Department of Pure & Applied Physics

B.Sc. (Electronics) Course Syllabus under CBCS/LOCF

<u>Semester- III</u>

<u>Electronic Circuit Lab</u>

1. **Study of half-wave and full-wave rectifier.**

2. **Study of Zener diode as a voltage regulator.**

3. **Designing of a single-stage CE amplifier.**

4. **Study of Colpitt's oscillator.**

5. **Study of Hartley's Oscillator.**

6. **Study of Phase Shift oscillator.**

7. **Designing and Testing of 5V/9V DC regulated power supply and find its load regulation.**

8. **Study of Clipping and Clamping Circuit.**

INSTRUCTION MANUAL

FOR

HALF WAVE/ FULL WAVE & BRIDGE RECTIFIER

Objective : Study of Half Wave/ Full Wave & Bridge Rectifier.

Half Wave/Full Wave & Bridge Rectifier has been designed to study the following

:

1. Half wave rectifier and effect of different filter circuits on AC ripple at different loads.
2. Full wave rectifier and effect of different filter circuits on AC ripple at different loads.
3. Bridge rectifier and effect of filter circuits on AC ripple at different loads.

The instrument comprises of the following built-in parts:-

1. AC stepdown transformer of secondary output taps 9V AC, 0V and 9V AC.
2. Four Diodes are mounted behind the front panel for rectification purposes.
3. Filter section consists of two filter (capacitor) selected using toggle switches.
4. Different types of load resistances from 500 to 5000 can be selected through band switch provided on front panel.
5. Two meters to measure voltage & current are mounted on the front panel & connections brought out on 4mmSockets.

STANDARD ACCESSORIES

1. Nine single point & Four interconnectable patch cords for interconnections.
2. Instruction manual**.**

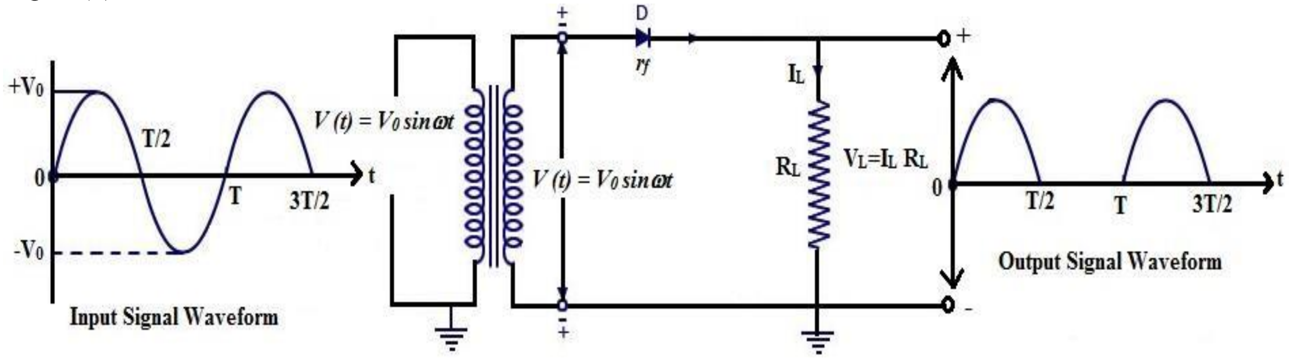
THEORY HALF WAVE RECTIFIER: -

Fig. (1a) shows the circuit diagram of a Half Wave Rectifier. In half wave rectification, the rectifier conducts current only during the positive half cycles of the input AC supply. The negative half cycles of a.c. supply is suppressed i.e, during negative half cycles, no current is conducted and hence no voltage appears across the load. Therefore, current always flows in one direction (ie DC) through the load after every half cycle. Fig (1) shows the circuit of a half-wave rectifier. The ac supply to be rectified is applied in series with the diode and load resistances RL Generally AC supply is given through a trans- former. The AC voltage across the secondary winding AB changes polarities after every half cycle. During the positive half cycle of input AC voltage, end A becomes positive w.r.t. end B This makes the diode forward biased and hence it conducts current. During the negative half cycle, end A is negative w.r.t. end B.

Under this condition, the diode is reverse biased and it conducts no current. Therefore current flows through the diode during positive half cycles of input AC voltage whereas it is locked during the negative half cycles. In this way, current flows through load R, always in the same direction. Hence DC output is obtained across

R_L. It may be noted that output across the load is pulsating DC. These pulsations in the output are further smooth-ended with the help of filters.

Figure(1)



For $0 \leq t \leq T/2$ Diode D= **Forward biased** or **ON (Conducting)** state

For $T/2 \leq t \leq T$ = **Reversed biased** or **OFF (Non=Conducting)** State

The current flowing through the load resistance R_L is

$I_L = \frac{V_0 \sin\omega t}{r_f + R_L}$ For $0 \leq t \leq T/2$

$I_L = 0$ For $T/2 \leq t \leq T$

Therefore, output voltage $V_L = I_L \times R_L$

$V_L = \frac{V_0 \sin\omega t}{r_f + R_L} R_L$ For $0 \leq t \leq T/2$

$V_L = 0$ For $T/2 \leq t \leq T$

The output current and output voltage across load resistance consists of only half wave pulses, as clearly visible form the output waveform shown in **Figure(1)**. Though the output current and voltage signals are unidirectional but their magnitude varies with time. Therefore, one can conclude that the output signals are not purely direct current or voltage i.e. output signal is superimposition of alternating part and direct part.

$$V_L = V_{Ldc} + V_{Lac}$$

EFFICIENCY OF HALF WAVE RECTIFIER

The ratio of DC output power to the applied input AC power is known as rectifier efficiency i.e.Rectifier efficiency h = 0.406/1+r/RL Where r is the Diode resistance & RL is the Load resistance Because 'r' is very small as compared to RL then

h = 0.406 =40.6%

RIPPLE FACTOR:-

The AC components present in the output of a rectifier is called ripple. It is measure of AC components present in the output of the rectifier.

Ripple Factor = r.m.s. value of AC components/r.m.s. value of DC components

= AC (Ripple) Voltage / DC Voltage

= 1.21

Observed results are within 10% tolerance range as compared to standard results because of diode dropage and tolerances of load resistances.

This shows that AC components in the output of half wave rectifier exceeds the DC component, thus this is a poor device for converting AC to DC.

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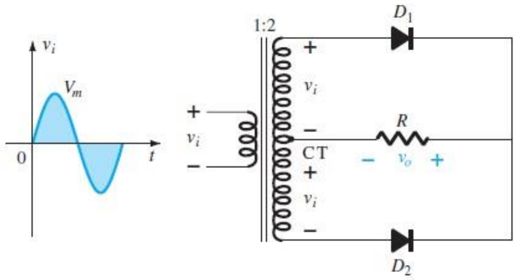
FULL WAVE RECTIFIER

In a full wave rectifier, current flows through the load in the same direction for both half cycles of input ac voltage. This can be achieved with two diodes working alternately, circuit diagram of a full wave rectifier is shown in Fig. (1b).

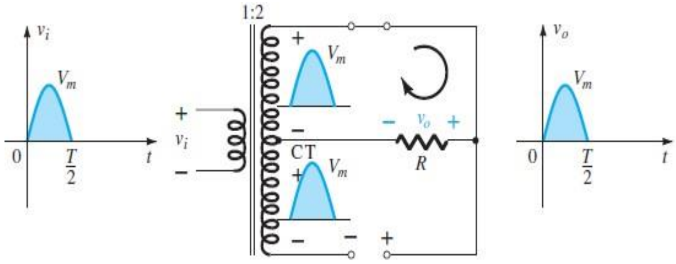
During the +ve half cycle of secondary voltage, end A of secondary winding becomes positive and end B negative This makes the diode D1 forward biased and diode D2 reverse biased. Therefore, diode D1 conducts while diode D2 does not.The conventional current flows through diode D1 load resistor RL and the upper half of secondary winding. During the negative half cycle, end A of secondary winding becomes negative arid end B positive. Therefore, diode D2 conducts while diode D1 does not. The conventional current flows through diode D2 load RL and lower half winding. The current flowing through load resistance RL is in the same direction for both half cycles of input AC voltage.

Therefore, DC is obtained across the load RL.

Centre – Tapped Full Wave Rectifier

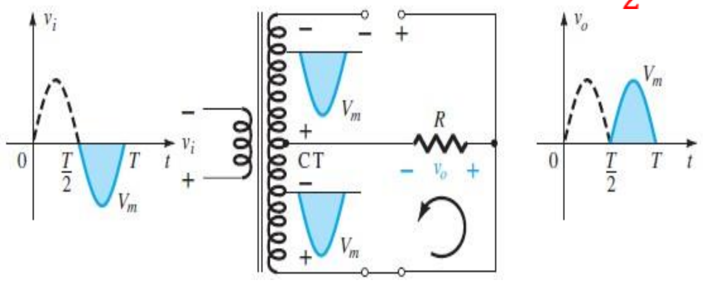


$For\ 0 \le t \le \frac{T}{2}$

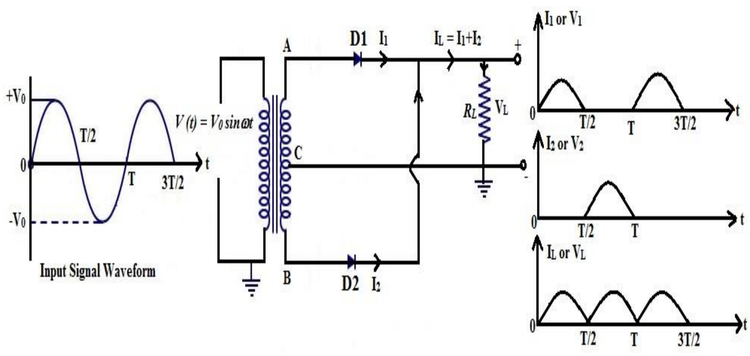


Diode D1 = Forwards biased, So in ON/Conducting state
Diode D2= Reversed biased So, OFF/Non-Conducting) State

$For\ \frac{T}{2} \le t \le \mathrm{T}$



Diode D1 = Reversed biased So, OFF/Non-Conducting) State
Diode D2= Forwards biased, So in ON/Conducting state



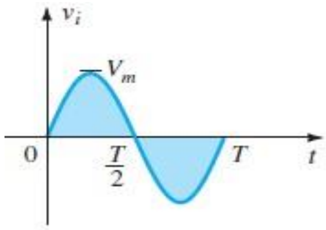
If the voltage between A and C is $V_{AC} = V_o \sin \omega t$

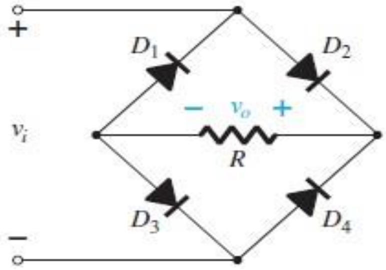
then, the voltage between B and C is $V_{BC} = -V_o \sin \omega t$

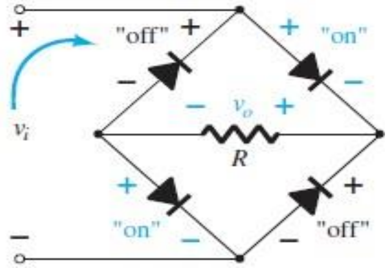
$I_1 = \frac{V_o \sin\omega t}{r_f + R_L}$, $I_2 = 0$ For $0 \le t \le T/2$

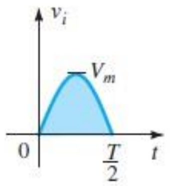
$I_1 = 0$ $I_2 = -\frac{V_o \sin\omega t}{r_f + R_L}$, For $T/2 \le t \le T$

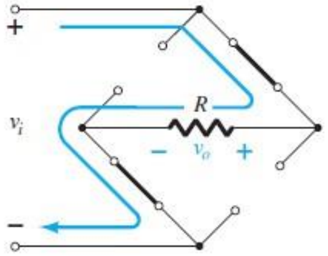
Full Wave Bridge Rectifier

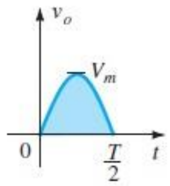


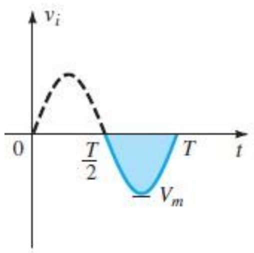


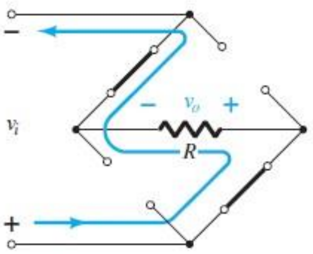


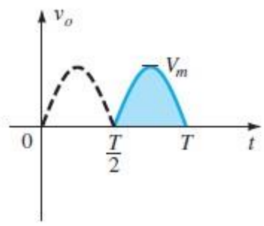


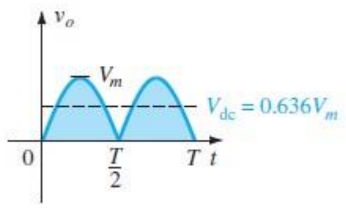












PROCEDURES

HALF WAVE RECTIFIER:-

1. Connect the circuit as shown in Fig. (1a). Also connects 15V DC Voltmeter and 250mA DC current meter in the spaceprovided on the front panel.
2. Connect electronic AC millivoltmeter/CRO across output to measure the ripple directly.
3. Connect load (R) in circuit for measuring DC output current.
4. Switch ON the instrument using ON/OFF toggle switch provided on the front panel
5. Note down the observations V A i.e. DC output voltage, DC current and AC ripples on the meters.
6. Switch ON the toggle switch S1 to connect the capacitor C1 in the circuit again check the DC output voltage, DC current and AC ripples.
7. Switch ON toggle switch S2 so that capacitor C2 also connect in the circuit. Now the filter circuit is in p type configuration. Again note down output voltage, output current and AC ripple.
8. Repeat the experiment for different values of load resistances.

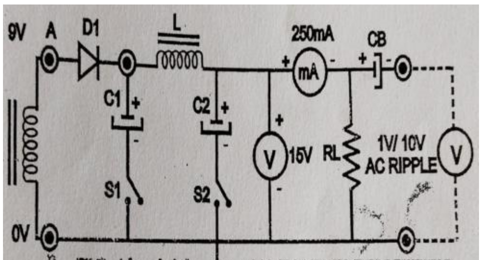


FIG. No. 1 (a) HALF WAVE RECTIFIER

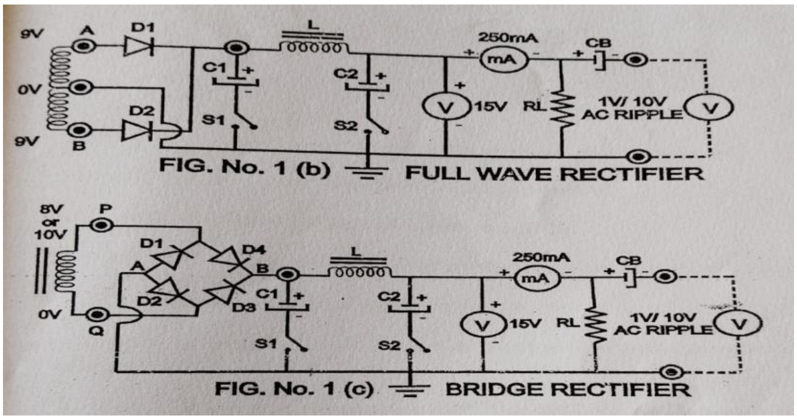
FULL WAVE RECTIFIER :-

1. Connect the circuit as shown in Fig. (1b).
2. Repeat steps 2-8 and take all the possible observations.

BRIDGE RECTIFIER :-

1. Connect the circuit as shown in Fig. 1(c).
2. Repeat steps 2 to 8 and note down all the possible observations.

NOTE :- AC ripples are maximum without filter circuit, but reduces as C1 is introduced and reduces further as C2 is also introduced. Ripples are minimum when (p) type filter is used.



RESULT:

PRECAUTIONS:

1. The primary and secondary sides of the transformer should be carefully identified.
2. The polarities of the diode & capacitor should be carefully connected.
3. While determining the % regulation, first Full load should be applied and then it should be decremented in steps.
4. Avoid loose contact.
5. CRO must be handled carefully. Use CH1 for input and CH2 for output signal.

REFERENCES:

- V.K. Mehta,(Principles of Electronics)
- Louis Nashelsky and Robert Boylestad (Electronic devices and circuit theory)

INSTRUCTION MANUAL
FOR

ZENER DIODE CHARACTERISTICS APPARATUS (FORWARD & REVERSE)

Objective: To study the Forward & Reverse characteristics of a Zener Diode.

The Instrument comprises of the following built in parts:-

1. One continuously variable DC regulated power supply of 0-15V.

2. Two moving coil meters are mounted on front panel to measure voltage & current.

3. One series resistance & one Zener diode of 8.2 V has been provided on front panel.

STANDARD ACCESSORIES

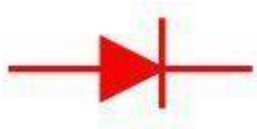
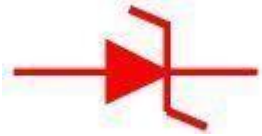
1. Six single-point patch cords for interconnections.
2. Instruction manual.

THEORY

A rectifier with appropriate filter serves as a good source of DC output. However, the major disadvantage of such a power supply is that the output Vo .value changes with the variations in the input voltage or load. Thus, if the input voltage increases,the DC output voltage of the rectifier also increases. Similarly, if the load current increases, the output voltage falls due to the voltage drops in the rectifying element, filter chokes, transformer vending etc. In many electronic applications, it is desired that the output voltage should remain constant regardless of the variations in the input village or load, in order to ensure this, a voltage stabilizing device, called voltage stabilzer is used. Several stabilizing circuits have been designed but only Zener Diode as a voltage stabilizer will be discussed.

When the reverse bias cm a crystal diode is increased, a critical voltage, emailed breakdown voltage is reached where the reverse current increases sharply to a high value. The breakdown region is the knee of the reverse characteristics. The satisfactory explanation of this breakdown of the junction was first given by the American scientist C Zener. Therefore, the breakdown voltage is sometimes called, Zener voltage and the sudden increase in current is known as Zener current.

The breakdown or Zener voltage depends upon the amount of doping. If the diode is heavily doped, depletion layer will bethin and consequently, the breakdown of the junction will occur at a lower reverse voltage on the other hand, a lightly doped diode has a higher breakdown voltage. When an ordinary crystal diode is properly doped so that it has a sharp breakdown voltage, it is called a Zener Diode. A properly doped crystal diode which has a sharp breakdown voltage Is known as a Zener Diode.

Basis For Comparison	**PN Junction Diode**	**Zener Diode**
Definition	It is a semiconductor diode which conducts only in one direction i.e. in forward direction.	The diode which allows the current to flow in both the direction i.e., forward and reverse, such type of diode is known as the Zener diode.
Symbol		
Reverse Current Effect	Damage the junction.	Do not damage the junction.
Doping Level	Low	High
Breakdown	Occurs in higher voltage.	Occur in lower voltage.
Applications	For rectification	Voltage stabilizer, motor protection and wave shaping.

Zener Diode is just like an ordinal diode except that the bar is turned into Z- shape. The following points may be notedabout the Zener diode:

i. A Zener diode is like an ordinary diode except that it is properly doped so as to have a sharp breakdown voltage.

ii. A Zener diode is always reverse connected i.e. it is always reverse biased. iii. A Zener diode has sharp breakdown voltage, called Zener voltage Vz . iv. When forward biased, its characteristics are just those of ordinary diode.

v. When Zener diode is not immediately burnt just because it has entered the break down region. As long as the external circuit connected to the diode limits the diode current to less than burn out value, the diode will not burnout.

When the reverse voltage across a Zener diode exceeds the breakdown voltage Vz, the current increases very sharply. In this region, the curve is almost vertical. It means that voltage across Zener diode is constant at Vz even though the current through it changes. Therefore, in the breakdown region, an ideal Zener may be represented bya battery of voltage Vz.

PROCEDURES

For Forward Bias Characteristics

1. Make all the connection as shown in fig.(1) using Patch-cords. Connect positive end of power supply to positive of voltmeter, Negative end of power supply to
Negative of Voltmeter. Connect other end of resistance Rs to anode of Zener diode. Connect cathode of Zener diode to positive socket of mA meter connect negative socket of power supply to negative of mA.
2. Select the current meter to the 15-mA range using toggle switch.
3. Switch on the instrument and set the voltage to 0 volts.

Circuit Diagram:

Fig (1) – Forward Bias Condition:

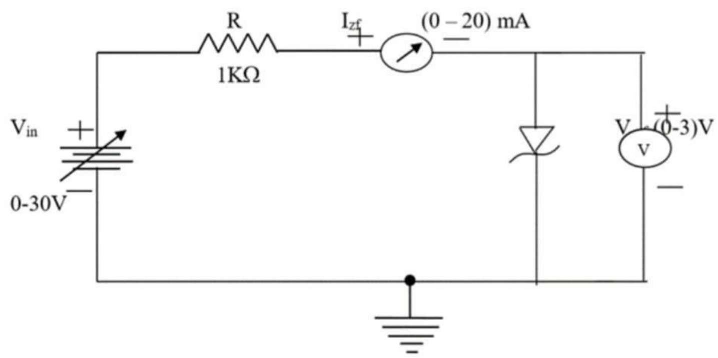
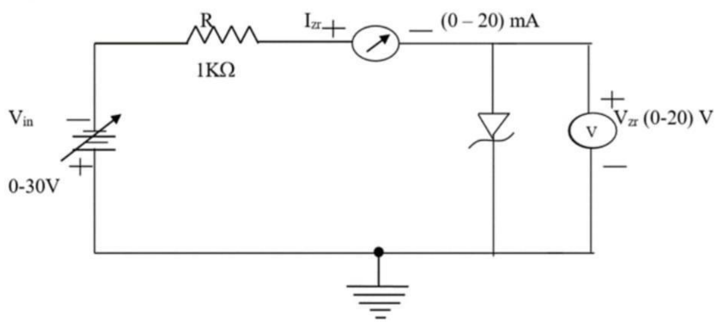


Fig (2) – Reverse Bias Condition:



4. Increase the voltage slowly and note down the corresponding current. Notedown the observation in table no. 1
5. Plot a graph between voltage and current.

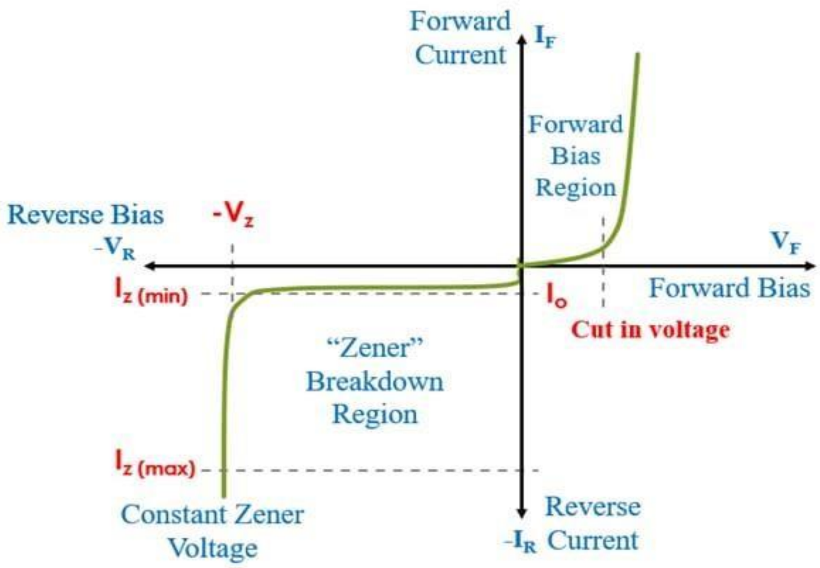


TABLE NO.1

SNO.	FORWARD VOLTAGE	FORWARD CURRENT
1		
2		
3		
4		
5		
6		
7		

For Reverse Bias Characteristics

1. Make all the connections as shown in fig.2.
2. Initially keep the current meter on 1.5 mA range, voltage selection knob on extreme left & Switch on the instrument.
3. Increase the voltage slowly & note down the corresponding current. As soon as the current increases beyond the current meter range, change the scale of the current meter to 15mA range using toggle switch. Note down the observations in table no.2
4. Keep on increasing the voltage till current is rising uniformly. At a particular voltage (the voltage rating of Zener diode), current rises abruptly. This is called Zener Breakdown Voltage of PN Junction Diode.Plot a graph between V & I for reverse characteristics as shown in above fig.

TABLE NO.2

SNO.	REVERSE VOLTAGE	REVERSE CURRENT
1		
2		
3		
4		
5		
6		
7		

RESULTS:

PRECAUTIONS:

1. All connections should be neat, clean and tight.
2. The Zener diode should be connected in reverse bias.
3. Voltmeter and microammeter of appropriate least count and ranges are to be chosen.
4. Zero error if any in the voltmeter or milliammeter should kept nil..

REFERENCES:

- V.K. Mehta,(Principles of Electronics)
- Louis Nashelsky and Robert Boylestad (Electronic devices and circuit theory)

INSTRUCTION MANUAL

FOR

SINGLE STAGE COMMON EMITTER AMPLIFIER

Objective: Study of single stage common emitter amplifier.

Single Stage RC Coupled Amplifier circuit has been designed to study the:

1. Voltage Gain & Frequency response of First Stage Amplifier.The instrument comprises of the following built in parts :-

i. Fixed Output DC Regulated Power Supply of -12 VDC connected to the circuits internally

ii. One PNP transistors (CK100) is mounted on the front panel for amplification purpose

iii. Combination of Resistances and capacitors are connected in the circuit for biasing of transistors

iv. One SPST switches is provided on the front panel for feed-back purpose.

ADVANTAGES OF R.C COUPLING

1. It requires no expensive or bulky components and no adjustments. Hence, it is small and inexpensive.
2. It has excellent frequency response. The gain is constant over the audio frequency range
3. Its overall amplification is higher than that of the other couplings
4. It has minimum possible non-linear distortion because it does not use any coils or transformer which might pick upundesired signals. Hence, there are no magnetic fields to interfere with the signal.

PROCEDURE

1. Connect with frequency signal generator across input terminals. Set it at a sine wave of 100 Hz, 20mV peak to peak amplitude.
2. Connect CRO across output of first stage amplifier.
3. 3.Switch ON the instrument as well as CRO.
4. Throw the feed-back SPDT switch (S1) towards, with feed-back position and keep switch (S) to OFF position.
5. Observe the output signal on CRO. Adjust the output signal through set amplitude potentiometer provided on the frontpanel. Calculate the voltage gain of first stage by using formula:

Voltage Gain (Av1) = Output Voltage (P-P)/ Input Voltage (P-P)

6. Repeat the same procedure for without feed-back position for this throw the feed-back switch (S1) toward without feed-back position.

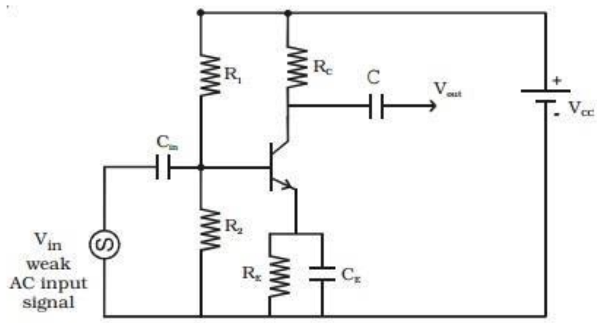


Fig Single stage CE amplifier

OBSERVATION TABLE

SNO.	FREQUENCY	INPUT SIGNAL	OUTPUT SIGNAL	GAIN OUTPUT/INPUT

RESULTS:

PRECAUTIONS:

1. Vary the input signal frequency slowly.
2. Connect electrolytic capacitors carefully.
3. All connections should be neat, clean, and tight.
4. Identify the emitter, base, and collector of the transistor properly before connecting it the circuit.

REFERENCES:

- V.K. Mehta,(Principles of Electronics)
- Louis Nashelsky and Robert Boylestad (Electronic devices and circuit theory)

INSTRUCTIONAL MANUAL

FOR

TRANSISTORISED COLPITT'S OSCILLATOR

Objective : Study of the transistorized Colpitt's Oscillator.

Transistorized Colpitts's Oscillator has been designed to study the wave shape & frequency produced by Colpitts Oscillator.The instrument comprises of the following built in parts:-

1. Fixed output DC regulated power supply of 12volts.
2. One medium wave frequency coil is mounted inside.
3. Amplifier circuit consists of Transistor (CL100), Inductance (45µH), Resistance & Capacitors combination.
4. Tank circuit consists of medium wave frequency coil in parallel with capacitor

THEORY

Oscillator is an important device for many electronic circuit applications and its prime function is to generate waveforms at constant amplitude and desired frequency Basically an oscillator is a electronic circuit which converts DC supply voltage to an output wave form of some frequency. The oscillator circuit must also be capable of producing constant oscillations. The oscillators are classified into two basic categories: Sinusoidal & Non - sinusoidal. If the wave form generated looks like sine wave, the circuit is called a sinusoidal oscillator and the circuit producing all other wave forms are called non- sinusoidal oscillator. Sometimes, the oscillators are also classified on the basis of frequency of the generated wave form, viz. Audio frequency, radio frequency and ultra-high frequency oscillators.

Each oscillator has a tank circuit. This tank circuit consists of inductance coil (L) connected in parallel with capacitor (C). The frequency of oscillations in the circuit depends upon the value of the coil and capacitance of capacitor. The frequency of the oscillation is determined by the values of the C1, C2 & L and is given by

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

where, $C = C1.C2/C1 + C2$

PROCEDURES

1. Connect the CRO probes across the output of the Colpitts Oscillator.

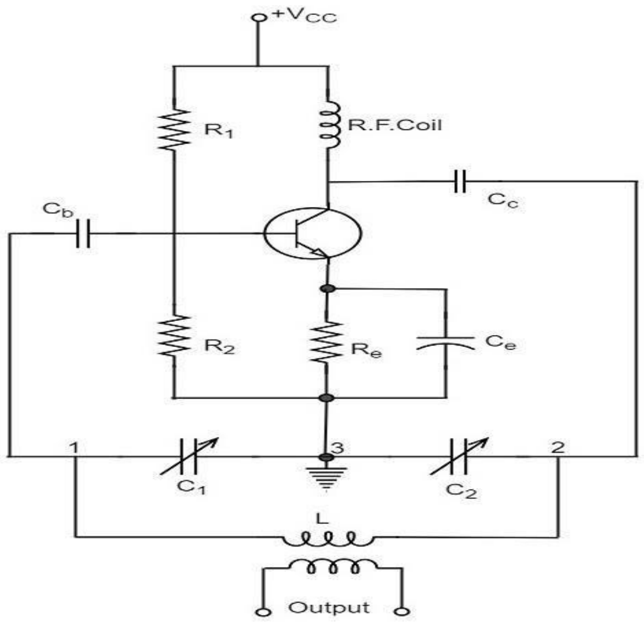
2. Switch ON the instrument as well as CRO

3. Observe the output waveform on CRO and note down the frequency of oscillations. The formula used to calculate the frequency of oscillations

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

where $C = C1.C2/C1 + C2$

4. Take different set of reading by changing the value of C using band switch.



Applications of Colpitts Oscillator

1. It is used for generation of sinusoidal output signals with very high frequencies.
2. The Colpitts oscillator using SAW device can be used as the different type of sensors such as temperature_sensor. As the device used in this circuit is highly sensitive to perturbations, it senses directly from its surface.
3. It is frequently used for the applications in which very wide range of frequencies are involved.
4. Used for applications in which undamped and continuous oscillations are desired for functioning.

5. This oscillator is preferred in situations where it is intended to withstand high and low temperatures frequently.
6. The combination of this oscillator with some devices (instead of tank circuit) can be used to achieve great temperature stability and high frequency.
7. It is used for the development of mobile and radio communications.

RESULT :

PRECAUTIONS: -

1) Check the continuity of the connecting terminals before going toconnect the circuit.

2) Identify the emitter, base, and collector of the transistor properly before connecting it the circuit.

3) The horizontal length between two successive peaks should accurately be measured.

REFERENCES:

- V.K. Mehta,(Principles of Electronics)
- Louis Nashelsky and Robert Boylestad (Electronic devices and circuit theory)

INSTRUCTION MANUAL

FOR

HARTLEY OSCILLATOR

Objective: Study of Hartley Oscillator.

Hartley Oscillator has been designed to study the following-

1. RF Oscillations produced by the circuit
2. Change in the frequency of oscillations with the change in the inductance provided on front panel

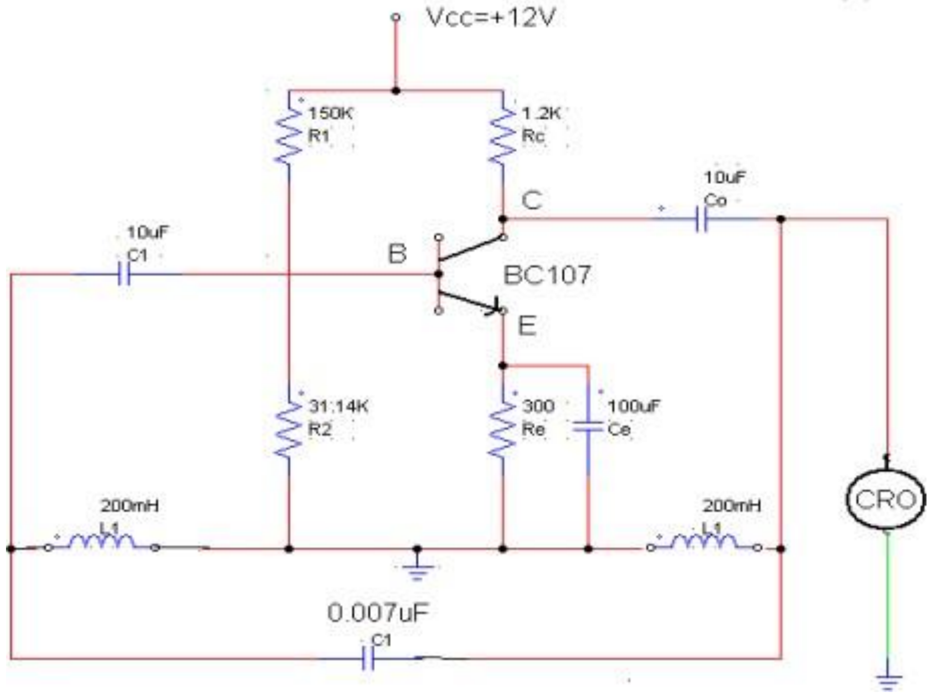
The instrument comprises of the following built in parts:-

1. Fixed output DC Power supply of 12V
2. Two inductance L1 & L2 have been provided & hence two different frequencies can be produced.
3. Transistor BC 109, Resistance and Capacitor are provided
4. Transistor (BC 109) & Biasing circuit is provided on the front panel to give 180° phase shift

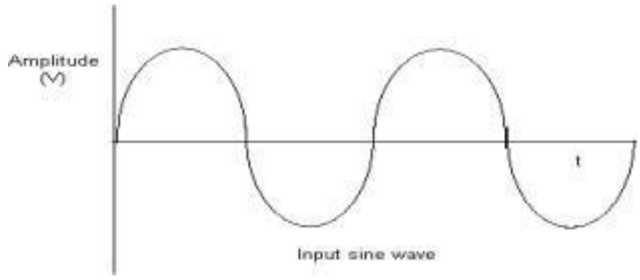
THEORY

Hartley Oscillator using a junction transistor in the common emitter mode is shown in the circuit diagram. Inductors L1, L2, and capacitor C form the tank circuit. Resistance RL and Vcc provide the biasing for the Hartley oscillator. Capacitor C1 and CB block and bypass capacitors since the transistor is operating in common emitter mode, it introduces a 180° phase difference between its input and output voltage, and the output voltage appears in the tank circuit. A part of this voltage appears across inductance L1 and is fed back to the input circuit. Feedback voltage is again 180° out of phase with the output so that a net 360° phase difference around the loop results in oscillations.

DAIGRAM



Model Graph



PROCEDURES

1. Connect the circuit by connecting dotted lines through patch cords, this connects inductor L1 in the circuit.
2. Connect Frequency Counter/ CRO across output sockets
3. Switch ON the instruments using the ON/OFF toggle switch provided on the front panel.
4. Observe the wave shape on CRO and note down the frequency of oscillation from CRO
5. Repeat step 4 for the other coil L2 after having disconnected L1.
6. Compare the observed frequency with the calculated frequency by using the formula:

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

$$L1 = 12\mu H \pm 10\%$$

$$L2 = 25\mu H \pm 10\%$$

$$C1 = 0.01\mu F$$

Observation Table

SNO.	Amplitude(V)	Time (ms)	Frequency(KHz)

Results:

PRECAUTIONS:

1) Check the continuity of the connecting terminals before going to connect the circuit.

2) Identify the emitter, base and collector of the transistor properly before connecting it in the circuit.

3) The horizontal length between two successive peaks should accurately measured

REFERENCES:

- V.K. Mehta,(Principles of Electronics)
- Louis Nashelsky and Robert Boylestad (Electronic devices and circuit theory)

INSTRUCTION MANUAL

FOR

PHASE SHIFT OSCILLATOR

Objective: Study of Phase Shift Oscillator.

Transistor Phase shift oscillator has been designed to study the wave shape & frequency generated by Phase Shift Oscillator. The instrument comprises of the following built-in parts:

1. Fixed DC regulated power supply of-12V
2. A phase shift network consists of three sections R1C1, R2C2 & R3C3. The total phase shift produced by the RC network is 180°.
3. One PNP Transistor for further phase shift of 180°.

THEORY

Oscillators using RC network are known as RC Phase Shift Oscillators. LC oscillators are used for generating high frequencies. These are not suitable for low frequency ranges, such as audio frequencies the alternative is RC network. The above block diagram shows the essential components of a transistorized phase shift oscillator.

1. TANK CIRCUIT:-

The tank circuit consists of three resistances connected in parallel with three capacitors. It is known as frequency determining network. The frequency of oscillations in the circuit depends upon the values of resistances & capacitors.

2. TRANSISTOR AMPLIFIER :-

The function of the amplifier is to amplify the oscillations produced by RC circuit. The amplifier receives DC power from the battery & converts it into AC power supplied to the tank circuit. The oscillations produced in the tank circuit are applied to the input of the transistor. The transistor increases the output of these oscillations

3. FEEDBACK CIRCUIT :-

The function of feedback circuit is to transfer a part of the output energy to R.C. network in proper phase. When the feedback is positive, the overall gain of the amplifier is

Written as Af=A/1-AB where AB is feedback factor .

If AB=1, Afc. Thus the gain becomes infinity i.e., there is output without any input. In other words, the amplifier works as oscillator. The condition AB=1 is known as the Barkhausen criterion of oscillation

A transistor phase shift oscillator must introduce in-phase feedback from the output to the input to sustain oscillation. If a common emitter amplifier is used with a resistive collector load, there is a 180 °phase shift between the base & collector. Hence the phase shift feed back network between collector & base must introduce an additional 180º phase shift. at some frequency if oscillation is to take place. A transistor connected as a phase shift oscillator is shown on the engraved front panel of the instrument. In this common emitter amplifier, feedback is from the collector to the base, i.e. from the output to the input. The 3- section phase shift network consists of C1R1, C2R2, C3R3. So that each section may introduce a 60° phase shift (approx.) at the resonant frequency.

The frequency of the oscillations may be expressed as

$$f = 1/2\pi c[6(R1+VR1)^2+4(R1+VR1)RL]^{1/2}$$

Where C = 0.047µF

RL=2.2kΩ

R1=1.2kΩ

PROCEDURE

1. Connect 1k pot socket with ground.

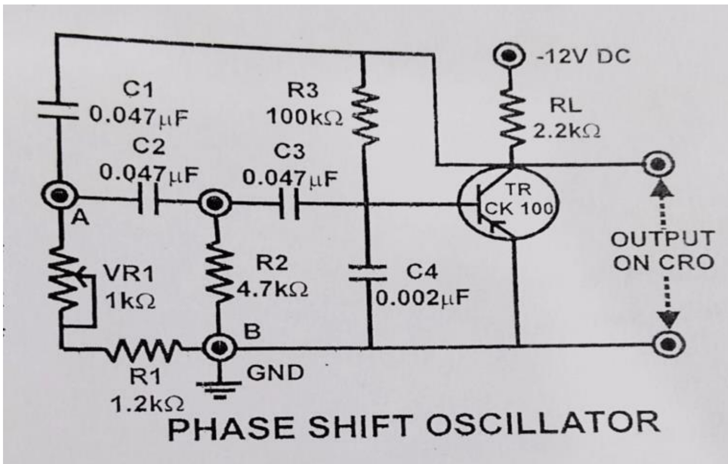
2. Connect the CRO probe at output terminals. Switch ON the instrument with an oscilloscope. Observe & measure the output frequency and peak to peak values of the output wave form.

3. By setting the frequency control pot knob at different positions, measure the value of output frequency with an oscilloscope (CRO) Compare this observed frequency with actual calculated frequency.

STANDARD ACCESSORIES

1. Instruction Manual.

<u>Circuit Diagram:</u>



<u>Results:</u>

<u>Precautions:</u>

1. All the connections should be correct.
2. Transistor terminals must be identified properly.
3. Reading should be taken without any parallax error.

REFERENCES:

- V.K. Mehta,(Principles of Electronics)
- Louis Nashelsky and Robert Boylestad (Electronic devices and circuit theory)

INSTRUCTION MANUAL

FOR

DESIGN OF REGULATED POWER SUPPLY

Objective: Designing and testing of 5v/9v DC regulated power supply and find its load regulation.

PRELAB

1. Design and create a SPICE model of a bridge-type, full-wave rectified, dc power supply using a filter capacitor.
2. Analyse the circuit for different values of filter capacitors. Observe the change in ripple content and comment on your observation.
3. Analyse the circuit for different load conditions. Observe the change in ripple content and comment on your observation.
4. From the IC 7805 datasheet, write down the minimum, typical and maximum values of the output voltage *V0*.
5. Determine the smallest value of the input voltage *VI* for which IC7805 can still work as a voltage regulator.

EQUIPMENT AND COMPONENTS USED

30 MHz Dual Channel Cathode Ray Oscilloscope 3 MHz Function Generator

0-30 V dc dual regulated power supply 4 ½ digit Digital Multimeter

230 V/ 9 V, 1A Step down transformer 1N4007 Diode

IC 7805

Resistor 100Ω, ¼W

Electrolytic Capacitor 1000µF/25V Ceramic Capacitor 0.33 µF, 0.1 µF Breadboard and Connecting wires BNC Cables and Probes

THEORY

- Every electronic circuit is designed to operate off of supply voltage, which is usually constant.
- A regulated power supply provides this constant DC output voltage and continuously holds the output voltage at the design value regardless of changes in load current or input voltage.
- The power supply contains a rectifier, filter, and regulator.
- The rectifier changes the AC input voltage to pulsating DC voltage.
- The filter section removes the ripple component and provides an unregulated DC voltage to the regulator section.
- The regulator is designed to deliver a constant voltage to the load under varying circuit conditions.

- The two factors that can cause the voltage across the load to vary are fluctuations in input voltage and changes in load current requirements.
- Load regulation is a measurement of power supply, showing its capacity to maintain a constant voltage across the load with changes in load current.
- Line regulation is a measurement of power supply, showing its capacity to maintain a constant output voltage with changes in input voltage.

FURTHER READING

1. Paul Horowitz and Winfeld Hill, *'The Art of Electronics'*, Cambridge University Press, New York, 2nd edition, 1989.
2. James Cox, 'Fundamentals of Linear Electronics: Integrated and Discrete', Delmar Thomson Learning, 2nd edition, 2001.
3. Price T.E., 'Analog Electronics: an integrated PSpice approach', Prentice Hall, 1997

DESIGN -

Design a 5 V DC regulated power supply to deliver up to 1A of current to the load with 5% ripple. The input supply is 50Hz at 230 V AC.

Selection of Voltage regulator IC:

Fixed voltage linear IC regulators are available in a variation of voltages ranging from -24V to +24V. The current handling capacity of these ICs ranges from 0.1A to 3A. Positive fixed voltage regulator ICs have the part number as 78XX.

The design requires 5V fixed DC voltage, so 7805 regulator IC rated for 1A of output current is selected.

Selection of Bypass Capacitors:

The data sheet on the 7805 series of regulators states that for best stability, the input bypass capacitor should be 0.33µF. The input bypass capacitor is needed even if the filter capacitor is used. The large electrolytic capacitor will have high internal inductance and will not function as a high frequency bypass; therefore, a small capacitor with good high frequency response is required. The output bypass capacitor improves the transient response of the regulator and the data sheet recommends a value of 0.1µF.

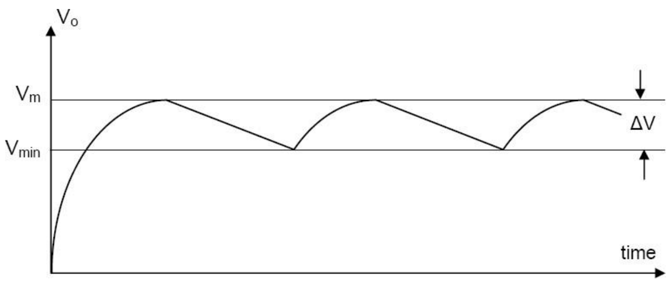
Dropout voltage

The dropout voltage for any regulator states the minimum allowable difference between output and input voltages if the output is to be maintained at the correct level. For 7805, the dropout voltage at the input of the regulator IC is Vo +2.5 V.

$V_{dropout} = 5+2.5 = 7.5V$

Selection of Filter Capacitor:

The filter section should have a voltage of at least 7.5V as input to regulator



IC. That is Vdc = 7.5 V

Figure 1: Output wave shape from a full-wave filtered

rectifier Ripple voltage = ΔV = Vr

Two figures of merit for power supplies are the ripple voltage, Vr, and the ripple

$$V_r(rms) = \frac{V_m - V_{\min}}{2\sqrt{3}} = \frac{V_r}{2\sqrt{3}}$$

factor, RF. RF = Vr(rms) / Vdc

Vdc = 2Vm/π = 0.636 Vm

$$V_{dc} = V_m - \frac{V_r}{2} = \frac{V_m + V_{\min}}{2}$$

Vr = IL x Toff/C can be solved for the value of C.

The ripple frequency of the full-wave ripple is 100 Hz. The off-time of the diodes for 100 Hz ripple is assumed to be 85%. Toff = 8.5mS.

C = IL x Toff / Vr

Selection of Diodes:

1N4007 diodes are used as it is capable of withstanding a higher reverse voltage, PIV of 1000V whereas 1N4001 has PIV of 50V.

Selection of Transformer:

Maximum unregulated voltage, Vunreg(max) = Vdropout + Vr =

Two diodes conduct in the full-wave bridge rectifier, therefore peak of the secondary voltage must be two diode drops higher than the peak of the unregulated DC.

Vsec(peak) = Vunreg(max) + 1.4V

= Vsec(rms) = 0.707 x Vsec(peak)

=

The power supply is designed to deliver 1A of load current, so the secondary winding of the transformer needs to be rated for 1A.

CIRCUIT DIAGRAM

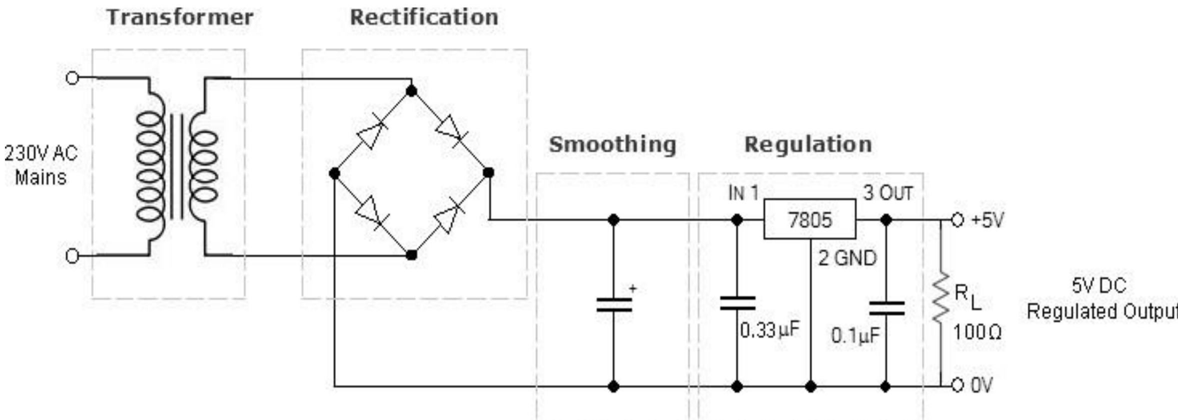


Figure 2

PRACTICE PROCEDURE

1. Power Supply

1. Connect the circuit as shown in Figure 2.
2. Apply 230V AC from the mains supply.
3. Observe the following waveforms using oscilloscope

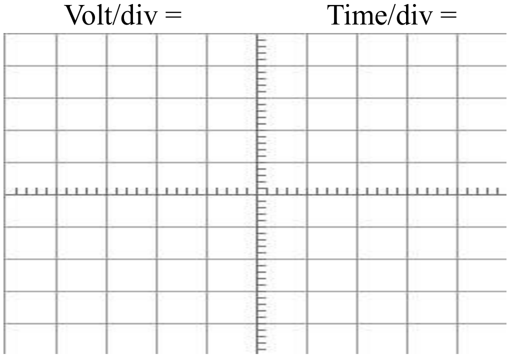
(i) Waveform at the secondary of the transformer

(ii) Waveform after rectification

(iii) Waveform after filter capacitor

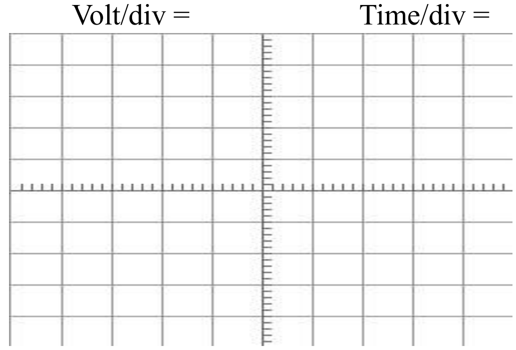
(iv) Regulated DC output

Volt/div = Time/div =



Graph 1: Waveform at the secondary of the transformer

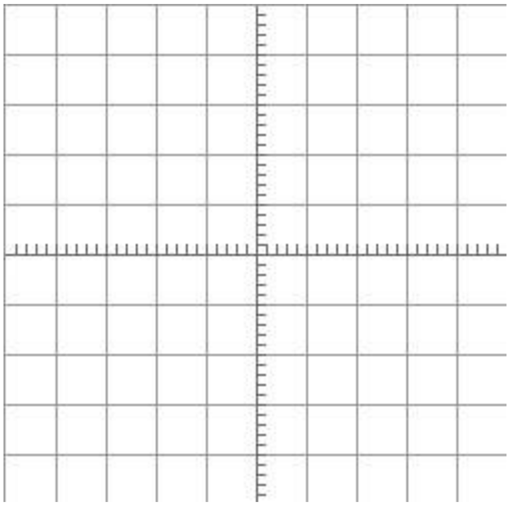
Volt/div = Time/div =



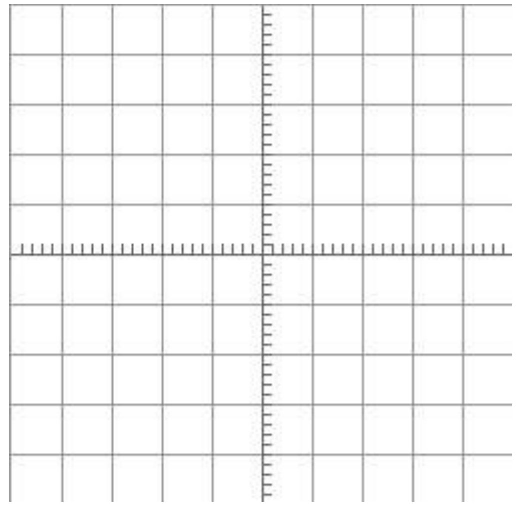
Graph 2: Waveform after rectification

Volt/div = Time/div =

Volt/div = Time/div =



Graph 3: Waveform after filter capacitor



Graph 4: Regulated DC output

2. Load Regulation

1. Observe the No load voltage and Full load voltage
2. Calculate the load regulation.

Load Regulation = ((VNL – VFL)/VFL) x 100 %

Theoretical efficiency of linear voltage regulator =

RESULTS:

PRECAUTIONS:

1. Use the Power Supply in the standard mounting.
2. All the connections should be correct.
3. Check the continuity of the connecting terminals before going to connect the circuit.

REFERENCES:

- V.K. Mehta,(Principles of Electronics)
- Louis Nashelsky and Robert Boylestad (Electronic devices and circuit theory)

INSTRUCTION MANUAL
FOR
CLIPPING AND CLAMPING CIRCUITS

Objective: Study of Clipping and Clamping circuits.

THEORY Clipping Circuits

Clipping circuits are nonlinear wave-shaping circuits. A clipping circuit is useful to cut off the positive or negative portions of an input waveform. Clipping circuits are also known as voltage limiters or slicers.

Positive clipper

The positive half cycle is clipped by diode and only the drop across diode will appear across the load. During negative half cycle, the diode does not conduct and the voltage across RL is given by VL = Vs RL/ RL+ R

Since RL >> R, the output voltage will be close to input voltage during negative half cycle.

Negative clipper

The negative half cycle is clipped by diode and only the drop across diode will appear across the load. During positive half cycle, the diode does not conduct and the voltage across RL is given by VL = Vs R_L / (R_L + R)

Since RL >> R, the output voltage will be close to the input voltage during the positive half cycle.

Biased positive clipper

Here a reference voltage is given to the clipper circuit by a Zener diode. Up to Vz, the output voltage is Vo = Vin R_L /(R_L +R)

At Vo = Vz, the zener breakdown occurs and the voltage Vo is constant. Here the reference voltage is used to clip only a part of the positive half cycle.

Biased negative clipper

The principle is similar to that of a biased positive clipper. Here a reference voltage is provided by a zener diode to clip a portion of the negative half cycle. During the positive half cycle Vo = Vin R_L /(R_L+R)

Slicer

This is the combination of both biased positive clipper and biased negative clipper. The peak portion of the signal determined by the Zener voltage reference is clipped.

Clamping Circuit

Clamping is a function which must be frequently performed with a periodic waveform in the establishment of the recurrent positive or negative extremity at some constant reference level. Clamping circuits are also referred to as dc restorer or dc inserters.

A positive clamper adds positive dc level and a negative clamper adds a negative dc level. A positive clamper clamps a negative extremity of the input signal to the reference voltage level. A negative clamper adds to negative dc level by clamping the positive extremity of the input to the reference voltage level.

PROCEDURE

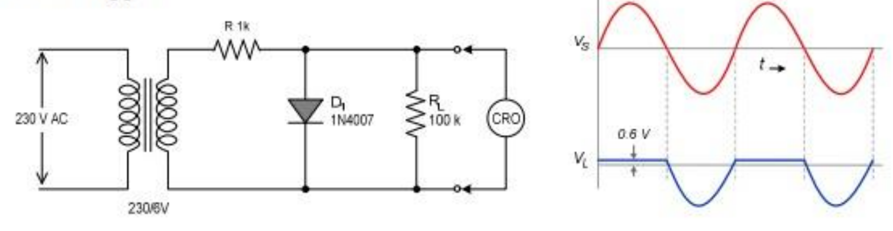
Experiment Procedure for Clipper –

1. Connect the function generator with CRO. Set sine wave with 6V peak to peak. Ensure that the offset voltage is 0.
2. Connect the function generator at the input of the clipping circuit.
3. Observe output waveforms on the CRO for different clipping circuits and draw output waveforms.

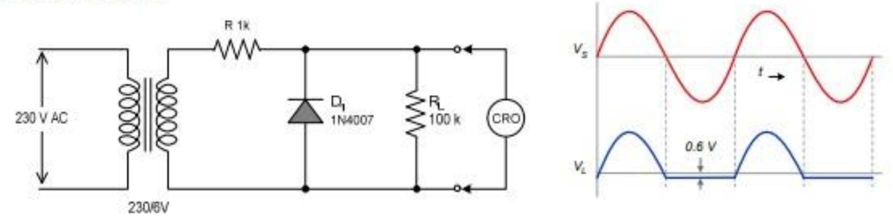
Experiment Procedure for Clamper –

1. Connect the function generator with CRO. Set sine wave with 4V peak to peak. Ensure that the offset voltage is 0.
2. Connect the function generator at the input of the clamping circuit.
3. Observe output waveforms on the CRO for different clamping circuits and draw output waveforms.

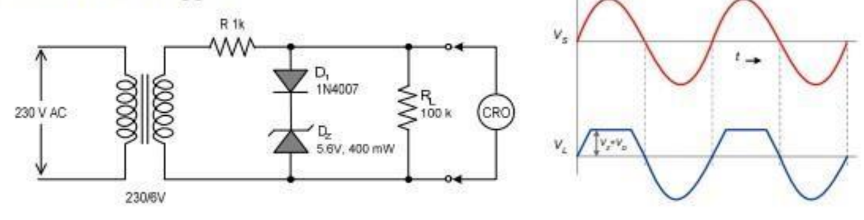
Positive clipper



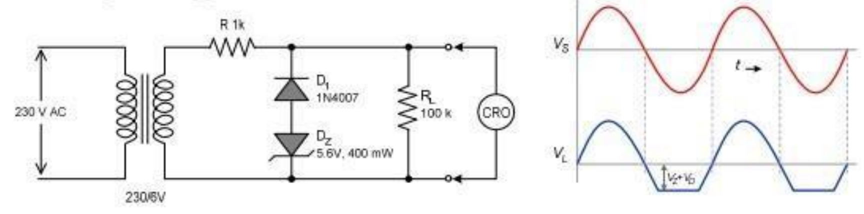
Negative clipper



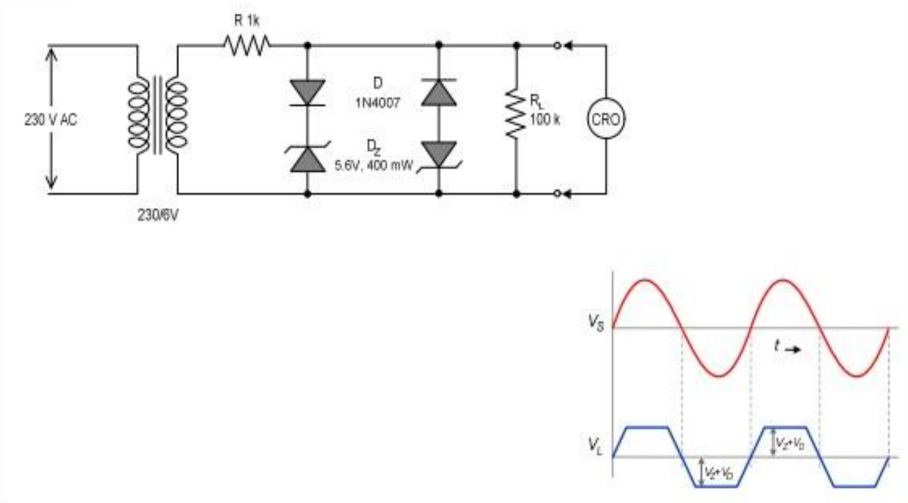
Biased Positive clipper



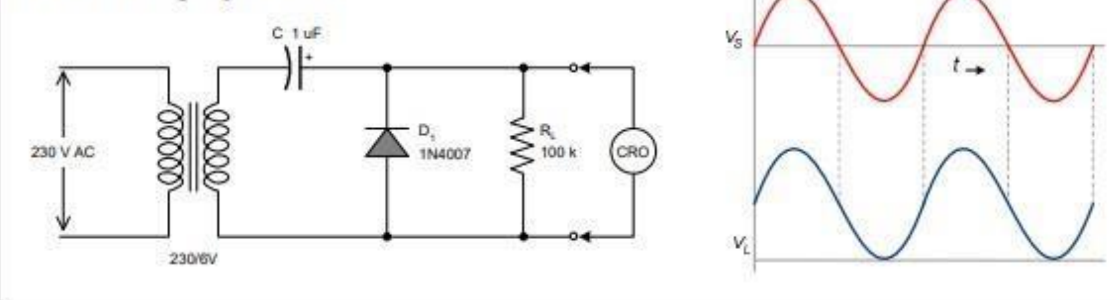
Biased Negative clipper



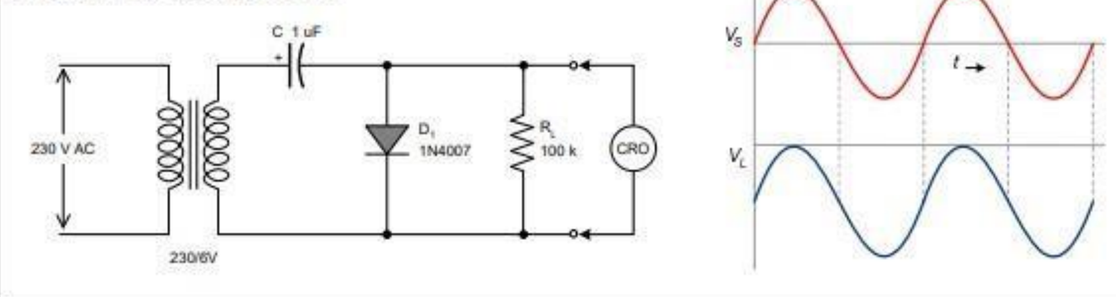
Slicer



Positive clamping Circuit



Negative clamping Circuit



Result :

Precautions :

1. Observe the wave shape on CRO.
2. Check the continuity of the connecting terminals before going to connect the circuit.
3. All the connections should be correct.

REFERENCES:

- V.K. Mehta,(Principles of Electronics)
- Louis Nashelsky and Robert Boylestad (Electronic devices and circuit theory)