EVALUATION
For each frequency f, the phase shift φ as well as the amplitudes U₀ and I₀ are read on the oscilloscope. The readings are used to calculate the total impedance \( Z = \frac{U}{I} \).

To simplify calculations for series and parallel connections, inductances \( L \) are assigned the following complex reactance:

\[
X_L = \frac{1}{2 \pi f L}
\]

Alternating current's frequency

Furthermore, capacitances \( C \) are assigned the following complex reactance:

\[
X_C = \frac{1}{2 \pi f C}
\]

The total impedance of a series connection without an ohmic resistance therefore is:

\[
Z_s = i \left( \frac{1}{2 \pi f L} - \frac{1}{2 \pi f C} \right)
\]

The corresponding calculation for a parallel connection is:

\[
Z_p = \frac{1}{\frac{1}{Z_s}} = \frac{1}{2 \pi f L} \cdot 2 \pi f C
\]

At the resonant frequency

\[
f_r = \frac{1}{2 \pi \sqrt{L C}}
\]

the impedance \( Z_r \) of the series connection comprising inductive and capacitive reactances therefore vanishes, i.e. the voltages across both individual reactances are opposite and equal. In contrast, the value of a parallel connection's impedance \( Z_p \) becomes infinite, i.e. the individual currents are opposite and equal. At the resonant frequency, the sign of the phase shift between the voltage and current furthermore changes.

In the experiment, resonant circuits are set up as series / parallel connections of capacitors and inductors. A function generator serves as a voltage source with an adjustable frequency and amplitude. An oscilloscope is used to measure current and voltage as functions of the set frequency. The voltage \( U \) and current \( I \) are displayed on the oscilloscope; \( I \) corresponds to the voltage drop across a small load resistor.

**EXPERIMENT PROCEDURE**

- Determining the impedances of series and parallel connections of capacitive and inductive reactances as a function of frequency.
- Determining resonant frequency as a function of inductance and capacitance.
- Observing changes in phase shift between voltage and current at the resonant frequency.

**OBJECTIVE**

Determining impedance in a circuit with an inductive and a capacitive reactance

**SUMMARY**

AC circuits with inductive and capacitive reactances show resonant behaviour. At the resonant frequency, the impedance of a series connection of an inductive and a capacitive reactance is zero, whereas the impedance of a parallel connection is infinite. This experiment examines this phenomenon with the help of an oscilloscope and a function generator which supplies voltages between 50 Hz and 20,000 Hz.

**REQUIRED APPARATUS**

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<th>Quantity</th>
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<tr>
<td>1</td>
<td>Plug-In Board for Components</td>
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<tr>
<td>1</td>
<td>Capacitor 1 µF, 100 V, P2W19</td>
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<td>Capacitor 4.7 µF, 63 V, P2W19</td>
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<td>Coil S with 600 Taps</td>
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<tr>
<td>1</td>
<td>Function Generator FG 100 (230 V, 50/60 Hz)</td>
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<td>Function Generator FG 100 (115 V, 50/60 Hz)</td>
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**BASIC PRINCIPLES**

As the frequency of an AC circuit’s current rises, the inductive reactance rises too, while the capacitive reactance drops. Series and parallel connections of capacitive and inductive reactances therefore exhibit resonant behaviour. One speaks here of a resonant circuit, its current and voltage oscillating back and forth between the capacitance and inductance. An additional ohmic resistor dampens these oscillations.