Universität Leipzig, Fakultät für Physik und Geowissenschaften

Exercises for Experimental Physics 3 – IPSP

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Exercise Sheet 4 (WS 2010/11)

Date of Issue to Students: Nov. 4^{th} 2010

Date of Submission: Nov. 11^{th} 2010

Submission Place: Marked mailbox next to room 302 (Linnestr. 5)
Submission Time: 11:00 a.m. at the submission day noted above

Please note: Write your name and matriculation number on EACH sheet of paper.
Only submit the calculations and results for exercise 1-3, exercise 4 will be discussed during the instruction classes.

Exercises:

1. A coil that has a resistance of 80.0 Ω has an impedance of 200 Ω when driven at a frequency of 1.00 kHz. What is the inductance of the coil? (3 Points)

2. A series RLC circuit that has an inductance of 10 mH, a capacitance of 2.0 μF, and a resistance of 5.0 Ω is driven by an ideal ac voltage source that has a peak voltage of 100 V. Find (a) the resonant frequency and (b) the root-mean-square current at resonance. When the frequency is 8000 rad/s, find (c) the capacitive and inductive reactances, (d) the impedance, (e) the root-mean-square current, and (f) the phase angle. (7 Points)

3. An ideal 0.25-H inductor and a capacitor are connected in series with an ideal 60-Hz generator. A digital voltmeter is used to measure the rms voltages across the inductor and capacitor independently. The voltmeter reading across the capacitor is 75 V and that across the inductor is 50 V. (a) Find the capacitance and the rms current in the circuit. (b) What is the rms voltage across the series combination of the capacitor and the inductor? (5 Points)

4. Figure 1 shows an inductor in series with a parallel plate capacitor. The capacitor has a width w of 20 cm and a gap of 2.0 mm. A dielectric that has a dielectric constant of 4.8 can be slid in and out of the gap. The inductor has an inductance of 2.0 mH. When half the dielectric is between the capacitor plates (when $x = \frac{1}{2}w$), the resonant frequency of this combination is 90 MHz. (a) What is the capacitance of the capacitor without the dielectric? (b) Find the resonance frequency as a function of x for $0 \leq x \leq w$.

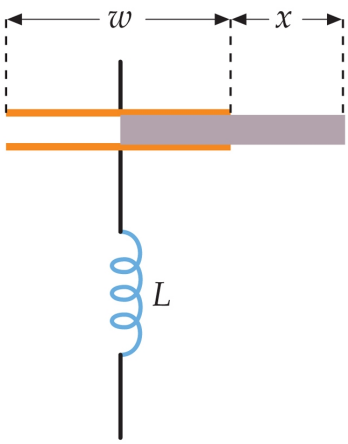

Figure 1: Exercise 4