

Physics 310

Experimental Analysis

Spring 2026

Instructor: Daniel Robb

Class Times: T 8:30-11:30 (Trexler 263)

Office: Trexler 172D

Th 8:30-11:30 (Trexler 272)

Email: robb@roanoke.edu

Office Hours: T/Th 2:00-3:30

Phone: 540-375-5250

(15-min appts at calendly.com/daniel_robb)

Course Description:

Laboratory experiments and computational projects related to advanced and modern topics in physics. Data analysis, error propagation, and written and oral scientific presentation skills.

Textbook:

• *An Introduction to Error Analysis*, by Taylor, 2nd edition (1996), ISBN-13 9780935702750
(You may use the hardback 2nd edition if you like, I chose the paperback 2nd edition to reduce cost.)

Purpose of the Course:

You will learn about handling experimental data and experimental uncertainty in greater depth. Through four modules, one in each of the areas of our four upper-level elective courses (astrophysics, biophysics, physics of materials, and optics and spectroscopy), you will be introduced to the topics of the elective courses. In addition, you will learn to present the results of a scientific project effectively in both written and spoken formats.

Specific Goals of the Course:

1. to understand the principles and practices of handling experimental uncertainty
2. to be introduced to the topic areas of the upper-level elective courses at Roanoke
3. to practice skills of effective scientific writing and effective oral presentation of scientific results

Academic Integrity:

I will follow the college's Academic Integrity policies, and you are responsible for knowing and following the college policies. You will be working in groups on course modules and may discuss concepts or aspects of the modules with your group members and with me; however, your submitted module reports should be your own work. Assigned homework problems may be discussed with others, but you should not take the entire solution process from a classmate. You may use generative AI as an aid for writing module reports or on homework problems if you wish. However, overuse of generative AI can result in less genuine learning on your part. In any case, you must acknowledge the use of generative AI if you have used it on an assignment. I am contractually obligated to report students if I suspect that they have engaged in academic dishonesty. Lastly, unless otherwise directed, cell phones should be silenced and out of sight during class periods.

Policy on Late Work:

It's important to be punctual in turning in your work, so that you can make use of feedback and so that you do not get behind on assignments. Each school day (M-F) that an assignment (whether a homework or a module report) is late will result in a late deduction of 20%. As a result, assignments more than one week late cannot be accepted.

Methods of Instruction:

Working on meaningful physics questions via laboratory and computational projects is interesting, but also challenging. To help tackle this challenge, we will spend the first part of many Tuesday classes learning about error analysis through lecture and worked examples, as well as assigned problems. The rest of the Tuesday class, and the Thursday class, each week is devoted to group work on the modules, which are guided projects in the areas of astrophysics, biophysics, materials, and optics/spectroscopy. To facilitate growth in written scientific communication, you will be provided with a sample lab report, as well as the rubric used for grading the module writeups. To assist with improvement in oral communication, the rubric used in evaluating final oral presentations will be shared. Assistance on the modules will be available from the instructor as well as other members of the Physics Group. You are encouraged to use office hours to discuss the material, especially if you are having trouble.

Attendance Policy:

If you are feeling ill, I ask that you inform me via email and not come to class, for your own health and out of consideration to other students in the class. Outside of illness, you are expected to attend every class. If you are going to be absent from class for a valid (excused) reason, I must be notified in advance, either in person or via email. Your fourth and each additional unexcused absence will result in a 2-point deduction in your final course grade. Furthermore, you are accountable for all work missed because of any absence. I will provide class materials for a missed class, but I will not re-teach a missed class during office hours.

Make-up Tests:

If you miss a test due to illness or to an official college excuse, and notify me before the test, then a make-up test can be arranged. If your test absence is unexcused, you will receive a zero on the test.

Use of Electronic Devices:

In class, you may use personal laptops, but only for course-related purposes. All other electronic devices must be turned off. On tests, you may use a scientific calculator; all other electronic devices must be turned off. Violation of this policy will be treated as a violation of academic integrity.

Feedback and Evaluation:

You should expect to receive a final grade of “A” for 93-100, an “A-” for 90-93, a “B+” for 87-90, a “B” for 83-87, etc. I may tweak final grades slightly based on the distribution of numerical grades and my estimation of your effort in the course. These are the categories and percentages that will be used:

<u>Mid-Term Exam:</u>	15%	<u>Final Exam (Oral Presentation):</u>	15%
<u>Classwork/Homework:</u>	10%	<u>Peer Review:</u>	10%
<u>Notebook:</u>	10%	<u>Module reports:</u>	40%

The Mid-Term Exam will be given during class on the date indicated. *You will be given all needed equations on the exam*, though the equations will not be labeled.

Final exam (Oral Presentation): Oral presentation is a primary means of communicating scientific activity. You will choose one of your module reports to adapt into an oral presentation to the class. This oral presentation will serve as the final exam.

Classwork/homework will entail the working of problems from the Taylor textbook, both in class and at home, with the goal of understanding how to handle experimental uncertainty.

Peer review: You will be required to observe and evaluate one classmate's oral presentation (during the final exam period). You will be evaluated on the completeness and thoughtfulness of your review.

Notebook: It's recommended scientific practice to keep a journal of data, thoughts, and ideas, since one can never be sure when creativity or insight will reveal itself. You will be required in this course to keep such a journal. The journal will be evaluated for the continuity of effort shown in keeping the journal throughout the four modules you complete.

Written reports on modules: For each of the four modules, you will submit an individual report in a structured format including Abstract, Data/Calculations, Discussion, and Conclusion/Future Directions.

Accessible Education Services:

Accessible Education Services (AES) is located on the first floor of the Bank Building. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Dustin Persinger, Assistant Director of Academic Services for Accessible Education, at 540-375-2248 or by e-mail at aes@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Dustin Persinger at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester. The testing center, also located on the first floor of the Bank Building, can be reached at 540-375-2247.

Writing Center:

The Dr. Sandee McGlaun Writing Center and Subject Tutoring, located in the lower level of the Fintel Library (Room 5), offers free one-on-one support in writing, oral presentations, and course content such as Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, and Social Sciences. Open Sunday–Thursday from 4–9 PM, students can stop by or schedule through Navigate by selecting “Schedule an Appointment” → “Writing Center and Subject Tutoring” → “Writing Support” or “Course Tutoring” → preferred date and tutor. Contact subject_tutoring@roanoke.edu or 540-375-2590 for more information.

Course schedule

#	Date	Schedule	Topic	Submission
1	Jan. 13 (Tu)	Rotation 1	Intro to course, Taylor Ch 1	
2	15 (Th)		Start work on Project 1	
3	20 (Tu)		Taylor Ch 2, work on Project 1	
4	22 (Th)		Work on Project 1	
5	27 (Tu)		Taylor Ch 3, work on Project 1	
6	29 (Th)		Work on Project 1	
7	Feb. 3 (Tu)		Taylor Ch 4, work on Project 1	
8	5 (Th)		Work on Project 1	
	9 (Mon)			Project 1
9	10 (Tu)	Rotation 2	Start work on Project 2	
10	12 (Th)		Work on Project 2	
11	17 (Tu)		Work on Project 2	
12	19 (Th)		Work on Project 2	
13	24 (Tu)		Work on Project 2	
14	26 (Th)		Work on Project 2	
	27 (Fr)			Project 2
	Feb. 28 -Mar 8		SPRING BREAK	
15	Mar 10 (Tu)	Rotation 3	Start work on Project 3	
16	12 (Th)		Work on Project 3	
17	17 (Tu)		Taylor: Mid-Term Exam	
18	19 (Th)		Work on Project 3	
19	24 (Tu)		Taylor Ch 5, work on Project 3	
20	26 (Th)		Work on Project 3	
21	31 (Tu)		Taylor Ch 6, work on Project 3	
	Apr. 1 (Wed)			Project 3
22	2 (Th)	Rotation 4	Start work on Project 4	
23	7 (Tu)		Taylor Ch 7, work on Project 4	
24	9 (Th)		Work on Project 4	
25	14 (Tu)		Work on Project 4	
26	16 (Th)		Work on Project 4	
	20 (Mon)			Project 4
	25 (Sat)		Final presentations: 2:00–5:00 PM	

Note: You should expect to spend about 12 hrs/week on this course.