

# Optics Laboratories I/II

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## 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 the 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.

## COVID-19 Specifics

According to the current COVID-19 directives issued by EPFL as of 13 October 2021, a COVID certificate is required to attend classes and practicals in person. Face masks are mandatory inside buildings and near other people outside. Social distancing (at least 1.5 meters) must be maintained to protect yourself and others. All teachers and students must comply with this directive and with the framework measures set out at the federal level and in the canton of Vaud. To minimize aggregation and potential spread of the virus, we have dispersed the TPs throughout all weekdays. We set up the schedule according to the availability of both the students and the assistants, aiming at a room occupancy no more than two groups per timeslot and no more than three groups in a timeslot in exceptional cases.

Following the federal, cantonal, and EPFL directives, we require that the rules outlined below be observed in order to ensure a safe conduct of the TPs (follow the signs marked in the lab):

- Everyone entering the lab must possess a COVID certificate recognized by Switzerland or a temporary pass issued by EPFL;
- Everyone entering the lab should wear a face mask. A box of face masks is provided in the lab in case anyone forget to bring a mask;
- Anything to be in contact with the eyes, such as the eye pieces of a microscope, or the view finder of a camera, must be cleaned with 70% ethanol before use;
- The ventilation should be turned on when the first person enters the lab, and turned off when the last person exits the lab;
- Maintain a minimum 1.5-meter interpersonal distance whenever possible;
- Stay at home and call for a doctor's visit if you have symptoms of COVID-19.

Note we no longer require everyone to register at the entry and exit of the lab.

You can request a COVID certificate if you are vaccinated, valid for 343 days since the 22nd day after the last dose, or if you recovered from a COVID infection, valid for 169 days since the 11th day after the positive PCR test result. You can also obtain a COVID certificate by being tested negative, valid for 72 hours with PCR test from when the sample is taken, or 48 hours with rapid antigen test from when the sample is taken.

If you are tested coronavirus-positive, please stay at home and do not come to the campus. Comply strictly with the public-health authorities' instructions. Notify your supervisor and reply to the public-health contact tracing survey.

From 4 to 31 October, universities in Vaud Canton, including EPFL, offers free saliva tests to people without a COVID certificate so that they can attend classes, exercise sessions and practicals in person. The temporary pass will be valid for one week (seven days).

## 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. For each student, the final grade is an average of all individual TPs 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 (10%);
- Experimental skills and quality of work (30%);
- Reports and lab notes (60%);
- Extra experiments (10% extra).

Each component is evaluated based on 1-10 points for the convenience of calculations. The first two components are evaluated on the basis of individual students, in which the grades may differentiate 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 a feedback to the students for their improvement in the subsequent reports. Late submissions will receive one-point penalty and are not entitled to a 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, i.e. the original assignment must be completed before moving to the extra experiment.

### **Unexpected events**

There is always a possibility of encountering unexpected events in any experimental work, which often leads to a failure in the production of data. The majority of such unexpected events involves equipment malfunctioning. In case of such events, students should inform the responsible TA and the instructor 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 replicate 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). Legitimate reasons for not retaking the measurements include unavailability of timeslots or COVID-19 considerations, but a prior approval is required.

### **Grading summary**

Please see the table below for a summary of the grading considerations:

| Item                    | Component                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Weight |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| <b>TP</b>               | <b>Prelab questions (10 points)</b><br>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.                                                                                                                                                                                                                                                                 | 10%    |
|                         | <b>Experimental skills and quality of work (10 points)</b><br>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. | 30%    |
| <b>Report</b>           | <b>Abstract (0.5 point)</b><br>An abstract is a brief statement of your work. Outline your motivation, your methodologies, and your results here.                                                                                                                                                                                                                                                                                                           | 60%    |
|                         | <b>Introduction (1.5 points)</b><br>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.                                                                                                                                                                                                                                                           |        |
|                         | <b>Methods (3 points)</b><br>Describe the procedures, equipment, and the parameters of the TP assignment in detail. Use equations, figures, and tables if necessary.                                                                                                                                                                                                                                                                                        |        |
|                         | <b>Results (3 points)</b><br>Describe the main results obtained from the TP assignment. Use equations, figures, and tables if necessary.                                                                                                                                                                                                                                                                                                                    |        |
|                         | <b>Discussions (1 point)</b><br>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.                                                                                                                                                                |        |
|                         | <b>Conclusion (0.5 point)</b><br>Briefly summarize the main findings and insights from the TP assignment results.                                                                                                                                                                                                                                                                                                                                           |        |
|                         | <b>References (0.5 point)</b><br>A list of references you cite in the main text of the report in support of the points you make.                                                                                                                                                                                                                                                                                                                            |        |
|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |        |
| <b>Extra Experiment</b> | <b>Experiment + Report (10 points)</b><br>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%    |