Experiment: no - 01

Aim:- construct the circuit and plot the VI - characteristics of P-n junction diode and find cut in voltage.

Apparatus Required:-

- PN- junction diode
- Voltmeter (0-2 V)
- Voltmeter (0- 30V)
- mili - ammeter
- micro- meter
- Variable source (0-2 ovolt and 0-30 volt)

Theory:- P-N junction diode -

The voltage current Equation for the diode is the given by following formula.

$$I = I_0 \left(e^{V/nV_T} - 1 \right)$$

Hence, I = current through diode,
VT = Voltage Equivalent to exp (KT)

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η = Constant (1 for distance Ge and 2 for Si)

In forward bais ÷

When $V_F \neq V$, then $e^{V/\eta V_T} > 1$ thus (Eq 1) becomes are $I_F = I_0 e^{V/V_T}$.

Hence, the theoritical analysis indicates that foward current increases, exponantially with voltage. But, practically it is not found because PN-Junction diode has a certain barrier / threshold / knee potential. Initially the forward potential to the diode is used to neturalize this barrier potential.

Therefore the current is approximately zero. The current increases appreciatly after the barrier potential.

In Reverse bais ÷

When $V_R = -V_T$ then $e^{V/V_T} < 1$ then Eq (1) becomes as $I_R = -I_0$.

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CIRCUIT-DIAGRAM :-

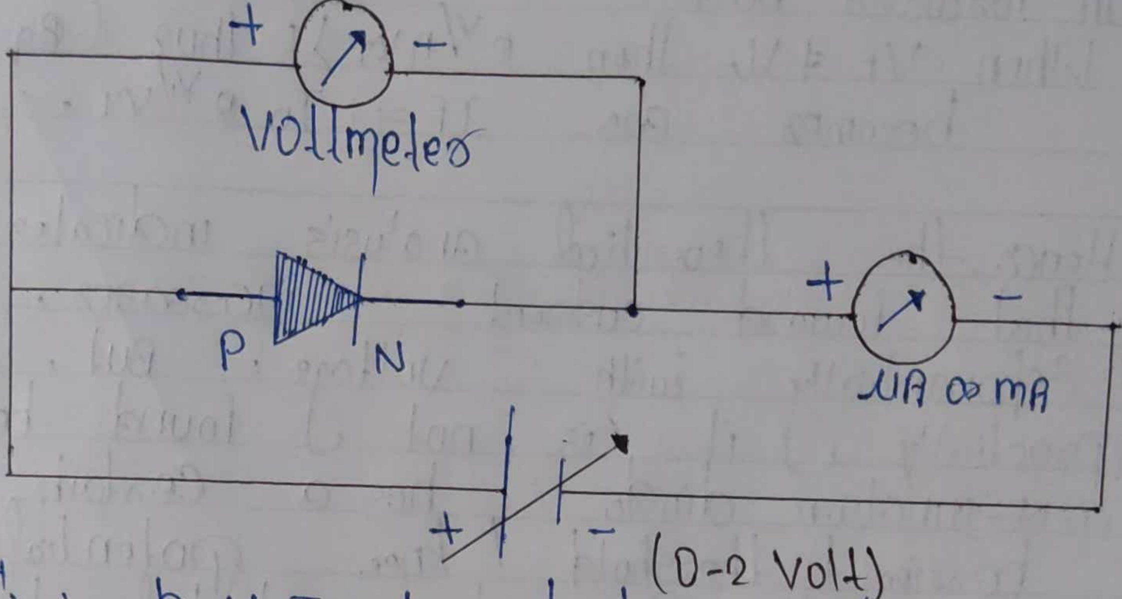

Fig :- P-N-Junction diode in F.B.

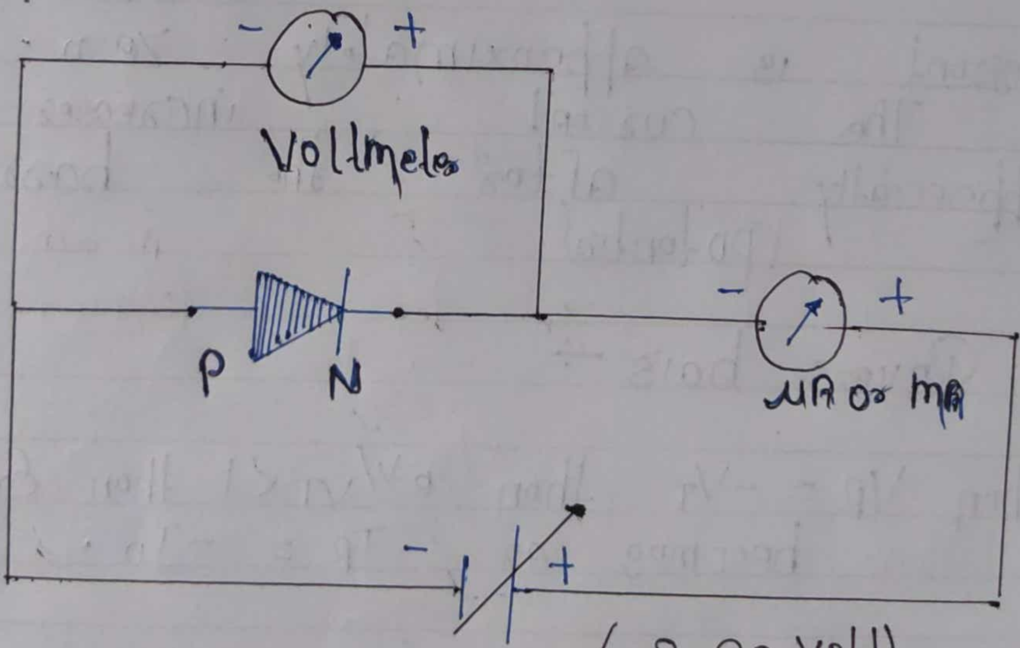

Fig :- P-N-Junction diode in R.B

Thus in reverse bais of diode a Constant current Flow through the diode whose direction is opposite to forward bais current. The current is known as reverse - Saturation current and it is idenpendent of voltage -

A large reverse bais voltage, the reverse bais current increases gradually to maximum due to alvanche breakdown voltage.

Observation -:

01 - least count of Voltmeter (0-2 volt) = 0.02V

02 - least count of voltmeter (0.30 volt) = 0.05V

03 - least count of milimeter = 0.2 mA

04 - least count of micro- ammeter = 0.5 μA

05 - VF and IF For P-N Junction diode in F.B -

S.no	VF(V)	IF(mA)
01	0	0
02	0.1	0
03	0.3	0
04	0.4	0
05	0.5	0
06	0.6	0.2
07	0.72	0.2
08	0.82	0.4
09	0.91	0.6
10	0.66	0.8

Fig :- In forward baising

S.no	VR (V)	IR(mA)
01	0	0
02	2	0.04
03	4	0.1
04	6	0.2
05	8	0.2
06	10	0.2
07	12	0.2
08	14	0.2
09	16	0.2
10	18	0.2

Fig :- In Reverse baising.

Calculation :-

Calculation of Static and dynamic Resistance for a given diode.

In Forward bais condition.

Static Resistance, $R_S = V_F / I_F =$

Dynamic Resistance, $R_D = \Delta V_F / \Delta I_F =$

In Reverse bais condition-

Static Resistance, $R_S = V_R / I_R =$

Dynamic " ", $R_D = \Delta V_R / \Delta I_R =$

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Procedure :-

A) Forward baising ←

01 Connection are made as per the circuit diagram.

02 For Forward bais, the R.P.S +ve is connected to the anode of the diode and R.P.S -ve is connected to the cathode of the diode.

03 Switch on the power supply and increases the input voltage (supply voltage) in step of 0.1 V.

04 Note down the corresponding current flowing through the diode and voltage across the diode for each other and every step of input voltage.

05 The reading of voltage and current are tabulated.

06 Graph is plotted between voltage (V) and X - axis and current (I) on Y - axis.

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B) Reverse baising :-

01 Connection are made as per the circuit diagram.

02 For Reverse bais, the R.P.S +ve is connected to cathode of the diode and R.P.S -ve is connected to the anode of the diode.

03 Switch on the power supply and increases the input voltage (supply) in step of IV.

04 Note down the crossponding current flowing through the diode voltage across the diode for each and every the input voltage.

05 The reading of voltage and current are tabulated.

06 Graph is plotted between voltage (VR) on X-axis and current (IR) on Y-axis.

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Precaution :-

01 The Connection should be tight Otherwise Flutuation in voltage and current happen.

02 AT the turning point of curve, more reading should be taken.

03 For the plot of graph, current should be taken mA For Both Forward and reverse baising diode.

04 The reading should be in multiple of least voltage. count.

05 Parallel Error should be avoided while taking the reading from the Analog meters.

06 All should be connection be True / correct.

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Result :-

The V-I Characteristic of PN Junction diode indicate that the Forward current in negligible up to the knee voltage / cut-in voltage. After that is approxmitely. The knee voltage for diode is 0.7 volt. In reverse bais, the constant current of μA order Flow through the diode and it gradually to max- at large reverse voltage.

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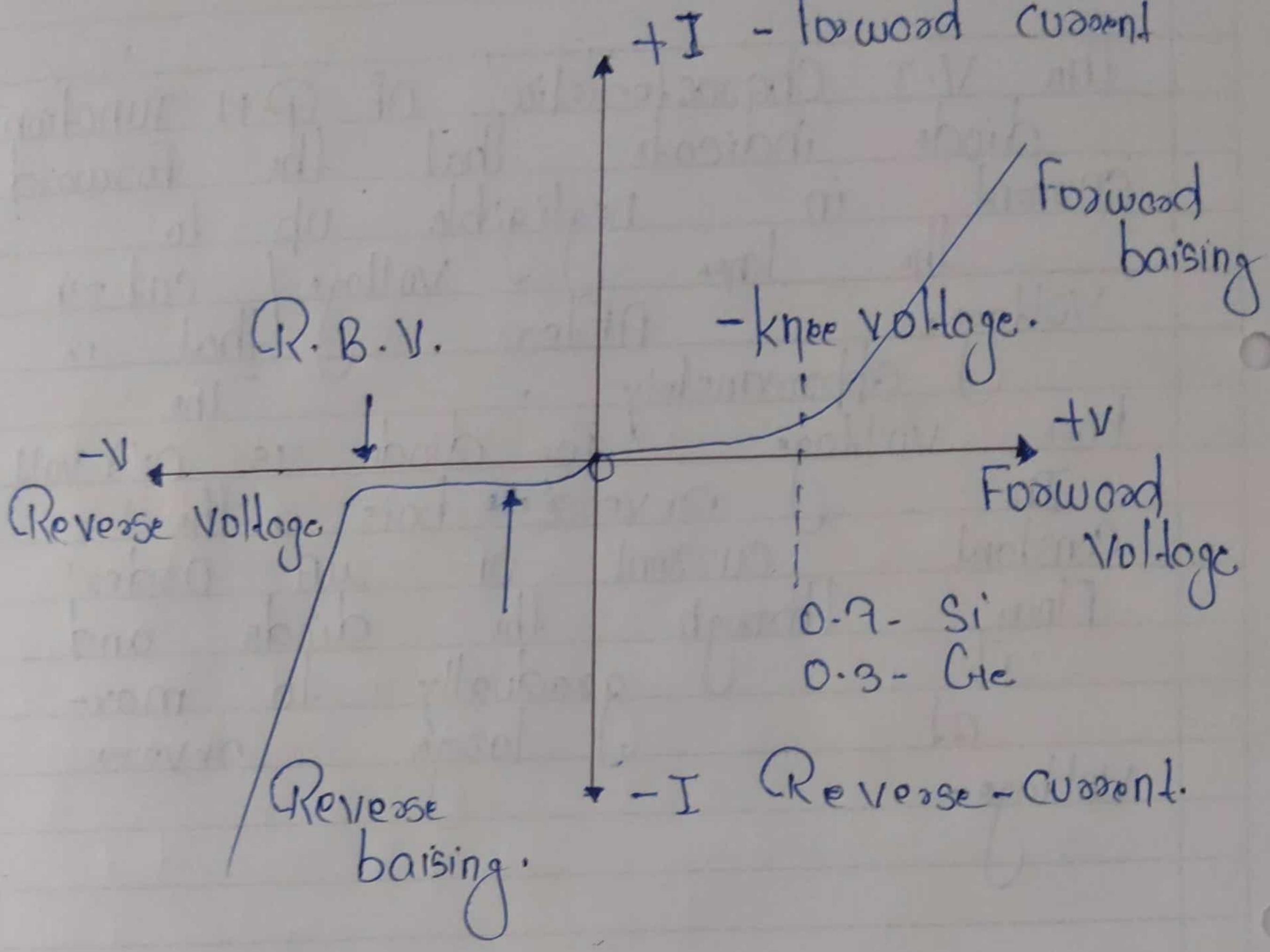
Modal-Graph:-



V-I. Chora of P-N Junction diode

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Experiment no - 02

Aim :- Construct the circuit and plot the characteristics of a Zener Diode. Find the breakdown voltage.

Apparatus Required :-

- Zener - diode;
- Voltmeter (0-2 volt)
- Voltmeter (0- 30 volt)
- mili - ammeter
- micro - ammeter
- Variable source (0-2 volt and 0-30 volt)

Theory :-

Zener diode :-

Zener diode is havily doped PN - junction diode. Due to heavily doped. It's depletion layer is very thin and is order of micro - meter. The Forward bais characteristics of Zener diode

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CIRCUIT - DIAGRAM ÷

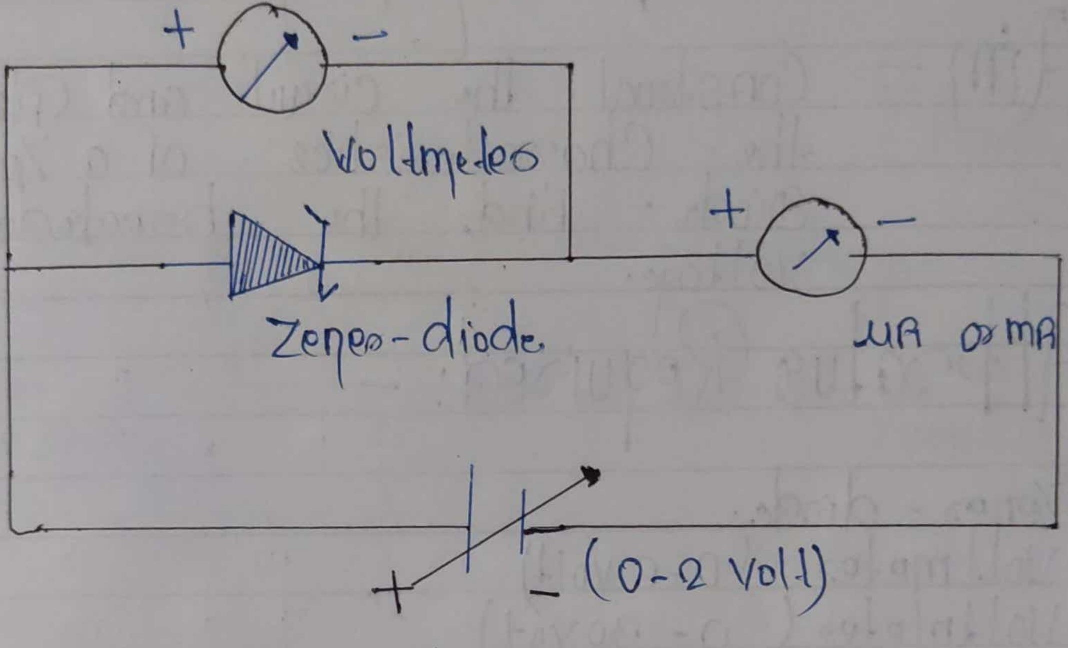

Fig ÷ Zener diode in F.B

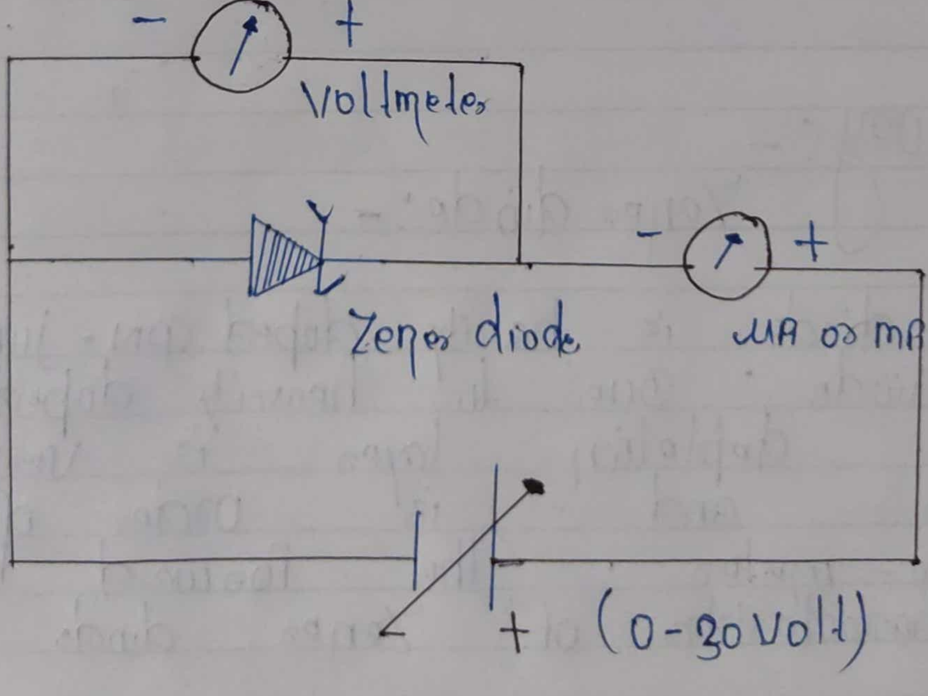

Fig = Zener diode in R.B

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is same as the normal P.N. junction diode but in reverse bais it has diff characteristics.

Initially a neglizible constant current flow through the Zener diode in its reverse baising but at certain voltage, the current becomes abruptly large. The voltage is called as zener voltage. This sudden and sharp increases in Zener current is called as Zener breakdown.

Observation:-

01 Least count of voltmeter (0-2 volt) = 0.02 V

02 Least count of voltmeter (0-30V) = 0.5 Volt

03 Least count of milimeter = 0.2 mA

04 least count of micro-ammeter = 5 μA

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S.no	VF(V)	IF(mA)
01	0	0
02	0.1	0
03	0.2	0
04	0.3	0
05	0.4	0
06	0.5	0
07	0.6	0.2
08	0.62	0.2
09	0.64	0.4
10	0.66	0.6
11	0.68	0.8

Fig - VF and IF For Zener diode in F.B.

S.no	VR(V)	IR(mA)
01	0	0
02	1	0
03	2	0
04	3	0
05	4	0
06	5	0
07	6	0
08	7	0
09	8	0
10	8.8	0.2
11	9	0.4

Fig ÷ VR and IR For Zener diode in R.B.

procedure:- (Zener breakdown voltage)

01 Connect the circuit as per circuit diagram on the break-board.

02 By changing the load resistance, kept constant I/p voltage at 5V, 10V, and 15 V as per table given below.

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Take the reading of o/p voltmeter ($V_0 = V_z$)

03 Now by changing the I/p voltage, kept constant load Resistor at 1k, 2k, 3k as per table given below.
Take the reading of o/p voltmeter ($V_0 = V_z$).

LOAD Regulation :-

S.no	R_L (Ω)	$V_{i1} = 5V$ $V_0 = (V)$	$V_{i2} = 10V$ $V_0 = (V)$	$V_{i3} = 15V$ $V_0 (V)$
01	100			
02	300			
03	500			
04	700			
05	900			
06	1k			
07	3k			
08	5k			
09	7k			
10	9k			

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Precaution:-

01 The Connection Should be tight otherwise fluctuation in voltage and current will happen.

02 At the turning point of curve, more reading show more reading should be taken.

03 For the plot of Graph, current should be taken mA for both Forward and reverse baising diode.

04 The reading should be multiple of least count.

05 The terminal of Zener diode should be properly identified.

Result:-

The VI char of Zener diode identified that charac of Zener diode is Forward bais is same as pn junction diode.

The sudden and sharp increases in Zener current is called as Zener breakdown -

V_{knee} = 0.7 volt and V_Z = 9 volt

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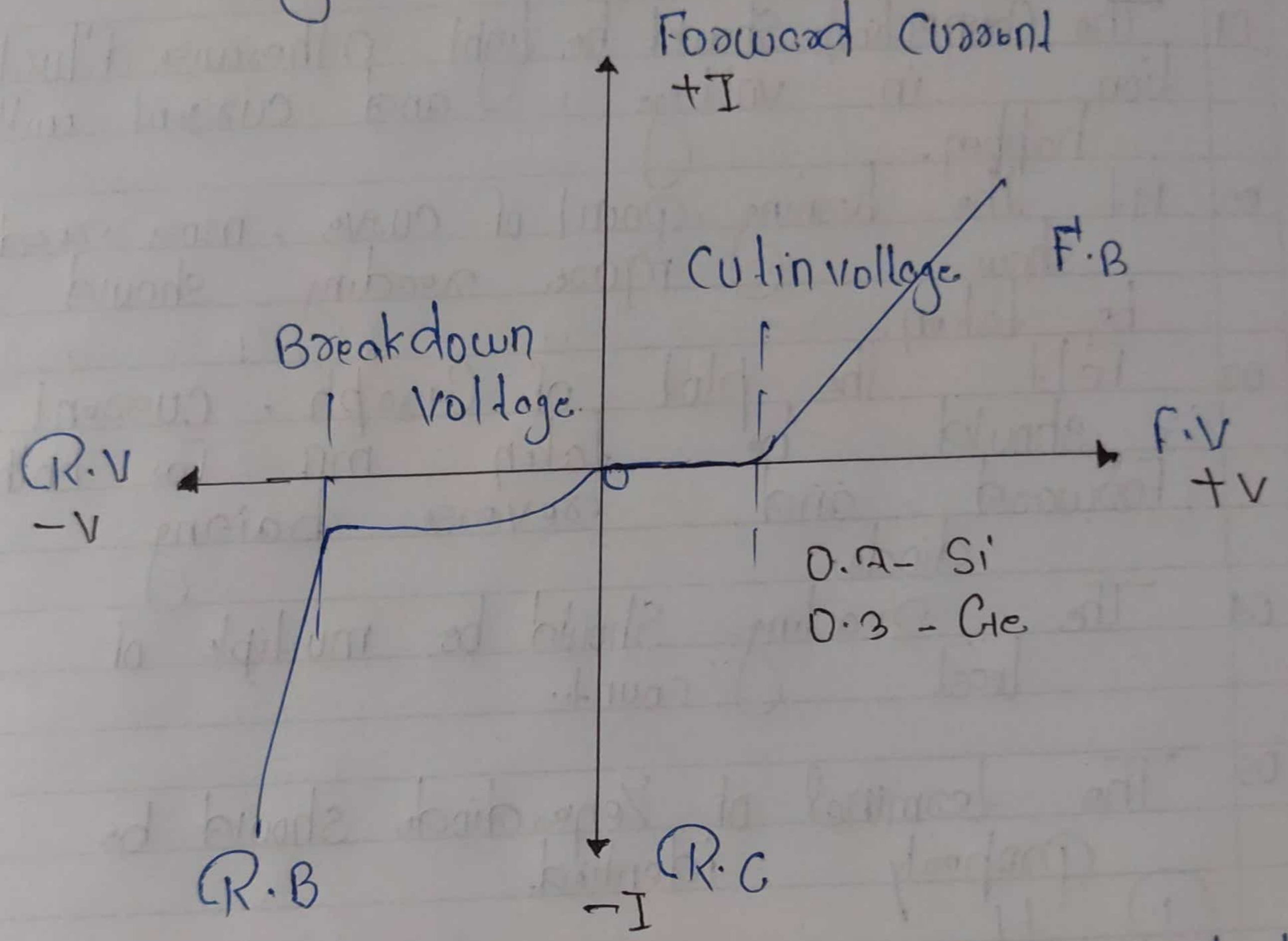
model - graph :-



V- I- Charac - of Zener - diode.

Experiment no - 03

Aim :- Construct a HALF wave - rectifier and obtain regulation char.... without Filters and with Filters. Compare the result.

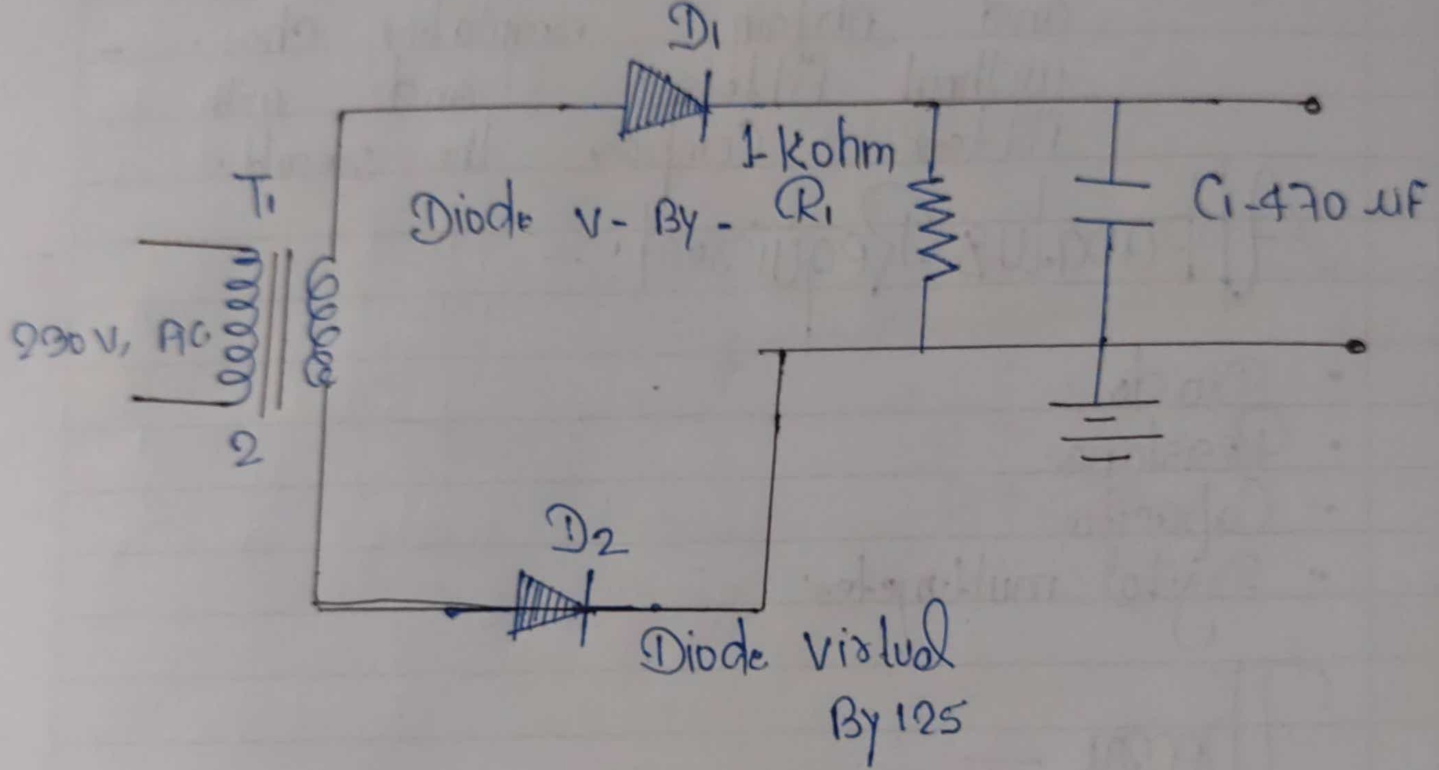
Apparatus Required :-

- Diode
- Resistance
- Capacitor
- Digital multimeter

Theory :-

The half wave rectifier consist of one rectifier circuit with common load. These are connected in such a way that conduction takes place through one diode in alternate half cycle and current through the load is sum to current, Thus - the output voltage waveform contains half sinusoidal in two half cycle of AC input signal.

CIRCUIT - DIAGRAM



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The output of a rectifier is a pulsating DC consisting of a DC component and superimposed ripple. A way to eliminate or reduce the ripple to the required level is to use a Filter.

For practicle circuit, transformer coupling is usally provide for two reason.

i) The voltage can be step-up or step-down as needed.

ii) The ac source is Electrically isolated from the rectifier, Thus preventing shock hazards in the Secondary circuit.

The Efficiency of Half wave rectifier = 40.6%

Theoritical calculation of Ripple Factor ÷

without Filter = $V_{rms} = V_m/2$

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$V_m = 2 V_{rms}$
$V_{dc} = V_m / \pi$

Ripple Factor $= r = \sqrt{(V_{rms}/V_{dc})^2 - 1}$
$= 1.21$

With Filters :-

Ripple Factor $= r = (1 / 2\sqrt{3} FCR)$

Tabulation :-
Without Filters ~~And~~ with Filters :-

S.no	Load R_L (in k-Ω)	O/P voltage Vac	V DC	% of Regul. $\frac{V_{NL} - L_{FL}}{V_{nL}} \times 100$
01	1			
02	2	–	–	– ×100%
03	3	–	–	– ×100%
04	4	–	–	– ×100%
05	5	–	–	– ×100%
06	6	–	–	– ×100%
07	7	–	–	– ×100%
08	8.08	–	–	– ×100%
				×

- V no load voltage (Vdc) = V

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Procedure:-

(without - Filters):-

01 Connect the circuit the as the circuit diagram.
02 Connect the CRO across the load..
03 Note down the peak value Vm of the observed on the CRO.
04 Switch the CRO into DC mode and observe the waveform, Note down the DC shift.
05 Calculate Vrms and V_{DC} Value by using the Formula.
06 Remove the load and measure the voltage across the circuit.
Take down the value of VNL.
Calculating the percentage the voltage regulation using the Formula.

Regulation = (VNL-FL)/VFL*1000

(With Filters):-

01 Connect the capacitor Filters across the load in above circuit diagram.

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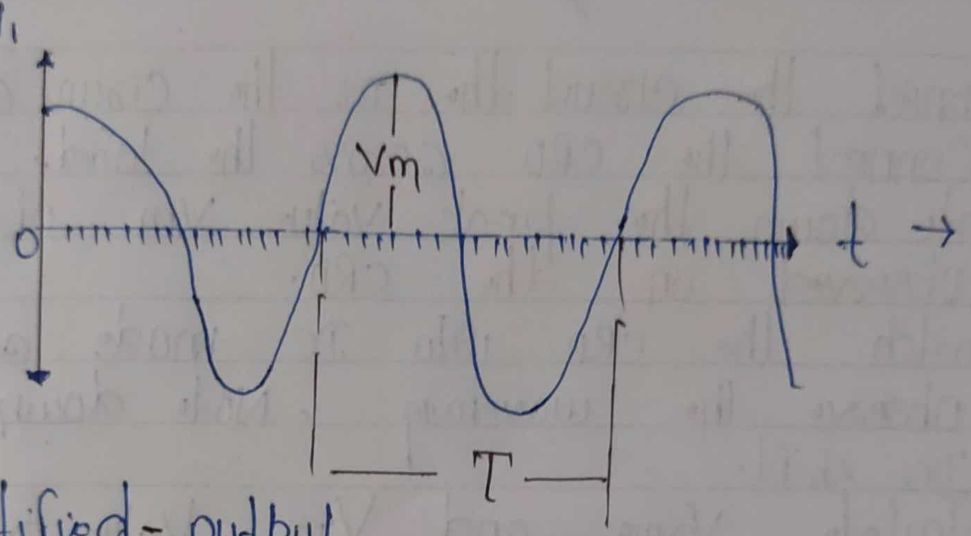
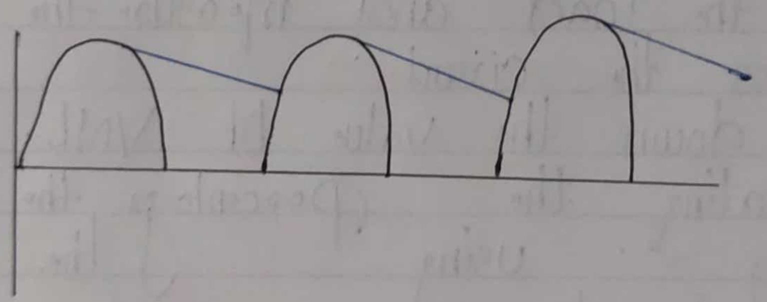
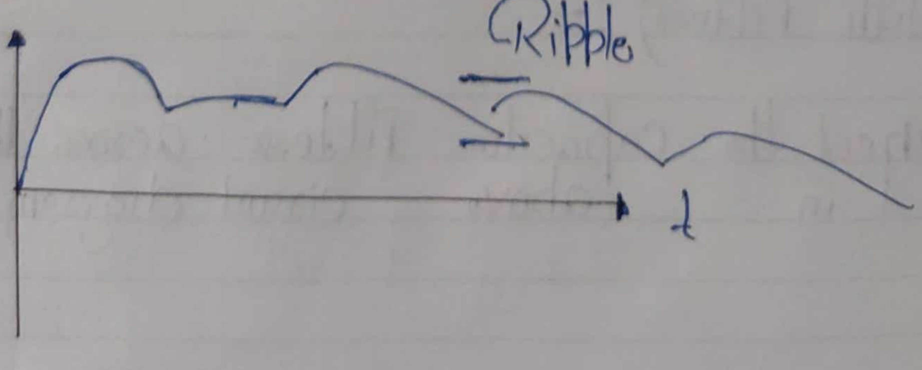
Expected - waveform :-



Rectified - output



Filters - output :-



02 Connect the capacitor filter across the
Proced with the same procedure
metioned above to measure Vr value
From the CRO and also dc
shift from CRO.

03 Calculate Vrms and Vdc by using the
Formula.

$V_{r,rms} = V_{dc} / 4\sqrt{3} FCRL$

$V_{dc} = 2V_M/\pi$

04 Calculating % regulation by using the
Formula –

$$\% \text{Regulation} = (V_{NL} - V_{FL}) / V_{FL} * 100$$

Precautions –

01 The primary and secondary side of Transformer should be carefully identified.

02 The polarities of all the diode should be ~~Corrly~~ Corolully identified.

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03 While determining the % regulation, First Full load should be applied and then it should be decremented in step.

Regulation characteristics :-

01 Connection are made as per the circuit diagram.

02 By increasing the value of rheostate, the voltage across the load, and current flowing through the load are connected.

03 The reading is tabulated.

04 From the voltage - no load, the % regulation is calculating using the Formula.

$$\% \text{ Regulation} = \left[(V_{NL} - V_{FL}) / V_{FL} * 100 \right]$$

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Experiment no- 04

Aim :- Construct a Full wave Rectifier and obtain regulation characteristics without and with Filters.

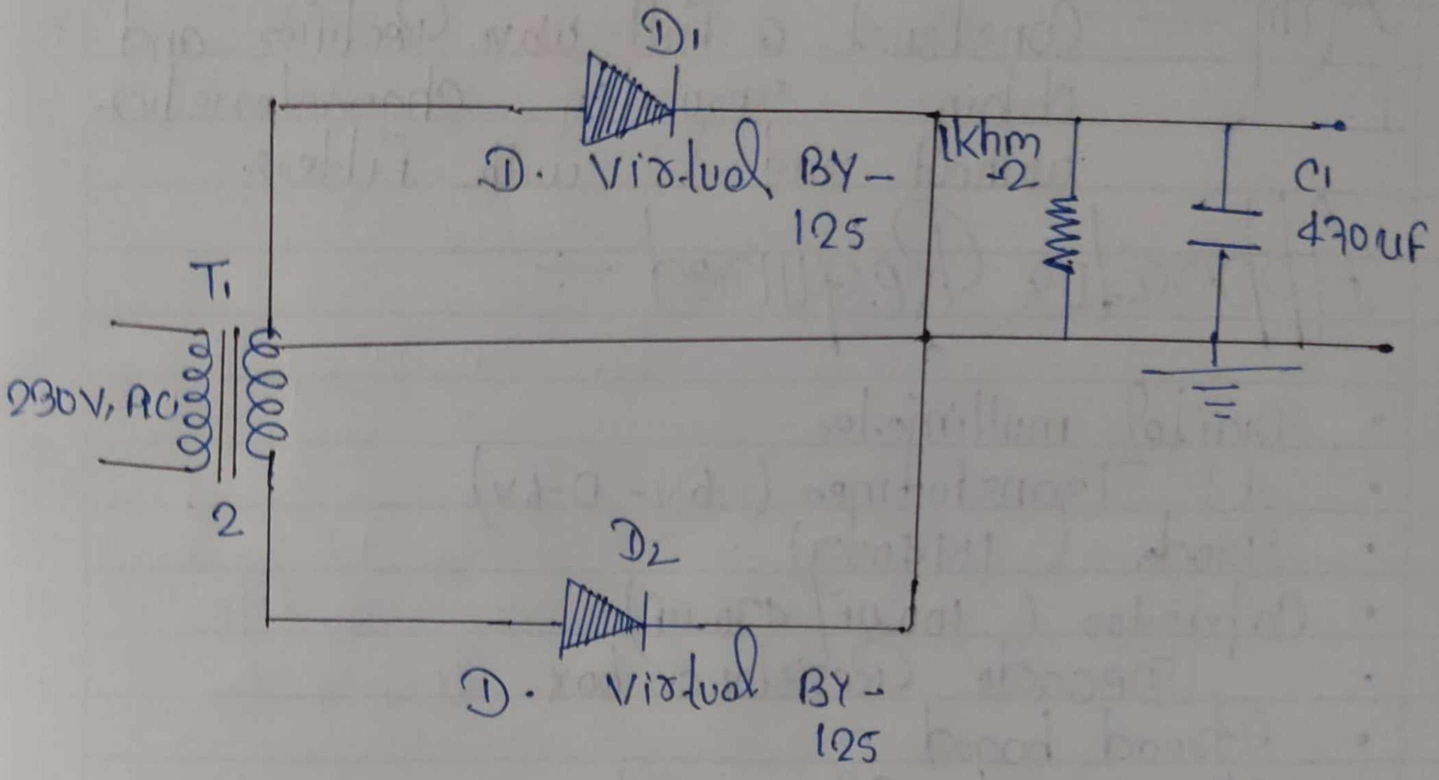
Apparatus Required :-

- Digital multimeter
- Transformer (6V- 0-6V)
- Diode (IN4007)
- Capacitor (100 uF/ 470 uF)
- Decade Resistance box
- Bread board
- CRO and CRO probes
- Connecting wires.

Theory :-

The F. wave rectifier Consist of two half rectifier circuit with Common load. These are connected in such a way that conduction takes place through two diode in a alternate half cycle and current through the load is sum

CIRCUIT- DIAGRAM :-



of two Current. Thus the output voltage waveform Contains two half sinusiodls in the two half cycle of Ac input signal.

The output of a rectifier is a pulsating Dc Constisting of a dc component and supraimosed ripple. A way of Elimate or reduce of the required level is to use a Filter.

Tabulation :-
Without Filters and with Filters :-

S.no	Load (RL) (Ω)	o/p Voltage (V)		% of Regulation ($\frac{V_n - V_F}{V_n} \times 100\%$)
		Voc (V)	Vdc (V)	
01	1			
02	2	—	—	— ×100%
03	3	—	—	— ×100%
04	4	—	—	— ×100%
05	5	—	—	— ×100%
06	6	—	—	— ×100%
07	7	—	—	— ×100%
08	8	—	—	— ×100%
				— ×100%

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Procedure:—

[without Filters] :-

01 Connect the circuit as per the circuit diagram.

02 Connect CRO across the load.

03 Note down the peak value of signal observed on the CRO.

04 Switch the CRO into DC mode and observed the waveform. Note down the DC shift.

05 Calculate the Vrms and Vdc, Value by using the Formula Calculate Vrms and Vdc by using the Formula.

→ $V_{rms} = V_m/\sqrt{2}$, $I_{rms} = I_m/\sqrt{2}$

→ $V_{dc} = 2V_m/\pi$, $I_{dc} = 2I_m/\pi$

06 Remove the load and measure the voltage across the circuit. Take down the value of V_{NL}, Calculating the percentage of voltage regulation using the Formula

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Using the Formula =

% Regulation = $(V_{NL} - V_{FL}) / V_{FL} * 100$

[with Filters] :-

01 Connect the Capacitor Filters across the load in the above (circuit diagram)

02 proceed with the same procedure mentioned above to measure V_T value from the CRO and also d.c shift from CRO.

03 Calculating V_{rms} and V_{dc} by using the formula

$$V_{T,rms} = V_{dc} / 4\sqrt{3} F C R_L$$

$$V_{dc} = 2V_m / \pi$$

where, V_r is peak to peak amplitude to Filter output.

04 Calculation % regulation by using the formula :-

% Regulation = $(V_{NL} - V_{FL}) / V_{FL} * 100\%$

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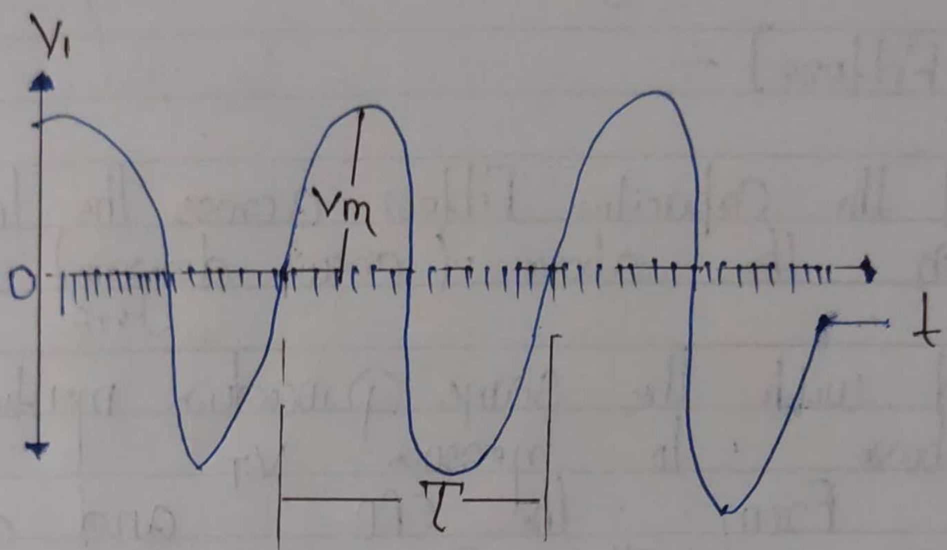
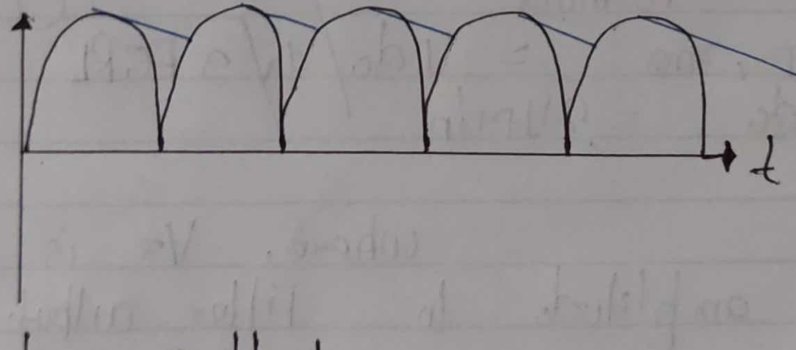
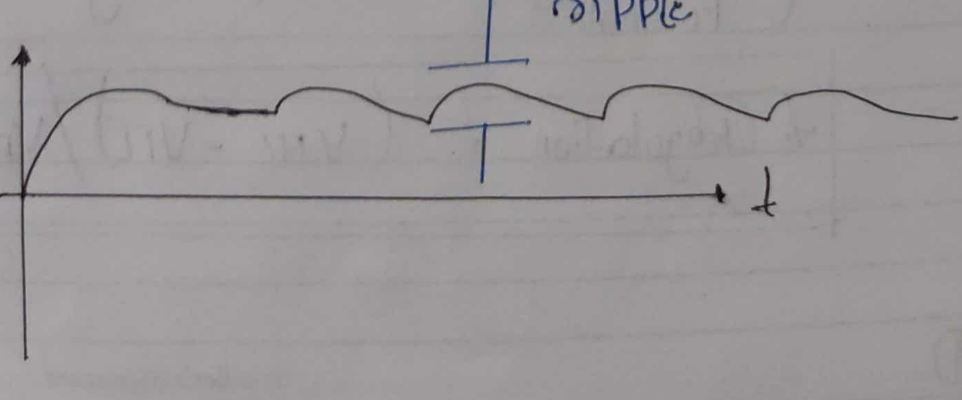
Expected - wave - form :



Rectified - output :



Filter - output



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Precaution :-

01 The primary and Secondary side of the transformer should be carefully identified.

02 The polarities of all the diode should be carefully identified.

% Regulation Char :-

$$= (V_{NL} - V_{FL}) / V_{FL} \times 100\%$$

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Experiment no - 05

Aim:- Construct a Bridge Rectifier and obtain regulation characteristics without and with Filters.

Apparatus Required :-

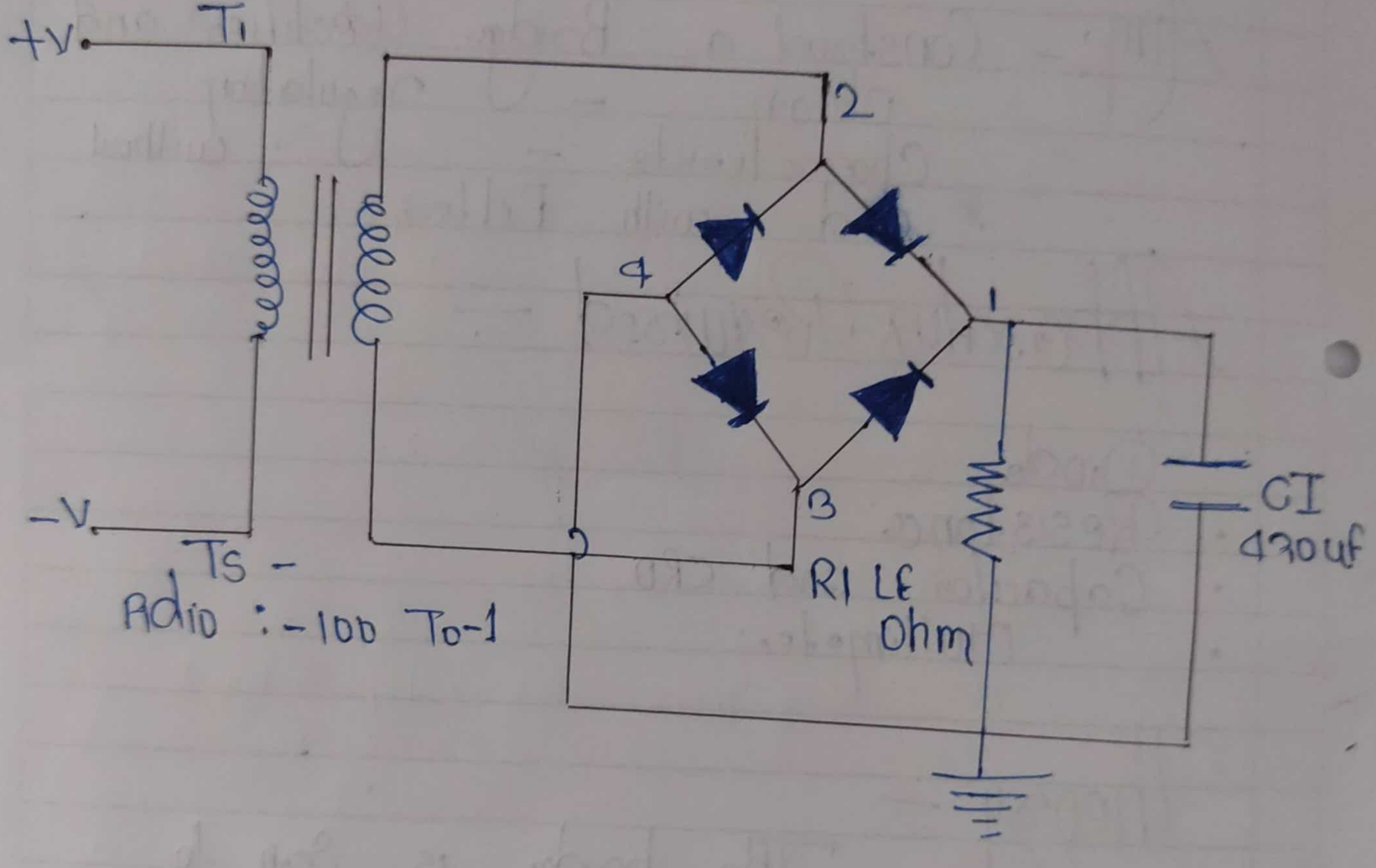
- Diode
- Resistance
- Capacitor and CRO
- Multimeter

Theory :-

The bridge is seen to consist of four diode connected with their arrowhead symbol all pointing towards the positive output terminal of the circuit.

During the positive half cycle of input voltage, the load current flow from the

CIRCUIT - DIAGRAM



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positive input terminal through D1 to RL and then through RL and D4 back to the negative input terminal. During this time, the positive input terminal is applied to the cathode of D_2 so, it is reversed baised and similiarly D_3 is also reverse baised.

These two diode are forward baising during negative half cycle. D_1 and D4 are reverse baising during this cycle. And finally both half cycle are rectified.

Procedure:-

[without filter] ÷

01 plot the Ac input voltage of the rectifier and the frequency.

02 Connect the circuit as per the circuit diagram.

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03 Connect CRO across the load.

04 Note down the peak value V_M of the single. Observed on the CRO.

05 Switch the CRO into DC mode and observe the waveform. Note down the DC shift.

06 Calculating V_{rms} and V_{DC} value by using the Formula

07 Remove the load and measure the voltage regulation and circuit take down the value

Regulation = $(V_{NL} - V_{FL}) / V_{FL} * 100\%$

[with Filter] :-

01 Connect the capacitor Filter across the load in the above circuit diagram.

02 procedure mentioned above to measure V_T Value and also dc shift from CRO.

03 Calculate V_{rms} by Using Formula

where, V_T = is the peak to Peak amplitude of output.

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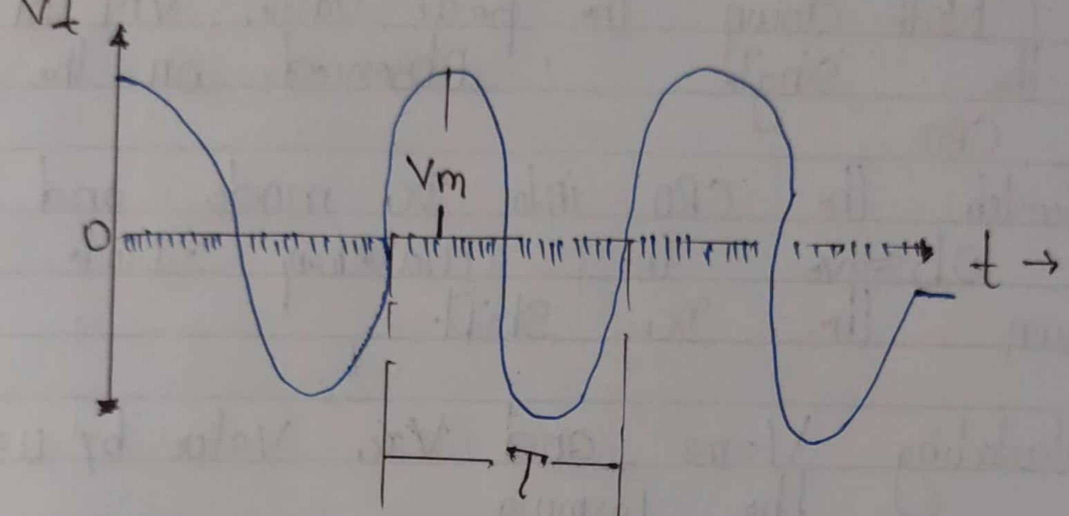
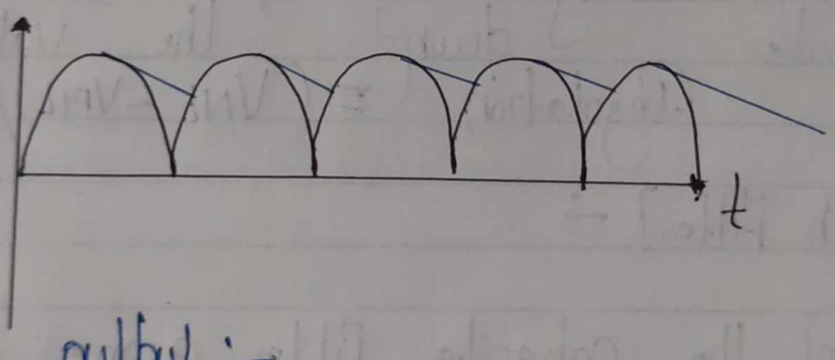
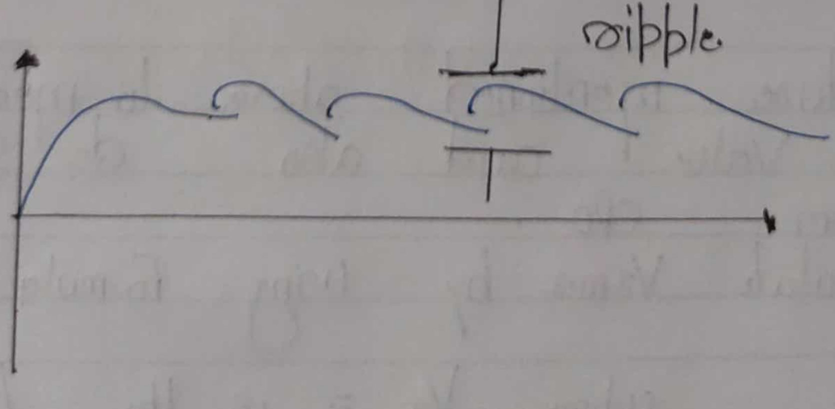
Expected waveform :-



Rectified output :-



Filters output :-



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~~D4 — By Usi~~

Discussion :—

1. Compare among the value of R.F
2. Discuss your result stating the Error Sources.

% Regulation Char :

By Using Formula —

$$\text{Regulation} = (V_{NL} - V_{FL}) / V_{FL} * 100\%$$

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Experiment no - 06

Aim:- Obtain the characteristics of DIAC and TRIAC.

A) For the DIAC :-

Apparatus Required:-

- Circuit board, 0-300 v high voltage supply, 0-30 voltage supply, voltmeter (0-100V), milimeter (0-1mA) multimeter, Connecting wire.

Theory :-

The DIAC is a diode that conduct Electrical current only after its break over voltage, VBO has been reached momentarily. The term is an acronym of diode For alternating current. When break-down occurs, The diode Enters a region of negative dynamic resistance,

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leading to decrease in voltage drop across the diode and usally, a sharp increase in current through the diode.

Most DIAC also called symmetrical trigger diode due to the symmetry of their char curve. Because DIAC are bi directional device, their terminal are not labled as anode and cathode but, as A1 and A2 or main terminal MT1 and MT2.

Tabulation:-

S.no	Forward direction		Reverse direction	
	Voltage(V)	Current(mA)	Voltage (V)	Current(mA)
01				
02				
03				
04				
05				

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Procedure:-

01 The Connection are made as shown in the circuit diagram.

02 Initially DIAC is a Connected in Forward direction.

03 The input supply is increased in step by varying the voltage of Power supply.

04 The corresponding ammeter and voltmeter reading are noted and Tabulated.

05 Then the DIAC is Connected in reverse condition.

06 The above Process are Repeated.

Result:- Thus the behind V-I Char of DIAC was obtained and graph was drawn.

Conclution:- Thus, was have studies V-I Char of diode..

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B) For the TRIAC :-

Apparatus Required :-

- Circuit board, 0-300V high voltage supply, 0-30 V low voltage supply, millimeter, (0-10 mA, 0-1 A), voltmeter (0-250). and Connecting wires.

Theory :-

TRIAC From triode for alternating current is a general name. For an Electronic component current in Either direction is tred (turned on) and Formally called a bidirectional triode thyristor or bilay triode thyristor.

Triac are a subset up thyristor and are closely related to silicon Controlled Rectifier. (SCR).

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Once trigged, the device continues to conduct untill current drops below a certain threshold called the holding current.

Procedure:-
[mode 1]:-

01 Connection made according to circuit diagram.

02 The value of Ig is set to convenient value by adjusting down Vgg.

03 By varying the supply voltage Vm gradually in step by step down the corresponding values of (Vm to V1) and i1 at the instant of firing of Triac and after firing by reducing the V. meter range and increase ammeter range), then the increased the supply voltage

Vm to V1 and i1

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03 The point at which TRIAC Free gives the value of over break voltage Vbo1.

04 A Graph of Vmt2t1 V/s is to be plotted.

05 The gate supply voltage Vgg to be switched off.

Mode 2 :-

01 Connect are made as shown in circuit diagram.

02 Step no :- 2, 3, 4, 5, 6 and 7 are to be repeated as in mode 1.

Result :- Behind, the value of V and I are noted down, plotted and Triac char are studied. The values obtained are verified.

Teacher's Signature : ....