SYLLABUS - PHYS 374 Introduction to experimental Physics (3 unit) at Northern Illinois University, Department of Physics

Professor C. Thompson[1, a)]
Northern Illinois University

(Dated: version 1.0a for Fall 2014 semester)

Phys 374 Class meets - Tuesday and Thursday 10:00 - 11:50 am. Using Faraday West 233 (Electronics Lab) for lectures or presentations. Laboratory used are LaTourette 219/Faraday Hall 121A and LaTourette 213.
Faculty - Professor C. Thompson (815-753-1772)- cthompson@niu.edu - LaTourette Hall 207
`http://www.physics.niu.edu\~cthompson`
Office hours - Tues 1:30-3pm and preferred is by mutual agreement. Please just go ahead and contact me!
Teaching Assistant - Mr. Daniel Boyden

Textbook -
Optional - Experiments in Modern Physics, Second Edition, Adrian C. Melissinos and Jim Napolitano (2003) Academic Press (Imprint of Elsevier).
Lichten used as guide for error analysis. 'Guides' for experiments will be made available, but for writing reports and preparing for experiments, students are expected to find appropriate references in the Library, in their textbooks, and on the Web.

Supplies - A Logbook (and non-erasable pens to write in it). Spiral bound is appropriate, although the pages must be numbered sequentially in pen before class. Also, continuing in older logbooks from prior lab classes is appropriate, however the labs for this class should be sequential in the book). Students need ready access to a computer that can run Latex (either via MikTex (PC), TexLive (linux), MacTex (Mac), or Sharelatex (cloud-based, student license is $8/month).

There is no midterm or final, the grading is primarily based on demonstrating understanding of the material through observations and questions during lab sessions, the content quality of the presentations and reports, the preparation quality of the presentation and reports, the logbook maintenance (careful and complete reporting in the logbooks at each lab session). Attendance is required.

Two unexcused absences equals an F for the course

This syllabus is a guide and every attempt is made to provide an accurate overview of the course. However, circumstances and events may make it necessary for the instructor to modify the syllabus during the semester and may depend, in part, on the progress, needs, and experiences of the students. Changes to the syllabus will be made with advance notice.

I. CLASS INFORMATION AND CONTEXT

The one semester course (Phys 374) is the junior-senior undergraduate advanced laboratory course for physics majors. Students enrolled for Phys 374 are expected to demonstrate a considerably deeper level of inquiry with respect to an experiment and its scientific context than expected in the introductory physics labs (Phys I and Phys II). Students will be expected to act independently to research the topics via use of the libraries, textbooks, prior course work, and web to find sources and information, and using standard technical convention to reference those sources in their reports and presentations.

A yearly report based on the observations of the instructor on student mastery of concepts in physics is an important component of the physics program assessment activity.

Catalog description:
PHYS 374 - Selected experiments from classical and modern physics stressing laboratory practices and current measurement techniques such as STM and SQUID. Includes lecture and one four-hour laboratory a week. PRQ: PHYS 284. CRQ: PHYS 383. Credits: 3.

A. Experiments for Fall 2014

While there may be additional experiments offered, the following options should be available Fall 2014

- Optical Activity in materials under magnetic fields (Faraday Effect)
- Tunneling, and the imaging of surfaces using the

[a)] cthompson@niu.edu; http://www.physics.niu.edu/~cthompson

tunneling effect in the Scanning Tunneling Microscope (gold single crystal terraces, atomic imaging of graphite)

- Electrical transport (Hall effect as function of temperature, Band gap determination)
- Nuclear Magnetic Resonance in the Earths Field
- Muon lifetime experiments (based on the Teachspin system)
- X-ray diffraction and spectroscopy
- Superconductivity and Meissner effect
- Ferroelectric Properties of Materials - and the ferroelectric phase transition
- Mossbauer spectoscopy

B. Laboratories

Four laboratory reports are required, and four 15 minute presentations and four 15 minutes group debriefings to the class. Each lab will get 4 2-hour in-class sessions devoted to it, with 2 2-hour sessions devoted to the debriefings and the presentations.

Students will perform lab work in teams of 2 and occasionally 3 if necessary, but we will also rotate team members. As in the 'real world' of research and technical problem solving, we encourage discussion, arguments (with professional courtesy maintained) and questions during the collaboration between members of a team.

C. Other In class activities

Debriefing sessions, Presentation sessions, and a lab report will be required on each of the 4 labs. Copies of logbook entries for each expeimental session are required.

1. Latex for lab reports

One of the skills acquired will be using the technical report/equation editing scripting of Latex. **Lab reports will be required to be written in Latex (use the template provided)**. At least one class session is devoted to going through Latex templates and trying out and several working templates (showing equations, figures, and bibliography) are on the course dropbox website. Besides MikTex (PC) and TexLive (Linux) and MacTex (mac) distributions, there is an on-line version of Latex (ShareLatex) that is very convenient and well-maintained. A student license is very reasonable, cost is $8/month. It also can be used for free (to try out), however, it runs a lot slower (sometimes achingly slow!) in the free account. See the course website for documentation on how to upload the class templates and how to upload figures to ShareLatex.

2. Logbooks

An electronic copy of the logbook pages (either photo, scanned, etc) must be turned in after every lab session (even independent ones). Required component before leaving the lab is an ending debriefing description/analysis of results/activities/progress of the lab session.

A logbook is a *chronologically accurate* account and record of activities in the lab. This includes observations, attempts at the experiment, equipment configurations at point in time of measurements, logic of steps, hypotheses, and analysis during the measurements and experiments, tables of measurements, documentation of filesnames/location of data or data backups. Chronological accuracy and detail is important - if a sample was first used for one thing, then reused several days later for something else, or if the batteries were changed before or after a set of measurements and the measurements are different than before, or if the experimenter is using a different protocol because she/he has learned from a previous mistake, - these all are important things to go into a logbook.

The logbook serves as a reliable memory, and also serves as concrete proof that the scientist or student is not 'making up' of fiddling with the data in order to get a particular conclusion.

All the types of things that might typically get jotted down on various sheets of scrap paper during working on the experiment - THOSE are the things that should be in the logbook, not written and thrown away.

Reports, presentations, and summaries of activities and results are NOT chronologically accurate accounts and records. They are NOT a log of the work during the experiment. They are organized to communicate effectively the background, the results and the context of the experiments.

3. Debriefing meetings

Debriefing meetings concentrate on presenting and organizing the information about the equipment, methods, problems, misunderstandings, and pose questions about the experiments. While they can be unpolished, they should show efforts to organize the information for the audience. What will the next group need to know from your mistakes or successes on the equipment? What will they learn and how can they take the experiment further? What outstanding equipment issues still remain?

4. Presentations on the science

Presentations should be more polished, and concentrate on the background science, and on the results or measurements obtained, and how to interpret these measurements. They should follow format for typical technical presentation.

5. Written Reports

Written reports are due the day of the presentation. Electronic versions of a working latex zip file is turned in (with figures, raw latex and bibliography files, and the pdf output). Reports up to one week late will be accepted without penalty (as long as students have been in discusison with the instructor). 10 points off scoring per week late. Written reports follow standard technical report format. The rubric for scoring re

II. GRADING AND GRADING POLICIES

While every effort will be made to keep the website up to date - students are responsible for any administrative issues that occur if they were absent for missed in-class announcements that affect grading, activities, and lab changes. Note that as a lab class, missed classes or being very late to classes (unexcused absences) carry a big penalty.

Grades: The majority of the grades will be based on the lab report and presentations. The grading is primarily focused on assessing a student demonstrating understanding of the material through observations and questions during lab sessions, and students the presentations and reports, and the logbooks.

Assessment of a students level of understanding of the material through the reports and presentations is based on rigorousness and completeness of background and theory development organization and clarity shown in the report and overall quality of analysis of data, appropriate use of figures, tables, charts quality of data and description of data and technique appropriate references, and adequate use of outside literature according to standard technical references conventions.

Class is graded on an A, B, C, D, F system. Final grade weighting will be based as follows -

- Attendance - **A student with more than 2 unexcused absences automatically receives an F for the course.** Keep in contact with the instructor in advance of class attendance issue.
- Careful and complete logbook documentation each session 10%
- Experimental skills or progress in acquiring skills - (from instructors observations of work and progress during experiments) - 10%
- Lab reports (only working Latex accepted) - 40%
- Class presentations - 30%
- Active participation in the debriefings - 10%

Note that for each item - Rubric level of 'meets expectations' is usually equivalent to a B..

III. LABORATORY STANDARD PRACTICES

Use sensible and standard laboratory safety protocols. This lab has some chemical hazards at various times, (there are chemicals stored in the lab, and used in some of the lab modules), it has mechanical hazards (pinch points, sharp corners and metal edges on equipment, heavy objects being moved), it has electrical hazards. Be aware and think through potential hazards before starting activities.

A student who does not satisfy the required items as listed below will not be allowed to work in the lab for that session and it will be counted as an unexcused absence against him or her.

- REQUIRED - Closed toe shoes in the labs and shoes should cover the top of the foot (no sandals, high heels, platforms, slippers)
- REQUIRED - Covered legs (long pants), and torsos (i.e., keep those bellies, chests and cleavage covered! and avoid sleeveless shirts.)
- REQUIRED - Absolutely NO food or drink in the lab, no gum or tobacco chewing, no smoking. Treat all these actions like smoking - take them outside. Keep these items stored securely out of the lab environment.
- REQUIRED - Take off scarves, dangling jewelry and tie back long hair. If a headscarf is required due to religious preferences, secure it carefully so that it does not dangle or have loose ends.
- REQUIRED - Safety glasses when handling chemicals and gloves if instructed to do so for certain lab modules.
- REQUIRED - Use the buddy system if working in the lab after hours or on weekends. Do not work alone.

The following are important safety considerations.

- Maintain a neat laboratory workbench and floorspace. Do not create trip hazards. Put tools and excess equipment away. Know the location of the nearest exit. Pathways to exits must be clear.
- Keep aware of what is around you, and think ahead to identify potential safety hazards so that they can be avoided or designed out of process in advance.
- WASH HANDS immediately after leaving lab and going on to other activities. An antiseptic wipe is not the point (it isn't just 'germs' but lab dust and grit, whether it is metal filings, plastic, or chemicals that you need to remove).
- Do not chew on pencils, pens, etc - keep things away from your mouth and eyes. Be aware of your habits.

- Report accidents and give as much background information on activity and actions as possible. We need to learn from what occurred. And, if there was a previously unidentified hazard, we need to understand it and either eliminate it or change the process or protocols or engineer safeguards as appropriate.

IV. STANDARD POLICIES AND PROCEDURES

1. Cheating will not be tolerated, and will be dealt with according to the NIU Student Code of Conduct.

2. Working together - Students should be comfortable acknowledging and citing sources that are used whether in writing a paper, developing research ideas, or getting significant help on answering or understanding answers on working problems. Be transparent and honest. Acknowledge (in writing) sources or students who helped significantly, in particular, if the work would not have been done on time and correctly without that help.

3. Attendance: As a laboratory class, attendance is important and non-attendance impacts the grade. More than 2 unexcused absences is an automatic F.

   Excused absences are usually medical emergencies, or occasionally scheduling issues that are discussed bf in advance by the student with the instructor. Note that as a student, you may still be required to reschedule or change the other activity to attend class.

   What are examples unexcused absences? Sleeping late and missing class is an example of an unexcused absence! Missing class for other activities (club meetings, travel, waiting for the repairman at home) that could have been discussed in advance with the instructor is an unexcused absence.

   If emergency medical or family crisis interferes with attending, contact Professor Thompson by phone, mail, or email, as soon as practical. Give enough specific information to let Professor Thompson assess the situation and plan for accommodation. Any realistic timeline is also helpful (i.e., is this life-altering for several weeks, or was this just a very scary event but has a quick recovery?).

4. NIU abides by Section 504 of the Rehabilitation Act of 1973 which mandates reasonable accommodations be provided for qualified students with disabilities. The NIU Disability Resource Center, located on the 4th floor of the University Health Service (815.753.1303) is the designated office on campus to provide services and accommodations to students with diagnosed disabilities. You need to provide documentation of your disability to DRC if you seek accommodations in this course. Your success as a student is of utmost importance. If you have a disability or any other special circumstance that may have some impact on your work in this class, and for which you may require special accommodations, please contact me early in the semester so that accommodations can be made in a timely manner.

5. Requests for accommodation for missing classes due to work schedule changes, department, student club, or class activities - please handle these outside of class (in my office or by email or phone).

6. Incompletes and procrastination: Grades of Incompletes (I) are given when serious circumstances arise causing chronic disruptions of the student's ability to concentrate at his or her usual level of performance. This can happen to anyone. So please, be proactive, be professional and be realistic.

   Examples might be severe illness lasting several weeks or more, or the normal coping response to physical or emotional traumas such as an assault, the death or illness of a close family member, divorce, breakup. These can really throw off any student! Please be proactive and do not 'tough it out' when special situations arise. Students should start talking to the instructor or the college advisors when things start breaking down.

   Note that an I (incomplete) is not given for 'chronic' procrastination due to poor schedule planning, inability to develop good study habits, ignorance, or immaturity.

7. For medical withdrawals, (requests to college to be dropped from a class (after the deadline for withdraw has passed) - the Withdraw Pass (WP) or Withdraw Fail (WF) grade will usually be determined by the pro-rated grade that the student was achieving at the start of the 8th week.