Preliminary Study 1

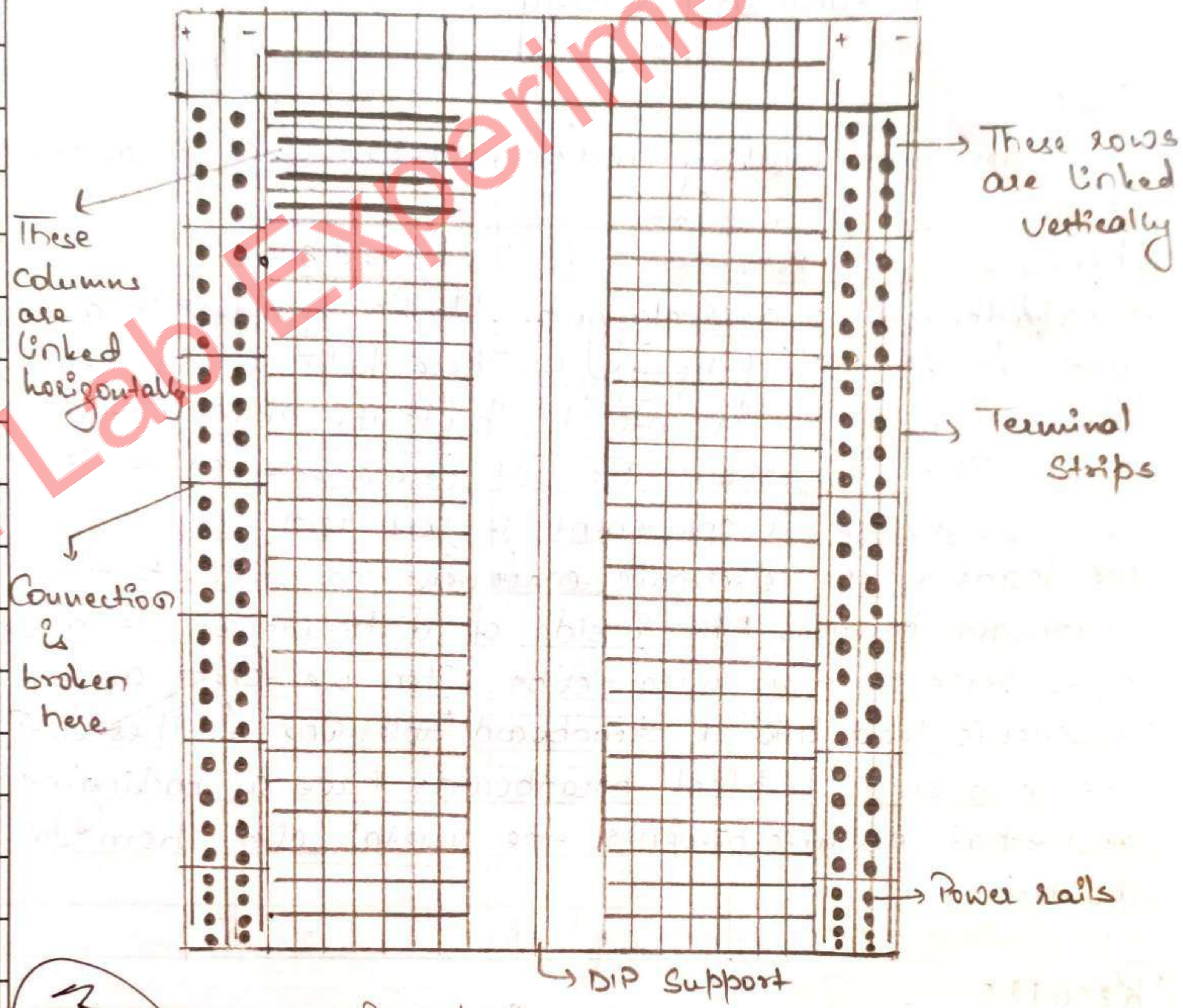
Aim:
To understand working and connection of a bread board

Theory:
A breadboard is a rectangular plastic board with a bunch of ~~the~~ tiny holes in it. These holes let you easily insert electronic components to prototype and electronic circuit. The connections are not permanent, so it is easy to remove a component if you wish.
The leads of an electronic component can fit into the breadboard because the inside of a breadboard is made up of rows of tiny metal clips. When we press a component's lead into a breadboard hole, one of these clips grab onto it. Most breadboards have a backing layer that ~~permits~~ prevents the metal clip from fall--ing out.

Result:
Understood working and connection of a breadboard.

Precautions:
i) Push the leads and wires down firmly all the way.
ii) Make connections carefully to avoid accidental short circuits.

Teacher's Signature :............................



+
-
+
-
These rows are linked vertically
These columns are linked horizontally
Terminal Strips
Connection is broken here
Power rails
DIP Support

Bread Board

Preliminary Study 2

Aim:
To study the working of a digital multimeter and measurement of resistance, DC voltage and capacitance.

Theory:
A multimeter is an electrical measuring instrument which can directly measure current, potential difference and resistance. For this reason, a multimeter is generally known as an AVO (Ampere, Volt, Ohm) meter. Some multimeters can also measure capacitance.

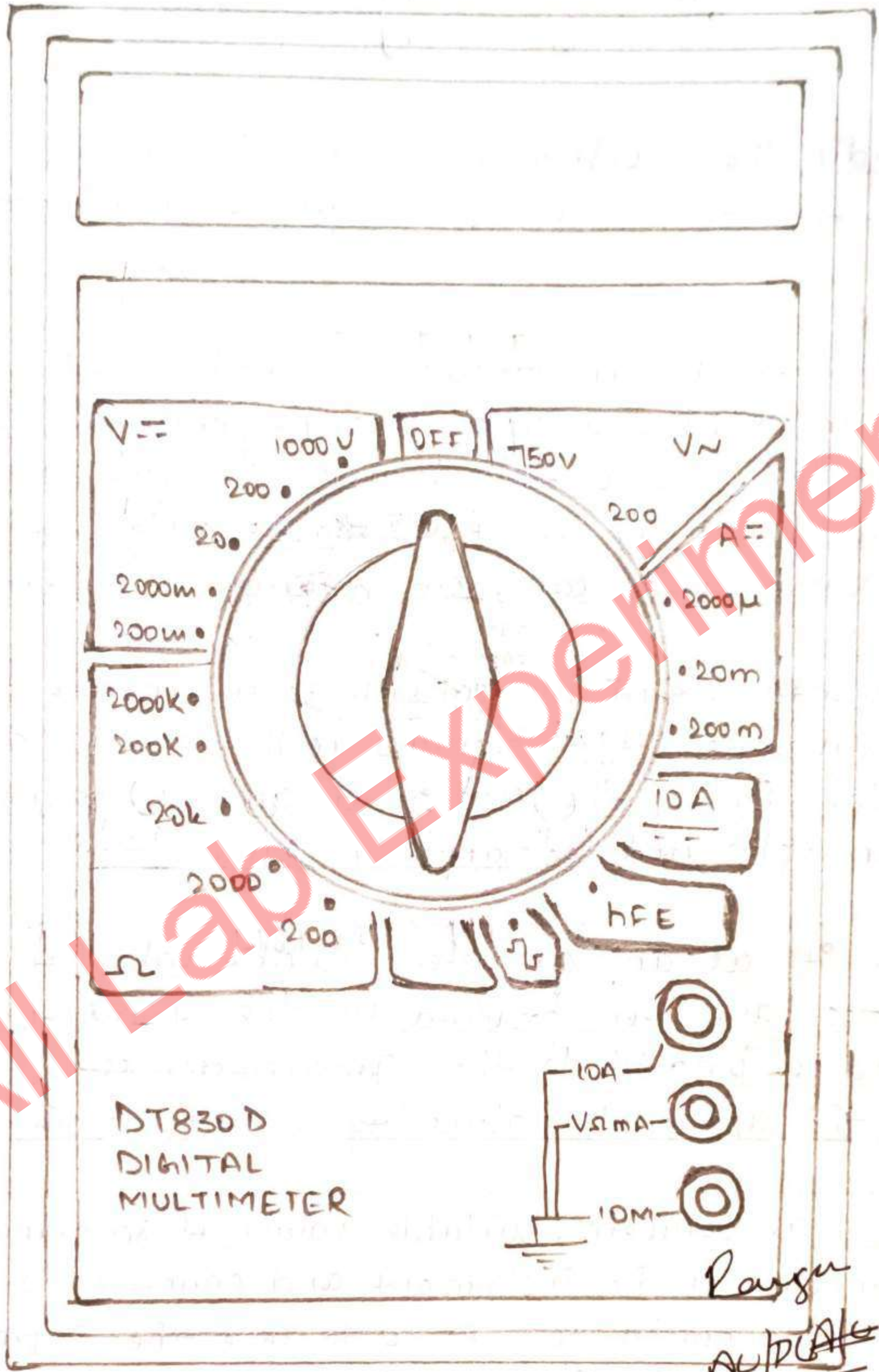
A multimeter essentially consists of a sensitive moving coil galvanometer. It is provided with several scales on its dial reading the current in amperes, potential difference in volts and resistances in ohm.

To use it as an ammeter, suitable values of shunt resistances have been provided in the instrument and connected in parallel to the galvanometer coil, so as to give the appropriate values of current in μA, mA or A.

To use it as voltmeter, suitable values of resistances have been provided in the instrument and connected in series to the galvanometer coil, so as to give the appropriate values of potential difference in mV or V.

Procedure:

DIGITAL MULTIMETER



Rangu

AC/DC/A/G

V, R, I

A. Measurement of resistance

i) Set the position of the function switch D.C.

ii) Connect the black coloured test lead to the 'common' (-) socket and the red coloured test lead to the (+) socket. Connect the metallic pins of the test lead with each other.

iii) Adjust the position of the range switch to (Rx2). Connect the pins of the two test leads to the ends of the unkn-own resistance.

B. Measurement of DC Voltage:

i) Set the position of the function switch to D.C.

ii) Connect the black coloured lead to (-) and the red one to the (+) socket.

iii) Connect the metallic pin of the black test lead to the -ve terminal of the voltage to be measured and the pin of the red test lead and note the scale reading.

C. Measurement of capacitance:

i) Ensure all power to the circuit is OFF.

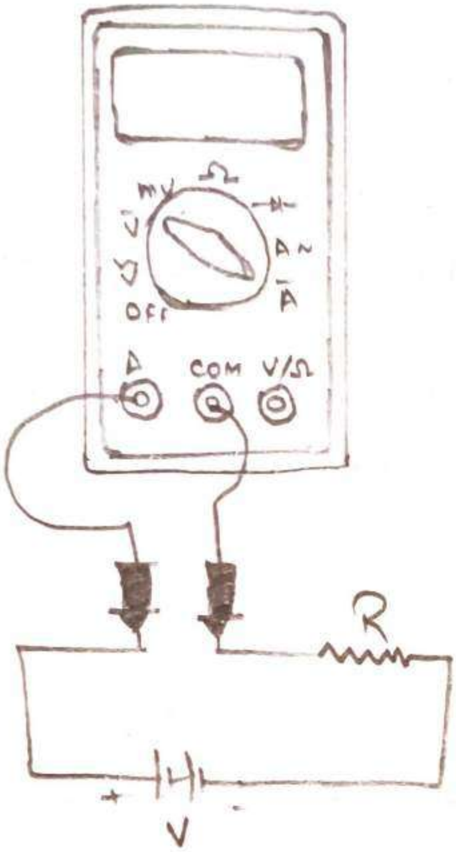
ii) Turn the dial to the capacitance measurement mode.

iii) Connect the test leads to the capacitor terminals. Keep test leads connected for a few seconds to allow the multimeter to automatically select the proper range.

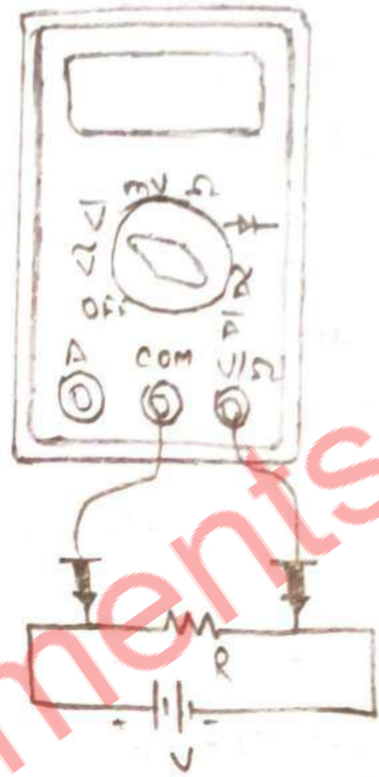
iv) Read the measurement displayed.

Result:

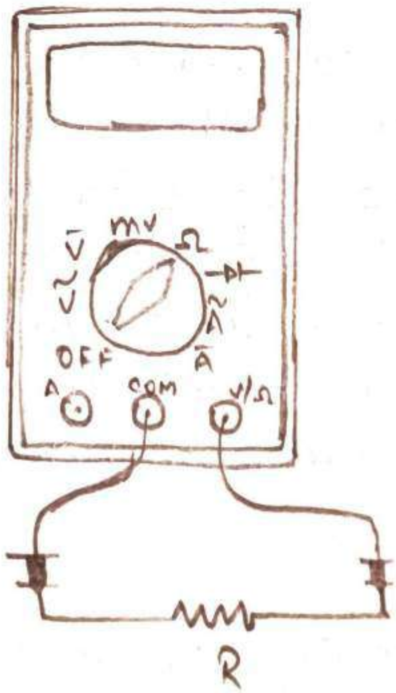
Studied the working of a digital multimeter



Measuring Current



Measuring voltage



Measuring resistance

Precautions:

i) For accurate measurement of voltage and resistance, set the range switch at the appropriate range.

ii) Do not touch the meter or the test leads when the voltage to be measured is on and switch off the current before disconnecting the leads.

Preliminary Study 3

Aim:

To study the working of a CRO and measurement of voltage and frequency of signals coming from a function generator.

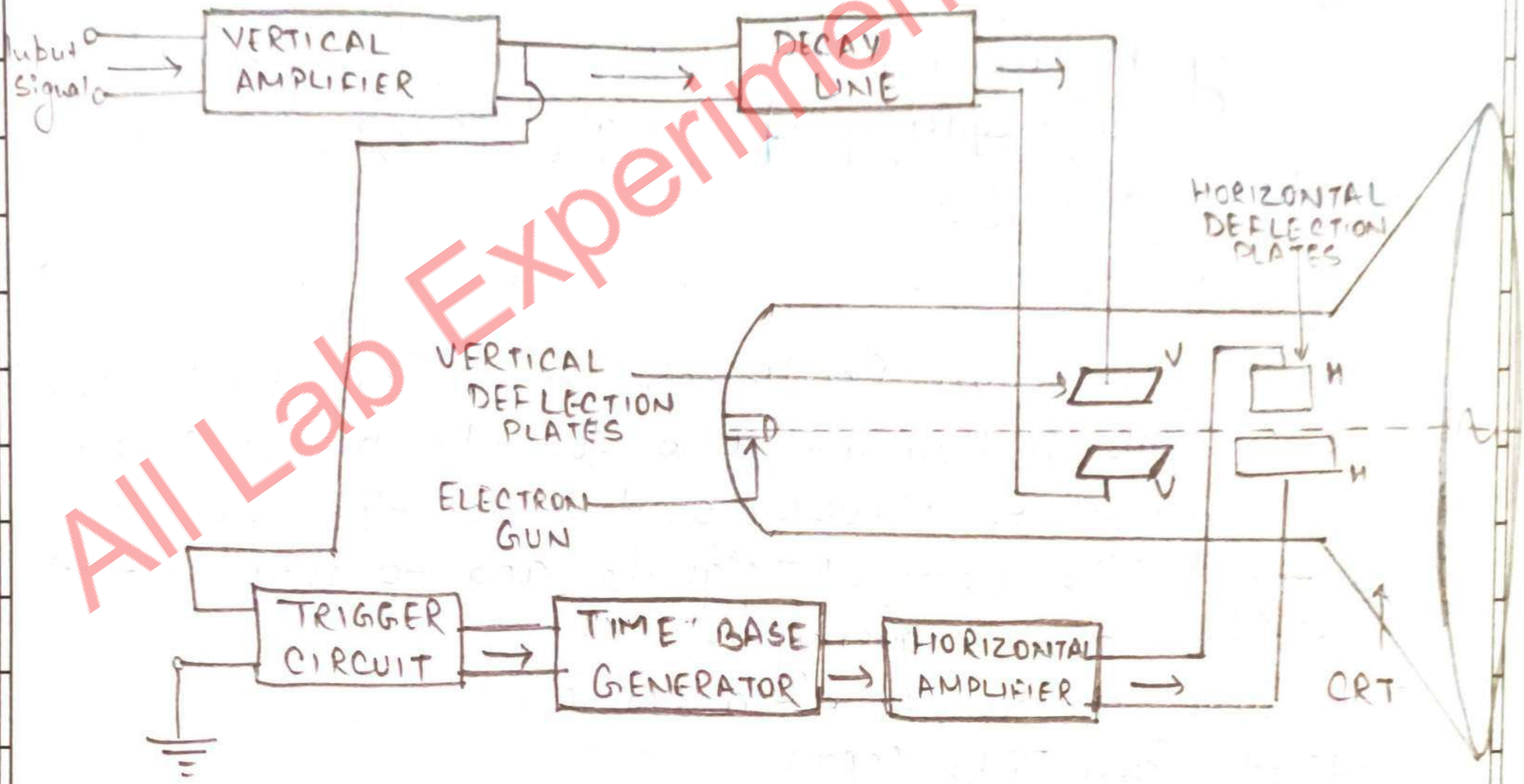
Theory:

The Cathode Ray Oscilloscope is an extremely useful and versatile instrument used for the measurement and analysis of waveforms. It allows the user to display the electrical signals and to measure their amplitudes and frequency.

The basic components of a CRO are:

i) Cathode Ray Tube (CRT)
ii) Vertical Amplifier
iii) Delay line
iv) Trigger circuit
v) Sweep generator or time base generator
vi) Horizontal amplifier

The CRT is the major component of a CRO and is called the "heart of the oscilloscope". It generates the electron beam, accelerates the beam to a high velocity, deflects the beam to create the image and contains a phosphor screen where the beam eventually becomes visible. The signal ~~wafe~~ waveform to be displayed is applied to the input. The vertical deflection of the spot is proportional to the instantaneous value of the input signal. The magnitude of the input signal can be read with the



Basic CRO Block Diagram

calibrated volts markings on the front panel of the CRO.

To produce a stable pattern on the CRT screen, each horizontal sweep should be started at the same point on the signal waveform. For this purpose, a part of the input signal is applied to a trigger circuit that generates a triggered pulse at a predetermined point of the input signal.

Procedure:

A. Measurement of AC Voltage:

If an AC sinosidal voltage is to be measured by a C.R.O it is applied to the Y input. If the Time/Div knob is kept at zero, a vertical line appears on the screen. The length of the vertical line gives peak of the A.C. voltage (V_{pp}).

$$V_{rms} = \frac{V_{pp}}{2\sqrt{2}} = 0.707\, V_m$$

$$V_m = \text{Peak amplitude} = \frac{V_{pp}}{2}$$

B. Measurement of frequency:

i) Direct method-

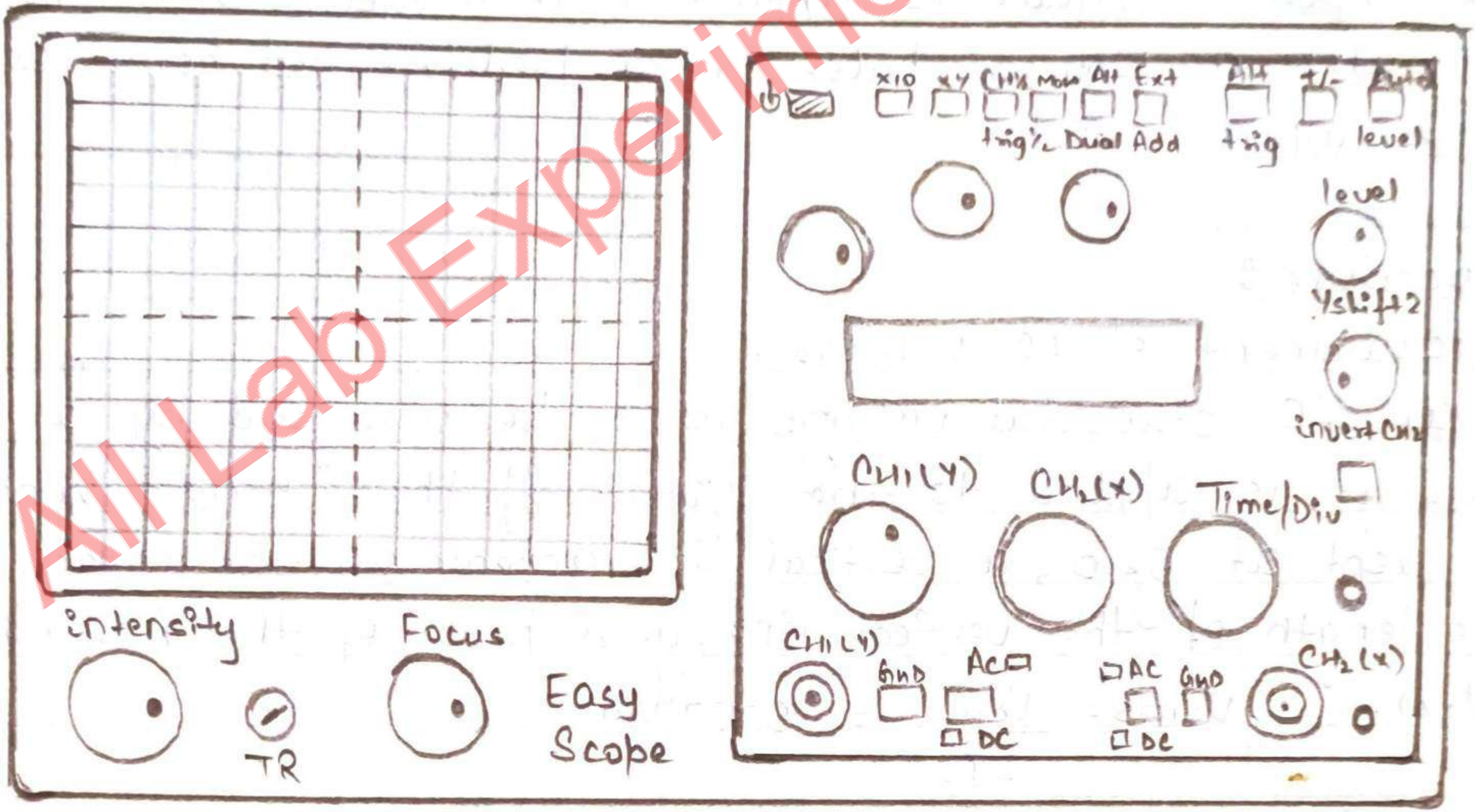
Suppose the frequency of a waveform is to be meas--ured with wavelength 10.8. If the Time/Div knob is at 0.25 ms $T = 10.8 \times 0.25 = 2.7\,ms$

The frequency is given by:-

$$f = \frac{1}{T} \simeq 370\ Hz$$

ii) Lissajous pattern method-

i) The formation of lissajous figures when two A.C voltages



Oscilloscope

of different frequencies are superimposed in mutually perpendicular directions may be used for the measurement of frequency.

ii) The ratio of frequencies is given by

$$\frac{f_{vertical}}{f_{horizontal}} = \frac{\text{no. of peaks which touch horizontal}}{\text{no. of peaks which touch vertical}}$$

Result:

Studied the working of a CRO.

Precautions:

i) A stable pattern must be obtained before taking the readings.

ii) It is advisable to operate the CRO at a reduced brightness to avoid burn-out of the screen.

Preliminary Study 4

Aim:

To study AC bridges for measurement of capacitance and inductance.

Theory:

1. Owen's bridge for measurement of self inductance of coil.

Owen's bridge is the AC bridge used for accurate measurement of inductance. The balanced condition for the bridge is

$$\frac{Z_1}{Z_2} = \frac{Z_3}{Z_4}$$

where Z_1, Z_2, Z_3 and Z_4 are respectively the impendences of arms AB, BC, AD and DC

$$\therefore \left(R_1 + \frac{1}{i\omega C_1}\right) i\omega C_2 = \frac{R_3 + (i\omega_L + r)}{R_2}$$

where R is the resistance of the inductive coil

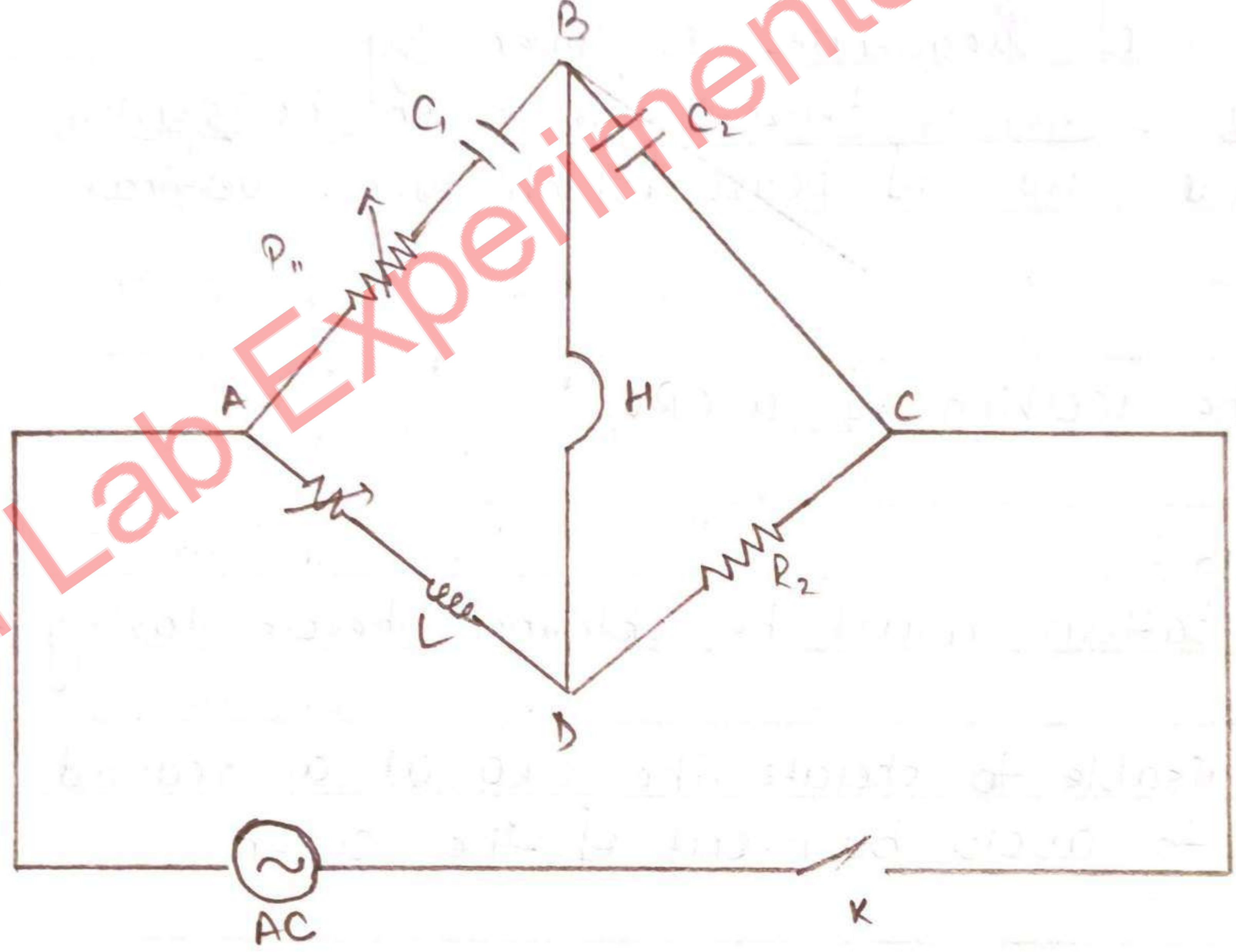
Neglecting r and equating real and imaginary parts, we get,

$$\frac{C_1}{C_2} = \frac{R_2}{R_3} \qquad \text{—— (i)}$$

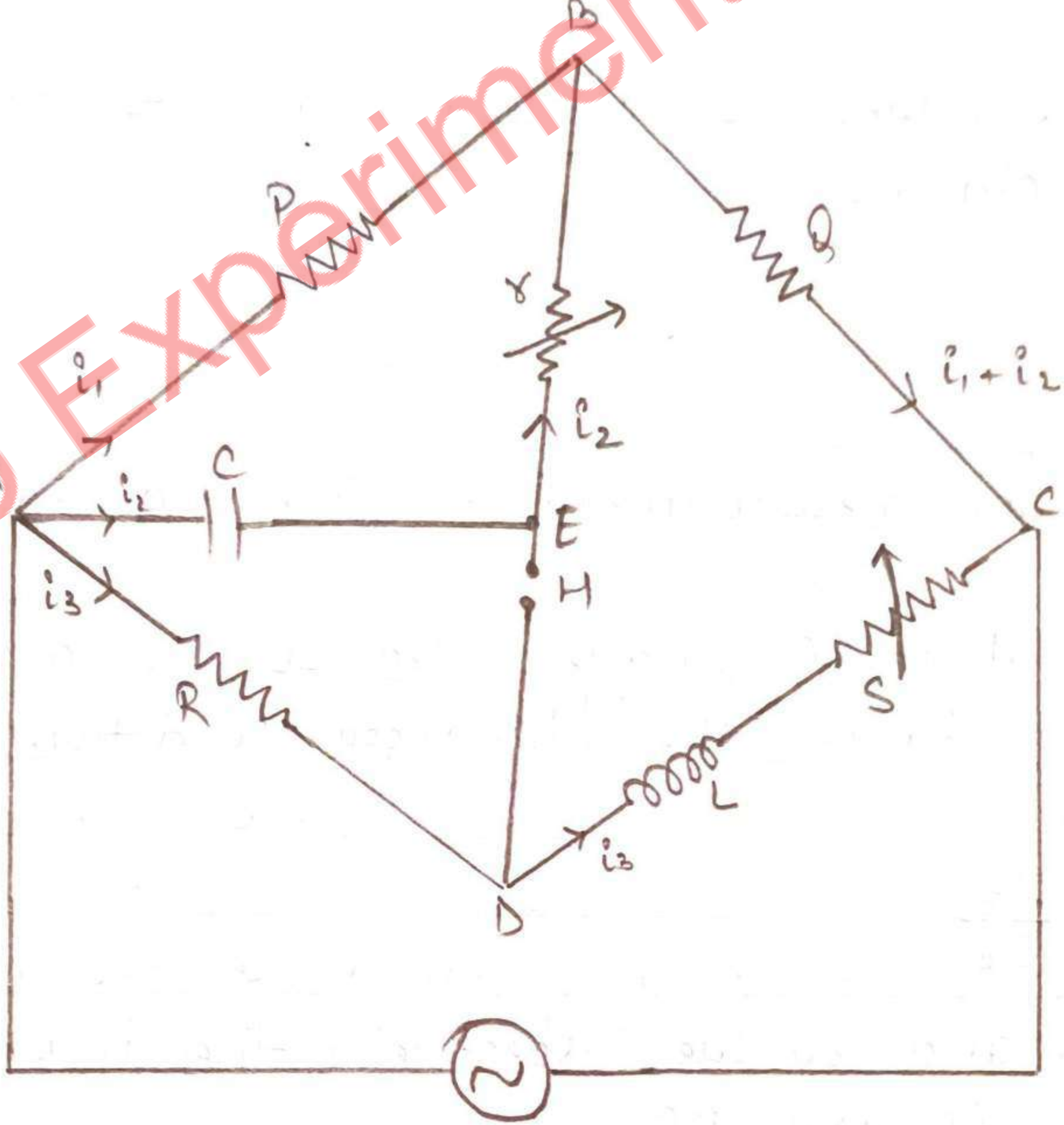
~~On eliminating i_1 and i_2, equating imaginary parts~~

~~$$S' = \frac{RQ}{P}$$~~

~~Equating real parts,~~



Owen's Bridge



Anderson's Bridge

and $L = C_2 R_1 R_2$ —— (ii)

Thus, the bridge gives us two balance conditions independent of one another and the frequency of the supply.

2. Anderson's bridge for measurement of self inductance of a coil.

Anderson's bridge is shown in the diagram where C is a fixed standard capacitor, P, Q, R, S and r are resitances, G is an audio oscillator and H is a head phone.

The condition of balance in this case is that the potential at D and E are same. Under these conditions, the current can be represented by the diagram.

The potential drop along ABC = potential drop along ADC.

$$i_1 P + (i_1 + i_2) Q = i_2 (R + i\omega L + S')$$

where $S' = S + R_L$, where R_L is the resistance of the coil.

From mesh ABEA

$$i_1 P - i_2 \left(r + \frac{1}{i\omega C} \right) = 0$$

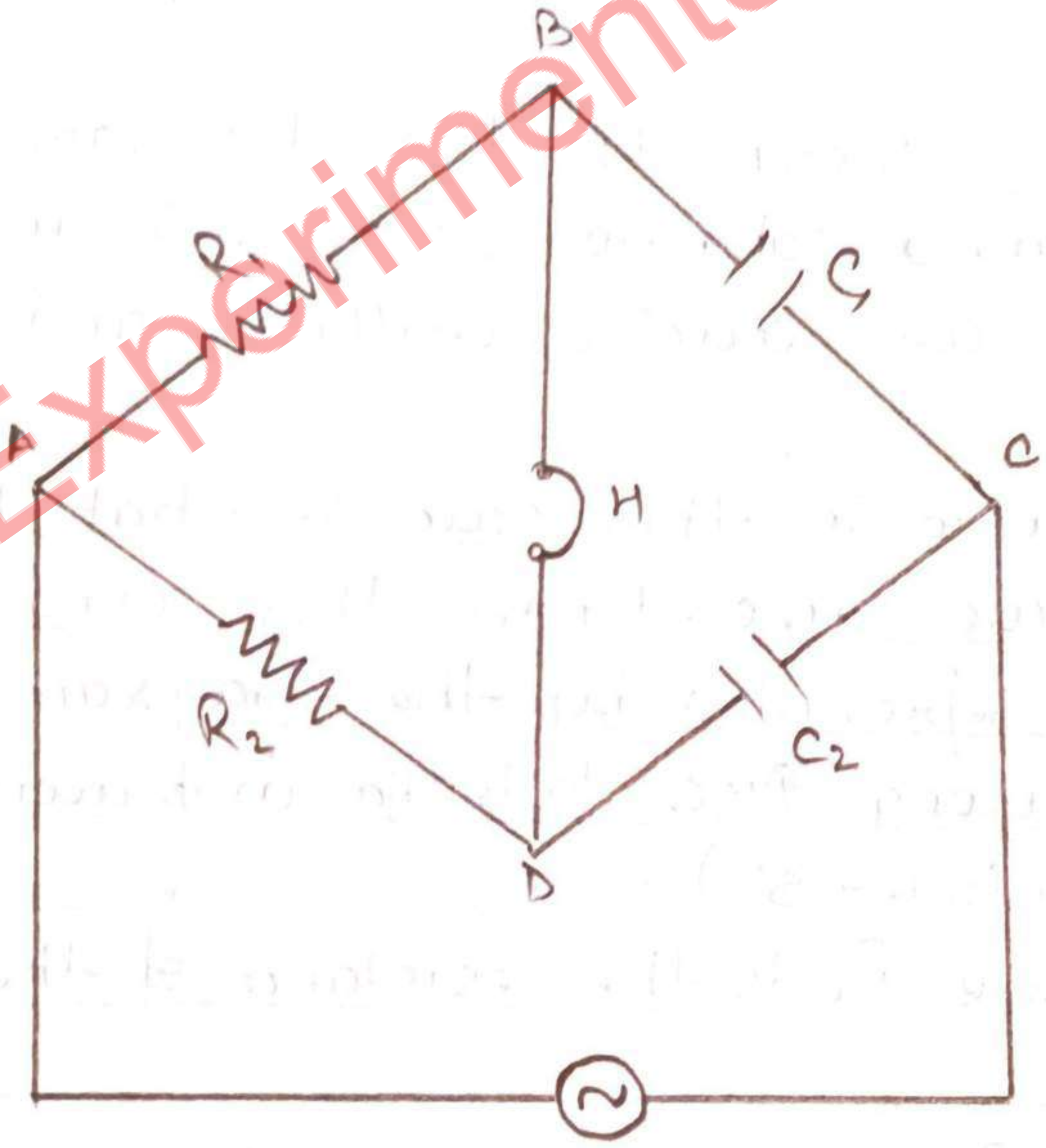
The potential drop from A to E is equal to that from A to D as no current flows through the headphone for the balance.

Thus, $\frac{i_2}{i\omega C} = i_3 R$

On substituting i_3,

$$i_1 (P + Q) = \frac{1}{i\omega CR} i_2 [R + S' + i\omega L] - i_2 Q$$

$$i_1 (P + Q) = i_1 \left[\frac{R + S' + i\omega L}{i\omega CR} - Q \right]$$



De- Sauty's Bridge

On eliminating i_1 and i_2, equating imaginary parts

$$S' = \frac{RQ}{P}$$

Equating real parts,

$$L = \frac{CR[Pr + Qr + PQ]}{P}$$

$$\Rightarrow L = C\left[Rr + \frac{RQr}{P} + RQ\right]$$

$$\Rightarrow L = C[Rr + S'r + RQ]$$

$$\Rightarrow L = C[RQ + r(S'+R)]$$

Thus, the values of C, R, Q, S' and r at the balance condition give us the self-inductance L of the coil.

3. De-Sauty's Bridge for measurement of capacitance

The De-Sauty's bridge is a simple AC wheatstone bridge that uses two resistances to compare two capacitances. If one of the capacitances is known, the unknown capacitance can be determined.

The detector used is generally a pair of headphones and the balance point corresponds to no sound or minimum sound in it. The balance is achieved by varying R_2 for a given value of R_1. The balance condition for this bridge is

$$\frac{Z_1}{Z_2} = \frac{Z_3}{Z_4}$$

$$Z_1 = R_1 \qquad Z_2 = R_2 \qquad Z_3 = \frac{1}{i\omega C_1} \qquad Z_4 = \frac{1}{i\omega C_2}$$

where ω is the angular frequency of the AC source. The balance condition, therefore, takes the form

$$\frac{R_1}{R_2} = \frac{1/i\omega C_1}{1/i\omega C_2} = \frac{C_2}{C_1}$$

$$\frac{R_1}{R_2} = \frac{C_2}{C_1}$$

The resistances used are supposed to be non-inductive and the capacitances to be free from dielectric losses.

Result:

Studied various AC bridges for measurement of inductance and capacitance.