University of Wisconsin-Stevens Point
Physics and Astronomy
Experimental Physics — PHYS 470
2017 Spring

Course Information

- **Course title:** Experimental Physics — PHYS 470
- **Instructor:** Palash Banerjee
- **Contact:** B125 Science, x–4187, palash.banerjee@uwsp.edu.
- **Office hours:** MTWF 12 noon - 1 p.m. The laboratory will also be open daily from 9 a.m. - 5 p.m.
- **Pre-requisites:** PHYS 300 (Modern Physics) or consent of instructor.
- **Required:**
  1. Textbook: *Experiments in Modern Physics*, Adrian C. Melissinos and Jim Napolitano, 2nd edition, Academic Press, ISBN number 0-12-489851-3.
  2. Research laboratory notebook: The bookstore should have a proper cloth bound research grade notebook with numbered pages. The page size should be $11\frac{3}{4} \times 9\frac{1}{4}$ inches. Your notebook should look like this: `http://amzn.to/XRk7hD`. Please do not buy a cheap notebook.
- **Course description:** This is a hands-on course that introduces you to the art of being a professional experimental research physicist. You will complete two junior-level experimental exercises and three major senior-level experiments during the semester. An introductory guide with several exercises will be provided for most experiments but the guide may not be complete. It will be your responsibility to learn the theory behind each experiment, learn how the apparatus works and how to make the necessary measurements.

  You will submit *individual* reports on each laboratory exercise. For the junior-level experiments, the reports will be limited in scope and will mostly include graphs and a proper analysis with uncertainty estimates. For the senior-level experiments, you will submit a professional quality manuscript.

  I will use the lectures to introduce you to selection of supplementary topics and techniques that belong in the toolbox of a good experimental physicist — these include a reasonably complete discussion of how to estimate uncertainties in any experimental measurement, and an introduction to several different data analysis techniques.

  I will provide you with a theoretical background for each experiment. This information will be in form of my own notes and references to books and papers. As part of your background reading, I may ask you to derive and calculate certain quantities. These calculations should be done in your laboratory notebook. When you turn in your laboratory notebook for evaluation, I will look for these calculations.

- **Course objectives:**

  1. Learn the art of making reliable scientific measurements using complicated apparatus.
  2. Learn to maintain a high quality research notebook that documents your scientific work.
  3. Learn to write a clear technical narrative of your work.
  4. Practice giving a scientific talk to a technical audience.

- **Classroom times:** All classes are held in the Science building.

  - **Lectures:** Monday 2 pm in A106
  - **Laboratory:** Monday and Thursday 3 - 5 p.m. in 012.
  - **Additional hours:** The laboratory will also remain daily from 9 a.m. - 5 p.m.

- **Homework:** I will occasionally assign homeworks (based on the content of the lectures). Your written solutions must be turned in by the due date. Please respect the deadlines — late solutions will not be accepted.

- **Manuscripts:** You will present the results of your senior-level experiments as a manuscript written according to the style of an "American Journal of Physics" article.

- **Laboratory notebook:** A very important part of being a scientist is to maintain a laboratory notebook that documents your work, ideas and thoughts clearly. You will turn in your notebook for evaluation after each experiment. Your notebook should be full of important details, calculations, experimental tips and tricks and shortcuts you discovered and other things you deem worthy. Please be conscientious in maintaining your notebook as you work — a good notebook is an extremely precious laboratory resource that allows others to recreate your experiment long after you are gone and prevents them from making the same mistakes you did.

- **Oral presentation:** Each of you will give one oral presentation the last week of the semester. These will be timed, 12 minute presentations on one experiment of your choice. Guidelines on how to give an effective technical presentation will be provided during the semester.

- **Midterm:** The midterm exam will be based on the lectures in class as well as the experiments you have completed.

- **Final Exam:** The final exam is comprehensive and will be held on Tuesday, May 16 from 12:30 - 2:30 p.m.

General Course Policies

- Food and drinks are absolutely **not** permitted in the laboratory. No exceptions.
- Make-up work will only be accepted in the case of excused absences. Excused absences include death in the immediate family, illness with a note from the appropriate health care professional, religious observance, an event in which you officially represent the University of Wisconsin-Stevens Point and the event directly conflicts with an exam or lab. Excused absences must be approved with documenting materials prior to the date of absence.
- The schedule for the finals is set by the University. I will not schedule an early final exam for whatever reason. Please don't ask.
- I *do not* assign work for extra credit. There are *no* bonus points that you can earn.
- **Once you hand in your final exam, there is nothing more you can do to change your grade**.

Grading and Evaluation

I will calculate your grade based on a weighted percentage of your scores as follows:

Report from Junior exercises (5% each)	10%
Manuscripts from 1st two Senior exercises (10% each)	20%
Manuscript from Senior exercise 3	20%
Laboratory notebook (five evaluations)	25%
Midterm	10%
Research presentation	5%
Final exam	10%

Your final grades will be determined as follows:

Total score	Grade
90% and above	A
85–89%	A-
80–84%	B+
75–79%	B
70–74%	C
60–69%	D
below 60%	F

I do *not* grade on a curve. Scores will be rounded according to the following example: 79.6 will be rounded up to 80% but 79.2 will remain a 79%.

Tentative Course Schedule

The tentative course schedule is as follows. This might change and I will try my best to announce changes beforehand.

Week of	Laboratory times Mon 2 – 5 p.m. & Thu 3 - 5 p.m.	
(1): Jan 22	Mon: How to report & use uncertainties; propagation of uncertainties; Wed: Theoretical introduction to Junior exercise-1 (JE1): Atomic spectroscopy of hydrogen and sodium.	
(2): Jan 29	Theory: Propagation of uncertainties (continued) Laboratory: JE-1 (continued)	
(3): Feb 5	Theory: Statistical analysis of random uncertainties; Report on JE1 due. Laboratory: Begin Junior exercise-2 (JE2)	
(4): Feb 12	Theory: Graphical analyis of uncertainties, Least-squares fitting; Laboratory: JE2 (continued).	
(5): Feb 19	Theory: Exercises on graphical analyis of uncertainties; Report on JE2 due. Laboratory: Begin Senior exercise-1 (SE1), 2 ½ weeks	
(6): Feb 26	Laboratory: Senior exercise-1 (SE1), continued	
(7): Mar 5	Theory: The Poisson distribution and the uncertainties in a counting experiment Laboratory: SE1 ends; data analysis and finish report.	
(8): Mar 12	Theory: Exercises on interpreting experiments; SE1 manuscript due. Mar 16; Midterm 3 – 5 p.m. Turn in notebooks for evaluation.	
(*): Mar 19	**Spring break**	**No labs**
(9): Mar 26	Laboratory: Begin Senior exercise-2 (SE2), 3 weeks	
(10): Apr 2	Laboratory: SE2 (continued)	
(11): Apr 9	Theory: Exercises on SE2 Laboratory: conclude SE2	
(12): Apr 16	Laboratory: SE2 manuscript due; begin SE3, 3 weeks	
(13): Apr 23	Laboratory: SE3 (continued)	
(14): May 30	Theory: Exercises on SE3; Laboratory: SE3 (continued)	
(15): May 7	Laboratory: SE3 manuscript due; Research presentations on any one senior exercise.	
(16): May 14 Finals week	Final exam, Tue May 16, 12:30 – 2.30 p.m.	