CARL VON OSSIETZKY universität OLDENBURG
FAKULTÄT V
INSTITUT FÜR PHYSIK

Introductory Laboratory Course Physics

Part I (Winter term)

General remarks on the course and on the preparation of reports

The Greek alphabet

Name	**Minuskel**	**Majuskel**
Alpha	α	A
Beta	β	B
Gamma	γ	Γ
Delta	δ	Δ
Epsilon	ε	E
Zeta	ζ	Z
Eta	η	H
Theta	θ	Θ
Iota	ι	I
Kappa	κ	K
Lambda	λ	Λ
My	μ	M
Ny	ν	N
Xi	ξ	Ξ
Omikron	ο	O
Pi	π	Π
Rho	ρ	P
Sigma	σ	Σ
Tau	τ	T
Ypsilon	υ	Y
Phi	φ	Φ
Chi	χ	X
Psi	ψ	Ψ
Omega	ω	Ω

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October 2016

(Translated by Christian Schöne, Angelika Sievers, Liz von Hauff, and Julika Mimkes)

Carl von Ossietzky University Oldenburg – Faculty V - Institute of Physics
Module Introductory laboratory course physics – Part I

Contents

Introductory remarks

In this introductory script general information about the module “Grundpraktikum Physik” is given. In particular, aid in creating of experimental reports, using of computers and software in the course, and applying error theory and regression analysis is provided.

For data analysis and graphical display of measurement data the software `Origin` (Version 2016) is available. There is a software licence available for every student of Faculty V; the same applies to the `Matlab` program. Appropriate exercises on each program are intended to get familiar with the programs and should be solved by each student. The exercises will not be graded, but must be passed in order to complete the module successfully. The respective exercise sheets are provided under StudIP or on the homepage[1].

At the end of this introductory script you will also find the first experiment: “Oscilloscope and function generator ", in which you get to know how to deal with these two important physical instruments which will be continuously used in following experiments. Therefore, take your time and perform this experiment carefully. For this experiment, a first report is expected, in which you should describe and document your results. Again, still there are no specific marks for this report but it must be graded with "passed". So, take the feedback of your assistant seriously and consider it for your report on the following experiments. In addition there is a list translating German denotations in figures into English at the end of this script (p. 71-72).

For the following experiments individual marks will be given and an additional script will be handed out, in which all details for performing the experiments are listed. Feedback and suggestions for improvements to the experimental descriptions or the script in general can be written into the hardcopy lab version of the script or sent to the laboratory manager.

I wish you a successful participation in the course and hope that besides all work and efforts, joy and curiosity for experimental work will be inspired.

Dr. Michael Krüger

Laboratory Manager

[1] https://www.uni-oldenburg.de/en/physics/teaching/laboratory-courses/basic-laboratory-course/

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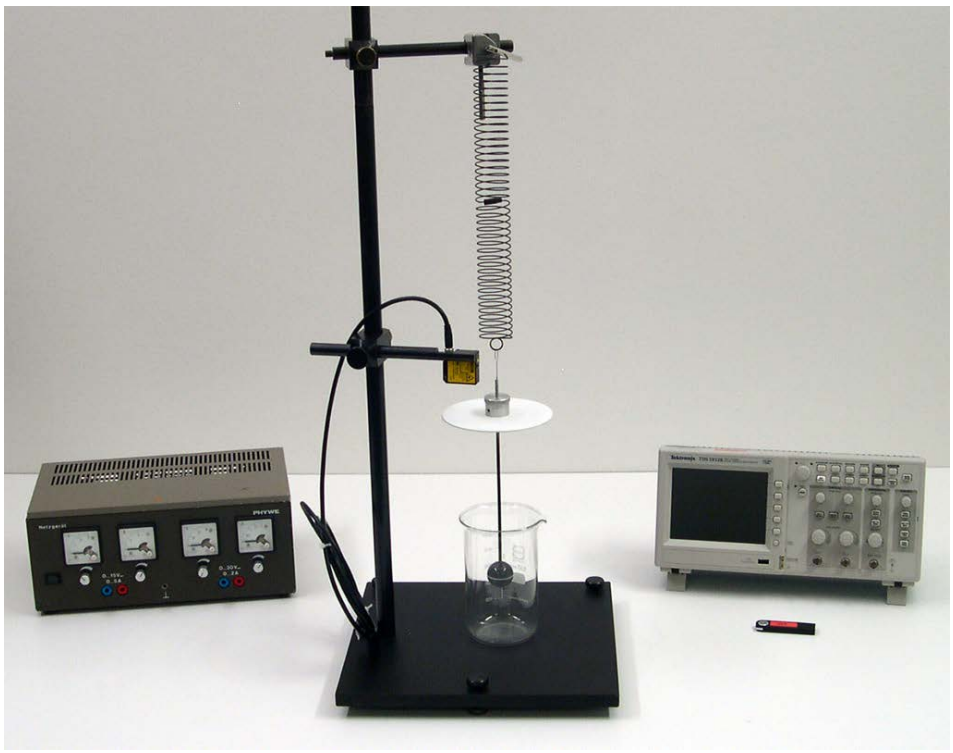

The Greek alphabet

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Pictures on the title page:

Parts of experimental components for the experiment "sensors".
Top: Test components for distance measurement with a laser distance sensor.
Bottom: Test components for measuring the light intensity by means of a photodiode.

Contents

Succession of the experiments

Schedule	Week	Remarks	Subject
1	42		General remarks on the module *Introductory Laboratory Course Physics*, the preparation of reports, and the usage of computers. Exercises to `Origin` and `Matlab` (Introductory Script)
2	43		Oscilloscope and function generator (Introductory Script) **(Extra seminars: Error theory I + II,** the times will be announced**);** Excercises in error theory
3	44	Reformation Day Wed. 31.10.18	Measurement of ohmic resistances, bridge circuits, and internal resistances of voltage sources
4	45		Measurement of capacities – Charging and discharging of capacitors
5	46		Sensors for force, pressure, distance, angle and light intensity
6	47		Force, momentum and impulse of force
7	48		Data acquisition and data processing using a PC
8	49		Characterization of a transreceiver system
9	50		Conservation of momentum and energy - Law of collision
10	51		Moment of inertia - Steiner's theorem
11	2		Forced mechanical oscillations
12	3		Fourier analysis
13	4		Surface tension, minimal surfaces and coffee stains
14	5		Viscosity and Reynolds numbers

The first experiments performed in the introductory laboratory course in physics serve to become acquainted with measuring instruments, function generators, sensors and data acquisition as well as data processing using a PC and to carry out introductory quantitative measurements. Only part of the subjects treated in these experiments are dealt with in the lecture, too. A sound school knowledge of physics, however, will do all right to understand them.

The following experiments are thematically coupled to the lecture contents that are dealt with synchronously.

An ***Open Lab*** is offered at a time announced on the notice-board of the laboratory course. During this time the labs are opened and the devices are placed at the students' disposal. By this, the possibility is offered to the students to deepen and improve experimental abilities independently and to repeat experiments if necessary. Supervision is done in turns by one of the tutors and technical assistants.

Recommended values of some fundamental physical constants (2014) [1]

Constant	Symbol	Value	Unit	Remark
Atomic mass unit	u	1,660 539 040 (20)·10^{-27}	kg	
Avogadro constant	N_A	6,022 140 857 (74)·10^{23}	mol^{-1}	
Boltzmann constant	k	1,380 648 52 (79)·10^{-23}	J/K	
Electric constant: $1/(\mu_0 c^2)$	ε_0	8,854 187 817...·10^{-12}	As/(Vm)	exact
Elementary charge	e	1,602 176 6208 (98)·10^{-19}	As	
Faraday constant	F	96 485,332 89 (59)	C/mol	
Constant of gravitation	G	6,674 08 (31)·10^{-11}	$m^3/(s^2 kg)$	
Speed of light in vacuum	c	2,99792458·10^8	m/s	exact
Magnetic constant: $4\pi \cdot 10^{-7}$	μ_0	1,256 637 0614…·10^{-6}	Vs/(Am)	exact
Molar gas constant	R	8,314 4598 (48)	J/(mol K)	
Planck constant	h	6,626 070 040(81)·10^{-34}	Js	
Electron mass	m_e	9,109 383 56(11)·10^{-31}	kg	
Neutron mass	m_n	1,674 927 351 (74)·10^{-27}	kg	
Proton mass	m_p	1,674 927 471 (21)·10^{-27}	kg	
Standard acceleration of gravity	g	9,80665	m/s^2	exact (Definition)

The numbers in parentheses indicate the single standard deviation in units of the last decimal position.

Prefixes

Factor	Name	Symbol	Factor	Name	Symbol
10^{-1}	deci	d	10^{1}	deca	da
10^{-2}	centi	c	10^{2}	hecto	h
10^{-3}	milli	m	10^{3}	kilo	k
10^{-6}	micro	μ	10^{6}	mega	M
10^{-9}	nano	n	10^{9}	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f	10^{15}	peta	P
10^{-18}	atto	a	10^{18}	exa	E
10^{-21}	zepto	z	10^{21}	zetta	Z
10^{-24}	yocto	y	10^{24}	yotta	Y

[1] Source: Peter J. Mohr; David B. Nevell; Barry N. Taylor: "CODATA Recommended Values of the Fundamental Physical Constants: 2014", arXiv: 1507.07956v1 [physics.atom-ph] 21. of July 2015. See also: http://arxiv.org/pdf/1507.07956v1.pdf and http://physics.nist.gov/cuu/Constants/index.html.