open circuit for dc analysis • to isolate the dc biasing arrangement from the applied signal and load • to create a short-circuit equivalent for ac analysis
10.	What is the input resistance ($R_{in(source)}$) of a common-gate amplifier?	$1 / g_m$

EXPERIMENT NO. 12

AIM: To Study the Series and Shunt Voltage Regulator.

THEORY: The regulated power supply is a combination of three circuits, the bridge rectifier, the capacitor filter and zener diode voltage Regulator. Basically there are two types of voltage regulators

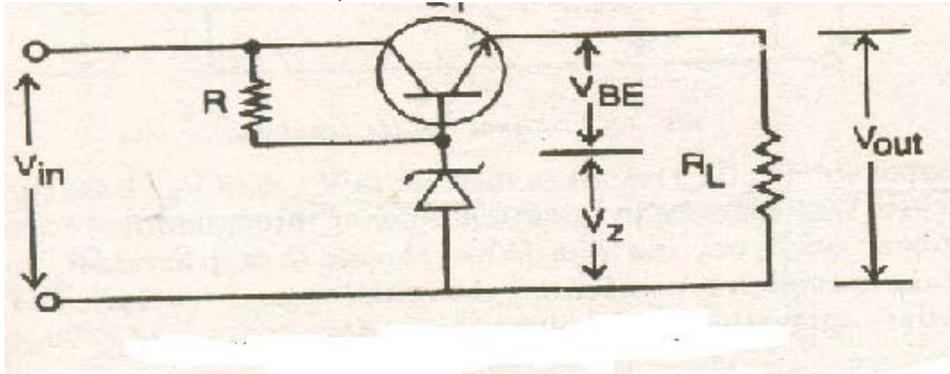
(i) Series Voltage Regulator

(ii) Shunt Voltage Regulator

The series Regulator is placed in series with load and Shunt Regulator is placed in parallel with Load.

TRANSISTOR SERIES VOLTAGE REGULATOR

A voltage Regulator generally employs some active devices such as zener, or a transistor or both to achieve its objective. A series voltage regular using a transistor and zener diode is as shown,



The circuit is called a series voltage regulator because the load current passes through the series transistor Q1. The main drawback of series regulator is that the pass transistor can be destroyed by excessive load current.

TRANSISTOR SHUNT VOLTAGE REGULATOR

An increase in input voltage results in increase in output voltage and base –Emitter voltage.

QUIZ:

Q1. What is the efficiency of CVT?

Ans. Less than 60%

Q2. The efficiency of voltage stabilizer is between

Ans. 70 % to 80%

Q3. What is the output voltage of 7824 IC voltage regulator.

Ans. 12V

Q4. What is the limitation of zener diode voltage regulator

Ans. It has low efficiency for heavy load.

ANALOG ELECTRONICS LAB (EE-222-F)

Q5 What are the two types of voltage regulator.

Ans. (i) Series Voltage Regulator

(ii) Shunt Voltage Regulator

Q6. Voltage regulators keep a constant _____ output voltage when the input or load varies within limits.

Ans. DC

Q7. What is the range of the voltage level of the LM317 adjusted voltage regulator?

Ans. 1.2 V to 37 V

Q8. The 7912 regulator IC provides _____

Ans. -12 V

Q9. What is the typical dropout voltage for the 7812 fixed positive voltage regulator?

Ans. 2V

Q10. What is the ratio of the period of the output voltage to the period of the input voltage in a full-wave rectifier?

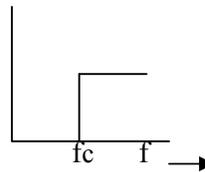
Ans. 0.5

EXPERIMENT NO.13

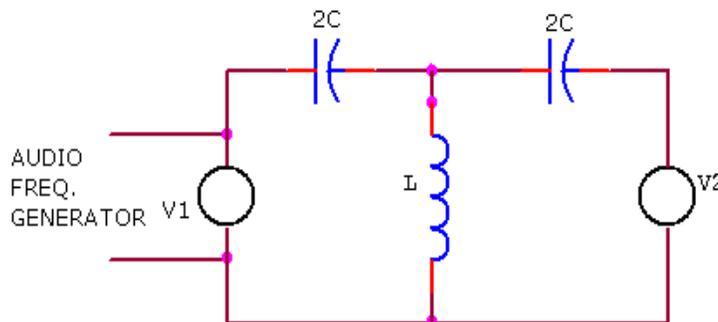
AIM: Study of frequency response of active filters HP, LP & BP.

APPARATUS REQUIRED: Power Supply, Filter circuit. Kit, Resistances, Audio Frequency Generator, two voltmeters.

HIGH PASS FILTER: A HP filter attenuates all frequencies below a designated cut-off frequency f_c , & passes all freq. above f_c . Thus the pass band of this filter is the freq. range above f_c & the stop band is the freq. range below f_c . An attenuation characteristic of a HP filter is shown in fig.



CIRCUIT DIAGRAM:



PROCEDURE:

- a) Connect the circuit. according to the circuit diagram.
- b) Connect the audio signal generator with $600\ \Omega$ source impedance to the I/P of the filter terminate that the O/P with a $600\ \Omega$ resistive load.
- c) Connect two voltmeter at I/P & O/P terminal.
- d) Set the I/P voltage to app. 1V_{rms} at 1 KHz.
- e) Vary the I/P freq. from 0 to 10KHz in small steps. Measure I/P& O/P voltage at each Step.
- f) Take more reading where the attenuation roll off is predominant.
- g) Draw the graph.

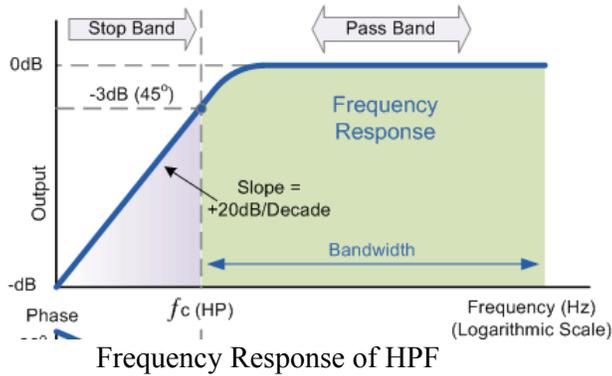
OBSERVATION TABLE:

S.N.O	Frequency (KHz)	I/P Voltage V_1 (Volts)	O/P Voltage V_2 (Volts)	$\alpha = 20 \log V_2/V_1$

CALCULATION:

$$\alpha = 20 \log V_2/V_1$$

GRAPH:



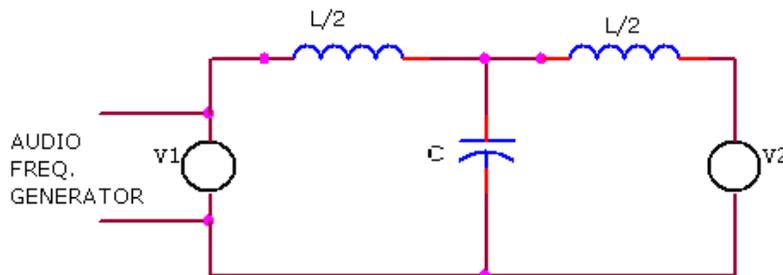
LOW PASS FILTER: A Low pass filter is one which passes without attenuation all frequencies up to the cut-off frequency f_c & simultaneously attenuates all other frequencies greater than f_c . The attenuation characteristic of an ideal L P filter is shown in fig.

$$f_c \quad f$$

This filter transmits all frequencies from zero to cut-off frequency. The band is called pass band. The frequency range over which transmission does not take place is called the stop band.

$$f_c = 1/ \pi(LC)^{1/2}$$

CIRCUIT DIAGRAM:



PROCEDURE: Same as above.

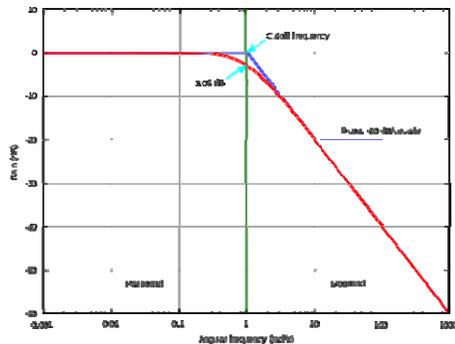
ANALOG ELECTRONICS LAB (EE-222-F)

OBSERVATION TABLE: Same as above

CALCULATION:

$$\alpha = 20 \log V_2/V_1$$

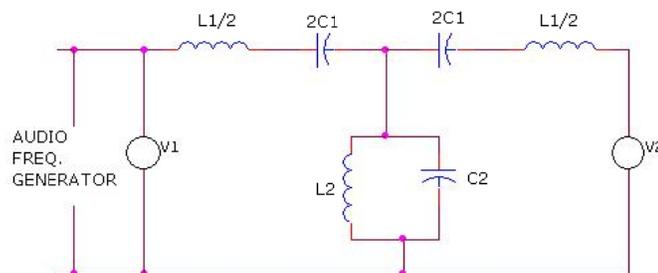
GRAPH:



Frequency Response of LPF

BAND PASS FILTER: A band pass filter passes freq. Between two designated cut-off freq.& attenuates all other freq. . BPF has two cut-off freq. As shown in fig. f_1 is called lower cut-off freq.& f_2 is upper cut-off freq.

CIRCUIT DIAGRAM:



PROCEDURE: Same as above.

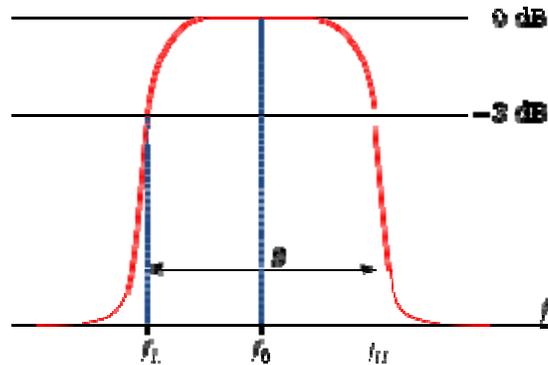
OBSERVATION TABLE: Same as above

CALCULATION:

$$\alpha = 20 \log V_2/V_1$$

GRAPH:

ANALOG ELECTRONICS LAB (EE-222-F)



RESULT/CONCLUSION: The frequency response of High pass, Low pass and Band Pass Filter has been plotted on the graph.

DISCUSSION: High Pass Filter passes the frequencies above cut-off frequencies.
 Low Pass Filter passes the frequencies below cut-off frequencies
 The Band Pass Filter is obtained by connecting Low Pass and High Pass Filter in cascade provided that the Low Pass Filter has cut-off frequency higher than High Pass Filter.

PRECAUTIONS:

- a) Make the connections according to the circuit diagram. Power supply should be switched off.
- b) Connections should be tight.
- c) Note the readings carefully.
- d) Take output carefully.
- e) Handle the CRO carefully.

QUIZ/ANSWERS:

Q1 .Define Filter ?	A1. A filter is an electrical network that can transmit signals within a specified frequency range
Q2. Define Pass Band?	A2. The frequency range which is passed by the filter is called pass band
Q3. Define Stop Band?	A3. The frequency range which is suppressed by the filter is called stop band.
Q4. Define Cut-Off frequency?	A4. The frequency that separates the pass band & attenuation band is known as the cut-off frequency.
Q5. Define High Pass Filter?	A5. A high pass filter attenuates all frequency below the cut-off frequency & allows to pass all other frequencies above the cut-off frequency
Q6. A high pass filter is one which a) passes all high freq. b)attenuates all low freq. c)attenuates all freq. below designated cut-off freq. &	A6. (c)

ANALOG ELECTRONICS LAB (EE-222-F)

passes all freq. above cut-off	
Q7. Where filter circuits are used ?	A7. Filter circuits are used in TV receivers, audio amplifiers etc
Q8. What are the units of attenuation?	A8 . Decibels (dB) & Nepers.
Q9. An ideal filter should have a) Zero attenuation in the pass band b) Infinite attenuation in the pass band c) Zero attenuation in the attenuation band	A9. (a)
Q10. In the m-derived high pass filter, the resonant frequency is to be chosen so that it is a) Above the cut-off frequency b) Below the cut-off frequency c) None of the above	A10. (b)
Q11. Define Low Pass Filter?	A11. The low pass filter allows all frequencies up to the specified cut-off frequency to pass through it & attenuates all the other frequencies above the cut-off frequencies.
Q12. Define cut-off frequency?	A12. It demarcates the pass band & the stop band.
Q13. What is the freq. Range of Pass Band?	A13. The frequency range of pass band is from 0 to f_c .
Q14. What is the freq. Range of Stop Band?	A14. The frequency range of stop band is from f_c to ∞ .
Q15. Relation between Decibel & Nepers?	A15. Attenuation in dB = 8.686 * attenuation in nepers
Q16. Neper ----- *dB.	A16. 0.115.
Q17. In the m-derived low pass filter, the resonant frequency is to be chosen so that it is a) Above the cut-off frequency b) Below the cut-off frequency c) None of the above	A17. (a)
Q18. Give the classification of filters depending upon the relation between Z_1 & Z_2	A18. Constant K- filters & m-derived filters.
Q19. Give the classification of filters on the basis of frequency	A19. Low pass , High pass , band pass & band elimination filters
Q20. Define decibel.	A20. It is defined as ten times the common logarithms of the ratio of input power to the output power.
Q21. Define Band Pass Filter?	A21. It is a combination of two parallel tuned circuits
Q22. Can a combination of Low Pass & High Pass Filters use as a Band Pass filter, how?	A22. Yes, By cascading LPF & HPF provided that the low pass filter has cut-off frequency higher

ANALOG ELECTRONICS LAB (EE-222-F)

Q23. A Band Pass Filter is one which Passes all high freq. b) Attenuates all low freq. c) attenuates all freq. below a designated cut-off frequency & passes all above cut-off frequency	A23. (c)
Q24. The propagation constant of a symmetrical T-section & π -section are the same (a) true (b) false	A24. True.
Q25. What is Prototype Filter?	A25. Any filter where the relationship $Z_1 Z_2 = R_0^2$ is maintained is known as constant K or prototype filter.
Q26. Define Attenuators?	A26. An attenuator is a two-port resistive network & its propagation function is real
Q27. Write the expression of resonance frequency in terms of two cut-off frequencies?	A27. $f_0 = (f_1 f_2)^{1/2}$.
Q28. Explain the making of High Pass Filter	A28. Capacitors in series arm & inductor in series arm.
Q29. Define Neper .	A29. It is defined as the natural logarithm of the ratio of input voltage (or current) to the output voltage (or current) provided that the network is terminated in its characteristic impedance Z_0 .
Q30. Is filter a resistive or reactive network	A30. Reactive network