PHSX 616: Physical Measurements Fall 2024

Professor Michael Murray, 785-550-8835, mjmurray@ku.edu.

When I was 16, I fell in love with physics because of a sense of wonder at creation. We live in an incredible universe full of beauty at all scales. If that were not enough, we can, a at least partially, understand how the universe works by taking and analyzing data, then using these data to confront a theory. This work requires great effort, honesty and integrity but is very rewarding. The purpose of this course is to engender within you the habits of an experimental physicist and hopefully a sense of wonder.

Course Goals and Objectives: The mastery of experimental techniques, estimating uncertainties, numerical data analysis, scientific writing, and presentations. It is important to learn the importance of checking data while taking it. Students will also learn the great satisfaction of ethical practice for a scientist.

Class Time: Tuesday & Thursday 11 am-noon in Malott 2005 and 1-3pm in 4082. If you are sick, please contact both Michael and me. We will work something out.

Teaching Assistant: Michael Chukwuka, mikemors@ku.edu Malott 4091
Office hours: Murray 3-4pm Tuesday/Thursday, Chukwuka 2-3pm Wednesday/Friday in 4088.

Text: Bevington and Robinson, "*Data Reduction and Error Analysis for the Physical Sciences*" 3rd edition, McGraw Hill, it is out of print but still available online. This should be a constant reference for your analysis.

Lab Notebook: For each experiment you need to keep a GoogleDoc as a lab notebook, with all your raw data and dates for each day that you worked on the experiment. This does not need to be polished but it should be referenced as a link in your reports.

Experiments: The core of the class is of course taking and analyzing data. You are required to complete at least four experiments, one of which must be by yourself. You should not have the same partner twice. To do well in the class it is essential that you learn to take high quality data and then confront theory with your data. This will require significant reading, thought and just straight trial and error to understand the equipment and the physical principles upon which the measurement is based. Graph your data while taking it and to show these graphs to me or the TA before starting analysis. To confront theory, you will need to make statistical tests of whether a model can fit your data. A set of tools for doing this in *Python* will be provided.

Safety: Experimentalists must take upon themselves a culture of safety. You will be expected to be aware and respectful of the apparatus and obey all safety rules described in the lab manual. If you work alone, please make sure that you have access to a cell phone to call for help if needed and do not work alone outside 9am - 5pm.

Written Reports: For many this may be the hardest part of the course. The reports should read like Physical Review articles see, http://journals.aps.org/prb/authors. They should be sufficiently complete and clearly written that readers would be able to use it to reproduce results. They must (i) explain the underlying physics as and its importance BEFORE the original experiment was done., particularly in the title and abstract (ii) reference peer-reviewed literature for closely related results at that time; (iii) show high quality data; (iv) present results effectively using figures and/or tables; (v) applying statistics to test if the data is consistent with various models (vi) draw sound conclusions from the results. Each report must also contain a hyperlink to your Google Docs notebook. Final reports must contain a specification section on improvements over the initial report.

Schedule: For each lab you will do initial & final reports, due either Tuesday & Thursday evenings at 11.59pm. For each lab 30% of the grade will be for the initial attempt and 70% for the final. Reports submitted after the deadline will be counted as late. No late report will be accepted at all after the deadline for the next report.

Week	*Tuesday*		*Thursday*	
1	27-Aug-24		29-Aug-24	
2	**9/3/24**		**9/5/24**	
3	**9/10/24**	Lab 1 Initial	**9/12/24**	
4	**9/17/24**		**9/19/24**	Lab 1 Final
5	**9/24/24**		**9/26/24**	
6	**10/1/24**	Lab 2 Initial	**10/3/24**	
7	**10/8/24**		**10/10/24**	Lab 2 final
8	**10/15/24**	**Fall Break**	**10/17/24**	
9	10/22/24		**10/24/24**	
10	**10/29/24**		**10/31/24**	Lab 3 initial
11	**11/5/24**		**11/7/24**	
12	**11/12/24**	Lab 3 final	**11/14/24**	
13	**11/19/24**		**11/21/24**	Lab 4 initial
14	**11/26/24**		**11/28/24**	**Thanksgivin**
15	**12/3/24**		**12/5/24**	
16	**12/10/24**	Lab 4 Final	**12/12/24**	

Grading:

Lab Reports	68%
Lab Notebook	5%
Ethics, quizzes, & attendance	12%
Talks in class + poster.	10%
Peer review	5%

A ≥ 90 **outstanding quality**
B 80-89 **high quality**
C 70-79 **acceptable quality**.
D 60-69 **minimally passing**,
F ≤ 59

Harassment: Please treat all with kindness

- Respect others' rights to hold opinions and beliefs that differ from your own. Challenge and criticize *ideas,* not the person.
- Listen carefully to what others are saying, even when you disagree with what is being said. Comments that you make (asking for clarification, sharing critiques, expanding on a point, etc.) should reflect you have paid attention to the speaker's comments.
- Be courteous. Don't interrupt or engage in private conversations while others are speaking.
- Allow everyone a chance to talk. If you have much to say, hold back, if hesitant seek to contribute.
- Respect the purpose of this class, restrict discussions to topics related to the course.
- Strive for intellectual humility since you don't know what you don't know.

Students with Disabilities: The office of Disability Resources, http://disability.ku.edu coordinates accommodations for all eligible students. If needed contact them soon as possible and contact me privately.

Academic Misconduct: The most severe sanctions allowed by KU will be applied to anyone caught fabricating data. Your reports must be written by you. If you refer to any written materials, you must reference the source. Lifting blocks of text (even if cited), paraphrasing, and copy and pasting materials are all considered plagiarism which is serious academic misconduct. If you copy without an appropriate reference, you will receive no credit for that lab, must redo it, and face academic misconduct charges. A 2nd offense will result in an **F** for the course.

Religious Observances: Students will not be penalized for absences due to mandated religious observances.