Maritime University of Szczecin

Faculty of Marine Engineering

Department of Physics and Chemistry

Physics Laboratory

Laboratory Manual

Verification of Ohm's law for alternating current circuits

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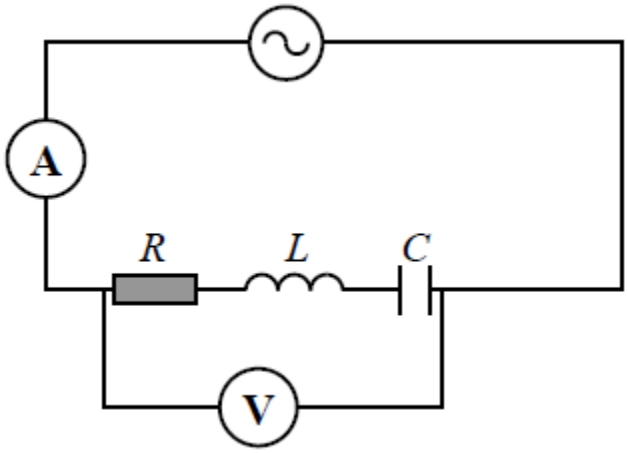
Equipment:

1. AC generator.
2. Dekade resistor.
3. Decade coil.
4. Decade capacitor.
5. Two multimeters.

Exercise:

1. Check if the electrical circuit is connected according to the scheme:



2. Set the resistance, induction and capacitance values to: R = 0 Ω, L = 10 mH and C = 10.1 nF, respectively.
3. Set voltmeter to 20 V AC range and ammeter to 2 mA AC. The range of the ammeter should be adjusted so that the measurement is carried out with the highest possible accuracy.
4. Using the frequency adjustment knob set the generator frequency to approximately 2 kHz. Using the AMPL knob set the voltage value $V_{p\text{-}p}$ to approximately 15 V.
5. Attach the ammeter and the voltmeter.
6. From the meters read values of voltage U and current I flowing in the RLC circuit.
7. Using the equation:

$$Z = \frac{U}{I}$$

   calculate the impedance Z. Compare the received value with the theoretical one Z':

$$Z' = \sqrt{R^2 + \left(2\pi f L - \frac{1}{2\pi f C}\right)^2}.$$

8. Repeat steps 6 – 8 for 9 different combinations of R, L and C values, which should be changed within the range: R = 0 – 100 kΩ, L = 10 – 100mH and C = 5 – 20 nF.
9. Repeat steps described in 6 – 8 for frequency of about 1 kHz.
10. Set the values of R, L ,C and f indicated by the teacher.
11. Calculate theoretical value of impedance Z'.

12. By adjusting the voltage value in the RLC circuit by the AMPL knob, verify the dependence of the current *I* flowing in the circuit from the voltage *U*.
13. Using the linear regression

$$I = \frac{1}{Z} \cdot U$$

$$y = a \cdot x + b$$

determine the impedance *Z*. Compare obtained value with the theoretical one *Z'*.

Table:

f [Hz]	*R* [Ω]	*L* [mH]	*C* [nF]	*U* [V]	*I* [mA]	*Z* [Ω]	*Z'* [Ω]
	0	10	10.1				

R = …… Ω

L = ……mH

C = …..nF

f = …..Hz

U [V]	*I* [mA]
0.5	
1.0	
1.5	
2.0	
2.5	
3.0	
3.5	
4.0	
4.5	
5.0	
5.5	
6.0	

Z = ……, *Z'* = …….