Laboratory Journal

of

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curriculum program

Bachelor of Technology

In

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION

ENGINEERING

Dr. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY

Lonere-402 103, Tal. Mangaon, Dist. Raigad (MS)

INDIA

LIST OF EXPERIMENTS

Sr. No.	Titl e
1	To observe sine wave, square wave, triangular wave and ramp waveforms on the C.R.O. and to measure amplitude and frequency of the waveforms.
2	To obtain V - I characteristics of PN junction diode
3	To obtain V-I characteristics of Zener diode
4	To observe waveform at the output of half wave rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor
5	To observe waveform at the output of full wave rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor
6	To observe waveform at the output of bridge rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor
7	To obtain common emitter characteristics of NPN transistor
8	To understand working of transistor as a switch. To draw DC load line for given circuit
9	To measure gain of two stage RC coupled amplifier
10	To obtain common base characteristics of NPN transistor
11	To obtain characteristics of field effect transistor (FET)

EXPERIMENT NO. 1

Aim: To observe sine wave, square wave, triangular wave and ramp waveforms on the C.R.O. and to measure amplitude and frequency of the waveforms.

Introduction:

C.R.O.(Cathode Ray Oscilloscope) is the instrument which is used to observe signal waveforms. Signals are displayed in time domain i.e. variation in amplitude of the signal with respect to time is plotted on the CRO screen. X-axis represents time and Y-axis represents amplitude. It is used to measure amplitude, frequency and phase of the waveforms. It is also used to observe shape of the waveform. C.R.O. is useful for troubleshooting purpose. It helps us to find out gain of amplifier, test oscillator circuits. We can measure amplitude and frequency of the waveforms at the different test points in our circuit. Thus, it helps us for fault finding procedure. In dual channel C.R.O. X-Y mode is available which is used to create Lissajous patterns

Latest digital storage oscilloscope display voltage and frequency directly on the LCD and does not require any calculations. It can also store waveform for further analysis. More detailed study on C.R.O. will be covered in EMI laboratory (SEM-V). In this practical, we will measure amplitude and frequency of the different waveforms like sine wave, square wave, triangular wave and ramp wave.

Procedure:

1. Connect function generator output at the input of C.R.O. at channel 1 or at channel 2
2. Select proper channel i.e. if signal is connected to channel 1 select CH1 and if signal is connected to channel 2 select CH2
3. Adjust Time /Div knob to get sufficient time period displacement of the wave on the CRO screen.
4. With fine tuning of time/Div make the waveform steady on screen.
5. Use triggering controls if waveform is not stable
6. Keep volt/div knob such that waveform is visible on the screen without clipping
7. Measure P-P reading along y-axis. This reading multiplied with volt/div gives peak to peak amplitude of the ac i/p wave.
8. Measure horizontal division of one complete cycle. This division multiplied by time/div gives time period of the i/p wave.
9. Calculate frequency using formula f = 1/T.
10. Note down your readings in the observation table
11. Draw waveforms of sine, square, ramp and triangular in the given space.

:: WORKSHEET ::

Observation table:

Function	Vertical Division (a)	Volt/div (b)	Amplitude (p-p) V=a*	Horizontal Div (c)	Time/div (d)	Time T =c*d	Freq. F=1/T
Sine wave							
Square Wave							
Triangular Wave							
Ramp Wave							

Draw observed waveforms:

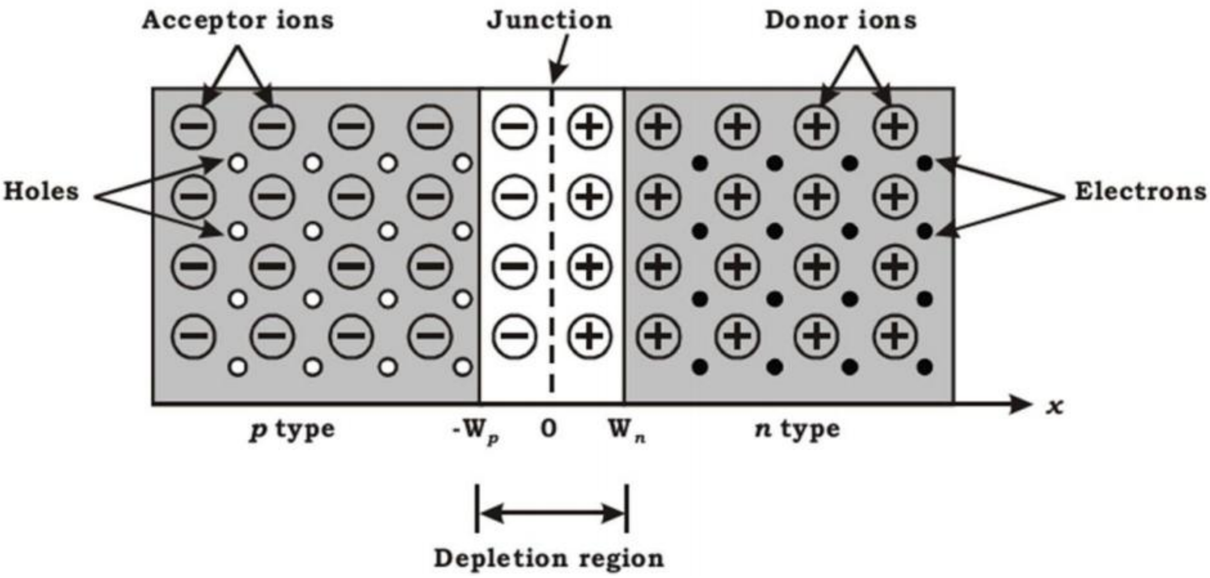
Conclusion:

EXPERIMENT NO.2

Aim: To obtain V-I characteristics of PN junction diode.

Introduction:

The semiconductor diode is formed by doping P-type impurity in one side and N-type of impurity in another side of the semiconductor crystal forming a p-n junction as shown in the following figure.



At the junction initially free charge carriers from both side recombine forming negatively charged ions in P side of junction (an atom in P-side accept electron and becomes negatively charged ion) and positively charged ion on n side (a atom in n-side accepts hole i.e. donates electron and becomes positively charged ion) region. This region deplete of any type of free charge carrier is called as depletion region. Further recombination of free carrier on both side is prevented because of the depletion voltage generated due to charge carriers kept at distance by depletion (acts as a sort of insulation) layer as shown dotted in the above figure.

Working principle:

When voltage is not applied across the diode, depletion region forms as shown in the above figure. When the voltage is applied between the two terminals of the diode (anode and cathode) two possibilities arises depending on polarity of DC supply.

[1] Forward-Bias Condition:

When the +Ve terminal of the battery is connected to P-type material & -Ve terminal to N-type terminal as shown in the circuit diagram, the diode is said to be forward biased. The application of forward bias voltage will force electrons in N-type and holes in P-type material to recombine with the ions near boundary and to flow crossing junction. This reduces width of depletion region. This further will result in increase in majority carriers flow across the junction. If forward bias is further increased in magnitude the depletion region width will continue to decrease, resulting in exponential rise in current as shown in ideal diode characteristic curve.

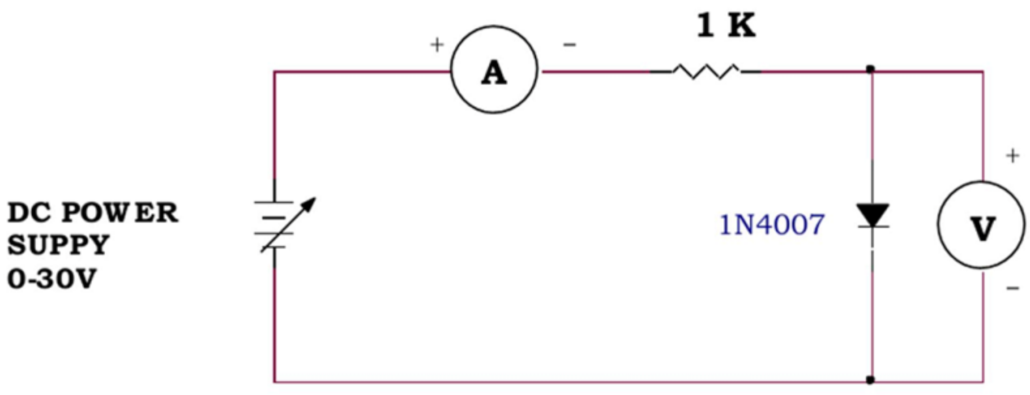
[2] Reverse-biased:

If the negative terminal of battery (DC power supply) is connected with P-type terminal of diode and +Ve terminal of battery connected to N type then diode is said to be reverse biased. In this condition the free charge carriers (i.e. electrons in N-type and holes in P-type) will move away from junction widening depletion region width. The minority carriers (i.e. –ve electrons in p-type and +ve holes in n-type) can cross the depletion region resulting in minority carrier current flow called as reverse saturation current (Is). As no of minority carrier is very small so the magnitude of Is is few microamperes. Ideally current in reverse bias is zero. In short, current flows through diode in forward bias and does not flow through diode in reverse bias. Diode can pass current only in one direction.

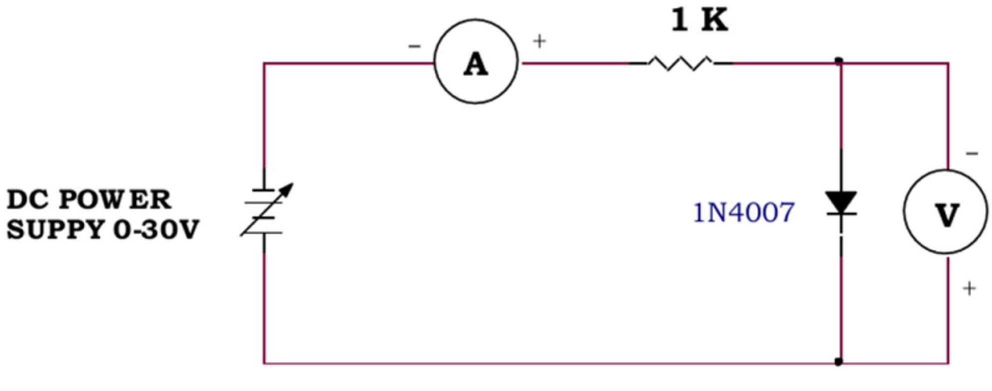
Experiment Procedure:

- Connect the power supply, voltmeter, current meter with the diode as shown in the figure for forward bias diode. You can use two multimeter (one to measure current through diode and other to measure voltage across diode).
- Increase voltage from the power supply from 0V to 20V in step as shown in the observation table
- Measure voltage across diode and current through diode. Note down readings in the observation table.
- Reverse DC power supply polarity for reverse bias
- Repeat the above procedure for the different values of supply voltage for reverse bias
- Draw VI characteristics for forward bias and reverse bias in one graph.

Circuit diagram (forward bias):



Circuit diagram (reverse bias):



Observation table:

Sr. No.	Supply voltage	Diode voltage	Diode current
1.	0		
2.	0.2		
3.	0.4		
4.	0.6		
5.	0.8		
6.	1		
7.	2		
8.	4		
9.	6		
10.	8		
11.	10		
12.	15		
13.	20		

Conclusion:

EXPERIMENT NO. 3

Aim: To obtain V-I characteristics of Zener diode

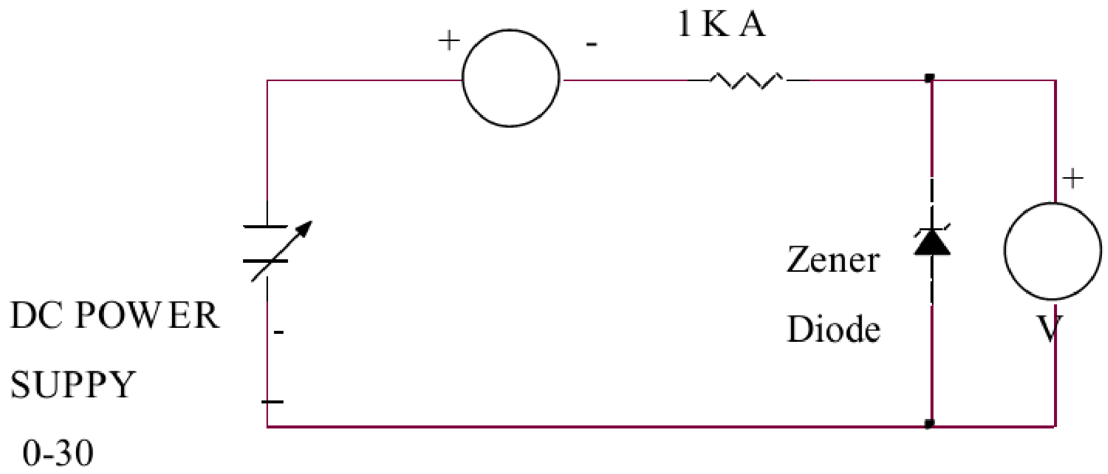
Introduction:

The Zener diode is designed to operate in reverse breakdown region. Zener diode is used for voltage regulation purpose. Zener diodes are designed for specific reverse breakdown voltage called Zener breakdown voltage (VZ). The value of VZ depends on amount of doping. Breakdown current is limited by power dissipation capacity of the zener diode. If power capacity of the Zener is 1 W and Zener voltage is 10V, highest reverse current is 0.1A or 100 mA. If current increases more than this limit, diode will be damaged. Forward characteristics of the Zener diode are similar to normal PN junction diode.

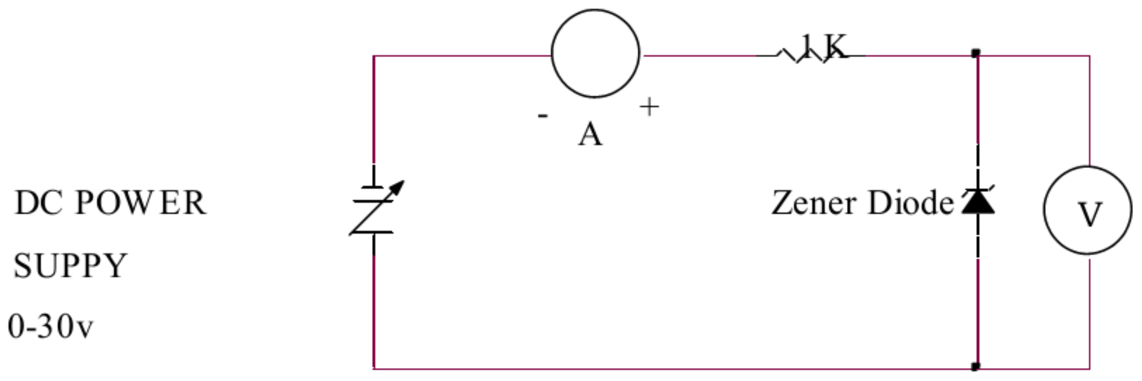
Experiment Procedure:

- Connect the power supply, voltmeter, current meter with the diode as shown in the figure for reverse bias. You can use two multimeter (one to measure current through diode and other to measure voltage across diode)
- Increase voltage from the power supply from 0V to 20V in step as shown in the observation table
- Measure voltage across diode and current through diode. Note down readings in the observation table.
- Reverse DC power supply polarity for forward bias
- Repeat the above procedure for the different values of supply voltage for reverse bias
- Draw VI characteristics for reverse bias and forward bias in one graph

Circuit diagram (reverse bias):



Circuit diagram (forward bias):



Observation table: (Reverse bias)

Sr. No.	Supply voltage (Volt)	Diode voltage (VZ)	Diode current (IZ)
1.	0		
2.	1		
3.	2		
4.	5		
5.	8		
6.	10		
7.	12		
8.	15		
9.	18		
10.	20		
11.	22		
12.	25		
13.	30		

Observation table: (Forward bias)

Sr. No.	Supply voltage (Volt)	Diode voltage (Vd)	Diode current (Id)
1.	0		
2.	0.2		
3.	0.4		
4.	0.6		
5.	0.8		
6.	1		
7.	5		
8.	10		
9.	15		
10.	20		
11.	25		

Draw V-I characteristics of Zener diode:

Conclusion:

EXPERIMENT NO. 4

Aim: To observe waveform at the output of half wave rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor

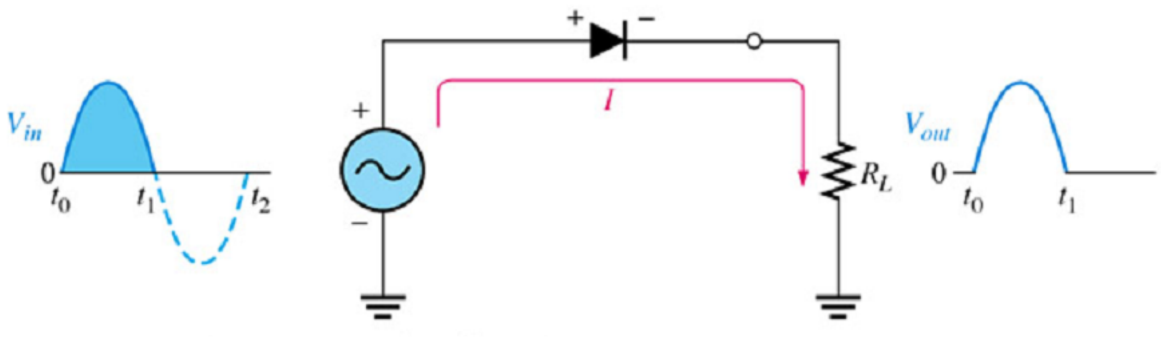
Introduction:

One of the very important applications of diode is in DC power supply as a rectifier to convert AC into DC. DC Power supply is the important element of any electronic equipment. This is because it provides power to energize all electronic circuits like oscillators, amplifiers and so on. In electronic equipments, D.C. power supply is must. For example, we can’t think of television, computer, radio, telephone, mobile as well as measuring instruments like CRO, multi-meter etc. without DC power supply. The reliability and performance of the electronic system proper design of power supply is necessary. The first block of DC power supply is rectifier. Rectifier may be defined as an electronic device used to convert ac voltage or current into unidirectional voltage or current. Essentially rectifier needs unidirectional device. Diode has unidirectional property hence suitable for rectifier.

Rectifier broadly divided into two categories:
Half wave rectifier and full wave rectifier.
In this experiment, you will construct half wave rectifier.

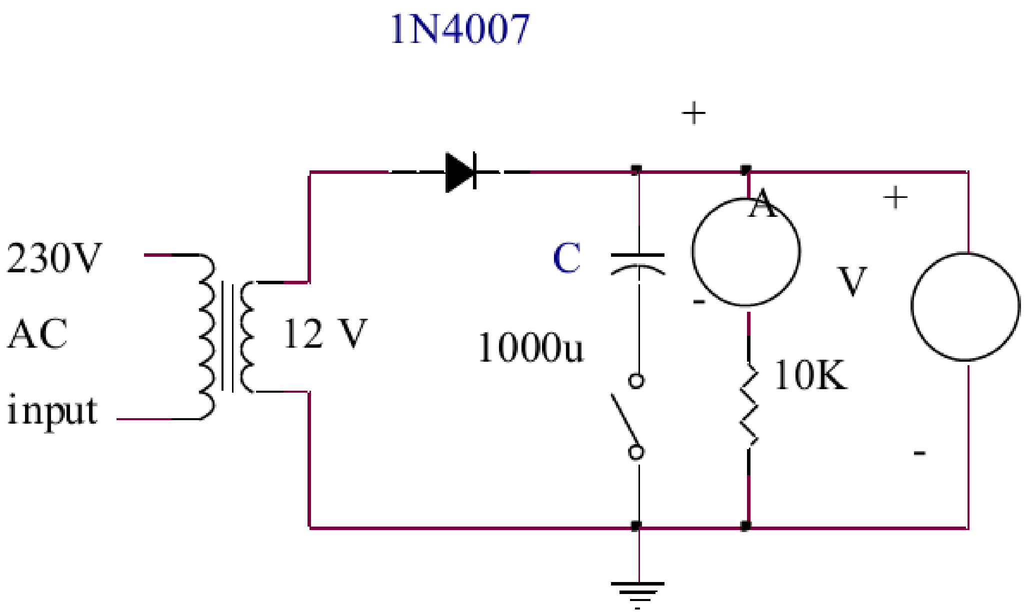
Working principle of half wave rectifier:

In half wave rectifier only half cycle of applied AC voltage is used. Another half cycle of AC voltage (negative cycle) is not used. Only one diode is used which conducts during positive cycle. The circuit diagram of half wave rectifier without capacitor is shown in the following figure. During positive half cycle of the input voltage anode of the diode is positive compared with the cathode. Diode is in forward bias and current passes through the diode and positive cycle develops across the load resistance RL. During negative half cycle of input voltage, anode is negative with respecte to cathode and diode is in reverse bias. No current passes through the diode hence output voltage is zero.



Half wave rectifier without filter capacitor convert AC voltage into pulsating DC voltage. Filter capacitor is used to obtain smooth DC voltage. Construct following circuit to perform this practical.

Practical Circuit diagram:



List of components:

[1] Transformer Input: 230V AC, output: 12V AC, 500 mA

[2] Diode 1N4007

[3] Resistor 10K

[4] Capacitor 1000µF

[5] Toggle Switch

Construct circuit on the general purpose PCB. Keep toggle switch OFF to perform practical of half wave rectifier without filter capacitor and ON to connect filter capacitor.

Observations:

[1] Without filter capacitor

AC Input voltage (rms) Vrms=

DC output voltage VDC =

DC current: IDC =

AC output voltage (Ripple voltage) Vr:

Ripple factor: (Vr/VDC) =

[2] With filter capacitor

AC Input voltage (rms) Vrms=

DC output voltage VDC =

DC current: IDC =

AC output voltage (Ripple voltage) Vr:

Ripple factor: (Vr/VDC) = _________

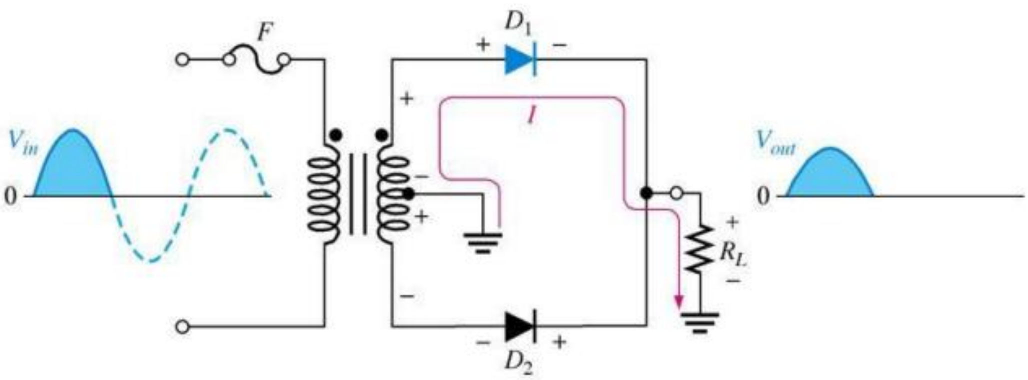
Conclusion:

EXPERIMENT NO. 5

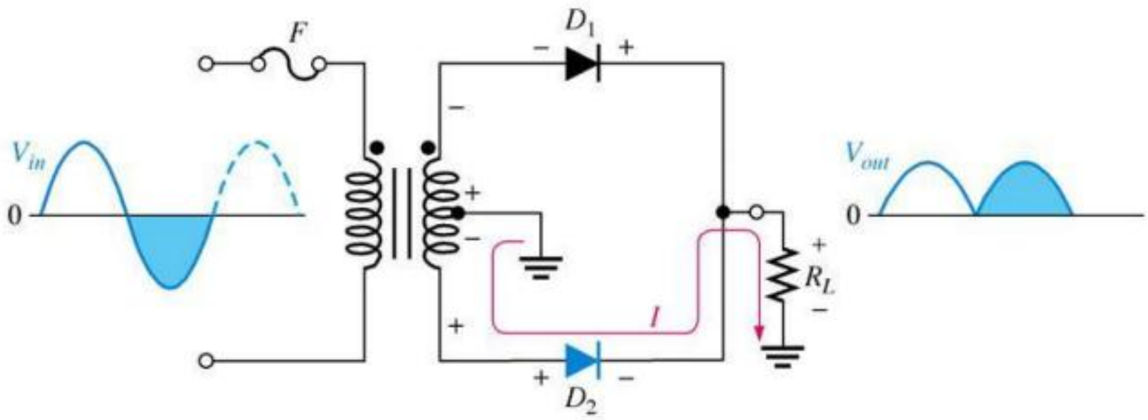
Aim: To observe waveform at the output of full wave rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor.

Introduction:

Full wave rectifier utilizes both the cycle of input AC voltage. Two or four diodes are used in full wave rectifier. If full wave rectifier is designed using four diodes it is known as full wave bridge rectifier. Full wave rectifier using two diodes without capacitor is shown in the following figure. Center tapped transformer is used in this full wave rectifier. During the positive cycle diode D1 conducts and it is available at the output. During negative cycle diode D1 remains OFF but diode D2 is in forward bias hence it conducts and negative cycle is available as a positive cycle at the output as shown in the following figure. Note that direction of current in the load resistance is same during both the cycles hence output is only positive cycles.



(a) During positive half-cycles, D_1 is forward-biased and D_2 is reverse-biased.



(b) During negative half-cycles, D_2 is forward-biased and D_1 is reverse-biased.

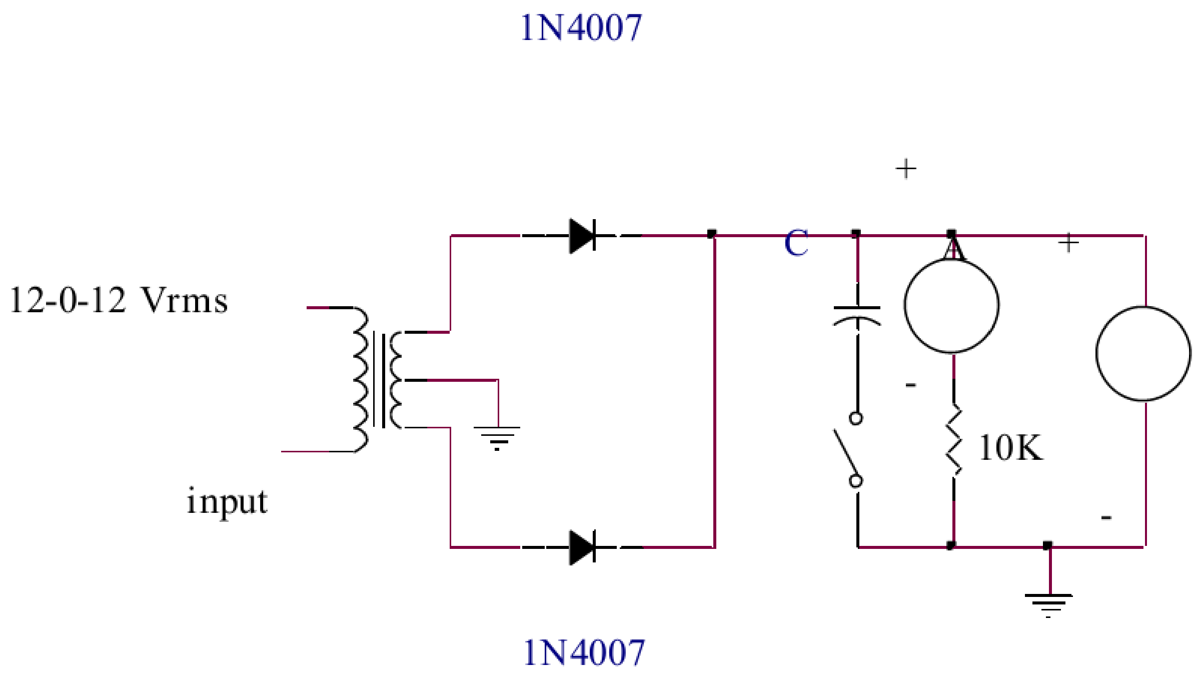
Advantages of full wave rectifier over half wave rectifier:

- The rectification efficiency is double than half wave rectifier
- Ripple factor is less and ripple frequency is double hence easy to filter out.
- DC output voltage and current is higher hence output power is higher. Better transformer utilization factor .
- There is no DC saturation of core in transformer because the DC currents in two halves of secondary flow in opposite directions.

Disadvantages:

- Requires center tap transformer
- Requires two diodes compared to one diode in half wave rectifier.

Practical Circuit diagram:



List of components:

[1] Transformer (center tapped) 12-0-12 V AC, 500 mA

[2] Diode 1N4007 ---- 2 No.

[3] Resistor 10K

[4] Capacitor 1000µF

[5] Toggle Switch

Construct circuit on the general purpose PCB. Keep toggle switch OFF to perform practical of full wave rectifier without filter capacitor and ON to connect filter capacitor.

Observations:

[1] Without filter capacitor

AC Input voltage (rms) Vrms= __________

DC output voltage V_{DC} = _______________

DC current: I_{DC} =___________________

AC output voltage (Ripple voltage) Vr: _________________

Ripple factor: (V_r/V_{DC}) = ___________________

[2] With filter capacitor

AC Input voltage (rms) Vrms=

DC output voltage V_{DC} = ______________

DC current: I_{DC} =__________________

AC output voltage (Ripple voltage) Vr: ________________

Ripple factor: (V_r/V_{DC}) = __________________

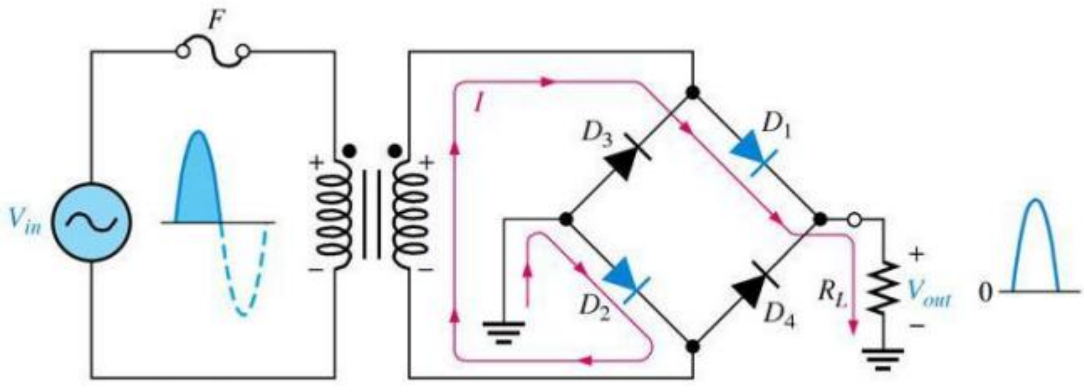
Conclusion:

EXPERIMENT NO. 6

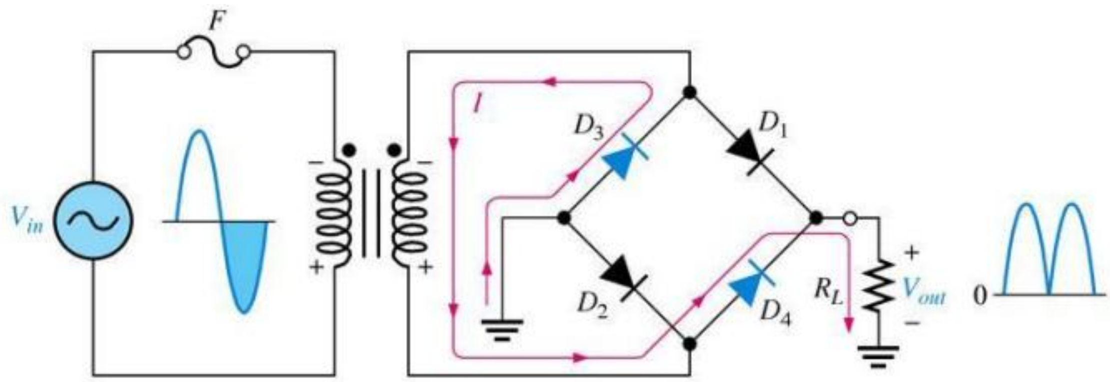
Aim: To observe waveform at the output of bridge rectifier with and without filter capacitor. To measure DC voltage, DC current, ripple factor with and without filter capacitor.

Introduction:

The Bridge rectifier is a circuit, which converts an ac voltage to dc voltage using both half cycles of the input ac voltage. The Bridge rectifier circuit is shown in the following figure.



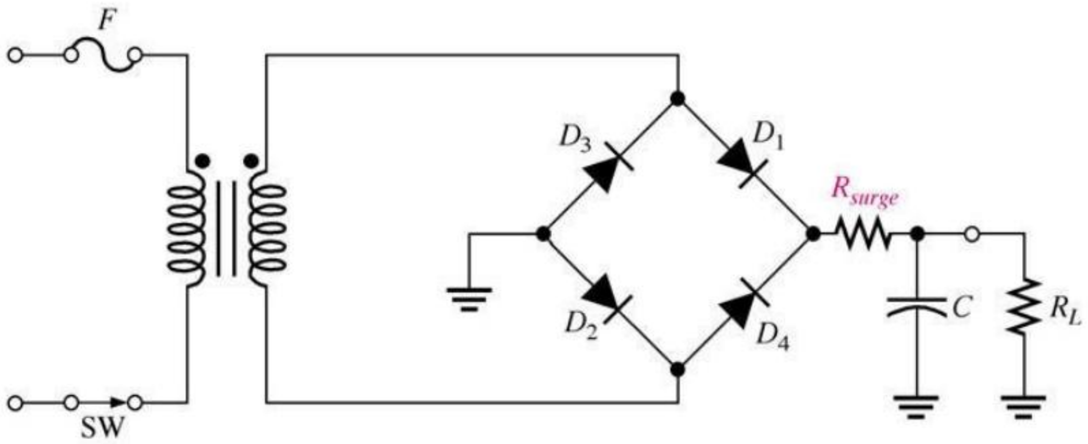
(a) During positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased.



(b) During negative half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased.

The circuit has four diodes connected to form a bridge. The ac input voltage is applied to the diagonally opposite ends of the bridge. The load resistance is connected between the other two ends of the bridge. For the positive half cycle of the input ac voltage, diodes D1 and D2 conduct, whereas diodes D3 and D4 remain in the OFF state. The conducting diodes will be in series with the load resistance RL and hence the load current flows through RL. For the negative half cycle of the input ac voltage, diodes D3 and D4 conduct whereas, D1 and D2 remain OFF. The conducting diodes D3 and D4 will be in series with the load resistance RL and hence the current flows through RL in the same direction as in the previous half cycle. Thus a bi-directional wave is converted into a unidirectional wave.

The circuit diagram of the bridge rectifier with filter capacitor is shown in the following figure. When capacitor charges during the first cycle, surge current flows because initially capacitor acts like a short circuit. Thus, surge current is very large. If surge current exceeds rated current capacity of the diode it can damage the diode. To limit surge current surge resistance is used in series as shown in the figure. Similar surge resistance can be used in half wave as well as center-tapped full wave rectifier also.



Bridge rectifier package (combination of four diodes in form of bridge) is easily available in the market for various current capacities ranging from 500 mA to 30A. For laboratory purpose you can use 1A package.

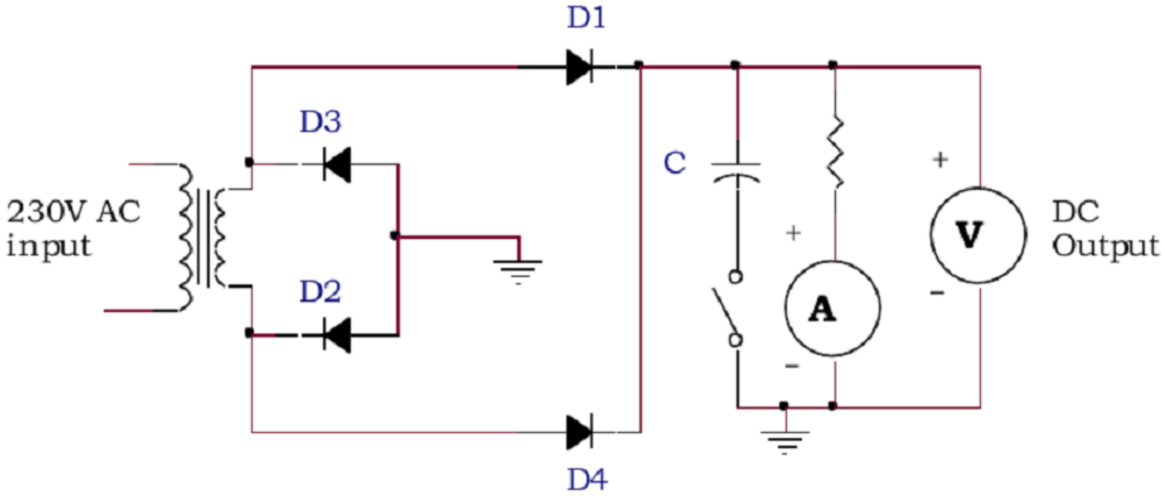
Advantages of bridge rectifier:

- No center tap is required in the transformer secondary hence transformer design is simple. If stepping up and stepping down not required than transformer can be eliminated. (In SMPS used in TV and computer, 230V is directly applied to the input of bridge rectifier). The PIV of the
- diode is half than in center tap full wave rectifier Transformer utilization factor is higher than in center tapped full wave rectifier
- Smaller size transformer required for given capacity because transformer is utilized effectively during both AC cycles.

Disadvantages of bridge rectifier:

- Requires Four diodes (But package is low cost)
- Forward voltage drop across two diodes. This will reduce efficiency particularly when low voltage (less than 5V) is required.
- Load resistance and supply source have no common point which may be earthed.

Practical circuit diagram:



List of components:

[1] Transformer 12 V AC, 500 mA

[2] Diode 1N4007 ---- 4 No. or 1 A bridge rectifier package

[3] Resistor 10K

[4] Capacitor 1000µF

[5] Toggle Switch

Construct circuit on the general purpose PCB. Keep toggle switch OFF to perform practical of full wave rectifier without filter capacitor and ON to connect filter capacitor.

Observations:

[1] Without filter capacitor

AC Input voltage (rms) Vrms= __________

DC output voltage V_{DC} = ________________

DC current: I_{DC} =___________________

AC output voltage (Ripple voltage) Vr: _________________

Ripple factor: (V_r/V_{DC}) = ___________________

[2] With filter capacitor

AC Input voltage (rms) Vrms= __________

DC output voltage V_{DC} = ________________

DC current: I_{DC} =___________________

AC output voltage (Ripple voltage) Vr: ____

Ripple factor: (V_r/V_{DC}) = ___________________

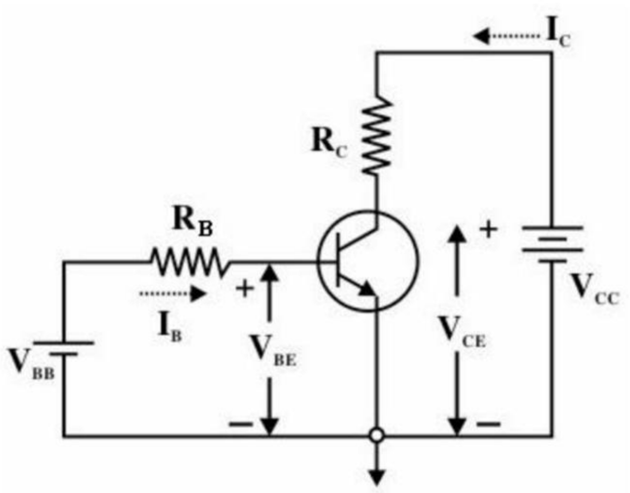
Conclusion:

EXPERIMENT NO.7

Aim: To obtain common emitter characteristics of NPN transistor

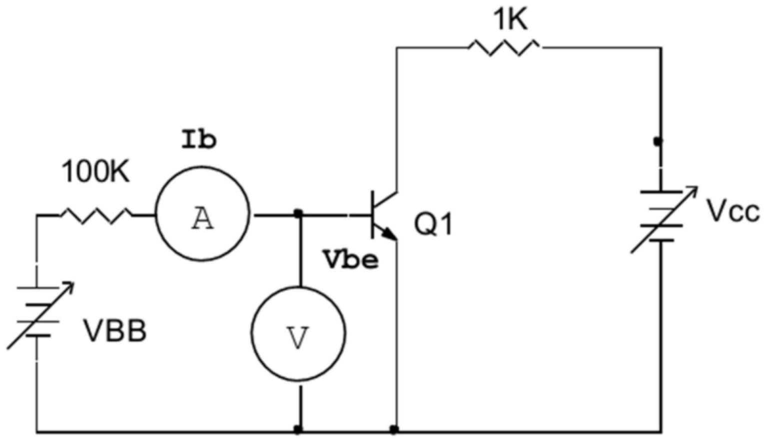
Introduction:

Transistor is three terminal device having base, emitter, collector terminal. It can used as switch and so many other electronics circuits for variety of applications. To understand operation of the transistor, we use three configurations common emitter, common base and common collector. In this practical, we will understand common emitter configuration. As the name suggest, emitter is common between input and output. Input is applied to base and output is taken from collector.



We will obtain input characteristics and output characteristics of common emitter (CE) configuration. We will connect variable DC power supply at VBB and VCC to obtain characteristics. Input voltage in CE configuration is base-emitter voltage Vbe and input current is base current Ib. Output voltage in CE configuration is collector to emitter voltage VCE and output current is collector current Ic. We will use multi-meter to measure these voltages and currents for different characteristics. Collector to emitter junction is reverse biased and base to emitter junction is forward biased. The CE configuration is widely used in amplifier circuits because it provides voltage gain as well as current gain. In CB configuration current gain is less than unity. In CC configuration voltage gain is less than unity. Input resistance of CE configuration is less than CC configuration and more than CB configuration. Output resistance of CE configuration is more than CC configuration and less than CB configuration.

Circuit setup for input characteristics:



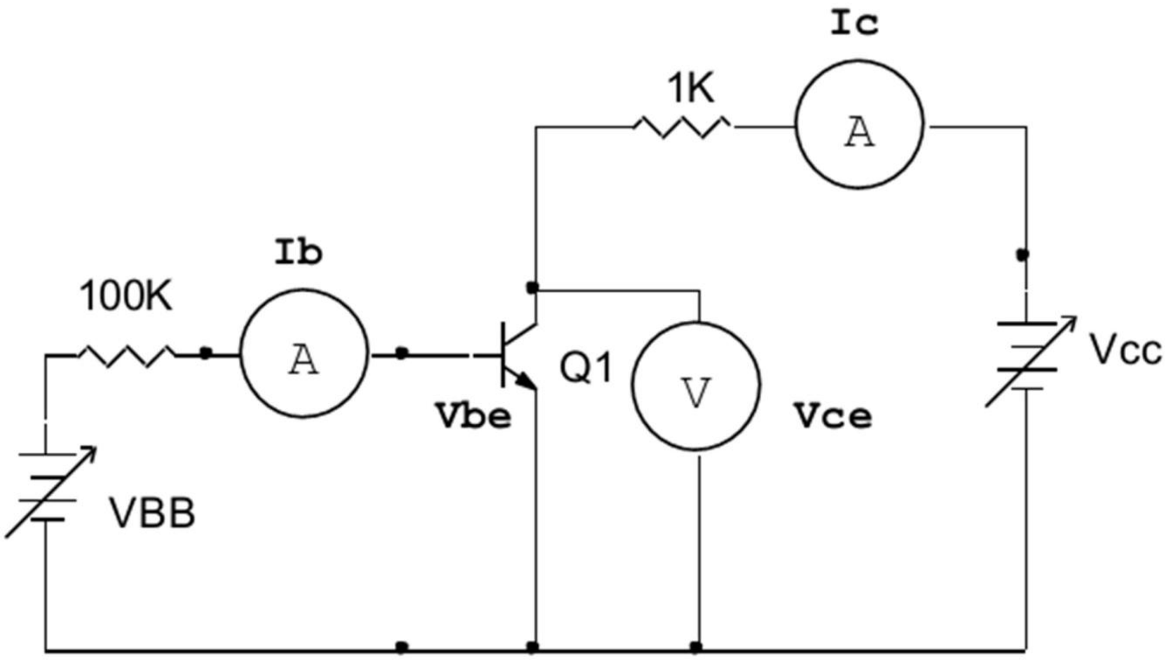
Experiment Procedure:

- Connect circuit as shown in the circuit diagram for input characteristics
- Connect variable power supply 0-30V at base circuit and collector circuit.
- Keep Vcc fix at 0V (Or do not connect Vcc)
- Increase VBB from 0V to 20V, note down readings of base current Ib and base to emitter voltageVbe in the observation table.
- Repeat above procedure for Vcc = +5V and Vcc = +10V
- Draw input characteristics curve. Plot Vbe on X axis and Ib on Y axis.

Observation table:

Sr. No.	Vcc = 0V		Vcc = +5V		Vcc=+10V	
	Vbe	Ib	Vbe	Ib	Vbe	Ib
1						
2						
3						
4						
5						
6						

Circuit setup for output characteristics:



Experiment Procedure:

- Connect circuit as shown in the circuit diagram for output characteristics
- Connect variable power supply 0-30V at base circuit and collector circuit.
- Keep base current fix (Initially 0) Increase VCC from 0V to 30V, note down readings
- of collector current Ic and collector to emitter voltage Vce in the observation table.
- Repeat above procedure for base currents Ib = 5|iA, 50 |iA, 100 |iA.
- Increase base current by increasing VBB.
- Draw output characteristics curve. Plot Vce on X axis and Ic on Y axis.

Observation table:

Sr. No.	Ib = 0		Ib = 5uA		Ib = 50uA		Ib = 100uA	
	Vce	Ic	Vce	Ic	Vce	Ic	Vce	Ic
1								
2								
3								
4								
5								
6								
7								
8								

Conclusion:

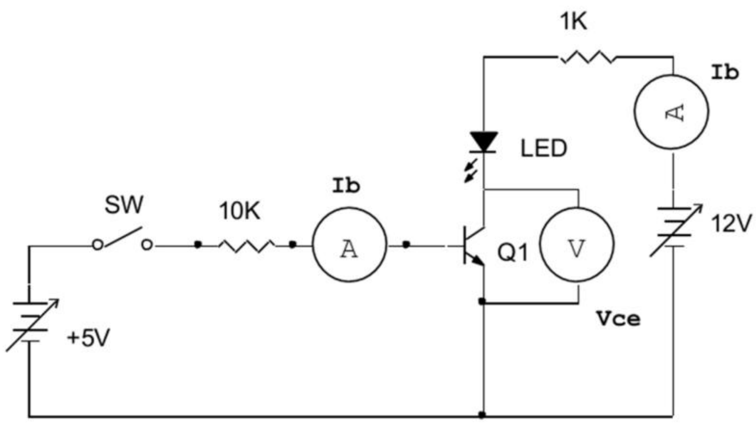
EXPERIMENT NO. 8

Aim: To understand working of transistor as a switch. To draw DC load line for given circuit

Introduction:

Transistor can be operated in three region: cut-off region, active region and saturation region. While using transistor in amplifier circuit, we are using active region. If transistor operated in cut-off and saturation region in amplifier, clipping of waveforms will occur. When we use transistor as a switch, only two regions cut-off and saturation are used. In saturation region transistor acts as ON switch. In cut-off region, transistor acts as OFF switch. We are using only two points of DC load line while using transistor as a switch.

Circuit Diagram:



Experiment Procedure to obtain input characteristics:

- Connect circuit as shown in the circuit diagram for input characteristics
- Adjust collector supply Vcc = + 12V and base supply VBB=+5V
- You may use base voltage supply switch instead of switch shown in the circuit diagram.
- Measure base current when switch is OFF (It will be zero). Measure collector current and voltage between collector and emitter. LED is off because transistor is in cut-off region,
- Now apply base voltage +5V, LED will be ON. Measure collector current and collector-emitter voltage. Transistor is in saturation region

Observations:

[1] Switch off (V_{RR}=0): Ib VCE = Ic =

= [2] Switch ON (V_{RR}=+5V) VCE

Draw DC load line and show saturation and cut off points:

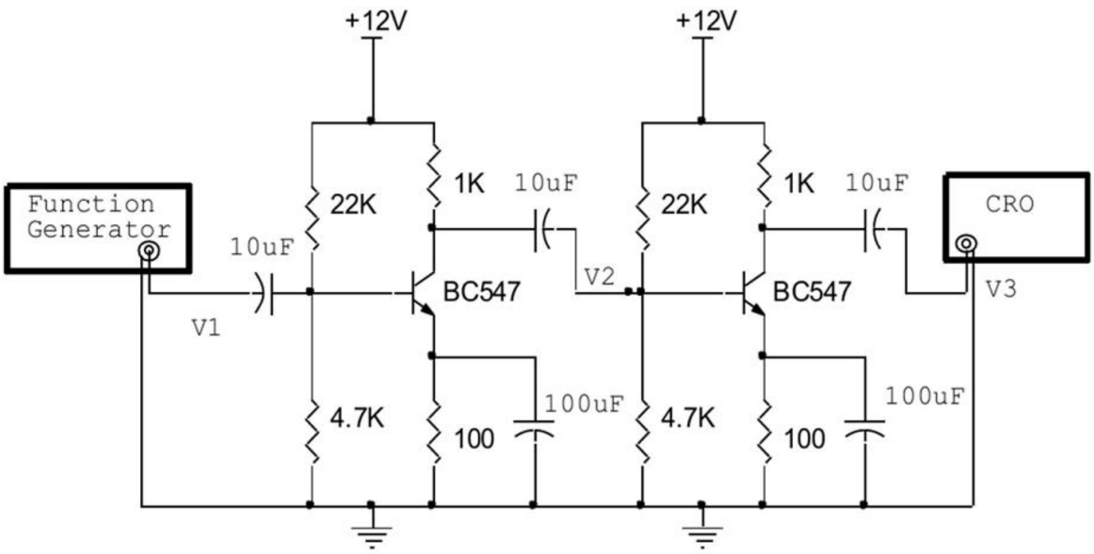
Conclusion:

EXPERIMET NO. 9

Aim: To measure gain of two stage RC coupled amplifier

Introduction:

To achieve higher gain, we can use multi-stage amplifier where output of one amplifier is connected to input of next amplifier. Amplifiers are connected in cascade arrangement so it is also called cascade amplifier. Output of first amplifier is connected to input of second amplifier by coupling device like coupling capacitor. Direct coupling or transformer coupling is also used. Capacitor coupling is used to couple AC signal from output of first amplifier to input of second amplifier. Coupling capacitor does not pass DC signal so DC biasing of second stage is not affected by first stage and vice-versa. In this practical, we will use capacitor coupling which is also known as two stage RC coupled amplifier. Typical circuit diagram is shown below:



In this circuit diagram, output of first stage is connected to input of the second stage by coupling capacitor of 10uF. RC network is formed by this coupling capacitor and voltage divider bias of the next stage. Input signal V1 is amplified by first amplifier. Amplified signal from first amplifier is V2 which is further amplified by second amplifier. Output signal from the second amplifier is V3. If gain of amplifier 1is Ai then V2=AiV1. If gain of amplifier2 is A2 then V3=A2V2. From this relationship, V3=A^V1. This theoretical overall gain of cascade amplifier is A = V3/V1 = A1A2.However practically overall gain is slightly less than A1A2 because of loading effect of second stage on the first stage. Overall bandwidth of amplifier will decrease.

Experimental Procedure:

- Connect function generator at the input of the amplifier circuit.
- Set input voltage V1 = 1 mV and frequency 100 Hz.
- Connect CRO at the output of the first amplifier circuit at point V2.
- Observe amplified signal and measure output voltage at V1
    - Find out gain of first amplifier A1=V2/V1.
    - Observe amplified signal at the output of second amplifier and measure output voltage at V3
- Find out gain of second amplifier A2=V3/V2.
    - Find overall gain of amplifier A = V3/V1= A1A2
- Increase frequency from the function generator and repeat above steps.Note down readings of output voltage in the observation table for frequency range from 100 Hz to 10 MHz Calculate voltage gain A1 and A2 for different frequencies and gain in db. Plot frequency response.

Draw circuit diagram from the board available in the laboratory:

Conclusion:

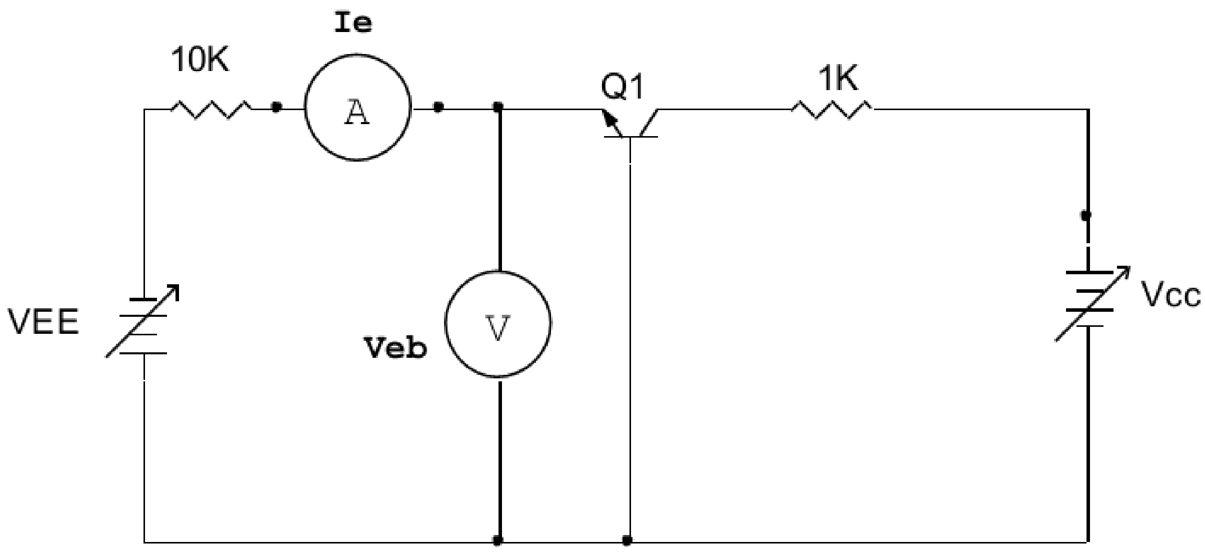
EXPERIMENT NO. 10

Aim: To obtain common base characteristics of NPN transistor

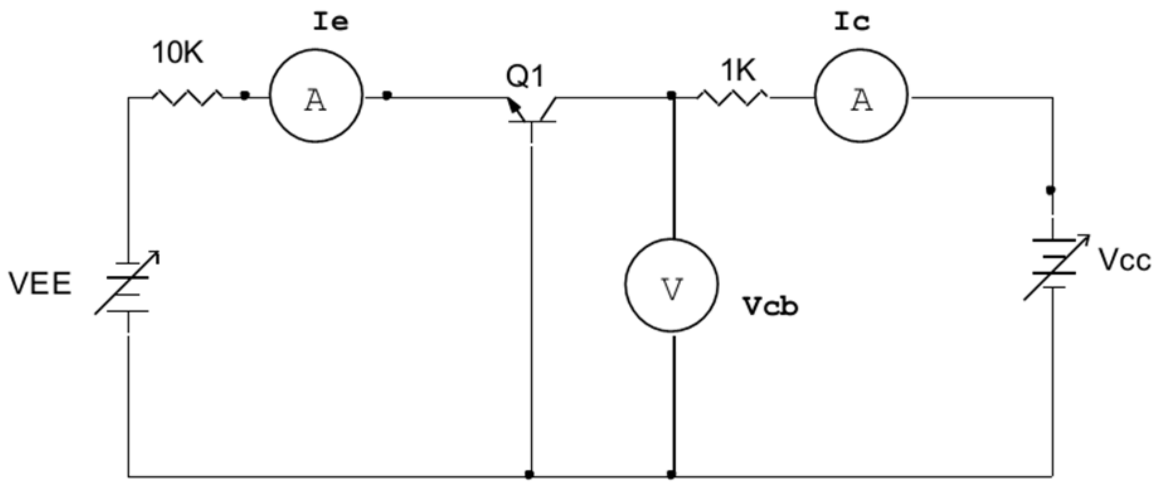
Introduction:

In a common base configuration, base terminal is common between input and output. The output is taken from collector and the input voltage is applied between emitter and base. The base is grounded because it is common. To obtain output characteristics, we will measure collector current for different value of collector to base voltage (VCB). Input current is emitter current Ie and input voltage is Veb. To plot input characteristics we will plot Veb versus Ie. Current gain for CB configuration is less than unity. CB configuration is used in common base amplifier to obtain voltage gain. Output impedance of common base configuration is very high .CB amplifier is used in multi -stage amplifier where impedance matching is required between different stages.

Circuit diagram to obtain input characteristics:



Circuit diagram to obtain output ccharacteristics:



Experiment Procedure to obtain input characteristics:

- Connect circuit as shown in the circuit diagram for input characteristics
- Connect variable power supply 0-30V (VEE) at emitter base circuit and another power supply 0-30V at collector base circuit (Vcc).
- Keep Vcc fix at 0V (Or do not connect Vcc)
- Increase VEE from 0V to 20V, note down readings of emitter current Ie and emitter to base voltage Veb in the observation table.
- Repeat above procedure for Vcc = +5V and Vcc = +10V
- Draw input characteristics curve. Plot Veb on X axis and Ie on Y axis

Experiment Procedure to obtain output characteristics:

- Connect circuit as shown in the circuit diagram for output characteristics
- Connect variable power supply 0-30V at emitter circuit and collector circuit.
- Keep emitter current fix (Initially 0)
- Increase VCC from 0V to 30V, note down readings of collector current Ic and collector to base voltage Vcb in the observation table.
- Repeat above procedure for base currents Ie = 1mA, 5 mA and 10mA.
- Increase emitter current by increasing VEE.
- Draw output characteristics curve. Plot Vcb on X axis and Ic on Y axis.

Observation table for input characteristics:

Transistor: ____________

Sr. No.	Vcc = 0V		Vcc = +5V		Vcc=+10V	
	Veb	Ie	Veb	Ie	Veb	Ie
1						
2						
3						
4						
5						
6						

Observation table for output characteristics

Transistor: ___________________

Sr. No.	Ie = 0		Ie = 1 mA		Ie = 5 mA		Ie = 10 mA	
	Vcb	Ic	Vcb	Ic	Vcb	Ic	Vcb	Ic
1								
2								
3								
4								
5								
6								
7								
8								

Conclusion:

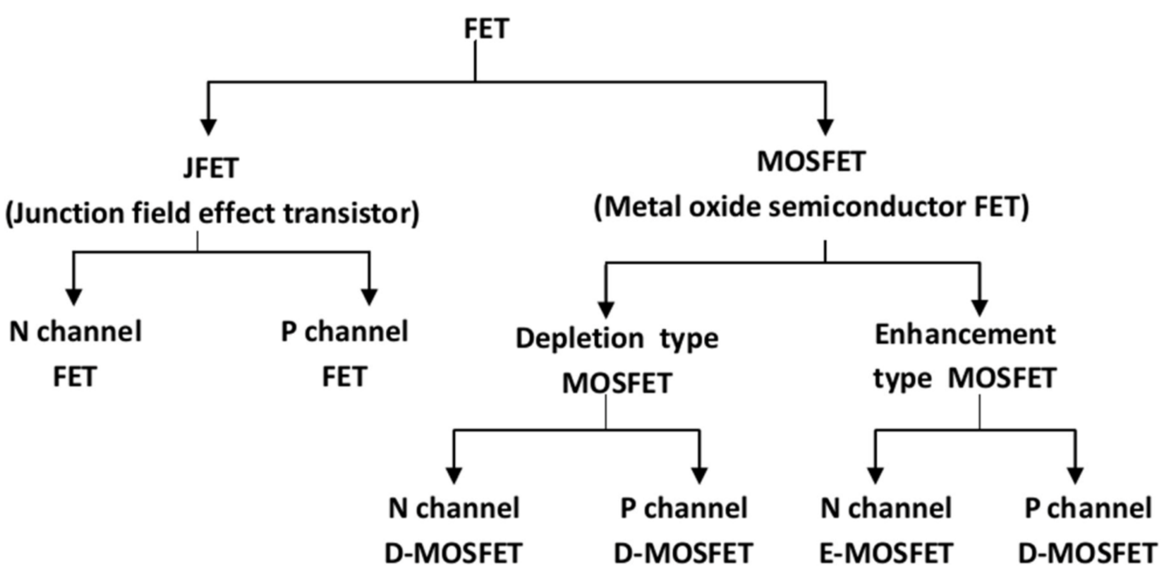
EXPERIMENT NO.11

Aim: To obtain characteristics of field effect transistor (FET)

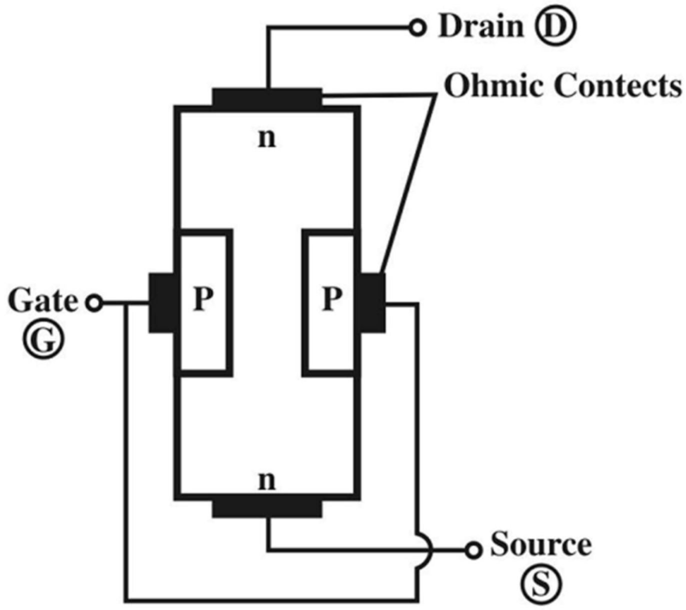
Introduction:

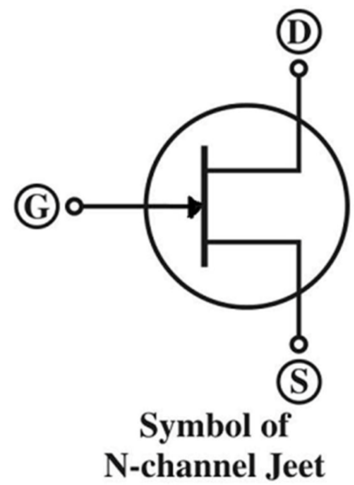
The Field Effect Transistor (FET) is a three terminal device. Three terminals are Drain (D), Source (S) and Gate (G). In FET, current flow is due to only one type of charge particles, either electrons or holes. So FET is known as unipolar device. The name "field effect" is derived from the fact that the current is controlled by an electric field set up in the device by an externally applied voltage. Thus FET is a voltage controlled device while bipolar transistor is current controlled device.

The Field Effect Transistor (FET) can be broadly classified into following categories:

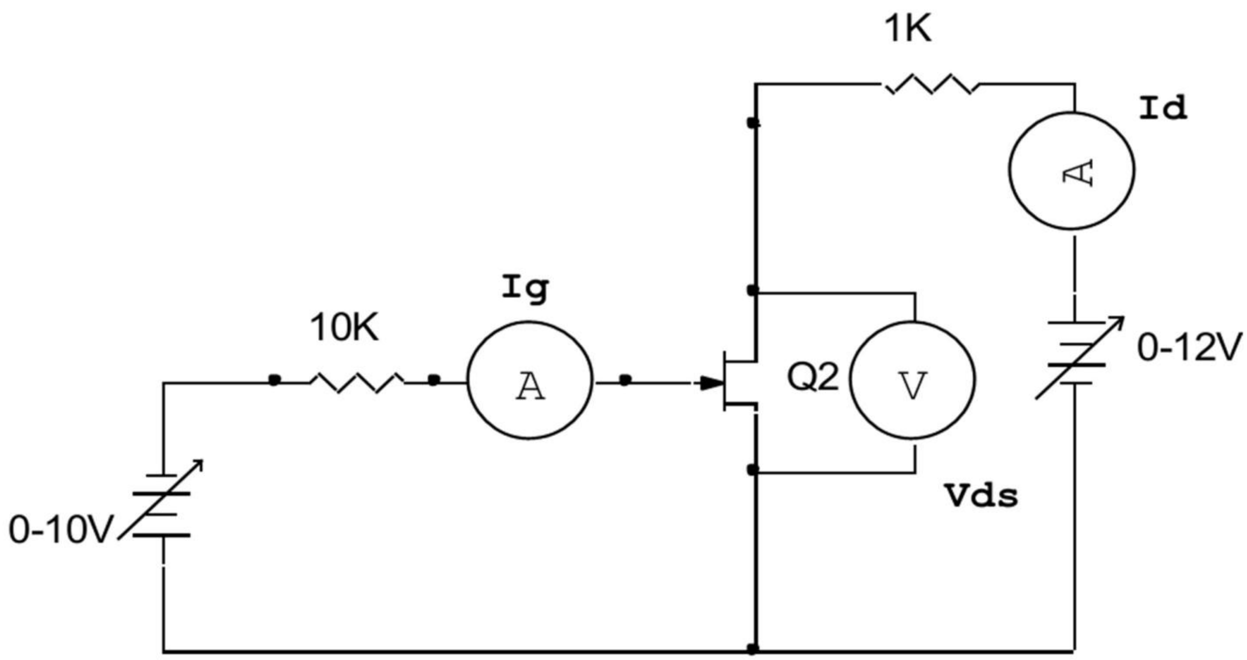


In this experiment we will obtain output characteristics of N-channel FET using CS (Common source) Configuration. It is also known as drain characteristics. Basic construction of N-channel FET and its symbol are shown in the following figure. When gate to source voltage VGS is zero, N type channel is open so drain current will flow through it. As we increase negative voltage on the gate terminal, VGS=-1V, -2V, -3V etc., drain current reduces. The reduction in drain current is due to reduction in width of channel. As we increase negative gate voltage, width of depletion region spreads in the channel. Depletion region (generated field due to reverse bias) does not have charge carriers so width of channel will reduce. As we increase negative value of VGS, penetration of depletion region (field) will be more and more due to which channel becomes narrower. At one point drain current reduces to zero when entire channel will be closed due to penetration of depletion region. The value of VGS at which drain current reduces to zero is called cut-off voltage VGS(off). Normally Drain current reduces to zero at VGS=-Vp. Thus VGS(off) = -VP where VP is pinch-off voltage Pinch-off voltage VP is the value of voltage VDS at which drain current becomes constant





Circuit Diagram:



Experiment Procedure:

- Connect circuit as shown in the circuit diagram for output (drain) characteristics
- Connect variable power supply 0-10V at gate circuit and 0-12V at drain circuit.
- Keep gate to source voltage zero (VGS=0).
- Increase drain supply Vdd from 0 V to 12 V, note down readings of drain current Id and drain to source voltage Vds in the observation table.
- Repeat above procedure for different gate to source voltages VGS = -1,-2, -3, -4 etc. Note down reading of Gate to source voltage at which drain current remains zero. This is cut-off voltage VGS(off). Note down pinch-off voltage for all values of VGS.
- Draw output characteristics curve. Plot Vds on X axis and Id on Y axis.

Draw circuit diagram of the circuit available in the laboratory

Observation Table:

Sr. No.	VGS=0V		VGS = -1V		VGS = -2V		VGS = -4 V	
	Vds	Id	Vds	Id	Vds	Id	Vds	Id
1								
2								
3								
4								
5								
6								
7								
8								
9								

Conclusion: