B.Sc. III - Physics

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Experiment No. [1]

Object →

To plot the characteristics of a Zener Diode.

Apparatus Required →

Zener Diode of different ratings (4, 5V, 6V, 9V). Milliammeter, Voltmeter, d.c Suffply of 12V. Rehostat.

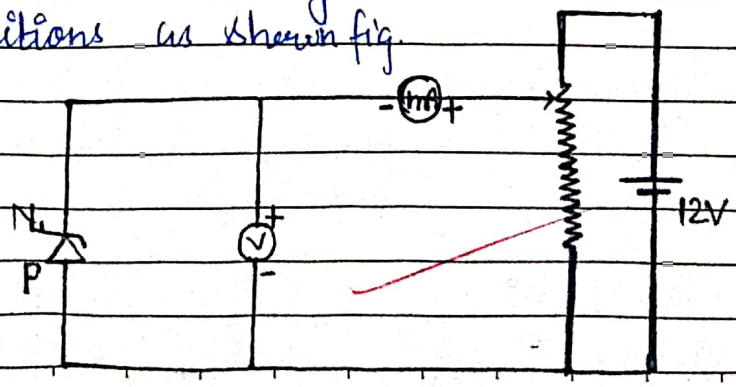
Theory →

Zener diode is an ordinary P-N junction diode except that it is properly doped to have a very sharp and almost vertical breakdown. It is exclusively operated under reverse-bias conditions and designed to operate in breakdown region without damage.

When a Zener Diode is operated in the breakdown region, the voltage across the diode remains almost constant (equal to V_z) for the large change of reverse current.

Circuit Connections →

We study its characteristics only in revers bias conditions as shown fig.



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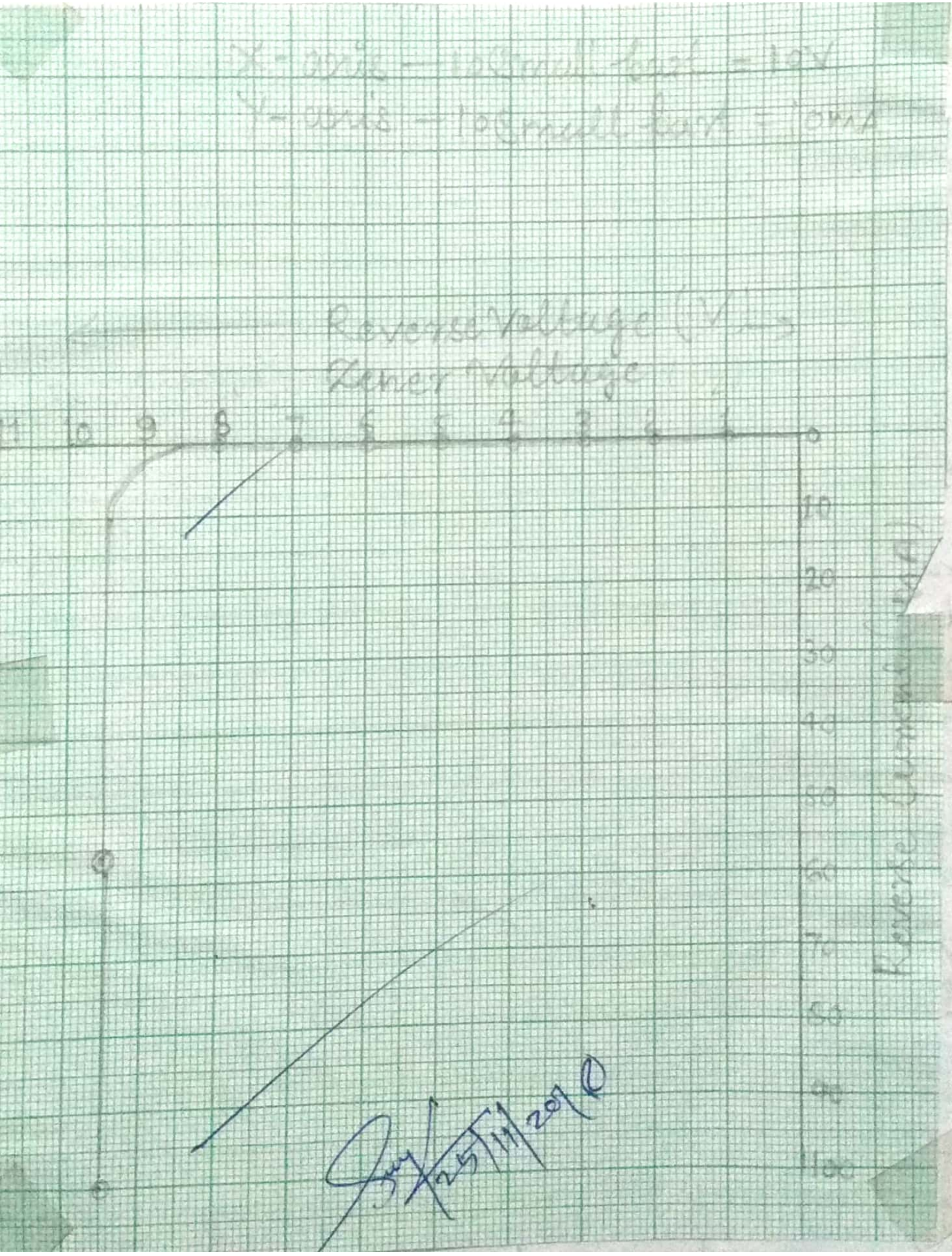
X - axis = Horizontal axis = 1 V

Y - axis = Vertical axis = 10 mA



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Procedure →

(i) Adjust the supply at 0 volt and note the current, if any.
(ii) Increase the supply voltage in steps of 0.5 volt and note the corresponding current each time.
(iii) At a particular voltage, V_z (depending upon the rating of zener diode e.g. for 4.5 volt zener, this particular voltage will be 4.5 volt) the current is maximum and there is no effect on this current, the voltage is further increased.
(iv) Repeat the whole procedure with a zener diode of some other ratings.

Observations →

Voltmeter (V) Least count = .25	Milliammeter (mA) Least count = .2
0 X 0.25 = 0	0
4 X 0.25 = 1	0
8 X 0.25 = 2	0
12 X 0.25 = 3	0
16 X .25 = 4	0
20 X .25 = 5	0
24 X .25 = 6	0
28 X .25 = 7	0
32 X .25 = 8	0
36 X .25 = 9	0
37 X .25 = 9.25	28 X 2 = 56
38 X .25 = 9.50	50 X 2 = 100

Teacher's Signature: _____

Result → Plot a graph in current and applied voltage.

Precautions →

(i) Zener diode should be connected in reverse bias condition.
(ii) Rating of diode is an important consideration. Therefore when using this diode in voltage regulation, a current limiting resistor of appropriate value should be used in series with it so that the power dissipated across the junction within its power handling capability.

Experiment No. [27]

Object → To draw the characteristics of a PNP junction transistor ( ) in common emmiter arrangement.

Apparatus Required → PNP transistor, batteries, voltmeter, millivoltmeter, milli and micro arrangement (ammeters).

Theory → In common emitter arrangement we draw—

(i) I_c/I_b characteristics. (Input characteristics) → We plot collector current versus base current for a constant collector voltage.

(ii) Output Characteristics (I_c/V_c characteristics) → We plot collector current versus collector voltage for a constant base current.

Procedure →

[1] Common Emmiter Arrangement

[i] Input Characteristics →

(i) Make the connections as shown fig.

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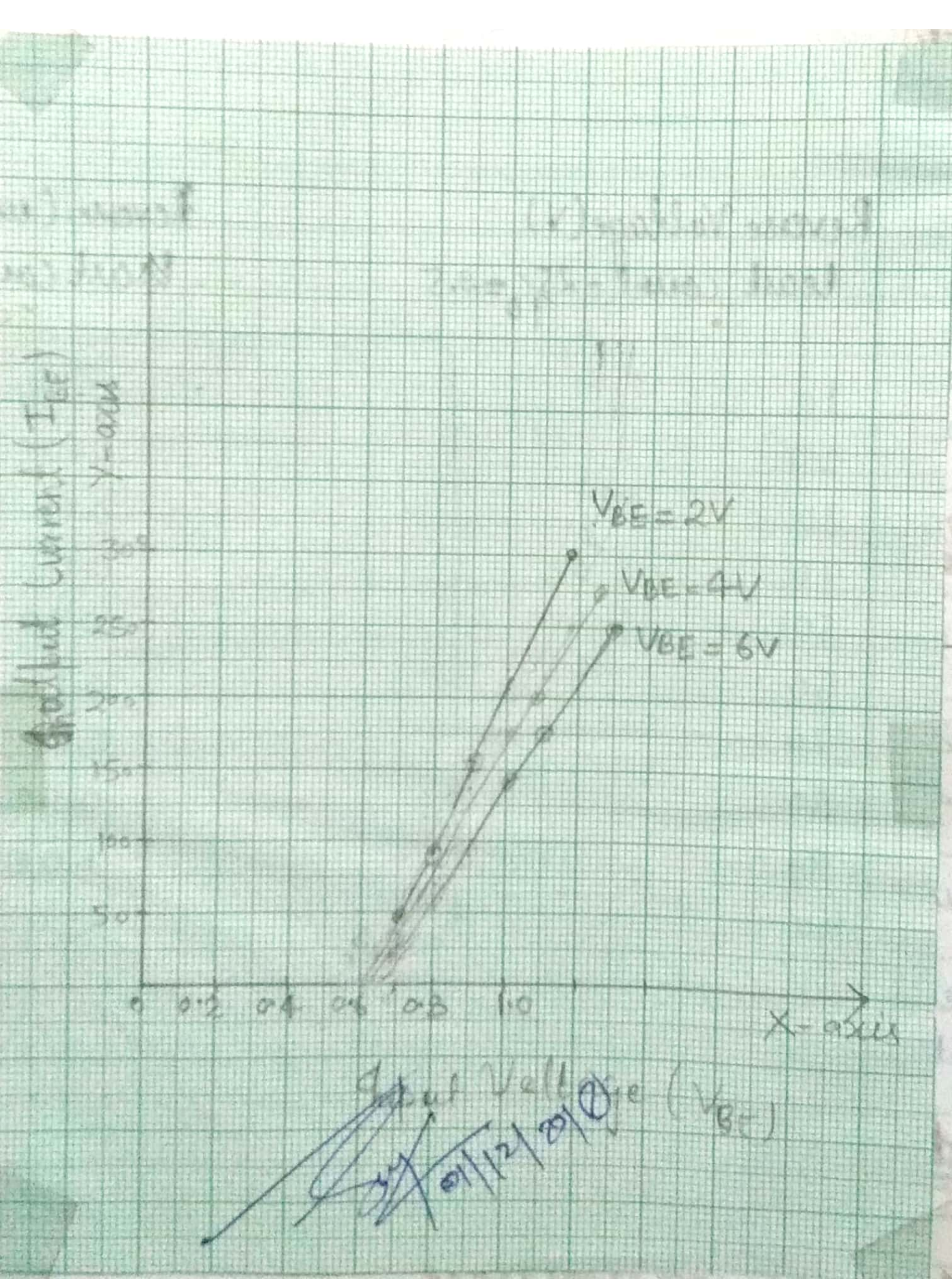

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(ii) Adjust the collector voltage to -2V by means of R_2 and keep it fix for the whole experiment.

(iii) Adjust the base current to 20uA by means of R_1 and note the collector current.

(iv) Increase base current in steps and note the corresponding collector current till the latter reaches, say about 4 mA. If collector voltage changes then readjust it to -2V.

(v) Plot collector current against base current as shown fig.

Observations →

Table for Input characteristics—

V_{CE} = 2V		V_{CE} = 4V		V_{CE} = 6V	
V_{BE}	I_B(uA)	V_{BE}	I_B (uA)	V_{BE}	I_B (uA)
0.1	0	0.1	0	0.1	0
0.2	0	0.2	0	0.2	0
0.3	0	0.3	0	0.3	0
0.4	0	0.4	0	0.4	0
0.5	0	0.5	0	0.5	0
0.6	0	0.6	0	0.6	0
0.7	5	0.7	0	0.7	0
0.8	18	0.8	0	0.8	0
0.9	32	0.9	18	0.9	16
1.0	44	1.0	31	1.0	29
			44		44

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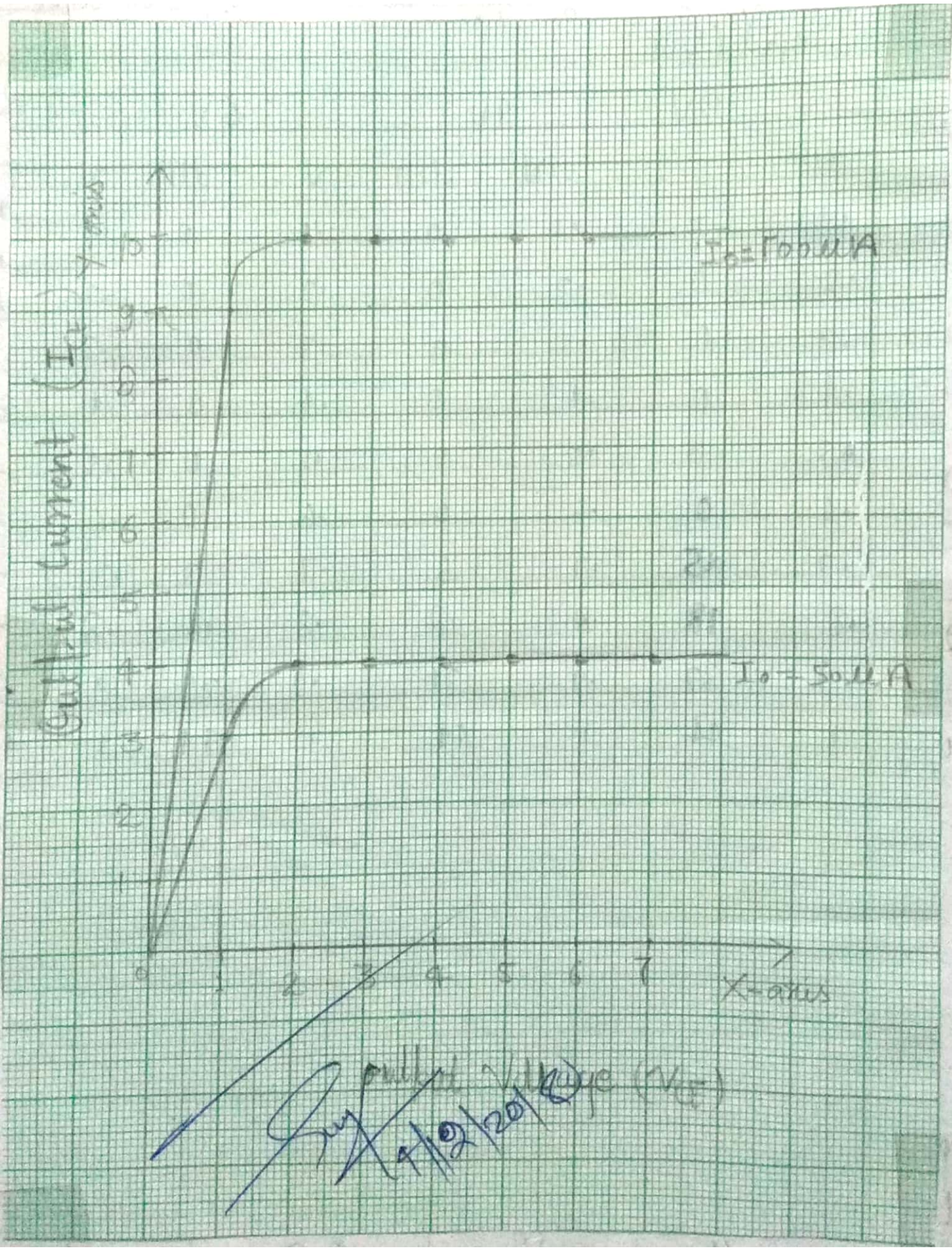

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(ii) Output characteristics →

(i) Adjust base current to 20 μA by means of R_1.
(ii) Increase collector voltage in steps of 1 volt by means of R_2 and note the corresponding collector current.
(iii) The base current is now adjusted to 40 μA, 60 μA etc, and with every value of base current, procedure of point (ii) is repeated.
(iv) Plot curves b/w collector current and collector voltage as shown fig.

Observations →

Table for output characteristics —

I_{CE} = 50 μA		I_{CE} = 100 μA	
V_{CE}	I_C (mA)	V_{CE}	I_C (mA
1	3	1	9
2	4	2	10
3	4	3	10
4	4	4	10
5	4	5	10
6	4	6	10
7	4	7	10

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Result →

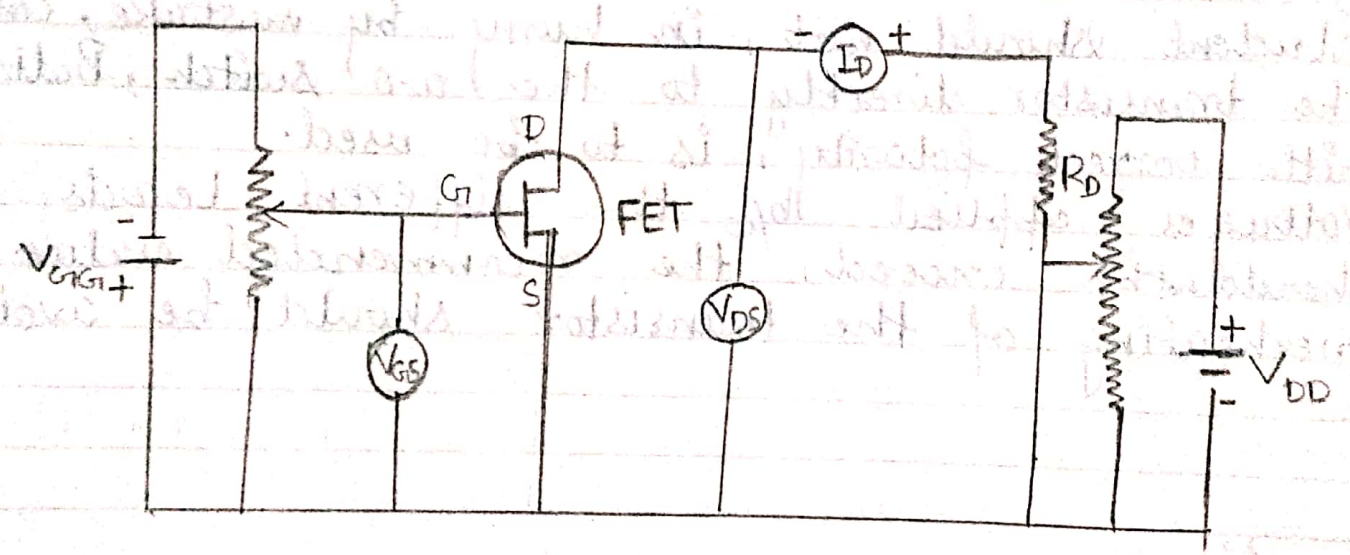
Characteristics of PNP transistor ( ) in common emmiter arrangement have been plotted.

Source of Error & Precautions →

(i) Student should not, in hurry by mistake, connect the transistor directly to the a.c switch, Battry with correct polarity, is to be used.

(ii) Voltages applied b/w the different leads should not be exceed the recommended value.

(iii) Overheating of the transistor should be avoided.



Experiment No. [3]

Object →

To plot output & Transfer characteristics of FET and mesure pinch off voltage.

Apparatus Required →

FET, D.C voltmeters (0–30V & 0–10V), D.C milliammeters (0-50 mA and 0–50 μA), D.C power supplies (for V_{GG} & V_{DD}).

Circuit →

Circuit is shown in fig. G is gate, D is drain and S is source current meter, I_D, may have a swith to put milliammeter or microammeter into the circuit (Whichever is needed)

Procedure →

(i) Make the electrical connections as shown in fig.

[i] Output or Drain Characteristics →

The curve obtained by plotting drain current (I_D) and drain to source voltage (V_{DS}) for fixed gate source voltage (V_{GS}) is called the drain charcteristics. In the output characteristics, kepping V_{GS} fixed at some value, the drain source voltage (V_{DS}) is changed in steps and corresponding drain current

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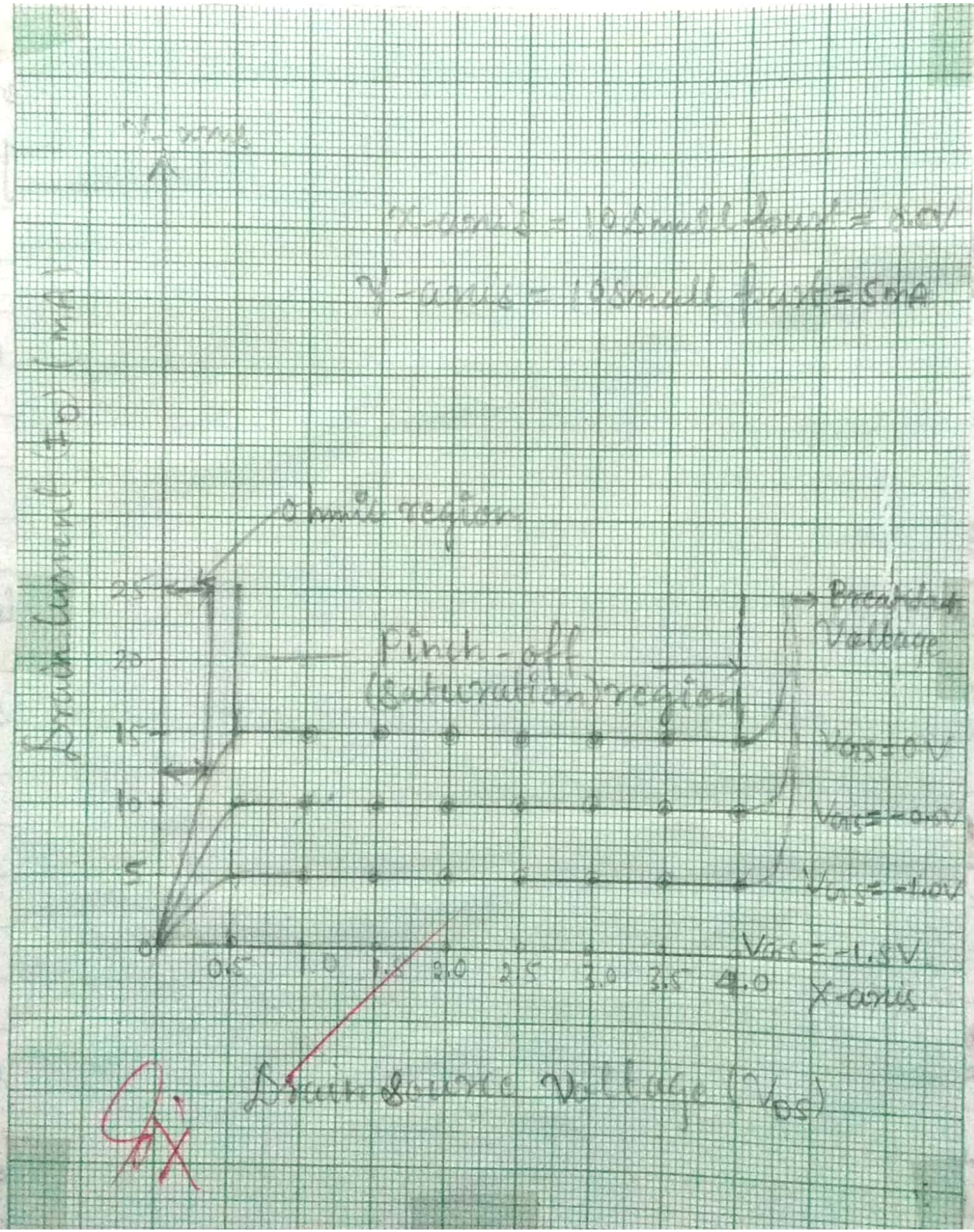

Observations

Table for output characteristics or drain characteristics b/w V_{DS} & I_D at constant V_{GS}

$V_{GS} = 0V$	Least count = 0.25 (V_{DS})	Least count = 5mA (I_D)
0	0	0
0.5	0.5	5
1.0	1.0	10
1.5	1.5	15
2.0	2.0	15
4.0	4.0	15
$V_{GS} = -0.5$	0	0
	0.5	5
	1.0	10
	2.0	10
	4.0	10
$V_{GS} = -1.0$	0	0
	0.5	5
	1.5	5
	2.0	5
	4.0	5
$V_{GS} = -1.5$	0	0
	0.5	0
	1.5	0
	2.0	0
	2.5	0
	3.0	0
	4.0	0

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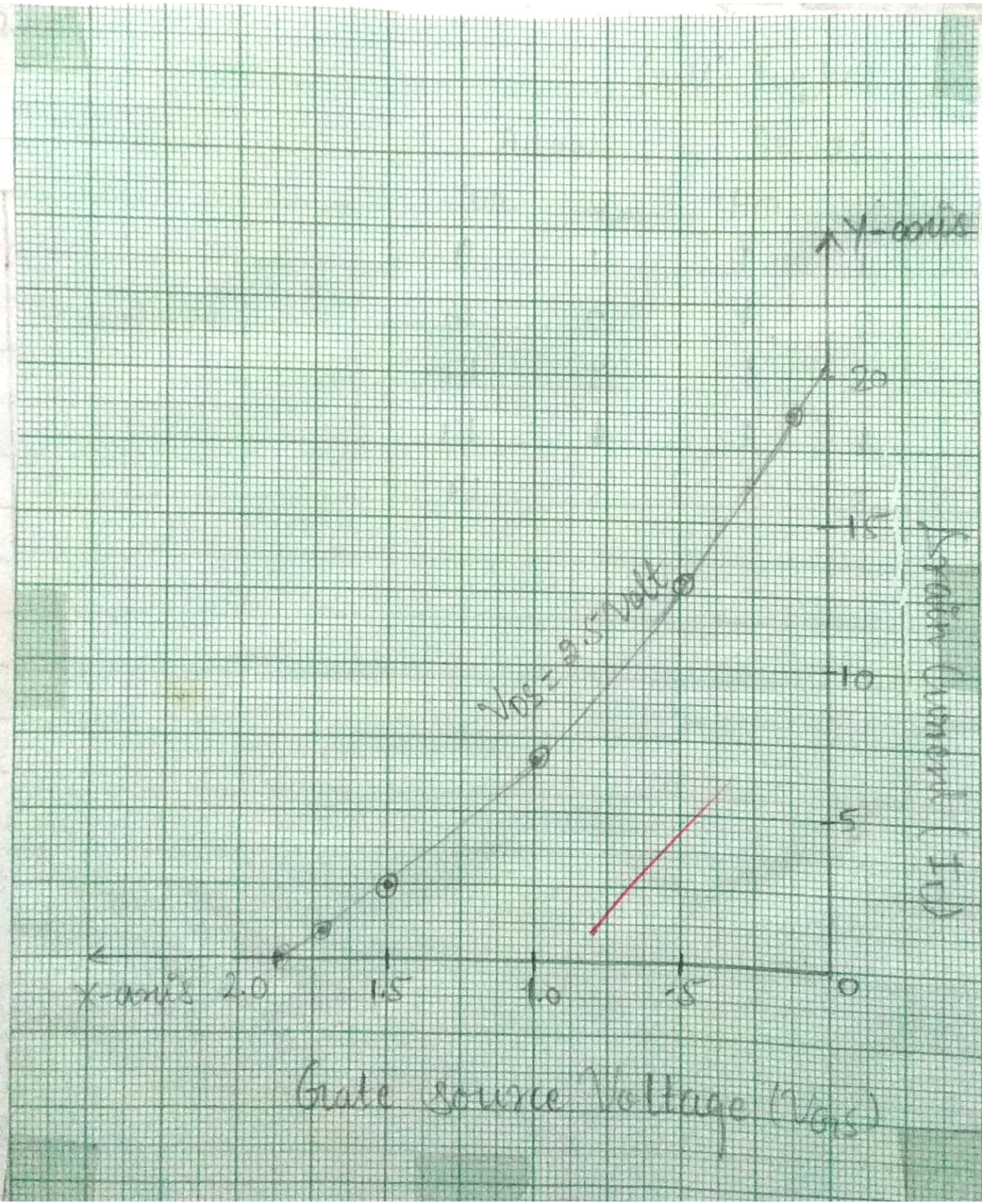

Transfer characteristics →

To get the characteristics, V_{DS} is kept fixed while (V_{GS}) is varied in steps and the corresponding (I_D) is noted.

Observations →

Table for Transfer characteristics b/w V_{GS} & I_D at constant V_{DS}.

$V_{DS} = 2.5V$

V_{GS}	I_D
0 X 0.05 = 0	40 X 0.5 = 20.0
2 X 0.05 = 0.1	38 X 0.5 = 19.0
4 X 0.05 = 0.2	35 X 0.5 = 17.5
6 X 0.05 = 0.3	31 X 0.5 = 15.5
8 X 0.05 = 0.4	29 X 0.5 = 14.5
10 X 0.05 = 0.5	26 X 0.5 = 13.0
12 X 0.05 = 0.6	24 X 0.5 = 12.0
14 X 0.05 = 0.7	22 X 0.5 = 11.0
16 X 0.05 = 0.8	19 X 0.5 = 9.5
18 X 0.05 = 0.9	16 X 0.5 = 8.0
20 X 0.05 = 1.0	14 X 0.5 = 7.0
24 X 0.05 = 1.2	11 X 0.5 = 5.5
26 X 0.05 = 1.3	10 X 0.5 = 5.0
28 X 0.05 = 1.4	7 X 0.5 = 3.5
30 X 0.05 = 1.5	5 X 0.5 = 2.5
32 X 0.05 = 1.6	3 X 0.5 = 1.5
34 X 0.05 = 1.7	2 X 0.5 = 1.0
36 X 0.05 = 1.8	1 X 0.5 = 0.5
37 X 0.05 = 1.85	0 X 0.5 = 0

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Result →

Plot a graph in V_{DS} & I_D for various values of (V_{GS}) i.e output characteristics & a graph V_{GS} & I_D for various values of (V_{DS}) i.e Transfer characteristic.

Precautions & Sources of Error →

(i) Handle FET gently.
(ii) Gate should never be given a positive voltage.
(iii) Voltages, being applied, should not exceed the rated values.

Experiment No. [4]

Object → To draw the output characteristics of MOSFET (Metal oxide semiconductor field effect Transistor).

Apparatus → MOSFET, connecting wires, battery (source of voltage), milliammeter, voltmeter power supply.

Theory → The construction of an enhancement type MOSFET is shown in fig. It consists of a lightly doped substrate of P-type silicon. Two highly doped N-regions are diffused in the substrate which serve as the source (S) and the drain (D).

Procedure →

[i] Make the electrical connections as shown fig.

[ii] **Output or Drain Characteristics →**

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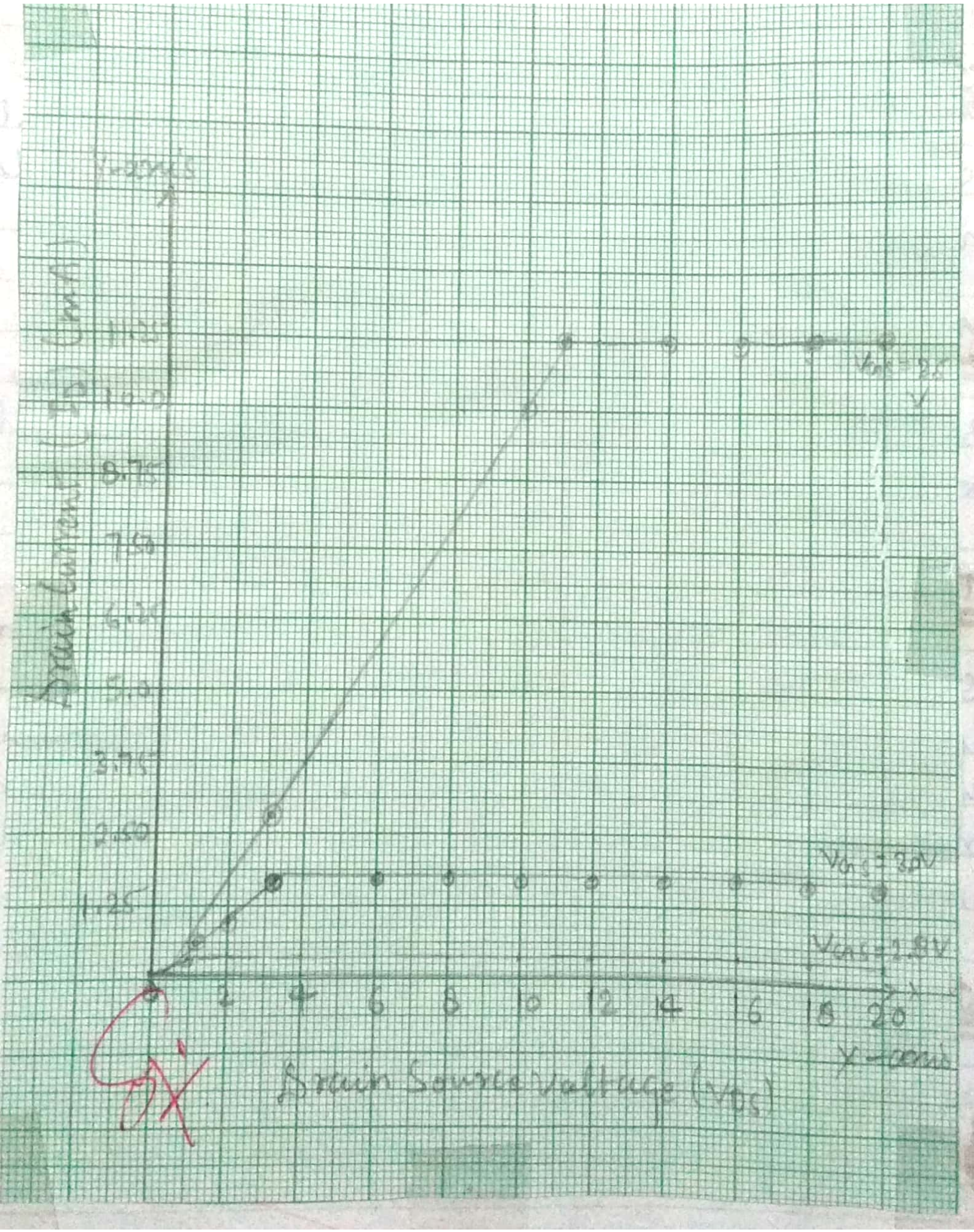

Observations →

Table for drain characteristics b/w V_{DS} & I_D at constant V_{GS}

V_{GS}	V_{DS}	I_D
$V_{GS} = 2.0V$	$0 \times 0.5 = 0$	$0 \times 0.25 = 0$
	$2 \times 0.5 = 1.0$	$1 \times 0.25 = 0.25$
	$40 \times 0.5 = 20.0$	$1 \times 0.25 = 0.25$
$V_{GS} = 3.0V$	$0 \times 0.5 = 0$	$0 \times 0.25 = 0$
	$2 \times 0.5 = 1.0$	$2 \times 0.25 = 0.50$
	$4 \times 0.5 = 2.0$	$4 \times 0.25 = 1.00$
	$8 \times 0.5 = 4.0$	$8 \times 0.25 = 2.00$
$V_{GS} = 3.5V$	$0 \times 0.5 = 0$	$0 \times 0.25 = 0$
	$2 \times 0.5 = 1.0$	$2 \times 0.25 = 0.5$
	$4 \times 0.5 = 2.0$	$6 \times 0.25 = 1.5$
	$6 \times 0.5 = 3.0$	$10 \times 0.25 = 2.5$
	$8 \times 0.5 = 4.0$	$14 \times 0.25 = 3.5$
	$10 \times 0.5 = 5.0$	$18 \times 0.25 = 4.5$
	$12 \times 0.5 = 6.0$	$23 \times 0.25 = 5.75$
	$14 \times 0.5 = 7.0$	$28 \times 0.25 = 7.0$
	$16 \times 0.5 = 8.0$	$31 \times 0.25 = 7.75$
	$18 \times 0.5 = 9.0$	$36 \times 0.25 = 9.0$
	$20 \times 0.5 = 10.0$	$41 \times 0.25 = 10.25$
	$22 \times 0.5 = 11.0$	$45 \times 0.25 = 11.25$
	$40 \times 0.5 = 20.0$	$45 \times 0.25 = 11.25$

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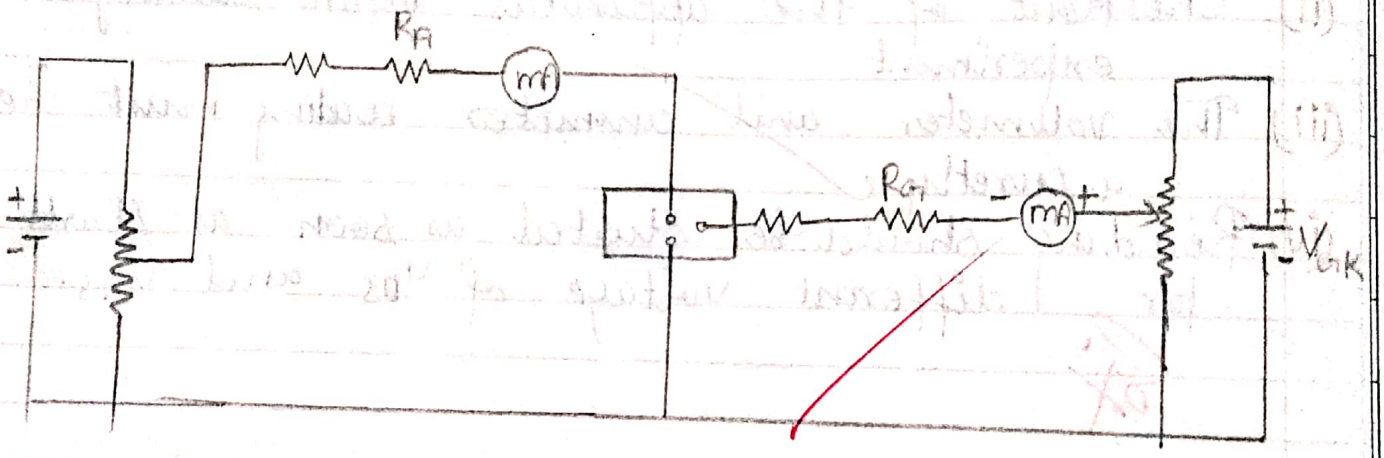
Result →

The output characteristics of MOSFET is given in graph.

Precautions →

(i) Wire must be connected properly.
(ii) Checkout of the apparatus before starting the experiment.
(iii) The voltmeter and ammeter reading must be taken accurately.
(iv) Reading should be started as soon as starts at I_D for different voltage of V_{DS} and V_{GS}.



Experiment No. [5]

Object →

To plot SCR characteristics under different gate conditions.

Apparatus Required →

SCR, d.c milliammeters, voltmeter, resistances and potentiometers, switch (S) to change milliammeter without breaking anode circuit.

Theory →

A silicon controlled rectifier is a semiconductor device that acts as an electronic switch. It is a four layer PNPN or NPNP device. It consists of three diodes connected back to back with a gate connection. It can control loads by switching current OFF & ON upto many thousand times a second. It can switch ON for variable length of time, thereby delivering selected amount of power to the load. Since, they conduct large currents, junction areas of SCRs are very large.

Circuit Connection →

The ↑ equivalent electrical circuits of SCR as shown in the figure.

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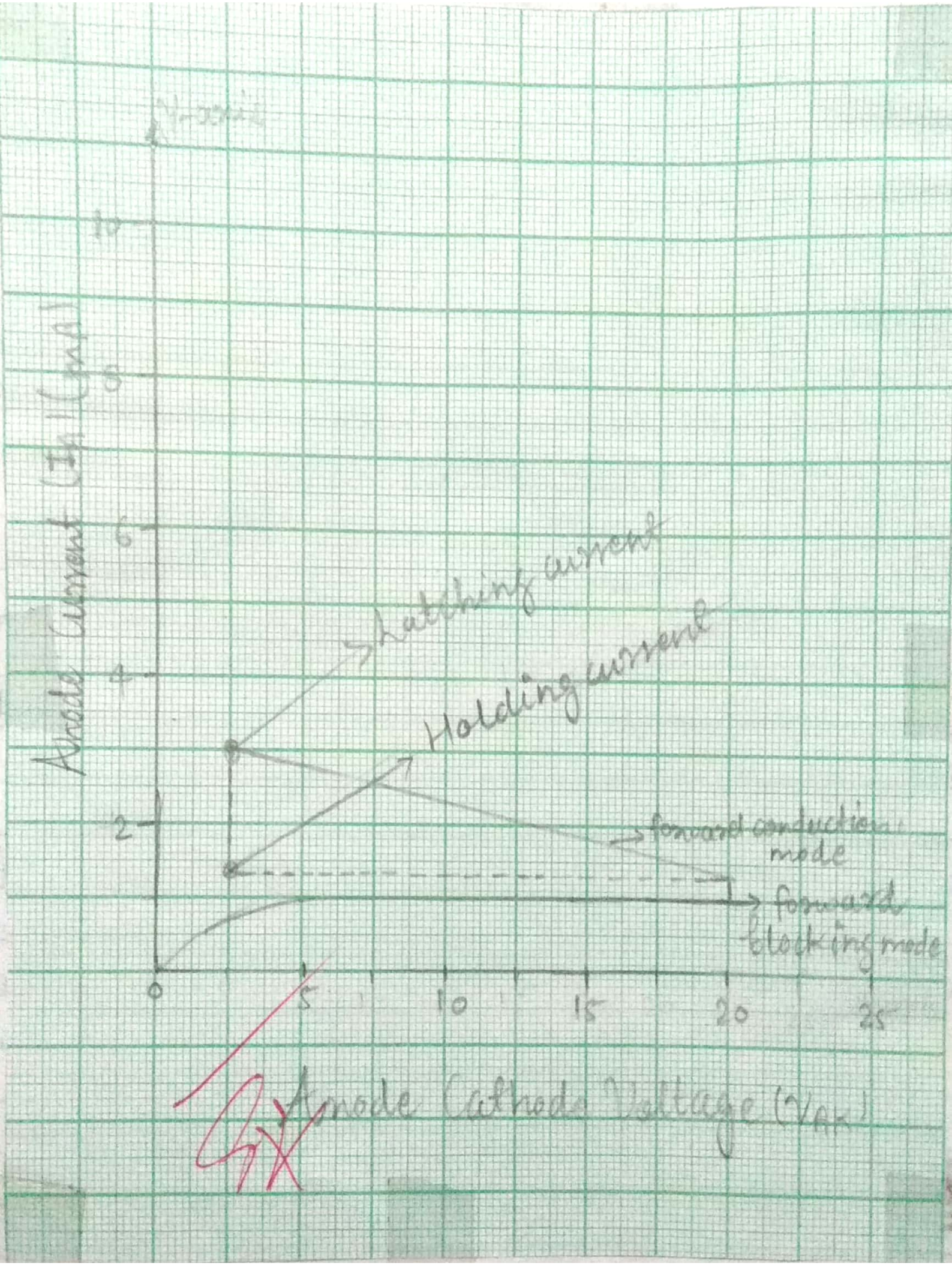

Procedure → (i) Set I_G to some appropriate value. Keep switch S, OFF. Keep P_1 fully clockwise (maximum), use (0-1 mA) milliammeter.
Then increase V_{AK} and note V_A and I_A at regular intervals. At a particular value of V_A, called breakover voltage, current will at once shoot up. The voltage will also drop to a low value. Change at once milliammeter to (0-100 mA) range by closing switch (S) first, then open (S) and without changing V_{AK}, turn potentiometer (P_1) anticlockwise. Note V_A & I_A at each steps.
(ii) Repeat above procedure for some other value of I_G.

Observations → Observation table b/w V_{AK} & I_A —

I_G (mA)	V_{AK} (Volt)	I_A (mA)
4.5 mA	40 x 0.5 = 2.0	1 x 1 = 1
5 mA	4 x 0.5 = 2.0	60 x 1 = 60

Result → We plot a graph b/w V_{AK} & I_A for various values of I_G.

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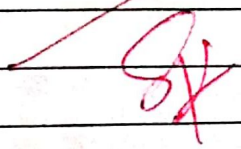
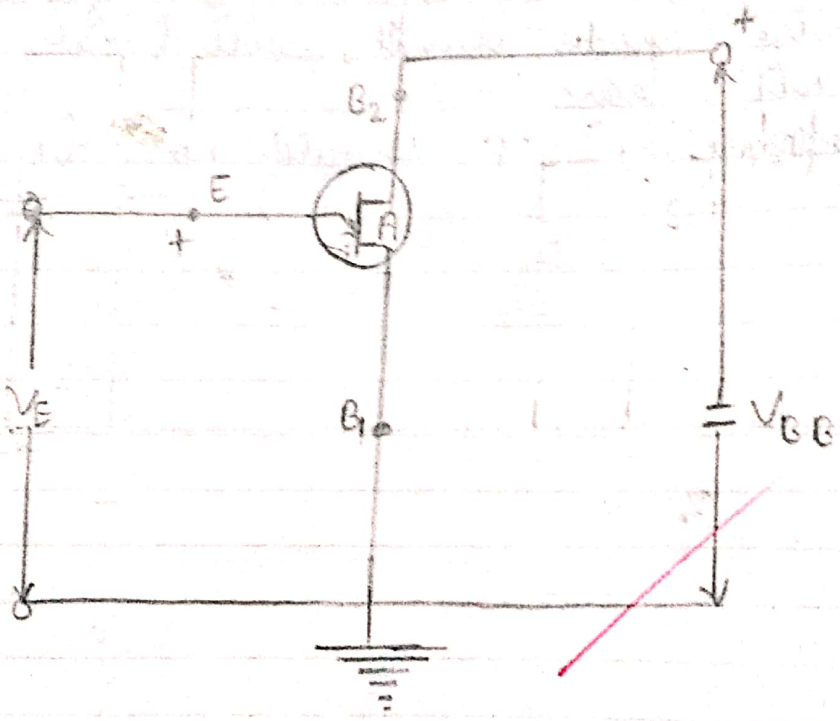
Precautions and Sources of Error →

(i) SCR must be handled gently.

(ii) Use of switch, S, is necessary to change the milliammeter otherwise anode circuit will break and SCR operation will cease.

(iii) While in operation, SCR should not be touched.





Experiment No. [6]

Object → To draw the V.I characteristics of a unijunction Transistor (U.J.T).

Apparatus Used → U.J.T kit, voltmeter, ammeter, D.C power supply, connecting wire.

Observation Table →

$V_{BB} = 4V$		$V_{BB} = 6V$		$V_{BB} = 8V$	
V_E	I_E	V_E	I_E	V_E	I_E
1	0.2	1	0	1	0.2
1.4	0.2	1.4	0.2	2	0.2
1.8	0.2	2	0.2	3	0.2
2	0.2	3	0.4	4	0.4
2.4	0.2	3.6	0.4	5	0.6
3	2.2	4	0.4	5.8	0.6
4	2.6	4.6	0.4	6	0.6

Result → The characteristics of UJT given in the graph.

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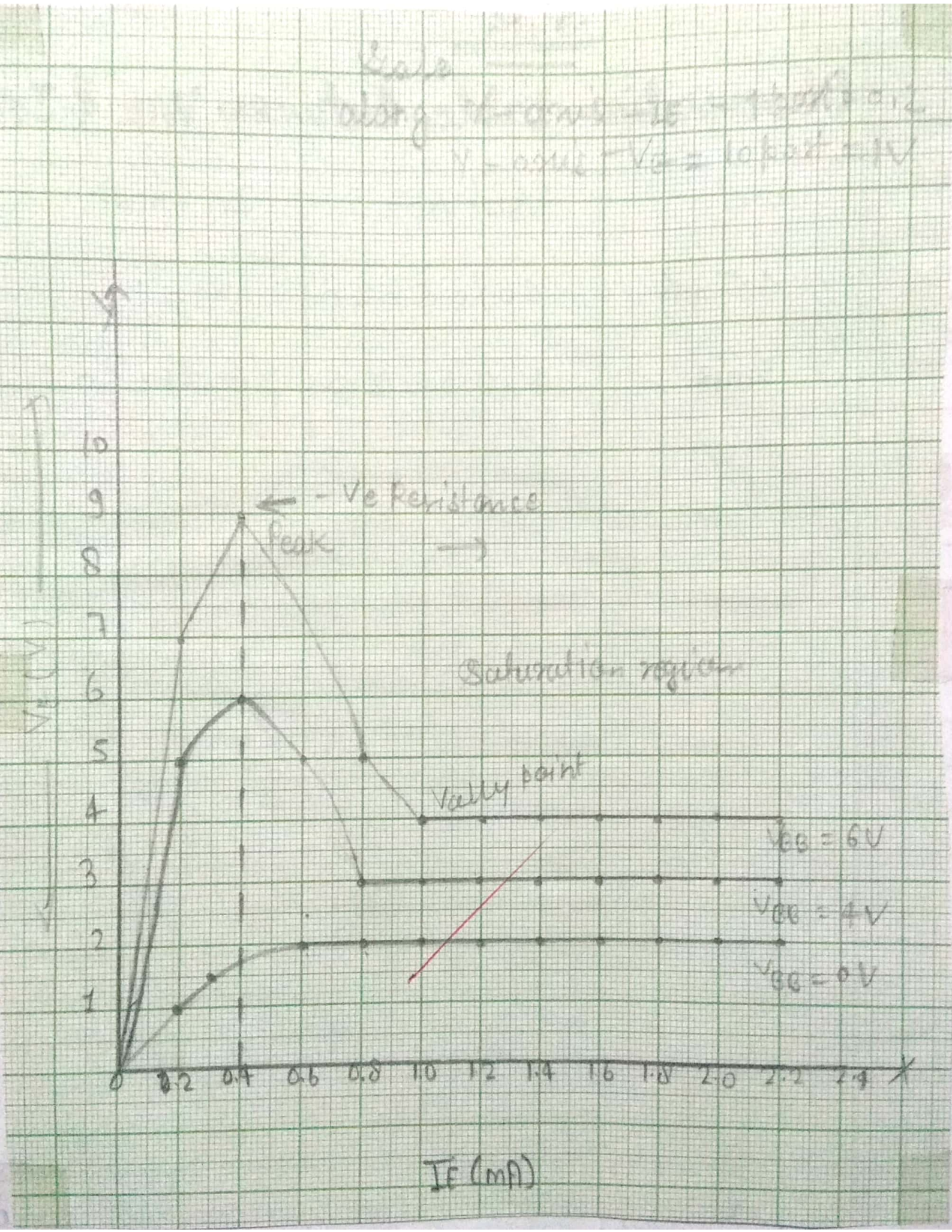

Precautions →

(i) Handly kit gently.
(ii) Before note down the reading we must check the continuity of circuit.