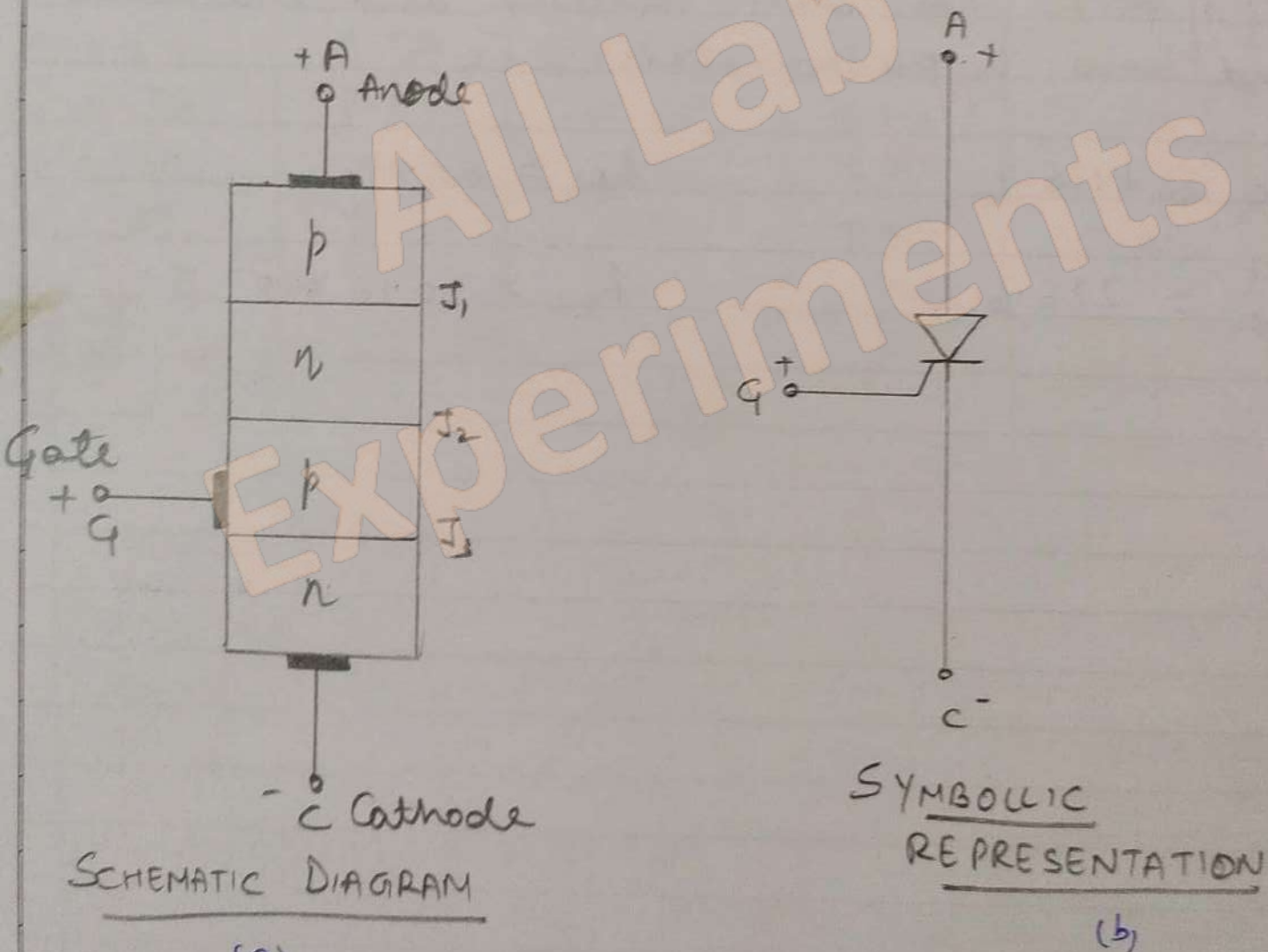
EXPERIMENT-6

AIM:- To study the I-V characteristics of the SCR.

Apparatus:- Variable d.c. regulated power supply, milliammeter, voltmeter(0-20v) and resistors and SCR.



SCHEMATIC DIAGRAM

(a)

SYMBOLIC REPRESENTATION

(b)

SILICON CONTROLLED RECTIFIER

Fig 6

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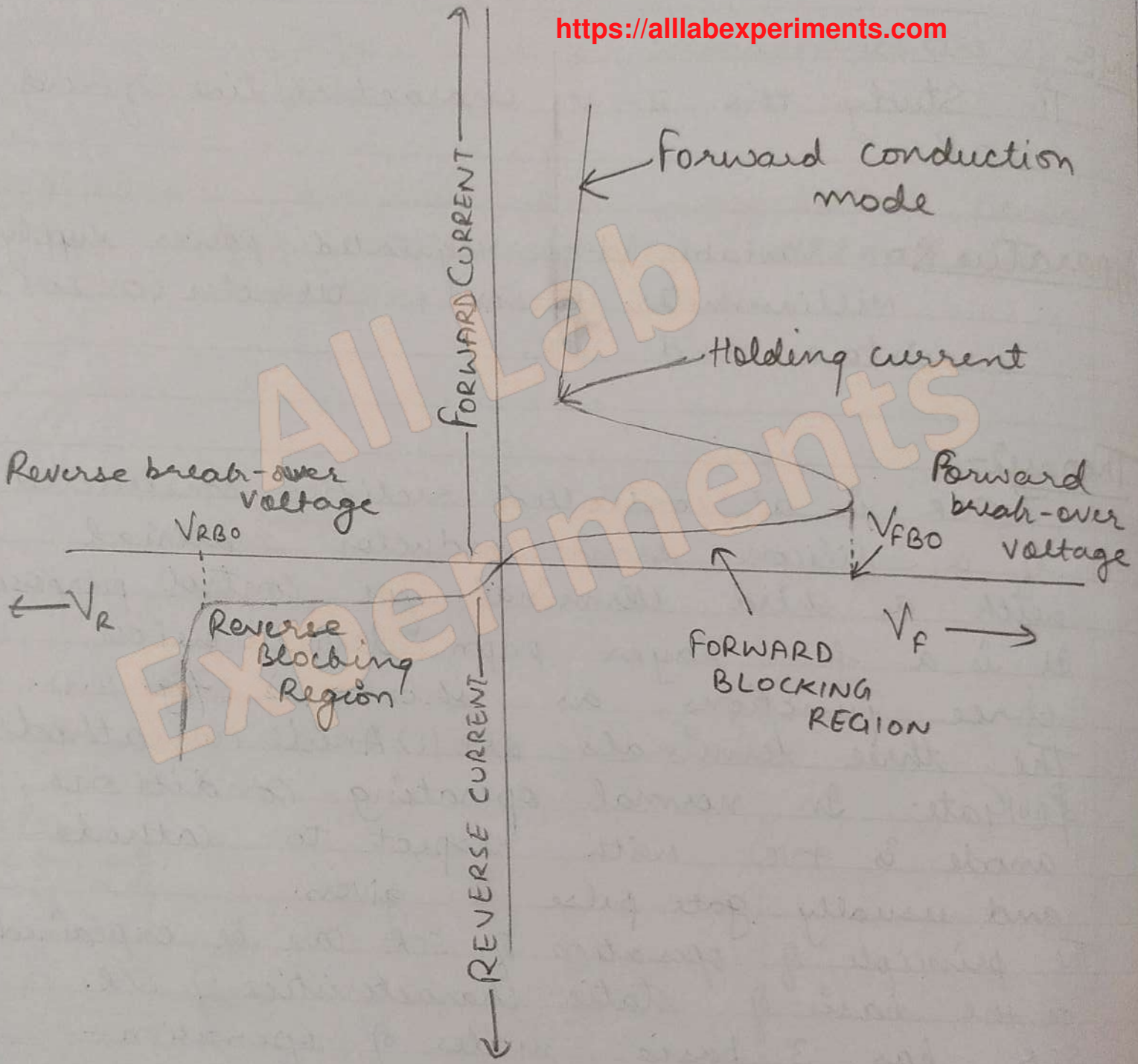
To Study the I-V characteristics of the SCR.

Apparatus:- Variable d.c. regulated power supply, Milliammeter (0-20V), voltmeter (0-20V), resistors and SCR.

Theory:-
SCR is a controlled rectifier constructed of a silicon semi-conductor material with a third terminal for control purposes. It is a four layer pnpn device with three junctions as shown in fig. (6.a). The three terminals are (i) Anode (ii) Cathode & (iii) Gate. In normal operating conditions, anode is +ve with respect to cathode and usually gate pulse is given.
The principle of operation of SCR can be explained on the basis of static characteristics of SCR. SCR has 3 basic modes of operation - Forward blocking, Forward conduction and Reverse blocking.

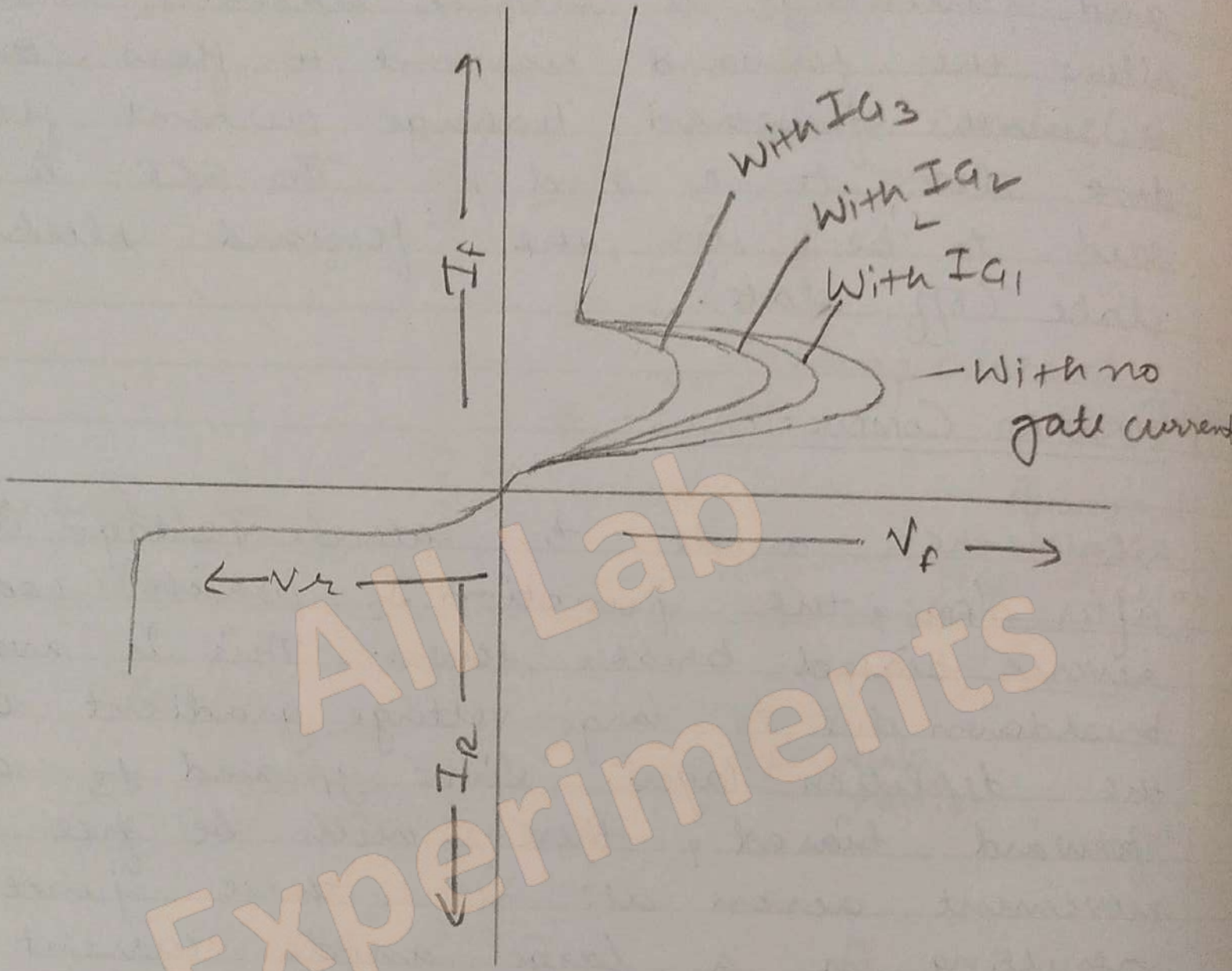
(1) Forward blocking. When the anode is made +ve with respect to the cathode, junctions J_1 and J_3 are forward biased



and junction J_2 is reverse biased. J_2 will not allow the forward current to flow. Only a small forward leakage current flows ~~due~~ due to n_1 and p_2. The SCR is said to be in the forward blocking state (Off state)

(ii) FORWARD CONDUCTION :-

When the anode to cathode voltage is inc. after V_{FBO}, the junction J_2 which was reverse biased breaks down. This is avalanche breakdown due to large voltage gradient across the depletion layers. Since J_1 and J_3 are forward biased, there will be free carrier movement across all the three junctions, resulting in a large anode current. The voltage drop V_T across the device is the ohmic drop across four layers. With inc. in current, V_T increases only slightly. If the anode to cathode voltage is now reduced, the device continues to stay in ON state. The original depletion layer and the reverse biased junction J_2 no longer exists. When the forward current falls below the level of holding current I_H, the depletion region will

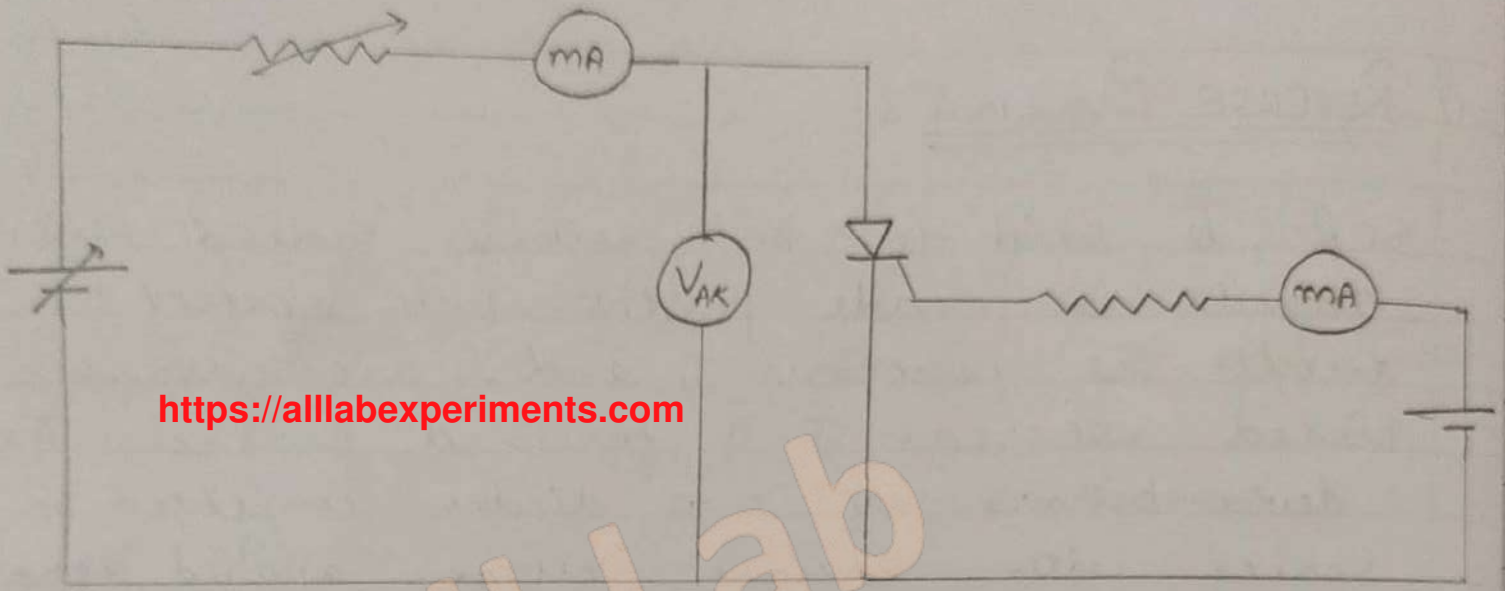


begin to develop around junction j_2 due to reduced no. of carriers.

(iii) REVERSE BLOCKING :-

SCR is said to be reverse biased when cathode is made positive with respect to anode. The junctions J_1 and J_3 are reverse biased whereas J_2 is forward biased. The device behaves as two diodes connected in series with reverse voltage applied across them. A small reverse current is produced as the reverse voltage is inc. until the reverse avalanche region is reached. After this pt., the reverse current increases rapidly as the reverse breakdown voltage. The presence of high current in conjuction with a high voltage gives rise to large power dissipation. This can damage SCR due to junction temp. crossing the permissible values.

Now, if we apply a +ve voltage between the gate and the cathode, when the device is forward biased, the leakage current through ~~the~~ junction J_2 increases. This is because the resulting gate current consists

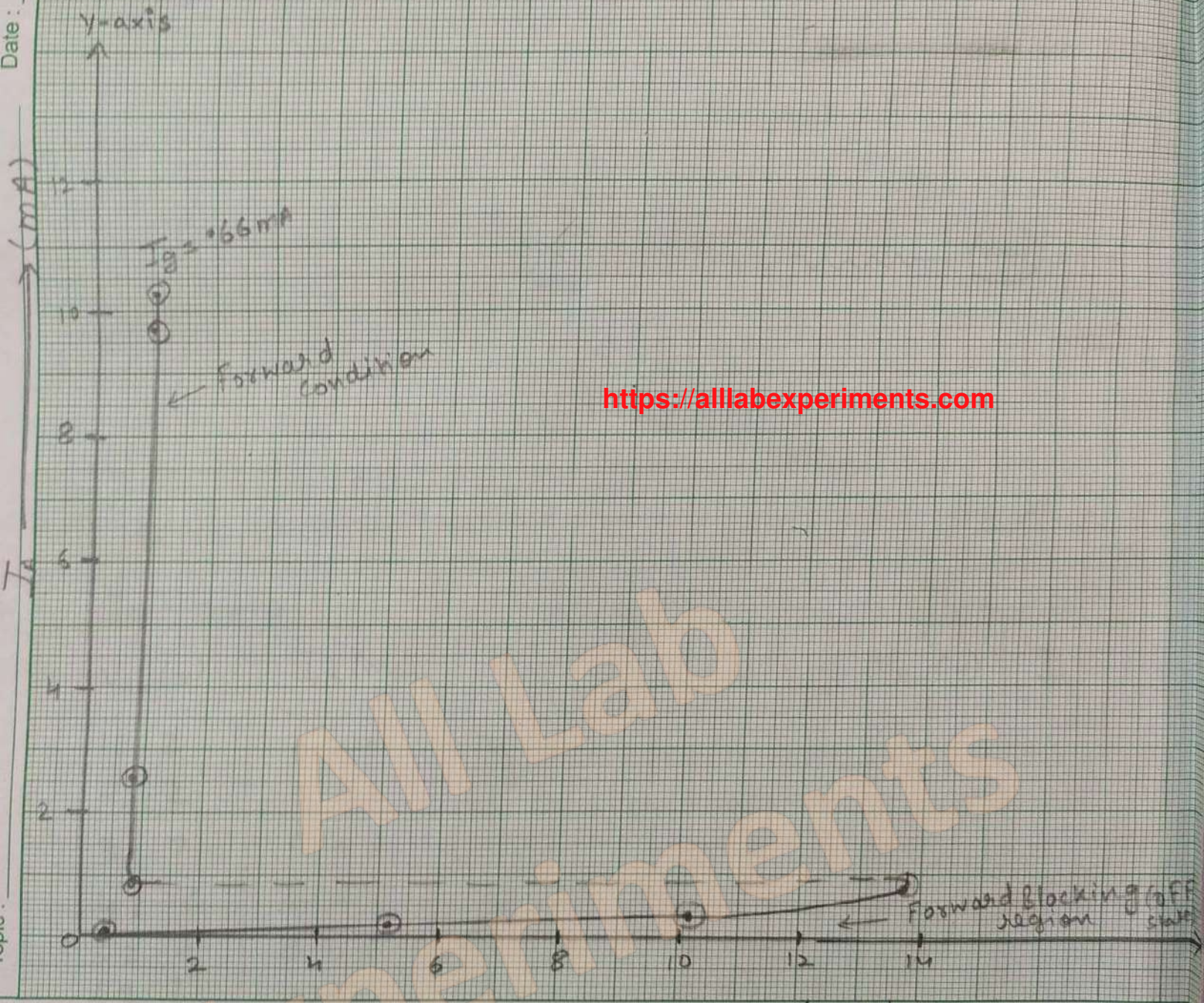


$I_G = 0mA$		$I_G = 0.50mA$		$I_G = 0.66mA$	
V_{AK} (V)	I_K (mA)	V_{AK} (V)	I_K (mA)	V_{AK} (V)	I_K (mA)
12.2	0.01	11.3	0.01	0.4	.01
22.2	0.02	21.3	0.02	1.0	.12
32.7	0.03	31.4	0.03	2.0	.12
42.2	0.04	41.3	0.04	3.0	.13
52.3	0.05	51.9	0.05	5.5	.13
62.8	0.06	62.1	0.06	8.0	.14
73.0	0.07	71.1	0.07	10.1	.14
81.4	0.08	81.5	0.08	13.7	.75
				0.8	0.71
				0.8	6.25
				0.9	9.66
				0.9	10.22

Scale

x-axis 1 div = 0·1

y-axis 1 div = 0·1



mainly of electron flow from cathode to the gate. Due to applied voltage gradient, some of the e^- reach junction J_2 and add to the minority carrier concentration in the P_2 region. This raises the reverse leakage current and consequently leads to a breakdown even though the applied forward voltage is lower than V_{FBO}. The effect of gate current on the forward and reverse blocking currents and breakover voltages is shown in fig. ( ).

PROCEDURE :-

1. Connect the circuit as shown.
2. Fix the gate to cathode voltage V_{GK} to zero.
3. Vary V_{AK} and note down the voltage V_A and current I_A.
4. Now change the value of V_{GK} and repeat step 3. Do so for 2-3 values of V_{GK}.
5. Now plot I_A versus V_A for different values of V_{GK} and trace the curve obtain. This is the I-V characteristic of the Silicon Controlled Rectifier.

RESULT :-

The I-V characteristic of SCR has been studied and evaluated.