

Spring 2021

OPSE 402-002: Optical Science and Engineering Application

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Course Outline: OPSE 402

Spring 2021

CONVERGED LEARNING

Instructor: **Andrei Sirenko**
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tel: (973) 596-5342

Class time: **Monday 12:30 pm – 3:30 pm** **OPSE Lab: FMH 403B**

Office hours: Monday 3:30 pm – 5:00 pm or by appointment

Course Materials: *Instructor handouts. Lecture notes will be posted on Canvas.*

Recommended book: Hecht, *Optics*

Also consult the Physical Review Style and Notation Guide at <http://publish.aps.org/STYLE/> a copy is available in the labs

Goals:

- Learn about physical and optical phenomena by performing quantitative measurements
- Gain experience with techniques and instrumentation used in modern physics laboratories in Academia and Industry
- Gain experience in solving problems, which occur in experimental measurements
- Learn basics of data acquisition, data analysis, data storage, and data presentation

Materials:

for this course you will need a Lab Notebook with numbered pages

Note: The laboratory manual will be distributed in class or via the World Wide Web. OPSE web address: web.njit.edu/~sirenko

Error Reporting

LECTURE NOTES and the LIST of EXPERIMENTS

- Lecture 1 Nonlinear Optics and Raman Scattering
- Lecture 2 Second Harmonic Generation
- Lecture 3 High Power Lasers

LAB MANUALS:

SECON HARMONIC GENERATION

OPSE Lab Open Hours: OPSE lab (642-4956) will be open on Mondays 12:30 pm – 3:30 pm or by appointment.

Prerequisites: Recommended: Math 222 (differential equations), OPSE 301.

Assignments: You are responsible for all weekly reading and homework assignments listed in this outline. The reading should be completed BEFORE class each week. Homework assignments must be turned in according to the schedule listed in the outline. Homework assignments may be turned in up to 1 week late with a penalty of 1 full grade (ie. A becomes a B, B becomes a C). Each student must turn in individual Homework assignments. No group submissions will be accepted.

During the course, you will complete 3 laboratory assignments. The lab reports are due as indicated in the outline (nominally due 2 weeks after each experiment is completed). Laboratory reports may be turned in up to 1 week late with a penalty of 1 full grade (ie. A becomes a B, B becomes a C). Each student must turn in an individual laboratory report. No group laboratory reports will be accepted.

Groups and Working Together: You will typically work with one (maybe two) partners for these experiments. You are encouraged to help each other with homework and laboratory assignments. It is expected (although not required) that lab groups will present the same raw data in their laboratory reports. However, each student must submit an individual laboratory report with their own analysis, graphs, and discussion. DO NOT CUT AND PASTE your laboratory reports from other students' work.

Attendance Delivery of instruction is independent of place, merging the physical and virtual classrooms. There is an attendance expectation and students can choose to attend class face-to-face or using real-time synchronous video conferencing technology. Some instructors may require occasional proctored exams. (sometimes referred to as a synchronous distributed course).

*Contact hours are independent of delivery method and defined in the course catalog. Please be PROMPT and do not miss your assigned times. If you anticipate an absence, please let your lab partners and your instructor know immediately.

Exams: No written examinations will be given. Instead a Final Oral Report will be presented during the week of Final Exams. The final oral report will be a formal presentation of one of the experiments performed during the semester. Each student must present an individual laboratory oral report. No group reports will be accepted.

Grades: Final Oral presentation will count as 1/4 of grade. Homework assignments will count as 1/4 of your grade. The lab reports will collectively count as 1/2 of your final grade. Grades of below 50% are failing (F).

- There will be no food or beverages allowed in the Lab.
- If equipment seems to be malfunctioning, see the lab instructor or teaching assistant. You are not permitted to repair electrical equipment yourself.
- If you have to move the equipment, make sure it is unplugged.
- Lab manuals and equipment manuals may be signed-out for copying, but must be returned immediately. Ask the staff for instrument manuals.
- Damaged or lost manuals should be reported to the staff for replacement.
- If you break something, report it to the lab instructor immediately so that it may be fixed or replaced. Do not try to fix it yourself without reporting it. If you break equipment while doing something less than brilliant, do not be embarrassed to report it. You will not lose points if you break something, but you will be in big trouble if you do not report it. Reporting problems so that they can be corrected will gain you psychological points with the staff.
- Clean up after your lab session; leave the apparatus and work area in good condition for the next group.
- Return tools, support stands, rods, brackets, etc. to proper place. If you don't know the proper place, ask.
- When you need a tool from a set (e.g. set of wrenches), take the whole set, then return it whole. It is easier to locate a whole set than one missing piece.
- Do not use sticky tape, glue, aluminum foil, etc. in experiments; it never works. Use a proper, professional-level method; ask the lab instructor if you want to find the proper method.

Lab Reports:

- The report should be typed double-spaced (12 point font), and should be 5-10 pages long, excluding figures.
- While your experimental results may not be publishable, your report should be of publishable quality.
- Writing style should follow that outlined in "Style for students (and Others)" by J. Schall, or the American Physical Society (APS) standard outlined in

<http://www.aip.org/pubservs/style/4thed/toc.html>

and/or

[Reviews of Modern Physics Style Guide](#)

The Lab Report should include the following sections:

1. Title page with

- **Title of experiment**
- **Author name**
- **Date submitted**

2. Abstract

with a short summary of the main results. It should be a self-contained paragraph, which interprets the findings and describes their significance. The length is about 5-10 lines.

3. Introduction

2 or 3 paragraphs with description of the point of the experiment, historical overview, and a few references to recent scientific papers on the related subject. References can be obtained by literature search at <http://www.library.njit.edu/>

4. Theory

This should describe the theory and other background information relevant to your experiment, including all relevant equations and derivations where necessary.

5. Experimental procedure

This section should be a general description of the method you have followed, and should be complete and relatively detailed. It may include schematics of the experimental setup. However, it should not be an excruciating list of every small adjustment you made. This section can be a summary of the procedures described in the various manuals you will be consulting, but it should not be a literal transcription! Just for future reference for this lab, put detailed procedures in an appendix to your paper.

6. Experimental results

In this section, results are reported in Tables and Figures, and the data and error analyses you have done are described. Note that Figures and Tables need to be numbered, to have captions, and to be introduced in the text (e.g. "In Figure 4 and Table 2 the measured voltage as a function of applied external magnetic field is presented."). Data in Figures and Tables should not duplicate each other.

7. Discussion

This is where you bring it all together. You can restate your salient final results. You can comment on sources of error, difficulties encountered, and suggest ways to improve the measurements in the future.

8. Conclusions

should not repeat the Abstract

9. References

follow the APS style when citing references

Please proofread your reports thoroughly and check your calculations carefully before handing them in. Where appropriate (but only where appropriate), perform fits to your data and report the fit parameters with errors. Be as quantitative as possible in your analysis and discussion. Please read what you write and be advised that the following will result in lost points:

- Typographical errors
- Figures or tables without captions

- **Plots or tables without error bars**
- **Misreported numbers of significant figures in any $x \pm d$**
- **Miscalculated errors**
- **Missing or faulty units**
- **Egregiously bad English writing**
- **Undefined parameters used in equations**
- **Reports handed in late will be severely penalized**

Schedule can change to accommodate new experiments

Final Oral Presentation: Present a 15 minute oral presentation on one of the laboratory experiments that you conducted during the course.