

EMBRY-RIDDLE

Aeronautical University

PC-PS 315 Modern Physics Laboratory
Section(s): 50PC

Course Information

Academic Term: Prescott Spring 2025
Term Dates: January 8, 2025 - May 1, 2025
Credit Hours: 2
Mode of Delivery: In Person
Class Meetings: 09:00 AM - 11:50 AM Monday, Wednesday
Location: Building 76 Room 221

Instructor Information

Name

Andri Gretarsson

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Name

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Catalog Course Description

Experiments in atomic and nuclear physics, including spectroscopy, nuclear particle analysis, X-ray analysis, and laser applications.

Course Goals

This laboratory is a core requirement for the Space Physics degree program. It provides students hands on experience in support of the Modern Physics course, PS 303. Furthermore, it introduces students to several sophisticated devices used in the discovery of fundamental properties of atomic and nuclear systems.

Student Learning Outcomes

1. Carry out an open-ended investigation using moderately sophisticated hardware
2. Analyze properties of electromagnetic radiation including polarization, diffraction and refraction effects
3. Utilize diffraction and prism elements in a spectrometer to identify emission spectra
4. Measure the components of an X-ray source and describe the events leading to the production of X-rays
5. Measure the attenuation lengths of various materials using a Geiger-tube
6. Measure the lifetime of radioactive nuclides using a multichannel analyzer (MCA) and a quantum photomultiplier tube (PMT)
7. Produce a concise and informative written record of laboratory test work
8. Determine the quality of the measurements obtained by using statistical fitting techniques, including linear and non-linear fits, goodness of fit, and chi-square tests
9. Produce at least one formal paper, fit for printing in a scientific journal, describing the method used and the results obtained from pursuing an open-ended investigation on a Modern Physics experiment

Prerequisite(s): PS 315 Prerequisite is PS 221 . Corequisite is PS 303.

Required Course Materials

Text/Tool: Experiments in Modern Physics

ISBN: 978-0-12-489851-6

Authors: Melissinos and Napolitano

Publisher: Academic Press

Publication Date: 2003

Edition: 2nd

Text/Tool: Two laboratory logbooks

Notes

Logbooks can be purchased at the bookstore.

Suggested Supplemental Materials

Text/Tool: An Introduction to Error Analysis

Subtitle: The Study of Uncertainties in Physical Measurements

ISBN: 978-0-935702-75-0

Authors: John R. Taylor

Publisher: University Science Books

Publication Date: 1997

Edition: 2nd

Notes

This is a book I have recommended in past PS315 labs. It is easy to read and it explains statistical concepts very well. It is 322 pages long.

Text/Tool: Measurements and Their Uncertainties

Subtitle: A Practical Guide to Modern Error Analysis

ISBN: 978-0-19-956633-4

Authors: Hughes and Hase

Publisher: Oxford
Publication Date: 2009

Notes

I came across this book last year and I like it too. It covers the basics of error analysis and hypothesis testing, and is only 129 pages long.

Text/Tool: Data Reduction and Error Analysis in the Physical Sciences

ISBN: 9789339221201

Authors: Bevington

Publisher: McGraw Hill

Publication Date: 2015

Edition: 3rd

Link: <https://www.amazon.com/Reduction-Error-Analysis-Physical-Sciences/dp/9339221206>

Notes

This book is a classic when it comes to Error Analysis. It comes with computer programs in Fortran and C++ (sorry, no Python). But you can easily convert the computer code presented in the book to Python. I would Google first and see if someone hasn't done it already.

Grading

Letter Grade	Percent
A	90 - 100
B	80 - 89
C	70 - 79
D	60 - 69
F	< 60

Grade Points

Labs 160 points
Pre-Labs 8 points
Homework 40 points

Formal Labs 100 points
Attendance 50 points

Total → 358 points

Course Policies

You must complete every lab exercise. You and your lab partner will be assigned 8 labs to complete. Each lab is worth 20 points. If you miss a lab, or anticipate missing a lab, you must discuss the situation with your instructor and lab assistant. Do not wait until the end of the term and then attempt to remedy the problem. **If you do not complete and submit all 8 labs for grading, you will fail the course.**

Plagiarism. Formal lab reports should reflect the student's work resulting from the data recorded during the course of the lab. If any part of your report is identical or very similar to the report of another student or any other source, that is considered plagiarism and will be disciplined in the same manner as cheating. (Note: your raw data should be the same as that recorded by your lab partner.). Using citations (i.e., bibliographic references) as part of your formal lab report is a good way to refer the reader to other materials outside your report that support your statements and conclusions.

Incomplete grades. The Incomplete (I) grade is only possible for students who have suffered medical emergencies or some other unusual hardship. The instructor will consider giving an "I" grade only if a student provides written evidence (e.g., a letter from a physician) concerning the hardship. A written agreement, detailing remaining work to be completed and the deadline, must be signed and dated by the student and the instructor before the end of the semester.

Lab Notebooks. Each student will need to purchase **two logbooks** from our campus bookstore to write and record experimental observations. In preparation for each lab, every student is required to write a **laboratory plan** (i.e., a **pre-lab**) describing both the physics principles being investigated and the apparatus to be used to measure the physical phenomenon. **Laboratory plans** must be written in LaTeX, and discussed and approved by the lab assistants before the beginning of each lab. As part of the "sign off," students should be prepared to answer questions regarding the experiment. The calendar for the Spring 2025 semester can be found in a Canvas module..

Lab Assistant's email:

A.J. Fabrega fabregaa@my.erau.edu

Lucas Murphy murphy19@my.erau.edu

Formal Reports. Each student will submit two formal reports as part of the course. The reports will be written using LaTeX, a type setting language used in scientific journals. The first report (40 points) will be from an experiment performed before Spring Break, while the second report (60 points) will be based on an experiment performed after the Spring Break. Both formal reports are limited to 4 pages, including bibliography (similar to the length of a Physical Review Journal article).

Supplemental Material. I will include additional material on my website as they relate to these modern physics experiments. So, periodically check my website for leaflets, manuals, and other material that will assist you with the understanding the physics, or the operation of the experiment.

***Attendance:** Regular attendance and punctuality, in accordance with the published class schedule, are required. The first day of lab is Wednesday January 8th at 9:00 am.

Final Exam. Because this lab meets twice-a-week, we are obliged to have a final "experience." Because both lab sections have been combined to occur at the same time, we do not have sufficient time to do an end-of-year oral presentation by you, our PS315 students. This year's final "experience" will be at the scheduled time: **Tuesday, April 29, at 12:30-2:30 pm.** Please come by in that time

period to do an attendance check, and grab some pizza. Your Formal Lab Report #2 will serve as your **Final** assignment. See you then.

Academic Integrity/Conduct

Embry-Riddle is committed to maintaining and upholding intellectual integrity. All students, faculty, and staff have obligations to prevent violations of academic integrity and take corrective action when they occur. The adjudication process will include the sanction imposed on students who commit the following academic violations, which may include a failing grade on the assignment, a failing grade for the course, suspension, or dismissal from the University:

1. Plagiarism: Presenting as one's own the ideas, words, or products of another. Plagiarism includes the use of any source to complete academic assignments without proper acknowledgement of the source.
2. Cheating is a broad term that includes the following:
 - a. Giving or receiving help from unauthorized persons or materials when preparing a graded course deliverable.
 - b. The unauthorized communication of examination questions prior to, during, or following administration of the examination.
 - c. Collaboration on examinations or assignments expected to be individual work.
 - d. Fraud and deceit, which include knowingly furnishing false or misleading information or failing to furnish appropriate information when requested.
 - e. Facilitation of academic dishonesty, which includes knowingly or negligently enabling one's work to be copied by others, such as posting one's work on a common networked drive.

For more information, see the [Undergraduate/Graduate Catalog](#).

Class Attendance

Class attendance is an important part of the educational process, and it is linked to student success.

Should you be unable to attend class(es) due to illness, injury, bereavement, accident, or other extenuating circumstance, please inform your instructor immediately. Your instructor reserves the right to excuse absences based on the class attendance policy.

Quick Access to Institution Policies and Services

- [Academic Calendar \(Links to an external site.\)](#)
- [Tutoring - Homepage](#)
- [Student Accessibility Services \(Links to an external site.\)](#)
- [Student Handbook \(Links to an external site.\)](#)
- [Sexual Misconduct & Title IX \(Links to an external site.\)](#)
- [Safety and Security \(Links to an external site.\)](#)
- [Vet Resources \(Links to an external site.\)](#)
- [IRB \(Links to an external site.\)](#)

Summary

The below assignments are showing the due date in Eastern Standard Time (EST) not Mountain Standard Time (MST). Please use the links below to verify your due dates in the Canvas Calendar.

Date Due	Name (Link)	Event Type	Points
	Final Presentation	Assignment	0
	Lab A	Assignment	20
	Lab B	Assignment	20
	Lab C	Assignment	20
	Lab D	Assignment	20
	Lab E	Assignment	20
	Lab F	Assignment	20
	Lab G	Assignment	20
	Lab H	Assignment	20
	Lab I	Assignment	0

Date Due	Name (Link)	Event Type	Points
	Pre Lab E	Assignment	1
	Pre lab G	Assignment	1
	Pre-Lab D	Assignment	1
	Pre-Lab A	Assignment	1
	Pre-lab B	Assignment	1
	Pre-lab C	Assignment	1
	Pre-Lab F	Assignment	1
	Pre-Lab H	Assignment	1
	Pre-Lab I	Assignment	0
3/8/24	Formal 1	Assignment	40
4/20/24	Formal 2	Assignment	60
4/29/24	Roll Call Attendance	Assignment	50
1/22/25	Homework 1	Assignment	20
1/29/25	Homework 2	Assignment	20

Continuity of Education Statement

In the event of a temporary campus closure due to extreme circumstances, courses will continue on Canvas with ongoing communication to occur via Canvas.