

Optics Laboratories I/II

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Goal

The goal of Optics Laboratories I and II is for students to gain hands-on experience in a wide variety of optical setups, instruments, and devices, acquiring practical skills in optical alignments and diagnosis, and acquaint themselves with data distillation and reporting in efficient technical communications.

Overview

Optics Laboratories I and II are master-level optics laboratory courses offered annually in the fields of geometrical, physical, and modern optics. These courses allow students to deepen their understanding of optical instruments, optoelectronic devices, and diagnostic methods. Students will be introduced to state-of-the-art optical instruments and measurement principles. The goal of the courses is for the students to gain hands-on experience in a wide variety of optical experiments, experimental data collection and analysis, and communication of key results.

In these two courses, students will complete four laboratory experiments (designated as TPs) of their choice from a number of standard setups. The specific number of choices in a particular semester depends on the availability of the teaching assistants (TAs). Each TP consists of two sessions, each of which lasts four hours. Students will be organized into groups of two or three depending on the size of the class enrollment. Each group of students will conduct the experiment under the supervision of a TA. They will be required to jointly submit the experimental methods, results, and data analyses in a journal-style report within two weeks after the completion of the experiment.

Enrolled students will be given a first class on course overview and laser safety in the first week, during which the groups are also formed. A second class on error analysis will be given in the second week. The TPs commence in week three or four depending on the logistics.

An operation manual is available for each TP on the table of the setup and on the course Moodle page as well. Students are expected to read the TP manual and familiarize themselves with the principle and the operations of the TP before actually performing the experiment. Prior to the beginning of each TP, the responsible TA will assess the students' understanding in the specific TP by asking prelab questions, and may cancel the TP if it is clear that the students are not ready for the TP. In such cases, the students should study the TP materials more carefully and negotiate with the TA another timeslot for the TP. During the TP, students are also encouraged to ask for assistance when unsure of proper operation of laboratory equipment. This ensures that the student and the equipment are protected from harm.

The laboratory room contains class 3 lasers, and students are instructed to wear appropriate laser eye protection goggles when operating in a TP involving such lasers. Laser warning signs can be found above each optical table and on the outside of the laboratory. Students need to take every preventative measure to ensure the laser does not harm themselves and other students nearby.

The laboratory is equipped with 10 optical tables hosting the TPs in this course, labeled T1 – T10. An additional regular table hosts another TP, which is less sensitive to environmental vibrations. In recent years, an increasing number of courses use this laboratory for their TP needs. Therefore, to accommodate these TPs, some tables will need to be shared by moving the experimental modules on and off the table. We try to ease the situation by reasonable scheduling and minimize the impact by moving only those TPs less subject to alignment issues.

There are three laptop computers in the code-operated cabinet. The computers are for the purpose of data acquisition purposes only, and their access and use are regulated by the assistants. The username and the password can be found on the laptop. At the end of the TP, it is required that the data be transferred to external storage, either a USB drive or network storage, and the laptops be returned to the cabinet. Wi-Fi networking is available should the need arise. However, given the public shared account, it is strongly suggested that you “forget” the Wi-Fi settings at the end of use for security reasons.

The occupancy of the laboratory can be well beyond 10 people at times. Therefore, it is required that the ventilation be turned on when the first person enters the lab and turned off when the last person exits the lab to maintain fresh air.

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Grading Guidelines

In consistency with all the courses offered in EPFL, the full score of this course is 6 with an increment of 0.25. The course-internal evaluation follows a 10-point scale. For each student, the final grade is an average of all individual TPs in which he/she participates with appropriate scaling to the 6-point system. Each TP is evaluated in a weighted average of the following components:

- Prelab questions (3 points with 40% weight);
- Experimental skills and quality of work (7 points with 40% weight);
- Reports and lab notes (10 points with 60% weight);
- Extra experiments (10 point extra with 10% weight).

The first two components are evaluated based on individual students, in which the grades may differ among group members. The rest of the components are evaluated on the basis of a group, which are the same for all group members.

To promote skills in collaboration and technical communications, we require the report to follow a journal-style format. Briefly, a journal-style report contains the following components (with points in evaluation of the grade):

- Abstract (0.5 point);
- Introduction (1.5 points);
- Methods (3 points);

- Results (3 points);
- Discussion (1 point);
- Conclusion (0.5 point);
- References (0.5 point)

Note that references are mandatory and at least one reference, the relevant TP manual, should be cited. We encourage citations beyond the TP manual, such as a text book. Reliable Internet sources, such as HyperPhysics and RP Photonics, are acceptable. Additional information, including a writing guide and other resources on the journal-style lab report can be found on the Moodle page.

Students should submit their report within two weeks after the completion of the TP. The TA will grade the report in one week and give feedback to the students for their improvement in the subsequent reports. Late submissions will receive one-point penalty and are not entitled to feedback.

Extra experiments

To further encourage curiosity and inspire creativity, we encourage the students to explore an extra experiment in the remaining timeslot and earn extra points if a group of students is able to finish an experiment in one session. The extra experiments will be evaluated at 1-10 points and weight 10% on top of the 100% grade. Use an independent section to report the extra experiment. Note that no extra points can be given beyond the full score of 6 in the final grade. Please observe the following rules when planning an extra experiment:

- The experiment must be closely related to the goal of the TP concerned;
- It must address or clarify a meaningful question. Extra data serving no clear purpose will earn few points;
- It should not involve any extra equipment;
- The students must propose their plan and obtain approval from the responsible TA before proceeding;
- Alternatively, the TA can suggest an experiment instead;
- The experiment is not to be used as a replacement of the original assignment.

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Unexpected events

There is always a possibility of encountering unexpected events in any experimental work, which often leads to failure in the production of data. The majority of such unexpected events involve equipment malfunctioning. In case of such events, you should inform the responsible TA and me of what happened. If the equipment in question cannot be repaired in a timely fashion, students should perform theoretical calculations in place of the required measurements in the TP. Use independent thinking and analysis rather than simply replicating the TP manual.

In a lesser extent, the experimental data produced in a TP may be lost due to technical glitches or simple negligence. In such events, arranging an additional timeslot and retaking the measurement data are highly encouraged. If this is not possible, use theoretical calculations in place of the physical measurements (same rules as the equipment malfunctioning case).

Grading summary

Item	Component	Weight
TP <i>10 points</i>	<p>Prelab questions (3 points) The TA will ask you to describe the purpose, the principle, and the basic procedures of the TP, and questions in the TP manual before the TP begins.</p> <p>Experimental skills and quality of work (7 points) In a TP, the TA will evaluate the experimental skills you demonstrate, such as identifying the correct components, establishing the required setup, and efficient alignment of the optical path. In a design or simulation TP, the evaluation will cover operating the relevant software proficiently, setting up a working design/simulation scheme, and efficient finetuning of parameters.</p>	40%
Report <i>10 points</i>	<p>Abstract (0.5 point) An abstract is a brief statement of your work. Outline your motivation, your methodologies, and your results here.</p> <p>Introduction (1.5 points) State of the purpose of the TP. Rephrase the TP assignment and the related theory in your own understanding. Use equations, figures, and tables if necessary.</p> <p>Methods (3 points) Describe the procedures, equipment, and the parameters of the TP assignment in detail. Use equations, figures, and tables if necessary.</p> <p>Results (3 points) Describe the main results obtained from the TP assignment. Use equations, figures, and tables if necessary.</p> <p>Discussions (1 point) Discuss what insights you obtain from these results. Analyze the quality of data or design resulted from the TP assignment and identify possible sources of errors or causes for unsatisfied design target. Use equations, figures, and tables if necessary.</p> <p>Conclusion (0.5 point) Briefly summarize the main findings and insights from the TP assignment results.</p> <p>References (0.5 point) A list of references you cite in the main text of the report in support of the points you make.</p>	4 60%
Extra Experiment <i>10 points</i>	Experiment + Report To encourage curiosity and inspire creativity, the students who complete their TP assignment early are encouraged with extra points to conduct additional experiments, simulations, or designs closely-related to the TP for further verification or confirmation of the theory.	10%