Physics 360 – Modern Physics II – Fall 2017

Instructor: Dr. Andrew B. Croll
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Office Hours: Monday and Friday 9:00 to 11:00

Aim: To learn how the interaction of matter and energy govern the behavior of the universe around us.

Description: Continuation of modern physics covering molecular structure, nuclear physics and solid state physics with an embedded modern physics laboratory with experiments such as atomic and molecular spectroscopy, electron diffraction, nuclear spectroscopy, photoelectric effect and computer simulations of experiments.

Prerequisites: MATH 266, PHY 252, PHY 350

Class: M/W/F 11:00 - 11:50 - NDSU South Engineering, Rooms 221 and 312 (Class participation is expected! Laboratory attendance is mandatory (i.e. Fridays)!)

Required Course Materials: (available at NDSU Bookstore)
(1) Morrison, *Modern Physics for scientists and Engineers*.
(2) Scientific calculator.

Evaluation:

1 midterm exam	20%
1 final exam	20%
5 assignments	20%
6 Lab Assignments	40%

Grading:

85%	-100%	A,
70%	- 85%	B,
60%	- 70%	C,
50%	- 60%	D,
0%	- 50%	F.

Marking Scheme: three point marking system

0	– nothing of any value is written down
1	– something useful has been written down
2	– the main idea of how to solve the problem appears
3	– mostly a correct answer (1 minor mistake permitted)

Assignments: Homework problem sets on current course material will be assigned in class. There will be a problem set covering each chapter, which is required to be submitted at the time indicated on each problem set. **No late homework will be accepted.** You may work together on homework sets, but do not simply copy another's answers; this will not benefit you when it comes to the exams or your future.

Attendance: According to NDSU Policy 333 (http://www.ndsu.edu/fileadmin/policy/333.pdf), attendance in classes is expected.

Make-up Policy: There shall be no make-up allowed for missed assignments or quizzes. If the midterm is missed and a student provides written documentation of a legitimate reason the final exam will be made worth double.

Service Members: Veterans and student service members with special circumstances or who are activated are encouraged to notify the instructor as soon as possible and are encouraged to provide Activation Orders.

Special Needs: Any students with disabilities or other special needs, who need special accommodations in this course, are invited to share these concerns or requests with the instructor and contact the Disability Services Office (http://www.ndsu.edu/disabilityservices/) as soon as possible.

Academic Honesty: The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at www.ndsu.edu/academichonesty.

Modern Physics Laboratory

Each student will individually complete six experiments during the semester. Each laboratory will nominally take two weeks (2 hours/week) to complete. Students will rotate through the experiments during the course of the semester. Each laboratory period will replace one lecture during the 12 weeks that they are scheduled. Additional times for lab work will be coordinated at the beginning of the semester since the experiments will not usually be completed in one hour. The laboratories will complement the sections covered in lecture and in general the material covered will not be repeated in lecture. Corresponding reading sections will be assigned in the text for the experiment.

All students must have a lab notebook, with the pages numbered consecutively, in which all notes and experimental data, including graphs and tables, will be entered. The suggested notebook is Lab Book Large, 43-581, available in the NDSU Bookstore.

Tentative Laboratory Choices

Lab Number	Topic
1	Atomic and molecular spectroscopy
2	Electron diffraction
3	Michelson interferometer
4	e/m, photoelectric effect, determination of h
5	Frank-Hertz experiment
6	Millikan oil drop experiment
7	Muon lifetime measurement
8	Single Photon Interference
9	Diffusion – particle tracking and correlation.
10	Chaotic Pendulum

Lab Report Preparation

General comments:

1. Read the experiment manual **before** coming to lab.
2. Data is to be defended before writing up the lab. This means presenting your data to the instructor, and proving that it is adequate to meet the goals of the lab.
3. Lab reports will be prepared using Microsoft Word.
4. Images, plots, etc. will be prepared in MatLab, Excel, or your favorite software and inserted into the Word document. MatLab and Excel are available on the SE312 computers.
5. Lab reports will be submitted using BlackBoard Assignment. Reports are due 1 week after the lab is scheduled to be completed. **Late reports will not be accepted and will result in no credit** (except for exceptional excused delays such as medical or blizzards).

Content of lab reports

Parts a) through i) below must be included in all reports. One basic standard is that you must include enough information so that another student would be able to easily repeat the experiment, avoiding any problems that you experienced.

a) In an introductory section, explain the purpose of the experiment and the physics behind the experiment. In the body of your report indicate the purpose of each set of measurements or calculations you report. Clearly explain what you have done. **For calculations explain what you are calculating and how it was calculated (including appropriate equations). Carefully identify all the variables used in equations and calculations. SHOW INTERMEDIATE STEPS IN ALL ANALYSIS.**

b) Discuss any problems encountered in the experiment and how you overcame them.

c) Draw or copy a diagram of the experimental apparatus used to perform the experiment. Clearly show how any parts are connected. Also give a complete list of parts (pieces of equipment etc.) used in experiment.

d) Collect and record at least two sets of data for every measurement you take. Assign experimental errors to your measured data. For example, if you take a reading from an analog meter or a meter stick, an estimate of the experimental error would be some reasonable fraction of the smallest division on the scale. For digital instruments you can usually use changes in the signal over time to estimate an error.

e) Calculate errors in the physical constants or other parameters you determined in your experiment. Assume that these are random uncorrelated errors. Calculation of random errors will be discussed in class.

f) Neatly tabulate and plot your data using Excel, Matlab or other software.

g) **Fitting of equations to experimental data.** In experiments you are requested to fit equations to your data to **determine significant experimental parameters.**

h) Always plot "best-fit" functions (that is the appropriate equation using the best-fit parameter value or values) as a **solid line** (without points**).** On the same graph plot your data points as large symbols like diamonds not connected by a line. This allows a direct comparison that often tells you if something has gone wrong with your attempt to fit an equation to your data or your measurements are corrupted in some way. **As discussed in class, data points should distribute evenly on both sides of your best-fit curve in a "good" fit.**

i) Finally summarize your experiment. The results found and the conclusions reached should be discussed. For example, if you have determined a physical constant, one part of your summary should be to compare your value with the accepted value for this constant. A discussion of the difference in these quantities in terms of your calculated error in the constant should also be given. Discuss other problems which may produce errors.