

Experiments

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Edition:

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Introduction

This section of the guide to the laboratory physics course refers to general and binding rules and security instructions.

The second part of the guide, which can be found on

<http://www.uni-due.de/agfarle/grundlagenpraktikum/ANLEITUNGEN/ISE.pdf>

presents a short comprehensive description of the basic physics of the experiments to be performed in this laboratory course including instructions on carrying out the experiments and on the evaluation of results. The last section gives a short introduction to the qualitative and quantitative estimation of experimental errors.

The experiments in this laboratory course have been selected from a series of experiments from the basic laboratory course for physics students. The aim of this laboratory course is to introduce the participant to the principal experimental methods in physics.

The description of each experiment contains some major keywords to the subject of the course and should be considered for further studies in the available literature. Please note that the basic physical descriptions given afterwards are only introductory, i.e., they do not cover the subject exhaustively. Further reading of textbooks on undergraduate physics is strongly recommended. Questions presented at the end of each experiment are intended to serve for self-checking. You have to be able to answer them before the explicit course.

The participant in the physics laboratory course should be as conscientious as possible in carrying out the experiments. It does not matter if an experimental value obtained by many students before is just reproduced. Instead, one should learn to take measurements as reliable as possible independent of the well known result. The error inherent to the result obtained from the experiment is decisive for the quality of the experiment performed and the reliability of the result. Later on, when one is confronted with problems, for which the solution is not known a priori, the situation will be the same.

It is therefore required to study the introduction to the evaluation of errors given in the appendix and to include the estimated error to every experimental result obtained. A quantitative experimental result presented without the estimated error is not meaningful. Furthermore, the numerical result should be rounded to the extent given by the errors involved. Significant to the latter are usually 2 or 3 decimal places. The large number of decimal places displayed by a pocket calculator have to be justified with respect to their physical significance. The sources of striking large errors obtained (sometimes of striking small ones as well) are to be discussed. They must originate from the conditions of the experiments performed.

Advice for Laboratory Course Participants

In the Laboratory physics course, the experiments are carried out in groups (usually two to three students per group). The time schedule and selection of the experiments is determined by grouping the participants. The grouping is carried out together with handing out these experiment instructions after registering for the laboratory course (usually at the beginning of the semester). Please note the “Vorlesungsverzeichnis” and the posting before room ME 142.

With your registration data two lab cards are filled out for each participant with: family name, first name, matriculation number, discipline of study and group number. One lab card remains by the laboratory course administration. The other card is issued to the participant at the first Lab course and is to be presented at every discussion before the experiments and at the final discussion at the end of the semester as well.

One should prepare thoroughly for every experiment and consider the physical questions arising in the particular context, e.g., by using the keywords for further consulting textbooks. To verify the trainee's preparation a discussion is given by a lecturer before each experiment. This discussion serves, at the same time, to ensure the participant's security and to avoid any damage to the equipment.

One should pay attention that every discussion finished successfully is registered on the lab card with the date and signature of the lecturer.

If the discussion has not been finished successfully, the experiment (including the discussion) is to be repeated at a further date. Out of the four experiments to be carried out in the ISE laboratory physics course, only one experiment can be repeated for any reason. If more than one discussion has ended unsuccessfully, or the student is absent (with an excuse) more than once the whole laboratory course has to be repeated. There is only one extra date!

A record including all measured data and parameters is to be prepared immediately during the experiment. It is to be signed by the assisting lecturer of the experiment on the same day. A handwritten experimental report is to be prepared by the group afterwards. Computer printed text in the report is not permitted or at least the lecturer has to be asked in advance.

Every report should contain a short text with the physical context (1 to 3 pages) and a short presentation of the experimental setup and the carrying out of the experiment. Afterwards, the evaluation of results and a short discussion - including a discussion of experimental errors (important! / at least 1 page) – has to be included. The results are to be compared with data known from literature if possible. The original record with the measured data is to be attached. The cover sheet of the report should be filled out as the template available in the laboratory. The lower half of this sheet should be kept free for comments of the correcting lecturer.

Every experimental report has to be submitted to the assisting lecturer before the next experiment personally if not told by the Lecturer otherwise. The report of the last experiment or that of the extra date has to be prepared in two weeks. If the report is handed in later, the experiment is considered as not valid and is to be repeated. (Once again: only one repetition is possible) Having been checked by the assisting lecturer, the report is returned to the group for further corrections and resubmission if necessary. There is only one resubmission per experiment and this resubmission has to be handed personally to the lecturer not later than 2 weeks after the report was given back to the group (date of the lecturers signature counts).

All reports approved by the assisting lecturer are to be presented at the final discussion. If all reports are accepted by the lecturer, the laboratory course is considered as successfully finished and is noted by the lecturer on the lab cards. The date and place of the final discussion is announced on the information board (at room ME 142) before the end of the laboratory course. The lab cards and all reports are to be presented at this date.

The laboratory course is to be completed successfully before the next particular semester. The successful participation is reported to the Prüfungsamt.

Laboratory Security Instructions

General behaviour in the laboratory physics course

Every course participant should observe caution in the laboratory in order to prevent any personal hazard or damage of laboratory equipment.

Advice given by the lecturers and assisting students responsible for the laboratory course and given in the guide to the experiments, i.e., how to handle the experimental instruments, should be explicitly obeyed.

Before starting an experiment, one should wait for the instructions of the assisting student responsible for the experiment (see name list on the information board). After the experiment, the space should be left tidy. Eating, drinking, smoking, and the use of cellular telephones are not allowed in the laboratory.

Working with electric circuits

Contacting live parts of current sources with DC or AC voltages above 50 V can be lethal or, in the least, can cause personal damage. Surges caused by short circuits can cause instrument damages and fire.

When working with electric circuits with high voltages, at least two persons are to be present. In cases of emergency, the mains voltage is to be switched off. This is done either by switching off the local block distributor or by pressing the emergency button (red button on the terminal box next to the door).

All experimental setups with electrical circuits are to be checked by the assisting student before operating. Completing, dismantling or alteration of electric circuits is to be done with the line disconnected.

To avoid errors, circuits should be clearly built up using cables with proper length and color. When working with electric measurement devices, one should pay attention that the correct polarity, measuring range, and measuring input is used (danger of overload).

After the end of an experiment, all electric instruments and the terminal blocks at the experiment are to be switched off. Batteries are to be separated from circuits, circuits previously completed are to be dismantled.

Using ionizing radiation (x-rays)

High energy electromagnetic radiation (x-rays) penetrates human tissue and causes damage due to its ionizing effect; the amount of damage corresponds to the absorbed radiation dose. The x-ray apparatus used in the laboratory course is an instrument designed to be operated in schools. It has a complete protection enclosure and, therefore, a very low external radiation power, being at the lowest limit to be detectable at all. Opening of the protection enclosure automatically switches off the radiation. Every trial to bypass the protection circuit is strictly forbidden.

Behaviour in emergency cases

Keep calm! - Warn persons running into danger! - During help pay attention to your own security!

Accident

For immediate help for injuries, there are first aid boxes containing bandaging material in room ME 142 (room of the assisting students) and room MD 147.

For further assistance, **call the emergency (phone no. 2111)** or the fire brigade (phone no. 112).

Explain: *Who is reporting the accident?*
 What has happened?
 Where did it happen?
 Are there injured persons?
 When did it happen?

In Case of Fire

If an alarm is heard, leave the building using the shortest way out (see site plan on the information board ME 142 and escape route signs in every floor and building entrance). Do not use the elevators! The meeting place for the M-area is the parking lot of the school at Geibelstraße (the street across the Mensa).

In the case of a fire in the rooms of the laboratory physics course, the following measures should be taken:

Rescuing people
Fire fighting using fire extinguishers

Reporting the fire **to emergency (phone no. 2111)**
 or to the fire brigade (phone no. 112).

Explain: *Who is reporting? (Name, institution, phone no.)*
 Where is the fire? (Building, room)
 What is burning?
 Are there any injured people?

Close windows and doors
Leave the room and building.

Laboratories with telephones: ME 142, MD 147, MD 163, MD 165

Responsible for Physics Laboratory course:

Dr. Ralf Meckenstock	(ME 344)	phone 2094
Secretary	(ME 348)	phone 2382
Prof. M. Farle	(ME 347)	phone 2075