P 211 Lab Syllabus Fall 15 (4/20/15)

ALL course information is posted on Blackboard

PREREQUISITE(s): P211 Lab is part of a consolidated 4-credit course – See P211 Course Syllabus for general course information and requirements for passing the course.

A. Lab Handouts - Available on Blackboard.

Students must print them out, read them and bring them to each lab session. Note that most labs have a "Prelab" that must be **completed and handed in at the beginning** of the lab period to receive the indicated points.

Recitation

The P211 lab sessions include a roughly 1 hour "Recitation Exercise", which will be available in a separate document on Blackboard.

B. Submission of Lab Reports (Weekly)

- Students will have 1 week to complete their lab reports after doing a lab experiment. Students must turn in a paper copy of their lab report to their TA at the **beginning** of the following week's lab session.

- Starting with the first Experimental Lab students must upload their lab report to Blackboard's **SafeAssign** system and attach a printout of the first page of the resulting SafeAssign report to the paper copy of the lab report they turn in to their TA. Instructions are provided on Blackboard for how to do the SafeAssign submission.

C. Passing the Lab Portion of the course

You must receive a minimum of 60% of the total possible points in the lab to pass the lab portion of P211. Failing the lab results in failing the entire P211 course.

Reports are due ONE week after the lab session and must be handed in to your TA at the START of the lab session
Late reports will have points deducted as follows:

.. Up to 1 week late - 25% deduction
.. From 1 to 2 weeks late - 50% deduction
.. More than 2 weeks late - 100% deduction

Missing the lab will result in 0 points. You can makeup a lab IF you contact the lab TA PRIOR to the lab and get their approval for legitimate reasons like family emergency, illness. Note: Documentation may be required

D. Grading of lab reports

Experimental Lab (General point distribution, some labs may have different point allocations) - 100 total possible points for each lab

(1) 10 points for completing and handing in the PreLab

(2) 10 points for Title & Objective section

(3) 15 points for Theory section

(4) 5 points for Apparatus section

(5) 10 points for Procedure section

(6) 10 points for Data section (writing up the data you gathered in your lab report)

(7) 15 points for Results section in you lab report

(8) 25 points for Discussion section

E. LAB POLICIES INCLUDE:

1. Be respectful of each other (this applies to Instructors, TA's and students). Some specifics include:
    a. Follow the TAs instructions and the equipment setup described in the Lab Experimental document. Note: TAs can deduct points if students break lab equipment, don't follow instructions or are disruptive.
    b. Use of cell phones/ tablets/ computers during lab is limited to lab related activities.

2. TA's can assign and change seat assignments to facilitate lab management.

3. The instructor and the university reserve the right to modify, amend, or change the lab syllabus (course requirements, grading policy, etc.) as the curriculum and/or program require.

4. If you feel there was an error in the grading of a lab report, discuss your specific questions with your TA.

F. Lab Report Format/ Rules

1. Academic Honesty

You should work together with your lab partners in taking and analyzing data, and you will find that discussing the experiment with your partners helps you to understand the results.
However, you should record your own data, and the lab reports that you turn in **must** be your own work in your **own words**. ***You cannot copy or paraphrase ANY portion of your partner's reports, doing so will be considered plagiarism.***

Please refer to the section on Academic Misconduct in the NIU Student Code of Conduct. It is available on line at http://www.stuaff.niu.edu/judicial/24430jo(body).pdf

2. Lab report format

Lab reports MUST BE TYPED, no hand written lab reports will be accepted. Use an NIU computer since equation editor is installed on all of them. All graphs must be produced using Excel, unless your Lab TA indicates otherwise.

Title/ Objective
Your name, your lab partner's names, Lab Section, the name and date of the lab should be typed at the top of the lab report. State the objective of the lab in 1 sentence.

Theory
State the physics theory, objectives and equations (use equation editor to enter in your lab report) that are explored in this lab using your own words – do not repeat or paraphrase the theory given in the lab manual.
Comment on how the results of your experiment compare to the theory/objective of the lab.
One paragraph is sufficient.

Apparatus
List all the equipment used in the lab

Procedure
Document the steps you took to complete the experiment in a narrative, not numbered style in enough detail that someone could follow how you performed the experiment.

Data

.. Tables must have a title and appropriate units shown

.. Use Excel to produce all graphs

.. Graphs must be titled with labels and units on the axes. Use captions wherever appropriate.

Results
Show your final measurements and explain how you derived them. Record one sample calculation for each type of calculation you performed, i.e. do NOT type out all your calculations. Include any mean and uncertainty calculations and results (see Appendix). Note: Some labs may require graphs in this section rather then the Data section.

Note: Each lab experimental document may state what specific graphs & tables are to be included in the Data & Results sections

Discussion
Write in a narrative style, answering each question with at least a paragraph in length. Failure to write complete paragraphs with a justification for your answer will result in point deductions.

Each question that is skipped or not completely answered will result in point deductions

Appendix A – Calculating means and associated uncertainties

Types of Uncertainties

Uncertainty in a measurement can arise from three possible origins: the measuring device, the procedure of how you measure, and the observed quantity itself. Usually the largest of these will determine the uncertainty in your data.

There are two different types of uncertainties: systematic and random uncertainties:

Systematic Uncertainties

Systematic uncertainties/errors always bias results in one specific direction for a variety of reasons like an inaccurate measuring device that results in measurements being consistently too high or too low. Generally, lab equipment won't introduce systematic errors assuming it has been calibrated correctly. Human bias can introduce systematic errors, which is why we have multiple lab partners participate in making measurements.

Random Uncertainties

Random errors are the ones most commonly encountered in lab experiments. In contrast to systematic uncertainties, random uncertainties are unbiased - it is equally likely that an individual measurement is too high or too low. Random uncertainty means that several measurements of a quantity will result in a range of measured results, but will spread around a mean value. The mean value will be much closer to the "most accurate" value than any individual measurement.
How can one reduce the effect of random uncertainties? Consider the following *example:*
Ten people measure the time of a sprinter using stopwatches. It is very unlikely that each of the ten stopwatches will show exactly the same result. You will observe a spread in the results. Everyone won't start/stop their stopwatches at exactly the same time. But if you *average* the times of the ten stop watches, the *mean* value will be a better estimate of the true value than any
individual measurement, since the effects of the people who stop early will compensate for those who stop late. In general, making multiple measurements and averaging them will tend to cancel out most of the random uncertainties.

Calculation of mean and uncertainties for P211 Lab reports

Mean: $\overline{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$, which is just the simple average of n measurements

Variance: $s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(X_i - \bar{X})^2$, which is the statistical average deviation of each measurement from the mean. The larger the differences between each measurement and the mean, the larger the variance.

Finally, the actual error or uncertainty is: $u = \sqrt{\frac{s^2}{n}}$, which is the square root of the variance divided by the number of measurements made.

Example

Four measurements are made of a distance (cm): 5.1, 5.2, 5.0, 5.3

Mean is:

$\bar{x} = \frac{1}{4}(5.1+5.2+5.0+5.3) = 5.15\text{cm} \rightarrow 5.2\text{cm}$ (round to same sigfigs as original measuremnts)

Variance is:

$$s^2 = \frac{1}{4-1}\left[\left(5.1-5.2\right)^2 + \left(5.2-5.2\right)^2 + \left(5.0-5.2\right)^2 + \left(5.3-5.2\right)^2\right]$$

$$s^2 = \frac{1}{3}\left(0.06\right) = 0.02cm$$

Error is: $u = \sqrt{\frac{0.02}{4}} = 0.0711 \simeq 0.07cm$

So, you would record your final mean distance value including the uncertainty as $5.2 \pm 0.07cm$