Course Number and Title: PHYS 3270 02: Advanced Physics Laboratory

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Office Hours:
- Monday, 2:00pm-5:30pm;
- Thursday 1:00pm-2:00pm;
- Friday 10:00 am-12:00 pm;
or by appointment.

Catalog Description: This is a required course for physics majors. This course is intended to advance the student's practice and experience in physical measurements and serve as an introduction to the techniques and instruments used in experimental research in optics, atomic and nuclear physics, and astrophysics. This is an experience-enriched course.

Pre-requisites: PHYS 3300. You should also be comfortable with the material of Phys 2520 including its lab portion. Some knowledge of Statistics (MATH 3351) and Multivariable Calculus (MATH 3301) will be useful.

Course Overview: Advanced Physics Laboratory (1-3 cr.) is intended to advance student’s practical knowledge and experience in physical measurements and to serve as an introduction to the techniques and instruments used in experimental research in optics, atomic and nuclear physics. It is one-semester course which consists of three major modules: 1) Classical Physics Experiments, 2) Wave Optics Experiments, and 3) Modern Physics Experiments. Each module employs a variety of formats to present the material, a variety of learning modes, multiple assignment types, and group as well as individual student work. The intention is to maximize the number of contexts in which students have to work with the topic’s material. Making students reuse their knowledge in different situations, that might each require different kinds of knowledge representation (mathematical, verbal, graphical, etc.), enhances development of scientific reasoning and acquisition of functional understanding of physics concepts behind the experiments. Most of these activities involve peer interactions, which enhances motivation to learn the subject as well as increases the autonomy of students.

For each particular experiment in the course sequence, the class will have a student-leader (on some occasion instructor may take on that role), who does background reading on the subject and directs the class through the theory behind the experiment as well as general ideas about experimental design. This student-leader is responsible for preparing a short introductory lecture at the beginning of the class period.

In the course of the lab sessions, experiments are performed by students working either individually or in groups. Experimental equipment may vary from one person/group to another and part of the task is to figure out the appropriate design for detailed experimental procedure. Experiments in each module are interrelated, so that an information obtained from previous experiments may be needed in order to be able to complete the following experiment. For each experiment a student has to write the formal lab report describing experimental goals, experimental procedure, in order to achieve these goals, the data collected, their analysis and conclusions derived from the experiment.

Last several weeks of the semester will be devoted to the large experimental project undertaken by the class as a whole. The semester is finished by the final oral presentation and the formal written report on based on this project. Every student should take some part in this presentation/report.
Course Objectives:

- Students will enhance their understanding of the basic concepts of Electromagnetism, Optics, Atomic and Nuclear Physics introduced in University and Modern Physics courses.
- Students will improve their laboratory techniques and proficiency in the use of laboratory equipment.
- Students will sharpen their data analysis skills and the ability to use the appropriate computational software for the error analysis.
- Students will develop and/or improve their leadership skills and get experience working as part of a team on group projects.

Course Materials and Support:

Required Course Materials:

Laboratory notebook. Scientific calculator. The Advanced Physics Laboratory Manual which will be published online through Moodle. 
Class Web Page at [http://www.mcm.edu/~bykov.tikhon/phys3270/phys3270.html](http://www.mcm.edu/~bykov.tikhon/phys3270/phys3270.html) for supplemental information and assignments--check frequently!

Optional or Recommended Course Materials:

The books used as textbooks for Phys 2520 and Phys 3300 are useful. The additional list of references is available in the laboratory manual for every experiment.

AEC and Other Educational Support Resources:

Your instructor is normally available at the posted office hours or by appointment. You may drop in without an appointment, but may be asked to come back later. You may ask questions by E-mail. This usually works fine for short questions about a specific concept or method, but do not expect that the instructor will do the entire assignment for you. Your instructor and fellow students won't be much help if they merely provide answers.

Course Policies:

Attendance:

It is understood that attendance is part of the learning commitment — placing oneself in a class setting where effective educational communication and interaction can happen. Students are expected to be regular and punctual in their attendance habits. The students who are late may not be admitted to the class room. Attendance is required and will be noted through activity participation. Any necessary absence occurring while a student is representing the University in some official way will be considered an authorized absence. Work missed due to such an absence is to be made up as instructor determines. It is students’ responsibility to inform the instructor about their authorized absences in advance and arrange the make-ups.

Grade Determination:

- Lab reports scores constitute 75% of the course grade. See lab report grading guidelines on Moodle for details.
- Student-leader performance 10%. The grade will be based on the quality of the lecture, leading the class through experiment, and the feedback received from other students in class.
- Final group project 15% (7% for the final presentation, 7% for the final written report, 1% peer review inside of the group).

The scale for the letter grades is the following: A=93-100, A-=90-92, B+=87-89, B=83-86, B-=80-82, C+=77-79, C=73-76, C-=70-72, D+=67-69, D=63-66, D-=60-62. Grades are final and cannot be negotiated unless an error has occurred.
Make-up Work:

All make-ups have to be authorized by the instructor and arranged in advance.

+/− Grade System: See the grade scale above.

Academic Dishonesty:

Every student is fully responsible for the work which he/she submits as his/her own. Some of the class activities are designated as a group work. In these cases every group member should have complete understanding and active participation in the group work. In some designated cases collaboration between the students is encouraged, but every student should keep in mind that this collaboration is not possible for other activities, especially during exams. For individual assignments, presenting other people’s work as your own automatically leads to the assignment failure and may have even harder consequences up to expelling from the University.

ADA Compliance:

McMurry University abides by Section 504 of the Rehabilitation Act of 1973, which stipulates that no otherwise qualified student shall be denied the benefits of an education “solely by reason of a handicap”. If you have a documented disability that may impact your performance in this class and for which you may be requesting accommodation, you must be registered with and provide documentation of your disability to the Disability Services Office. Arrangements will be made for students needing special accommodations.

Cell Phones, Calculators, and other Electronic Devices:

You must disable all audible communication devices and anything else that goes 'beep' or 'ding'. PCs are to be used during the class periods strictly according to the instructor’s directions. They shall not be used for browsing internet, playing videogames, charting with friends and/or any other activities not directly related to the content of the class. In the case if these rules are violated, the student maybe asked to leave the classroom until the end of the current class period and the missed class activities will be counted as unexcused absence.

Other Course Policies:

This syllabus spells out specific policies concerning attendance, participation, assignments, deadlines and examinations; however, it is subject to change according to particular circumstances which may take place during the term. In addition to this syllabus, you have rights and responsibilities described in the Student Handbook and Schedule of Classes. Of particular importance are maintaining academic honesty and personal conduct. It is the responsibility of all members of McMurry University scholarly community to conduct themselves in a professional manner. It is also the policy of McMurry University to not discriminate on the basis of sex, sexual orientation, disability, race, color, religion, national or ethnic origin in its educational programs. This means you should not engage in behavior disruptive to the class or the learning experience of other students. You must fully participate in class which includes being seated and ready to participate in all class activities and waiting until class is over before packing up your things and leaving. During the class periods you may not read material and participate in any discussions not directly connected with the course content as well as you may not comment loud on any other subjects but physics.
Major Projects, Required Activities, and Assignments:

*Advanced Physics Laboratory* is an upper division physics course where every topic is based on both theoretical knowledge acquired through the study of University and Modern Physics and laboratory experiments performed during the semester. This is why it essentially important to recall many of the subjects learned in previous courses as well as to participate in all of the experiments in order to succeed in this class.

The specific methods designed to achieve this success are:

- **Reading the material related to each of the experiments.** It is your responsibility to find the appropriate source of the material for each experiment. This can range from your old University/Modern physics textbook, the laboratory manual, and all the way up to the level of scholarly publication on the subject of these experiments.
- **Lectures.** For each particular experiment in this course, students should do background reading on the subject and be ready to present this material to the instructor at the beginning of class before performing the experiment.
- **Writing of the Lab Report.** The actual experiments are going to be performed by students working individually or in groups. Lab report will be required from each student for every experiment performed in the duration of the semester.
- **Project.** Participating in projects with your peers is of great importance not just to succeed in this class but to achieve a success in your future profession either in academia or in industry.

Class Preparation: You are responsible for all the material published in the lab manual, in handouts, presented in lecture during the laboratory sessions and posted on the class webpage and/or Moodle.

Lab Reports: Collaboration is encouraged on data collection and discussion of their meaning. However, each student should have a full understanding of any work that he/she submits as his/her own. Individual lab reports can not be the exact copies of somebody else’s work except for the "data" section. The “data” section of the lab report should be submitted electronically as a Microsoft Excel file. The rest of the report should be typed and submitted electronically as a Microsoft Word file. (Also see the report grading guidelines on Moodle).

Feedback: At several points in the course, you will be asked to provide feedback in the form of surveys and course evaluations. Please take the surveys seriously, as they will help me to provide more effective learning experience.

Final Project: Last several weeks of the semester will be spent on the project, where entire class will be working on creating additional laboratory experiments and/or data analysis to be used in Advanced Physics Lab in future years. Particular roles will be assigned to every student working on the project; active contribution from every student is expected.

Tentative Course Schedule:

The tentative course schedule is published online at [http://mail.mcm.edu/~bykov.tikhon/phys3270/Physics3270/sec.html](http://mail.mcm.edu/~bykov.tikhon/phys3270/Physics3270/sec.html)
## Course Objectives/Student Learning Outcomes and their Linkage to Program and University Goals and Outcomes.

### Course Number and Title: Physics 3270, Advanced Physics Lab

<table>
<thead>
<tr>
<th>Course objectives and goals</th>
<th>Linked to which departmental program goal(s)</th>
<th>Linked to which institutional goal(s)?</th>
<th>Types of evidence that might be used to demonstrate student achievement of objectives &amp; goals</th>
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<tbody>
<tr>
<td>Students will enhance their understanding of the basic concepts of Electromagnetism, Optics, Atomic and Nuclear Physics introduced in University and Modern Physics courses</td>
<td>- to enhance non-physics science majors' understanding of science through the application of the scientific process into disciplines that overlap their interests, but view the material from a different perspective, thereby providing a richer understanding of the interconnectedness of their discipline to other fields</td>
<td>1, 2, 3</td>
<td>Successful completion of the pre-lab lectures as a student-leader. Successful completion of the “theory” sections in the lab reports and presentations.</td>
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<td>Students will improve their laboratory techniques and proficiency in the use of laboratory equipment.</td>
<td>- to prepare physics graduates for a wide range of career opportunities including not only graduate study in physics, engineering, pre-med, or other sciences; but also, science teaching and careers in industry and science-related business</td>
<td>1, 2, 3, 8</td>
<td>Successful completion of the “equipment” and “experimental procedure” sections in the lab reports and presentations.</td>
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<tr>
<td>Students will sharpen their data analysis skills and the ability to use the appropriate computer software for the error analysis.</td>
<td>- to enhance non-physics science majors' understanding of science through the application of the scientific process into disciplines that overlap their interests, but view the material from a different perspective, thereby providing a richer understanding of the interconnectedness of their discipline to other fields</td>
<td>1, 2, 3, 8</td>
<td>Successful completion of the “data” and “analysis” sections in the lab reports and presentations.</td>
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<td>Students will develop and/or improve their leadership skills and get experience working as part of team on the group projects.</td>
<td>- to develop students who are within our influence as whole people, well-rounded beyond simply the classroom experience, who have collaborated on group projects and socialized in technical and in colloquial environments so that they can more easily grow into contributing, respected, and influential members of their future communities</td>
<td>1, 2, 3, 4, 8</td>
<td>Successful performance as a student-leader, active participation in the peer-review activities. Successful collaboration with other students during the experiments and on the Final Group Project.</td>
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**Institutional Goals:**

1. Students acquire an education shaped by Christian values.
2. Students are equipped for successful careers and post-graduate education.
3. Students acquire an enthusiasm for lifelong learning through expanded intellectual and cultural experiences.
4. Students, in a community where leadership is cultivated, acquire a solid basis for future lives of leadership.
5. The institution will engage in an ongoing pursuit of excellence in curricula, programs, and policies.