Rajeev Gandhi Memorial College of Engineering and Technology

AUTONOMOUS

Nandyal – 518501, A. P., India

(ESTD-1995)

(A0491203) ELECTRONIC DEVICES AND CIRCUITS LAB

COURSE OBJECTIVES:

- This Lab provides the students to get an electrical model for various semiconductor devices. Students can find and plot V_I characteristics of all semiconductor devices. Student learns the practical applications of the devices. They can learn and implement the concept of the feedback and frequency response of the small signal amplifier

COURSE OUTCOMES:

- Students able to learn electrical model for various semiconductor devices and learns the practical applications of the semiconductor devices.
- Understand and analyse the applications of PN junction diode (Clipper, Clamper, Half wave rectifier and Full wave rectifier with and without filters)
- Understand the application of the Zener diode experimentally.
- Analyse the characteristics of different electronic devices such as PN diode, BJT and JFET
- Analyse the characteristics of MOSFET and CMOS inverter.

MAPPING WITH COs & POs:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				2				3				2		1
CO2	3	1	2		2				3				2	1	
CO3	3	3	2	2	1	2			3		2		2	2	
CO4	3	1	1	1		1			3				1	2	1
CO5	3	2	1	2		2			3		2		1	1	1

(For Laboratory examination – Minimum of 8 experiments)

1) PN Junction diode characteristics.
2) Zener diode characteristics and Zener as a Regulator.
3) Design a clipper circuit using PN junction diode.
4) Design a clipper circuit using Zener diode.
5) Design a clamper circuit using PN junction diode.
6) Rectifier without filters (Full wave & Half wave).
7) Rectifier with filters (Full wave & Half wave).
8) Transistor CB characteristics (Input and Output).
9) Transistor CE characteristics (Input and Output).
10) Design and verification of BJT biasing techniques
11) FET characteristics.
12) MOSFET characteristics.
13) Design and verification of MOSFET biasing techniques
14) CMOS inverter

Equipment required for Laboratories:

1) Regulated Power supplies (RPS) - 0-30v
2) CROs - 0-20M Hz.
3) Function Generators - 0-1 M Hz.
4) Multimeters
5) Decade Resistance Boxes/Rheostats
6) Decade Capacitance Boxes
7) Micro Ammeters (Analog or Digital) - 0-20 µA, 0-50µA, 0-100µA, 0-200µA
8) Voltmeters (Analog or Digital) - 0-50V, 0-100V, 0-250V
9) Electronic Components - Resistors, Capacitors, BJTs, LCDs, SCRs, UJTs, FETs, LEDs, MOSFETs, Diodes (Ge& Si type), Transistors (NPN&PNP type)

R.G.M.COLLEGE OF ENGINEERING & TECHNOLOGY, NANDYAL – 518 501

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

II B.Tech., I-Semester **Academic Year: 2022-23**

w.e.f: 07-10-2022

A-Section RB2130 B-Section RB2010

C-Section RB2020 D-Section RB2030

Period/ Day	Section	1	2	3	4	5	6	7
		9.00 AM To 9.50 AM	**9.50 AM To 10.40 AM**	**11.00 AM To 11.50 AM**	**11.50 AM To 12.40 PM**	**1.50 PM To 2.40 PM**	**2.40 PM To 3.30 PM**	**3.30 PM To 4.20 PM**
MON	A	SS	VC&CV	MEFA	DTI	DLCD	EDC	EDC
	B	DLCD	EDC	SS	MEFA	VC&CV	DTI	SS
	C	DTI	EDC	SS	DLCD	EDCLab/BS Lab/EE Lab		
	D	DLCD	SS	EDC	VC&CV	EDCLab/BS Lab/EE Lab		
TUE	A	EDCLab/BS Lab/EE Lab			SS	EDC	VC&CV	DLCD
	B	EDCLab/BS Lab/EE Lab			DTI	SS	DLCD	EDC
	C	DLCD	MEFA	SS	VC&CV	EDC	VC&CV	DTI
	D	SS	SS	EDC	EDC	DLCD	MEFA	VC&CV
WED	A	SS	EDC	DLCD	DTI	VC&CV	SS	MEFA
	B	DLCD	DTI	MEFA	SS	VC&CV	VC&CV	EDC
	C	EDCLab/BS Lab/EE Lab			EDC	MEFA	SS	DLCD
	D	EDCLab/BS Lab/EE Lab			SS	DLCD	EDC	MEFA
THU	A	DLCD	MEFA	VC&CV	EDC	EDCLab/BS Lab/EE Lab		
	B	VC&CV	MEFA	EDC	DLCD	EDCLab/BS Lab/EE Lab		
	C	EDCLab/BS Lab/EE Lab			VC&CV	EDC	SS	DLCD
	D	EDCLab/BS Lab/EE Lab			DLCD	DLCD	MEFA	DTI
FRI	A	EDCLab/BS Lab/EE Lab			DTI	MEFA	DLCD	SS
	B	EDCLab/BS Lab/EE Lab			VC&CV	SS	MEFA	DLCD
	C	DLCD	MEFA	VC&CV	DTI	SS	EDC	MEFA
	D	EDC	DTI	DLCD	VC&CV	MEFA	VC&CV	SS
SAT	A	SS	EDC	VC&CV	MEFA	DLCD	**EAA**	
	B	EDC	SS	DLCD	EDC	MEFA		
	C	SS	VC&CV	EDC	MEFA	DLCD		
	D	DTI	MEFA	VC&CV	SS	EDC		

Subject	Section	Name of the Faculty
VC&CV	A	Dr.K.V.Surya Narayana Rao
EDC	A	Dr.M.Chennakesavalu
DLCD	A	Dr.K.Mallikarjuna
S&S	A	Mr.P.Chandra Sekhar
MEFA	A	Mr.K Rama Krishna
DTI	A	Mr.Shaik.Asif Basha
EDC Lab	A	Dr.MCK/Mr.KMVK/YPKR
EE Lab	A	Mr.C.Ashok Kumar
BS Lab	A	Mr.PCS/Mr.JLMK/KSR

Subject	Section	Name of the Faculty
VC&CV	B	Dr.P.Sreedevi
EDC	B	Mr.K.Vijaya Kamalnadh
DLCD	B	Mr.Y.Praveen Kumar Reddy
S&S	B	Mr.P.Chandra Sekhar
MEFA	B	Mr.Rajasekhar
DTI	B	Dr.J.Sofia Priyadarshini
EDC Lab	B	Dr.MCK/Mr.KMVK/YPKR
EE Lab	B	Mr.C.Ashok Kumar
BS Lab	B	Mr.PCS/Mr.JLMK/KSR

Subject	Section	Name of the Faculty
VC&CV	C	Dr.P.Chandra Sekhar Reddy
EDC	C	Mr.T.Tirumalesh
DLCD	C	Mr.P.Mahesh
S&S	C	Mrs.M.Hemalatha
MEFA	C	Dr.Aliya Sulthana
DTI	C	Smt.B.Indu
EDC Lab	C	Dr.AS/Dr.CV/Mr.TT
EE Lab	C	Dr.A.Suresh Kumar
BS Lab	C	Mr.D.UsenMr.SAB/BI

Subject	Section	Name of the Faculty
VC&CV	D	Dr.P.Chandra Sekhar Reddy
EDC	D	Dr.A.Sathish
DLCD	D	Miss.N.Fouzia Sulthana
S&S	D	Dr.R.Hanuma Naik
MEFA	D	Dr.Aliya Sulthana
DTI	D	Smt.B.Indu
EDC Lab	D	Dr.AS/Dr.CV/Mr.TT
EE Lab	D	Dr.A.Suresh Kumar
BS Lab	D	Mr.D.Usen/Mr.SAB/BI

Principal
Dr.T.Jaya Chandra Prasad

Dr.K.Mallikarjuna
HOD OF ECE

STUDENT PERFORMANCE EVALUATION

EXTERNAL EVALUATION (50 MARKS)

CIRCUIT DIAGRAM	10M
PROCEDURE	5M
CONNECTIONS	5M
CALCULATIONS,GRAPHS & RESULTS	10M
OBSERVATIONS	10M
VIVA VOCE	10M

INTERNAL EVALUATION (25 MARKS)

DAY-DAY WORK & OBSERAVTION	10M
RECORD	10M
INTERNAL EXAM	5M

ELECTRONIC DEVICES AND CIRCUITS
LAB MANUAL

II-B.Tech, I-Semester ECE

RGM-R-2020

ESTD. 1995

DEPARTMENT OF ECE

RGM COLLEGE OF ENGG. & TECHNOLOGY

AUTONOMOUS

OFFERING B.Tech, & M.Tech. Courses Accredited by NBA

Approved by A.I.C.T.E., New Delhi, Affiliated to JNT University, Anantapuramu

NANDYAL- 518501, KURNOOL (Dt.), A.P.

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Evaluation Procedure for Internal Laboratory Examination

- For Practical subjects, there shall be a continuous evaluation during the semester for 25 internal marks and 50 external (End Examination) marks. Out of 25 marks (internal), 15 marks will be awarded by observing day-to-day performance and 5 marks will be awarded by conducting an internal lab test at the end of the semester and 5 marks will be awarded for any creativity/innovation/additional learning in lab beyond prescribed set of experiments etc.

- **Day-to-day Performance evaluation:**
  - The concerned Faculty has to do necessary corrections in the observation book of each student with explanation and has to evaluate each lab experiment.
  - Concerned Faculty should enter the marks in index page of the record and observation book & also at the end of each experiment with signature.

- **Internal Laboratory examination:**
  Five marks will be awarded for internal Lab exam and the distribution of the marks is as given below:
  1. Circuit Diagram : 01 Marks
  2. Procedure and Expected Waveforms : 01 Marks
  3. Observations and Graph : 01 Marks
  4. Result : 01 Marks
  5. Viva voce : 01 Marks

  Internal lab exam will be conducted by the Faculty member in-charge along with Associate Faculty members

Evaluation Procedure for External Laboratory Examination:

- This examination will be conducted by the External examiner (from other college), internal examiner (faculty in-charge of the lab) and one faculty member of the same department (who have more knowledge in the concern lab), recommended by Head of the Department with the approval of Principal.

- The maximum marks for this examination is 50.

- The distribution of marks for the evaluation is as follows.
  1) Circuit Diagram : 10Marks
  2) Procedure and Expected waveforms : 10 Marks
  3) Connections : 05 Marks
  4) Observations and calculations : 10 Marks
  5) Result with graphs : 05 Marks
  6) Viva voce : 10 Marks

STUDY OF CRO AND IT'S USES

AIM:

1) To measure the frequency and amplitude of different waves (sinusoidal, square and triangular).
2) To measure the unknown frequency of the signal.
3) To find the phase shift introduced by an RC network.

APPARATUS REQUIRED:

1) Cathode Ray Oscilloscope (CRO)
2) Function generators –2, Connecting wires-15, CRO probes: BNC-BNC type- 2 nos. & BNC-Crocodile Clips type – 2 nos.
3) Resistor –1 KΩ
4) Capacitor – 1 μF

CONNECTION DIAGRAMS:

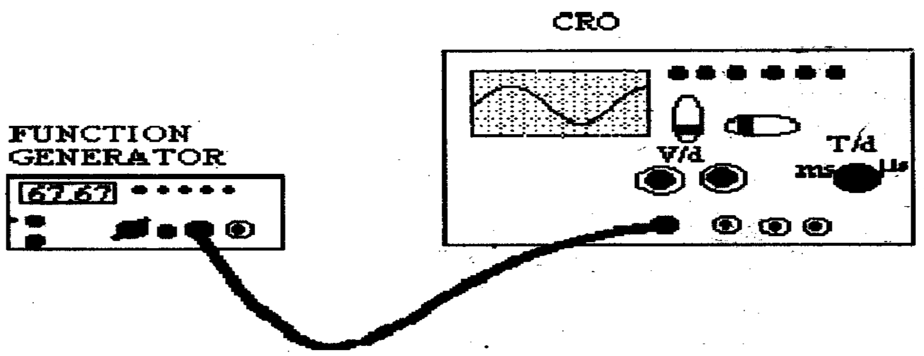


Figure 1 Connection diagram for measurement of amplitude and frequency

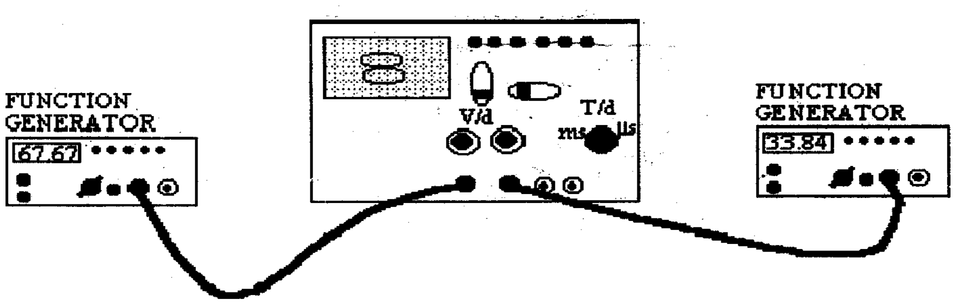


Figure 2 Connection diagram for Measurement of unknown frequency

CIRCUIT DIAGRAM:

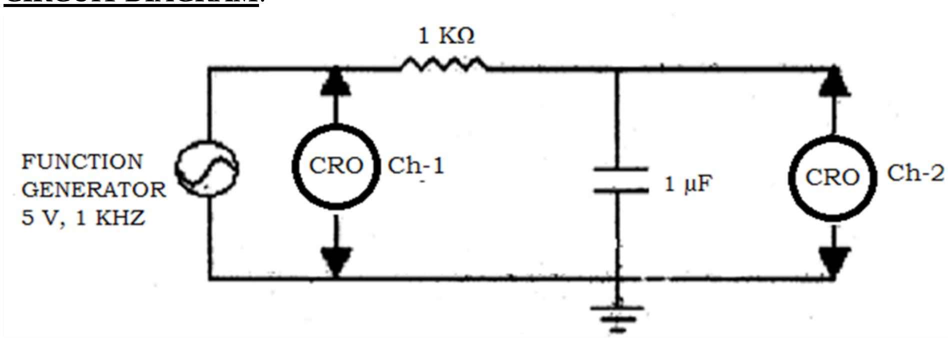


Figure 3 Circuit Diagram for Phase shift measurement

PROCEDURE:

Measurement of amplitude and frequency

1) Verify the functionality of CRO, Function Generator and CRO probes.
2) Connect the output of the function generator to one of the two channels of CRO as shown in fig. 1.
3) Adjust volt/div, time/div and Var. knobs such that the wave forms displayed in CRO are observable in all aspects.
4) Measure the amplitude of the signal in divisions and volts/div value. Note down the values in corresponding columns of the observation table.
5) Measure the time-period in divisions and time/div value. Note down the values in corresponding columns of the observation table.
6) Fill up the remaining columns of the observation table through the calculations.

Finding unknown frequency

1) Connect the signal of known frequency to X-channel and the signal of unknown frequency to Y-channel of CRO as shown in fig.2.
2) Keep the CRO in X-Y mode and vary the known frequency of the signal in X-Channel until we get observable Lissajous patterns
3) Note down the number of loops along the X-axis and number of loops along the Y-axis and calculate the N value using the formulae:

$$N = \frac{\text{number of loops along the x-axis}}{\text{number of loops along the y-axis}}$$

4) Then calculate the unknown frequency using the formulae $N = \frac{f_y}{f_x}$

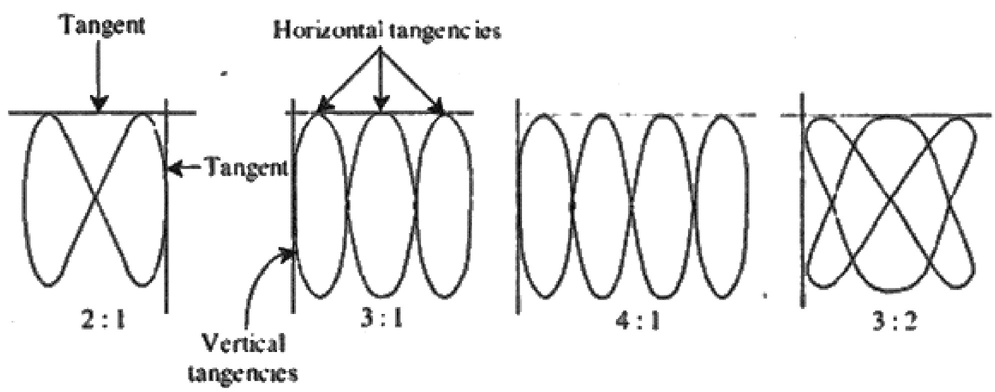


Figure 4 Measurement of unknown frequency using Lissajous patterns

Measurement of phase shift

1) Make the connections as per the circuit diagram of fig.3.
2) Connect input signal of the circuit to the X-channel and it's output signal to the Y- channel of the CRO and keep the CRO in XY-mode.
3) Adjust the Volt/div knob to get the ellipse
4) Note down the values of A and B from the ellipse on the CRO screen as shown in fig.5
5) Calculate phase shift using the following expression Phase shift $\varphi = \sin^{-1}(B/A)$ (refer fig.5)
6) Calculate theoretical value of phase shift using following equation Theoretical phase shift $\varphi = \tan^{-1}(\omega RC)$
7) Compare theoretical and practical phase shift values.

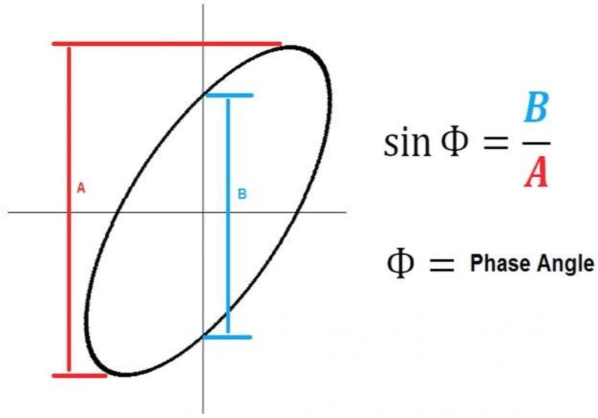


Figure 5 Measurement of phase shift from CRO.

OBSERVATIONS:

Table 1 Measurement of amplitude and frequency

S No	Type of the signal	Amplitude in divisions (D)	Volts/div (S)	Amplitude D * S (volts)	Time in Divisions (D)	Time/div (S)	Time period T=D*S (seconds)	Frequency f =1/T
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Table 2 Measurement of unknown frequency

S.No	Known frequency f_x	Lissajous patterns	$N = \frac{\text{no. of loops along x-axis}}{\text{no. of loops along y-axis}}$	Unknown frequency $f_y = N.f_x$	Unknown frequency From FG*
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

***FG** – Function Generator

CALCULATIONS:

$$N = \frac{\text{no. of loops along x-axis}}{\text{no. of loops along y-axis}}$$

$$f_y = N.f_x$$

Phase shift $\varphi = \sin^{-1}(B/A)$

Theoretical phase shift $\varphi = \tan^{-1}(\omega RC)$

THEORY:

DISCUSSION:

CONCLUTION:

VIVA QUESTONS

[1] What is CRO?
[2] What are the uses of CRO?
[3] Which effect is employed by the CRO?
[4] What is the heart of the CRO.
[5] To which plates of the CRO the signal which is to be displayed is connected?
[6] What signal is connected to horizontal deflection plates CRO?
[7] What is the example for electromagnetic deflection?
[8] What is deflection sensitivity?
[9] What are the various potentials used for various anodes of CRT?
[10] What electrical quantity may not be measured directly by CRO?
[11] What are the applications of CRO?
[12] What is the charge of an electron?
[13] What is the mass of an electron?
[14] What is the path of an electron in uniform electric field between plates?
[15] What is the path of an electron in uniform magnetic field?
[16] Define electrostatic deflection sensitivity of CRT?
[17] Define magnetic deflection sensitivity of CRT?
[18] Write the equation for the electrostatic deflection of an electron beam on the CRT screen.
[19] Write the equation for the electrostatic deflection Sensitivity of CRT.
[20] Write the equation for the magnetic deflection of an electron beam on the CRT screen.
[21] Write the equation for the magnetic deflection Sensitivity of CRT.

VI-CHARACTERISTICS OF PN JUNCTION DIODE

AIM:

1) To establish the electrical equivalent model of the given device by obtaining the forward and reverse characteristics of the PN-diode.
2) To find the type of material used for manufacturing the diode.
3) To obtain the static and dynamic resistances of the diode from the characteristics.

APPARATUS:

1) OA76 Diode, BY127 Diode, DR25 Diode, IN4007 Diode
2) Ammeters (0-10m.A), (0-500µA)
3) Voltmeter (0-1V)
4) Regulated Power Supply.
5) Resistor- 1 KΩ and
6) Connecting Wires.

CIRCUIT DIAGRAMS:

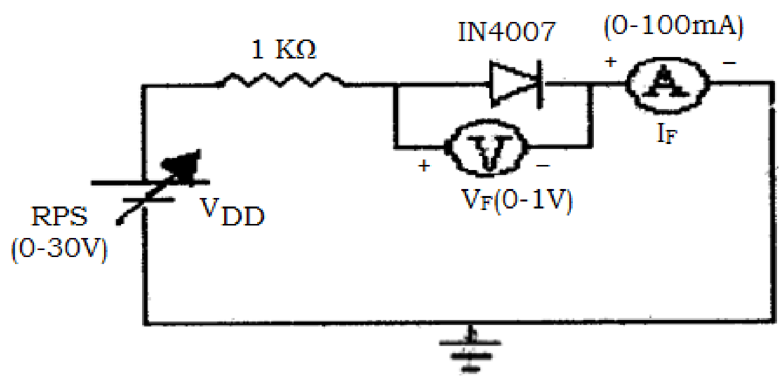


Figure 1 Measurement of Voltage and current in forward biasing

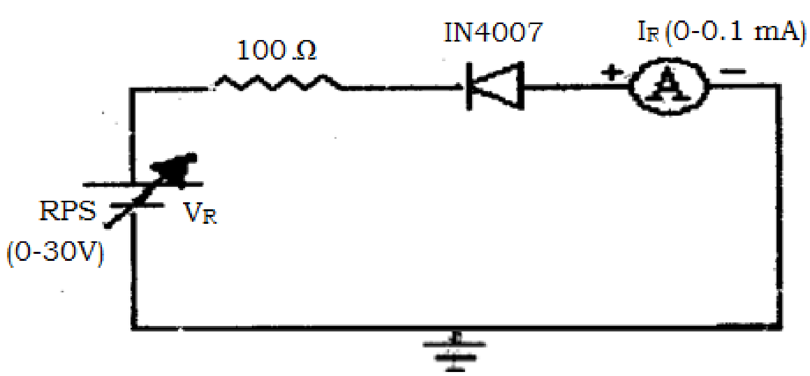


Figure 2 Measurement of Voltage and current in reverse biasing

PROCEDURE:

1) Connect the circuit as per the circuit diagram of fig. 1.
2) Set the RPS to minimum position and switch on.
3) By slowly varying the RPS observe and tabulate the values of Voltmeter and ammeter.
4) Take the voltmeter reading at which the current starts raising as cut-in voltage
5) Plot the graph between $V_{f,}$ and I_f.
6) From the graph calculate static and dynamic resistances (Fig. 5)
7) Repeat the same procedure for another diode.
8) Find the type of diode depending upon the cut in voltage.
9) For reverse bias characteristics connect the circuit as per the diagram of fig. 2.

EXPECTED GRAPHS:

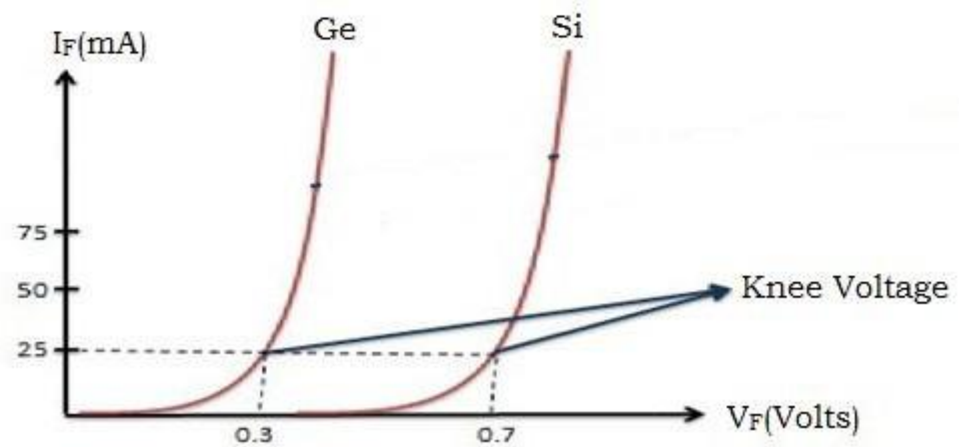


Figure 3 V-I characteristics of Ge and Si diodes in forward bias

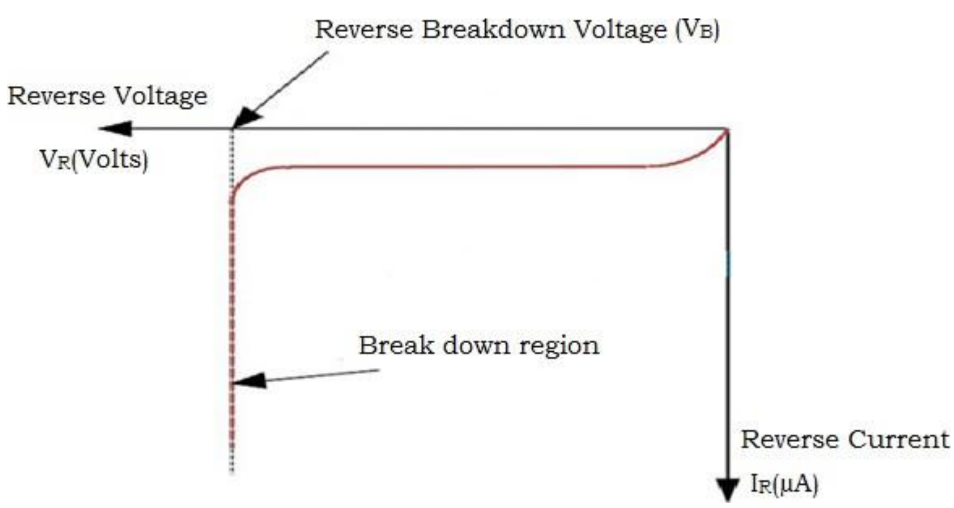


Figure 4 V-I characteristics of Ge diode in reverse bias (I_R is in nano amperes for Si diode)

OBSERVATIONS:

Table 1 Forward characteristics

S No	Diode voltage V_F in volts	Diode current I_F in mA

Table 2 Reverse characteristics

S No	Diode voltage V_r in volts	Diode current I_r in μA

CALCULATIONS:

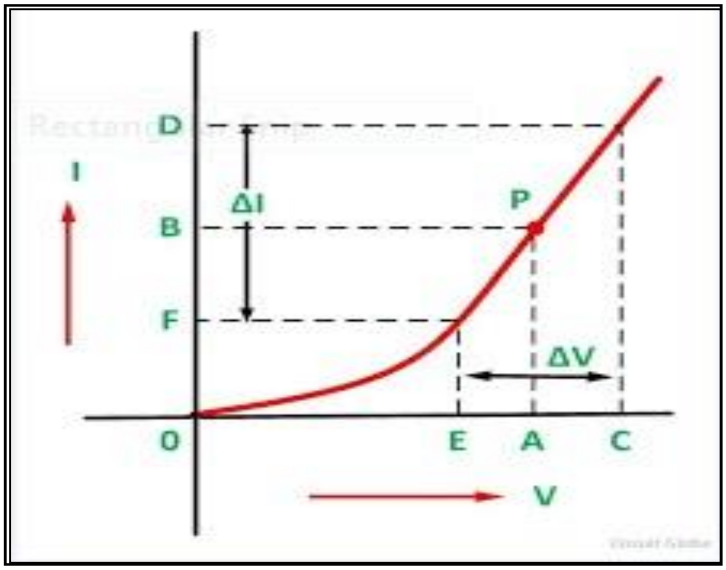


Figure 5 Calculation of Static and Dynamic Resistances

Static resistance = V_F/I_F = A/B (from fig.5)

Dynamic resistance = $\Delta V_F / \Delta I_F$ = (C-E) / (D-F) (from fig.5)

Reverse saturation current $I_o = \dfrac{I_F}{\left(e^{(V/\eta V_T)} - 1\right)}$

Where V_T = 26 mV - Volt equivalent of temperature, η= 1 for Ge & η= 2 for Si

RESULT:

Cut in voltage of Ge diode =

Cut in voltage of Si diode =

Static resistance of Ge diode=

Static resistance of Si diode =

Dynamic resistance of Ge diode =

Dynamic resistance of Si diode =

Reverse saturation current of Ge diode =

Reverse saturation current of Si diode =

THEORY:

DISCUSSION:

CONCLUTION

VIVA QUESTIONS:

1) What are the applications of diode?
2) Define the cut-in voltage of the diode.
3) What is the cut-in voltage of the silicon diode?
4) What is the cut-in voltage of the Germanium diode?
5) What is the typical value of depletion region width?
6) What is the reverse saturation current of diode?
7) What is forward biasing?
8) What is reverse biasing?
9) What is doping level of an ordinary diode?
10) What are the specifications of diode?
11) What is PIV rating of diode?
12) What is depletion region?
13) What is potential barrier?
14) What happens to the depletion region on forward biasing?
15) What happens to the depletion region on reverse biasing?
16) Define static resistance of the pn-junction diode.
17) Define dynamic resistance of the pn-junction diode.
18) Define breakdown voltage of the diode?
19) What is varactor diode?
20) What is tunnel diode?
21) What is Zener diode?
22) What are the differences between normal and Zener diodes?
23) Draw the VI-characteristics of normal diode.
24) Draw the VI-characteristics of zener diode.
25) Draw the VI-characteristics of tunnel diode.
26) Write the diode current equation.
27) Define rectifying and non-rectifying junction.
28) How the depletion region penetrates into equally doped p- and n- type materials?
29) How the depletion region penetrates into unequally doped p- and n- type materials?
30) What is Schottky diode?

VI AND LOAD CHARACTERISTICS OF ZENER DIODE

AIM:

1) To study the VI-Characteristics of given Zener diode.
2) To study the load characteristics of given Zener diode.
3) To calculate the Zener resistance of the given Zener diode.

APPARATUS:

1) IZ 5.1 zener diode.
2) Ammeters (0-30 mA) –2
3) Voltmeter (0—10V)
4) Regulated Power Supply (RPS).
5) Resistor- 1KΩ
6) Decade Resistance Box and Connecting Wires.

CIRCUIT DIAGRAM:

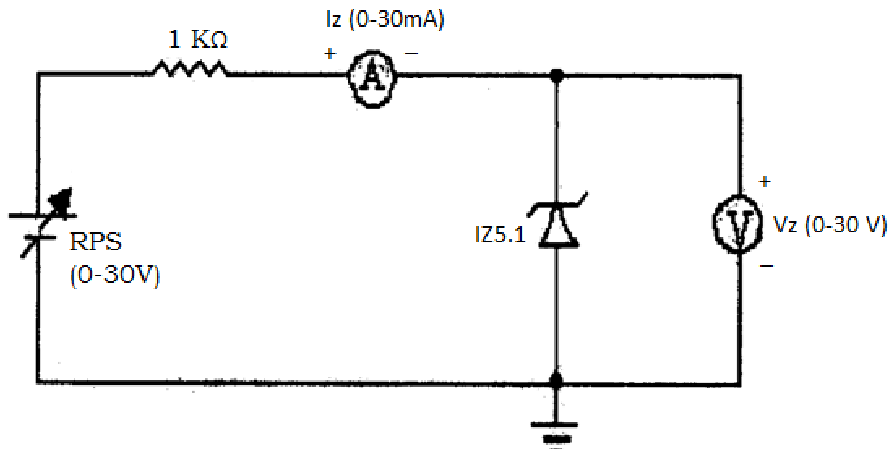


Figure 1 Circuit Diagram to study the VI-Characteristics of Zener diode

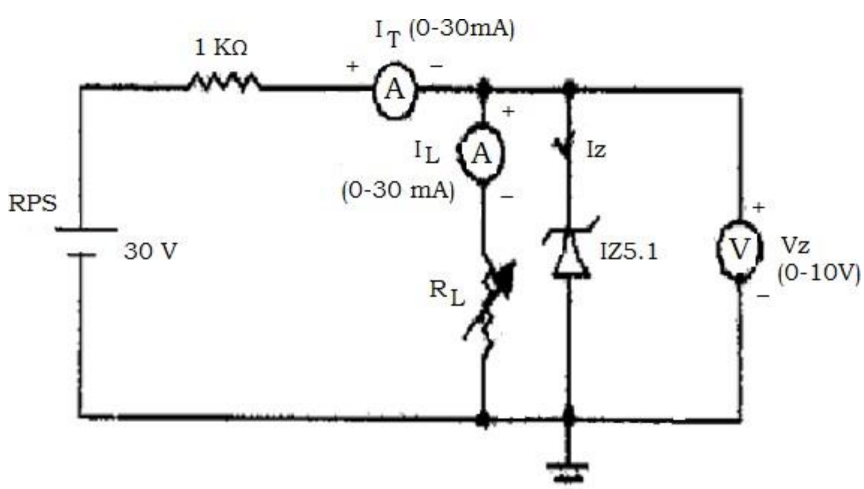


Figure 2 Circuit Diagram to study the load characteristics of Zener diode

PROCEDURE

ZENER CHARACTERISTICS

1) Make the connections as per the circuit diagram of fig. 1
2) By slowly increasing the input voltage, tabulate the readings of Voltmeter and ammeter.
3) Plot the graph between I_Z and V_Z (VI-Characteristics).
4) The voltage at which the current starts increasing is called the breakdown voltage.
5) From the breakdown region calculate the zener resistance of the Zener diode.

LOAD CHARACTERISTICS

1) Make the Connections as per the circuit diagram of fig(2)
2) Setting RPS value to 30 V vary the load in steps and tabulate the readings of total current, load current and Zener voltage.
3) Plot the graph between I_L and V_z (load characteristics).

EXPECTED GRAPHS:

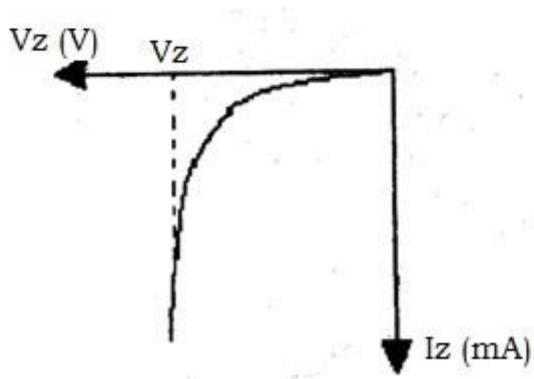


Figure 3 VI-Characteristics of Zener Diode

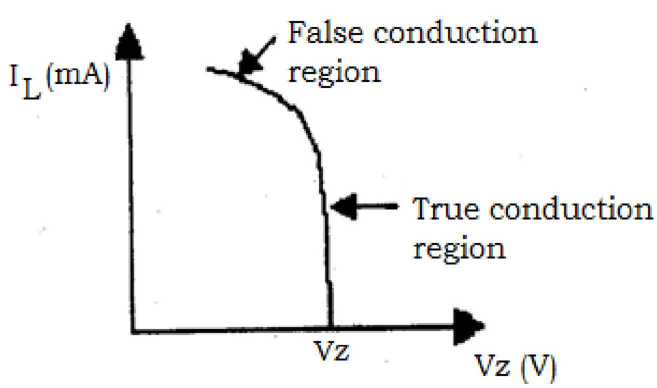


Figure 4 Load Characteristics Zener Diode

OBSERVATIONS:

Table 1 VI-Characteristics

S No	Zener Voltage V_Z (Volts)	Zener Current I_Z (mA)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Table 2 Zener diode load characteristics

S No	R_L in Ω	V_Z in volts	I_L in mA	I_T in mA	I_T - I_L =I_Z in mA
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

CALCULATIONS:

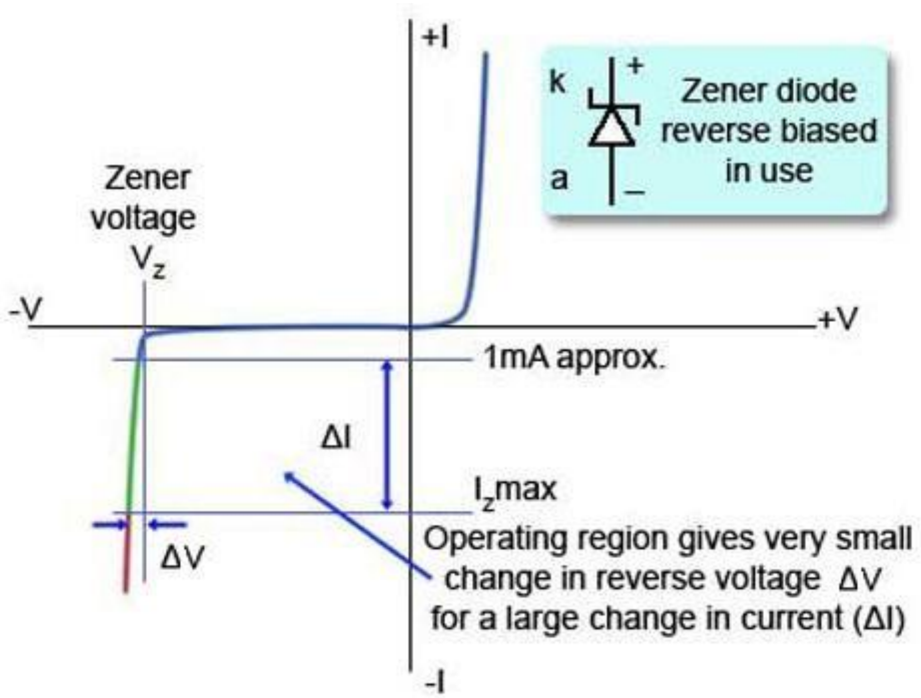


Figure 5 Calculation of Zener Resistance from VI-Characteristics

Dynamic resistance = $\Delta V_Z / \Delta I_Z$

VIVA QUESTIONS:

1. What is Zener diode?
2. What are the differences between normal diode and Zener diodes?
3. In which region the Zener diode normally operates?
4. Name another diode which has a similar region like Zener diode?
5. Explain Zener breakdown?
6. Draw the VI characteristics of Zener diode?
7. What is the significance of Zener diode coding IZ 5.1?
8. Name any diode which has different doping levels?
9. What are the applications of Zener diode?
10. What is Zener diode voltage regulator?
11. What is regulation?

HALF WAVE RECTIFIER WITHOUT FILTER

AIM: - To find the ripple factor and percentage regulation of the half wave rectifier at various loads.

APPARATUS:

1) Transformer
2) Diode BY 127
3) DC ammeter- (0-500 mA)
4) DC Voltmeter- (0 – 30) V
5) DRB
6) AC Voltmeter- (0- 30) V

CIRCUIT DIAGRAM:

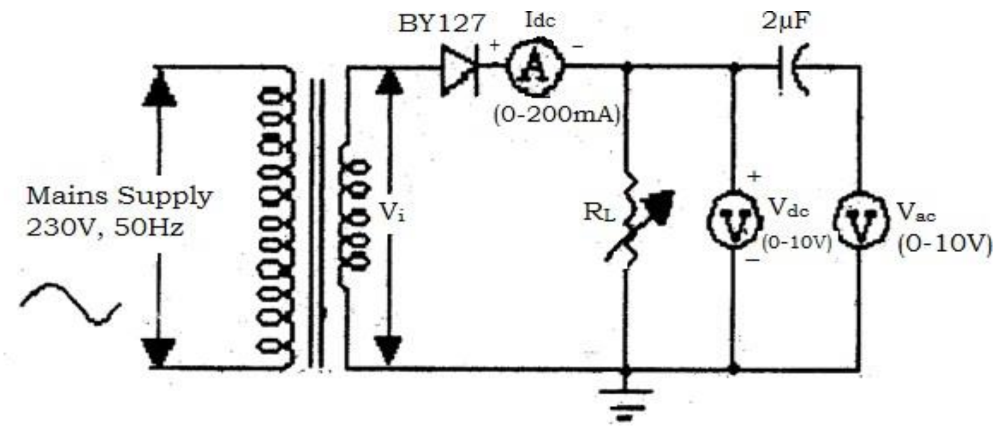


Figure 1 Circuit diagram of Half-Wave Rectifier without filter

PROCEDURE:

1) Make the connections as per the circuit diagram fig.1.
2) Tabulate the readings of DC ammeter and DC and AC voltmeters for various values of load resistance.
3) Find the no load dc voltage by opening the load and note it as $V_{No\ load}$.
4) Also observe the output waveform across R_L on CRO screen.
5) Calculate the ripple factor for all load resistances.
6) Calculate the percentage regulation for all values of load resistances.
7) Plot the graphs for V_{dc} Vs I_{dc}, percentage regulation Vs I_{dc}, ripple factor Vs I_{dc}.

EXPECTED GRAPHS:

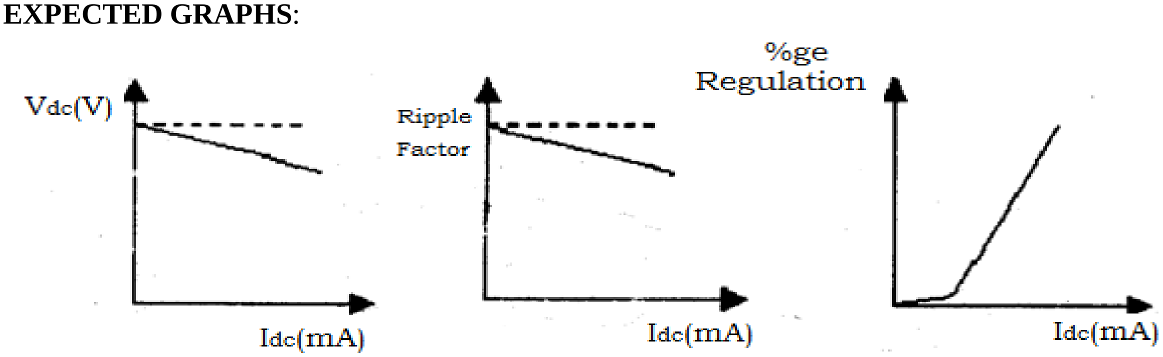


Figure 2 Plots for V_{dc} VS I_{dc}, ripple factor VS I_{dc} , %ge regulation VS Idc

EXPECTED WAVE FORMS:

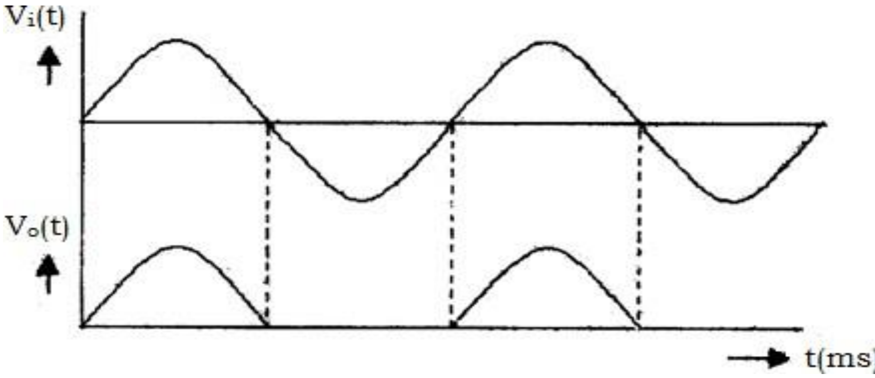


Figure 3 Input and output waveforms of Half-Wave Rectifier without filter

OBSERVATIONS:

Open circuited dc voltage $V_{No\ load}$ = -------

S No	R_L	I_{dc}	V_{dc}	V_{ac}	Ripple factor	% Regulation

CALCULATIONS:

% regulation = $((V_{No\ load} – V_{Full\ load})/ V_{Fullload})$ x 100

Ripple factor = V_{ac}/ V_{dc}

RESULT:

THEORY:

DISCUSSION:

CONCLUTION:

VIVA QUESTIONS:

1) What is the average current of the half wave rectifier?
2) What is the R.M.S. current of the half wave rectifier?
3) What is the efficiency of the half wave rectifier?
4) What is the ripple factor of the half wave rectifier?
5) What is the disadvantage of half wave rectifier?
6) What is advantage of full wave rectification operation?
7) What is the transformer utility factor?
8) What is the main drawback of full wave center tap rectifier?
9) What is the remedy for High PIV rating necessity in half wave rectifier with center tapped transformer?
10) Why bridge rectifier is preferred compared to full wave rectifier?

FULL WAVE RECTIFIER WITHOUT FILTER

AIM: **-** To find the ripple factor and percentage regulation of the full wave rectifier without filter at various loads.

APPARATUS:

1) Transformer
2) BY 127 diodes --2
3) DC ammeter (0-500 mA)
4) DC Voltmeter (0 – 30V)
5) DRB
6) AC Voltmeter (0- 30 V)

CIRCUIT DIAGRAM:

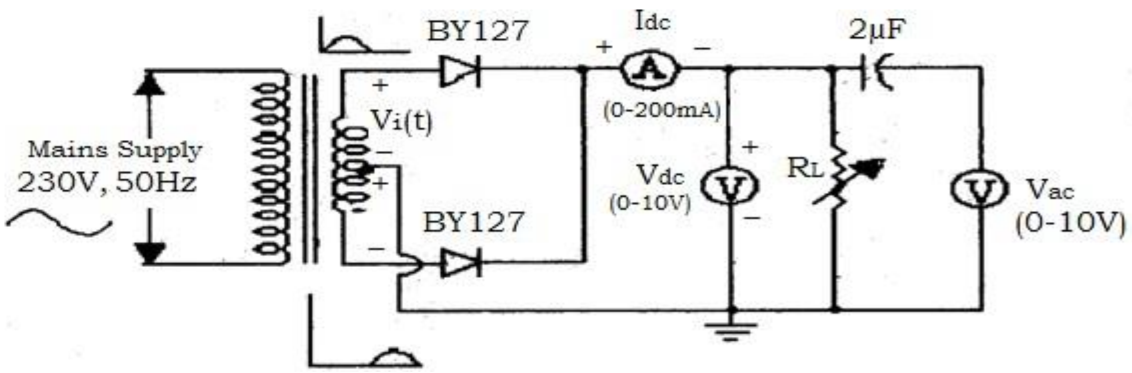


Figure 1 Circuit diagram of Full-Wave Rectifier without filter

PROCEDURE:

1) Make the connections as per the circuit diagram of fig.1.
2) Tabulate the volt meter and ammeter readings for various values of load resistance.
3) Find the no load dc voltage by opening the load and note it as $V_{No\ load}$.
4) Also observe the output waveform across the load resistance on CRO screen.
5) Calculate the ripple factor for all load resistances.
6) Calculate the percentage regulation for all values of load resistances.
7) Plot the graphs for V_{dc} Vs I_{dc}, percentage regulation Vs I_{dc}, ripple factor Vs I_{dc}.

EXPECTED GRAPHS:

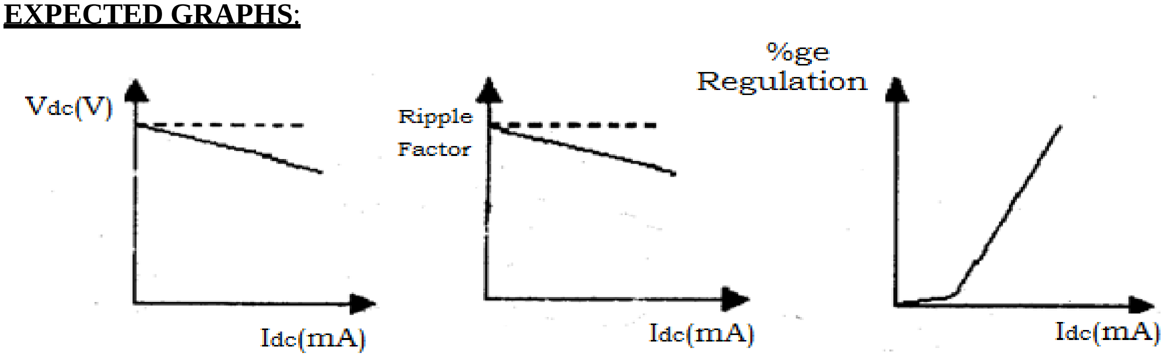


Figure 2 Plots for V_{dc} VS I_{dc}, ripple factor VS I_{dc} , %ge regulation VS Idc

EXPECTE WAVE FORMS:

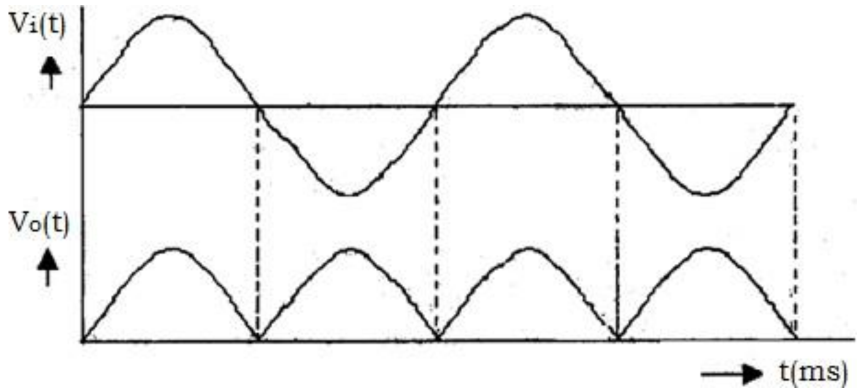


Figure 3 Input and output waveforms of Full-Wave Rectifier without filter

OBSERVATIONS:

Open circuited dc voltage $V_{No\ load}$ = -----

S No	R_L	I_{DC}	V_{DC}	V_{AC}	Ripple factor	% Regulation

CALCULATIONS:

% regulation = $((V_{No\ load} – V_{Full\ load})/ V_{Full\ load})$ x 100

Ripple factor = V_{ac}/ V_{dc}

RESULT:

THEORY:

DISCUSSION:

CONCLUTION:

VIVA QUESTIONS:

1) What is the average current of the full wave rectifier?
2) What is the R.M.S. current of the full wave rectifier?
3) What is the efficiency of the full wave rectifier?
4) What is the ripple factor of the full wave rectifier?
5) What is the disadvantage of full wave rectifier?
6) What is the transformer utility factor for full wave rectifier?
7) What are the applications of rectifiers?
8) What is the main drawback of full wave center tap rectifier?
9) What is the remedy for High PIV rating necessity in half wave rectifier? with entre tapped transformer?
10) Why bridge rectifier is preferred compared to full wave rectifier?

FULL WAVE RECTIFIER WITH FILTERS

AIM: - To find the ripple factor and percentage regulation of Full-Wave Rectifier with filters at various loads.

APPARATUS:

1) Transformer
2) Diodes BY127--2
3) DC ammeter (0-500 mA)
4) DC Voltmeter (0 – 30V)
5) DRB
6) AC Voltmeter (0- 30 V)
7) Inductor 100 mH
8) Capacitor 1000μF

CIRCUIT DIAGRAM:

With Π- Section Filter:

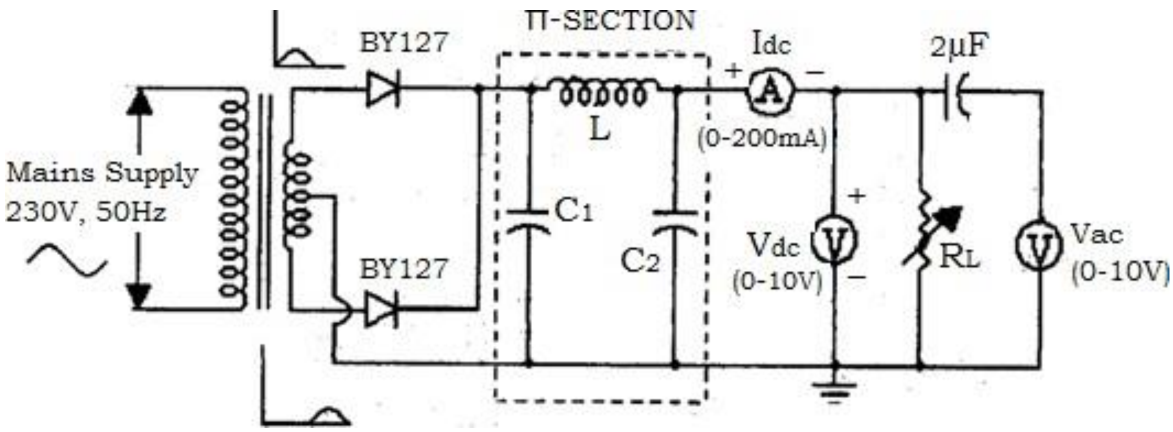


Figure 1 Circuit diagram of Full-Wave Rectifier with Π- Section Filter

With L- Section Filter

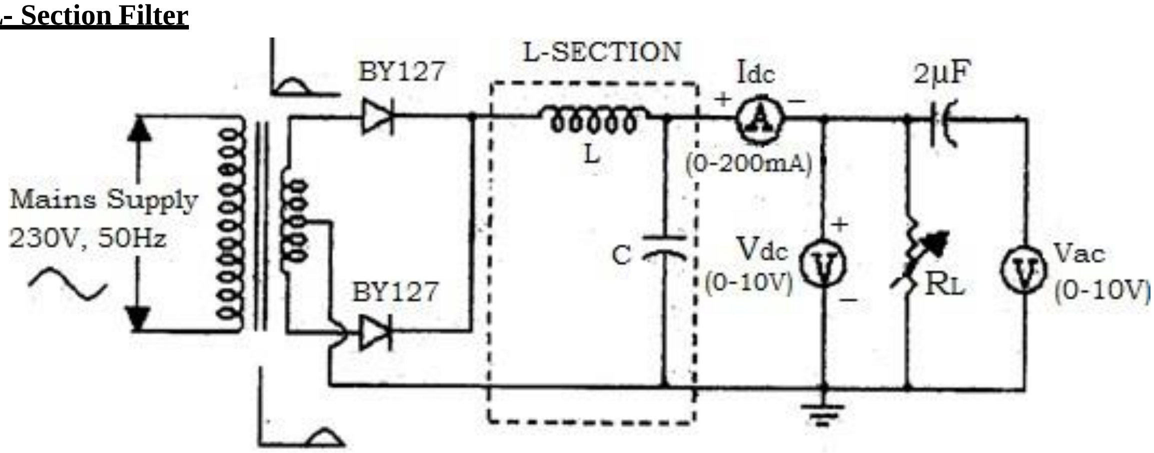


Figure 2 Circuit diagram of Full-Wave Rectifier with L-Section Filter

PROCEDURE:

1) Make the connections as per the circuit diagram of fig.1.
2) Tabulate the volt meter and ammeter readings for various values of load resistance.
3) Find the no load dc voltage by opening the load and note it as $V_{No\ load}$.
4) Also observe the output waveform across the load resistance on CRO screen.
5) Calculate the ripple factor for all load resistances.
6) Calculate the percentage regulation for all values of load resistances.
7) Plot the graphs for V_{dc} Vs I_{dc}, percentage regulation Vs I_{dc}, ripple factor Vs I_{dc}.

EXPECTED GRAPHS:

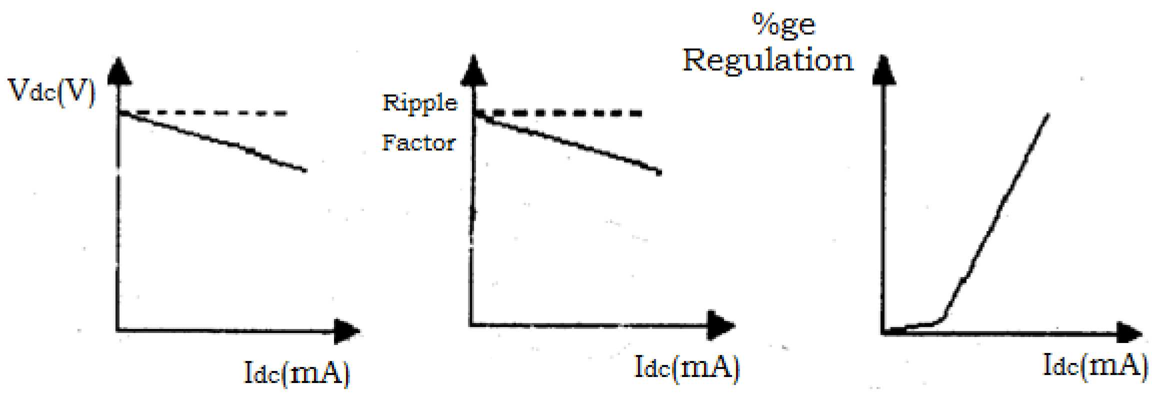


Figure 3 Plots for V_{dc} VS I_{dc}, ripple factor VS I_{dc} , %ge regulation VS Idc

OBSERVATIONS:

Table 1 With Π - Section Filter   Open circuited dc voltage $V_{No\ load}$ = --------

S No	R_L	I_{dc}	V_{dc}	V_{ac}	Ripple factor	% Regulation

Table 2 L-section filter   Open circuited dc voltag $V_{No\ load}$ = ----------

S No	R_L	I_{dc}	V_{dc}	V_{ac}	Ripple factor	% Regulation

CALCULATIONS:

% regulation =(($V_{No\ load}$ – $V_{Full\ load}$)/ $V_{Full\ load}$) x 100

Ripple factor = V_{ac}/ V_{ac}

RESULT:

THEORY:

DISCUSSION:

CONCLUTION

VIVA QUESTIONS:

1) What is the average current of the full wave rectifier with filters?
2) What is the R.M.S. current of the full wave rectifier with filters?
3) What is the efficiency of the full wave rectifier with filters?
4) What is the ripple factor of the full wave rectifier with filters?
5) What is the disadvantage of full wave center tapped rectifier?
6) What is the PIV rating of full wave rectifier?
7) What is the purpose of filter in rectifiers?
8) What is the reactance offered by the inductance to AC component?
9) What is the reactance offered by the capacitance to AC component?
10) What is the reactance offered by the inductance to DC component?
11) What is the reactance offered by the capacitance to DC component?

NON-LINEAR WAVE SHAPING-CLIPPING CIRCUITS

AIM:

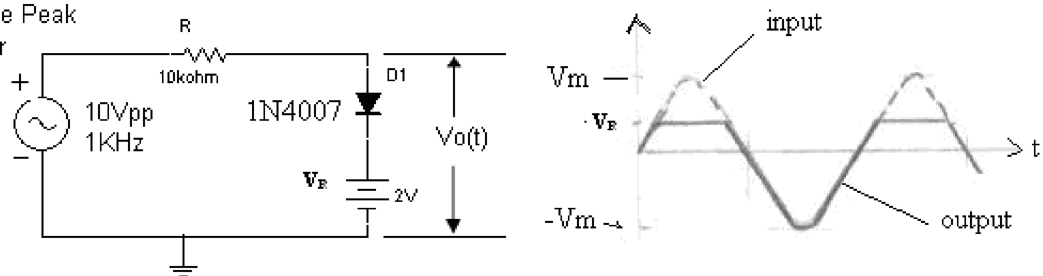
1) To study the operation of different clipping circuits.
2) To observe and plot the output wave forms of various clipper circuits for sinusoidal input.

APPARATUS REQUIRED:

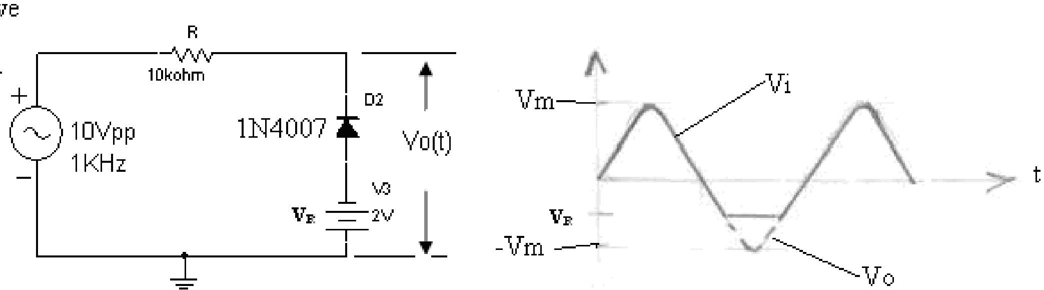
1) Diodes (IN4007)	-- 2 Nos.
2) Transistor (BC-107)	-- 1 No.
3) Resistor-10KΩ	-- 1 No.
4) Zener Diodes (IZ 5.1)	-- 2 Nos.
5) TRPS	-- 1 No.
6) Function generator	-- 1 No.
7) CRO	-- 1 No.
8) CRO probes	-- 3 Nos.
9) Connecting wires.	-- As required
10) Bread Board	-- 1 No.

CIRCUIT DIAGRAMS AND EXPECTED WAVEFORMS:

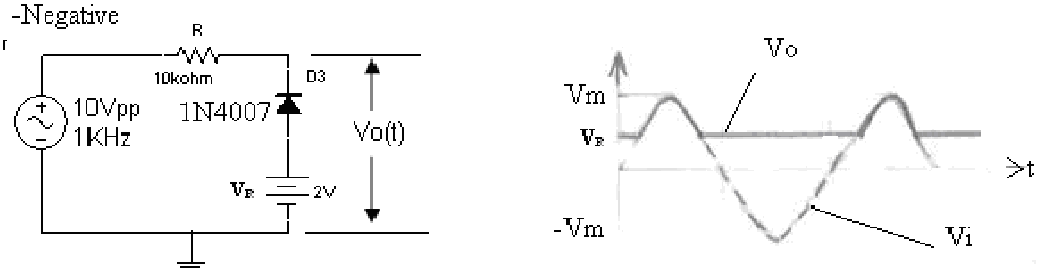
a) Positive Peak Clipper



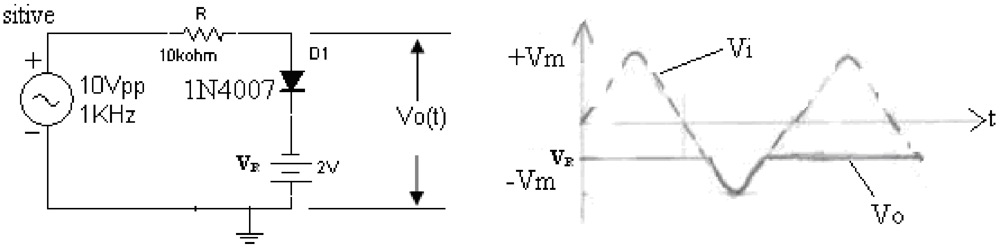
b)Negative Peak Clipper



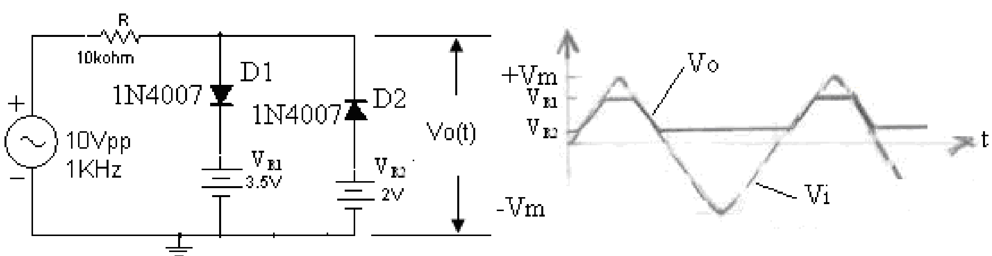
c) Biased -Negative Clipper



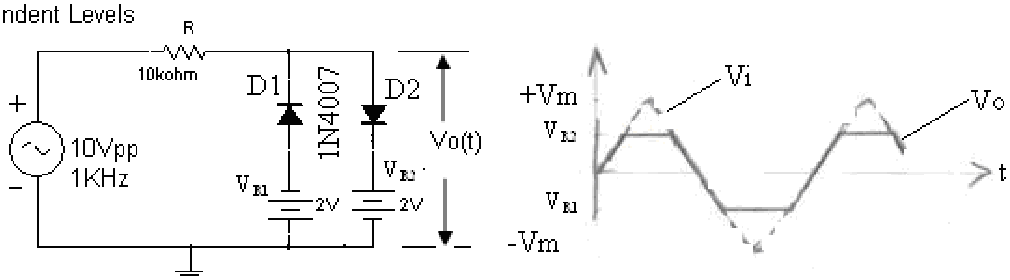
d) Biased Positive Clipper



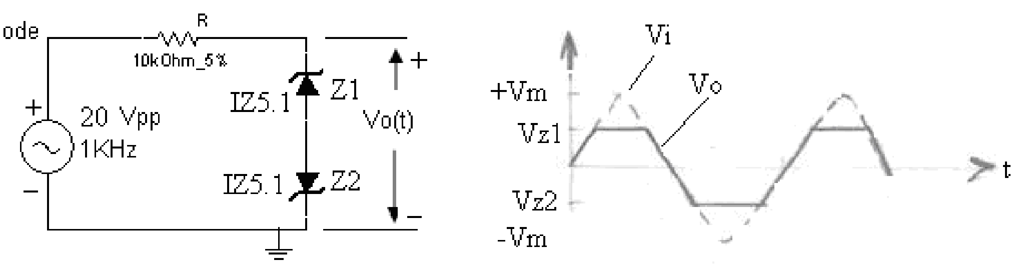
e) Slicer



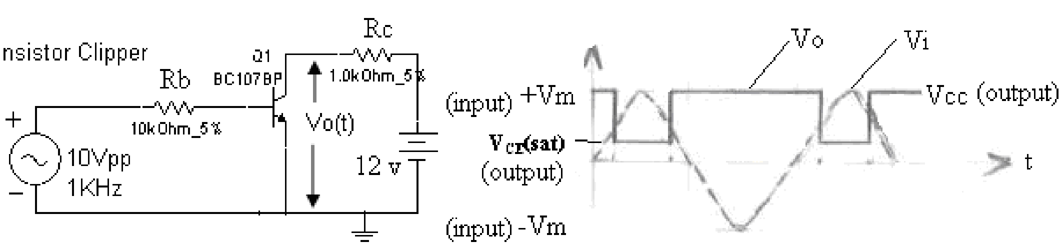
f) Clipping at two independent Levels



g) Zener Diode Clipper



h) Transistor Clipper



PROCEDURE

1) Make the Connections as per the circuit diagrams shown in figure.
2) Set the Function Generator to produce sinusoidal signal input voltage of 10 V_{p-p} and 1KHZ frequency. (For Zener diodes clipper, 20V_{p-p}, 1KHZ frequency sinusoidal signal is required).
3) Observe the output waveforms on CRO and plot them on the graph sheet.

REVIEW QUESTIONS:

1) Define nonlinear wave shaping?
2) What is a Clipper Circuit?
3) What are the types of Clipper Circuits?
4) What is Positive Peak Clipper?
5) Draw the Diode Positive Peak Clipper?
6) What is Negative Peak Clipper?
7) Draw the different Clipper circuits using diodes and their Input/output waveforms?
8) Draw the Zener Diode Clipper?
9) Draw the output waveform of zener diode clipper in question (8)?
10) What is Slicer Circuit?
11) Draw the Slicer Circuit and it's output waveform?
12) Which circuit will convert sinusoidal input to trapezoidal output? Draw it?

NON-LINEAR WAVE SHAPING-CLAMPING CIRCUITS

AIM:-

1) To study the operation of various clamper circuits.
2) To observe and plot the output wave forms of various clamper circuits for sinusoidal input.

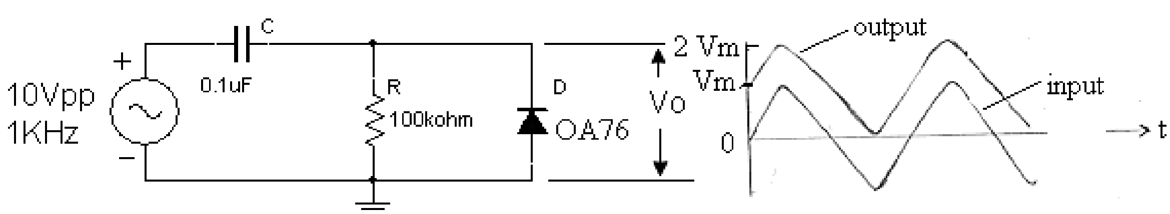
APPARATUS REQUIRED:-

1)	Resistor-100KΩ	-- 1 No.
2)	Function Generator	-- 1 No.
3)	Diodes-OA76	-- 2 Nos
4)	TRPS	-- 1 No.
5)	CRO	-- 1 No.
6)	CRO probes	-- 3 Nos.
7)	Capacitor-0.1µF	-- 1 No.
8)	Connecting wires	-- As required
9)	Bread Board	-- 1no.

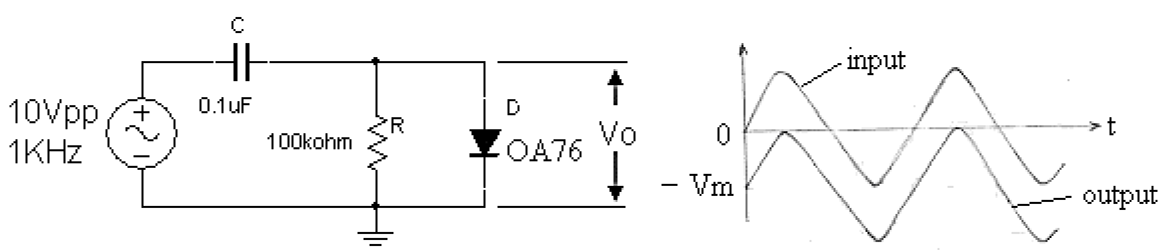
PROCEDURE

1) Make the Connections as per the circuit diagrams shown in figure.
2) Set the Function Generator to produce sinusoidal signal input voltage of 10 V_{p-p} and 1KHZ frequency.
3) Observe the output waveforms on CRO and plot them on the graph sheet.

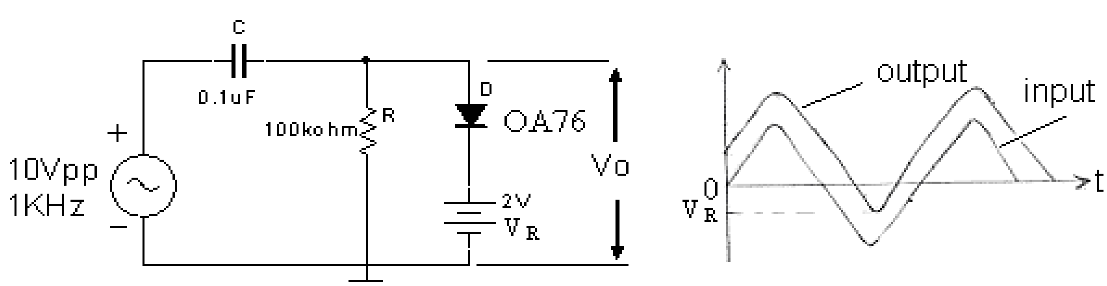
CIRCUIT DIAGRAMS & EXPECTED WAVEFORMS:-



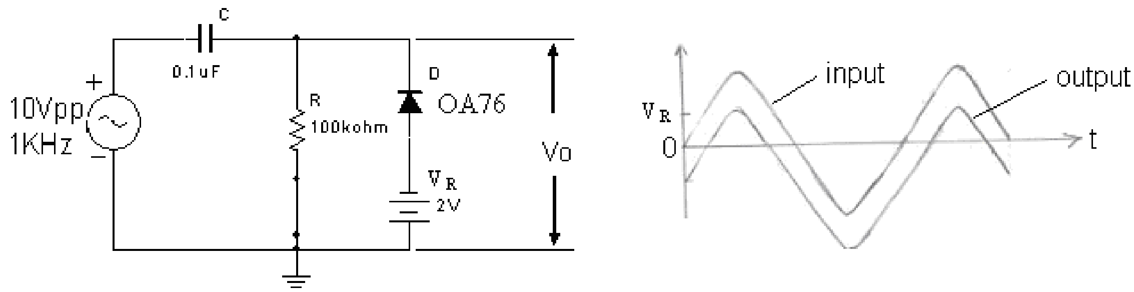
(a) Positive Clamper



(b) Negative Clamper



(C) Biased Positive Clamper



(d) Biased Negative Clamper

REVIEW QUESTIONS:

1) Explain Clamping operation?
2) What are the other names of Clamping circuit?
3) Classify the Clamper Circuits in detail?
4) State Clamping Circuit Theorem?
5) Draw the Positive Peak clamper circuit?
6) Draw the Negative Peak Clamper Circuit?
7) Draw the Clamper circuit to clamp the positive peak at +2 volts?
8) Draw the Clamper circuit to clamp the positive peak at -2 volts?
9) Draw the Clamper circuit to clamp the negative peak at +2 volts?
10) Draw the Clamper circuit to clamp the negative peak at -2 volts?

COMMON BASE CONFIGURATION OF BJT

AIM:

1. To study the input and output characteristics of the transistor in Common base configuration.
2. To obtain the h- parameters of the transistor in CB configuration.

APPARATUS:

1. CL 100 s transistor
2. Resistor 1K Ω
3. Ammeters [(0 –30 mA)—2]
4. Voltmeters [(0 –30 V)]
5. RPS unit
6. Connecting wires

CIRCUIT DIAGRAM:

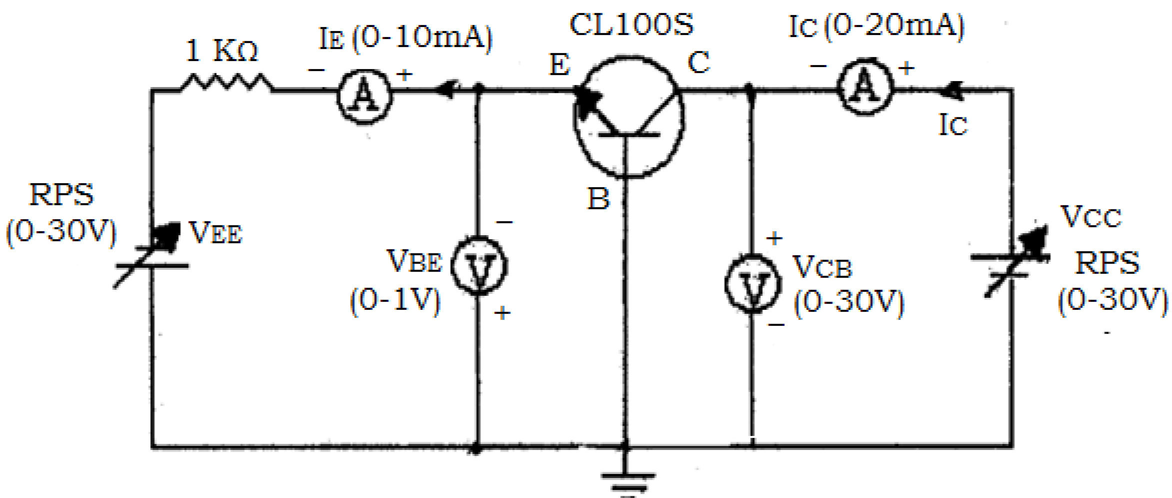


Figure 1 Circuit diagram for studying input and output characteristics of CB Transistor

PROCEDURE:

Input characteristics:

1. Make the Connections as per the circuit diagram fig.1.
2. Keep V_{CB} constant at 5 V and vary V_{EE} to tabulate the readings of voltmeter(V_{BE}) and ammeter(I_E) .
3. Repeat the above procedure for V_{CB} =10 V
4. Plot the input characteristics as shown in fig.2 and calculate h-parameters h_{ib}, h_{rb} from the input characteristics.

Output characteristics:

1. Vary V_{EE} to keep the input current I_E constant at 2 mA.
2. By varying $V_{CC,}$ tabulate the readings of voltmeter(V_{CB}) and ammeter(I_C)
3. Repeat the above procedure for I_E =5 mA.
4. Plot the output characteristics as shown in fig.3 and calculate h-parameters $h_{fb,}$ h_{ob} from output characteristics.

EXPECTED GRAPHS:

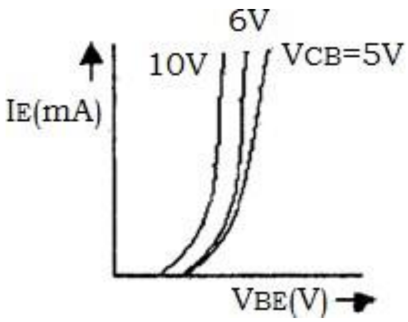


Figure 2 Input Characteristics

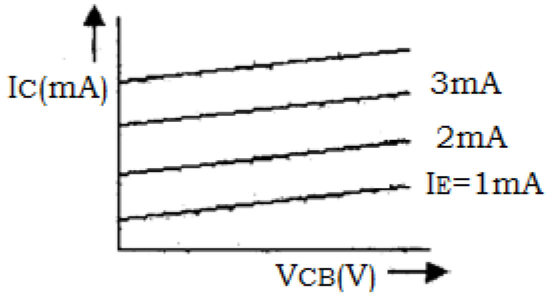


Figure 3 Output Characteristics

OBSERVATIONS:

Table 1 Input characteristics of CB Transistor

S No	V_{CB} = 5V		V_{CB} = 10 V	
	V_{BE} in volts	I_E in mA	V_{BE} in volts	I_E in mA

Table 2 Output characteristics of CB Transistor

S No	I_E = 2 mA		I_E = 5mA	
	V_{CB} in volts	I_C in mA	V_{CB} in volts	I_C in mA

CALCULATIONS:

$h_{ib} = \Delta V_{BE}/\Delta I_E \,|V_{CB}$ constant
$h_{rb} = \Delta V_{BE}/\Delta V_{CB} \,|\, I_E$ constant
$h_{fb} = \Delta I_C/\Delta I_E \,|V_{CB}$ constant
$h_{ob} = \Delta I_C /\Delta V_{CB} \,|\, I_E$ constant

VIVA QUESTIONS

1) What is a transistor?
2) Why it is called Bipolar Junction Transistor?
3) How many types of transistors (BJTs) are there?
4) What are the differences between npn and pnp transistors?
5) Why npn transistor is preferred in practical applications over pnp transistor?
6) Define □ ?
7) Define β ?
8) What are the three operating regions of BJT?
9) In which operating region the BJT acts as an amplifier?
10) How to use the BJT as a switch?
11) How connect the BJT as a Two-Port network?
12) Which configuration of BJT is suitable for voltage amplification?
13) What are applications of transistors?
14) What are specifications of transistors?
15) What is base width modulation?
16) What is early effect?

COMMON EMITTER CONFIGURATON OF BJT

AIM:

1) To obtain the input and output characteristics of the transistor in common emitter configuration.
2) To obtain the h-parameters from the graphs.

APPARATUS:

1) CL 100S transistor
2) DC Ammeters [(0-500μA), (0-20mA)]
3) DC voltmeters [(0-1V), (0-30V)]
4) Resistors [47 KΩ,2.2KΩ]

CIRCUIT DIAGRAM:

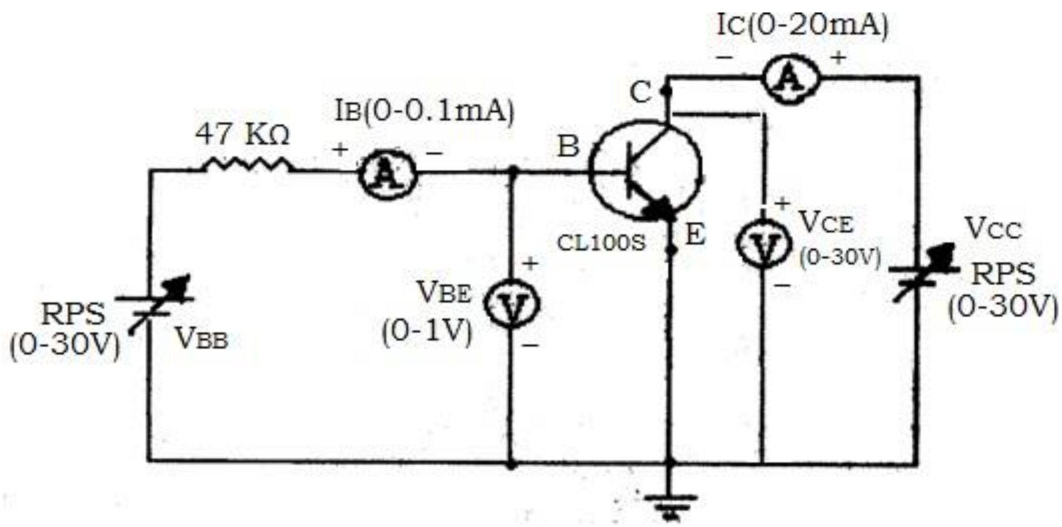


Figure 1 Circuit diagram for studying input and output characteristics of CE Transistor

PROCEDURE:

Input characteristics

1) Connect the circuit as per the diagram.
2) Keep V_{CE} at 5 V.
3) Now vary V_{BE} in steps and tabulate the values of I_B and V_{BE}.
4) Repeat the above procedure for V_{CE} =10 V.
5) Plot the graph between I_B and V_{BE} for various values of V_{CE}.
6) Calculate h_{ie} , h_{re} from input characteristics .

Output characteristics

1) By varying V_{BB} keep I_B at 100 μA.
2) Now vary V_{CE} with the help of V_{CC} and tabulate the values of I_C and V_{CE}
3) Repeat the above procedure for I_B at 50 μA.
4) Plot the graphs between I_C and V_{CE}.
5) Calculate h_{fe}, h_{oe} from output characteristics.

EXPECTED GRAPHS:

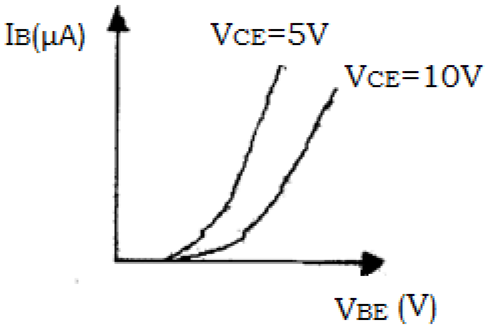


Figure 2 Input Characteristics

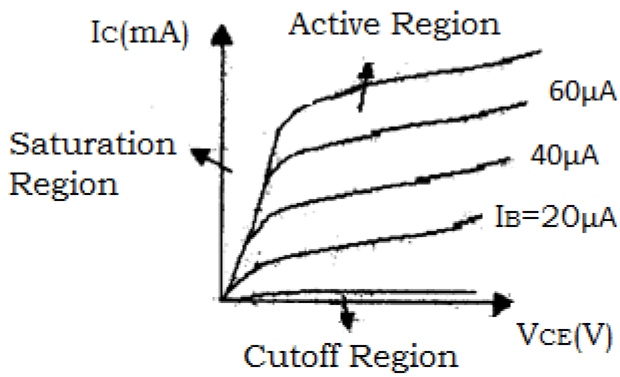


Figure 3 Output Characteristics

OBSERVATIONS:

Table 1 Input characteristics

S No	V_{CE} = 5V		V_{CE} =10V	
	V_{BE} in volts	I_B in μA	V_{BE} in volts	I_B in μA

Table 2 Output characteristics

S No	I_B = 50μA		I_B =100μA	
	V_{CE} in volts	I_C in mA	V_{CE} in volts	I_C in mA

CALCULATIONS:

$h_{ie} = \Delta V_{BE}/\Delta I_B$ |V_{CE} constant

$h_{re} = \Delta V_{BE}/\Delta V_{CE}$ | I_B constant

$h_{fe} = \Delta I_C/\Delta I_B$ |V_{CE} constant

$h_{oe} = \Delta I_C/\Delta V_{CE}$ | I_B constant

RESULT:

THEORY:

DISCUSSION:

CONCLUTION:

VIVA QUESTIONS

1) What are h- parameters?
2) Define α?
3) Define β?
4) Explain transistor working?
5) What are the three regions of operation?
6) What are applications of transistors?
7) What are specifications of transistors?
8) What is base width modulation?

DRAIN AND TRANSFER CHARACTERISTICS OF JFET

AIM:

1) To obtain the drain and transfer characteristics of the given FET,
2) To calculate drain resistance r_d and transconductance g_m of given FET,
3) To find the pinch off voltage (V_p) and drain to source saturation current (I_{DSS}).

APPARATUS:

1) FET - BFW10
2) Ammeter (0-20 mA)
3) Voltmeter (0-30V)
4) Diode – OA76
5) Regulated Power Supply (RPS)
6) Bread board
7) Connecting wires
8) Multimeter

CIRCUIT DIAGRAM:

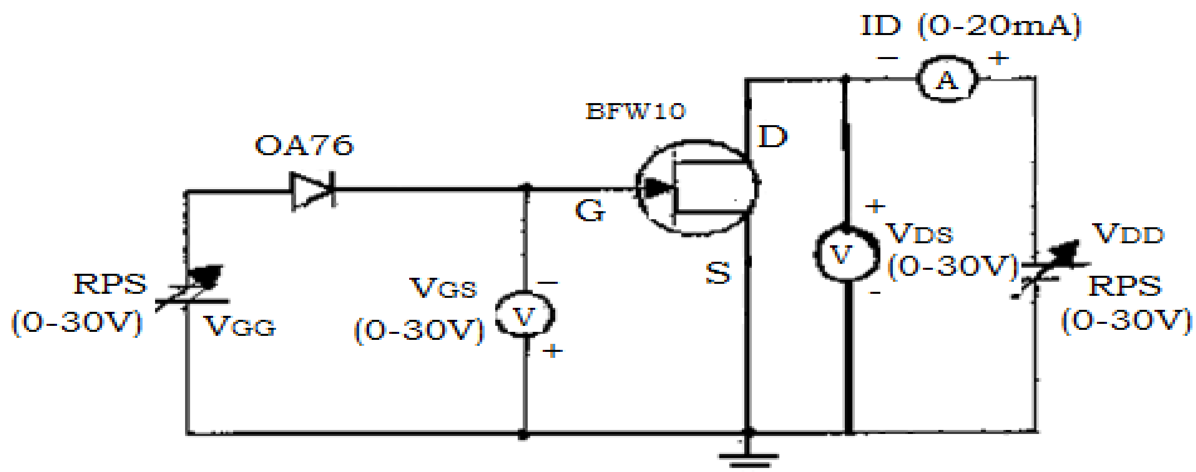


Figure 1 Circuit diagram for studying drain and transfer characteristics of given FET

PROCEDURE:

Drain characteristics

1) Make the connections as per then circuit diagram of fig.1.
2) Keep the V_{GG} and V_{DD} at minimum position before switch on the RPS, i.e., V_{GG} = 0 and V_{DD} = 0V.
3) Now vary the V_{DD} and tabulate the values of V_{DS} and I_D.
4) Repeat step 3 for V_{GS} = -2V and –4V.
5) Plot the graphs for V_{DS} Vs I_D for various values of V_{GS} .
6) Calculate r_d from drain (static) characteristics.
7) When V_{GS} = 0 the minimum value of V_{DS} for which the I_D is constant becomes the pinch-off voltage(V_P) and this constant current becomes the drain to source saturation current (I_{DSS}). Note down these values for the given FET.

Transfer characteristics

1) Keep the V_{DS} constant at 5V and V_{GS} at 0V by varying V_{DD} and V_{GG} , respectively.
2) Now vary the V_{GG} and tabulate the values of I_D and $V_{GS.}$
3) Repeat the step 2 for V_{DS} = 10V.
4) Plot the graphs for V_{DS} Vs I_D for different values of V_{GS} and V_{GS} Vs I_D for different values of V_{DS}.
5) Calculate g_m from the transfer characteristics.

EXPECTED GRAPHS:

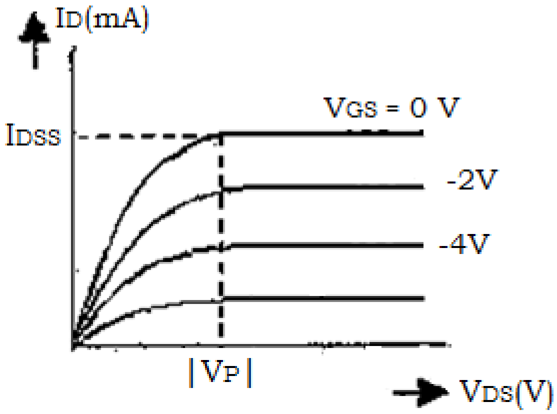


Figure 2 Drain Characteristics

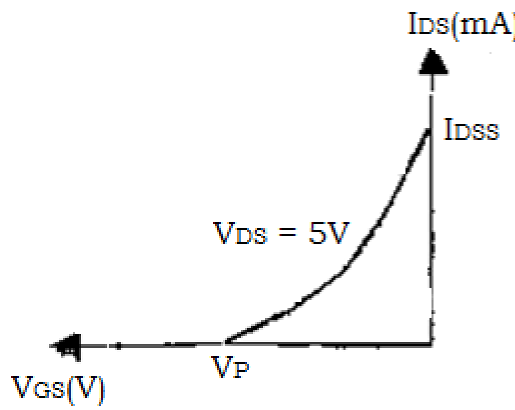


Figure 3 Transfer Characteristics

OBSERVATIONS:

Table 1 Drain or Static characteristics

S.No	V_{GS} =0 V		V_{GS} = - 2 V		V_{GS} = - 4 V	
	V_{DS} in Volts	I_D (mA)	V_{DS} in Volts	I_D (mA)	V_{DS} in Volts	I_D (mA)

Table 2 Transfer characteristics

S No	V_{DS}=5V		V_{DS}=10V	
	V_{GS} in volts	I_D in mA	V_{GS} in volts	I_D in mA

CALCULATIONS:

RESULT:

Pinch- off voltage (V_P) = ---------- volts

Drain to source saturation voltage (I_{DSS}) =---------- mA

Drain resistance (r_d) = $\Delta V_{DS}/\Delta I_D$ | at V_{GS} constant = ----------Ω

Transconductance (g_m) = $\Delta I_D / \Delta V_{GS}$ | at V_{DS} constant = ----------mhos

Amplification factor $\mu = r_d \times g_m$

THEORY:

DISCUSSION:

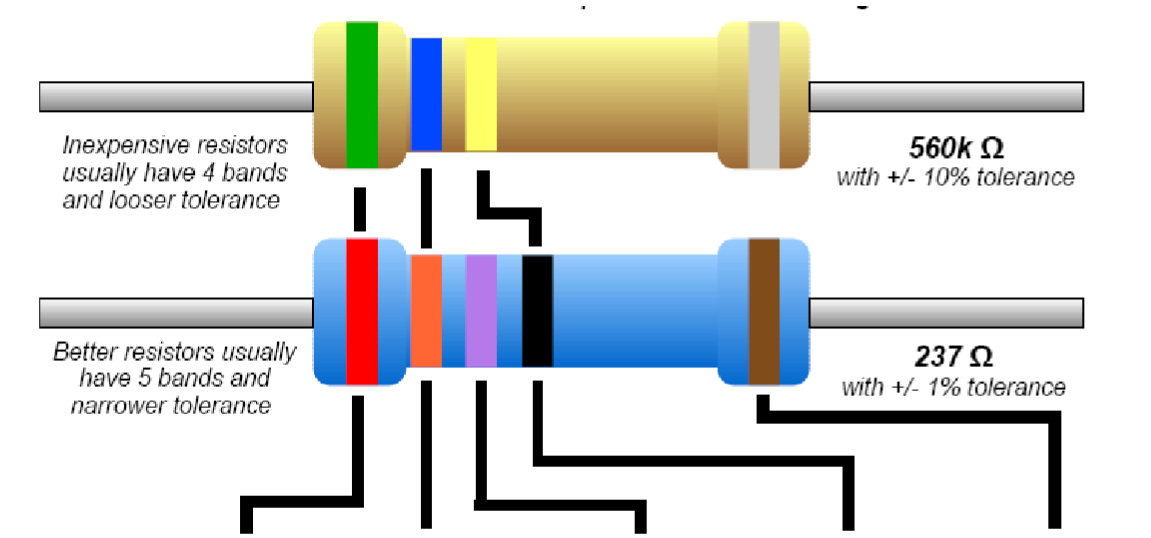
CONCLUTION:

VIVAQUESTIONS:

1) Classify the FET family?
2) What is the advantage of FET?
3) What are the biasing of FET junctions for active operation?
4) What are the disadvantages of FET?
5) What is meant by pinch –off voltage?
6) What do you understand by the term Drain to source saturation current?
7) What is the impedance of the FET at input?
8) What is the impedance of the FET at output?
9) What are applications of FET?
10) What are specifications of FET?

APPENDIX

Resistor Identification:



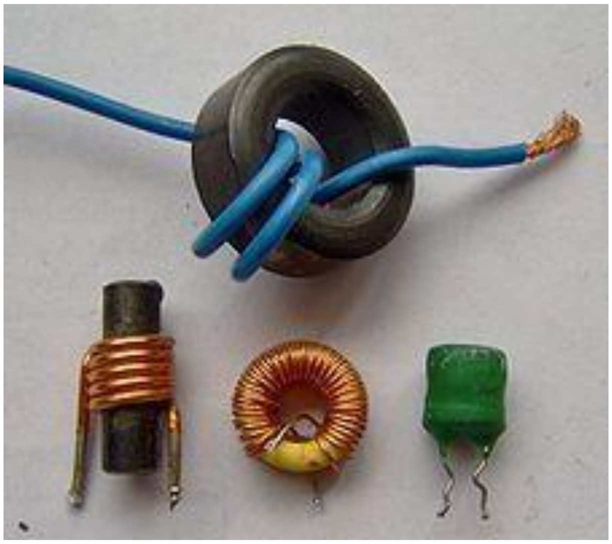
Color	1st Band	2nd Band	3rd Band	Multiplier	Tolerance
Black	0	0	0	x 1 Ω	
Brown	1	1	1	x 10 Ω	+/- 1%
Red	2	2	2	x 100 Ω	+/- 2%
Orange	3	3	3	x 1K Ω	
Yellow	4	4	4	x 10K Ω	
Green	5	5	5	x 100K Ω	+/- .5%
Blue	6	6	6	x 1M Ω	+/- .25%
Violet	7	7	7	x 10M Ω	+/- .1%
Grey	8	8	8		+/- .05%
White	9	9	9		
Gold				x .1 Ω	+/- 5%
Silver				x .01 Ω	+/- 10%

1st Digit	2nd Digit	3rd Digit (rare)	Multiplier
1	0		4

(10 with 4 zeros)
= 100k Ω

Surface-Mount Resistors

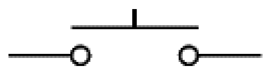
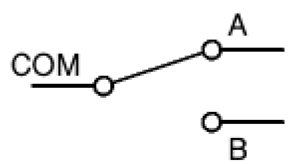
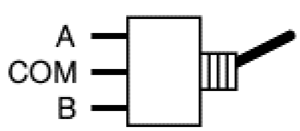
INDUCTOR:-

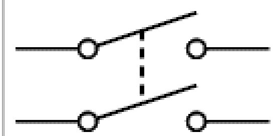
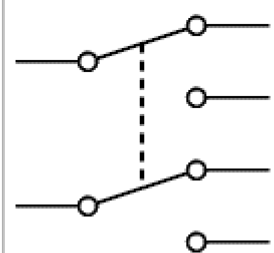
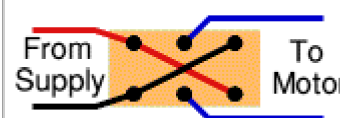


Capacitors:

Modern capacitors, by a cm rule.

Standard Switches:

Type of Switch	Circuit Symbol	Example
ON-OFF **Single Pole, Single Throw = SPST** A simple on-off switch. This type can be used to switch the power supply to a circuit. When used with mains electricity this type of switch *must* be in the live wire, but it is better to use a DPST switch to isolate both live and neutral.		 SPST toggle switch
(ON)-OFF **Push-to-make = SPST Momentary** A push-to-make switch returns to its normally open (off) position when you release the button, this is shown by the brackets around ON. This is the standard doorbell switch.		 Push-to-make switch
ON-(OFF) **Push-to-break = SPST Momentary** A push-to-break switch returns to its normally closed (on) position when you release the button.		 Push-to-break switch
ON-ON **Single Pole, Double Throw** **= SPDT** This switch can be on in both positions, switching on a separate device in each case. It is often called a **changeover switch.** For example, a SPDT switch can be used to switch on a red lamp in one position and a green lamp in the other position. A SPDT toggle switch may be used as a simple on-off switch by connecting to COM and one of the A or B terminals shown in the diagram. A and B are interchangeable so switches are usually not labelled. **ON-OFF-ON** **SPDT Centre Off** A special version of the standard SPDT switch. It has a third switching position in the centre which is off. Momentary (ON)-OFF-(ON) versions are also available where the switch returns to the central off position when released.	 	 SPDT toggle switch  SPDT slide switch (PCB mounting)  SPDT rocker switch

Dual ON-OFF **Double Pole, Single Throw = DPST** A pair of on-off switches which operate together (shown by the dotted line in the circuit symbol). A DPST switch is often used to switch mains electricity because it can isolate both the live and neutral connections.		 DPST rocker switch
Dual ON-ON **Double Pole, Double Throw = DPDT** A pair of on-on switches which operate together (shown by the dotted line in the circuit symbol). A DPDT switch can be wired up as a **reversing switch** for a motor as shown in the diagram. **ON-OFF-ON** **DPDT Centre Off** A special version of the standard SPDT switch. It has a third switching position in the centre which is off. This can be very useful for motor control because you have forward, off and reverse positions. Momentary (ON)-OFF-(ON) versions are also available where the switch returns to the central off position when released.		 DPDT slide switch  Wiring for Reversing Switch

Special Switches:

Type of Switch	Example
Push-Push Switch (e.g. SPST = ON-OFF) This looks like a momentary action push switch but it is a standard on-off switch: push once to switch on, push again to switch off. This is called a **latching action**.	
Microswitch (usually SPDT = ON-ON) Microswitches are designed to switch fully open or closed in response to small movements. They are available with levers and rollers attached.	
Keyswitch A key operated switch. The example shown is SPST.	

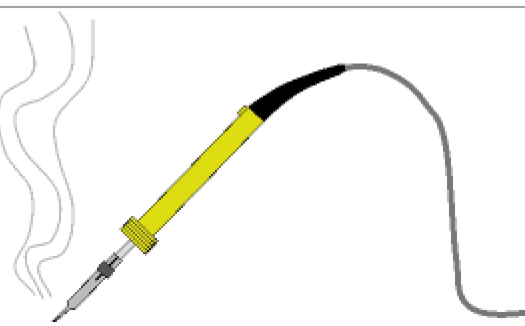
Tilt Switch (SPST)
Tilt switches contain a conductive liquid and when tilted this bridges the contacts inside, closing the switch. They can be used as a sensor to detect the position of an object. Some tilt switches contain mercury which is poisonous.

Reed Switch (usually SPST)
The contacts of a reed switch are closed by bringing a small magnet near the switch. They are used in security circuits, for example to check that doors are closed. Standard reed switches are SPST (simple on-off) but SPDT (changeover) versions are also available.
Warning: reed switches have a glass body which is easily broken! For advice on handling please see the website.
Photograph ©

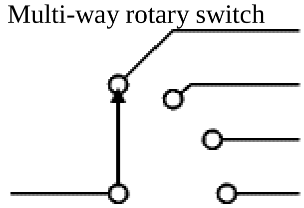
DIP Switch (DIP = Dual In-line Parallel)
This is a set of miniature SPST on-off switches, the example shown has 8 switches. The package is the same size as a standard DIL (Dual In-Line) integrated circuit.
This type of switch is used to set up circuits, e.g. setting the code of a remote control.

Multi-pole Switch
The picture shows a 6-pole double throw switch, also known as a 6-pole changeover switch. It can be set to have momentary or latching action. Latching action means it behaves as a push-push switch, push once for the first position, push again for the second position etc.

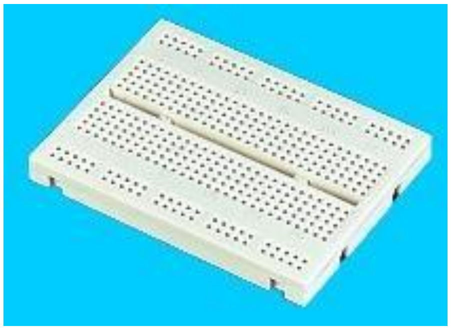
Multi-way Switch
Multi-way switches have 3 or more conducting positions. They may have several poles (contact sets). A popular type has a rotary action and it is available with a range of contact arrangements from 1-pole 12-way to 4-pole 3 way. The number of ways (switch positions) may be reduced by adjusting a stop under the fixing nut. For example if you need a 2-pole 5-way switch you can buy the 2-pole 6-way version and adjust the stop.
Contrast this multi-way switch (many switch positions) with the multi-pole switch (many contact sets) described above.

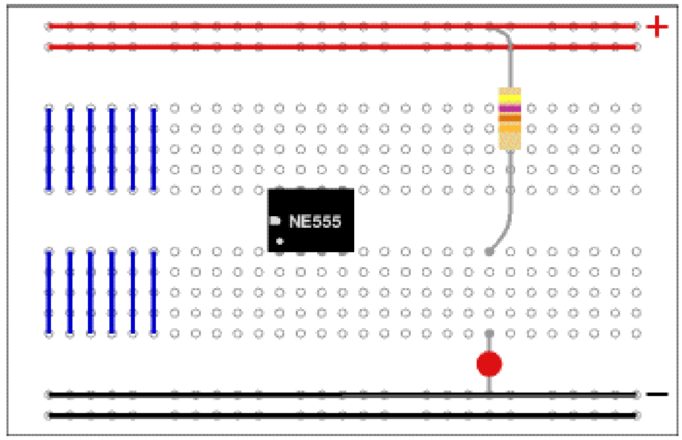



Multi-way rotary switch

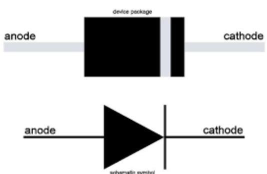

1-pole 4-way switch symbol

Breadboard:



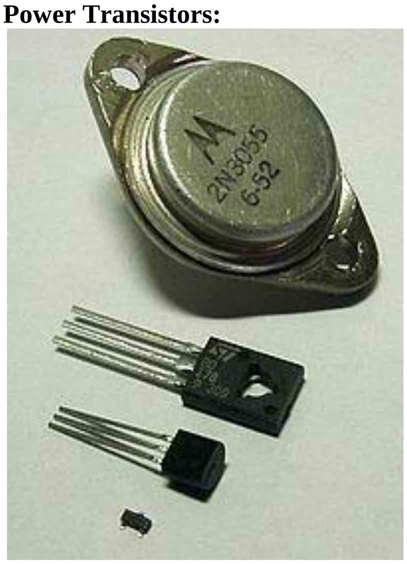


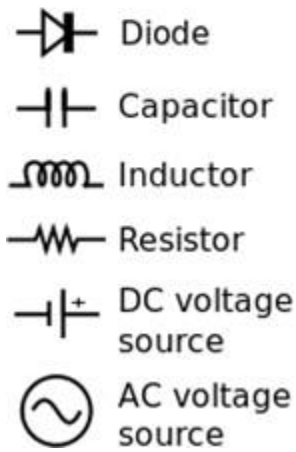
DIODES:

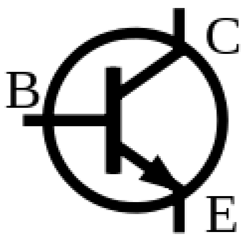


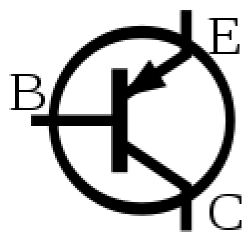
Rectifier Diodes

Power Transistors:

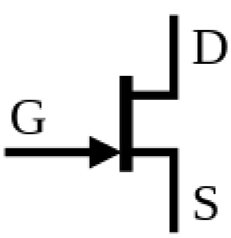


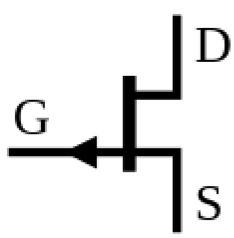


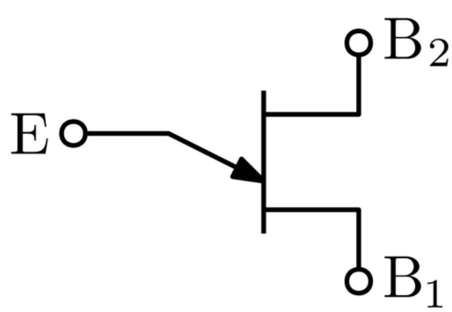




npn Transistor pnp Transistor

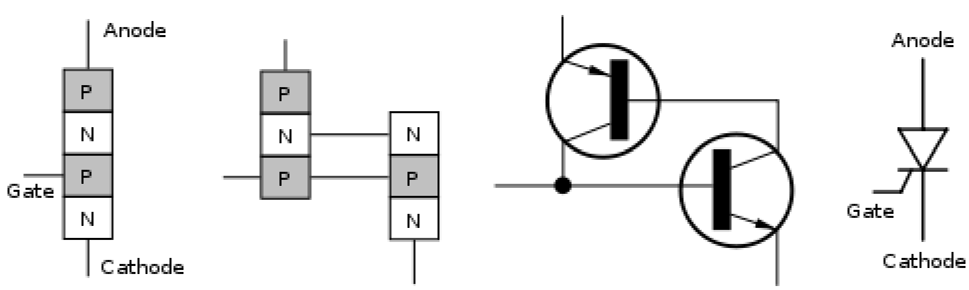






n-channel JFET p-channel JFET Circuit Symbol of UJT

SILICON CONTROLLED RECTIFIER (SCR)



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LABORATORY CERTIFICATE

This is certify that Mr. / Miss. M. Farhana Begum

Regd. No. 21091A0442 of II-1 year B.Tech has successfully completed the experiments in Electronic Devices and Circuits lab of the ECE Branch prescribed by the RGMCET (Autonomous), Nandyal. for the academic year 2022-2023

Signature of the Staff Member

Signature of the HOD 6/3/2023

Date 9/03/2023

Signature of the Internal Examiner 09.03.23

Signature of the External Examiner

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INDEX

EXPT. NO: 1	VI- CHARACTERISTICS OF PN JUNCTION DIODE	Date: 20/10/22

Aim : 1) To establish the electrical equivalent model of the given device by obtaining the forward and reverse characteristics of the PN-diode.
2) To find the type of material used for manufacturing the diode.
3) To obtain the static and dynamic resistances of the diode from the characteristics.

Apparatus : 1) OA76 Diode, BY127 Diode, DR25 Diode, IN4007 Diode
2) Ammeters (0-10mA), (0-500μA)
3) voltmeter (0-1V)
4) Regulated power supply
5) Resistor - 1kΩ and
6) Connecting wires.

Theory : A PN Junction is formed by diffusing P-type material to one half side and N-type other half side. The plane/Junction dividing the two zones is known as a functions. when voltage is not applied across the diode depletion region forms as known in the figure when voltage is applied between the two terminals of the diode (anode & cathode) two Junctions depending on polarity of DC Supply.

Circuit Diagrams:-

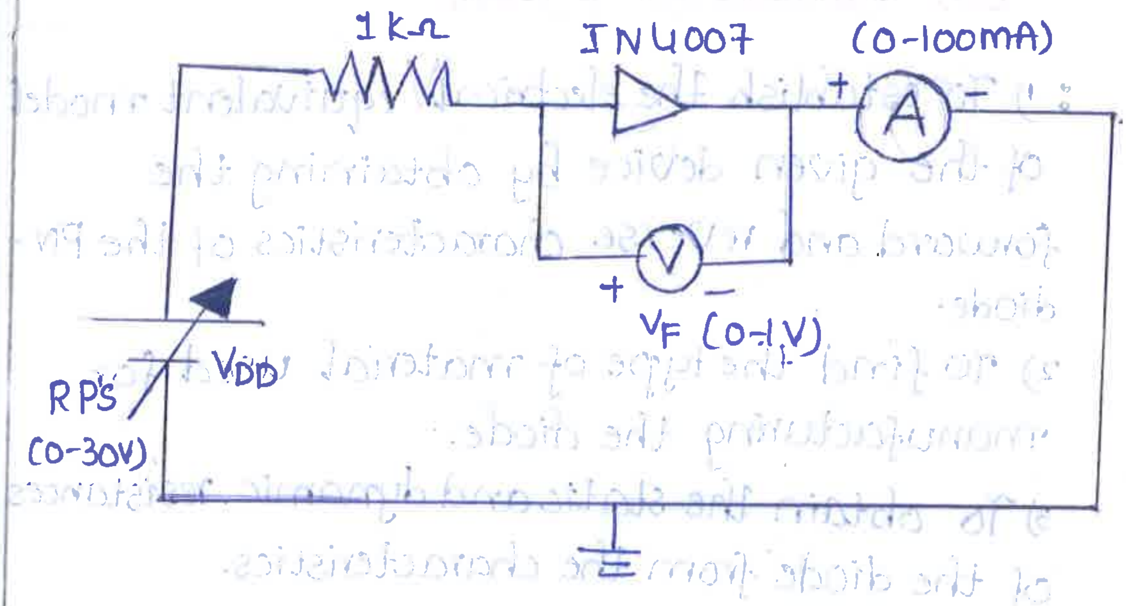


Figure 1 :- Measurement of voltage and current in Forward Biasing.

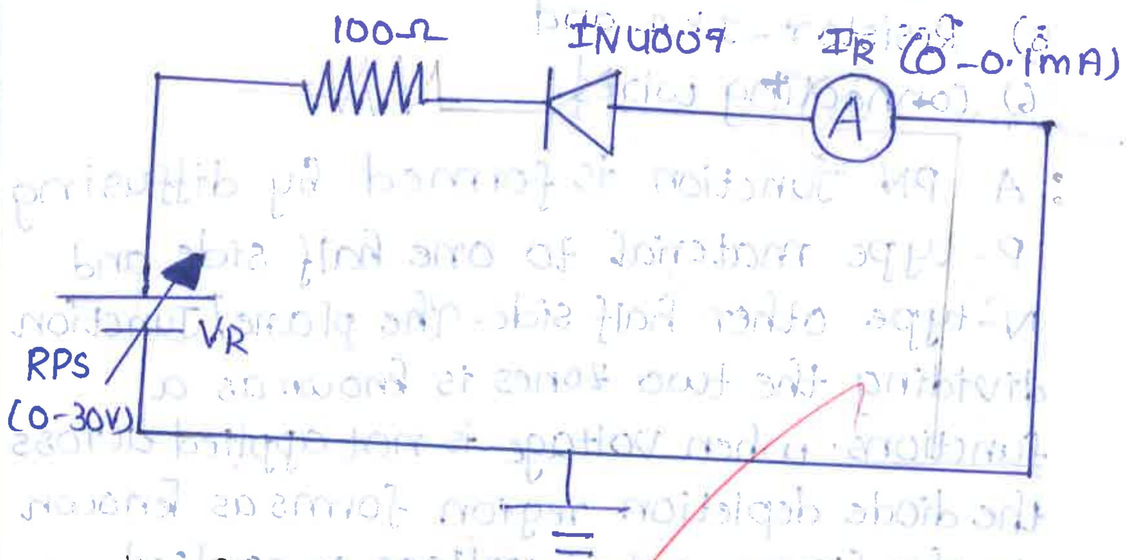


Figure 2 :- Measurement of voltage & current in Reverse Biasing.

Forward Bias:- when the positive terminal of the entire external battery is connected to the P-region and negative terminal is connected to N-region, Then it is called Forward Bias.

Reverse Bias:- when the negative terminal of the battery is connected to positive terminal is connected to N-region. This is called as Reverse Bias.

Procedure: 1) connect the circuit as per the circuit diagram of fig1.

2) set the RPS to minimum position and switch on.

3) By slowly varying the RPS observe and tabulate the values of Voltmeter & ammeter.

4) Take the voltmeter reading at which the current starts raising as cut-in-voltage.

5) Plot the graph between V_f & I_f.

6) From the graph calculate static and dynamic resistances.

7) Repeat the same procedure for another diode.

8) Find the type of diode depending upon the cut in voltage.

9) For reversebias characteristics connect the circuit as per the diagram.

Expected Graphs:-

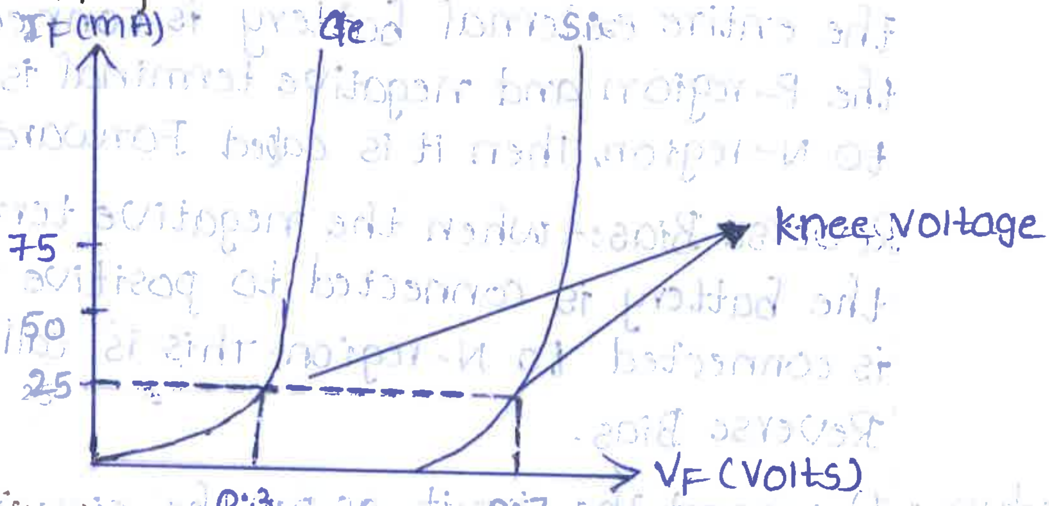


Figure : 3 :- V-I characteristics of Ge & Si diodes in forward bias

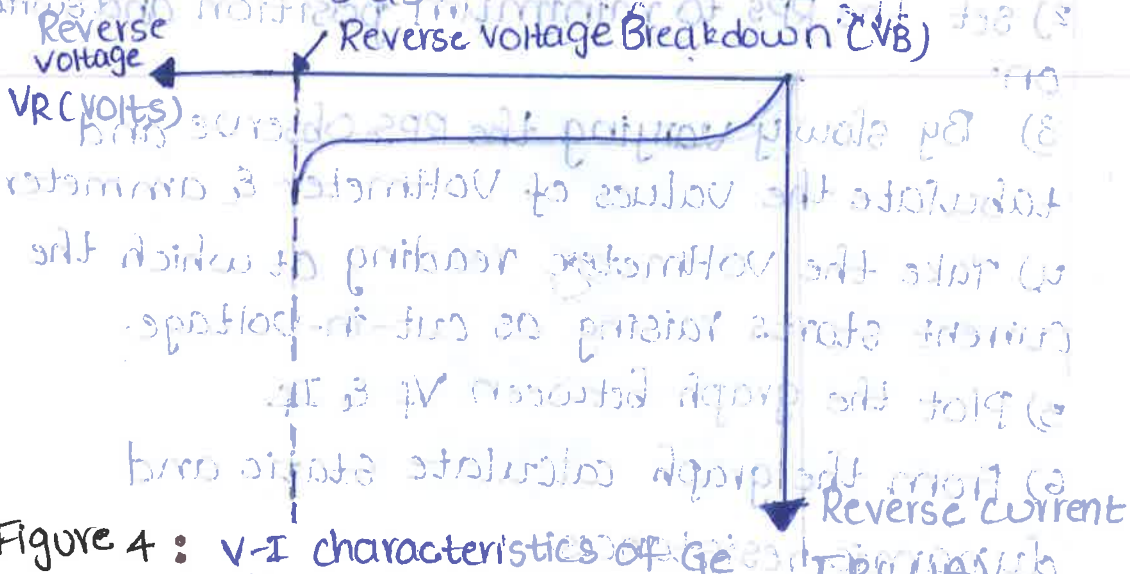
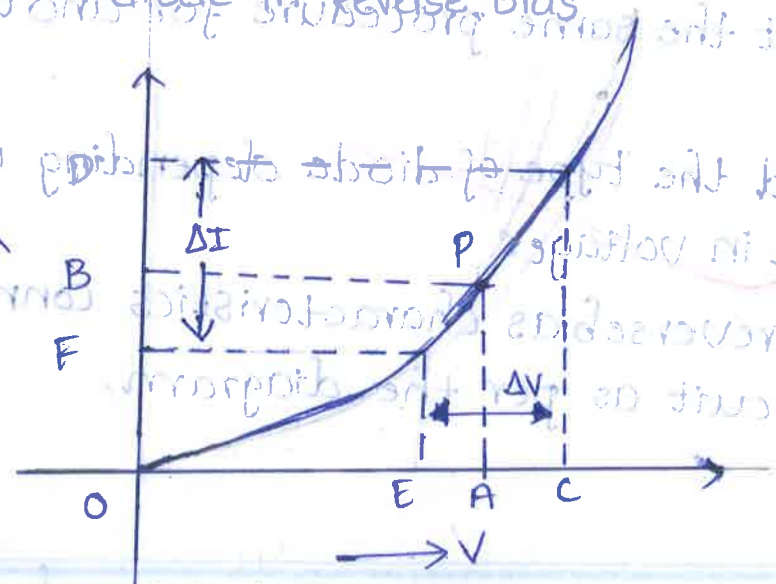


Figure 4 : V-I characteristics of Ge diode in Reverse Bias



Calculation of static & Dynamic Resistances.

Static resistance = $\frac{V_F}{I_F} = \frac{A}{B}$ (from fig 5)

Dynamic resistance = $\frac{\Delta V_F}{\Delta I_F} = \frac{C-E}{D-F}$ (from fig-5)

Reverse Saturation Current $I_O = \frac{I_F}{(e^{V/\eta V_T}-1)}$

where $V_T = 26mV$ - Volt equivalent temperature

$\eta = 1$ for Ge & $\eta = 2$ for Si

Calculations:

Static resistance for Si diode = $\frac{V_F}{I_F} = \frac{0.60}{2.5\times10^{-3}}$

$= 234.37\Omega$

for Ge = $\frac{V_F}{I_F} = \frac{0.30}{4\times10^{-3}} = 75\Omega$

Dynamic resistance for Si

$\frac{\Delta V}{\Delta I} = \frac{0.72 - 0.60}{13\times10^{-3} - 2.5\times10^{-3}} = 11.42\Omega$

for Ge = $\frac{\Delta V}{\Delta I} = \frac{0.35 - 0.30}{8.5\times10^{-3} - 4\times10^{-3}} = 11.11\Omega$

Reverse Saturation current $I_O = \frac{I_F}{(e^{V/\eta V_T}-1)}$

for Si = $\frac{2.5\times10^{-3}}{\left(e^{\frac{0.60}{2\times26\times10^{-3}}}-1\right)} = 24.36\times10^{-9}$ (nA)

24.36 nA

for Ge = $\frac{4\times10^{-3}}{\left(e^{\frac{0.30}{1\times26\times10^{-3}}}-1\right)} = 0.03899\ \mu A$

Observations:

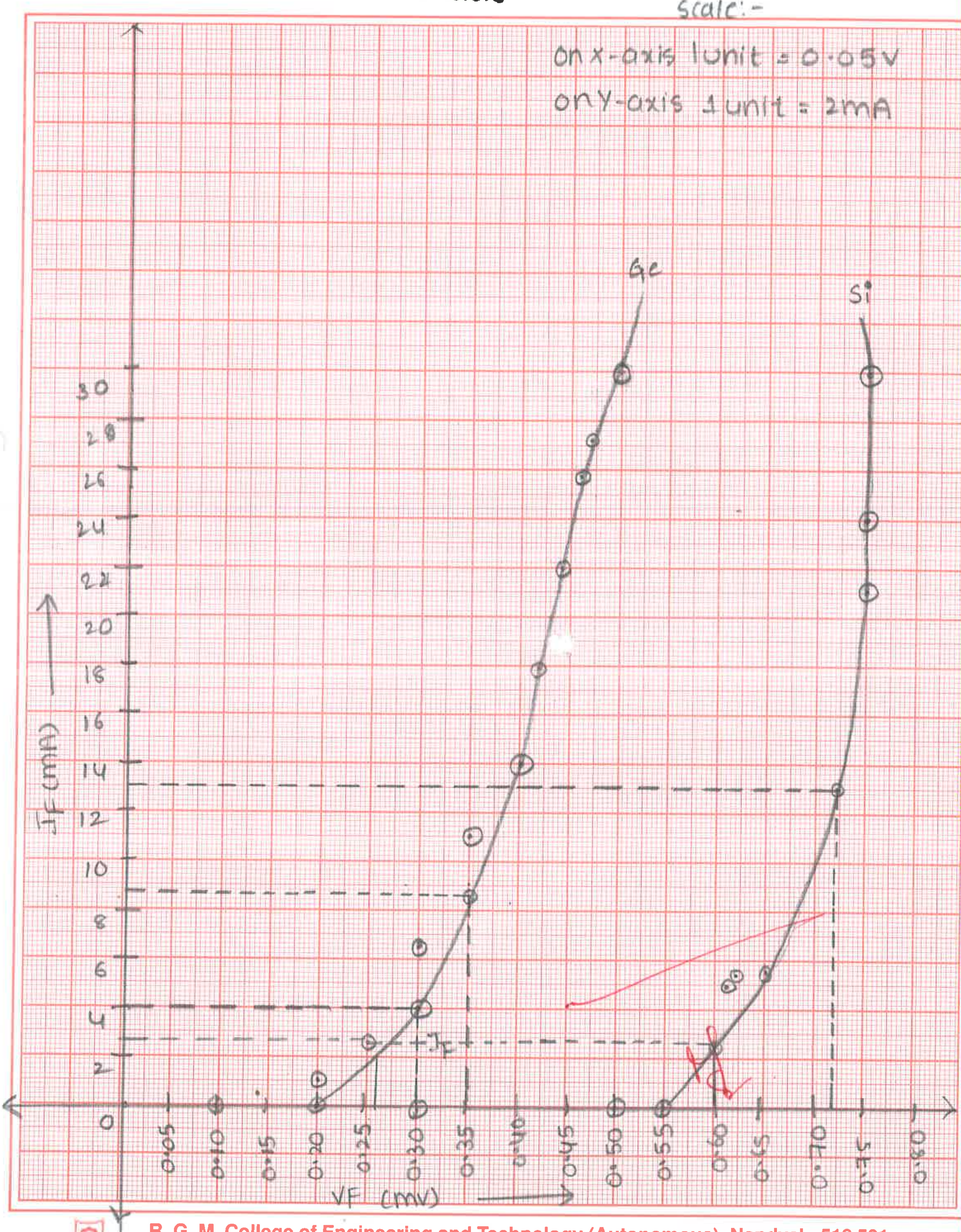
Table 1: Forward characteristics

S·NO	Si diode Voltage VF in Volts	Si Current IF in mA	Ge diode Voltage VF in volts	Si current IF in mA
1	0·1	0·0	0·1	0
2	0·2	0	0·2	1·0
3	0·3	0	0·2	1·5
4	0·4	0	0·25	2·5
5	0·5	0	0·3	4·0
6	0·55	0	0·3	6·5
7	0·6	2·5	0·35	8·5
8	0·61	5·0	0·35	11·0
9	0·62	5·4	0·4	14·0
10	0·65	5·5	0·42	18·0
11	0·72	13·0	0·44	22·0
12	0·75	21·0	0·46	25·8
13	0·75	24	0·47	27·2
14	0·75	80	0·5	30

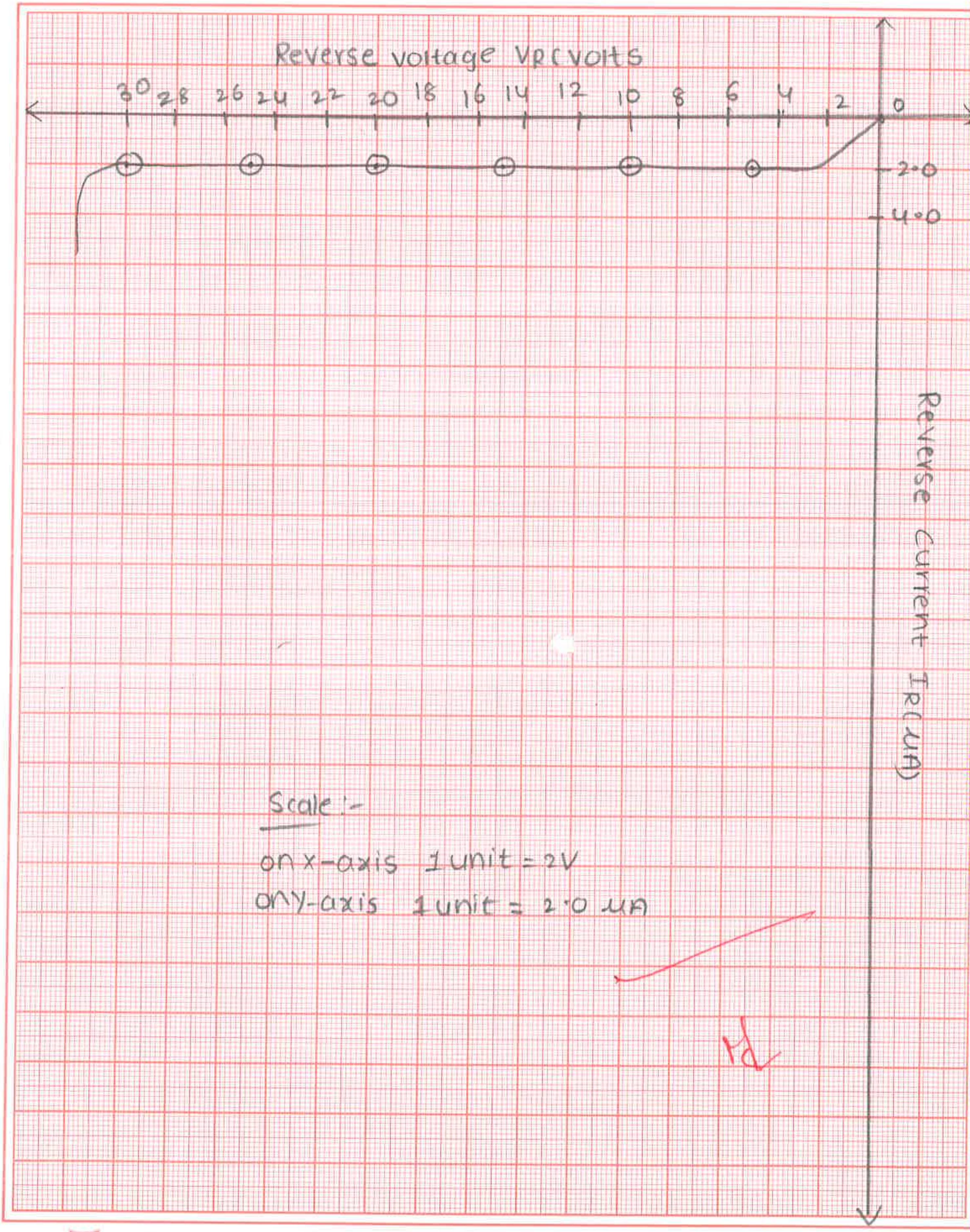
Table 2: Reverse characteristics

S·NO	Diode voltage Vr in volts	Diode current Ir in μA
1	5	2
2	10	2
3	15	2
4	20	2
5	25	2
6	30	2

Forward Bias



Reverse Bias



Result	: Cut in Voltage of Ge diode = 0.26V Cut in Voltage of Si diode = 0.60V Static Resistance of Ge diode = 75 Ω Static Resistance of Si diode = 234.37 Ω Dynamic Resistance of Ge diode = 11.11 Ω Dynamic Resistance of Si diode = 11.42 Ω Reverse Saturation current of Ge diode = 24.36 nA Reverse saturation current of Si diode = 0.0389
Conclusion	: Hence, established the electrical equivalent model of the given device by obtaining the forward & reverse characteristics of the PN Junction diode and also determined the static & dynamic resistances of diode from the characteristics by Si & Ge type of material used for manufacturing the diode.

EXPT. NO: 2	VI AND LOAD CHARACTERISTICS OF ZENER DIODE	Date: 27/10/22

Aim : 1) To study the VI characteristics of given Zener Diode

2) To study the load characteristics of given zener Diode

3) To calculate the zener resistance of the given zener Diode

Apparatus : 1) IZ 5.1 zener diode

2) Ammeters (0-30mA) - 2

3) voltmeter (0-10V)

4) Regulated power Supply (RPS)

5) Resistor - 1kΩ

6) Decade Resistance Box and connecting wires.

Theory : zener diodes are normally used in only reverse bias direction it means that anode must be connected to the negative side of voltage sources and the cathode must be connected to positive side it is primarily used to regulator circuit voltage as it has a constant Vn.

In forward bias, the zener diode behaves like an ordinary silicon diode.

In Reverse Bias, there is practically no reverse current flow until the break down voltage is reached when this occurs

Circuit diagrams.

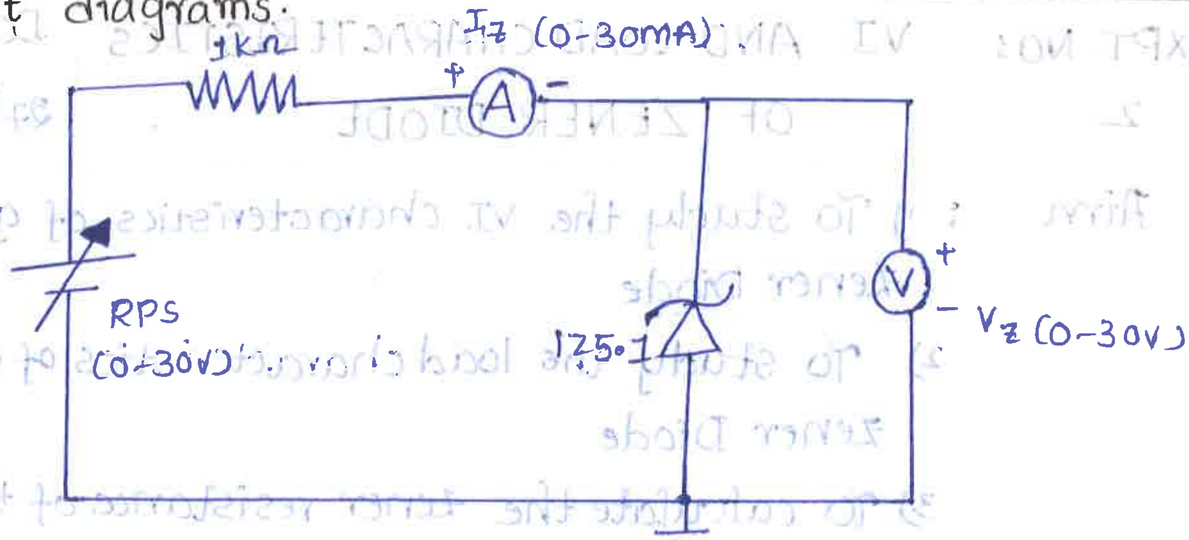


Figure 1: Circuit diagram to study the V-I characteristics of zener diode

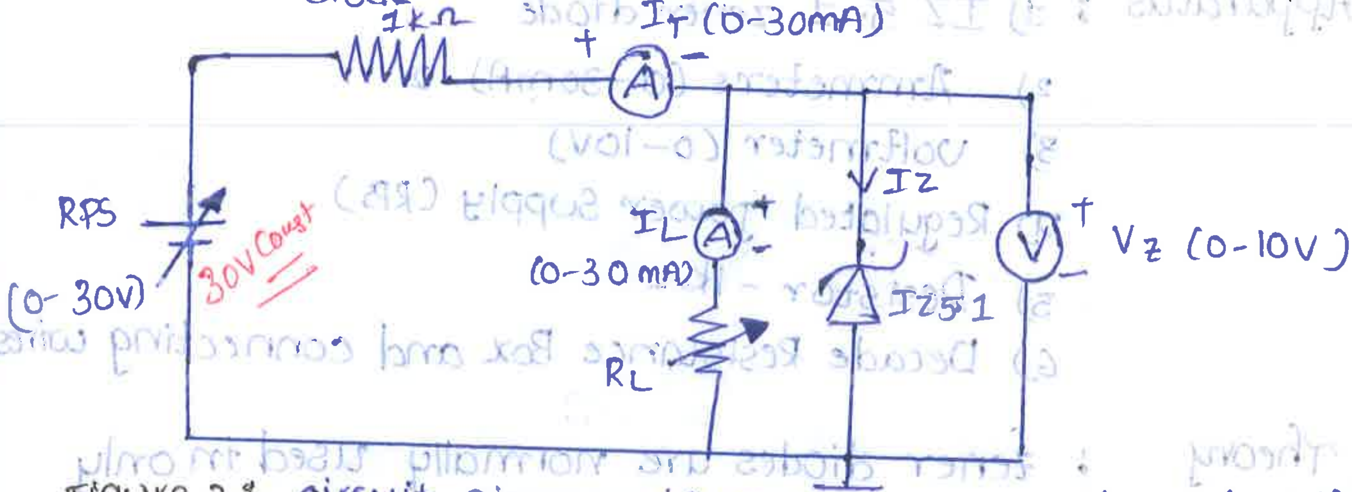


Figure 2: circuit Diagram to study the Load characteristics of zener Diode

Expected graphs:-

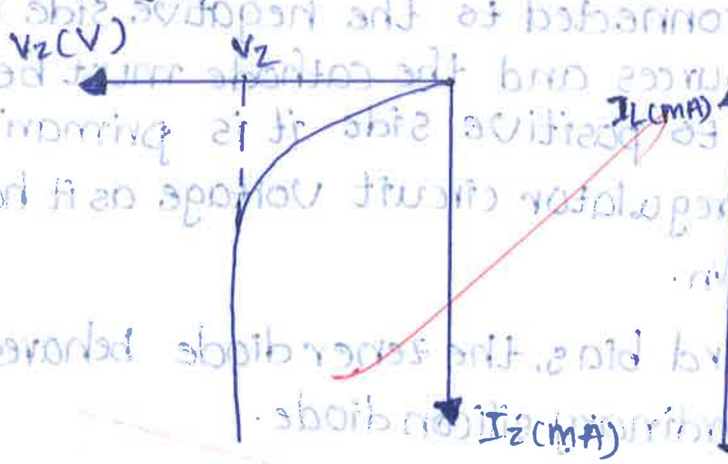


Figure 3: VI characteristics of zener Diode

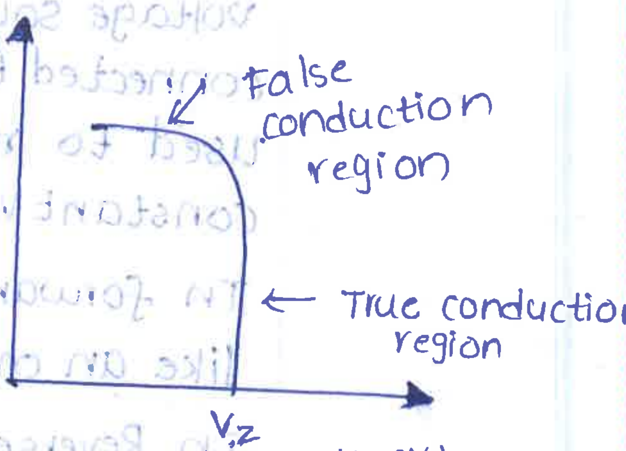


Figure 4: load characteristics of zener Diode

there is a sharp increase in reverse current.

when reverse-biased voltage is applied to a zener diode, it allows only a small amount of leakage current until the voltage is less than zener voltage.

Procedure : zener characteristics:

1) Make the connections as per the circuit diagram

2) By slowing increasing the input voltage tabulate the readings of voltmeter and ammeter.

3) Plot the graph between I_z and V_z (VI - characteristics)

4) The voltage at which the current starts increasing is called the break down voltage

5) From the breakdown region calculate the zener resistance of the zener diode.

Load characteristics:

1) Make the connections as per the circuit diagram

2) setting RPS value to 30V vary the load in steps and tabulate the readings of total current, load current and zener voltage.

calculation of zener Resistance from V-I characteristics

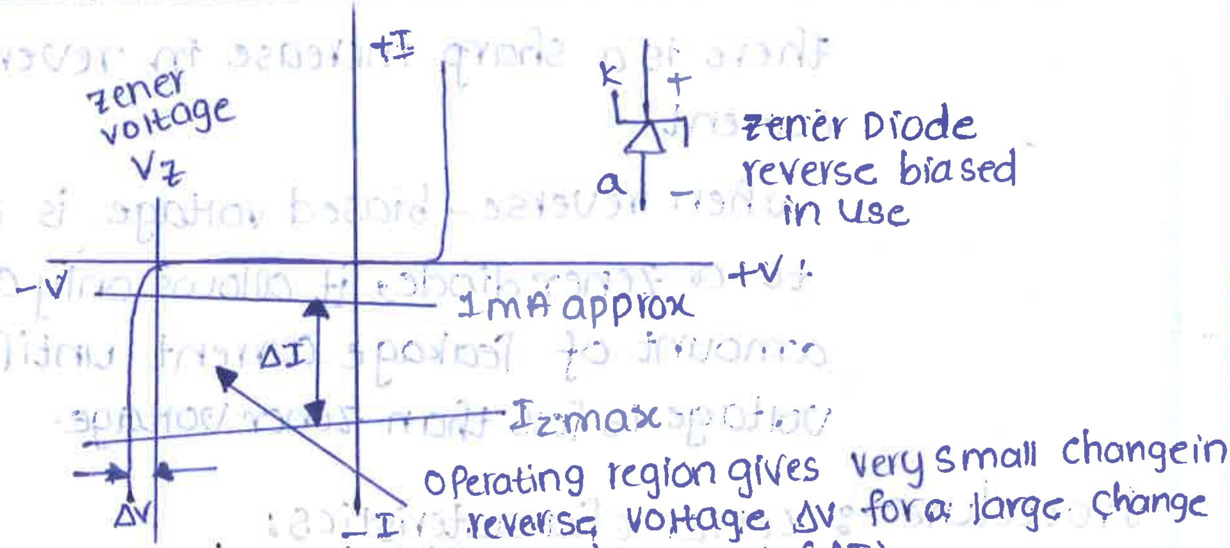


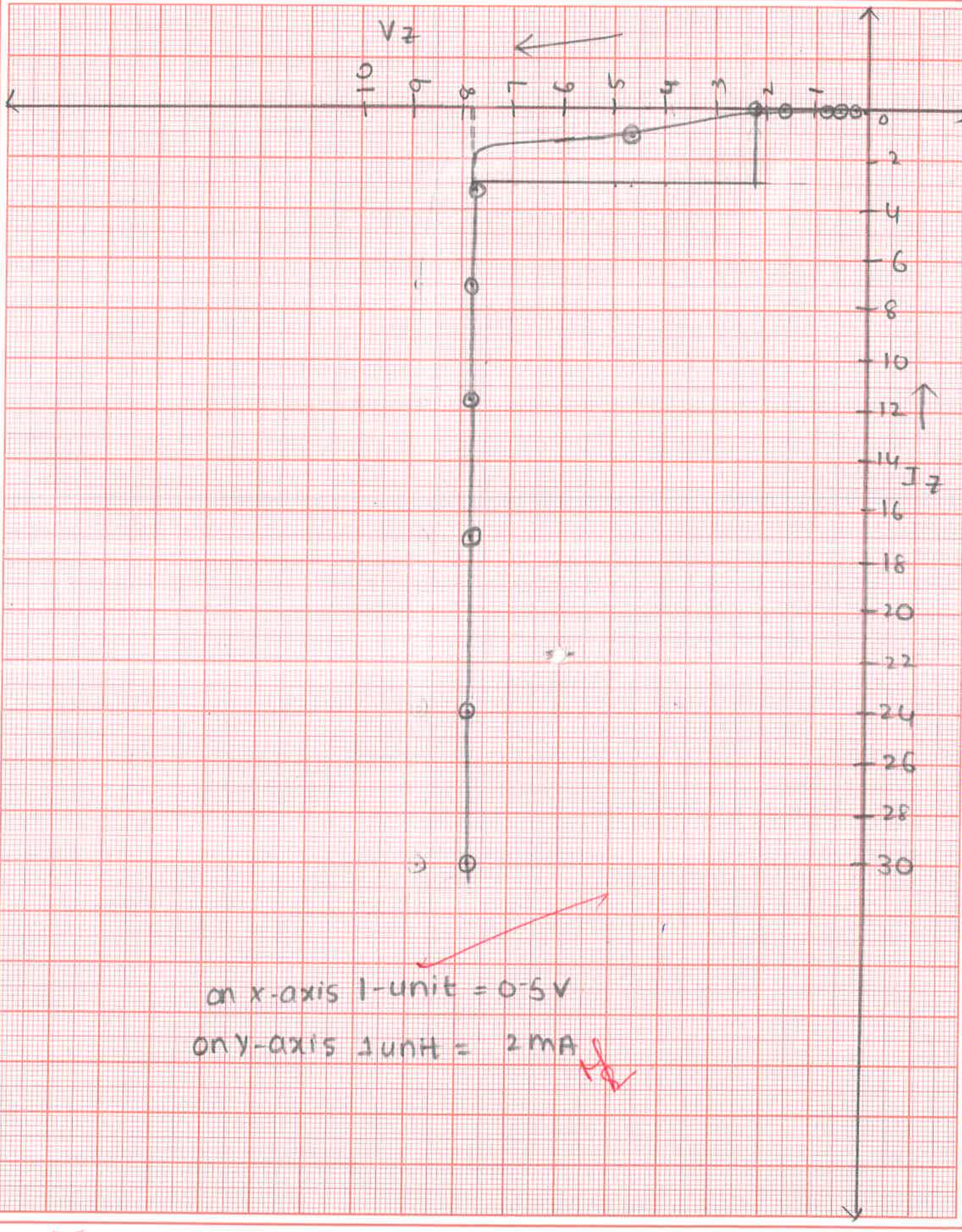
Table 1: V-I characteristics

SNO	Zener voltage V_Z (Volts)	Zener current I_Z (mA)
1	0.2	0
2	0.5	0
3	0.8	0
4	1.6	0
5	2.2	4
6	4.6	3.2
7	7.8	7.0
8	7.8	11.7
9	7.8	17.0
10	7.8	24
11	7.8	30

Table 2: zener diode load characteristics

SNO	R_L in Ω	V_Z in volts	I_T in mA	I_L in mA	$I_T - I_L = I_Z$ in mA
1	100	3.8	26	27	1
2	200	5.0	24	24	0
3	300	7.8	22	22	0
4	400	7.8	22.5	17	5.5
5	500	7.8	22.5	13	9.5
6	600	7.8	22.5	11	11.5
7	700	7.8	22.5	9	13.5
8	800	7.8	22.5	8	14.5
9	900	7.8	22.5	7	15.5
10	1000	7.8	22.5	5	17.5

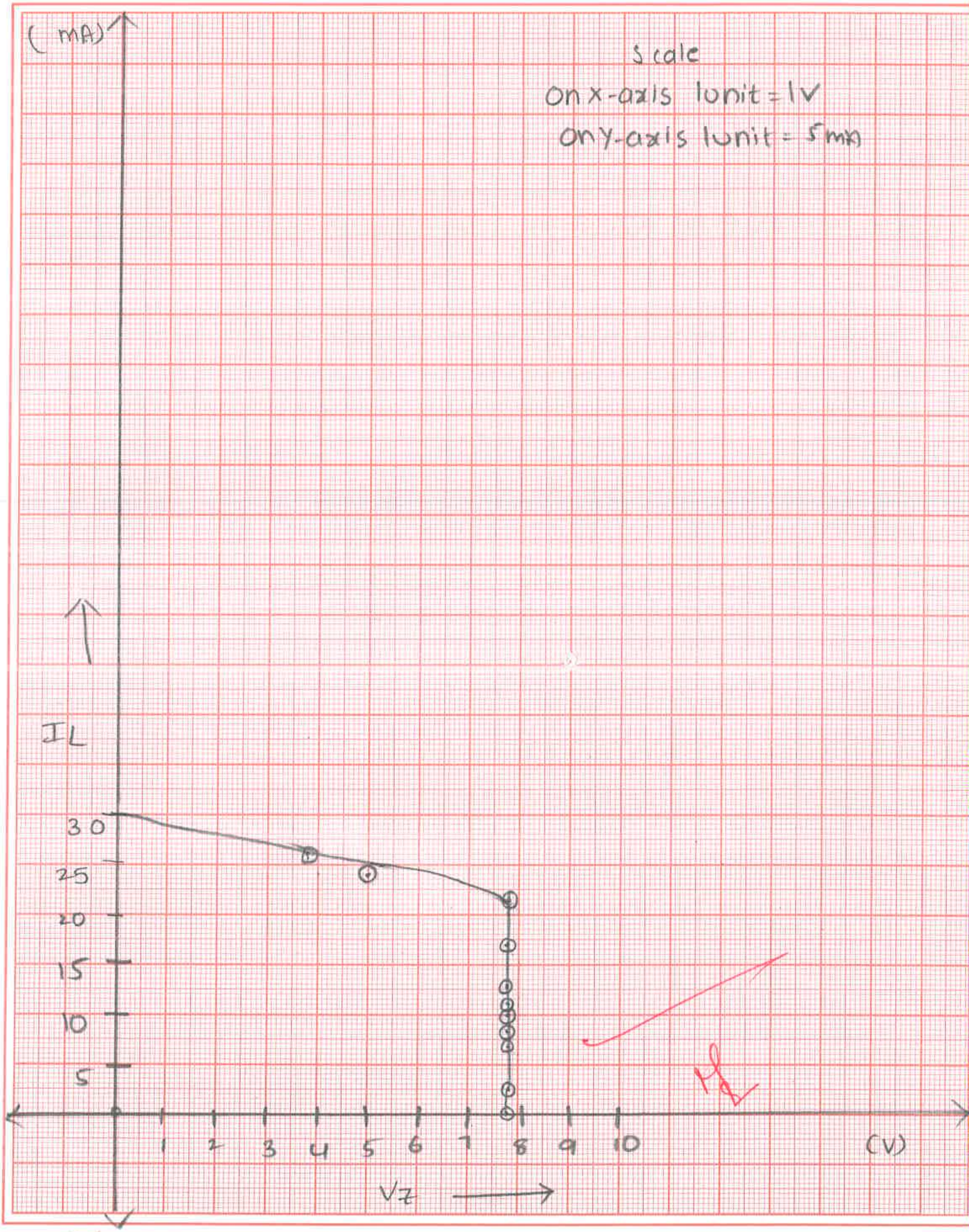
V-I characteristics of zener Diode



on x-axis 1-unit = 0.5 V

on y-axis 1 unit = 2 mA

Load characteristics of zener diode



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ESTD : 1995

3) Plot the graph between I_L & V_Z (Load characteristics)

calculations : Dynamic Resistance $R = \frac{\Delta V_Z}{\Delta I_Z}$

$$= \frac{8-2.2}{7.8\times10^{-3} - 3\times10^{-3}} = 1.20\,k\Omega$$

Result : $R = \frac{8-2.2}{(7.8-3)\times10^{-3}} \Rightarrow 1.20\,K\Omega$

conclusion : Hence, determined the VI-characteristics of given zener diode and the load characteristics of given zener diode & the zener resistance of the given zener diode is determined.

9½/10

EXPT. NO: 03	HALF WAVE RECTIFIER WITHOUT FILTER	Date: 2/10/22

Aim : To find the ripple factor and percentage regulation of the half wave rectifier at various loads.

Apparatus :
1) Transformer
2) Diode BY 127
3) DC ammeter - (0-500 mA)
4) DC voltmeter - (0-30)V
5) DRB
6) AC voltmeter - (0-30)V

Theory : The half wave rectifier converts the AC into DC. But the obtained DC at the output is not a pure DC. It is a pulsating Direct current.

The pulsating Direct current is not a constant. It fluctuates with respect to time. when this fluctuating DC is applied to any electric device, the device may not work Properly. Sometimes the device may also be damaged. So the fluctuating DC is not useful in most of the appliances.

Therefore, we need a DC that does not fluctuate with respect to time. The only

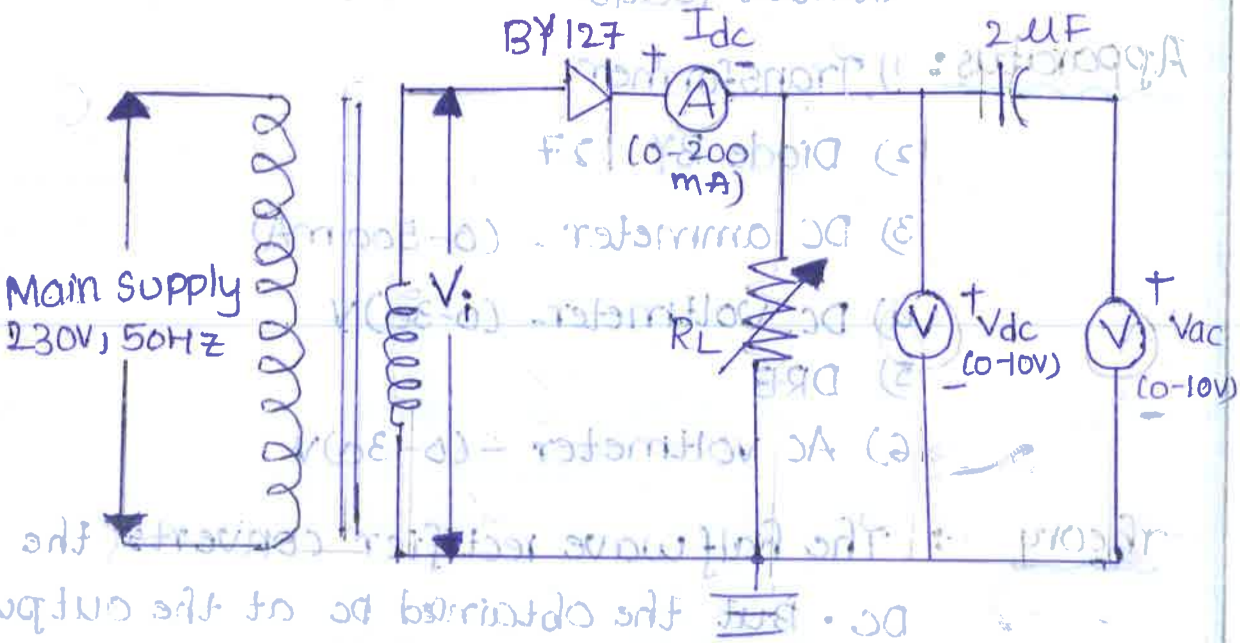


Figure 1 :- Circuit diagram of Half wave Rectifier without Filter

solution for this is smoothing the fluctuating DC. this can be achieved by using a filter called Filter.

The pulsating DC contains both Ac and DC components. DC components are useful but AC components are not useful. So, we need to reduce the Ac components. By using the filter, we can reduce the AC components at the output.

The filter is an electronic device that allows dc components & blocks the ac components of the rectifier output. The filter is made up of a combination of components such as capacitors, resistors & inductors. the capacitor allows ac & blocks the dc. the Inductor allows dc & blocks the ac.

The passage of ac components through the Capacitor is nothing but charging of the capacitor. In simple words, the ac component is nothing but an excess current that flows through the capacitor & charges it. This Prevents any sudden change in the voltage at the output.

Procedure : 1) Make the connections as per the circuit diagram as fig.1

2) Tabulate the readings of DC ammeter and DC & AC voltmeters for various values of

Expected Graphs:-

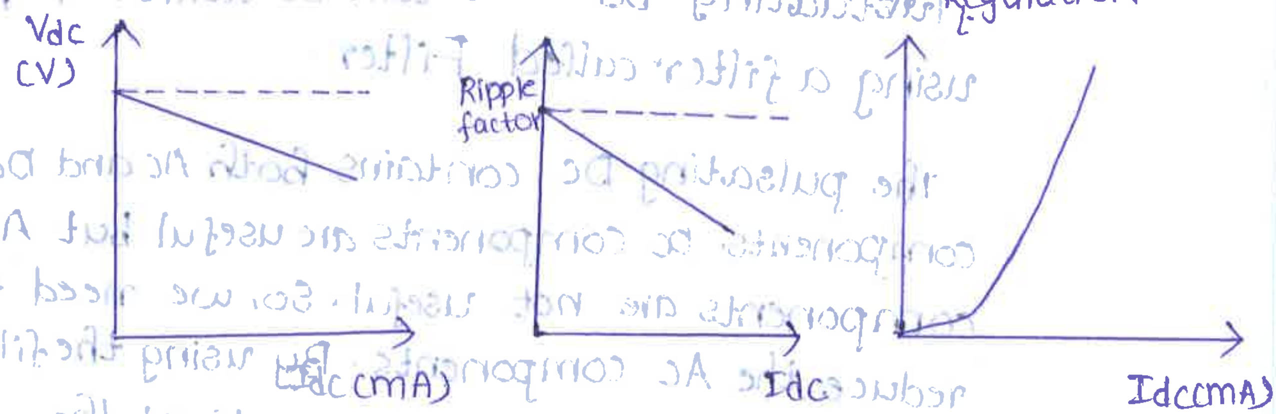


Figure 2:- Plot for Vdc Vs Idc, Ripple factor Vs Idc, % age Regulation Vs Idc

Expected waveforms:-

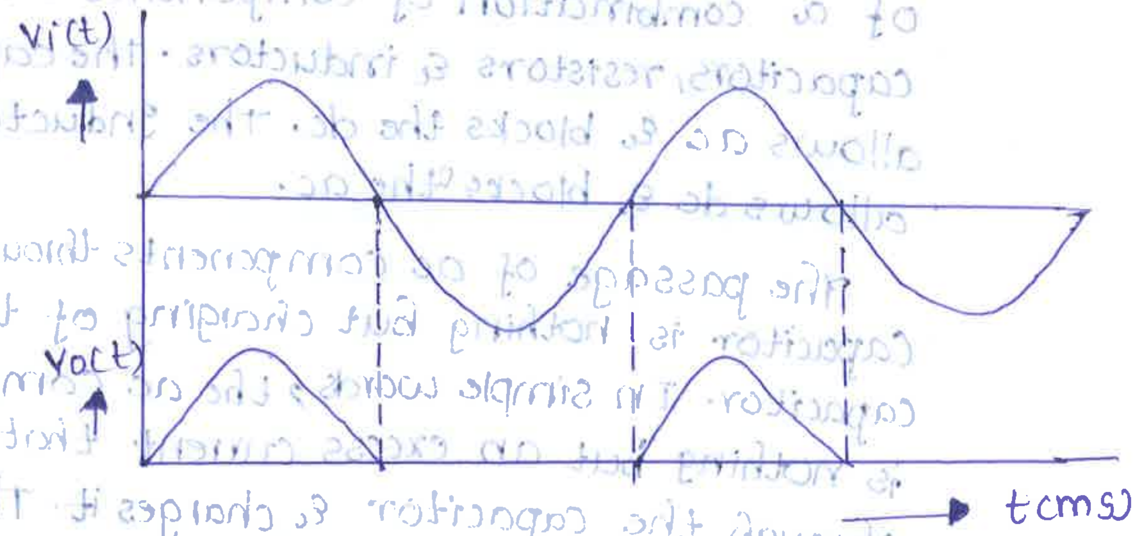


Figure 3:- Input & output waveforms of Half-wave Rectifier without Filter

load resistance.

3) Find the no load dc voltage by opening the load and note it as $V_{NO\ load}$.

4) Also observe the output waveform across R_L on CRO screen.

5) calculate the ripple factor for all load resistances

6) calculate the percentage regulation for all values of load resistances.

7) Plot the graphs for V_{dc} vs I_{dc}, percentage regulation of vs I_{dc}, ripple factor Vs I_{dc}.

calculations:

$$\%\ \text{regulation} = \left(\frac{(V_{NO\ Load} - V_{Full\ Load})}{(V_{Full\ Load})}\right) \times 100$$

$$\text{Ripple factor} = \frac{V_{ac}}{V_{dc}}$$

1. $\frac{V_{ac}}{V_{dc}} = \frac{7.41}{6} = 1.2$

2. $\frac{8.65}{7} = 1.2$

3. $\frac{9.20}{7.5} = 1.2$

4. $\frac{9.5}{8.0} = 1.18 \approx 1.2$

5. $\frac{9.7}{8.0} = 1.2$

6. $\frac{9.8}{8.0} = 1.2$

Observations:

Open circuit dc voltage, $V_{No Load} = 8.5V$

S.No	R_L	I_{dc}	V_{dc}	V_{ac}	Ripple factor	% Regulation
1	100	62	6	7.41	1.2	41.66
2	200	35	7	8.65	1.2	21.4
3	300	25	7.5	9.20	1.2	13.3
4	400	20	8.0	9.5	1.2	6.25
5	500	16	8.0	9.7	1.2	6.25
6	600	14	8.0	9.8	1.2	6.25
7	700	12	8.0	9.9	1.2	6.25
8	800	10	8.0	9.9	1.2	6.25
9	900	10	8.0	9.9	1.2	6.25
10	1000	10	8.0	10.0	1.2	6.25

7. 9.9/10 = 1.2

8. 9.9/10 = 1.2

9. 9.9/10 = 1.2

10 8.0/10.0 = 1.2

$$\% \text{ Regulation} = \left(\frac{V_{NoLoad} - V_{FullLoad}}{V_{Full load}}\right) \times 100$$

1. $\frac{8.5-6}{6} \times 100 = 41.66$

2. $\frac{8.5-7}{7} \times 100 = 21.4$

3. $\frac{8.5-7.5}{7.5} \times 100 = 13.3$

4. $\frac{8.5-8.0}{8.0} \times 100 = 6.25$

5. $\frac{8.5-8.0}{8.0} \times 100 = 6.25$

6. $\frac{8.5-8.0}{8.0} \times 100 = 6.25$

7. $\frac{8.5-8.0}{8.0} \times 100 = 6.25$

8. $\frac{8.5-8.0}{8.0} \times 100 = 6.25$

9. $\frac{8.5-8.0}{8.0} \times 100 = 6.25$

10. $\frac{8.5-8.0}{8.0} \times 100 = 6.25$

Result : At $R_L = 500\Omega$

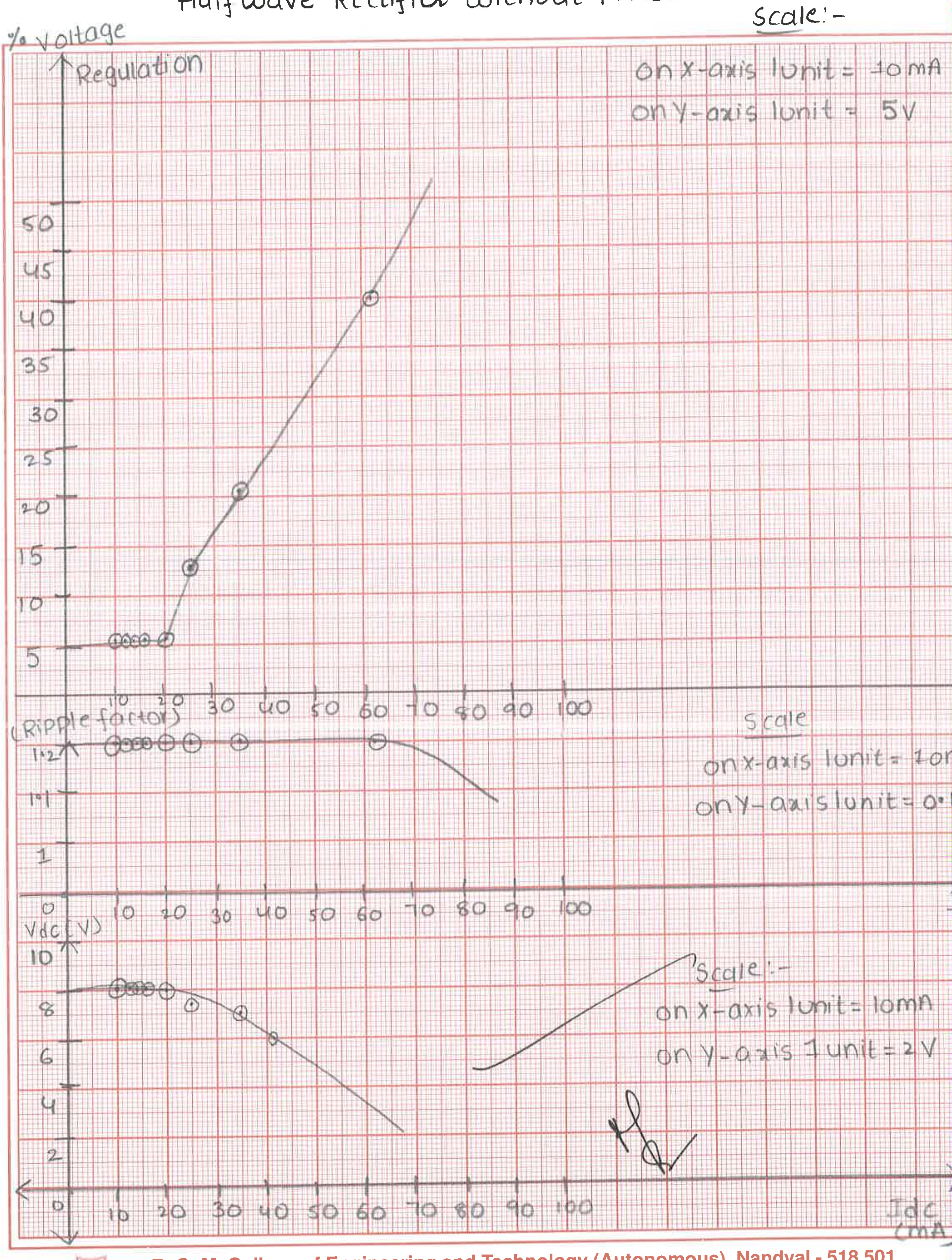
Ripple factor $= \frac{V_{ac}}{V_{dc}} = \frac{9.7}{8.0} = 1.2$

% Regulation = 6.25%

Conclusion : Hence the ripple factor and percentage regulation of the half wave rectifier at various load is verified.

9½/10

Halfwave Rectifier without Filter



EXPT NO: 04	FULL WAVE RECTIFIER WITHOUT FILTER	Date: 2/10/22

Aim : To find the ripple factor and percentage regulation of the full wave rectifier without filter at various loads.

Apparatus :
1) Transformer
2) BY 127 diodes-2
3) DC ammeter (0-500mA)
4) DC voltmeter (0-30V)
5) DRB
6) AC voltmeter (0-30V)

Theory : Full wave Rectifier is a diode circuit which is used to transform the complete cycle of Alternating voltage (AC supply) to Direct voltage (DC supply). In full wave rectification, current flows through the load in the same direction for the complete cycle of input AC supply.

A rectifier (without filter) with fundamental ripple frequency ~~equal~~ to twice the mains frequency, has ripple factor of 0.482 & Power conversion efficiency equal to 81.2%.

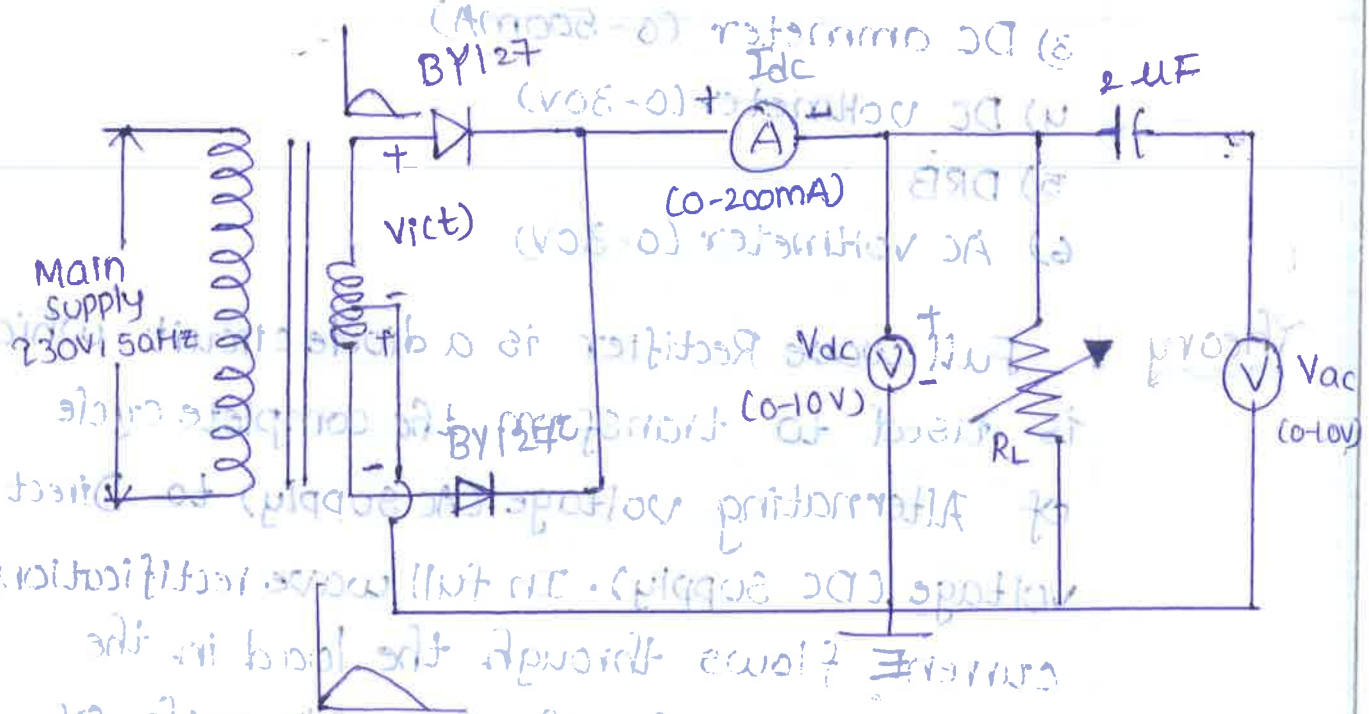


Figure 1 : circuit diagram of Full wave Rectifier without Filter

The full-wave rectifier consists of a center-tap transformer, which results in equal voltages above and below the center-tap. During the positive half cycle, a positive voltage appears at the anode of D_1 while a negative voltage appears at the node of D_2. Due to this diode D_1 is forward biased it results in a current I_{d1} through the load R.

During the negative half cycle, a positive voltage appears at the node of D_2 and hence it is forward biased. Resulting in a current I_{d2} through the load at the same instant a negative voltage appears at the anode of D_1 thus reverse biasing it and hence it doesn't conduct.

Procedure:
1) Make the connections as per the circuit diagram of fig.1.
2) Tabulate the voltmeter and ammeter readings for various values of load resistance
3) Find the no load dc voltage by opening the load and note it as V_{NoLoad}.
4) Also, observe the output waveform

Expected Graphs:

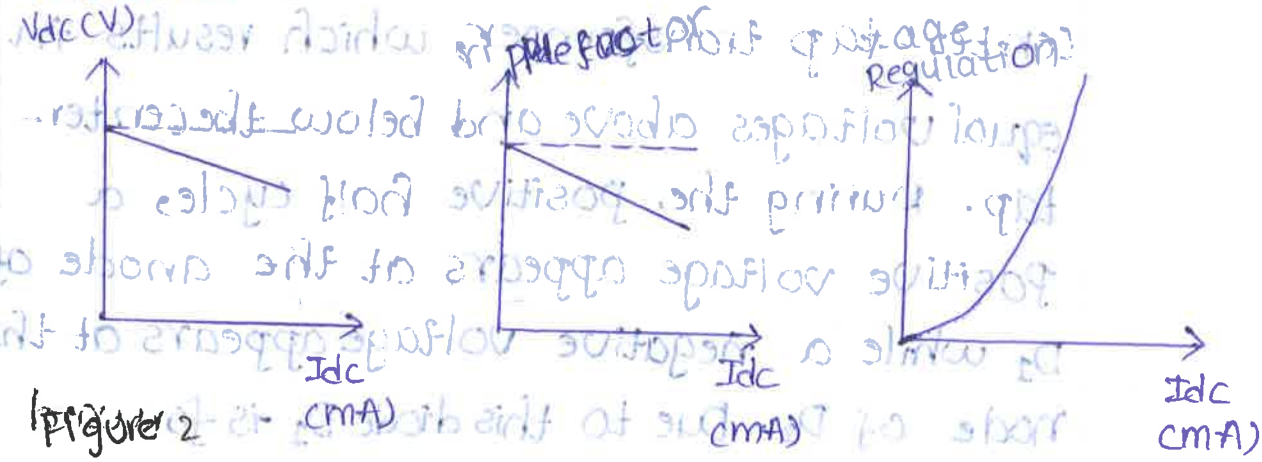


Figure 2

Plot for Vdc Vs Idc   Plot for ripple factor Vs Idc   Plot for % Regulation Vs Idc

Expected wave forms:

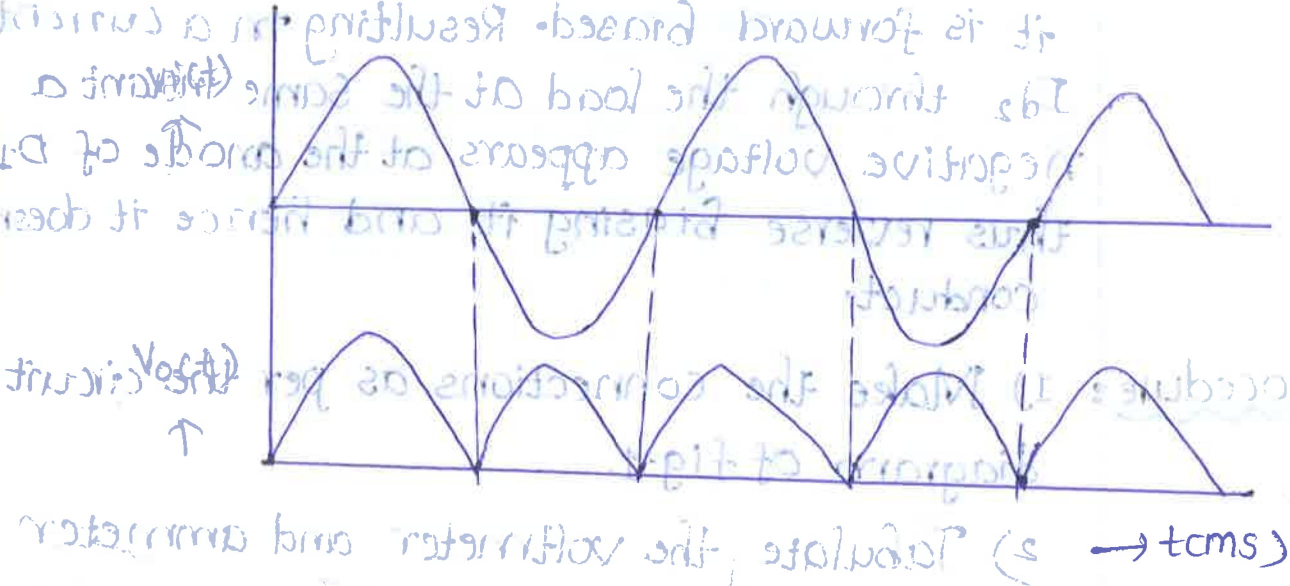


Figure 3: Input & output waveforms of Full-wave Rectifier without filter.

across the load resistance on CRO screen.

5) calculate the ripple factor for all load resistances.

6) calculate the percentage regulation for all values of load resistances.

7) Plot the graphs Vdc Vs Idc, percentage regulation Vs Idc, ripple factor Vs Idc.

Calculations:

$$\% \text{ Regulation} = \left(\frac{V_{No Load} - V_{Full Load}}{V_{Full\ load}}\right) \times 100$$

$$\text{Ripple factor} = \frac{V_{ac}}{V_{dc}}$$

1) $\frac{V_{ac}}{V_{dc}} = \frac{3.6}{7.0} = 0.5$

2) $\frac{4.0}{8.0} = 0.5$

3) $\frac{4.0}{8.0} = 0.5$

4) $\frac{4.0}{8.0} = 0.5$

5) $\frac{4.1}{8.0} = 0.5$

6) $\frac{4.1}{8.0} = 0.5$

7) $\frac{4.1}{8.0} = 0.5$

Observations:

Open circuited dc voltage $V_{No load}$ = 8.5V

S NO	RL	I_{DC}	V_{DC}	V_{AC}	Ripple factor	% Regulation
1	100	70	7.0	3.6	0.5	21.4
2	200	38	8.0	4.0	0.5	6.25
3	300	26	8.0	4.0	0.5	6.25
4	400	20	8.0	4.0	0.5	6.25
5	500	16	8.0	4.1	0.5	6.25
6	600	14	8.0	4.1	0.5	6.25
7	700	12	8.0	4.1	0.5	6.25
8	800	10	8.0	4.1	0.5	6.25
9	900	10	8.0	4.1	0.5	6.25

8) $\frac{4.1}{8.0} = 0.5$

9) $\frac{4.1}{8.0} = 0.5$

% Regulation :- $\left(\frac{V_{No load} - V_{Full load}}{V_{Full load}} \right) \times 100$

1. $\frac{8.5 - 7}{7.0} \times 100 = 21.4$

2. $\frac{8.5 - 8}{8} \times 100 = 6.25$

3. $\frac{8.5 - 8}{8} \times 100 = 6.25$

4. $\frac{8.5 - 8}{8} \times 100 = 6.25$

5. $\frac{8.5 - 8}{8} \times 100 = 6.25$

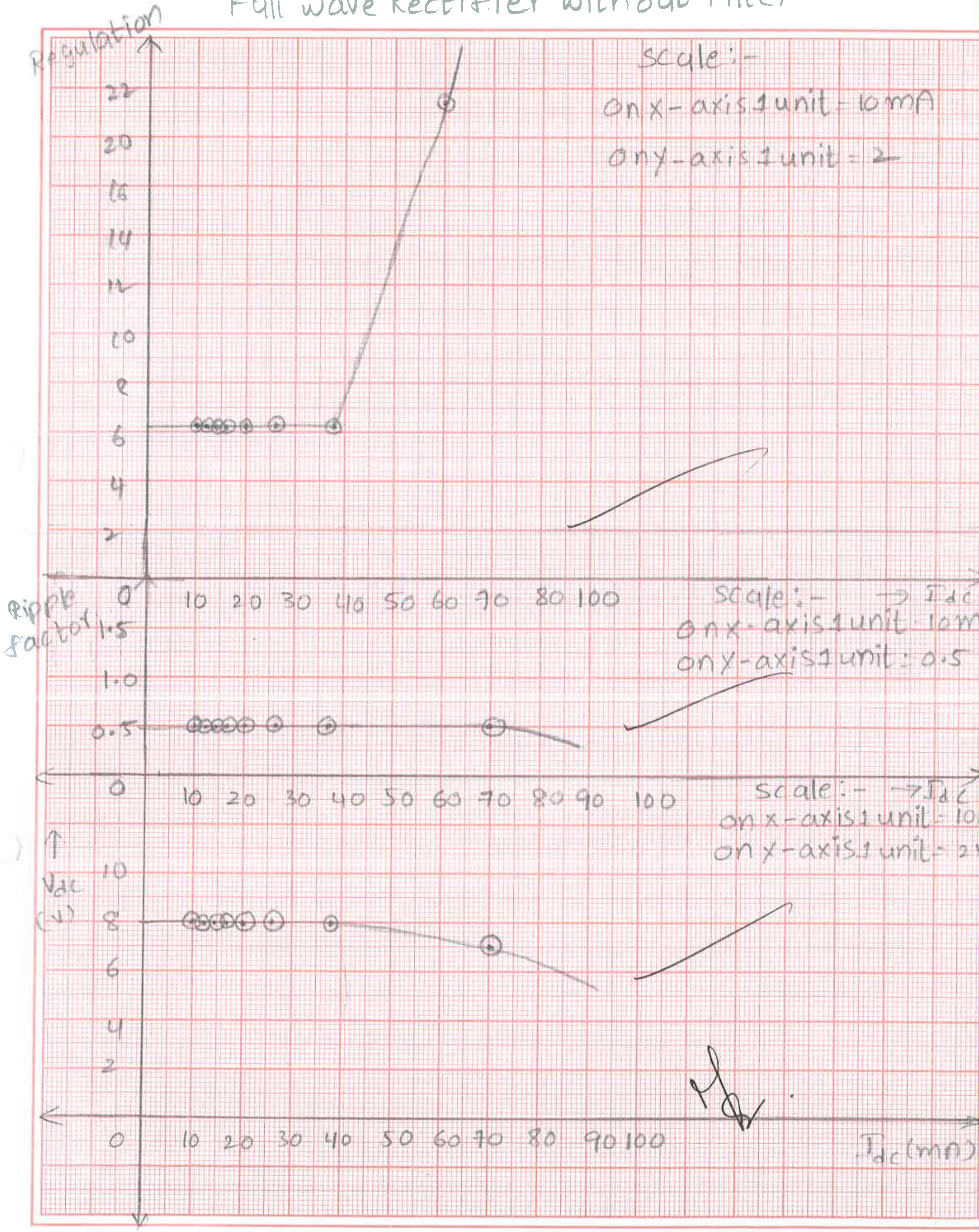
6. $\frac{8.5 - 8}{8} \times 100 = 6.25$

7. $\frac{8.5 - 8}{8} \times 100 = 6.25$

8. $\frac{8.5 - 8}{8} \times 100 = 6.25$

9. $\frac{8.5 - 8}{8} \times 100 = 6.25$

Full wave Rectifier without Filter



Result : At 500Ω

Ripple factor = $\frac{V_{ac}}{V_{dc}} = \frac{4.1}{8.0} = 0.5$

% Regulation = 6.25%

Conclusion : Hence the ripple factor & percentage regulation of the full wave rectifier without filter at various loads is verified.

9½/10

EXPT. NO	FULL WAVE RECTIFIER WITH FILTERS	Date:
5		9/11/22

Aim : To find the ripple factor and percentage regulation of Full-wave Rectifier with filters at various loads.

Apparatus :
1) Transformer
2) Diodes BY127 -- 2
3) DC ammeter (0-500mA)
4) DC Voltmeter (0-30V)
5) DRB
6) AC Voltmeter (0-30 V)
7) Inductor 100 mH
8) capacitor 1000 μF

Theory : The conversion of AC into pulsating DC is called Rectification. Electronic Devices can convert AC power into DC power with high efficiency.

The full wave rectifier consists of a center-tapped transformer, which results in equal voltages above & below the center tap. During the positive half cycle, a positive voltage appears at the anode of D_1 while a negative voltage appears at the anode of D_2.

Circuit Diagrams:-

With π- Section filter:

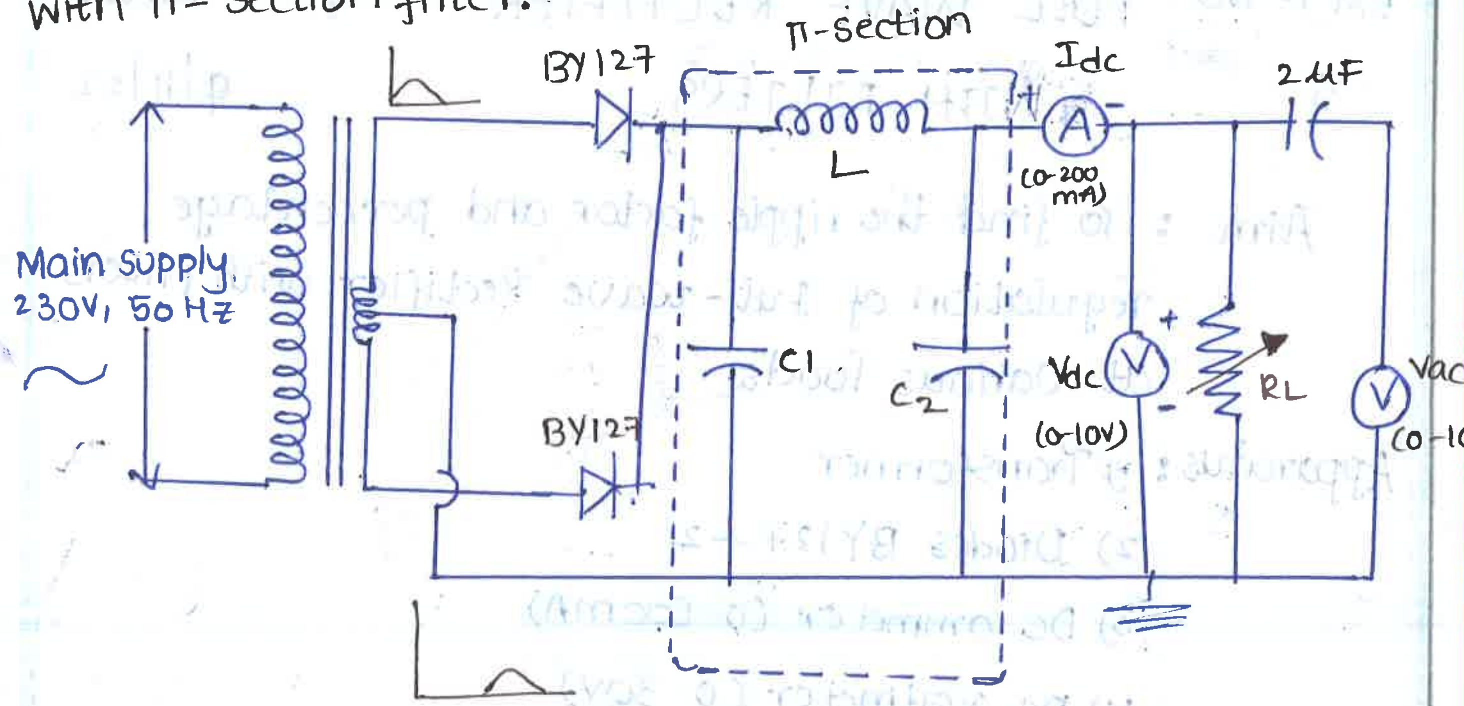


Figure 1: circuit diagram of Full-wave Rectifier with π-Section filter

With L-section filter

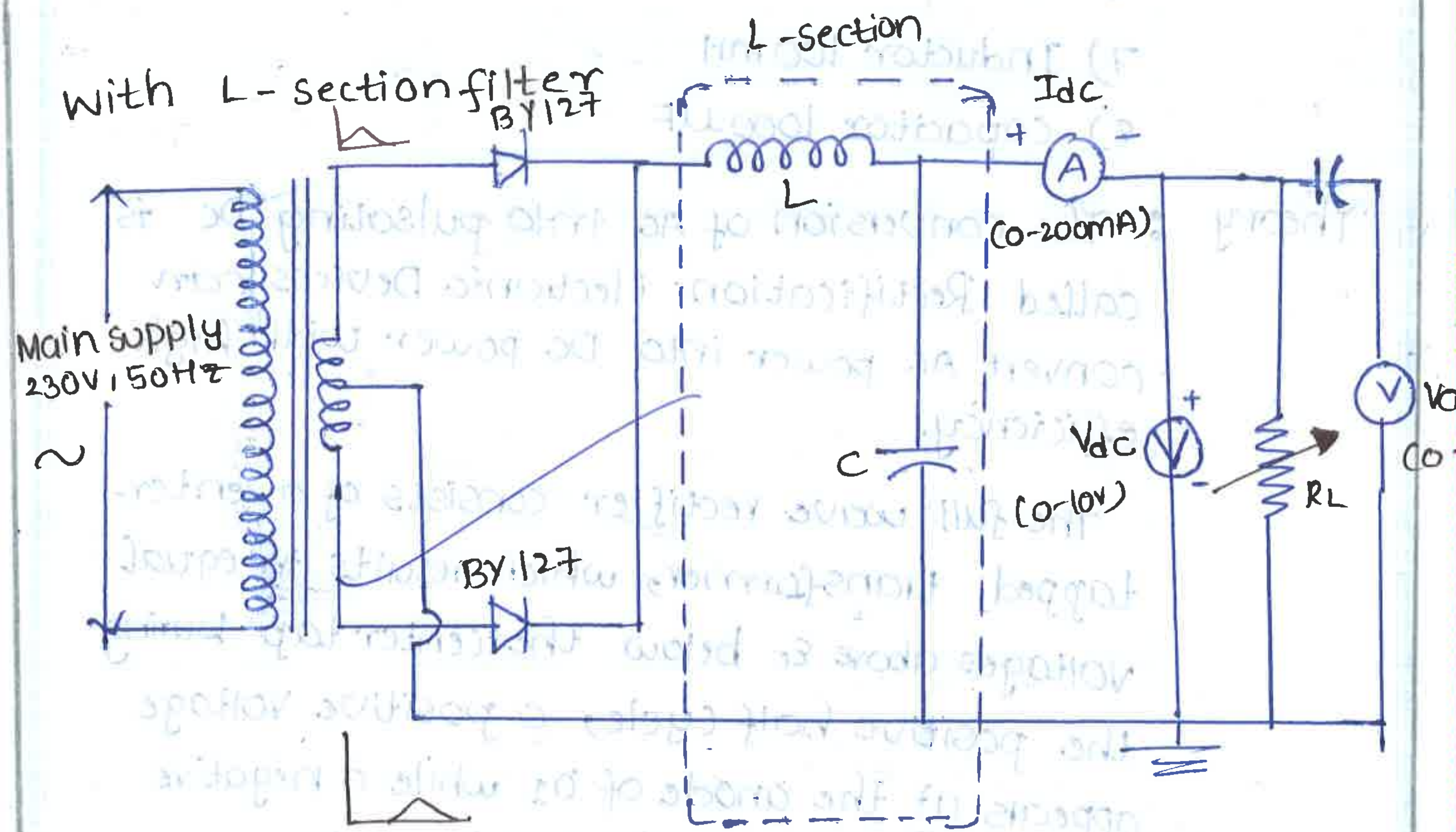


Figure 2: circuit diagram of Full-wave Rectifier with L-section filter

Due to this diode D_1 is forward biased. It results a current I_{d1} through the load R.

During the -ve half cycle, a +ve voltage appears at the anode of D_2.

Procedure: 1) Make the connections as per the circuit diagram of fig.1

2) Tabulate the voltmeter & ammeter readings for various values of load resistance.

3) Find the no load dc voltage by opening the load and note it as V_{NoLoad}.

4) Also observe the output waveform across the load resistance on CRO screen.

5) Calculate the ripple factor for all load resistances.

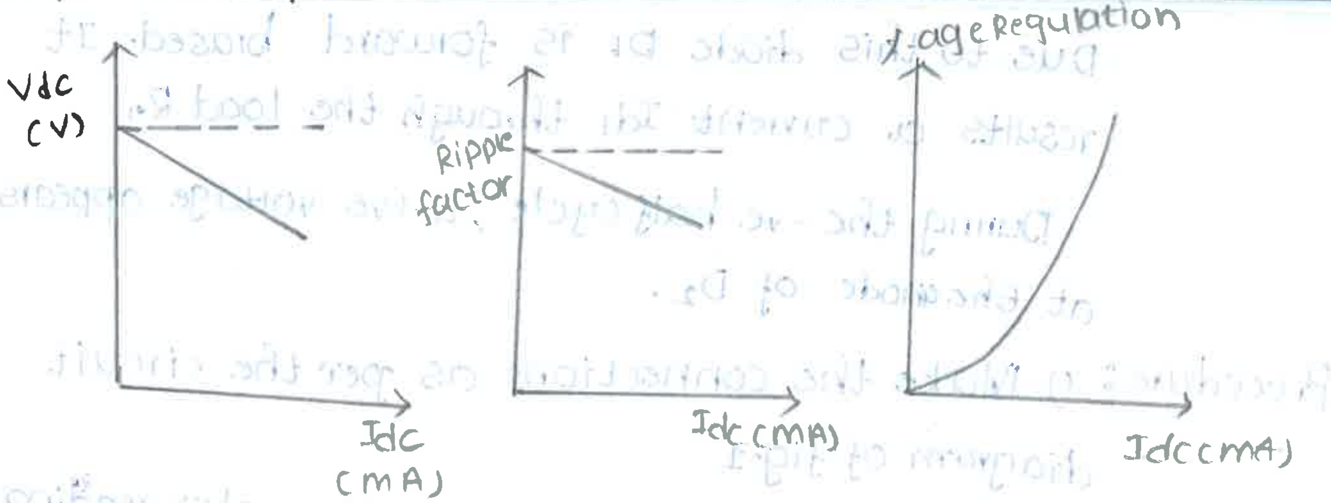
6) calculate the percentage regulation for all values of load resistances.

7) Plot the graphs for Vdc, Idc percentage regulation Vs Idc, ripple factor Vs Idc.

$$\% \text{Regulation} = \frac{(V_{NoLoad} - V_{Full\,load})}{(V_{full\,Load})} \times 100$$

$$\text{Ripple factor} = \frac{V_{ac}}{V_{dc}}$$

Expected Graphs:-



Observations

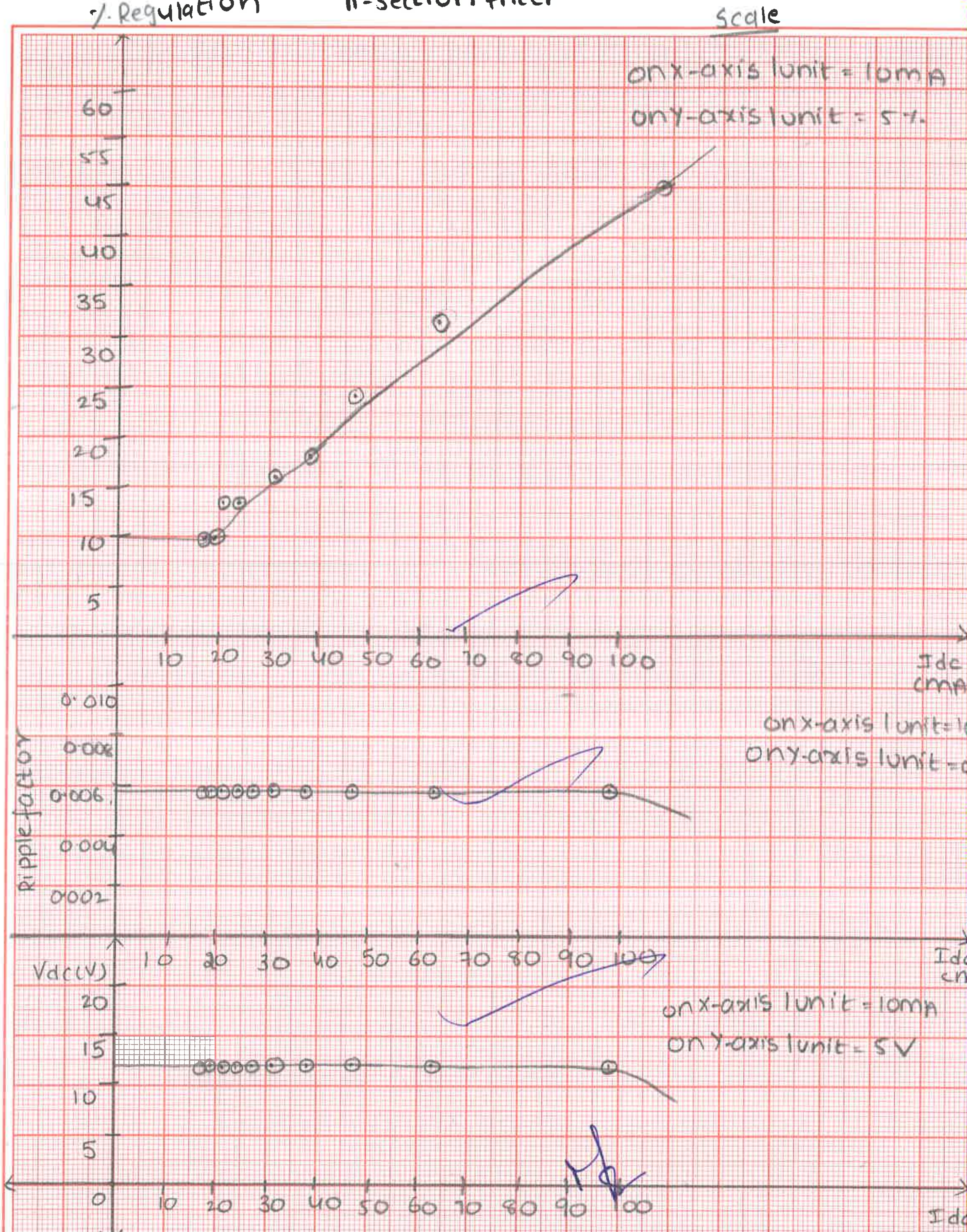
with π-section Filter open circuited dc voltage V_{NoLoad} = 18.5 V

SNO	RL	Idc	Vdc	Vac	Ripple factor	% Regulation
	100	98	17.0	0.01	0.0058	45.94
	200	63	17.0	0.01	0.0058	32.43
	300	47	17.0	0.01	0.0058	24.89
	400	38	17.0	0.01	0.0058	18.91
	500	31	17.0	0.01	0.0058	16.21
	600	27	17.0	0.01	0.0058	13.51
	700	24	17.0	0.01	0.0058	13.51
	800	21	17.0	0.01	0.0058	10.81
	900	19	17.0	0.01	0.0058	10.81
	1000	18	17.0	0.01	0.0058	8.82

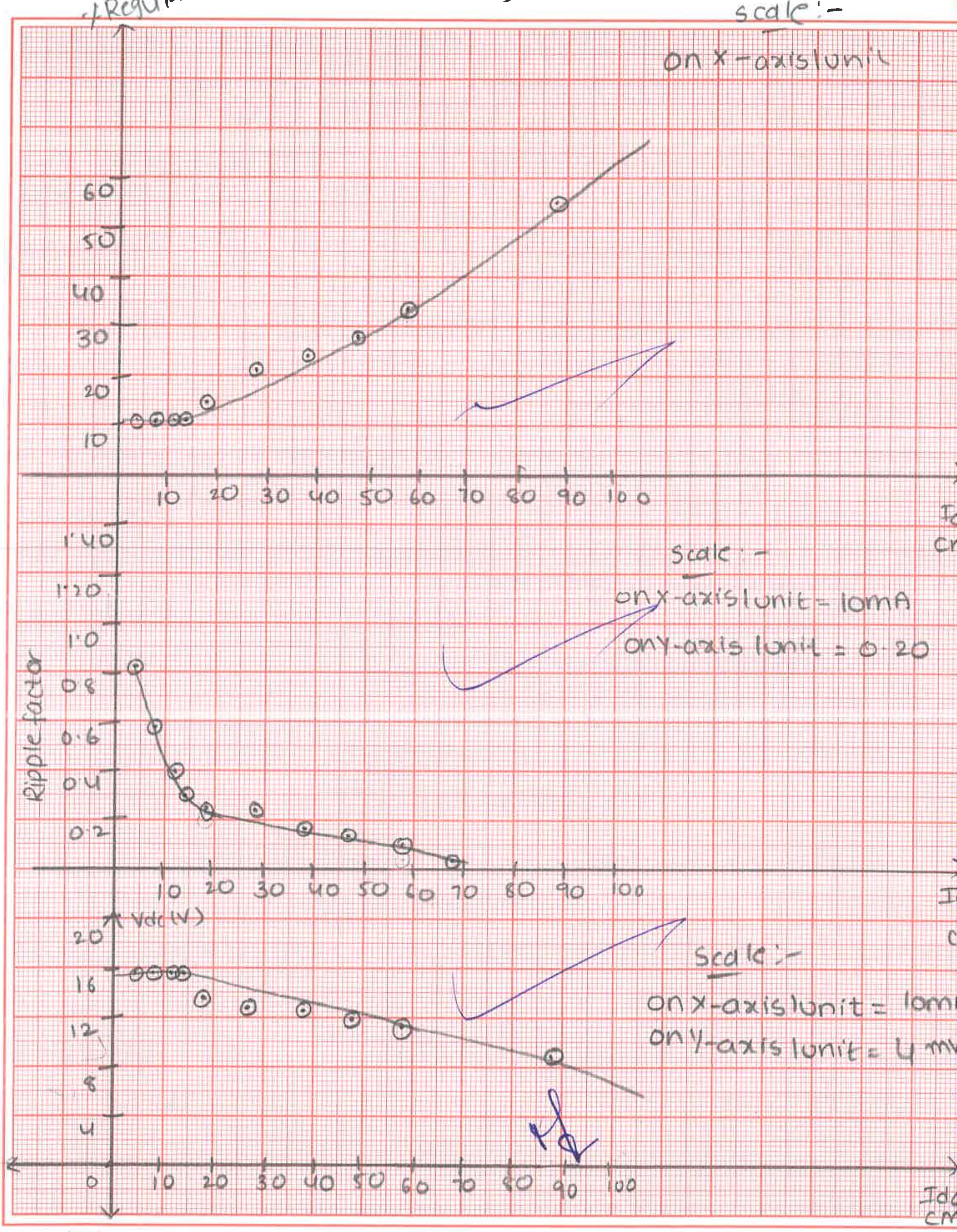
L-section filter open circuited dc voltage V_{Noload} = 16.5 V

RL	Idc	Vdc	Vac (mV)	Ripple factor	% Regulation
100	87	9	7.3	0.03	45.4
200	58	11.0	4.9	0.12	33.3
300	47	12.0	4.4	0.14	27.2
400	38	12.5	4.0	0.16	24.2
500	27	13.0	3.9	0.24	21.2
600	18	14.0	3.2	0.28	15.1
700	14	15.0	3.0	0.36	9.09
800	12	15.0	2.9	0.36	9.09
900	8	15.0	2.6	0.36	9.09
1000	4	15.0	2.3	0.36	9.09

% Regulation π-section filter



L-section filter



Result : At 500 Ω

for π-Section % Regulation = 8.82

Ripple factor = 0.0058

for L-Section: % Regulation = 9.09

Ripple factor = 0.81

Conclusion : Hence, the ripple factor & percentage Regulation of the full wave rectifier at various loads is verified.

9/10

EXPT. NO: 06	NON- LINEAR WAVE SHAPING - CLIPPING CIRCUITS	Date: 15/12/22

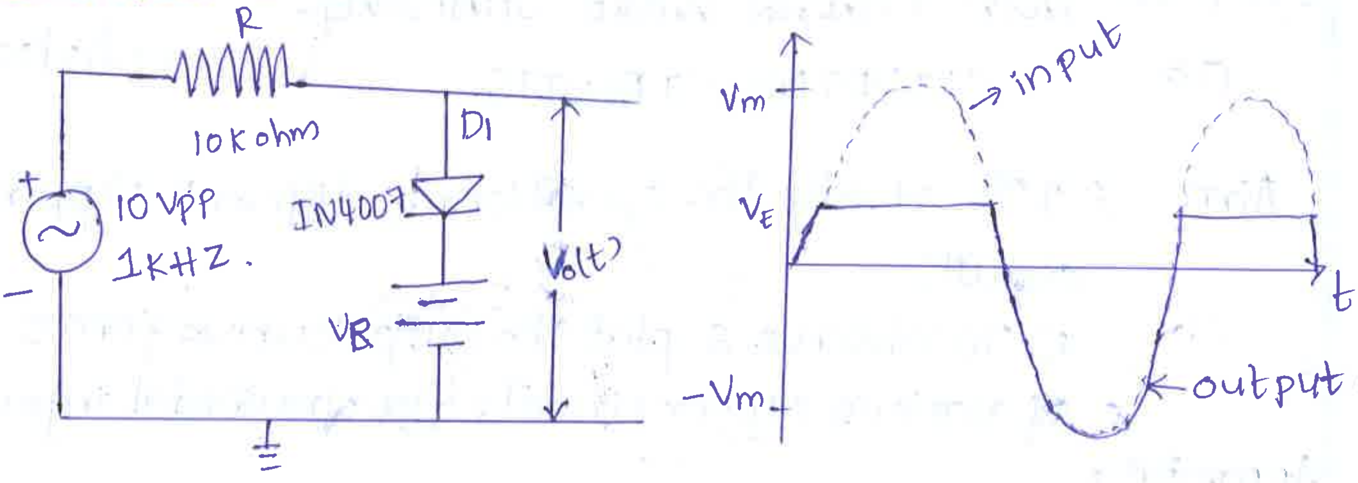
Aim : 1) To study the operation of different clipping circuits.
2) To observe & plot the output wave forms of various clipper circuits for sinusoidal input.

Apparatus Required :

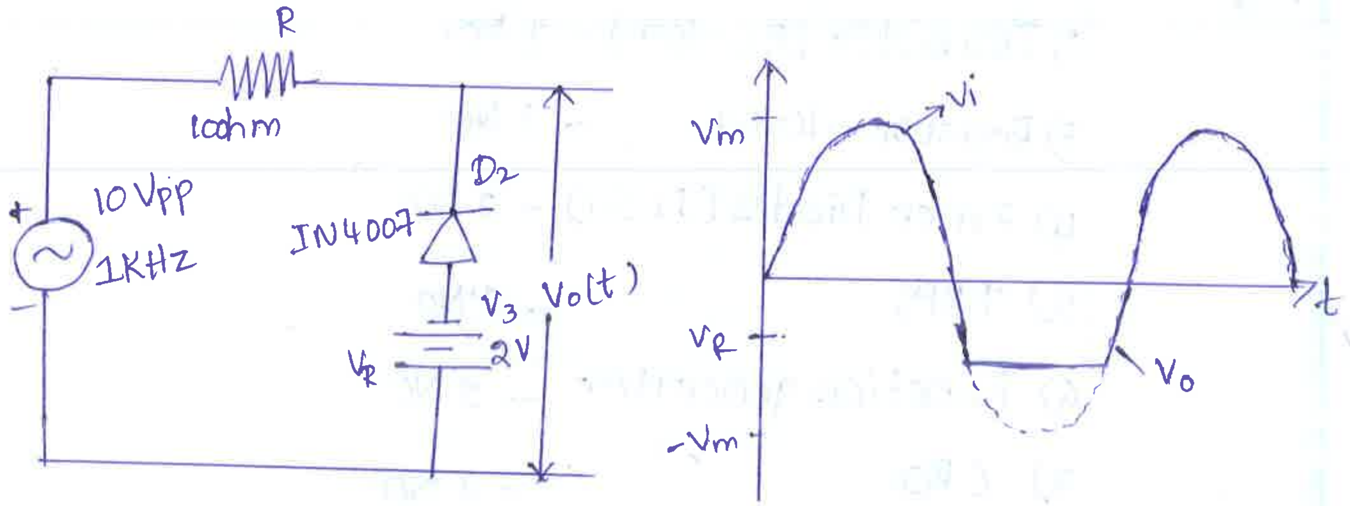
1) Diodes (IN4007) - 2 NO's
2) Transistor (BC-107) - 1 NO.
3) Resistor - 10kΩ - 1 NO.
4) zener Diodes (IZ5.1) - 2 NOs
5) TRPS - 1 NO.
6) Function generator - 1 NO.
7) CRO - 1 NO.
8) CRO probes - 3 NO's
9) connecting wires - As required
10) Bread Board - 1 NO.

Theory : A circuit which cutoff voltage above or below are both ~~at~~ specified level is called "clipper".
A clipper which removes a portion of positive half cycle of the input signal is called "Positive clipper".

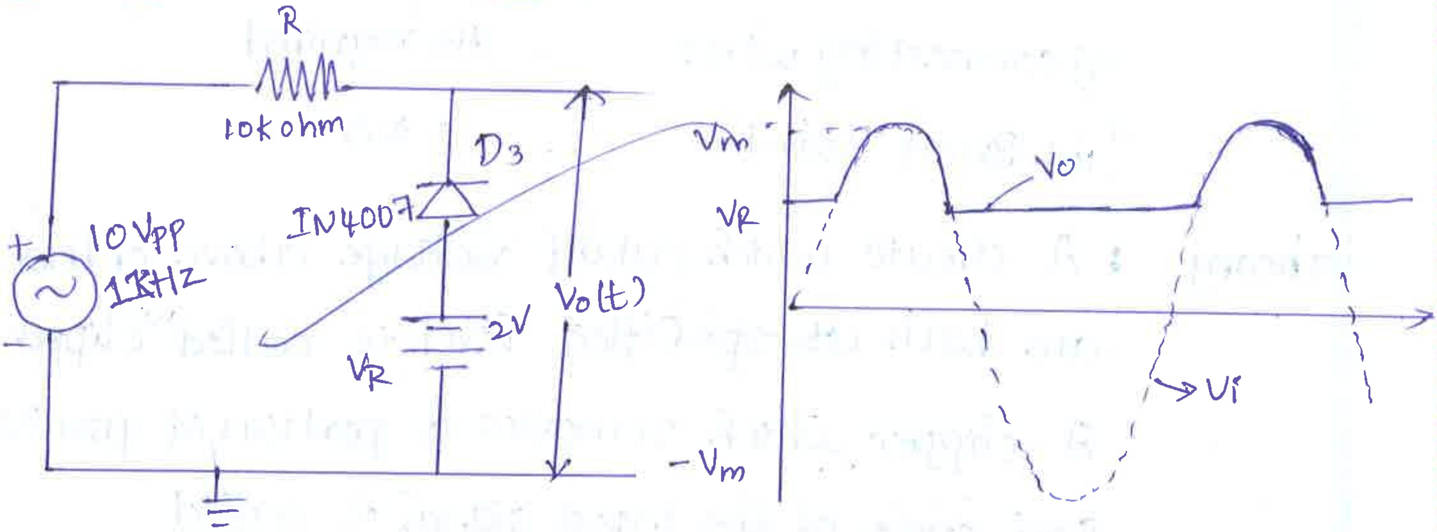
a) Positive peak clipper :-



b) Negative peak clipper :-



c) Biased - Negative clipper:



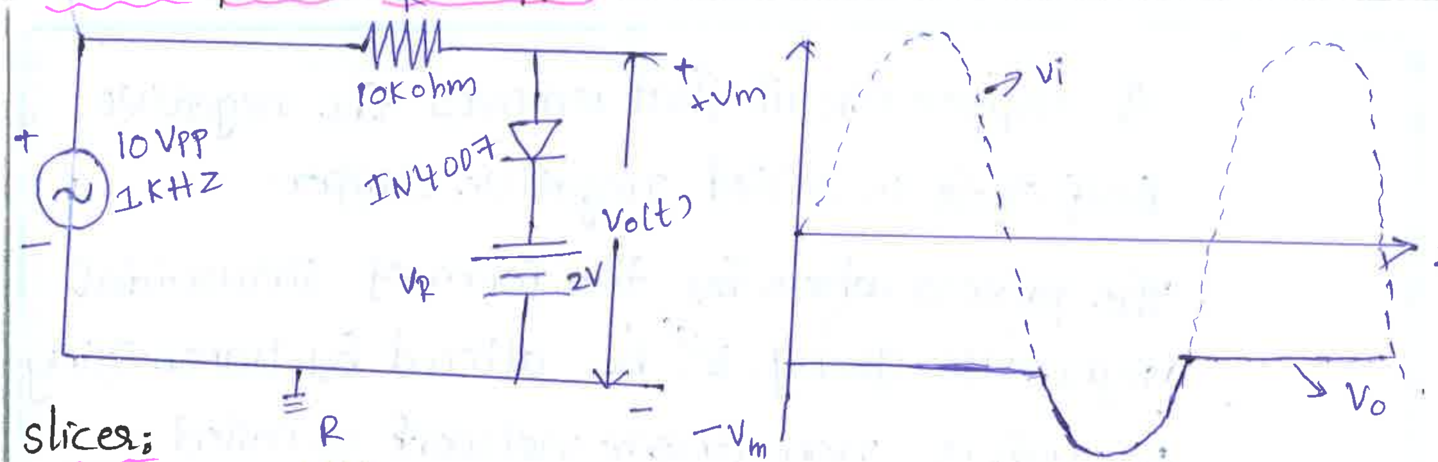
A clipper circuit that removes the negative half cycle is called negative clipper.

The process where by the form of sinusoidal signals is going to be altered by transmitting through a non-linear network is called "Non-Linear wave shaping". Non linear elements (like diodes, transistors) in combi-nation with resistors can function as clipper circuit either the shape of the wave is attenuated (or) the dc level of the wave is altered in the Non-linear wave shaping clippers clippers are basically wave shaping circuits that control the shape of an output wave form. It consists of linear & non-linear elements but does not contain energy storing elements.

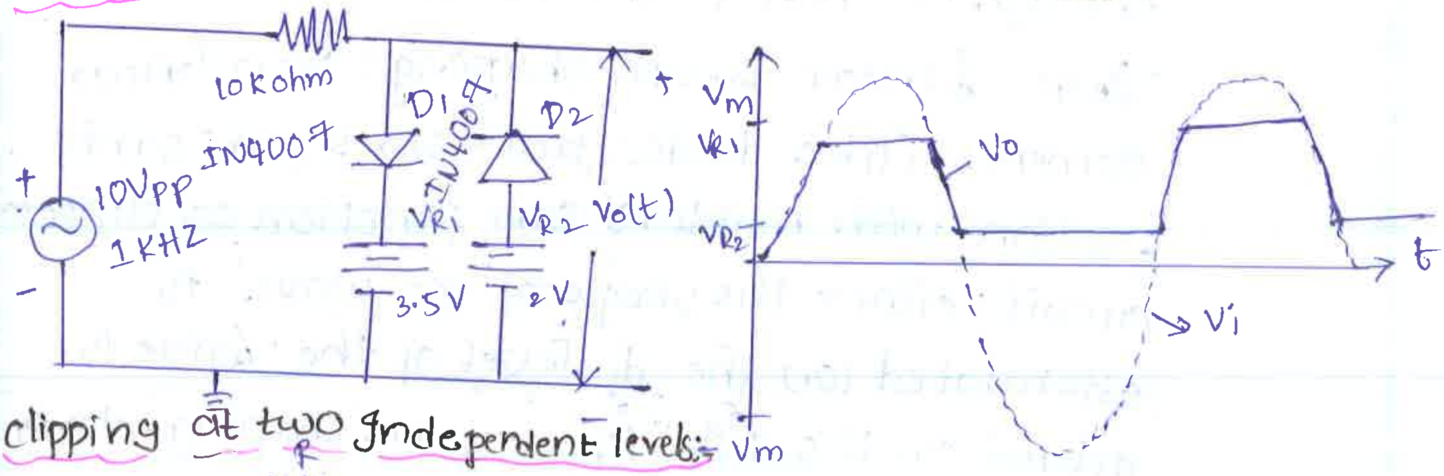
If bias voltage is placed in series with diode then the circuit is called biased clipper. This bias determines the point where the diode begins to conduct & duration of conduction. With bias, clipping can be done to any percent of the input signal ranging from 1% to 99%.

The construction of the series positive clipper with bias is almost similar to the series positive

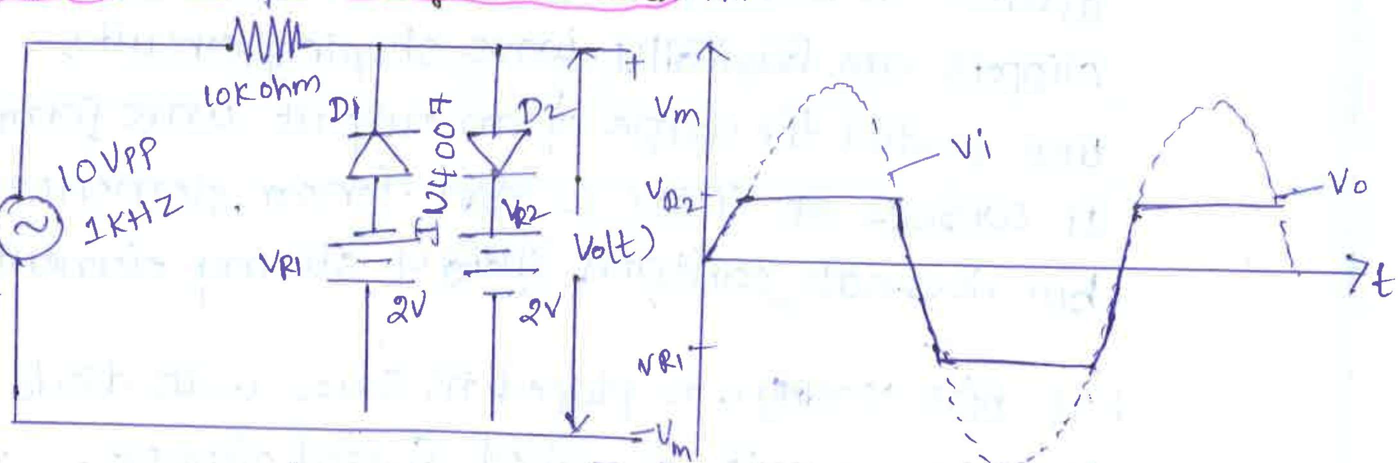
d) Biased - positive clipper



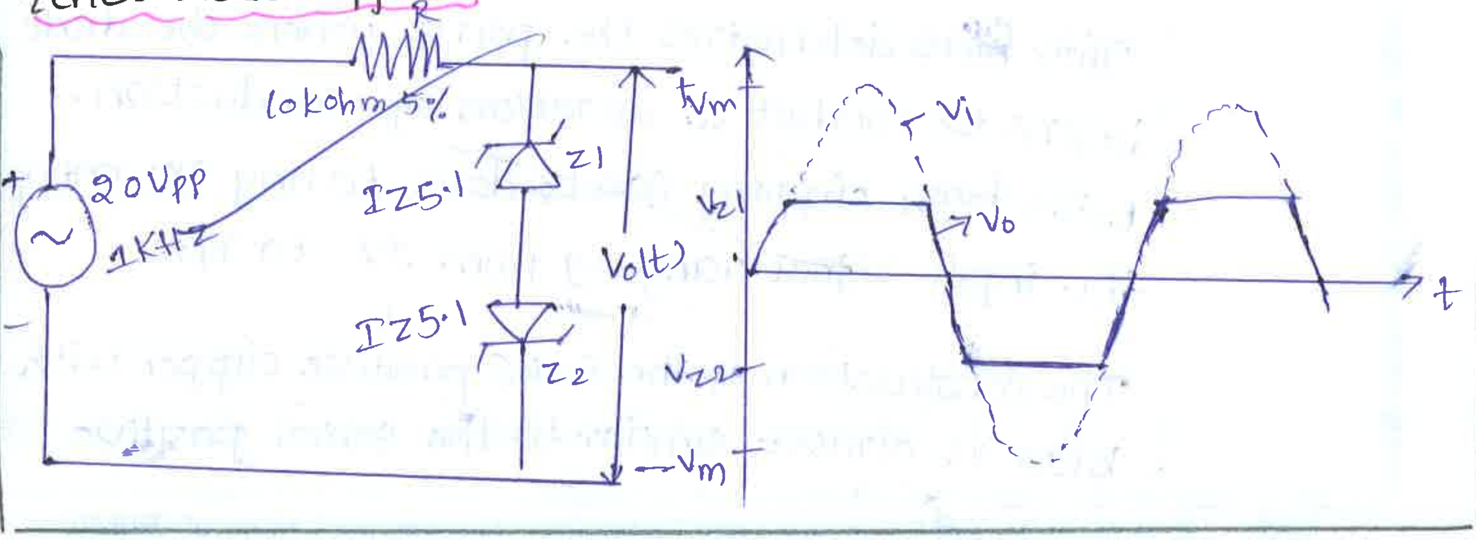
e) slicer:



d) clipping at two Independent levels:

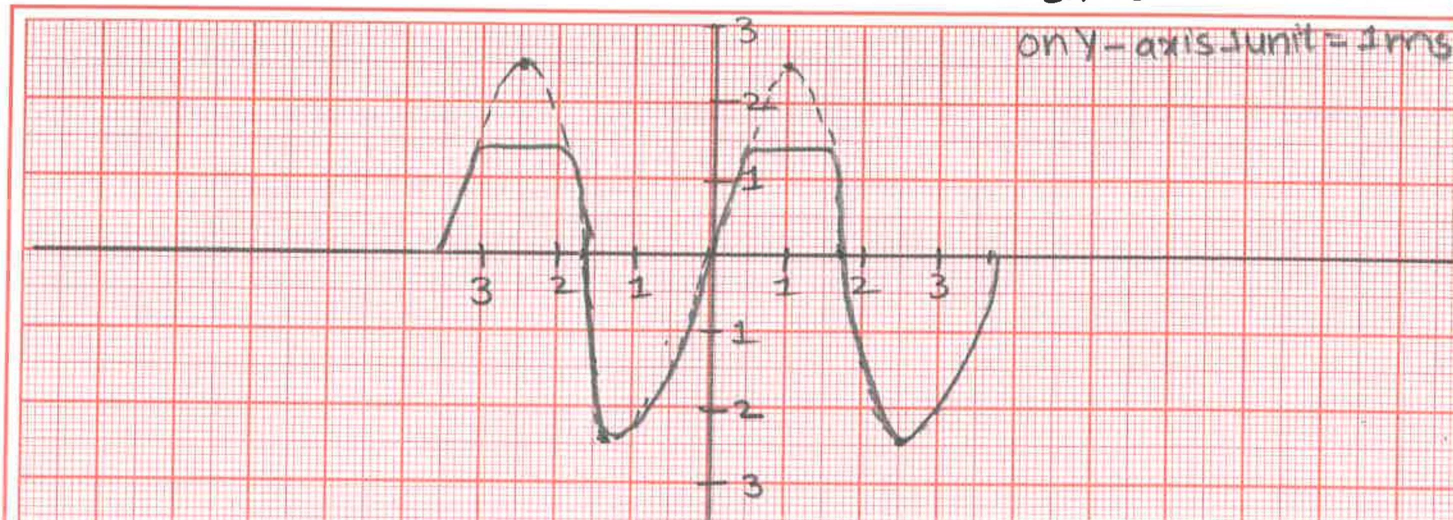


e) Zener Diode Clippers:-

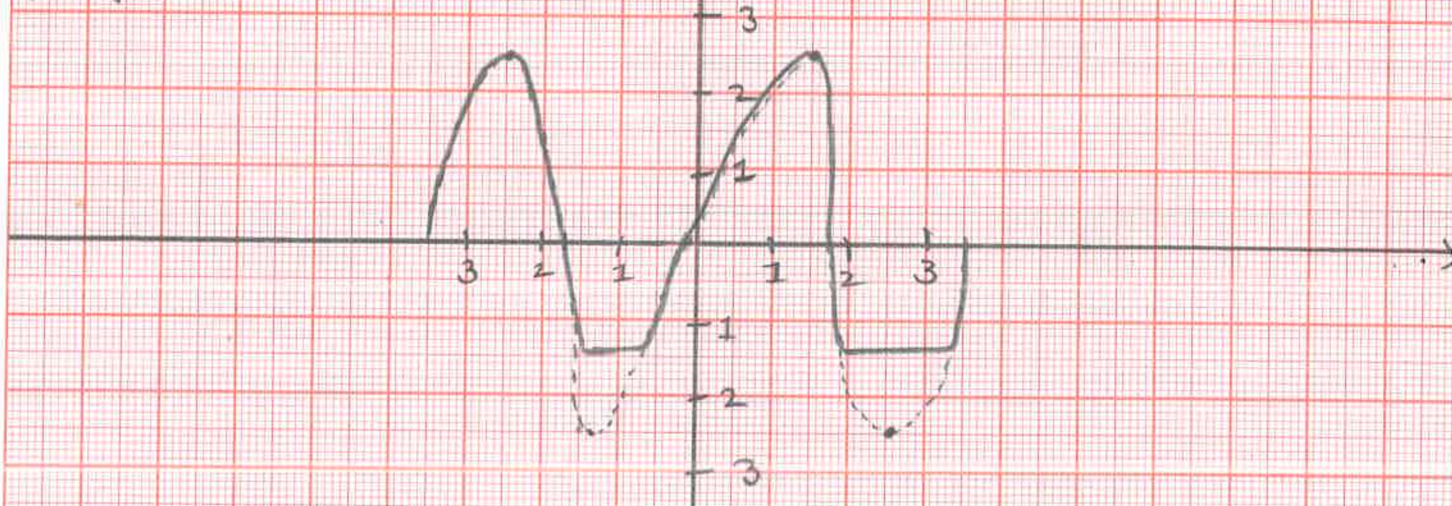


a) Positive peak clipper

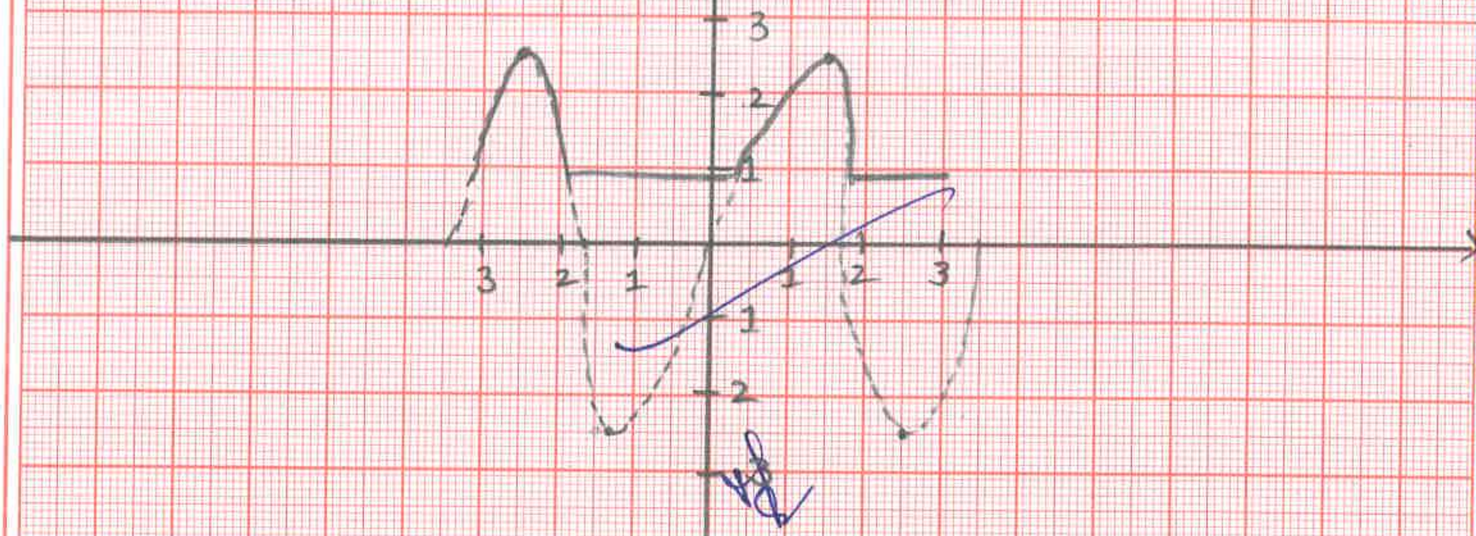
Scale:-
on x-axis 1unit = 1V
on Y-axis 1unit = 1ms



b) Negative peak clipper



c) Biased-Negative clipper

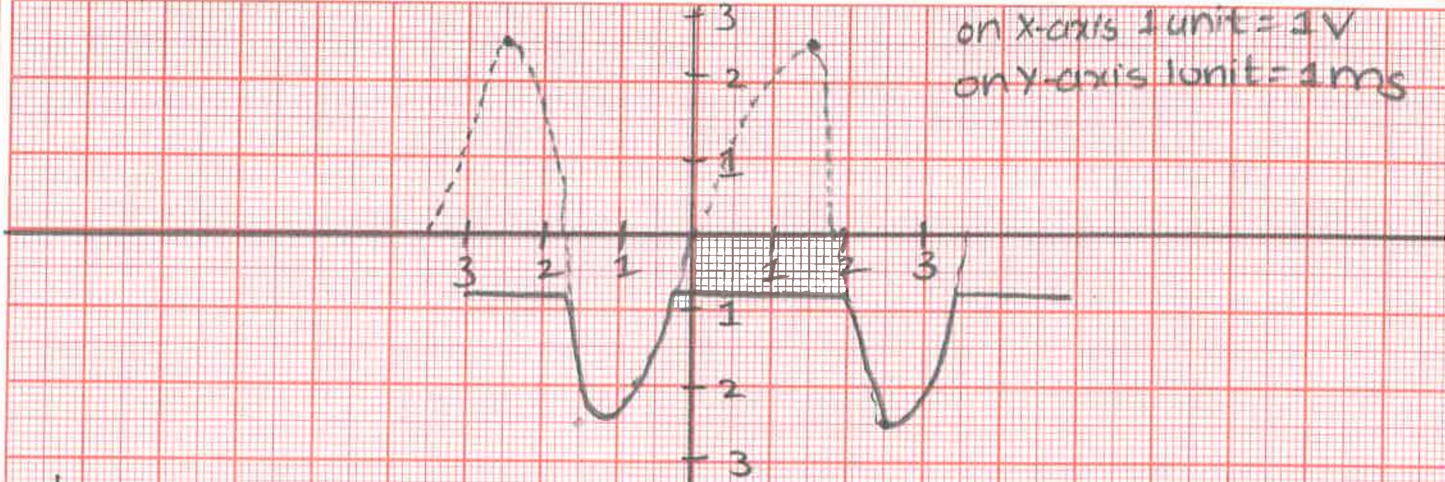


Scale:-

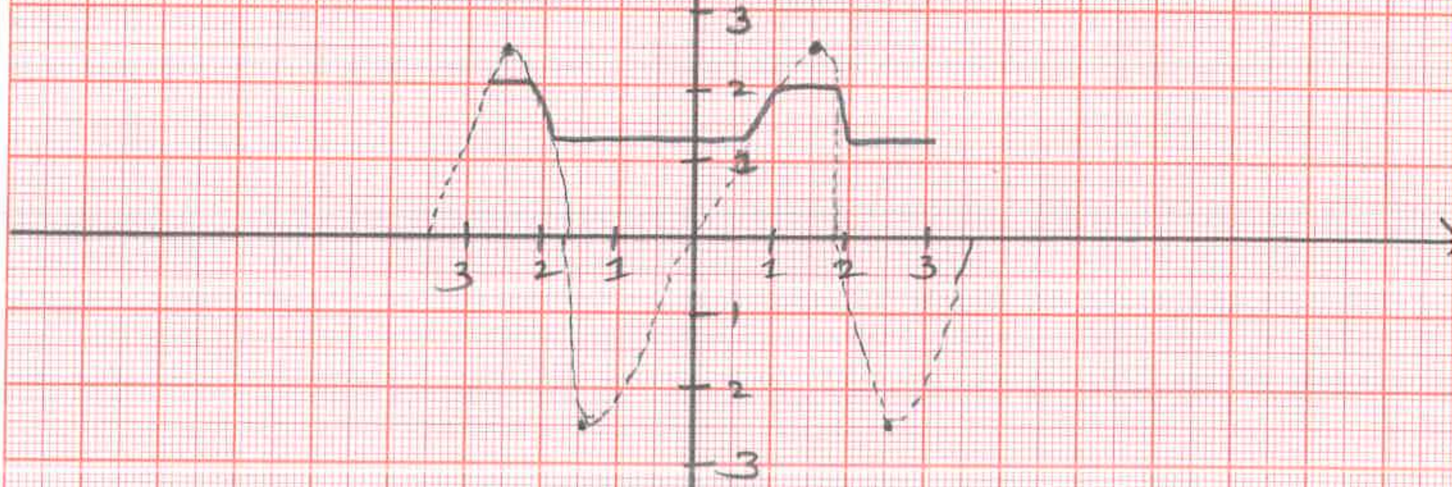
on X-axis 1 unit = 1V

on Y-axis 1unit = 1ms

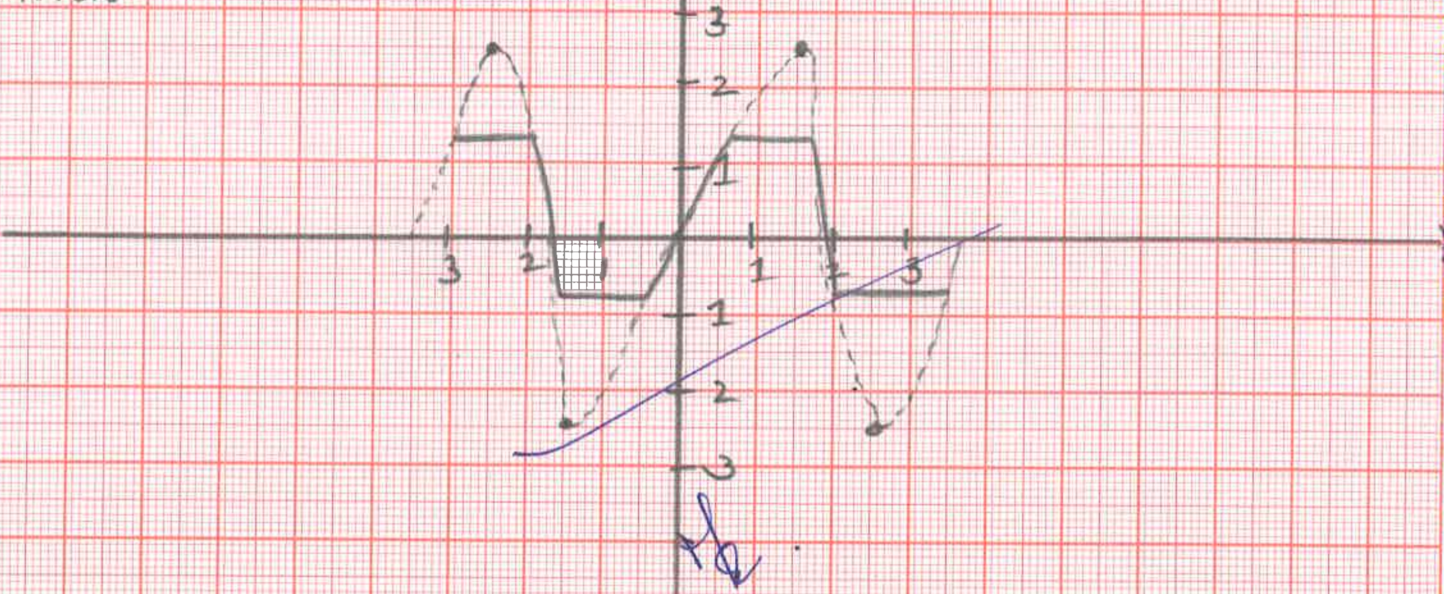
d) Biased positive clipper



e) slicer



f) clipping at two independent levels



g) zener diode clipper

Scale:-
on x-axis 1 unit = 1V
on Y-axis 1 unit = 1 m

clipper. The only difference is an extra element called battery is used in series Positive clipper with bias.

The zener diode is acting like a biased diode clipping circuit with the bias voltage being equal to the zener break down voltage.

clipping circuits are also called as "slicers" or "amplitude selectors".

Procedure: Make the connections as per the circuit diagram shown in the figure.

2) set the Function Generator to produce sinusoida signal input voltage of 10 V_{p-p} & 1 KHz frequency (For zener diodes clipper, 20 V_{p-p}, 1 KHz frequency sinusoidal signal is required)

3) observe the output waveforms on CRO & Plot them on the graph sheet

Result: Hence different non linear wave shapings of clippers are studied & graph is plotted by dividing all possible biasing's to clippers.

9½/10

EXPT·NO:- 07	NON-LINEAR WAVE SHAPING - CLAMPING CIRCUITS	Date: 22/12/

Aim: 1) To study the operation of various clamper circuits.

2) To observe & plot the output wave forms of various clamper circuits for sinusoidal input.

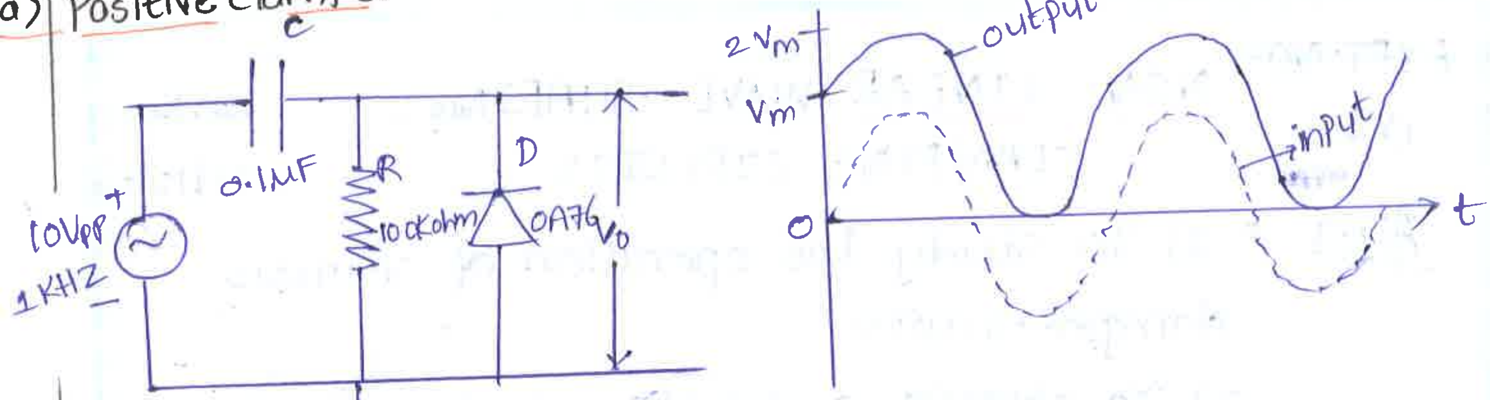
Apparatus Required:

1) Resistor - 100kΩ - 1 NO.
2) Function Generator - 1 NO.
3) Diodes - OA76 - 2 NOs
4) TRPS - 1 NO.
5) CRO - 1 NO.
6) CRO probes - 3 NOs.
7) capacitor 0.1uF - 1 No.
8) connecting wires - As required
9) Bread Board - 1 No.

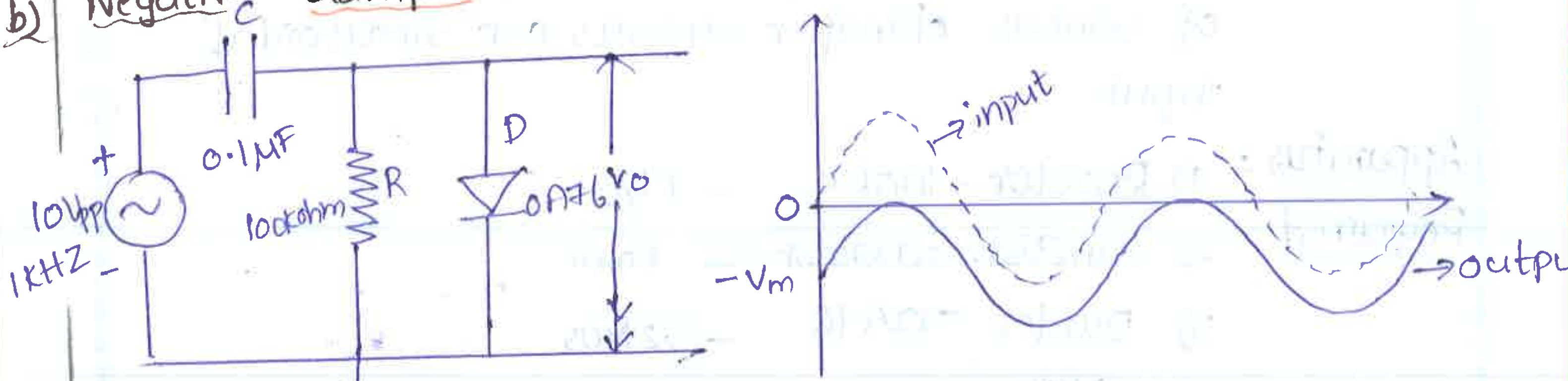
Theory: A clamper is an electronic circuit that fixes either the positive (or) negative peak excursions of a signal to a defined voltage by adding a variable positive (or) negative DC voltage to it.

The process where sinusoidal signals are going to be altered by transmitting through a

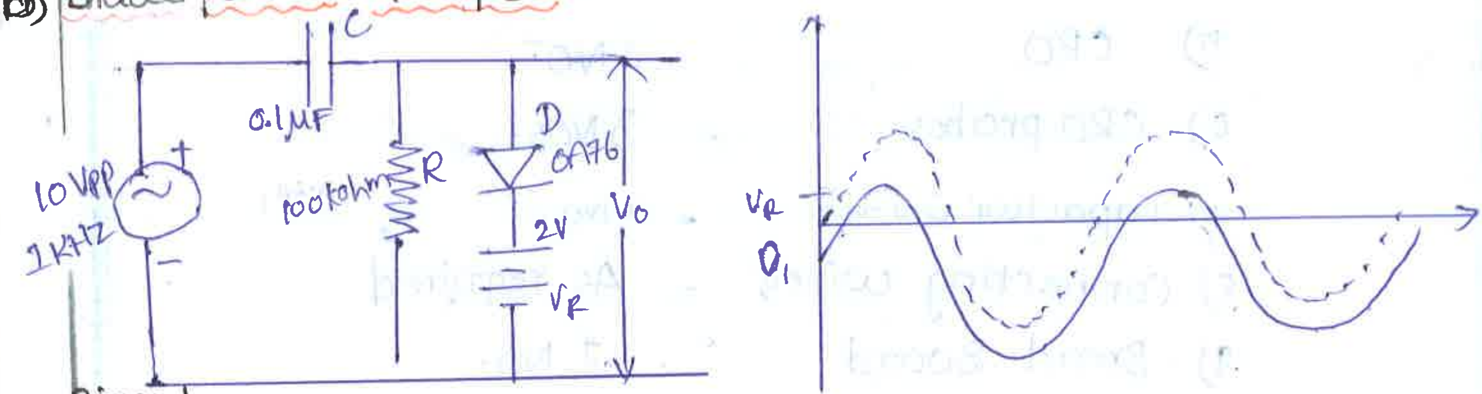
a) Positive clamper



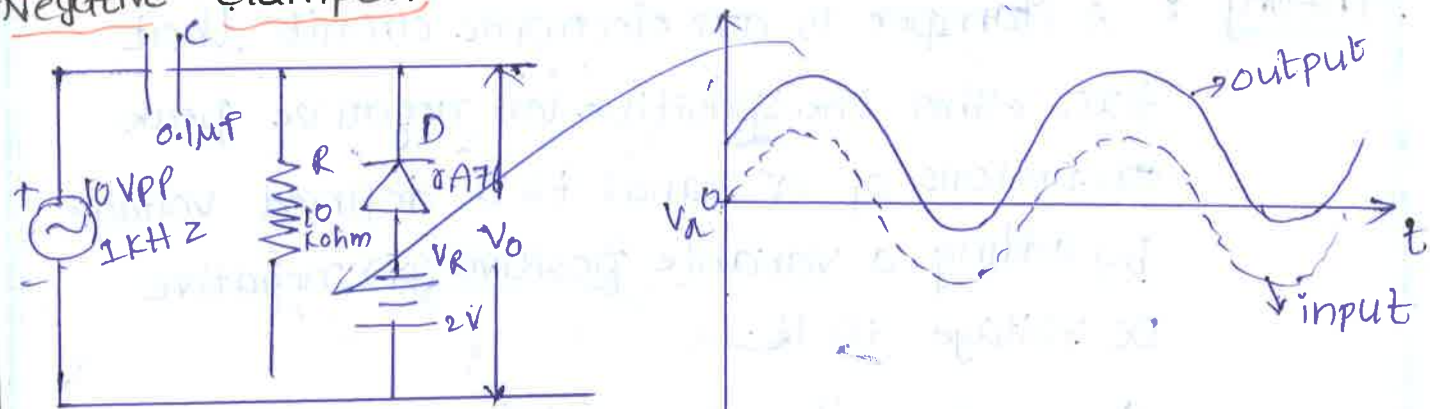
b) Negative clamper



c) Biased positive clamper



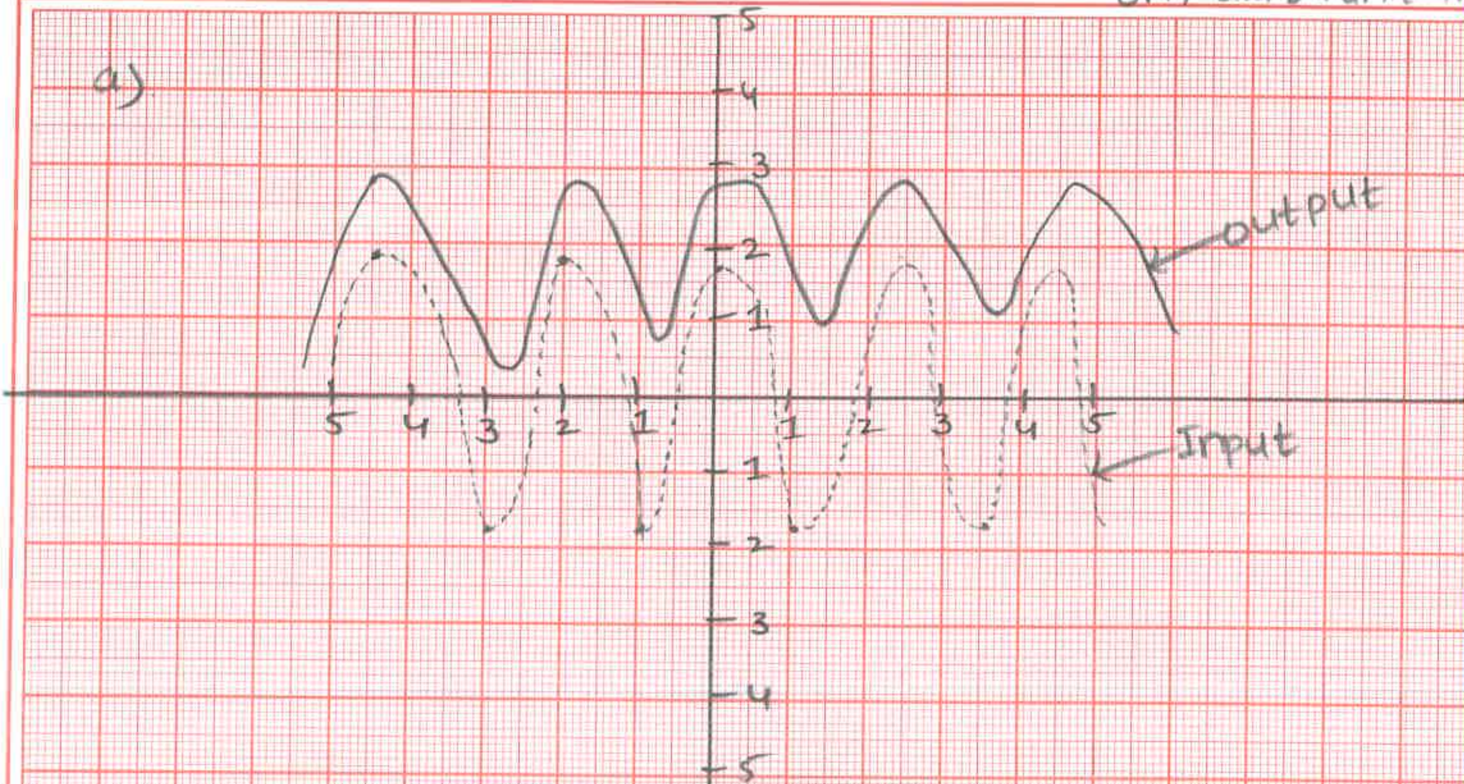
d) Biased Negative clamper:-



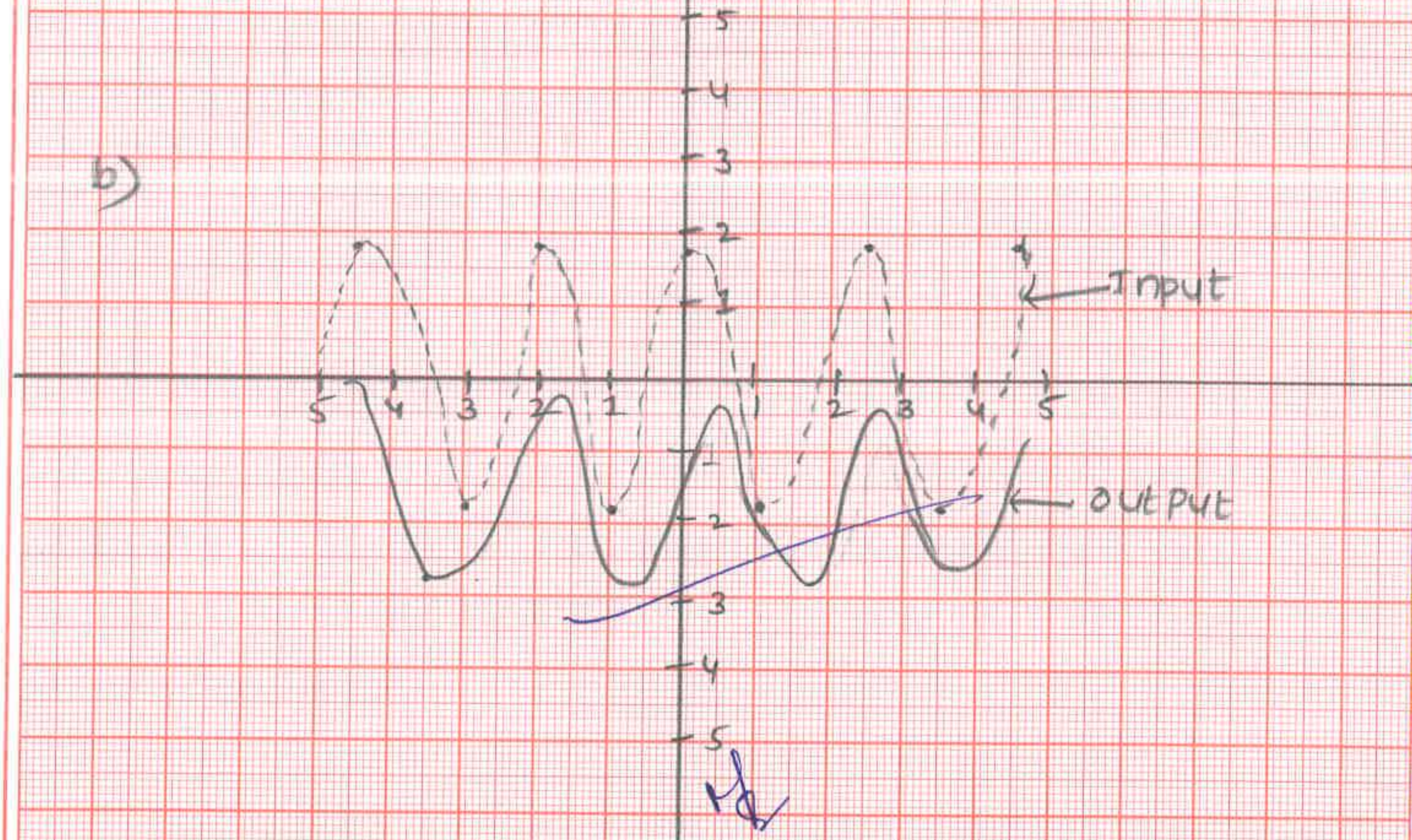
clampers

scale
on x-axis 1unit=
on y-axis 1unit=

a)



b)

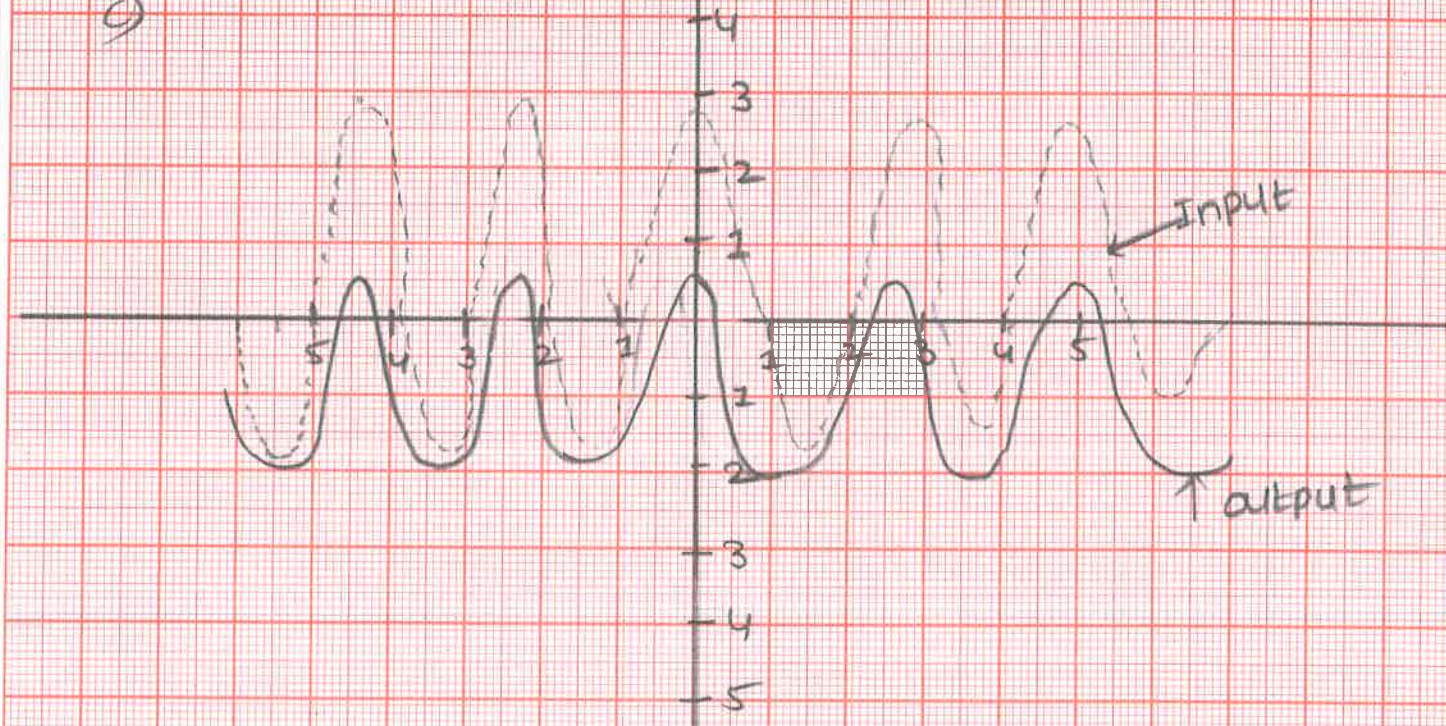


Scale

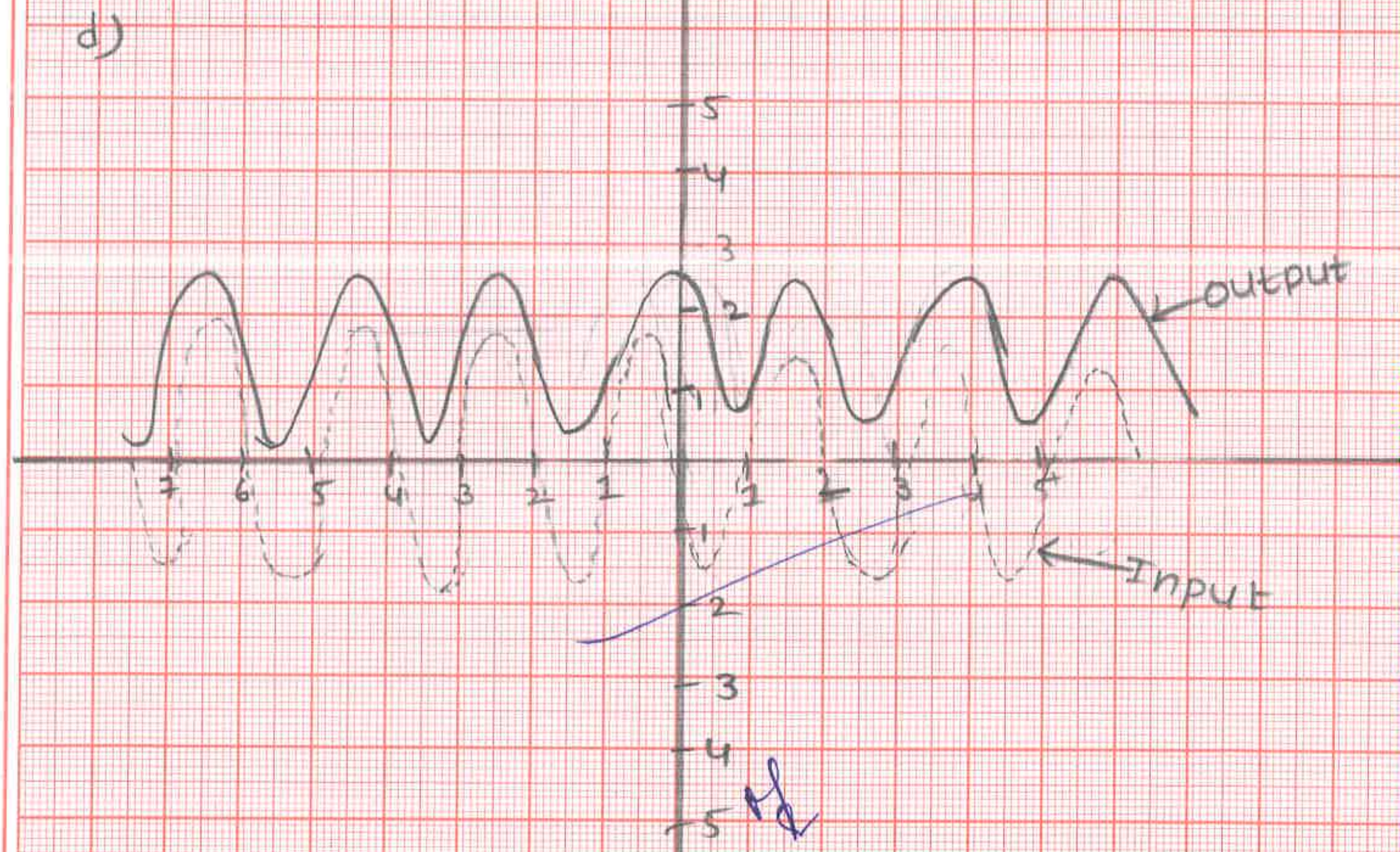
on x-axis 1unit = 1V

on y-axis 1unit = 1ms

c)



d)



non-linear network is called non-linear wave shaping. Non-linear elements (like diodes) in combination with resistors and capacitors can function as clamping circuit. clamping circuits add a DC level to an AC signal.

If the circuit pushes the signal upwards then the circuit is said to be a "Positive clamper". when the signal is pushed upwards, the negative peak of the signal meets the zero level. on the other hand, if the circuit pushes the signal downwards then the circuit is said to be a "Negative clamper".

Procedure: 1) Make the connections as per the circuit diagrams as shown in the figure.

2) Set the Function Generator to produce sinusoidal input Voltage of 10 Vp-p & 1KHz frequency

3) observe the output waveforms on CRO & Plot them on the graph sheet.

Result : Hence different ~~wave &~~ shaping's of clampers are studied & graph is plotted by giving Possible biasing to clampers.

9/10

EXPT. NO 08	COMMON BASE CONFIGURATION OF BJT	Date 12/1/

Aim : 1. To study the input and output characteristics of the transistor in the common base configuration.

2. To obtain the h-parameters in CB configuration.

Apparatus : 1. CL 100 S transistor
2. Resistor 1 kΩ
3. Ammeters [(0-30mA) - 2]
4. Voltmeters [(0-30V)]
5. RPS unit
6. connecting wires

Theory : In common base configuration, emitter is the input terminal, collector is the output terminal and base terminal is connected as a common terminal for both input & output. That means the emitter terminal & common base terminal are known as input terminals whereas the collector terminal and common base terminal are known as output terminals.

In CB configuration, the base terminal

Circuit Diagram:-

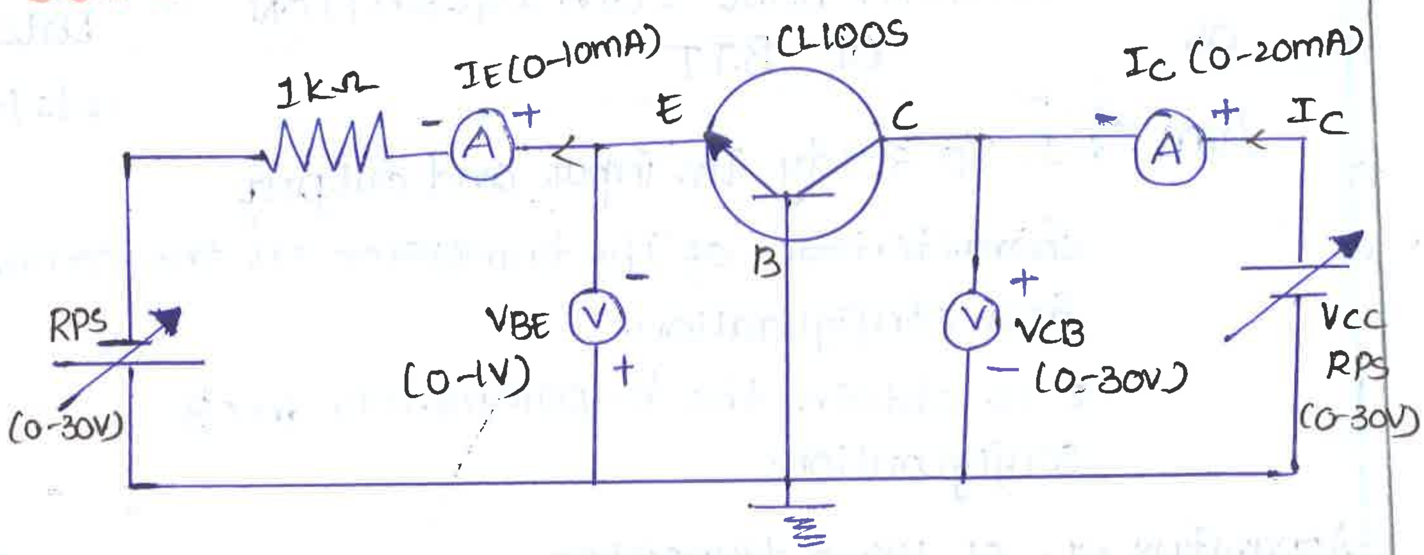


Fig: 1 Circuit diagram for studying input & output characterstics of CB Transistor

Expected graphs :

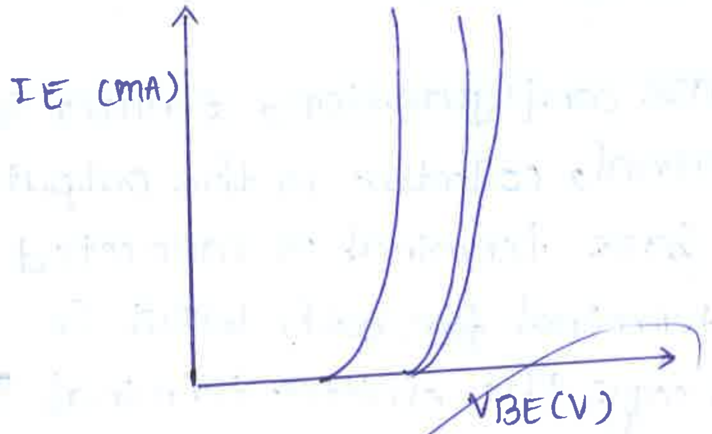


Figure 2: Input characteristics

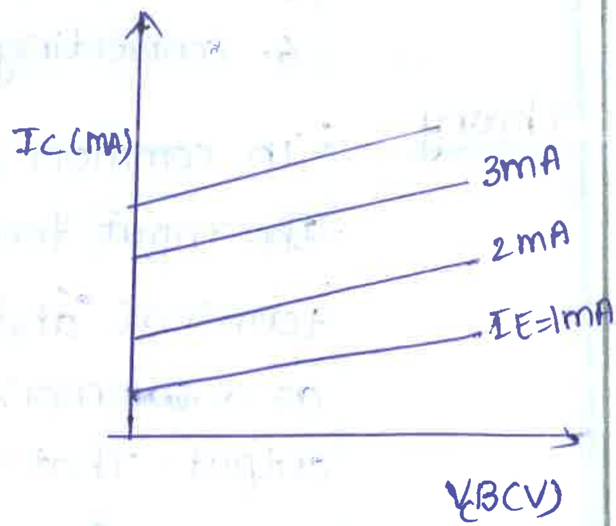


Figure 3: output characterstics

is grounded so the common base configuration is also known as grounded base configuration. Sometimes common base configuration is referred to as common base amplifier, CB amplifier.

The input signal is applied between the emitter & base terminals while the corresponding output signal is taken across the collector & base terminals. Thus the base terminal of a transistor is common for both input and output terminals and hence it is named as common base configuration.

The supply voltage between the base & emitter is denoted by V_{BE} while the supply voltage between collector and base is denoted by V_{CB}.

In CB configuration, the base emitter Junction J_E is forward biased & collector-base junction J_C is reverse biased.

Procedure: Input characteristics:

1. Make the connections as per the circuit diagram.
2. Keep V_{CB} constant at 5V and vary V_{EE}

observations:-

Table 1: Input characteristics of CB Transistor

S.NO	$V_{CB}=0V$		$V_{CB}=5V$	
	V_{BE} in volts	I_E in mA	V_{BE} in volts	I_E in mA
1	0.1	0	0.1	0
2	0.2	0	0.2	0
3	0.3	0	0.3	0
4	0.4	0	0.4	1.0
5	0.5	0	0.5	2.0
6	0.55	1	0.55	2.5
7	0.6	3	0.6	8.0
8	0.62	18	0.62	30.0
9	0.64	30		

Table 2: output characteristics of CB Transistor

S.NO	$I_E=2mA$		$I_E=5mA$	
	V_{CB} in volts	I_C in mA	V_{CB} in mA	I_C in mA
1	5	1.2	5	4.0
2	10	1.5	10	4.2
3	15	1.5	15	4.5
4	20	1.5	20	4.5
5	25	2.0	25	4.7
6	30	2.0	30	5.0

to tabulate the readings of voltmeter (V_{BE}) and ammeter (I_E)

3. Repeat the above procedure $V_{CB} = 10V$

4. Plot the input characteristics as shown in fig 2 and calculate h parameters hib, hrb from the input characteristics.

output characteristics:

1. Vary V_{EE} to keep the input current I_E constant at 2mA.

2. By varying V_{CC}, tabulate the readings of voltmeter (V_{CB}) and ammeter (I_C)

3. Repeat the above procedure for $I_E = 5mA$.

4. Plot the output characteristics as shown in fig 3. and calculate the h-parameters hfb, hob from output characteristics.

Calculations:

$$h_{ib} = \left.\frac{\Delta V_{BE}}{\Delta I_E}\right|_{V_{CB}\ constant}$$

$$h_{ib} = \frac{0.62 - 0.5}{(18-2)\times 10^{-3}} = 7.5\ \text{mA}\ \Omega$$

$$h_{rb} = \left.\frac{\Delta V_{BE}}{\Delta V_{CB}}\right|_{I_E\ constant} = \frac{0.62 - 0.5}{5 - 0} = 24mA$$

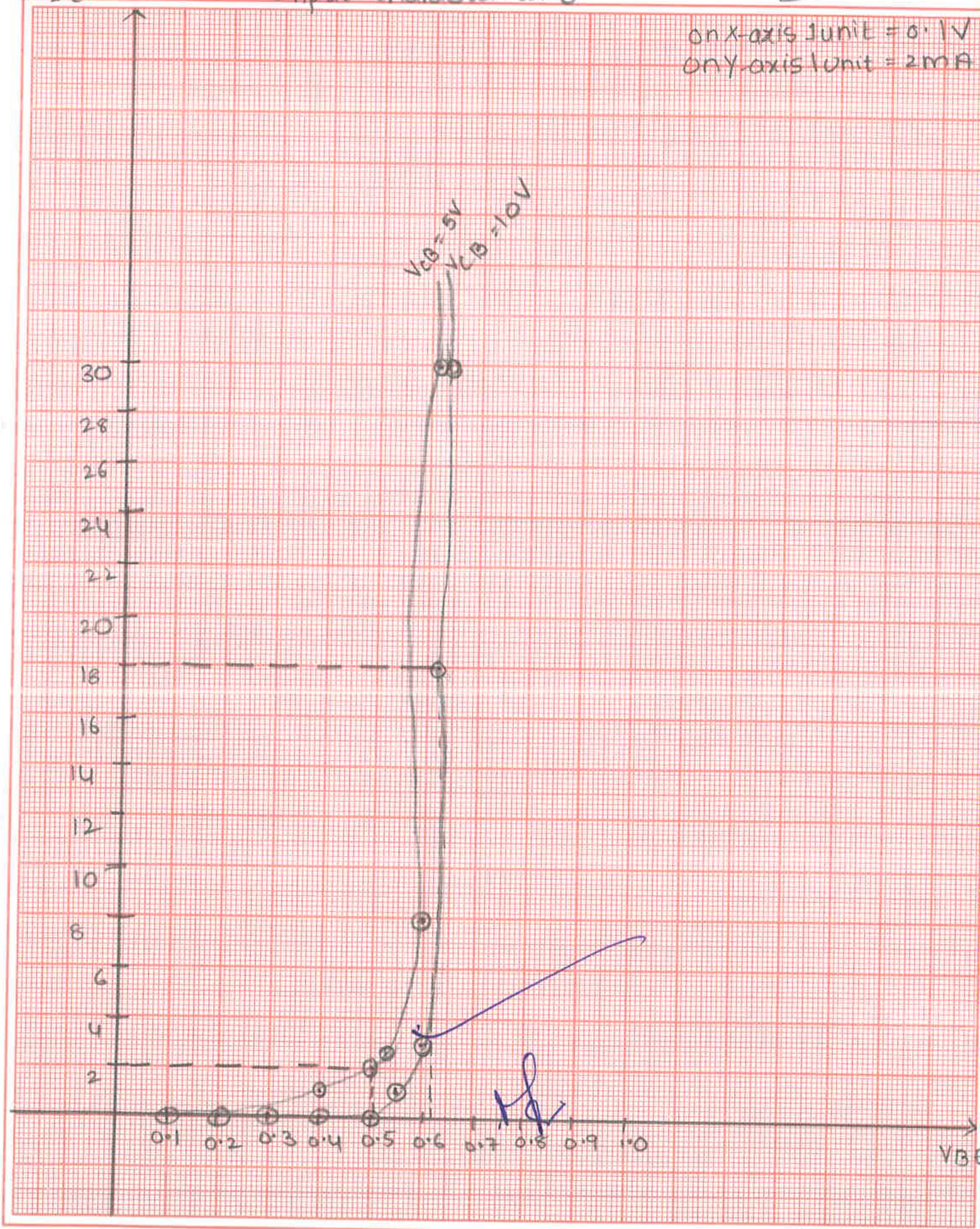
$$h_{fb} = \left.\frac{\Delta I_C}{\Delta I_E}\right|_{V_{CB}\ constant} = \frac{5-2}{5-2} = 1mA$$

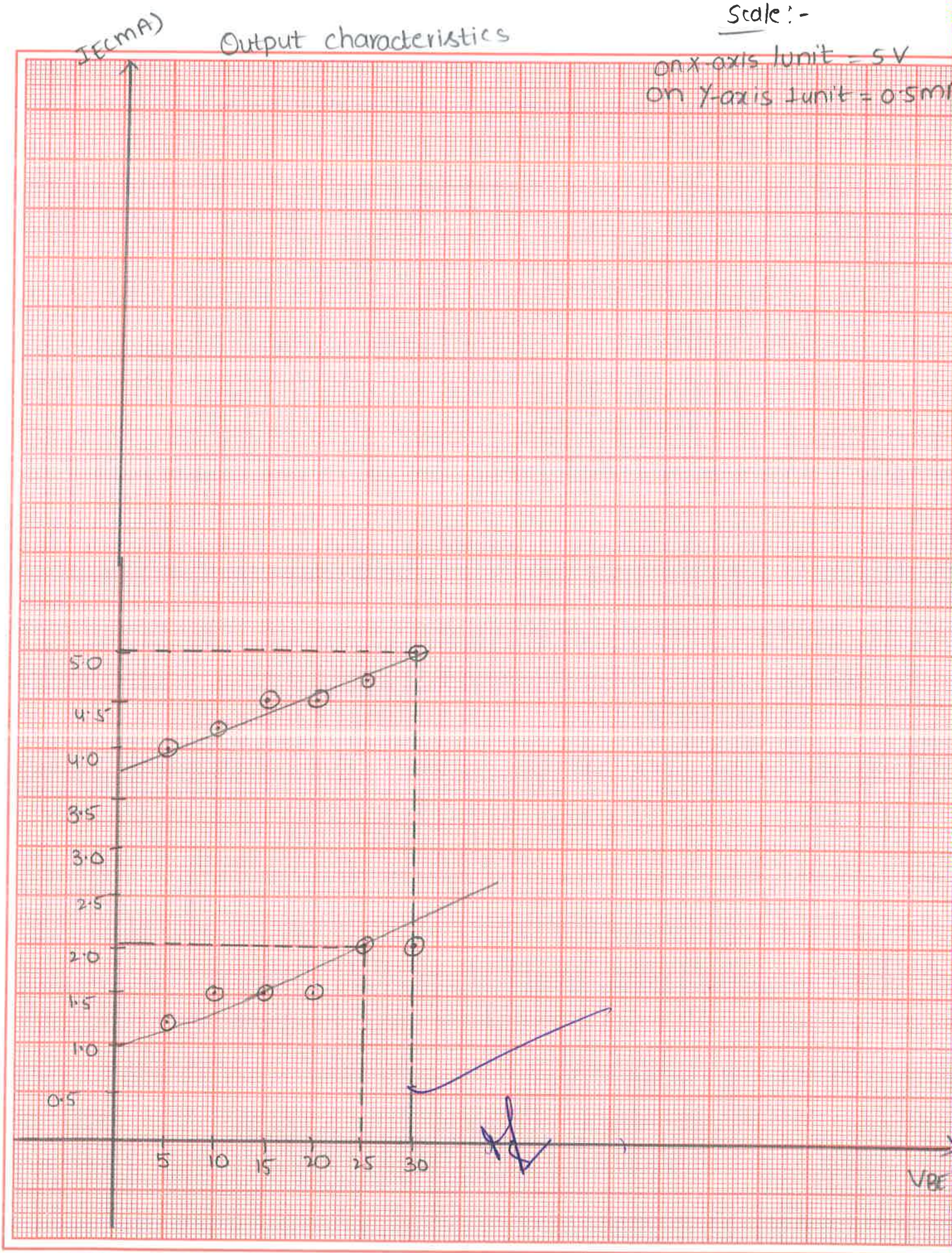
$$h_{ob} = \left.\frac{\Delta I_C}{\Delta V_{CB}}\right|_{I_E\ constant} = \frac{5-2}{30-25} = 600mA$$

Input characteristics

Scale:-

on X-axis 1unit = 0.1V
on Y-axis 1unit = 2mA




Output characteristics
Scale :-
on x-axis 1unit = 5 V
on Y-axis 1unit = 0.5mA
IE(mA)
VBE
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
5
10
15
20
25
30

Result : Input & output characteristics of transistor in common base configuration is studied. h-parameters of transistor in CB configuration is determined.

9/10

EXPT-NO: 09	COMMON EMITTER CONFIGURATION OF BJT	Date: 9/2/23

Aim : 1) To obtain the input and output characteristics of the transistor in common emitter configuration.

2) To obtain the h-parameters from the graphs.

Apparatus : 1) CL 100S Transistor

2) DC Ammeters [(0-500 μA), (0-20 mA)]

3) DC Voltmeters [(0-1V), (0-30V)]

4) Resistors [47 kΩ, 2.2 kΩ]

Theory : In this configuration, emitter is used as common terminal for both input and ouput. The common emitter configuration is an inverting amplifier circuit. Here the input is applied between base-emitter region and the output is taken between collector and emitter terminals. In this configuration the input parameters are V_{BE} and I_B and output parameters are V_{CE} and I_C.

This type of configurations are mostly used in the applications of transistor based amplifiers.

Circuit Diagram:-

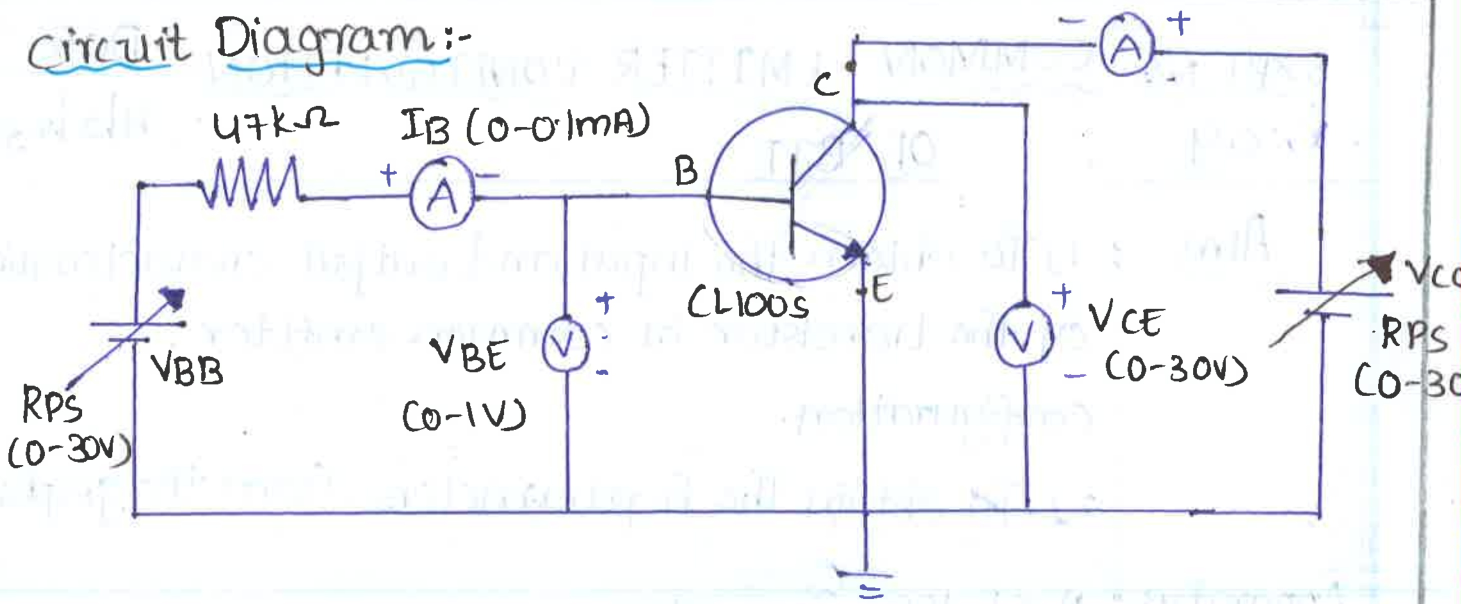


Fig1: Circuit diagram for studying input and output characteristics of CE Transistor

Expected Graphs:

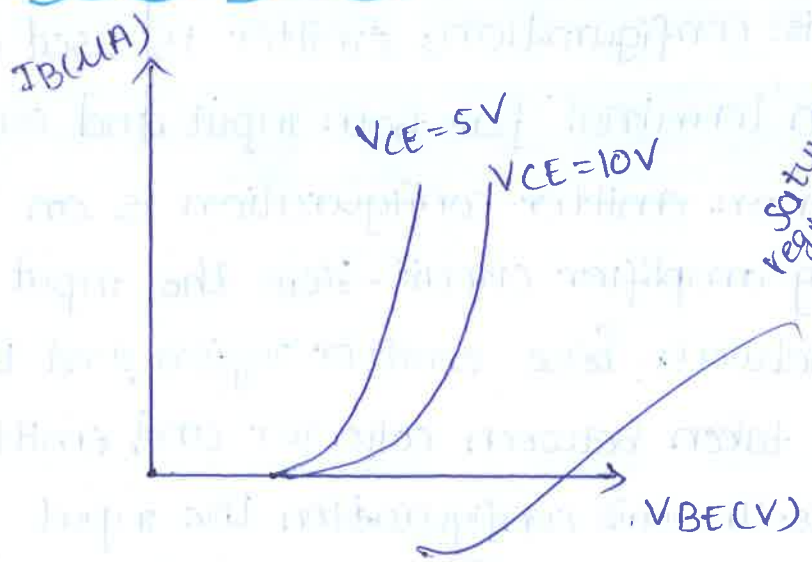


Fig2: Input characteristics

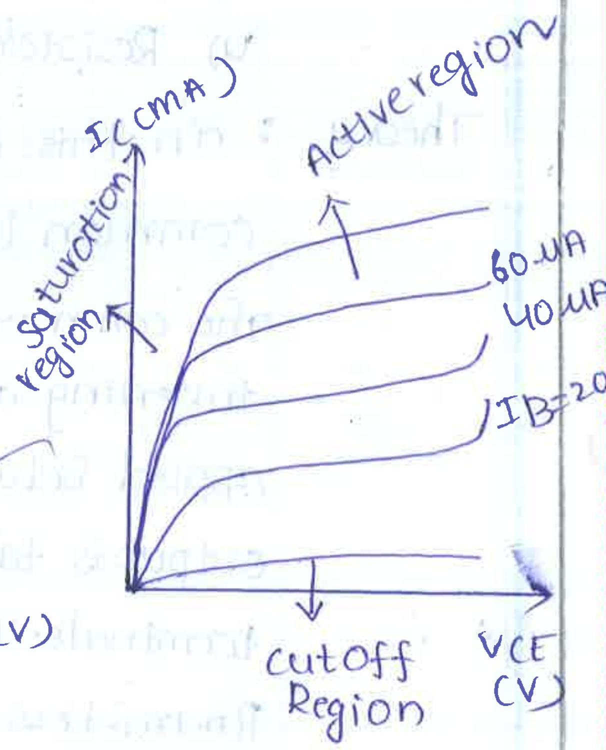


Fig3: output Characteristics

In this configuration the emitter current is equal to the sum of small base current and large collector current. we know that the ratio between collector current and emitter current gives current gain alpha in common Base configuration.

This configuration is mostly used one among all the three configurations. It has medium input and output impedance values. It also has the medium current and voltage gains. But the output signal has a phase shift 180o i.e both the input & output are inverse to each other.

The typical CE characteristics are similar to that of a forward biased of p-n diode. But as V_{CB} increases the base width decreases

Procedure : Input characteristics :

1) connect the circuit as per the diagram.
2) keep V_{CE} at 5V.
3) Now vary V_{BE} in steps and tabulate the values of I_B and V_{BE}
4) Repeat the above procedure for V_{CE} = 10V

Observations

Table 1: Input characteristics.

SNO	$V_{CE}=0V$		$V_{CE}=5V$	
	V_{BE} in volts	I_B in μA	V_{BE} in volts	I_B in μA
1	0.1	50	0.1	45
2	0.2	100	0.2	102
3	0.3	150	0.3	148
4	0.4	200	0.4	196
5	0.5	270	0.5	250
6	0.55	310	0.55	275
7	0.6	500	0.6	306
8			0.62	315
9			0.64	320
10			0.66	500

Table 2: output characteristics

SNO	$I_B=50μA$		$I_B=100μA$	
	V_{CE} in volts	I_C in mA	V_{CE} in volts	I_C in mA
1	2	6.0	2	20
2	5	8.0	5	22
3	10	10.0	10	24
4	15	13.0	15	25
5	20	19.0	20	26
6	25	24.0	25	26
7	30	26.0	30	28

5) plot the graph between I_B and V_{BE} for various values of V_{CE}.

6) calculate hie, hre from input characteristics

Output characteristics:

1) By varying V_{BB} keep I_B at 100µA

2) Now vary V_{CE} with the help of V_{CC} and tabulate the values of I_C and V_{CE}.

3) Repeat the above procedure for I_B at 50µA.

4) plot the graphs between I_C and V_{CE}.

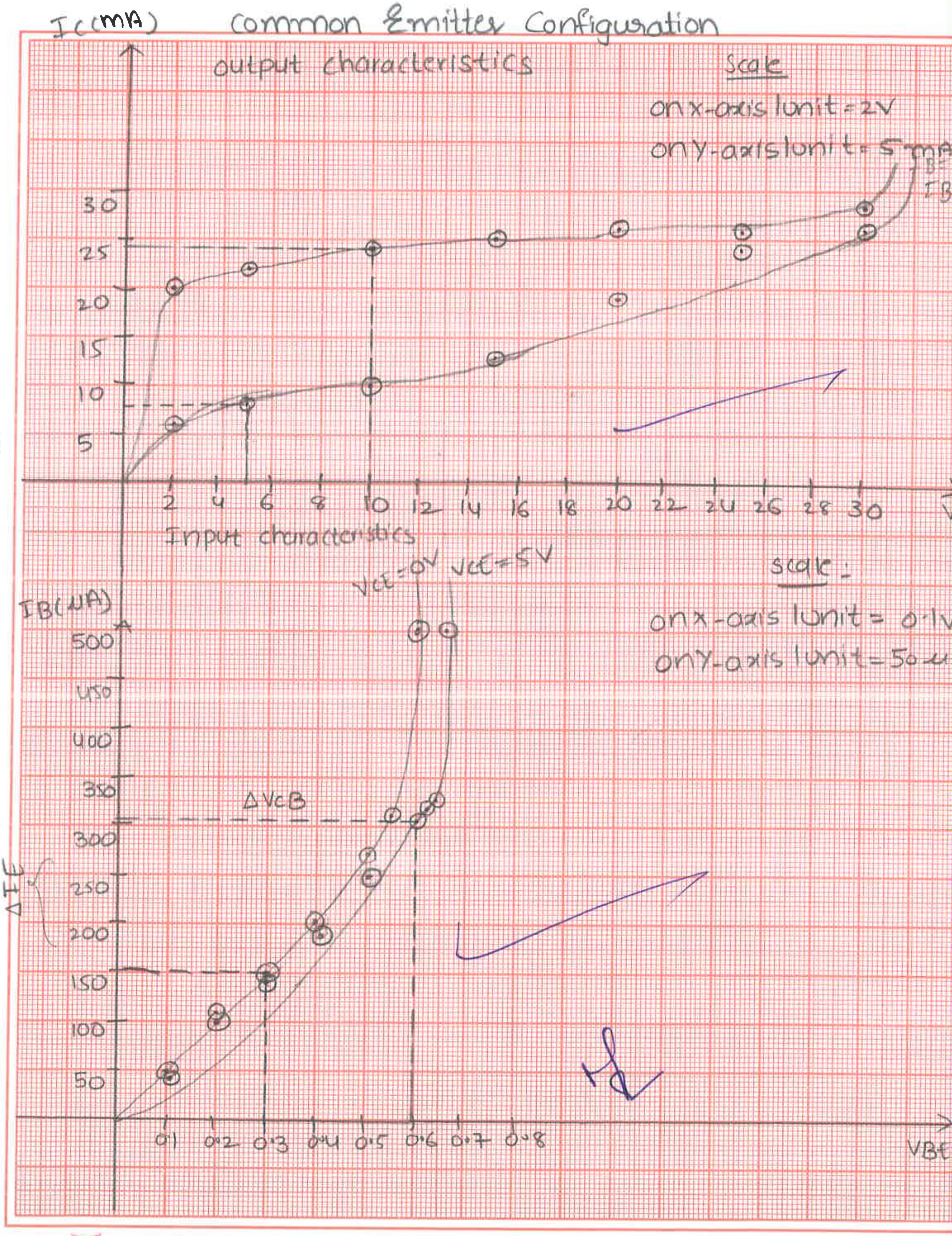
5) calculate the hfe, hoe from output characteristics.

Calculations: $h_{ie} = \left.\frac{\Delta V_{BE}}{\Delta I_B}\right|_{V_{CE}\ constant} = \frac{0.6-0.3}{(306-150)\times10^{-6}} = 19k\Omega$

$h_{re} = \left.\frac{\Delta V_{BE}}{\Delta V_{CE}}\right|_{I_B\ constant} = \frac{0.6-0.3}{10-5} = 0.06$

$h_{fe} = \left.\frac{\Delta I_C}{\Delta I_B}\right|_{V_{CE}\ constant} = \frac{(100-150)\times10^{-6}}{(306-150)\times10^{-3}} = 320$

$h_{oe} = \frac{\Delta I_C}{\Delta V_{CE}} = \frac{24-8}{(10-5)\times10^{3}} = 3.2k\mho$


Common Emitter Configuration
output characteristics
Ic(mA)
Scale
on x-axis 1unit = 2V
on Y-axis 1unit = 5mA
Input characteristics
VCE=0V
VCE=5V
IB(µA)
scale:
on x-axis 1unit = 0.1V
on Y-axis 1unit = 50 µ
ΔVCB
ΔIE
VBE

Result : Input & output characteristics of transistor in common Emitter configuration is studied H-parameters of transistor in common Emitter configuration is determined.

9½/10

Circuit Diagram:-

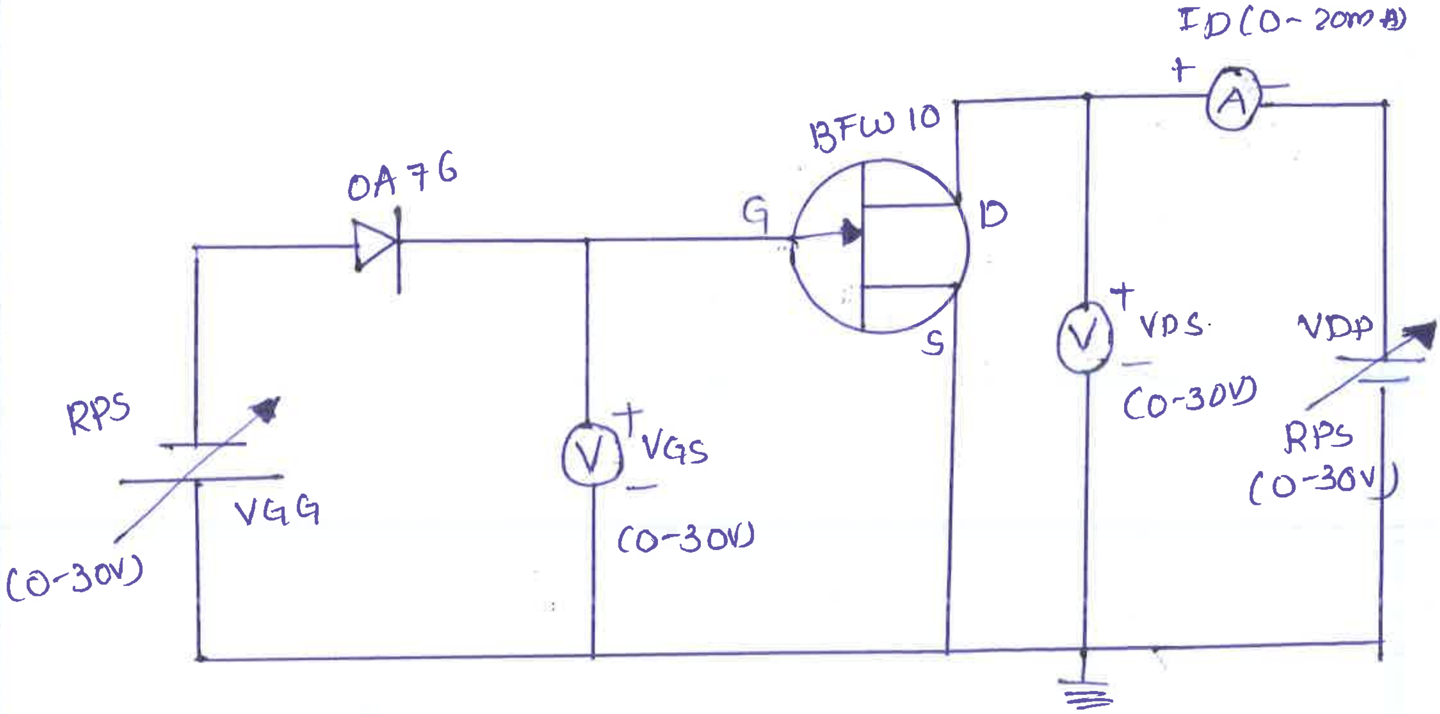


Figure 1: circuit diagram for studying drain and transfer characteristics of JFET

EXPT NO: 10	Drain and Transfer characteristics of JFET	Date: 2/2/22

Aim: 1) To obtain the drain and Transfer characteristics of the given JFET.

2) To calculate the drain resistance rd and transconductance gm of the given JFET.

3) To find the pinch off voltage (V_P) and drain to Source saturation current (I_{DSS}).

Apparatus:
1) FET - BFW 10
2) Ammeter (0-20mA)
3) Voltmeter (0-30V)
4) Diode (OA 76)
5) Regulated power Supply (RPS)
6) Bread Board
7) connecting wires
8) Multimeter

Theory: The Junction field effect transistor (or) JFET is a voltage controlled three terminal unipolar Semiconductor device available in n-channel & p-channel configurations.

In the Bipolar Junction transistor, the output collector current of the transistor is proportional to the input current.

when drain-source voltage V_{DS} is zero, there is

Observations:

Table 1 : Drain or static characteristics

S NO	$V_{GS}=0V$		$V_{GS}=2V$	
	V_{DS} in volts	I_D (mA)	V_{DS} (Volts)	I_D (mA)
1	1	4	1	0.6
2	2	6.0	2	0.6
3	3	6.2	3	0.7
4	6	6.5	6	1.0
5	9	6.7	9	1.0
6	12	6.7	12	1.1
7	15	6.8	15	1.3
8	18	6.8	18	1.3
9	21	6.8	21	1.4
10	24	6.8	24	1.5

Transfer characteristics

S.NO	$V_{DS}=5V$	
	V_{GS} (volts)	I_D (mA)
1	0	6.5
2	0.5	4.0
3	1	3.0
4	1.5	1.3
5	2	0.9
6	2.5	0.6
7	3	0.5
8	3.5	0.2

no potential at the drain, so no current flows inspite of the fact that the channel is fully open So, $I_D = 0$

For small applied voltage V_{DS}, the n-type bar act as simple semiconductor resistor, and the drain current increases linearly with the increase of V_{DS} upto the knee point.

This region, to the left of the knee point of the curve is called the "ohmic region" as in the region the JFET behaves like as an ordinary resistor. The region of the characterstic in which drain current I_D remains constant is called the pinchoff region. It is also called the amplifier region.

Procedure: Drain characteristics:

1) Make the connections as per the circuit diagram
2) keep the V_{GG} and V_{DD} at minimum positions before switch on the RPS $V_{GG}=0$, $V_{DD}=0V$
3) Now vary the V_{DD} and tabulate the values of V_{DS} and I_D.
4) Repeat step 3 for $V_{GS}=-2V$ & $-4V$
5) Plot the graphs for V_{DS} vs I_D for various values of V_{GS}
6) Calculate r_d from drain (static) characteristics.
7) when $V_{GS}=0$ the minimum value of V_{DS} for

Expected graphs:-

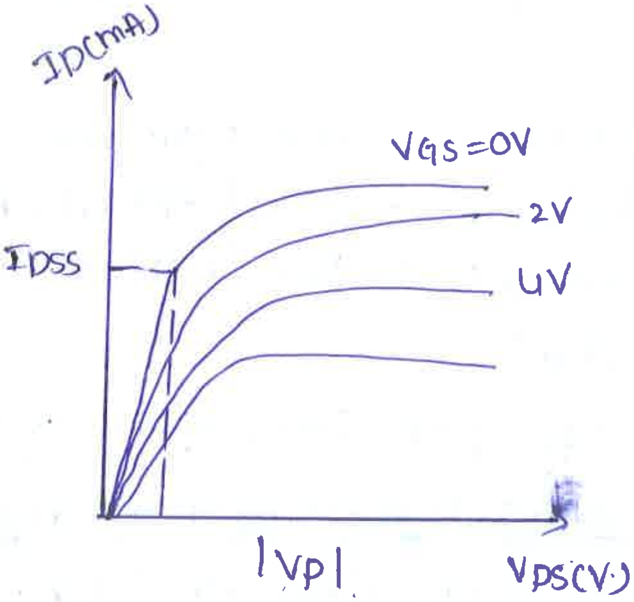


Fig 2: Drain characteristics

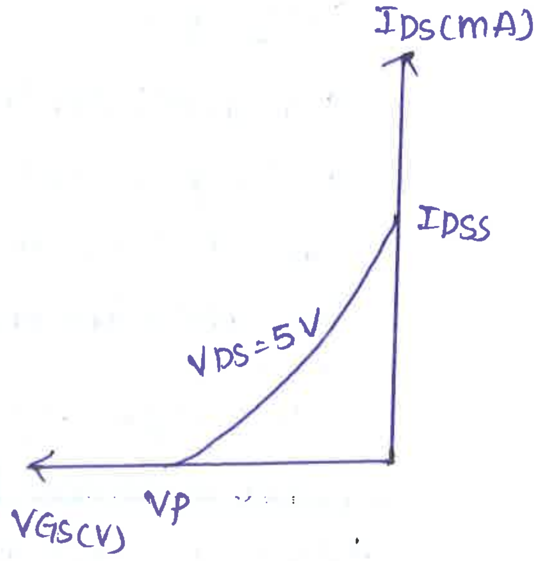


Fig 3: Transfer characteristics

which the I_D is constant becomes the pinch-off voltage (V_p) and this constant current becomes the drain to source current (I_{DSS}). Note down these values for the given JFET.

Transfer characterstics

1) keep the V_{DS} constant at 5V and V_{GS} at 0V by varying V_{DD} and V_{GG} respectively.
2) Now vary the V_{GG} and tabulate the values of I_D and V_{GS}.
3) Repeat the step. 2 for $V_{DS} = 10V$
4) Plot the graphs for V_{DS} vs I_D for different values of V_{GS} and V_{GS} vs I_D for different values of V_{DS}.
5) calculate gm from the transfer characteristics.

Calculations: Pinch-off voltage (V_p) = 3.5

Drain to source voltage (I_{DSS}) = 6.5 mA

Drain resistance (r_d) = $\left.\frac{\Delta V_{DS}}{\Delta I_{DS}}\right|_{V_{GS}\ constant} = \frac{6-2}{(6.5-6)\times10^{-3}} = 8k\Omega$

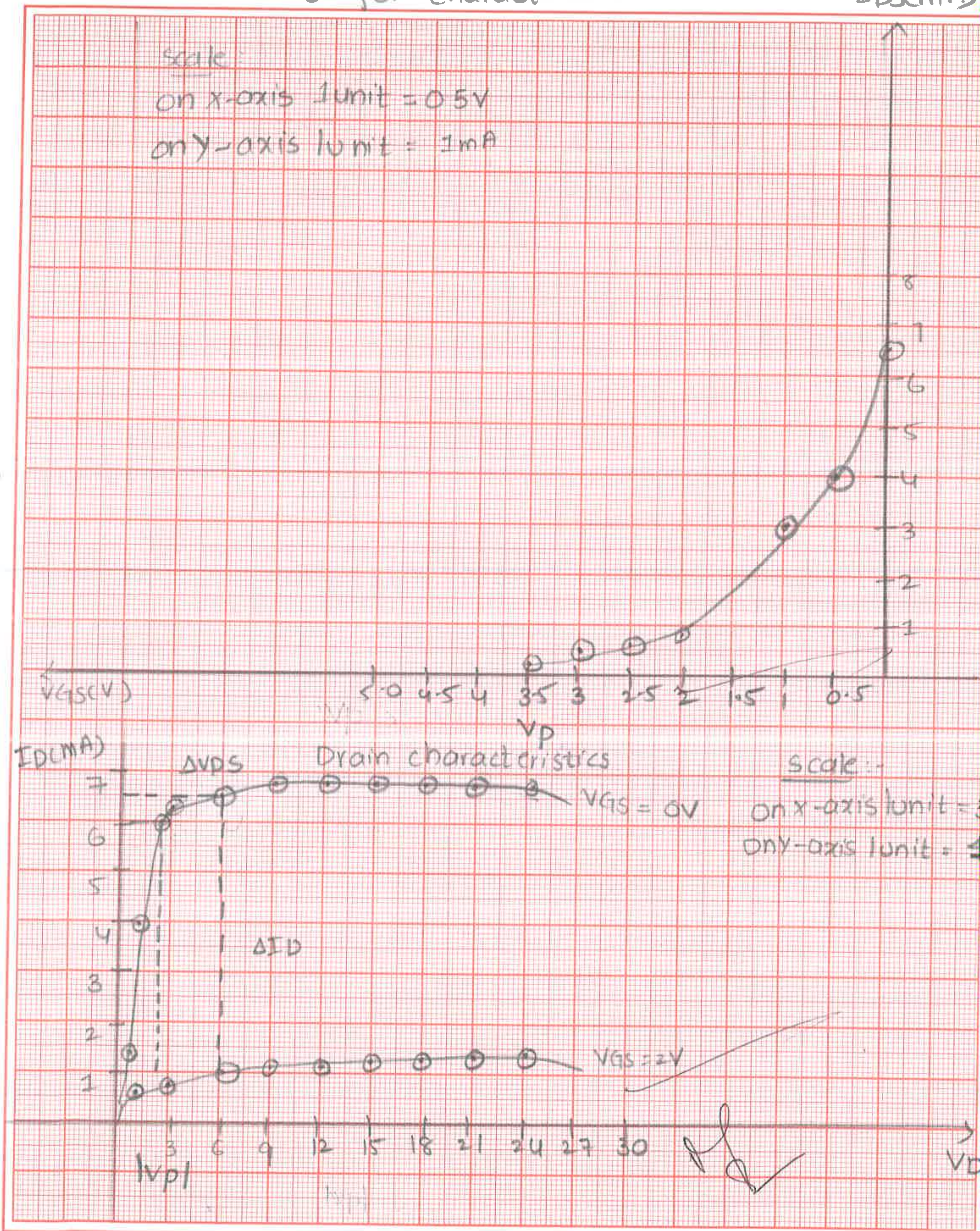
Transconductance (g_m) = $\left.\frac{\Delta I_D}{\Delta V_{GS}}\right|_{V_{DS}\ constant} = \frac{4-0.6\times10^{-3}}{2.5-0.5} = 1.7m\mho$

Amplification factor $\mu = r_d \times g_m$

$\mu = 8\times10^{3}\times1.7\times10^{-3}$

$\mu = 13.6$

Transfer characteristics



Result : Hence, obtained the drain and transfer characteristics of given JFET, and calculated the drain resistance r_d and trans conductance g_m of given JFET

9b/10

CO-PO ATTAINMENT PROCESS

Academic year: 2022-23
Regulation: R-20
Year & SEM: II B.Tech., I SEM
Batch: 21
Branch: Electronics and Communication Engineering
Subject code: A0491203 – Electronic Devices and Circuits Lab
Name of the Faculty: Dr. M. Chennakesavulu

S.No	Reg.No.	Final Internal Marks(25)	Total Final Marks(75)	External Marks(50)	N CO 1	N CO 2	N CO 3	N CO 4	NCO 5
1	21091A0401	18	55	37	73.34	73.34	73.34	73.34	73.34
2	21091A0402	22	65	43	86.67	86.67	86.67	86.67	86.67
3	21091A0403	17	20	3	26.67	26.67	26.67	26.67	26.67
4	21091A0404	19	51	32	68	68	68	68	68
5	21091A0405	19	55	36	73.34	73.34	73.34	73.34	73.34
6	21091A0406	21	61	40	81.34	81.34	81.34	81.34	81.34
7	21091A0407	23	63	40	84	84	84	84	84
8	21091A0408	21	62	41	82.67	82.67	82.67	82.67	82.67
9	21091A0409	23	69	46	92	92	92	92	92
10	21091A0410	22	44	22	58.67	58.67	58.67	58.67	58.67
11	21091A0411	23	67	44	89.34	89.34	89.34	89.34	89.34
12	21091A0412	22	67	45	89.34	89.34	89.34	89.34	89.34
13	21091A0413	18	39	21	52	52	52	52	52
14	21091A0415	20	46	26	61.34	61.34	61.34	61.34	61.34
15	21091A0416	23	66	43	88	88	88	88	88
16	21091A0417	22	62	40	82.67	82.67	82.67	82.67	82.67
17	21091A0418	20	51	31	68	68	68	68	68
18	21091A0419	19	45	26	60	60	60	60	60
19	21091A0420	24	65	41	86.67	86.67	86.67	86.67	86.67
20	21091A0421	22	61	39	81.34	81.34	81.34	81.34	81.34
21	21091A0422	21	64	43	85.34	85.34	85.34	85.34	85.34
22	21091A0423	23	71	48	94.67	94.67	94.67	94.67	94.67
23	21091A0424	21	66	45	88	88	88	88	88
24	21091A0426	22	55	33	73.34	73.34	73.34	73.34	73.34
25	21091A0427	23	63	40	84	84	84	84	84
26	21091A0428	22	59	37	78.67	78.67	78.67	78.67	78.67
27	21091A0429	22	68	46	90.67	90.67	90.67	90.67	90.67
28	21091A0430	21	64	43	85.34	85.34	85.34	85.34	85.34
29	21091A0431	22	65	43	86.67	86.67	86.67	86.67	86.67
30	21091A0432	21	46	25	61.34	61.34	61.34	61.34	61.34
31	21091A0433	19	40	21	53.34	53.34	53.34	53.34	53.34
32	21091A0434	22	64	42	85.34	85.34	85.34	85.34	85.34
33	21091A0435	24	68	44	90.67	90.67	90.67	90.67	90.67
34	21091A0436	20	49	29	65.34	65.34	65.34	65.34	65.34
35	21091A0437	20	36	16	48	48	48	48	48

S.No	Reg.No.	Final Internal Marks(25)	Total Final Marks(75)	External Marks(50)	N CO 1	N CO 2	N CO 3	N CO 4	NCO 5
36	21091A0438	20	30	10	40	40	40	40	40
37	21091A0439	19	62	43	82.67	82.67	82.67	82.67	82.67
38	21091A0440	22	64	42	85.34	85.34	85.34	85.34	85.34
39	21091A0441	22	50	28	66.67	66.67	66.67	66.67	66.67
40	21091A0442	23	52	29	69.34	69.34	69.34	69.34	69.34
41	21091A0443	21	23	2	30.67	30.67	30.67	30.67	30.67
42	21091A0444	17	30	13	40	40	40	40	40
43	21091A0445	21	45	24	60	60	60	60	60
44	21091A0446	20	41	21	54.67	54.67	54.67	54.67	54.67
45	21091A0447	21	68	47	90.67	90.67	90.67	90.67	90.67
46	21091A0448	24	72	48	96	96	96	96	96
47	21091A0449	24	68	44	90.67	90.67	90.67	90.67	90.67
48	21091A0450	21	31	10	41.34	41.34	41.34	41.34	41.34
49	21091A0451	24	70	46	93.34	93.34	93.34	93.34	93.34
50	21091A0452	23	70	47	93.34	93.34	93.34	93.34	93.34
51	21091A0453	20	50	30	66.67	66.67	66.67	66.67	66.67
52	21091A0454	23	70	47	93.34	93.34	93.34	93.34	93.34
53	21091A0455	23	70	47	93.34	93.34	93.34	93.34	93.34
54	21091A0456	24	69	45	92	92	92	92	92
55	21091A0457	22	48	26	64	64	64	64	64
56	21091A0458	23	55	32	73.34	73.34	73.34	73.34	73.34
57	21091A0459	22	44	22	58.67	58.67	58.67	58.67	58.67
58	21091A0460	23	67	44	89.34	89.34	89.34	89.34	89.34
59	21091A0461	24	70	46	93.34	93.34	93.34	93.34	93.34
60	21091A0462	23	71	48	94.67	94.67	94.67	94.67	94.67
61	21091A0463	22	63	41	84	84	84	84	84
62	21091A0464	19	29	10	38.67	38.67	38.67	38.67	38.67
63	22095A0402	24	69	45	92	92	92	92	92
64	22095A0403	24	66	42	88	88	88	88	88
65	22095A0404	24	65	41	86.67	86.67	86.67	86.67	86.67
66	22095A0406	24	72	48	96	96	96	96	96
67	22095A0410	24	72	48	96	96	96	96	96
68	22095A0416	24	64	40	85.34	85.34	85.34	85.34	85.34
70	22095A0420	24	72	48	96	96	96	96	96
71	22095A0424	24	49	25	65.34	65.34	65.34	65.34	65.34
72	22095A0427	23	67	44	89.34	89.34	89.34	89.34	89.34
73	22095A0433	18	63	45	84	84	84	84	84
74	21091A0465	20	61	41	81.34	81.34	81.34	81.34	81.34
75	21091A0466	18	30	12	40	40	40	40	40
76	21091A0467	21	46	25	61.34	61.34	61.34	61.34	61.34
77	21091A0468	18	25	7	33.34	33.34	33.34	33.34	33.34
78	21091A0469	20	61	41	81.34	81.34	81.34	81.34	81.34
79	21091A0470	23	53	30	70.67	70.67	70.67	70.67	70.67
80	21091A0471	22	56	34	74.67	74.67	74.67	74.67	74.67
81	21091A0472	23	44	21	58.67	58.67	58.67	58.67	58.67
82	21091A0473	22	63	41	84	84	84	84	84
83	21091A0474	18	44	26	58.67	58.67	58.67	58.67	58.67

S.No	Reg.No.	Final Internal Marks(25)	Total Final Marks(75)	External Marks(50)	N CO 1	N CO 2	N CO 3	N CO 4	NCO 5
84	21091A0475	22	48	26	64	64	64	64	64
85	21091A0476	21	64	43	85.34	85.34	85.34	85.34	85.34
86	21091A0477	21	47	26	62.67	62.67	62.67	62.67	62.67
87	21091A0478	21	35	14	46.67	46.67	46.67	46.67	46.67
88	21091A0479	21	49	28	65.34	65.34	65.34	65.34	65.34
89	21091A0480	17	41	24	54.67	54.67	54.67	54.67	54.67
90	21091A0481	21	64	43	85.34	85.34	85.34	85.34	85.34
91	21091A0482	23	70	47	93.34	93.34	93.34	93.34	93.34
92	21091A0483	22	46	24	61.34	61.34	61.34	61.34	61.34
93	21091A0484	21	32	11	42.67	42.67	42.67	42.67	42.67
94	21091A0485	21	48	27	64	64	64	64	64
95	21091A0486	23	68	45	90.67	90.67	90.67	90.67	90.67
96	21091A0487	21	46	25	61.34	61.34	61.34	61.34	61.34
97	21091A0488	21	57	36	76	76	76	76	76
98	21091A0489	21	45	24	60	60	60	60	60
99	21091A0490	19	42	23	56	56	56	56	56
100	21091A0491	21	61	40	81.34	81.34	81.34	81.34	81.34
101	21091A0493	21	42	21	56	56	56	56	56
102	21091A0494	21	52	31	69.34	69.34	69.34	69.34	69.34
103	21091A0495	20	45	25	60	60	60	60	60
104	21091A0496	22	49	27	65.34	65.34	65.34	65.34	65.34
105	21091A0497	20	56	36	74.67	74.67	74.67	74.67	74.67
106	21091A0498	20	42	22	56	56	56	56	56
107	21091A0499	21	62	41	82.67	82.67	82.67	82.67	82.67
108	21091A04A0	21	60	39	80	80	80	80	80
109	21091A04A1	22	48	26	64	64	64	64	64
110	21091A04A2	22	49	27	65.34	65.34	65.34	65.34	65.34
111	21091A04A3	23	50	27	66.67	66.67	66.67	66.67	66.67
112	21091A04A4	21	57	36	76	76	76	76	76
113	21091A04A5	22	45	23	60	60	60	60	60
114	21091A04A6	21	48	27	64	64	64	64	64
115	21091A04A7	23	56	33	74.67	74.67	74.67	74.67	74.67
116	21091A04A8	23	62	39	82.67	82.67	82.67	82.67	82.67
117	21091A04A9	22	49	27	65.34	65.34	65.34	65.34	65.34
118	21091A04B0	23	43	20	57.34	57.34	57.34	57.34	57.34
119	21091A04B1	20	45	25	60	60	60	60	60
120	21091A04B2	22	46	24	61.34	61.34	61.34	61.34	61.34
121	21091A04B3	22	63	41	84	84	84	84	84
122	21091A04B4	22	61	39	81.34	81.34	81.34	81.34	81.34
123	21091A04B5	22	50	28	66.67	66.67	66.67	66.67	66.67
124	21091A04B6	21	43	22	57.34	57.34	57.34	57.34	57.34
125	21091A04B7	22	64	42	85.34	85.34	85.34	85.34	85.34
126	21091A04B9	23	50	27	66.67	66.67	66.67	66.67	66.67
127	21091A04C0	23	67	44	89.34	89.34	89.34	89.34	89.34
128	21091A04C1	22	46	24	61.34	61.34	61.34	61.34	61.34
129	21091A04C2	22	45	23	60	60	60	60	60
130	21091A04C3	22	66	44	88	88	88	88	88

S.No	Reg.No.	Final Internal Marks(25)	Total Final Marks(75)	External Marks(50)	N CO 1	N CO 2	N CO 3	N CO 4	NCO 5
131	21091A04C4	23	48	25	64	64	64	64	64
132	21091A04C5	23	60	37	80	80	80	80	80
133	21091A04C6	23	68	45	90.67	90.67	90.67	90.67	90.67
134	21091A04C7	22	46	24	61.34	61.34	61.34	61.34	61.34
135	22095A0407	23	67	44	89.34	89.34	89.34	89.34	89.34
136	22095A0408	23	53	30	70.67	70.67	70.67	70.67	70.67
137	22095A0409	23	57	34	76	76	76	76	76
138	22095A0411	23	67	44	89.34	89.34	89.34	89.34	89.34
139	22095A0413	23	66	43	88	88	88	88	88
140	22095A0415	23	61	38	81.34	81.34	81.34	81.34	81.34
141	22095A0417	23	66	43	88	88	88	88	88
142	22095A0422	23	69	46	92	92	92	92	92
143	22095A0428	20	64	44	85.34	85.34	85.34	85.34	85.34
144	22095A0429	23	68	45	90.67	90.67	90.67	90.67	90.67
145	22095A0435	22	49	27	65.34	65.34	65.34	65.34	65.34
146	22095A0436	23	51	28	68	68	68	68	68
147	21091A04C8	18	54	36	72	72	72	72	72
148	21091A04C9	24	67	43	89.34	89.34	89.34	89.34	89.34
149	21091A04D0	15	21	6	28	28	28	28	28
150	21091A04D1	19	45	26	60	60	60	60	60
151	21091A04D2	16	45	29	60	60	60	60	60
152	21091A04D3	19	41	22	54.67	54.67	54.67	54.67	54.67
153	21091A04D4	24	65	41	86.67	86.67	86.67	86.67	86.67
154	21091A04D5	20	43	23	57.34	57.34	57.34	57.34	57.34
155	21091A04D6	19	51	32	68	68	68	68	68
156	21091A04D7	21	63	42	84	84	84	84	84
157	21091A04D8	23	64	41	85.34	85.34	85.34	85.34	85.34
158	21091A04D9	14	40	26	53.34	53.34	53.34	53.34	53.34
159	21091A04E0	24	67	43	89.34	89.34	89.34	89.34	89.34
160	21091A04E1	18	45	27	60	60	60	60	60
161	21091A04E2	19	52	33	69.34	69.34	69.34	69.34	69.34
162	21091A04E3	20	52	32	69.34	69.34	69.34	69.34	69.34
163	21091A04E4	23	68	45	90.67	90.67	90.67	90.67	90.67
164	21091A04E5	15	28	13	37.34	37.34	37.34	37.34	37.34
165	21091A04E6	17	38	21	50.67	50.67	50.67	50.67	50.67
166	21091A04E7	23	63	40	84	84	84	84	84
167	21091A04E8	22	64	42	85.34	85.34	85.34	85.34	85.34
168	21091A04E9	24	67	43	89.34	89.34	89.34	89.34	89.34
169	21091A04F0	21	57	36	76	76	76	76	76
170	21091A04F1	22	63	41	84	84	84	84	84
171	21091A04F2	24	60	36	80	80	80	80	80
172	21091A04F3	25	56	31	74.67	74.67	74.67	74.67	74.67
173	21091A04F5	22	49	27	65.34	65.34	65.34	65.34	65.34
174	21091A04F6	13	23	10	30.67	30.67	30.67	30.67	30.67
175	21091A04F7	25	71	46	94.67	94.67	94.67	94.67	94.67
176	21091A04F8	20	60	40	80	80	80	80	80
177	21091A04F9	24	61	37	81.34	81.34	81.34	81.34	81.34

S.No	Reg.No.	Final Internal Marks(25)	Total Final Marks(75)	External Marks(50)	N CO 1	N CO 2	N CO 3	N CO 4	NCO 5
178	21091A04G0	10	25	15	33.34	33.34	33.34	33.34	33.34
179	21091A04G1	25	53	28	70.67	70.67	70.67	70.67	70.67
180	21091A04G2	18	48	30	64	64	64	64	64
181	21091A04G3	12	29	17	38.67	38.67	38.67	38.67	38.67
182	21091A04G4	15	24	9	32	32	32	32	32
183	21091A04G5	22	53	31	70.67	70.67	70.67	70.67	70.67
184	21091A04G6	22	58	36	77.34	77.34	77.34	77.34	77.34
185	21091A04G7	19	35	16	46.67	46.67	46.67	46.67	46.67
186	21091A04G8	21	53	32	70.67	70.67	70.67	70.67	70.67
187	21091A04G9	17	47	30	62.67	62.67	62.67	62.67	62.67
188	21091A04H0	21	63	42	84	84	84	84	84
189	21091A04H1	18	59	41	78.67	78.67	78.67	78.67	78.67
190	21091A04H2	18	34	16	45.34	45.34	45.34	45.34	45.34
191	21091A04H3	20	51	31	68	68	68	68	68
192	21091A04H5	21	53	32	70.67	70.67	70.67	70.67	70.67
193	21091A04H6	20	60	40	80	80	80	80	80
194	21091A04H7	19	57	38	76	76	76	76	76
195	21091A04H8	19	36	17	48	48	48	48	48
196	21091A04H9	25	68	43	90.67	90.67	90.67	90.67	90.67
197	21091A04J0	25	69	44	92	92	92	92	92
198	21091A04J1	23	54	31	72	72	72	72	72
199	21091A04J2	25	53	28	70.67	70.67	70.67	70.67	70.67
200	21091A04J3	25	61	36	81.34	81.34	81.34	81.34	81.34
201	21091A04J4	25	62	37	82.67	82.67	82.67	82.67	82.67
202	21091A04J5	22	54	32	72	72	72	72	72
203	21091A04J6	20	50	30	66.67	66.67	66.67	66.67	66.67
204	21091A04J7	25	67	42	89.34	89.34	89.34	89.34	89.34
205	21091A04J8	24	59	35	78.67	78.67	78.67	78.67	78.67
206	21091A04J9	22	64	42	85.34	85.34	85.34	85.34	85.34
207	22095A0401	23	67	44	89.34	89.34	89.34	89.34	89.34
208	22095A0405	23	58	35	77.34	77.34	77.34	77.34	77.34
209	22095A0412	23	57	34	76	76	76	76	76
210	22095A0414	24	58	34	77.34	77.34	77.34	77.34	77.34
211	22095A0418	22	65	43	86.67	86.67	86.67	86.67	86.67
212	22095A0419	22	62	40	82.67	82.67	82.67	82.67	82.67
213	22095A0421	24	67	43	89.34	89.34	89.34	89.34	89.34
214	22095A0425	24	59	35	78.67	78.67	78.67	78.67	78.67
215	22095A0426	25	60	35	80	80	80	80	80
216	22095A0430	23	56	33	74.67	74.67	74.67	74.67	74.67
217	22095A0432	24	66	42	88	88	88	88	88
218	22095A0437	9	20	11	26.67	26.67	26.67	26.67	26.67
219	19091A04N9	22	58	36	77.34	77.34	77.34	77.34	77.34
220	20091A04A1	10	18	8	24	24	24	24	24
221	20091A04M4	24	64	40	85.34	85.34	85.34	85.34	85.34
222	21091A04K0	24	68	44	90.67	90.67	90.67	90.67	90.67
223	21091A04K1	20	65	45	86.67	86.67	86.67	86.67	86.67
224	21091A04K2	22	68	46	90.67	90.67	90.67	90.67	90.67

S.No	Reg.No.	Final Internal Marks(25)	Total Final Marks(75)	External Marks(50)	N CO 1	N CO 2	N CO 3	N CO 4	NCO 5
225	21091A04K3	22	65	43	86.67	86.67	86.67	86.67	86.67
226	21091A04K4	20	30	10	40	40	40	40	40
227	21091A04K6	10	15	5	20	20	20	20	20
228	21091A04K7	16	52	36	69.34	69.34	69.34	69.34	69.34
229	21091A04K8	21	61	40	81.34	81.34	81.34	81.34	81.34
230	21091A04K9	19	49	30	65.34	65.34	65.34	65.34	65.34
231	21091A04M0	21	64	43	85.34	85.34	85.34	85.34	85.34
232	21091A04M1	22	69	47	92	92	92	92	92
233	21091A04M2	24	64	40	85.34	85.34	85.34	85.34	85.34
234	21091A04M3	22	62	40	82.67	82.67	82.67	82.67	82.67
235	21091A04M4	15	47	32	62.67	62.67	62.67	62.67	62.67
236	21091A04M6	24	72	48	96	96	96	96	96
237	21091A04M7	24	71	47	94.67	94.67	94.67	94.67	94.67
238	21091A04M8	22	57	35	76	76	76	76	76
239	21091A04M9	17	47	30	62.67	62.67	62.67	62.67	62.67
240	21091A04N0	22	57	35	76	76	76	76	76
241	21091A04N1	20	31	11	41.34	41.34	41.34	41.34	41.34
242	21091A04N2	20	60	40	80	80	80	80	80
243	21091A04N3	19	52	33	69.34	69.34	69.34	69.34	69.34
244	21091A04N4	23	69	46	92	92	92	92	92
245	21091A04N5	22	63	41	84	84	84	84	84
246	21091A04N7	17	54	37	72	72	72	72	72
247	21091A04N8	23	69	46	92	92	92	92	92
248	21091A04N9	24	68	44	90.67	90.67	90.67	90.67	90.67
249	21091A04P0	18	51	33	68	68	68	68	68
250	21091A04P1	23	70	47	93.34	93.34	93.34	93.34	93.34
251	21091A04P2	23	69	46	92	92	92	92	92
252	21091A04P3	24	70	46	93.34	93.34	93.34	93.34	93.34
253	21091A04P4	21	57	36	76	76	76	76	76
254	21091A04P5	19	54	35	72	72	72	72	72
255	21091A04P6	23	67	44	89.34	89.34	89.34	89.34	89.34
256	21091A04P8	24	70	46	93.34	93.34	93.34	93.34	93.34
257	21091A04P9	23	68	45	90.67	90.67	90.67	90.67	90.67
258	21091A04Q0	22	65	43	86.67	86.67	86.67	86.67	86.67
259	21091A04Q1	23	70	47	93.34	93.34	93.34	93.34	93.34
260	21091A04Q2	22	61	39	81.34	81.34	81.34	81.34	81.34
261	21091A04Q4	23	62	39	82.67	82.67	82.67	82.67	82.67
262	21091A04Q5	21	58	37	77.34	77.34	77.34	77.34	77.34
263	21091A04Q6	20	50	30	66.67	66.67	66.67	66.67	66.67
264	21091A04Q7	21	62	41	82.67	82.67	82.67	82.67	82.67
265	21091A04Q8	22	63	41	84	84	84	84	84
266	21091A04Q9	21	48	27	64	64	64	64	64
267	21091A04R0	10	36	26	48	48	48	48	48
268	21091A04R1	19	49	30	65.34	65.34	65.34	65.34	65.34
269	21091A04R2	21	56	35	74.67	74.67	74.67	74.67	74.67
270	21091A04R4	21	49	28	65.34	65.34	65.34	65.34	65.34
271	21091A04R5	24	68	44	90.67	90.67	90.67	90.67	90.67

S.No	Reg.No.	Final Internal Marks(25)	Total Final Marks(75)	External Marks(50)	N CO 1	N CO 2	N CO 3	N CO 4	NCO 5
272	21091A04R6	18	61	43	81.34	81.34	81.34	81.34	81.34
273	21091A04R7	21	51	30	68	68	68	68	68
274	21091A04R8	21	51	30	68	68	68	68	68
275	21091A04R9	24	70	46	93.34	93.34	93.34	93.34	93.34
276	21091A04S0	17	56	39	74.67	74.67	74.67	74.67	74.67
277	22095A0423	24	70	46	93.34	93.34	93.34	93.34	93.34
278	22095A0431	23	66	43	88	88	88	88	88
279	22095A0434	24	60	36	80	80	80	80	80

CO-PO Calculation

	CO 1		CO 2		CO 3		CO 4		CO5	
	No. of students Attained	Weightage Points	No. of students Attained	Weightage Points	No. of students Attained	Weightage Points	No. of students Attained	Weightage Points	No. of students Attained	Weightage Points
>60%	235	3	235	3	235	3	235	3	235	3
40% to 60%	30	2	30	2	30	2	30	2	30	2
<40%	13	1	13	1	13	1	13	1	13	1
Total No. of students	278		278		278		278		278	
Atainment value		**2.80**		**2.80**		**2.80**		**2.80**		**2.80**
% of Attainment		**84.53**		**84.53**		**84.53**		**84.53**		**84.53**
Attained or not		**YES**		**YES**		**YES**		**YES**		**YES**

CO	CO Attainment Value	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2.80	3				2				3				2		1
CO 2	2.80	3	1	2		2				3				2	1	
CO 3	2.80	3	3	2	2	1	2			3		2		2	2	
CO 4	2.80	3	1	1	1		1			3				1	2	1
CO 5	2.80	3	2	1	2		2			3		2		1	1	1

EDC LAB	2.80	2.80	2.80	2.80	2.80	2.80	-	-	2.80	-	2.80	-	2.80	2.80	2.80