EXPERIMENT No. 7.

AIM → (a) To plot the emitter characteristics of a UJT and obtain the values of (i) intrinsic stand-off ratio η
(ii) Peak pt. emitter current I_p
(iii) Valley pt. emitter voltage V_v.
(iv) Valley point emitter current I_v.
(b) To study the working of UJT as a Saw tooth generator.

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APPARATUS → UJT Board, Ammeter, Voltmeter, CRO.

THEORY → UJT is a 3 terminal device with negative resistance characteristics. It consists of a band of n-type silicon with small p-type inserted in it. The two sides of the bar can be denoted by two bases b_1 and b_2. The small p-type insertion can be denoted by an emitter. The effective resistance between two bases is R_{BB}, which it can be thought as having two resistors R_{B1} and R_{B2} in series. The P-N junction represented by the diode in the equivalent circuit under normal operating condition, the emitter in forward biased and a supply voltage (V_{BB}) is used such that B_2 is +ve, wrt B_1, for small values of V_{EB}, the junction in reverse bias and therefore negligible current flows. When $V_{EB_1} \geq V_{BB} + V_1$, the diode.

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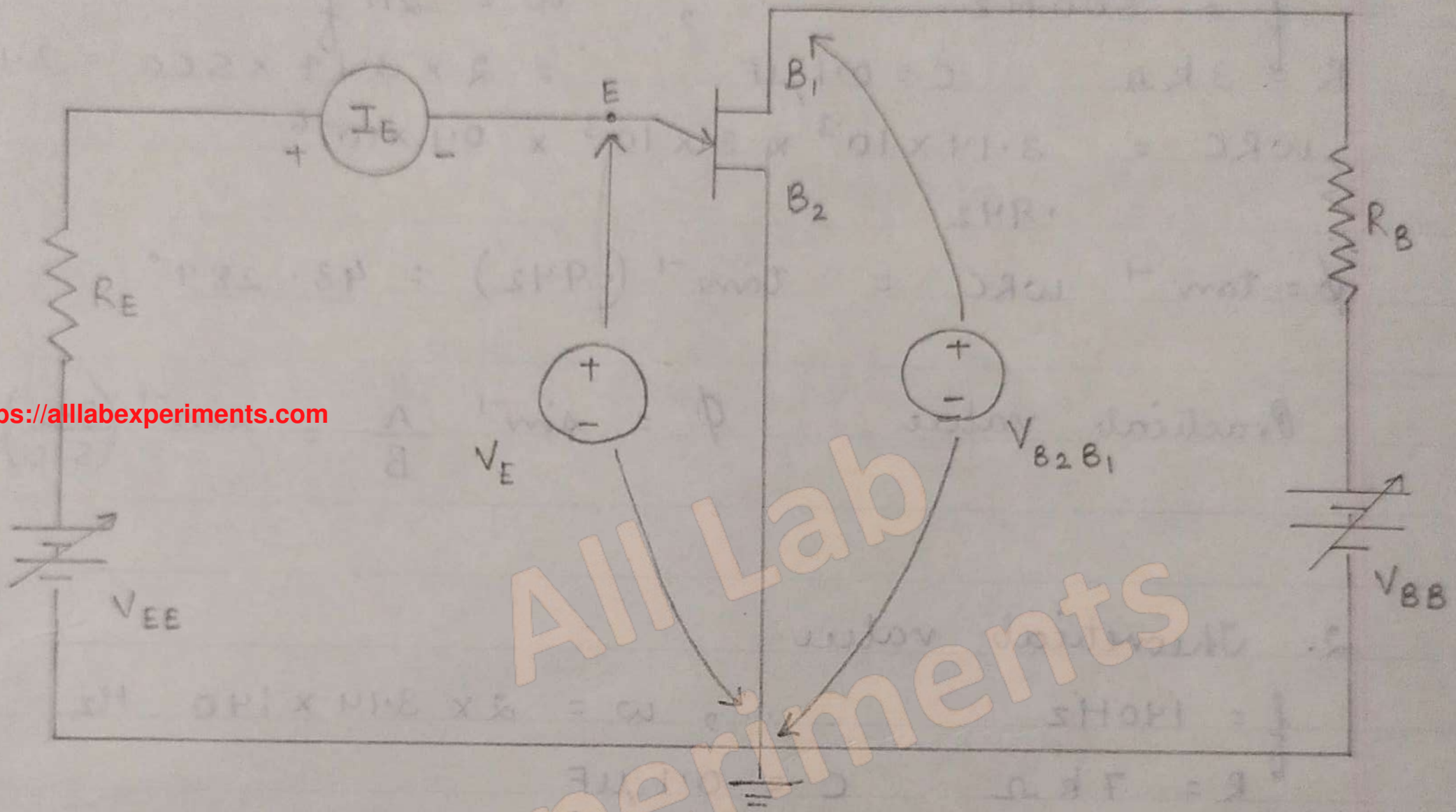

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CIRCUIT DIAGRAM.

is forward bias and holes are injected into R_{B_1}, they are attracted by -ve current flow. When, $V_{EB_1} > V_1$ of V_{BB}, this causes equal electron flow to emitter leading to decrease in R_{B_1}. Thus, an emitter current increases. This is called Negative resistance effect. When there is no emitter current potential V_{BB} is applied between B_2 and B_1. The total resistance between the two bases be R_{BB}.

$$R_{BB} = R_{B_1} + R_{B_2} \Big|_{\text{at } I_E = 0}$$

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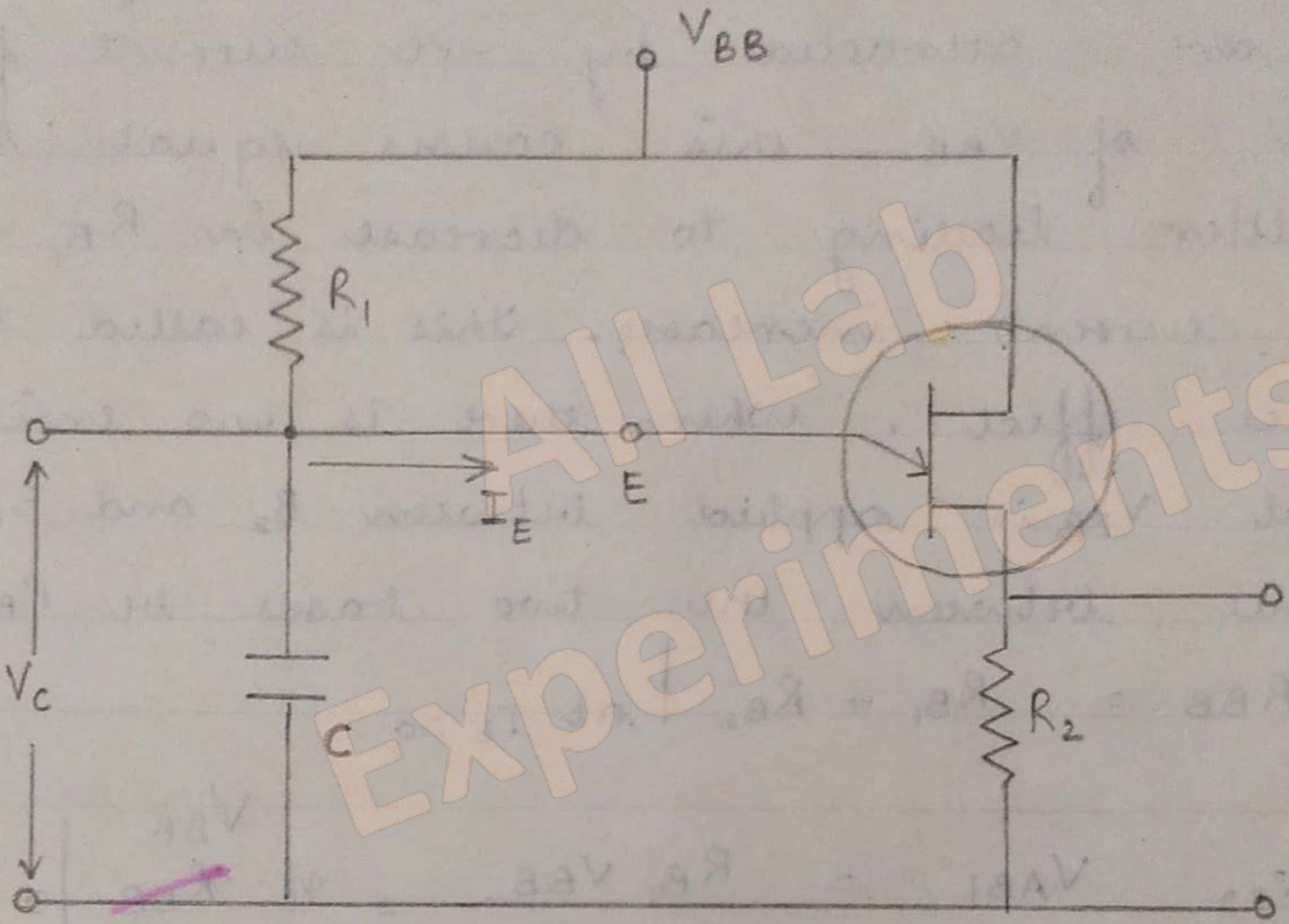
$$\therefore, \quad V_{AB1} = \frac{R_{B_1} V_{BB}}{R_{B_1} + R_{B_2}} = \eta V_{BB} \Big|_{I_E = 0}$$

$$\eta = \frac{R_{B_1}}{R_{BB}}$$

where η is the Intrinsic - Stand Off Ratio. It's value lies in between 0.5 and 0.8.

For values of V_E less than ηV_{BB}, the diode is reverse bias and the emitter current is just the reverse saturation current I_{ED} of input diode. When V_E is greater than ηV_{BB} by an amount equal to cut-in voltage of diode D_1, then this diode becomes forward bias and current I_E begins to flow. Due to sudden decrease in value of R_{B_1}, the voltage V_E drops and I_E increases. $\therefore$, $V_p = \eta V_{BB} + V_\gamma$.

V_γ is the cut - in voltage of the diode. As current



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UJT AS A SAW TOOTH GENERATOR.

I_B increases a valley point is reached beyond which V_E increases with I_E in forward biased diode.

INPUT CHARACTERISTICS - As they normally appear, note that I_{BO} (μA) does not appear because scale is in mA. The value of V_P is different for diff. values of V_{BB}.

UJT as a Saw Tooth generator - Initially, when UJT is in cut-off region the capacitor C starts charging through R_1, from the source V_{BB}. The voltage V_L across the capacitor C starts rising almost linearly until it reaches the firing potential of UJT. At $V_C = V_P$, the UJT goes into conduction and capacitor discharges through it. The wave-form generated due to this cycle is in the form of saw-tooth wave.

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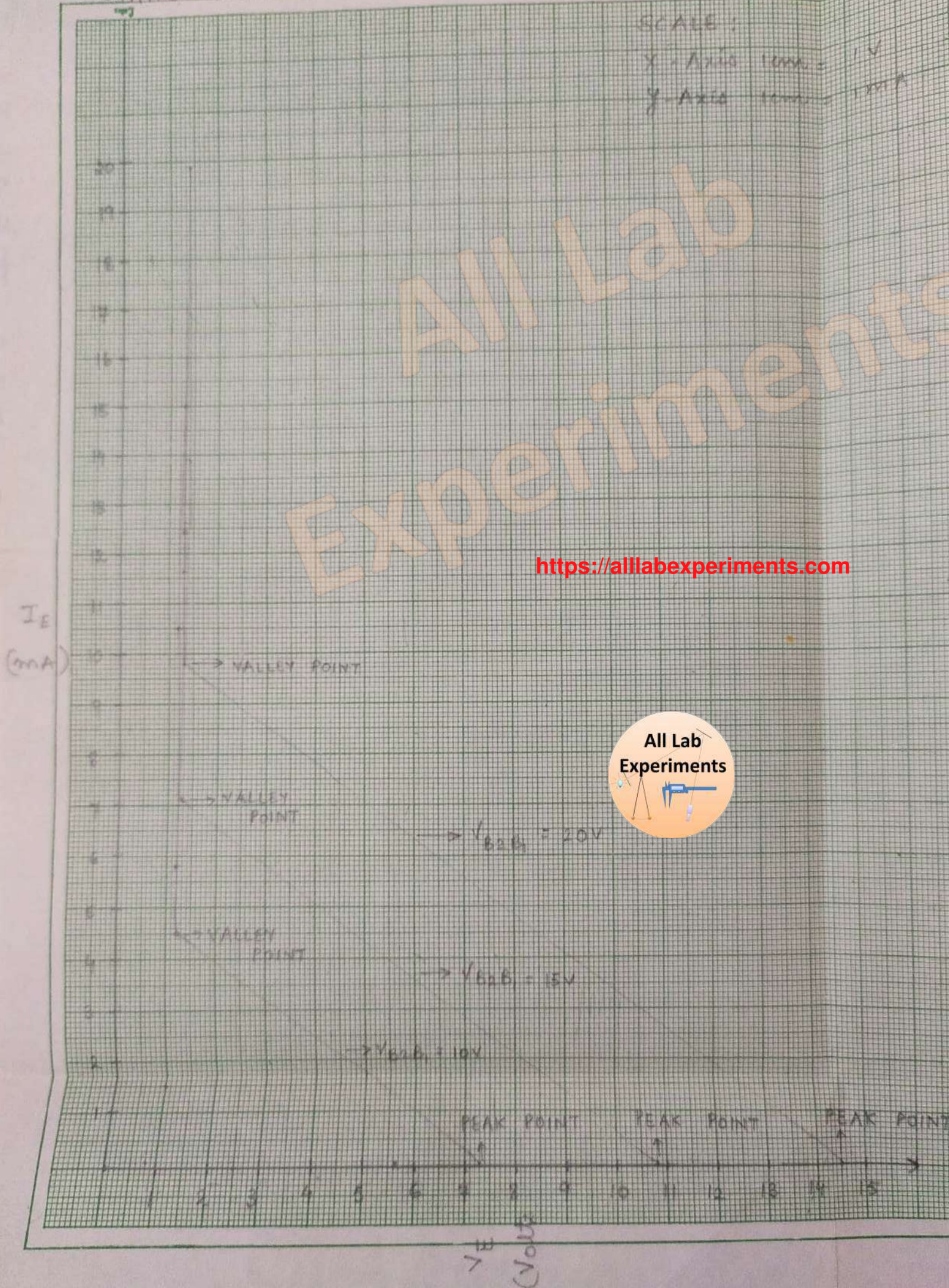
PROCEDURE → INPUT CHARACTERISTICS

1. Make the connections according to the circuit diagram.
2. Set $V_{B_2B_1}$ to 20 V and keep it constant.
3. Starting with $V_E = 0$, increase it slowly and note I_E at some intermediate step. At some point V_E will suddenly falls and I_E rises up. The value of V_E at which this happens is known as peak point emitter voltage, V_P.

STATIC EMITTER CHARACTERISTIC CURVES FOR UJT.



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4. Repeat steps for $V_{B_2B_1}$ equal to 15 V and 10 V.
5. Plot the graph and find the intrinsic stand-off ratio (η).

UJT as a saw tooth generator - Initially, when UJT is in cut-off region, the capacitor C starts charging through R_1 from the source. The voltage V_c across the capacitor C starts rising almost linearly until it reaches the firing potential V_p of the UJT. At $V_c = V_p$, the UJT goes into conduction and the capacitor discharges through it. Similar curves can be obtained across R_2.

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OBSERVATION TABLE →

S.No.	$V_{B_2B_1}$ = 20 V		$V_{B_2B_1}$ = 15 V		$V_{B_2B_1}$ = 10 V	
	V_E (V)	I_E (mA)	V_E (V)	I_E (mA)	V_E (V)	I_E (mA)
1.	0	0	0	0	0	0
	2.	0	2	0	2	0
	4	0	4	0	4	0
	6	0	6	0	5.6	0.01
	14.5	0.01	10.8	0.01	7.3	0.01
	1.3	9.77	1.3	7.11	1.2	4.53
	1.4	9.78	1.4	12.41	1.2	10.58
	1.4	13.92	1.4	19.90	1.3	11.75
					1.4	15.01
					1.4	19.90

UJT AS A SAW TOOTH GENERATOR

(i) OUTPUT ACROSS CAPACITOR

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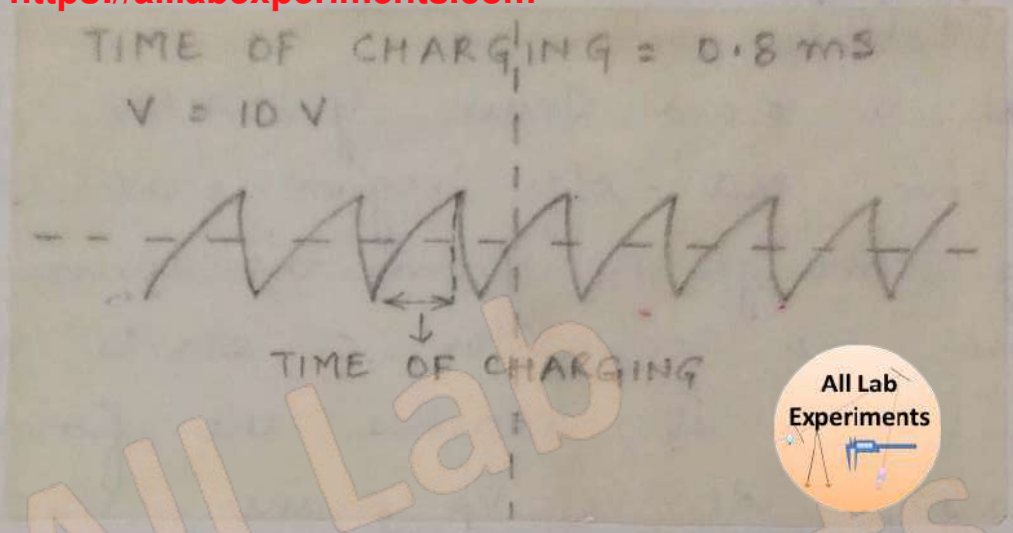

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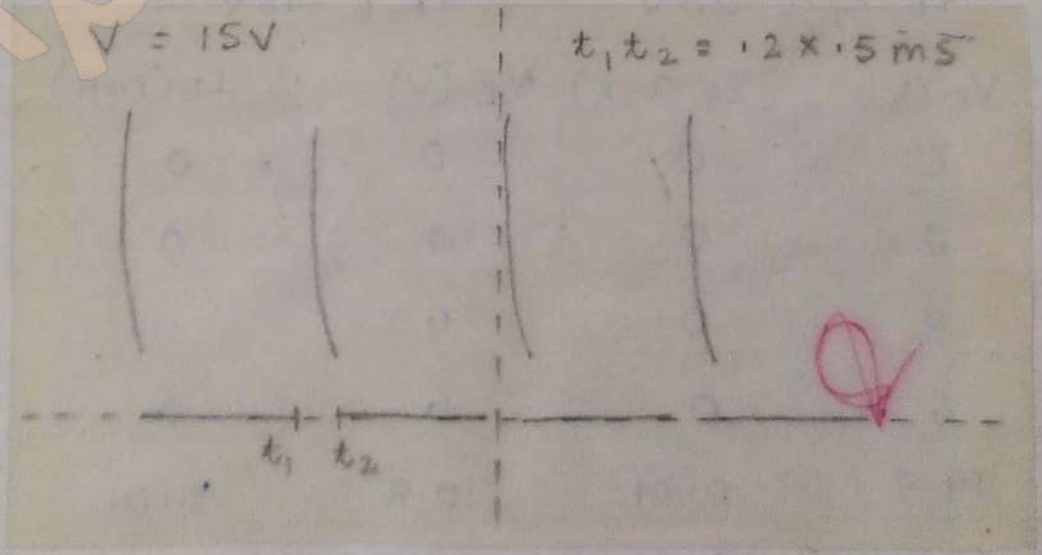
(ii) OUTPUT ACROSS RESISTOR.



CALCULATIONS → 1. $V_{BB} = 10V$ $V_\gamma = 0.8V$ $V_p = 7.3\ V$

∴, From $V_p = \eta V_{BB} + V_\gamma$.

$7.3 = \eta \times 10 + 0.8$

$10\eta = 7.3 - 0.8 = 6.5$

$\eta = 0.65$

2. $V_{BB} = 15\ V$ $V_\gamma = 0.8\ V$ $V_p = 10.8\ V$

$10.8 = \eta \times 15 + 0.8\ V$

$\eta = \frac{10}{15} = 0.66$

3. $V_{BB} = 20V$ $V_\gamma = 0.8\ V$ $V_p = 14.5V$

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$14.5 = \eta \times 20 + 0.8$

$20\eta = 13.7$

$\eta = 0.68$

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UJT as Saw tooth generator –

Time of charging $= \tau_1 = R_1 C$.

where $R_1 = 33\ K\Omega$ $C = 0.022\ \mu F$.

∴, $\tau_1 = 33 \times 10^3 \times 0.022 \times 10^{-6}$

$= 0.726 \times 10^{-3}$ sec. (theoretical)

and practical value $\tau_1 = 0.8$ ms.

RESULT → The graph for the characteristics curves matches with the graph for ideal curve. The values of peak voltage and valley voltage are

$V_p = 7.3\ V$ $V_V = 1.2\ V$ for $V_{BB} = 10\ V$

$V_p = 10.8\ V$ $V_V = 1.3\ V$ for $V_{BB} = 15\ V$

$V_p = 14.5\ V$ $V_V = 1.3\ V$ for $V_{BB} = 20\ V$

The intrinsic stand - off ratio η as has been calculated for $V_{BB} = 10\ V$ is 0.65

for $V_{BB} = 15\ V$ is 0.66

and for $V_{BB} = 20\ V$ is 0.68

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PRECAUTIONS → 1. Keep hands away from transformer.

2. Power supply voltages should be zero, initially.

3. Proper scales for graphs should be chosen.

DISCUSSION → There may be some error and inaccuracy in various instruments like resistance that we are getting some difference in the value of intrinsic stand - off ratio.