

PHY 357: Intermediate Physics Laboratory (Spring 2021, CRN 20128)

Instructor: Dr. Eric Edlund

SUNY Cortland, Physics Department

*Please note that the policies, dates, and course organization described here are subject to change if our circumstances change.

Course Meeting Times

MWF 1:50 PM – 3:50 PM

Standing Office Hours

Monday 4:00 PM – 5:00 PM

Wednesday 12:50 PM – 1:50 PM

Friday 12:50 PM – 1:50 PM

Contact Info

Email: eric.edlund@cortland.edu

Phone: 753-5697

Office: Bowers 133

Preferred contact method is email or text communication through Microsoft Teams.

Or by appointment:

If you are unable to attend these standing office hours or would like to speak privately about a specific matter, you are welcome and encouraged to make an appointment.

I can also hold office hours on Teams.

Course catalog description

A laboratory experience stressing precise experimental measurement using a variety of instruments and covering various branches of physics.

General education attributes

This is a **Writing Intensive (WI)** course, a SUNY Cortland General Education designation that you must complete a minimum of 15 pages of writing, which includes opportunities for revision. Your writing requirement will be fulfilled in the lab reports. This course also helps you to fulfill your liberal arts and sciences requirements (LASR).

Course student learning outcomes

Upon successful completion of this course, the student will be able to

1. design experiments to measure physical phenomena;
2. analyze data using appropriate error analysis and statistical techniques;
3. defend data-driven conclusions with appropriate quantitative arguments;
4. evaluate peer results and critique others' procedures;
5. apply peer review critiques to their own work;
6. and present original results in professional written and oral formats.

Writing intensive student learning outcomes

1. Students will undertake an effective writing process and make informed decisions about their writing with input from their instructor.
2. Students will write effectively in the technical style appropriate for physics.

Required course materials

- *An Introduction to Error Analysis (2nd edition)*, by John R. Taylor
- A dedicated, bound notebook (i.e. not loose-leaf or a 3-ring) for recording lab notes

My goals for this course

Physics 357 is the quintessential laboratory experience for upper-division physics majors. In this class you will revisit old experiments and conduct new experiments. My goals for this class are that you:

- conduct experiments with care, precision, and attention to detail;
- conduct experiments that expand your understanding of physics in new areas such as optics, fluid dynamics, and particle physics;
- apply advanced statistical methods to rigorously defend your claims;
- become more skilled in working with hardware and develop better physical intuition for what is and is not possible, feasible, and safe;
- significantly improve your technical writing skills;
- and enjoy your experience and in the process find new passion for your studies.

What you will need to do to be successful in this course

You will be expected to conduct multiple experiments in this course, and to do so with a maturity and focus well above that what is typically seen in 200-level experiments. Toward these ends, I expect that success in this course will require you to:

- come to class ready to work and to make the most use of your time, which will be especially important if we continue to be limited to 55 minutes of in-class time per day;
- understand that this class is not about following procedures to complete experiments, but is about the philosophy of thoughtful experimental design, precision measurements, application of statistics, and communication of observations;
- learn new mathematical techniques, which will require that you read the textbook and complete homework assignments as in other courses, and do so without the use of Chegg or other similar resources;
- embrace writing and the revision process as a central feature of your work where you prove both your understanding and written communication skills;
- and bring a big can of patience and whole lot of can-do attitude that will empower you to plan ahead, diligently study the equipment, trouble-shoot your experiment, stay cool when you realize that you need to try again, and persist in writing a quality lab report through the revision process.

Online meeting and coordination

We will use Microsoft Teams for all of our class organization activities, including online lectures (if needed), grades, and regular text communications. Please use access code **xdaeg23** to join the team for this class, called **PHY 357 - Spring 2021**.

Note: Please do not use the browser-based app for MS Teams and download the desktop app which is far more stable.

Important dates

Monday 2/1	First day of classes
Friday 2/5	End of the add/drop period
Friday 5/7	Last day of class (last date for submission of work)
Friday 5/14	Final Exam, 11:00 AM – 1:00 PM

Assessment weighting

Lab Reports	60%
Pre-lab designs	18%
Homework	16%
Final Exam	10%
Presentation	6%

Number of assignments in each assessment category

6 lab reports
6 pre-lab designs
4 problem sets
the final exam will cover statistical analysis
1 presentation on a lab of your choosing

Score-grade equivalence table

	76.7% ≤ C+ ≤ 79.9%	E ≤ 59.9%
93.4% ≤ A	73.4% ≤ C ≤ 76.7%	
90.0% ≤ A- ≤ 93.3%	70.0% ≤ C- ≤ 73.3%	
86.7% ≤ B+ ≤ 89.9%	66.7% ≤ D+ ≤ 69.9%	
83.4% ≤ B ≤ 86.6%	63.4% ≤ D ≤ 66.6%	
80.0% ≤ B- ≤ 83.3%	60.0% ≤ D- ≤ 63.3%	

Note: You will be required to conduct and report on five experiments. Assessment will occur through the final product of this work, being your lab report. A missing or incomplete lab report will result in a half letter grade (5%) reduction in your final course grade.

Course policies and explanation of assessment categories

Note that these policies, including the types of assessment used and weighting of assessment areas, are subject to change if the circumstances regarding the operation of this course changes due to factors outside my control.

Masks and Social Distancing Policy: This class will be taught in person. This means that you must wear a mask to class and when visiting me in office hours. While in class you must abide by social distancing guidelines. Failure to act responsibly in these ways will result in dismissal from class for the day. A second offense is grounds for academic misconduct.

Attendance: Attendance in lab is mandatory. Each unexcused absence in lab will incur a 2% penalty to your course grade.

Lab Reports: You will conduct a total of six investigations. A list of available experiments will be provided to you. You must conduct one experiment from each of the following categories:

- A. classical mechanics (introductory)
- B. resonance and oscillations (introductory)
- C. thermodynamics (introductory)
- D. waves and optics
- E. fluid dynamics
- F. modern physics

A lab report is required for each one of your investigations. We will use the contract grading system for scoring your writing assignments, which is based on the idea that all writing needs revision, and full credit can only be achieved by revising your work based on the feedback given to you. A supplementary guide and a report template will be provided to you which will define the specific details of the grading criteria and the revision process.

Pre-lab designs: Prior to beginning work on any laboratory investigation, you must complete and have approved a pre-lab design. This document will identify four main things:

1. the goals of the experiment and the theoretical basis for interpreting the results;
2. the equipment needed to conduct the experiment;
3. the experimental procedure that will be used to meet the goals, which will include the type and number of measurements that you believe are necessary to get good results;
4. and safety requirements and conditions.

Homework: In addition to developing familiarity with laboratory procedures, we will be studying statistical methods using *Introduction to Error Analysis*. You will have four problem sets over the course of the semester. While you are free to collaborate, all submitted work must be your own. That means no copying or otherwise directly using another students' work, no use of solution manuals or posted solutions from any outside source, and no use of internet resources like Chegg.

Final Exam: The final exam will focus on theoretical aspects of the class (i.e. statistical analysis techniques), but may also include content from specific experiments, about experimental procedures, and technical writing. No late exams will be permitted without a valid reason, as outlined in the college catalog.

Presentation: In order to pass this class you must make a presentation about one of your final three experiments (i.e. from category D, E, or F). This presentation must include discussions of theory, goals, apparatus, measurements, analysis, and conclusions.

Lab notebook: A final check at the end of the semester will be conducted to look for a complete notebook, which is required to receive your 18% credit for the pre-lab designs.

How this class will operate if we move to an online: Should we move to an online phase then there are many things that may need to change. It is impossible to specify what exactly will change in this class without knowing those details. However, it is likely that the amount of time that we will be able to spend in lab will be significantly curtailed. Under these circumstances, we will adapt this course by using a combination of at-home analysis of experimental data taken from other sources, increased emphasis on theoretical analysis of statistical problems, and further emphasis on technical writing. In such a scenario it may be necessary to adjust the organization of this course, including changes to assessment categories and weighting of categories/assignments.

Course Schedule

Note that this is a tentative schedule and is subject to change as necessary. In addition to the laboratory work that you will conduct on an on-going basis, we will have regular lecture meetings to discuss statistical analysis, various theoretical topics, and the style and process of technical writing. The list of topics below covers only the lecture topics for the week, and does not in any way relate to the experiments that you will be conducting.

Week	Date	Topic	Ch.	P-Set	Lab Report
1	2/1 to 2/5	WI: The technical report	1	-	
2	2/8 to 2/12	Uncertainties vs. error	2	-	A
3	2/15 to 2/19	Graphical uncertainty	2	#1	
4	2/22 to 2/16	WI: Introduction to Latex	3	-	B
5	3/1 to 3/5	Uncertainty in power law relations	3	-	
6	3/8 to 3/12	General propagation of uncertainty	3	-	C
7	3/15 to 3/19	Heuristics	3	#2	
8	3/22 to 3/26	WI: How to write an abstract	4	-	D
9	3/29 to 4/2	Systematic & random error	4	-	
10	4/5 to 4/9	Measures of statistical quantities	4	#3	
11	4/12 to 4/16	WI: Critical editing	5	-	E
12	4/19 to 4/23	Normal distributions	5	-	
13	4/26 to 4/30	Normal distributions in Excel	5	-	
14	5/3 to 5/7	Testing for normal distributions	5	#4	F
15	5/10 to 5/14	Final Exam on May 14, 11:00 AM			

The dates shown for the problem sets and the lab reports are the due dates, which will be generally taken to be Friday afternoon at the start of class on the indicated week.

Note: The chapters listed above comprise the focus of our discussions. However, we will be including topics beyond these chapters and will reach into the later chapters in the textbook both for additional readings and exercises. Further information will be provided to you as we approach that work.

SUNY Cortland Policies and Statements

Academic Integrity Statement: All students are expected to uphold academic integrity standards. Plagiarism is defined as taking the ideas of others and using them as one's own without due credit. Students who cheat in examinations, course assignments, or plagiarize in this course may be disciplined in accordance with university rules and regulations. SUNY Cortland College Handbook, Chapter 340.

Disability Statement: As part of SUNY Cortland's commitment to a diverse, equitable, and inclusive environment, we strive to provide students with equal access to all courses. If you believe you will require accommodations in this course, please place a request with the Disability Resources Office at disability.resources@cortland.edu or call 607-753-2967. Please note that accommodations are generally not provided retroactively so timely contact with the Disability Resources Office is important. All students should consider meeting with their course instructor who may be helpful in other ways. SUNY Cortland College Handbook, Chapter 745.

Diversity Statement: SUNY Cortland is dedicated to the premise that every individual is important in a unique way and contributes to the overall quality of the institution. We define diversity broadly to include all aspects of human difference. The College is committed to inclusion, equity, and access and thus committed to creating and sustaining a climate that is equitable, respectful and free from prejudice for students, faculty and staff. We value diversity in the learning environment and know that it enhances our ability to inspire students to learn, lead and serve in a changing world. We are committed to promoting a diverse and inclusive campus through the recruitment and retention of faculty, staff and students. As a community, we hold important the democracy of ideas, tempered by a commitment to free speech and the standards of inquiry and debate. To this end, we are dedicated to developing and sustaining a learning environment where it is safe to explore our differences and celebrate the richness inherent in our pluralistic society. SUNY Cortland College Handbook, Chapter 130.

Inclusive Learning Environment Statement: SUNY Cortland is committed to a diverse, equitable and inclusive environment. The course instructor honors this commitment and respects and values differences. All students enrolled in this course are expected to be considerate of others, promote a collaborative and supportive educational environment, and demonstrate respect for individuals with regard to ability or disability, age, ethnicity, gender, gender identity/expression, race, religion, sex, sexual orientation, socio-economic status or other aspects of identity. In an environment that fosters inclusion, students have the opportunity to bring their various identities into conversation as they find helpful, but are not expected to represent or speak for an entire group of people who share aspects of an identity. If you have any questions or concerns about this statement, contact the Institutional Equity and Inclusion Office at 607-753-2263. <http://www2.cortland.edu/about/diversity/>

Title IX Statement: Title IX, when combined with New York Human Rights Law and the New York Education Law 129-B, prohibits discrimination, harassment and violence based on sex, gender, gender identity/expression, and/or sexual orientation in the education setting. The federal Clery Act and NY Education Law 129-B provide certain rights and responsibilities after an incident of sexual or interpersonal violence. When a violation occurs, victims and survivors are eligible for campus and community resources. Where the College has jurisdiction, it may investigate and take action in accordance with College policy. If you or someone you know wishes to report discrimination based in sex, gender, gender identity/expression, and/or sexual orientation, or wishes to report sexual harassment, sexual violence, stalking or relationship violence, please contact the Title IX Coordinator at 607-753-4550, or visit <http://www2.cortland.edu/titleix> to learn about all reporting options and resources.

Updated by SUNY Legal on February 1, 2018.