APPLIED PHYSICS
PH-122
OPEN-ENDED LAB

FOR

First Year
Computer Sciences

Batch: 2023-24

GROUP- __

NAME OF STUDENT: **CLASS ROLL NO.:**

DISCIPLINE: FSCS (COMPUTER SCIENCE) SECTION: _____

SEMESTER: FALL 2023-24

DEPARTMENT OF PHYSICS

NED UNIVERSITY OF ENGINEERING &
TECHNOLOGY, KARACHI, PAKISTAN.

OPEN ENDED LAB

OBJECT:

To study the characteristics of a rejector circuit that is resonant at desired frequency and determine unknown _____.

APPARATUS:

Resistance, capacitors, inductor, a frequency generator/oscillator, an Oscilloscope, connecting wires, A.C. supply etc.

THEORY:

Rejector Circuit:

When the resistor R, inductor L and capacitor C are connected in parallel with a source of emf E, the circuit is known as the RLC-parallel or parallel resonant or parallel tuned circuit as shown in figure.
The total opposition offered by the RLC circuit in flow of current is called impedance Z. it depends on frequency of AC signal applied and given by:

$$\mathbf{Y} = \frac{1}{Z} = \sqrt{\left(\frac{1}{R}\right)^2 + \left(\frac{1}{X_L} - \frac{1}{X_C}\right)^2}$$

Where $X_L = \omega L$ and $X_C = \frac{1}{\omega C}$ are inductive and capacitive reactance of inductor and capacitor respectively. Admittance(Y) is the reciprocal of impedance, Z. In AC circuits admittance is defined as the ease at which a circuit composed of resistances and reactance allows current to flow when a voltage is applied.

In A.C. circuits the voltage and the current are usually not in phase. Across the inductor, the current lags behind the voltage by 90^0, whereas across the capacitor, the current leads the voltage by 90^0. But across the resistor the voltage and current both are in phase. At particular frequency the capacitive reactance Xc and the inductive reactance XL become equal and cancel effect of each other and circuit behave as purely resistive circuit. Under this condition, the voltage and current are in phase, even though the circuit consists of L, C and R. This phenomenon is called resonance and the frequency is known as resonant frequency.

$$X_L = X_C$$

$$\omega L = \frac{1}{\omega C}$$

$$\omega = 2\pi f = \frac{1}{\sqrt{LC}}$$

$$f = \frac{1}{2\pi\sqrt{LC}}$$

At this frequency, the impedance reaches its maximum, causing a minimum current to flow through the circuit. This particular frequency is termed the resonant frequency for the rejector circuit. Thus, it is a rejector circuit minimizes the flow of current at its resonant frequency.

We see that at resonate frequency inductive reactance cancels the capacitive reactance and the current are then entirely determined by the resistive element R of the circuit.

Hence at resonance minimum current is given by

$$I_{min} = \frac{E}{Z} = \frac{E}{R}$$

At this frequency the impendence is maximum and it is equal to R and the current is in phase with the applied voltage.

When the frequency of the applied voltage exceeds the resonant frequency, the capacitive reactance decreases, while the inductive reactance increases. Consequently, the impedance of the circuit rises, leading to a decrease in current flow.

Such a circuit is called a parallel resonant or most commonly an rejector circuit.

WORKING FORMULA:

Inductance is given as

$$\boxed{L = \frac{1}{4\pi^2 f^2 c}}$$

PRODPDURE:

1. Make the circuit connections as shown in circuit diagram i.e. take a resistor, an inductor and a capacitor of suitable values connect them with each other in parallel and connect an oscillator and cathode ray oscilloscope (CRO) across this combination of RLC.
2. Apply a signal of certain voltage by the oscillator at a certain frequency and note down the amplitude of output signal.
3. Now start increasing frequency of input signal (keeping the voltage constant), step by step, and each time note down the amplitude of the output signal. Take a number of observations. We will see that at first the amplitude of the output signal decreases as the frequency increases; it finally attains its minimum value and then again rises. At the resonant frequency the amplitude can be 2 minimum.
4. Plot a graph b/w frequency (f) on x-axis and the corresponding amplitude (A) of the signal on y-axis.
5. From graph calculate resonant frequencies for capacitor at which amplitude of signal is minimum.
6. Calculate the inductance with the help of resonant frequencies obtained through graph.

OBSERVATIONS:

Capacitance of capacitor C = ... µF

S. No.	Frequency f kHz	Amplitude of Signal Division

CALCULATIONS:

From Graph:

1. Value of resonant frequency f = ... kHz

$$L = \frac{1}{4\pi^2 f^2 c}$$

RESULT:

1. Characteristics of an acceptor circuit studied. It is seen that at resonant frequency the output signal is maximum / minimum.
2. The value of inductance is found L = _____ Henry.

PRECAUTIONS AND SOURCES OF ERROR:

1. Before switching on, get connections checked by teacher.
2. The amplitude of the signal at resonant frequency may not be exactly zero, which is due to the presence of the resistance.
3. Choose proper combinations of L, C & R

CIRCUIT DIAGRAM:

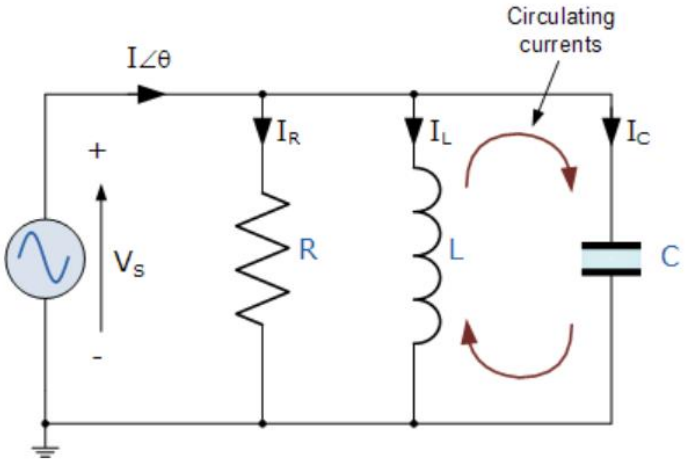

Figure 9: Circuit diagram of the rejector circuit

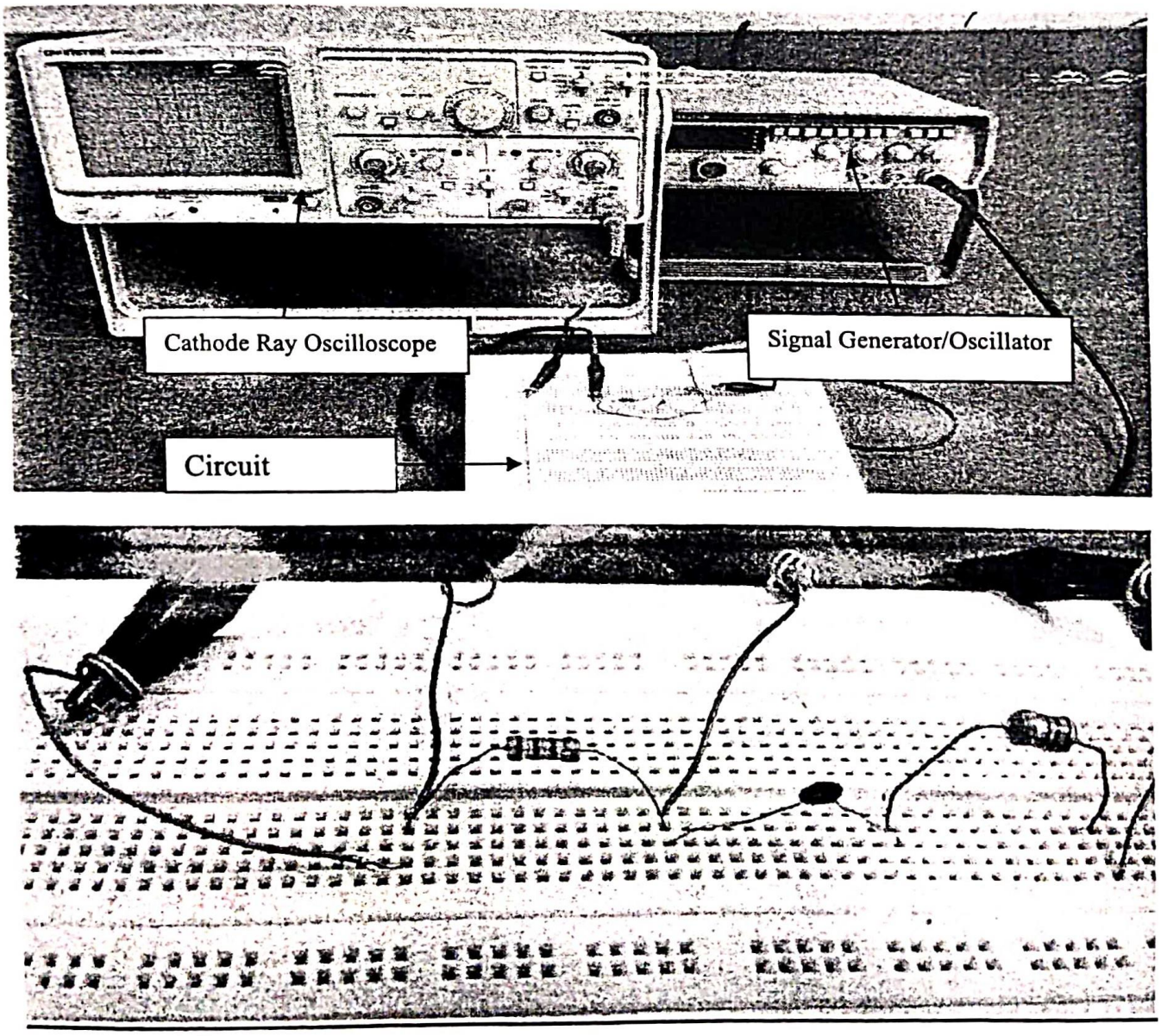

Figure 1: Photograph of the apparatus