PHYSICS 151: MECHANICS
Fall 2019

Monday, Wednesday & Friday @ 11:00AM-11:50AM in Science Center 145

Pre-Requisite:
MAT231

Instructor:
Michael Burns-Kaurin
Science Center Building 184
Office : 404-270-5849
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Office Hours:

Monday ..... 9 – 10 AM, 3 – 4 PM
Tuesday ..... 10 AM – 11 AM, 1 – 3 PM
Wednesday .... 9 – 10 AM, 3 – 4 PM
Friday ..... 9 – 10 AM
Or other times by appointment

Goals: Classical mechanics is the foundation of physics. To understand the physical world, one must first understand momentum, energy, forces, and motion. Our goal, therefore, is for the student

- To understand and practice the scientific process (through labs, study, computer work, and problems).
- To understand the foundations of mechanics and to apply this understanding to explanation of phenomena and solution to problems.
- To develop a positive attitude towards the methodology of proper experimentation, and modeling.
- To generate scientific mentality and acquire scientific knowledge that will lead to success in further studies in physics, other natural sciences, mathematics, and scientifically oriented courses as well as improve scientific literacy needed for various walks of life.

Objectives:

1. State briefly the philosophy of science, and the meaning and role of physics.
2. Explain the meaning of measurement and its role in experimentation; name different systems and types of units.
3. Demonstrate familiarity with space vectors and apply the knowledge to solve problems in physics.
4. Read a physics text with comprehension and be able to write physics text, terminology, and equations properly.

5. Explain the particle model of materials and be able to solve kinematical problems for different types of particle motion.
6. Demonstrate a thorough knowledge of Newton's laws of motion and their application to solve problems of science in general with a particular emphasis on materials.
7. Derive, apply, and interpret the work-energy theorem.
8. Derive, apply, and interpret the laws of conservation of energy and momentum.
9. Apply the laws of classical mechanics to the study of mechanical equilibrium.
10. Explain and apply Newton's theory of gravitation and theories of gravity near Earth's surface, friction, air resistance, and ideal springs at an elementary level.
11. Begin thinking about one's own questions and curiosities and develop an interest in current research.
12. Write proper computer code (*e.g.,* VPython/glowscript language) to model materials and solve problems in mechanics.

Format:

Class Sessions: SPHY151 is composed of a lab, and "lecture"...or course. In the course, my main goal is to create an active learning environment. It is assumed that this class will be more interactive than a traditional physics lecture. Physics education research shows students in an interactive classroom setup tend to understand physics much better than students in a traditional classroom setting. I expect you to read the corresponding chapters of the textbook and watch any videos posted prior to the class that will be assigned in advance. Some or most of the material in the course will be done as a flipped class, meaning you watch the video material and read the book before you come to the class and make your best attempt to understand the concepts. While in the class, we solve problems together and discuss concepts. As a class, you all MUST be involved in the learning process by actively participating discussions and constructing the knowledge. Questions during class are encouraged and appreciated. Please do not hesitate to ask for clarification. I will do my best to post class information on Moodle.

Classes will **not** consist solely of lecturing. Classes will focus on group discussion of questions and problems, and experiments. You should, therefore, come prepared for class by reading the assigned material, trying the examples and exercises, and thinking of questions about material that gives you difficulty. You should also participate actively in class by asking questions and joining in the in-class group experiments, activities, and discussions. If you miss class, you are responsible for getting the notes from your classmates and for making up any missed experiments and activities.

Lab Sessions: In the lab, you will be given a challenge or problem where you will design and carry out experiments to inform the solution. The lab class will not consist of disjointed weekly activities with a lab manual where you follow instructions. Each lab class will be a continuation from the previous lab class unless you start a new challenge. The continuation will depend on your group and your group's design or plan. The instructor will discuss experimental technique, data analysis, instruments, and other experimental issues as they become necessary to carry out your design. **The lab class is not designed to verify theories discussed during the regular class or in the textbook.** The main goal is for you to learn the process of science and how to design and conduct an experiment.

Your lab performance is based on attendance (20 points/week) and lab assignments (varies from 50 to 100 points/week). For attendance: up to 5 minutes and no time-wasting during the class (20 points); between 5 and 10 minutes late and no time-wasting (15 points), between 10 and 15 minutes and/or a little time-wasting (5 points), and more than 15 minutes late and/or more than a little time-wasting (0 points). Time-wasting includes being idle and not doing anything, doing other work, napping, using cell phones for non-course work, and leaving without permission. Your instructor will evaluate your performance each week and contact you if you are about improving your participation.

There will be a lab assignment each week that may involve more than one thing. They may be due on or before the following week. We strongly suggest you read the lab assignment immediately as they are posted and begin as early as possible. Most lab assignments will come with a rubric, which you are required to read and use in doing the lab assignment. We strongly suggest that you seek help by going to the professor or lab instructor as early as possible.

In order to pass the course with a C or better, it is necessary (*not* sufficient) that your lab performance grade be at least 60% by itself. If you obtain less than 60% in the lab performance grade, then your letter grade for the entire course is automatically F, even if your grade on everything else is much greater than 60%.

Text Book:

Primary:
Bruce Sherwood and Ruth Chabay, Matter & Interactions, 4th ed. (Pearson Press, 2015). **ISBN: 978-1-118-87586-5** [Required]

Supplemental:
Robert Brown, Introductory Physics I This online textbook is free, downloadable, and takes a very different approach.

OpenStax, *College Physics* (to access, follow instructions at www.openstax.org). This online textbook is free and downloadable.

There are a large number of textbooks available at this level. Some are at Woodruff Library. We keep some in the physics department. See your instructor or the lab manager to check one of them out. Because of the large number of students in this class, you may only check them out ***for a limited time***. In general, the word "College" in the title means that the text uses only algebra and trigonometry; the "University" or "Engineering" includes the use of calculus.

Grading:

Projects, HW, Moodle quizzes	30%	
In-class work, quizzes	10%	
Laboratory	25%	
Midterms (combined).....	20%	(15% if the final is better)
Final	15%	(20% if better than the midterms)

Final letter Grade:

92% to 100 % is an A	73% to 75% is a C+
89% to 91% is an A−	66% to 72% is a C
86% to 88% is a B+	65% to 65% is a C−
79% to 85% is a B	60% to 64% is a D+
76% to 78% is a B−	55% to 59% is a D

0% to 54% is an F

Exam Schedule:

Midterm Exams: Wednesday, October 2 and Wednesday, November 6.
Final Exam: Monday, December 9, 1-3 PM.

There will be two midterm exams and a cumulative final exam. You may bring a 3" x 5" card with anything written on it that you think would be useful – one side for the midterms and both sides for the final exam. Most equations in the book are unique to specific problems and are probably not very useful. General laws are useful, as are prototype solutions out of which you can construct more complex solutions. You will need to look with a critical eye and pull out those that seem to be generally useful in a lot of problems. While the final exam will concentrate on the later material, some problems may draw on ideas that were tested on the midterm. The nature of physics is to be cumulative.

Exams will be a combination of short answer questions and written mathematical problems. You must also be sure to arrive on time for all exams. If you arrive after the first person has turned in their exam and left the room, you will not be allowed to take the exam. I know that everyone occasionally has a bad day, so arrangements for a make-up exam must be made before the week of the exam.

Students are responsible for making arrangements in advance with Disability Services if they need special accommodations for exams (see below). It is the responsibility of Disability Services or the student to inform the instructor.

Absences: Any excused absence for exams must be verified by the Dean's office. Acceptable excuses include illness, death in the family, and travel related to the college. College-related travel must be discussed with the instructor in advance. Unacceptable excuses include personal travel, jobs, and oversleeping. If you miss a class session and have an acceptable excuse, the instructor may allow you to make up the work for credit; even without credit, you are responsible for the material on subsequent work and on exams.

Homework: Homework will consist of problems that require both strategy and solutions, project solutions, individual assignments, programming simulations, and quizzes on Moodle. Your course instructor will explain the evaluation of homework. Opportunity to re-do homework for partial credit may be given on occasion, but only for homework that shows serious effort. Sometimes, it helps to work with a group when doing the homework. Before you work with a group, however, you should try the problems on your own. When working on reports, you should work with your group in analyzing and understanding the data. In either case, individual work that you turn in must be your own; do not copy or paraphrase someone else's work. Please refer to College policies on plagiarism.

In-class Work: Class work will consist of a series of small projects that address the content of the course. You will work in pairs for the semester, and the pair should maintain a record of their work (real or virtual). When the group is working, it should be noted in the record. At the instructor's discretion, the logbook may be evaluated. This will serve as a sample of group work and communication.

In-class work will generally be done weekly until the project seems complete. A 10% deduction per week day will be taken for late reports. The instructor may allow a rewrite, if the report shows serious effort. Late penalties also apply to re-done and re-written work. You should start working on the all course work and on reports early, to give yourself time to seek assistance if needed.

Classes may also include written work or quizzes to be turned in during class. If you are absent, you are responsible for doing the work outside of class.

Attendance: You will learn the most and do best in this class if you attend class regularly. It is your choice to attend or not, but if you attend you must be respectful of everyone else in the classroom. Anyone who becomes a distraction during lecture will be asked to leave. If you choose not to attend, you need to be prepared for how your absence may affect your learning and your grade.

Student Behavior: The professor (me) reserves the right to exclude a student or group of students from class if found disruptive. Excessive talking, outbursts, and foul language are considered disruptive. Cell phones need to be silenced before class begins and put away during class, unless otherwise stated. I follow this rule as well. If I see any cell phones out during tests, I will assume you are cheating. If your phone causes a distraction, it may be brought to the attention of the entire class. Cell phones and electronic devices not being used for note taking or coursework may be confiscated until the end of the class if they are visible to the professor. Students may be refused entry if they arrive more than 15 minutes late for the class. No visitors are allowed in the classroom without prior, specific permission of the professor. Laptop computers are allowed in the classroom during discussions for the express purpose of taking notes and activities. Students are expected to abide by this policy. Checking Facebook, playing games, surfing the Internet, and otherwise causing distractions for those sitting around you will not be tolerated and you will be asked to leave.

Academic Honesty: At the heart of Spelman College's mission is academic excellence, along with the development of intellectual, ethical and leadership qualities. These goals can only flourish in an institutional environment where every member of the College affirms honesty, trust, and mutual respect. All members of the academic community of Spelman College are expected to understand and follow the basic standards of honesty and integrity, upholding a commitment to high ethical standards. Students are expected to read and abide by the Spelman College Code of Conduct (see the current Spelman College Student Handbook) and are expected to behave as mature and responsible members of the Spelman College academic community. Students are expected to follow ethical standards in their personal conduct and in their behavior towards other members of the community. They are expected to observe basic honesty in their work, words, ideas, and actions. Failure to do so is a violation of the Spelman College Academic Integrity Policy. Violators will be subject to the sanctions outlined in the Spelman College Bulletin.

Science is inherently a social and collaborative effort, each scientist building on the work of others. Nevertheless, each student must ultimately be responsible for his or her own education. Therefore, you are expected to abide by a number of Ground Rules:

- I strongly encourage students to work with each other, more advanced students, the SI, and the professor. However, for individual assignments each student is expected to turn in independent assignments that show evidence of individual thought. The final synthesis must be entirely your own. This applies also to, and especially to, computer-generated worksheets. **NEVER** work together so closely with someone that you produce the same solution or computer program. This invariably means that one person has been the dominant partner and it is impossible for the instructor to determine who it was. Such assignments will be returned ungraded, and both (or all) students requested to turn in a new assignment different from each other and different from the original.

- Homework solutions from previous years are very strictly off-limits. You are on your honor not to use them, and not to share your homework solutions with other students. Allow faculty to use their time interacting with you, rather than continually thinking up new assignments. Besides, if you don't do the work yourself, it will show up very clearly on exams later.

- Sources must be appropriately documented. If you work with other students in a laboratory assignment, you must write down who your partners were. If you find part of a homework problem worked out somewhere (other than homework solutions from previous years), you may use that resource; just make sure you reference it properly. If someone else helps you solve a problem, reference that too. In a research paper, the appropriate reference would be Jane Doe, (private communication).

- Plagiarism - representing someone else's work as your own - is unethical, but collaboration and exchange of ideas is healthy. You can avoid collaborative efforts taking on the look of plagiarism by acknowledging sources and by writing up your work independently.

Some students find it difficult to decide what constitutes too much collaboration. Here are some guidelines:

- Under no circumstances may you ever copy another student's work, even if you have collaborated to work through the problem. Under no circumstances may you ever allow your own work to be copied. Violation of this rule will certainly result in a zero grade for the assignment, and may result in referral to the Dean and an F grade in the course.
- Try to make progress on a problem on your own. If you cannot, seek help from other resources to overcome a specific hurdle, then try to make further headway on your own. Once you have solved the problem, be honest with yourself about how much intellectual input came from you, and try to improve next time. Rewrite the problem solution without reference to any notes, explaining the steps as you go, as you would to a novice problem solver. Once you have done this, you will have generated a unique solution and one that will have taught you something about what you really understand. Do not be discouraged if you find that some problems require hints and help all the way through.
- A good test of your understanding is to explain a problem to someone else. Be conscious of your role in a collaboration. If it is clear that you have mastered the problem and your collaborator is a novice, limit your help to put the person on the track to solving the problem alone. Do not give too much help. Conversely, if you are seeking help from an expert, don't allow the expert to guide you all the way through. If the exchange is between people of a similar level of understanding, keep challenging one another, asking questions and providing answers, going beyond the limits of the problem. This is the fun part of physics - endless discussion about interesting problems! (There is no intention to categorize students as "weak" or "strong". Expert and novice can refer to two students of equal talent and ability - but one happens to have already solved the problem!)

During exams, you will be allowed a calculator, something to write with, and the card discussed above. Handheld computers are not acceptable. You cannot refer to any materials other than the exam itself and the card. **Cheating will not be tolerated and will lead to immediate referral to the Dean as a serious violation of the academic honesty policy.**

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that you do not modify it and use it only for the duration of this course. Beyond this use, no material from the course or website may be copied, reproduced, re-published, uploaded, posted, transmitted, or distributed in any way without the permission of the original copyright holder. Neither the instructor nor the College assumes any responsibility for individuals who improperly use copyrighted material.

Students with Disabilities: Spelman College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements, or benefit from the College's programs or services, you should contact the Student Access Center (SAC) as soon as possible. To receive any academic accommodation, you must be appropriately registered with SAC. The SAC works with students confidentially and does not disclose any disability-related information without their permission. SAC serves as a clearinghouse on disability issues and works in partnership with faculty and all other student service offices. For further information about services for students with disabilities, please call 404-270-5289 (voice), located in MacVicar Hall, Room 106.

Pregnancy: None of the activities in this course will involve strenuous physical activity, radioactive sources, or other phenomena that may adversely affect a pregnancy. However, the College recommends that any student who is pregnant and enrolled in any laboratory and/or physical activity get written permission from her attending physician before participating in any laboratory and/or physical activity for the course. Please refer to the Student Handbook (pg. 32) for the College's policy statement on Students with Serious Medical Conditions.

DISCLAIMER: Although the course syllabus provides a general plan for the course, deviations may be necessary.

PHYSICS 241 - Physics II: Electricity & Magnetism
SYLLABUS
Fall 2019

INSTRUCTOR: Natarajan Ravi

OFFICE: SCI 321
Phone: 404-270-5857
Cell: 6786449742 (text ok)
Email: nravi@spelman.edu
aparnusha@gmail.com

LECTURE: MWF 1:00 – 1:50 PM
SCI 133

OFFICE HOURS: MWF: 10:00 – 12:00 noon or by appointment

TEXTBOOK: *Matter and Interactions II*
Electric & Magnetic Interactions (4th edition)
By Ruth Chabay and Bruce A Sherwood. Wiley 2015, and handouts on some selected topics.

Practical Physics, fourth edition, by G. L. Squires, Cambridge, 2001.

References:
There are numerous other textbooks at this level which can be used as reference material. Some are listed below and may be available for you to borrow from the Physics Department for a limited time (see me).

- Thomas A. Moore, *Six Ideas That Shaped Physics*, 3rd Edition, Unit E: Electromagnetic Fields Are Dynamic, WCB/McGraw-Hill
- David Halliday, Robert Resnick, and Jearl Walker, *Fundamental of Physics*, 10th edition, Volume 1, John Wiley (2014).
- Raymond A. Serway and John Jewett, *Physics for Scientists and Engineers with Modern Physics*, 9th Edition, Cengage, Philadelphis (2013).
- Douglas C. Giancoli, *Physics for Scientists and Engineers*, 6th Edition, Prentice Hall, Englewood Cliffs, New Jersey (2005).

Moodle:
All course documents, including assignments and lab work will be posted on Moodle. Moodle will also be used for forums and other course activities. The lab and regular class have separate Moodle pages.

You will be notified when something is added to Moodle; update your profile in Moodle so that emails are sent to the email address that is most convenient for you to check. Cross-registered students must see me immediately to set up access to Moodle.

Course Rationale:
Physics II is the second course in the introductory sequence. With students who have a basic knowledge of the nature of scientific investigation and the laws of classical mechanics, this course broadens their scope by introducing the classical theory of electromagnetism. Physics II builds scientific character while laying a foundation with concepts needed to pursue engineering and to unravel more modern theories on these subjects. The subject matter is relevant to all the natural sciences and is essential to all engineers and emerging physicists. The students will encounter more applications of mathematics and this course should strengthen their mathematical ability. This course teaches the fundamental laws of electromagnetism. The emphasis is on Coulomb's law, electric fields, electric potential, circuits, magnetic fields/forces, and Faraday's laws. Lecture 3 hours per week; laboratory 3 hours per week. **Prerequisites: Physics 151, and Math 232 or equivalent.**

Goals:
The goal of the course is to impart the basic knowledge of electromagnetism and circuitry while improving the ability to think like a physicist and the ability to conduct an experiment. Specific goals are:

1. To understand the foundations of the classical theories of electric and magnetic fields and to be able to apply this knowledge to the solution of problems of science and everyday life.
2. To become more competent in scientific experimentation and in writing a scientific paper.
3. To continue to develop the skill of scientific modeling with some applications to materials.
4. To enhance a scientific mentality and knowledge that will lead to success in further studies in physics, engineering, other natural sciences, mathematics, and scientifically oriented courses as well as improve scientific literacy needed for various walks of life.

Learning Outcomes: objectives or outcomes?

1. Analyze problems in electrostatics and magnetostatics qualitatively and quantitatively using Coulomb's law, Biot-Savart law, and a basic understanding of the microscopic structure of matter.
2. Model electric and magnetic properties of matter starting from fundamental physical laws.
3. Apply the concepts of electric charge and current, and their conservation, to analyze electric problems.
4. Distinguish among field, force, and potential. Explain electromagnetic phenomena from any of these points of view.

5. Calculate electric fields and electric potentials for various charge distributions.
6. Explain capacitance and resistance based on a microscopic model of matter, and apply these concepts in circuitry.
7. Use conservation laws to analyze elementary circuits.
8. Distinguish electric from magnetic fields.
9. Analyze qualitatively and quantitatively the interactions between magnetic fields, charges, and currents.
10. Explain Faraday's Law and apply it to certain phenomena.
11. Calculate magnetic fields for various distributions of currents.
12. Explain, calculate, and solve problems involving electric and magnetic dipole moments.
13. Increase the capability to perform a precise and successful experiment.
14. Critically analyze a scientific argument and clearly communicate analytical and experimental results.
15. Use computational techniques, along with an appropriate software and programming, as part of solving problems and creating models.

Course Structure:
The course consists of a regular class that meets three time per week for 50 minutes each and a laboratory session that meets once per week for 2 hours and 50 minutes. You must register for each separately, but only one grade will be listed on your transcript.

Regular Class Sessions
These sessions will consists of a variety of class activities – group progress reports on projects, peer-led or instructor-led discussions on issues dealing with the reading and projects, mini-lectures by the instructor, interactive lecture demonstrations, workshop-style activities, hands-on activities, experiments, computational activities etc. The main purpose of these activities is for you understand the material in order to construct models of a particular phenomenon. Each modeling activity will last about 2 to 3 weeks and they are intended to allow you to accomplish the learning objectives in a meaningful way. At the end of each modeling module, each group will submit a paper. In addition the regular class is not to lecture you on the material that you will be tested on. It is meant as a learning space, where you bring questions, discuss, engage in activities in order for you to develop you own understanding and skills.

Laboratory
The laboratory class meets once per week and focuses on the design of experiments, modeling of physical phenomena, analysis and interpretation of data, and use of evidence to justify theoretical claims and conclusions. The laboratory is not designed as a demonstration of claims made in the regular class or the textbook. Rather, you will be given challenges in order to learn experimental design and data analysis. The results of your experiments will inform a solution to the challenges. You will not be given a lab manual that contains instructions for experiments.

The laboratory component is intended to build your laboratory skills. It is not intended to reinforce ideas that you are learning during the regular class. The regular class and laboratory, therefore, may not be synchronized with each other, although the content overlaps. However, you are expected to apply learning outcomes from the laboratory to the regular classes and vice versa.

Evaluation:
Your course grade depends on the following, according to the given weights (see a description of each below):

Regular class work:	35%	(Quizzes: 5%, HW: 5%, Projects & Presentations 25%)
Laboratory :	25%	
Mid-term :	15%	(10% of less than the final)
Final exam :	25%	(30% if greater than the midterm)

Regular Class Work
Graded class work includes a group paper for each project, an individual assignment for each project, practice problem submitted twice per week or homework assignments consisting of problems and questions, other periodic assignments, and peer-led class work. Each of these will be explained when they are first assigned. Your grade is computed as points earned divided by maximum possible points.

Exams
Exams will consist of problems and discussion/essay questions that are at the same level as those on the activities, projects, and assignments or those discussed in class. The midterm exam will include a separate oral exam that will be conducted in the instructor's office. The oral exam will be for 15 minutes and individually scheduled the week of the College's midterm exams. All exams are intended to measure whether the objectives of the course are being met. For each written exam, you are allowed an index card (size 4" by 3" or 5" by 3"), where you may write formulae. No derivation or drawing should be includeed in the card. You are expected to bring a calculator to exams; calculator on phones are not allowed. The midterm exam is scheduled for the Thursday during the College's midterm schedule (Thursday, Oct 3, 2019, before Fall Break). The final exam is on the Wednesday of final exam week. These exams are scheduled outside of class time to give you more time for your convenience. Each exam is designed to be for no more than 2 hours.

The exam dates/times are: Midterm – October 3, 2018; 5 – 7:30 PM
Final Exam – TBA

Location will be the classroom. See the instructor immediately if there is a conflict with the exam schedule.

Laboratory
The laboratory grade consists of a attendance/participation component and weekly assignments. The weekly assignments are *not* to be thought of as lab reports since they will vary in content and requirted work. They will be posted on Moodle after each lab class. Your lab instructor will describe the laboratory work and grade in more detail and this description will be posted on Moodle.

You must earn at least a grade of 60% in the lab component of the course in order to pass the entire course. If a student earns less than 60% in the lab and receives an **A** in all other activities, the final grade is **F** for the course. In other words, if you fail lab, you will fail the course regardless of your other scores. Attendance is required for labs.

Letter Grade
The percentage/letter grade conversion is as follows:

90–100	A	87–89	A–	84–86	B+
77-83	B	74-76	B–	70-73	C+
62-69	C	61-61	C–	58-60	D+
55-59	D	Below 55	F		

Incomplete
A grade of incomplete (I) will be given only when a student has completed the majority of the course requirements, and a written excuse indicating a legitimate reasom why the course work cannot be completed by the close of the semester is provided by the Dean. The student must complete the required course work in the next semester on or before the date indicated by the Registrar's Office. Failure to adhere to these guidelines will results in a grade of "F" for the course.

COURSE OUTLINE

1. The Electric Force and Electric Field (Chapter 13, 14, & 15)
   A. Demonstration of the Electric Force
   B. Basic Theory of Electric Charge
   C. Coulomb's Law
   D. Definition and calculation of the Electric Field Using Coulomb's Law.
   E. Electric Fields and Matter
   F. Electric Field of Distributed Charges

2. Electric Potential and Capacitance (Chapter 16)
   A. Definition of Capacitance
   B. RC circuits
   C. Definition of Electric Potential

D. Electric Potential for Charge Distributions
E. Electric Potential Energy

3. Circuits (Chapter 18 and 19) (Some covered in lab)
   A. Definition of Electric Current and Electric Current Density
   B. A microscopic View of Electric Current
   C. Definition of Voltage and EMF
   D. Surface Charges
   E. Definition of Resistance and Ohm's Law
   F. Series and Parallel
   G. Electrical Power
   H. Kirchoff's Laws

4. The Magnetic Field (Chapter 17 and 20)
   A. Magnets and the Definition of Magnetic Field
   B. The Connection Between Electricity and Magnetism
   C. Magnetic Force on Charges and Currents
   D. Relationship Between Current and Magnetic Fields
   E. Biot-Savart Law
   F. Faraday's Law
   G. Applications

Policies:

Academic Integrity Policy:
At the heart of Spelman College's mission is academic excellence, along with the development of intellectual, ethical and leadership qualities. These goals can only flourish in an institutional environment where every member of the College affirms honesty, trust, and mutual respect. All members of the academic community of Spelman College are expected to understand and follow the basic standards of honesty and integrity, upholding a commitment to high ethical standards. Students are expected to read and abide by the Spelman College Code of Conduct (see the current Spelman College Student Handbook) and are expected to behave as mature and responsible members of the Spelman College academic community. Students are expected to follow ethical standards in their personal conduct and in their behavior towards other members of the community. They are expected to observe basic honesty in their work, words, ideas, and actions. Failure to do so is a violation of the Spelman College Academic Integrity Policy. Violators will be subject to the sanctions outlined in the Spelman College Bulletin.

We emphasize that all sources must be referenced, including sources used for images and sources used to get ideas (written or verbal). Paraphrasing is not accepted without reference, and you must indicate any material taken verbatim. You do not need to reference the instructor.

There will be group work in this course. We also encourage you to seek help from the instructor, the DI (if any), and other students. You may also work together in problem-solving and lab assignments. However, for all individual work, you must write it independently **after** you work together or get help, not during. No two individual assignments can be identical or paraphrased.

Students with Disabilities:
Spelman College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements, or benefit from the College's programs or services, you should contact the Office of Disability Services (ODS) as soon as possible. To receive any academic accommodation, you must be appropriately registered with ODS. The ODS works with students confidentially and does not disclose any disability-related information without their permission. ODS serves as a clearinghouse on disability issues and works in partnership with faculty and all other student service offices. For further information about services for students with disabilities, please contact the ODS at 404-270-5289 (voice), located in MacVicar Hall, Room 106
STOP
Late Assignments/Tardiness/Absences
No late assignments, tardiness, or absences will be accepted without a legitimate excuse as determined by the appropriate instructor (regular class, lab, recitation). Legitimate excuses must be presented as soon as the student is aware of it, otherwise, it will not be accepted. See Course Structure above for more information about tardiness.

Missed work due to an absence can only be made up if there is a legitimate excuse approved by the appropriate instructor (regular class, lab, recitation). Legitimate excuses must be presented as soon as the student is aware of it, otherwise, it will not be accepted. Unless missed work is made up, a student will receive a grade of zero. As soon as possible, the student has the responsibility to communicate with the appropriate instructor to make up missed work in a timely fashion. **It is not the responsibility of the instructor to initiate a discussion about make ups.** Any delay in communicating with the appropriate instructor will result in the decision that the work cannot be made up.

Pregnancy
None of the activities in this course will involve strenuous physical activity, radioactive sources or other phenomena that may adversely affect a pregnancy. However, the College recommends that any student who is pregnant and enrolled in any laboratory and/or physical activity get written permission from her attending physician before participating in any laboratory and/or physical activity for the course. Please refer to the Student Handbook (pg. 32) for the College's policy statement on Students with Serious Medical Conditions. Instructors will provide all students Material Safety Data Sheets and they will be made available for any hazardous materials used during the course.

Resources:

1. The instructor is the main resource for this course. Visit the instructor's office frequently.
2. Tutoring is available. See the instructor, Student Success Program, Academic Support Services.
3. Directed Supplemental Instruction is available. The schedule will be announced during the first week of classes.
4. Reference books are available. See the instructor.
5. Computers in the physics lab or room 133 are available for some use outside of class. Some equipments may be borrowed. Check with the instructor for using these facilities.
6. The writing Center is equipped to assist you in writing technical papers, reports, solutions, or any writing assignment.

PHYSICS 251: OSCILLATIONS AND WAVES

Fall 2019, Tuesday & Thursday @ 9:00AM-10:15AM in Science Center Building 186 & 171
CRN: 96353

Pre-Requisites:

SPHY241 – Physics II: Electricity & Magnetism
MATH324 – Calculus III (co-requisite)

Instructor:
Christopher Oakley
Science Center Building 179
404-270-5864
Coakley@scmail.spelman.edu
http://faculty.spelman.edu/christopheroakley/

Office Hours: I believe that "office hours" are silly. They tend to be chosen for my convenience with no knowledge of your schedule. Therefore, I encourage all of you to email me whenever you have a question about anything physics related and strongly encourage making appointments if email is not adequate. I do realize that some people need the structure of these hours, so I will arrange to be in my office to address any questions you have at the following times:

Wednesday:	10:30AM-12:45PM
Thursday:	1:30PM-3:00PM

If I am not in my office, there is a good chance I am in one of the laboratories in the Science Center (Rooms 186-188, 171, or 173). I'm happy to answer questions but know that in the lab, those students are my priority.

Course Goals:

1. To apply basic physical principles to a variety of oscillating systems.
2. To apply basic physical principles to a variety of wave phenomena.
3. To develop a sophisticated mathematical framework for describing oscillations and waves.
4. To develop connections between ideas from Physics I and Physics II.
5. To introduce the ideas of quantum physics.
6. To improve a student's analytical, experimental, and writing skills.

Course Objectives:

Through this course, the student should be able to:

1. Discuss the basic properties of an oscillating system and of wave phenomena.
2. Apply basic principles and the mathematics of complex numbers to analyze free harmonic and anharmonic oscillators, including the pendulum.
3. Apply basic principles and the mathematics of complex numbers to analyze driven oscillators, including the LRC circuit.
4. Apply the mathematics of Fourier series and the Fourier transform to the study of oscillating systems and wave phenomena.
5. Apply basic principles and complex mathematics to analyze wave phenomena such as standing waves, reflection, and transmission, including application to coaxial cable.
6. Discuss the history leading to the discovery of quantum waves.

7. Apply basic principles to the study of quantum waves, including the finite well and wave packets.
8. Plan, conduct, analyze, and discuss experiments involving oscillating systems and wave phenomena.
9. Use computer simulations to study oscillating systems and wave phenomena.
10. Identify and research a topic, and write a paper about an oscillating system or wave phenomenon not explored in the course.

You will become familiar with different simple oscillatory systems and learn to connect the mathematical descriptions with physical examples. The rigid pendulum is a time-honored illustration of many important principles (and is capable of chaotic behavior when excited beyond the oscillatory regime studied here). The response function of an electrical circuit has its own importance as a widely used application of the central concept in linear circuit theory. Both systems are exploited to learn about the free and forced motion of damped and undamped oscillators. There is no example more important in physics!

Format:

My main goal is to create an active learning environment. It is assumed that this class will be more interactive than a typical physics lecture. Physics education research shows students in an interactive classroom setup tend to understand physics much better than students in a traditional classroom setting. I expect you to read the corresponding chapters of the textbook and watch videos posted prior to the class that you would be assigned in advance. Some or most of the material in the course will be done as a flipped class, meaning you watch the video material and read the book before you come to the class and make your best attempt to understand the concepts. While in the class, we solve problems together and discuss concepts. You will be asked to discuss course material as well. As a class, you all MUST be involved in the learning process by actively participating discussions and constructing the knowledge.

Text Book:

Richard Fitzpatrick, *Oscillations and Waves: An Introduction*, 2nd ed. (CRC Press, 2019). **ISBN: 978-1-138-47971-5** [Required]

Hans J. Weber and George B. Arfken, *Mathematical Methods for Physicists*, 5th ed. (Elsevier Academic Press, 2004) [Recommended]

David J. Griffiths, *Introduction to Electrodynamics*, 4th ed. (Pearson Press, 2013) [Recommended]

John Taylor, *Classical Mechanics*, 5th ed. (Elsevier Academic Press, 2004) [Recommended]

Nota Bene: These "recommended texts" will be the course textbooks for advanced classes in physics.

Grading:

Reports/ In-Class Work	20%
Paper	25%
Short Writing Assignments	5%
Oral Exam	10%
Midterm Exam	15%
Final	25%

Final letter Grade:

94% to 100 % is an A	77% to 79% is a C+
90% to 93% is an A–	73% to 76% is a C
87% to 89% is a B+	70% to 72% is a C–
83% to 86% is a B	66% to 69% is a D+
80% to 82% is a B–	60% to 65% is a D

0% to 59% is an F

Note that grades of 89.5% to 89.9% round to 90%, similarly grades of 79.9% to 79.5% round to 80%, etc.

Tentative Exam Schedule (all in class):

Midterm Exam: September 30th – October 4th, Scheduled by Student
Final Exam: December 12th, 10:30AM-12:30PM

Exams will be a series of questions that will require a combination graphical, written and mathematical solutions. You must also be sure to arrive on time for exams. If you arrive after the first person has turned in their exam and left the room, you will not be allowed to take the exam. I know that everyone occasionally has a bad day. If your percentage for the final exam is better than your percentage for the midterm exam, the second set of weights listed above will be used. Since the final is comprehensive, it will therefore benefit you to get help with material that causes you difficulty on the midterm exam.

Class Sessions: Classes will **not** consist solely of lecturing. Classes will focus on group discussion of questions and problems, experiments, and computer simulations. You should, therefore, come prepared for class by reading the assigned material, trying the examples and exercises, and thinking of questions about material that gives you difficulty. You should also participate actively in class by asking questions and joining in the in-class group experiments, activities, and discussions. If you miss class, you are responsible for getting the notes from your classmates and for making up any missed experiments and activities.

Absences: Any excused absence for exams must be verified by the Dean's office. Acceptable excuses include illness, death in the family, and travel related to the college. College-related travel must be discussed with the instructor in advance. Unacceptable excuses include personal travel, jobs, and oversleeping. If you miss a class session and have an acceptable excuse, the instructor may allow you to make up the work for credit; even without credit, you are responsible for the material on subsequent work and on exams.

Homework and Reports: Homework may consist of problems, derivations, specific portions of data analysis or computer simulations, searching literature and gathering information, or reflection exercises. Homework turned in late but by the beginning of the next class period will receive 75% credit; homework turned in after that may be checked but will not receive a grade. Opportunity to re-do homework for partial credit may be given on occasion, but only for homework that shows serious effort.

Reports will generally be due one week after completion of an experiment or computer activity. A 10% deduction per week day will be taken for late reports. The instructor may allow a rewrite, if the report shows serious effort. Late penalties also apply to re-done and re-written work. You should start working on the homework and on reports early, to give you time to seek assistance if needed. Sometimes, it helps to work with a group when doing the homework. Before you work with a group, however, you

should try the problems on your own. When working on reports, you should work with your group in analyzing and understanding the data. In either case, the work that you turn in must be your own; do not copy or paraphrase someone else's work. Please refer to College policies on plagiarism.

Paper: For the paper, you will identify and research a phenomenon involving oscillations that is not already covered in the course. The paper must discuss the phenomenon qualitatively and must work through the mathematics of a model of the phenomenon. You must discuss your topic in detail with the instructor before beginning to write the first version. You will be graded on the paper in stages. Detailed rubrics will be given out for each version. All versions are subject to the rules of appropriate citation of sources and to the expectation of academic honesty. Uncited material will be considered to be plagiarized. Any plagiarism will be treated as at least a Level Two violation of the academic honesty policy, leading to failure in the course. Use discretion in choosing sources for the paper. Scholarly books and articles in academic journals are certainly appropriate. Secondary sources such as textbooks at the appropriate level can also be used. Any website used must have a clearly identified author who is an authority in the field. Any website citation must be specific enough to allow the reader to type in the URL and immediately see the source material. Sources such as Wikipedia are definitely not acceptable. Even if cited, lengthy direct or slightly modified quotations are not appropriate. To help improve writing, short writing workshops (10-15 minutes) will occur during class. Topics will include outline/organization, commenting on structure and level of each other's rough drafts, when and how to cite sources, and best methods of incorporating technical material such as figures and equations.

Presentations: Throughout the semester, you will present on a component of your paper or a recent activity in class. The instructor and your classmates will evaluate you. Peer evaluations will count as 30% of the grade and the instructor evaluation will count as 70% of the grade. Each audience member will be given a copy of a presentation rubric created for this purpose. Expect to give two presentations during the semester; one focusing on a simple and damped harmonic oscillator, and the second on your paper topic.

Due Dates:

08/25/2019: Meet with instructor regarding paper topic. (10%)
09/13/2019: Draft of Introduction/Background is due. (15%)
10/29/2019: Mathematical Model and Discussion of the paper will be due. (15%)
11/17/2019: First version of the complete paper will be due. (20%)
11/30/2019: Final version of paper will be due. (40%)

In-class Work: Classes may include written work to be turned in during class or computer simulations to be completed. This work will be evaluated primarily on diligent effort and adherence to solving methodology. If you are absent, you are responsible for doing the work outside of class.

Short Writing: Either as in-class activities or as assignments, students will complete several pieces of short writing (less than a page, sometimes one paragraph). These may include short predictions or explanations of phenomena, reflections on activities or assignments, preliminary summaries or conclusions for experiments, etc. One required assignment will be to submit written comments on the first version of another student's paper, as assigned by the instructor. These short writing assignments will not be graded, but students will receive credit for completing them on time.

Attendance: It is your choice to attend or not, but if you attend you must be respectful of everyone else in the classroom. Anyone who becomes a distraction during lecture will be asked to leave. If you

choose not to attend, you need to be prepared for how your absence may affect your learning and your grade.

Laptops: Laptop computers are allowed in the classroom during discussions for the express purpose of taking notes and activities. Students are expected to abide by this policy. Checking Facebook, playing games, surfing the Internet, and otherwise causing distractions for those sitting around you will not be tolerated and you will be asked to leave.

Cell phones: Cell phones need to be silenced before class begins and put away during class, unless otherwise stated. I follow this rule as well. If I see any cell phones out during tests, I will assume you are cheating.

Tardiness: Students will be refused entry of they arrive more than 15 minutes late for the class.

Student Behavior: The professor (me) reserves the right to exclude a student or group of students from class if found disruptive. Excessive talking, outbursts, and foul language are considered disruptive. Electronic devices not being used for note taking or coursework will be confiscated until the end of the class if they are visible to the professor. No visitors are allowed in the classroom without prior, specific permission of the professor.

Academic Honesty: At the heart of Spelman College's mission is academic excellence, along with the development of intellectual, ethical and leadership qualities. These goals can only flourish in an institutional environment where every member of the College affirms honesty, trust, and mutual respect. All members of the academic community of Spelman College are expected to understand and follow the basic standards of honesty and integrity, upholding a commitment to high ethical standards. Students are expected to read and abide by the Spelman College Code of Conduct (see the current Spelman College Student Handbook) and are expected to behave as mature and responsible members of the Spelman College academic community. Students are expected to follow ethical standards in their personal conduct and in their behavior towards other members of the community. They are expected to observe basic honesty in their work, words, ideas, and actions. Failure to do so is a violation of the Spelman College Academic Integrity Policy. Violators will be subject to the sanctions outlined in the Spelman College Bulletin.

Science is inherently a social and collaborative effort, each scientist building on the work of others. Nevertheless, each student must ultimately be responsible for his or her own education. Therefore, you are expected to abide by a number of Ground Rules:

- We strongly encourage students to work with each other, more advanced students, the TA, and the professor. However, each student is expected to turn in independent assignments that show evidence of individual thought. The final synthesis must be entirely your own. This applies also to, and especially to, computer-generated worksheets. **NEVER** work together so closely with someone that you produce the same solution or Mathematica worksheet. This invariably means that one person has been the dominant partner and it is impossible for the instructor to determine who it was. Such assignments will be returned ungraded, and both (or all) students requested to turn in a new assignment different from each other and different from the original.

- Homework solutions from previous years are very strictly off-limits. You are on your honor not to use them, and not to share your homework solutions with other students. Allow faculty to use

their time interacting with you, rather than continually thinking up new assignments. Besides, if you don't do the work yourself, it will show up very clearly on exams later.

- Sources must be appropriately documented. If you work with other students in a laboratory assignment, you must write down who your partners were. If you find part of a homework problem worked out somewhere (other than homework solutions from previous years), you may use that resource; just make sure you reference it properly. If someone else helps you solve a problem, reference that too. In a research paper, the appropriate reference would be Jane Doe, (private communication).

- Plagiarism - representing someone else's work as your own - is unethical, but collaboration and exchange of ideas is healthy. You can avoid collaborative efforts taking on the look of plagiarism by acknowledging sources and by writing up your work independently.

Some students find it difficult to decide what constitutes too much collaboration. Here are some guidelines:

- Under no circumstances may you ever copy another student's work, even if you have collaborated to work through the problem. Under no circumstances may you ever allow your own work to be copied. Violation of this rule will certainly result in a zero grade for the assignment, and may result in an F grade in the course.
- Try to make progress on a problem on your own. If you cannot, seek help from other resources to overcome a specific hurdle, then try to make further headway on your own. Once you have solved the problem, be honest with yourself about how much intellectual input came from you, and try to improve next time. Rewrite the problem solution without reference to any notes, explaining the steps as you go, as you would to a novice problem solver. Once you have done this, you will have generated a unique solution and one that will have taught you something about what you really understand. Do not be discouraged if you find that some problems require hints and help all the way through.
- A good test of your understanding is to explain a problem to someone else. Be conscious of your role in a collaboration. If it is clear that you have mastered the problem and your collaborator is a novice, limit your help to put the person on the track to solving the problem alone. Do not give too much help. Conversely, if you are seeking help from an expert, don't allow the expert to guide you all the way through. If the exchange is between people of a similar level of understanding, keep challenging one another, asking questions and providing answers, going beyond the limits of the problem. This is the fun part of physics - endless discussion about interesting problems! (There is no intention to categorize students as "weak" or "strong". Expert and novice can refer to two students of equal talent and ability - but one happens to have already solved the problem!)

During exams, you will be allowed a calculator and something to write with. You cannot refer to any materials other than the exam itself. **Cheating will not be tolerated and will lead to immediate referral to the Dean as a serious violation of the academic honesty policy.**

Copyright and Fair Use Statement: Copyright laws and fair use policies protect the rights of authors. Copyrighted materials may be used in this class, including articles, music, art work, etc. These materials are provided for private study, scholarship, or research, and they adhere to the copyright law of the U.S. (Title 17, U.S. Code). You may copy or download from the course website one copy of the

materials on any single computer for non-commercial, personal, or educational purposes only, provided that you do not modify it and use it only for the duration of this course. Beyond this use, no material from the course or website may be copied, reproduced, re-published, uploaded, posted, transmitted, or distributed in any way without the permission of the original copyright holder. Neither the instructor nor the College assumes any responsibility for individuals who improperly use copyrighted material.

Disability Statement: Spelman College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements, or benefit from the College's programs or services, you should contact the Office of Disability Services (ODS) as soon as possible. To receive any academic accommodation, you must be appropriately registered with ODS. The ODS works with students confidentially and does not disclose any disability-related information without their permission. ODS serves as a clearinghouse on disability issues and works in partnership with faculty and all other student service offices. For further information about services for students with disabilities, please contact the ODS at 404-270-5289 (voice), located in MacVicar Hall, Room 106.

Pregnancy: None of the activities in this course will involve strenuous physical activity, radioactive sources, or other phenomena that may adversely affect a pregnancy. However, the College recommends that any student who is pregnant and enrolled in any laboratory and/or physical activity get written permission from her attending physician before participating in any laboratory and/or physical activity for the course. Please refer to the Student Handbook (pg. 32) for the College's policy statement on Students with Serious Medical Conditions.

DISCLAIMER: The course syllabus provides a general plan for the course, deviations may be necessary.

SPELMAN COLLEGE
PHYSICS 261: OPTICS
FALL 2019

Instructor:

Marta Dark McNeese, Ph.D.
Science Center 194
Office phone: (404) 270-5850
Office email: mldark@spelman.edu (Please do not email assignments.)

Office Hours:
M 1 – 2pm T 2 – 4 pm Th 11 am – 1 pm
Other times are available by appointment or you may drop in briefly when I am in the office.

Prerequisites

PHY 241 Physics II: Electricity and Magnetism

Textbook

Introduction to Optics (3rd edition) by F. Pedrotti et al (required)

List of Reference Materials

Practical Physics by G.L. Squires
Introduction to Modern Optics by Grant R. Fowles
Optics by Eugene Hecht
Principles of Optics by Max Born and Emil Wolf

These books are not required, but copies are available at Woodruff Library and/or from the instructor. Additional materials (e.g. handouts, powerpoint slides) will be posted to Moodle.

Course Description

A laboratory-based course in introductory optics. Topics include laws of geometric and physical optics. Basic applications of optics and optical phenomena are presented. One two-hour lab session per week. One credit.

Course Objectives
Through this course, the student will:

1. Discover principles of optics and confirm them in the laboratory.

2. Practice optical techniques, thus gaining broad laboratory experience in optics.
3. Investigate optical phenomena using the scientific process.
4. Demonstrate critical thinking through planning, carrying out, and analyzing optics experiments.
5. Develop skills that are applicable to further study in the field of optics
6. Use lasers and optics safely.
7. Build and work with optical systems and components.
8. Practice writing reports on laboratory experiments that are clear, complete, accurate, relevant, and demonstrate the scientific process.
9. Discuss and apply principles of geometric and physical optics.

Grading and Course Policies

The general distribution of grading between lab reports, in-class work, etc. is shown below. Grading for the course will be part objective, and part subjective. The numerical grade received for any given item is the objective portion. The subjective portion arises from how the instructor perceives your involvement with the course - attendance, tardiness, active participation in labs and discussion, preparation for labs, detailed notebook, etc. – and will be factored into the participation percentage of the grade. All assigned work must be submitted in order to receive a grade.

Late assignments will lose up to 10% of the maximum possible value per class day that it is late. Attendance at each laboratory section is **mandatory**, and your attendance record during the semester will generally count as equal to one lab report. Absences will only be excused with prompt submission of documentation from the Dean that clearly indicates an illness, family or school related emergencies. Routine appointments, traffic, personal travel, work schedules, etc. are not considered emergencies.

Homework/In-class work 25%
Laboratory Reports 40%
Individual Project 10%
Final exam 20%
Participation/Notebook 5%

The final letter grade is calculated as follows:

90-100: A	70-75: C
88-89: A-	68-69: C-
86-87: B+	66-67: D+
80-85: B	55-65: D
78-79: B-	Below 55: F
76-77: C+	

You are responsible for retaining all graded materials in the event that there are any questions.

A grade of Incomplete (I) will be assigned only on submission of a written excuse provided by the Dean, which clearly explains why the remaining work cannot be completed. The student must complete the required work by the end of the next semester on or before the date indicated by the Registrar's Office.

Class Sessions
This course is laboratory based and the majority of class time will be devoted to hands-on experiments. However, sessions may also include discussions, mini-lectures, and data analysis. Students must come prepared for class by completing any assignments (e.g. assigned reading, homework problems, or pre-labs). Quizzes may occur periodically.

Students are required to bring a laboratory notebook and an external memory device to each meeting of the course. Students should also bring a scientific calculator to the lab. All students should have a record of experimental details, shared data, and any other pertinent information before leaving each week's session.

Safety Policies
Students will be informed about the safe use of lasers and optics. Although optical components are not generally dangerous, they are fragile and require care in handling. Repeated disregard of safety policies will lead to dismissal from the course. Students must pass a safety quiz before working in the laboratory.

Notebook
Each student must bring a notebook to each session. The lab notebook will be checked periodically to ensure the student is recording all pertinent information. A quadrille-lined composition notebook is recommended.

Moodle
I will use Moodle to post documents such as the syllabus, lab handouts, and updated schedules. Students will be asked to submit assignments by uploading them to Moodle. You must ensure you have access to the class on Moodle and that you are receiving any messages sent through Moodle – contact the Help Desk with any issues (x 5400).

Group Work
The purpose of this course is to provide students with experience in doing and thinking about experimental optics. To achieve this, each student must become actively involved in the lab. Since you may often work in groups of 2 or 3, there will be the possibility that some students will pick up concepts faster, be more vocal with their opinions, or tend to lead the group. It is the responsibility of each student to ensure that she is participating in and benefiting from lab activities.

Homework/In-class work
There will typically be bi-weekly homework assignments. These will typically be due one week from the hand-out date, during the class period. We may possibly have 2 – 3 pop quizzes (which would count towards in class work). You may also be asked to submit a short progress report at the end of lab.

Participation
Participation is based on being on-time, present, and engaged in all lab activities. We will also have a short assessment of your geometric optics (reflections, lenses) at the start of the semester and possibly again at the end of the semester. The score will be based only on completing the test and will count towards participation. The results will be used to assess your learning experiences in PHY 261 and improve future offerings.

Project
Each student will complete their own independent experimental investigation. Students will propose their own topic, and pending instructor approval, will carry it out independently. A student may begin working on the project as soon as possible, but at least 2 sessions at the end of the semester will be set aside for students to work on the project. Students must submit a written report and give an oral presentation to the class as part of the requirements for the project.

Final Exam
The final exam may include a written and a practical component. The practical exam will be held during the timeslots given by the Registrar's Office.

Course Outline
This course outline is tentative as some experiments may take more than one week to complete. Students in this course will complete experiments on the following list of topics:

Week 1	Introduction; Laws of Reflection and Refraction
Week 2	Refraction
Week 3	Refraction in Liquids
Week 4	Lenses and Images
Week 5	Lenses and Images
Week 6	Magnification: Telescopes & Microscopes
Week 7	Critical Angle and Optical Fibers
Week 8	Diffraction of Light/ Thickness of Human Hair
Week 9	Polarization
Week 10	Thin Film Interference
Week 11	Michelson Interferometer
Week 12	Independent Projects
Week 13	Independent Projects
Week 14	Presentations

Professionalism in the Optics Lab

- **At-Home "Labs"** – You will be required to carry out a few qualitative experiments on your own time outside of the lab. Generally you will be provided inexpensive equipment for these experiments, but you must take care of them and return them to the lab for full credit on the assignment.
- **Be on time** - If you are late, enter as unobtrusively as possible without disrupting others. Do not expect Dr. Dark to "rewind" and inform you of what you have missed. Assume that you have missed important information and talk to your peers after class so you are not left behind.
- **No food or drink** – Absolutely no food or drinks are allowed in the lab Students who do not comply will be asked to discard the materials or leave.
- **Electronics** – Computers, smartphones, iWatches etc. should be used only for class related activities. Preparedness for class includes silencing your devices. Earbuds are a safety hazard in the lab as is loud audio or video. Electronic usage for non-class related activity is considered uncivil behavior, and deductions from participation points may occur. **All such devices must be "off" during exams**.
- **FERPA** – Familiarize yourself with the Family Educational Rights to Privacy Act. In order to comply with Federal laws of privacy, there are some student requests
- **Late work** – Assignments may be submitted up to one week late, however there will be a penalty of up to 40% off. You may submit work early either to me in my office or to Ms. Lewis in Science 327. E*mailed assignments* and random papers left near my office will receive a zero. Do not assume that assignments left on my office door or slipped under the door will be received. They sometimes go missing.
- **Questions about revisions and graded assignments** – Questions about graded assignments and possible revisions must occur within 5 business days of my returning the graded assignment.
- **Email** – I will respond to emails within 24 – 36 hours. On weekends and holidays please allow up to 72 hours for a reply. Use the Spelman.edu address for questions, concerns, updates, etc. The gmail.com address is **only** for specifically requested assignments (group progress reports, for example).

General Precautions in the Laboratory

Appropriate clothing should be worn by all persons entering the lab, including guests. Substantial footwear should also be required (no bare feet, no rubber flip-flops). Backpacks and laptop bags should be kept off of the floor. Jewelry that could be placed in a beam path (rings, bracelets) should be removed. Dangling jewelry is also a hazard and should be removed.

Horseplay is not allowed in the lab. This includes the loud playing of audio or video, and the use of earbuds, which may interfere with communication. No preparation, storage or consumption of food and drink is permitted in the lab.

Individuals working outside of class time must notify the instructor or lab coordinator, especially after normal business hours. Unauthorized experiments will not be allowed. All laboratory work must be approved by the principal investigator, supervisor, or instructor.

Disability Statement
Any student who feels she may need an accommodation based on the impact of a disability should contact the Office of Disability Services privately to discuss her specific needs. Please contact the Office of Disability Service at 404-270-5289 in MacVicar Hall to coordinate reasonable accommodations.

Pregnancy Statement
In some experiments in this course, you may use chemicals. You should notify the lab instructor if you are pregnant. The College recommends that any student who is pregnant and enrolled in any laboratory and/or physical activity get written permission from her attending physician before participating in any laboratory and/or physical activity for the course. Please refer to the Student Handbook for the College's policy statement on Students with Serious Medical Conditions.

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PHY 311: Classical Mechanics
SYLLABUS
Spring 2019

Instructor: Derrick Hylton
Office: Science Center 183, 404-270-5846
Cell: 678 – 613 - 3313
Email: dhylton@spelman.edu

Office hours: M 11 AM – 12:30 PM
T 12:30 – 2 PM
W 1 – 2 PM
R 8:15 – 9:25 AM
or by appointment

You may come to the office any time and I will see you if I am there; there is no need for an appointment unless you want to make sure that I am there.

Textbook: *Classical Mechanics*, by John R. Taylor, University Science Books, 2005; ISBN 9781891389221.

Course Rationale

Classical Mechanics is a study of Newtonian mechanics including the Lagrangian and Hamiltonian formalisms and the precise mathematical framework constructed for the study of motion. It has been remarkably successful in presenting to us a structure, which can account for the motion around us and its initial success was in the study of planetary motion. Classical Mechanics is the foundation on which most of physics is built; it is, therefore, the most suitable starting point in the study of physics and is essential for the study of physics. It is required of all physics majors. Prerequisite: PHY 302.

Course Goals

1. To impart to the student the knowledge and role of Classical Mechanics and its application in understanding various phenomena and problems.
2. To equip the student to readily make a transition to the study of quantum mechanics and other advanced physics courses.
3. To develop a sophistication in the student so that the student makes substantial progress from the introductory to an advanced level in her development as an undergraduate student of physics. Certain skills are addressed; they include the ability to,
   a) Read and comprehend an intermediate physics text
   b) Write physics clearly
   c) Derive, interpret, and analyze mathematical descriptions of natural phenomena
   d) Design an experimental test of the theory.

Course Objectives

1. State the various formalisms of mechanics as well as to define and interpret concepts relevant to each – Newton's laws, energy principle, angular momentum principle, Lagrange's formalism, and Hamilton's formalism.

2. Solve problems using the calculus of variations and derive the equivalency of Lagrange's formalism to Newtonian mechanics.

3. Apply the various formalisms of mechanics to explain phenomena, to predict experimental results, and to solve problems within certain models, such a single particle model, a system of particles, or a rigid body model.

4. Analyze phenomena and problems with different interactions such as constant force, universal gravitation, friction, drag, central forces, and restoring forces.

5. Construct and apply a formalism to solve a two-body problem; identify problems to extend this formalism beyond two bodies.

6. Apply center of mass ideas to multi-particle systems and rigid bodies in order to describe phenomena that can be modeled as such.

7. Differentiate between inertial and non-inertial reference frames; construct a theory of non-inertial reference frames and apply it to rotating coordinate systems.

8. Discuss theories for collisions and scattering and apply them to explain phenomena, predict experimental results and solve problems.

9. State principles of relativity; construct apply the relativity theory of Galileo.

10. Criticize Galilean relativity based on certain experimental results; construct theory of special relativity of Einstein and apply it to predict experimental results and solve problems.

11. Identify development of personal skills in the process of science and the studying of science; build experience with metacognition.

Course Outline

1. Particle Mechanics (4 weeks)
   Newtonian Formalism
   Energy Principle
   Angular Momentum Principle

Lagrange's formalism and calculus of variation
Hamilton's formalism

2. System of Particles (4 weeks)
   Two-body problem
   Center of mass
   Central forces – universal gravitation
   Collisions
   Scattering
   Coupled Oscillations

3. Rigid Bodies (2 weeks)
   Inertia tensor
   Application of angular momentum
   Spinning Top

4. Non-Inertial Reference Frames (2 weeks)
   Fictitious forces
   Rotating coordinating systems
   Coriolis force

5. Relativity (3 weeks)
   Principle of relativity
   Galilean relativity
   Einstein's theory of special relativity

Classroom Sessions

The classroom sessions will consist of student-led activities with an interjection of instructor-led activities as they become necessary. Students will be individually assigned problems, projects, and topics and each student will create activities to lead the class to discuss and understand their progress on the work. As it become necessary, the instructor will present mini-lectures, demonstrations, computer activities, experimental activities, worksheets, and other activities to build the knowledge base of the students and enhance their learning. Thus, the content of the classroom sessions will be mostly student-driven.

Preparing for class

Preparation for class should include

- Critically reading the sections in the textbook that pertain to your assigned work
- Preparing your activities and lesson plan for the class, in consultation with the instructor
- Posting important material for the class in a repository
- Reflecting on your study habits, in consultation with the instructor
- Reviewing all previous material of the entire class once per week

- Engaging in activities that demonstrate your grasp of the material, such as solving problems, answering questions about the material, constructing qualitative and quantitative explanations for phenomena, and discussing the material with the instructor one on one
- Re-reading sections in the textbook presented in class
- Formulating questions about material that is not understood and posing them to the instructor to stimulate class discussion
- Reviewing all relevant mathematics
- Checking Moodle to review all posted material for the course, especially recent material.

The instructor suggests a minimum of 10 hours of study time per week.

Evaluation

Your grade will be based on:

- Mid-term exam, March 7, 2019 from 5:30 – 8:30 PM, Room TBD, 15% (10% if less than final exam)
- Final exam, May 8, 5:30 – 8:30 PM, Room TBD, 35% (40% if greater than midterm)
- Class work and assignments, 40%
- Attendance, 10%

Class work and assignments

Everything done inside or outside of class that is to be counted towards the grade will be given a point value. This includes leading the class, participating in class, reflections, solving assigned problems, class activities, reports on projects, etc. Your grade in this category is your total points earned divided by the maximum number of points. You will be given rubrics and guidelines for most of these activities.

Attendance

You are required to attend every class; attendance will be taken. The attendance grade is based on the total time that you are in class and engaged with the class work. Any missed time or time that the instructor decides that you are not engaged will result in a deduction in your attendance grade. Missed time in class will not count against this component of the grade only if you present a legitimate excuse (as determined by the instructor) ***as soon as*** you are aware of this excuse.

Exams

The mid-term and final exams will consist of: problems of the same level as those assigned or discussed in class; essay/discussion questions dealing with explanation of phenomena; application of the theory; and derivations.

The grading scale is:

90-100: A
87-89: A-
84-86: B+

77-83: B
74-76: B-
70-73: C+
60-69: C
59-59: C-
56-58: D+
45-55: D
Below 45: F

References

Classical Mechanics a Modern Perspective, by V. D. Barger and M. G. Olsson, McGraw-Hill, New York, (1995).

Analytical Mechanics, by G. R. Fowles and G. L. Cassiday, Fifth Edition, Saunders College Publishing, Orlando, (1993).

Classical Mechanics, Tai L. Chow, John Wiley, New York (1995).

An Introduction to Mechanics, by D. Kleppner and R. J. Kolenkow, McGraw-Hill.

Classical Dynamics of Particles and Systems, by J. B. Marion and S. T. Thorton, 4th edition, Saunders, 1995.

Most of these books are available in the Physics Department; see the instructor.

Policies:

Late Assignments/Tardiness/Absences
No late assignments, tardiness, or absences will be accepted without a legitimate excuse as determined by the instructor. Tardiness and absences affect the attendance grade (see Evaluation section). Legitimate excuses must be presented as soon as the student is aware of it, otherwise, it will not be accepted. When an acceptable excuse is presented, you and your instructor will agree on a due date for graded work.

Unless missed work is made up, a student will receive a grade of zero. As soon as possible, the student has the responsibility to communicate with the instructor to make up missed work in a timely fashion. It is not the responsibility of the instructor to initiate this discussion. Any delay in communicating with the instructor will result in the decision that the work cannot be made up

Academic Integrity:
At the heart of Spelman College's mission is academic excellence, along with the development of

intellectual, ethical and leadership qualities. These goals can only flourish in an institutional environment where every member of the College affirms honesty, trust, and mutual respect. All members of the academic community of Spelman College are expected to understand and follow the basic standards of honesty and integrity, upholding a commitment to high ethical standards. Students are expected to read and abide by the Spelman College Code of Conduct (see the current Spelman College Student Handbook) and are expected to behave as mature and responsible members of the Spelman College academic community. Students are expected to follow ethical standards in their personal conduct and in their behavior towards other members of the community. They are expected to observe basic honesty in their work, words, ideas, and actions. Failure to do so is a violation of the Spelman College Academic Integrity Policy. Violators will be subject to the sanctions outlined in the Spelman College Bulletin.

Although you may work together on assignments, the work you turn in must be written independently. It is better to reproduce any collaborative work without looking at notes. If the work is not written independently, it will be considered academic dishonesty.

Students Access Statement:
Spelman College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements, or benefit from the College's programs or services, you should contact Student Access Center (SAC) as soon as possible. To receive any academic accommodation, you must be appropriately registered with SAC. The SAC works with students confidentially and does not disclose any disability-related information without their permission. SAC serves as a clearinghouse on disability issues and works in partnership with faculty and all other student service offices. For further information about services for students with disabilities, please contact the SAC at 404-270-5289 (voice), located in MacVicar Hall, Room 106.

Pregnancy Statement
None of the activities in this course will involve strenuous physical activity, radioactive sources or other phenomena that may adversely affect a pregnancy. However, the College recommends that any student who is pregnant and enrolled in any laboratory and/or physical activity get written permission from her attending physician before participating in any laboratory and/or physical activity for the course. Please refer to the Student Handbook for the College's policy statement on Students with Serious Medical Conditions.

Incomplete Policy
An Incomplete (IP) is assigned to a student when extenuating circumstances (e.g., illness or family emergency) prevent a student who is passing a course from completing the final examination or final assignment(s) by the end of the semester. In consultation with a Dean, the faculty member determines if an Incomplete is appropriate and completes the necessary paperwork. The faculty member determines the date for completion of all work. An Incompletion must be changed by the deadline specified on the College academic calendar. A student who cannot complete the Incomplete by the specified deadline must request an extension

from the professor, who will notify the Office of the Dean of the extension. If the required work is not completed by the established deadline or the student is not given an extension, the IP will automatically be changed to an F.

Physics 312: Electromagnetic Theory
Spelman College
Spring 2019

Meeting Times and Location
Tuesdays and Thursdays, 9:00 to 10:50 AM, Tapley 133.

Instructor
Michael Burns-Kaurin
Science Center Building 184
Office : 404-270-5849
E-mail: mburns-k@spelman.edu

Office Hours:
Monday .....1 – 3 PM
Wednesday.....1 – 3 PM
Thursday.....11 AM – 1 PM
Friday .....1 – 3 PM
Or other times by appointment

Text
Introduction to Electrodynamics, David J. Griffiths, 4th ed. (Pearson, 2013).

Course Description
An advanced study of electric fields, magnetic fields, Maxwell's equations, and electromagnetic waves. The course focuses on the use of vector calculus for electrostatics and magnetostatics, analytical and computational methods for solving Laplace's equation and Poisson's equation, fields in matter, electrodynamics and Maxwell's equations, the interaction of electromagnetic waves with matter, and electromagnetic radiation. Lecture/activity four hours per week.

Course Rationale and Goals
A physics major requires deep understanding of electric and magnetic fields. This course builds on the basic material in Physics II by using more sophisticated mathematics such as vector calculus and separation of variables, by introducing analytical and computational methods of calculating fields and potentials in complicated situations, and by presenting a more detailed model of fields in matter. This course aims to increase the breadth and depth of the student's comprehension of electric and magnetic fields, to give the student an appreciation for the use of computer simulations, to provide the student with mathematical tools that are used in all fields of physics, and to give the student more experience using mathematics to describe and predict physical phenomena.

Course Objectives

Through successful completion of this course, the student will learn to

- apply more sophisticated mathematics to the description of physical phenomena;
- understand and produce complicated arguments and derivations;
- use computers to simulate physical phenomena;
- create and critique arguments proceeding from principles of physics;
- calculate and interpret vector differentials, and relate them to physical quantities;
- use and interpret the fundamental theorems of vector calculus;
- interpret and use rectangular, spherical, and cylindrical coordinates, and convert among them;
- use and interpret the Dirac delta;
- calculate electric fields, potentials, and energies for a variety of situations;
- explain and use the methods of images, separation of variables, multipoles, and relaxation;
- discuss and calculate the response of atoms and dielectric materials to electric fields;
- calculate magnetic fields and vector potential for a variety of situations and using a variety of analytical and numerical techniques;
- discuss and calculate the response of atoms and various materials to magnetic fields;
- interpret, discuss, and use Maxwell's equations in both integral and differential form;
- discuss and derive the electromagnetic wave equation;
- discuss and calculate the propagation of electromagnetic waves in a variety of media;
- discuss and calculate electromagnetic radiation from dipoles and from moving point charges.

More detailed objectives for the individual chapters will be provided later.

Exams

March 7 .....Midterm Exam
May 9, 10:30 AM to 12:30 PM.....Comprehensive Final

Grading and Course Policies

Homework.....40%
Class Participation and Activities 15%
Midterm Exam .....20% (15% if final exam is better)
Final Exam .....25% (30% if final exam is better)

Grading Scale

90% to 100 % is an A
86% to 89% is an A−
82% to 85% is a B+
75% to 81% is a B
70% to 74% is a B−
67% to 69% is a C+
60% to 66% is a C
56% to 59% is a D+
50% to 55% is a D
0% to 49% is an F

Class Participation and Activities

Each student is expected to actively participate in the lectures. Participation includes asking and answering questions, as well as engaging in class discussions. Participation requires preparation for class. Each class will count equally; the student will receive full credit, half credit, or no credit for each class, based on her level of participation. Unexcused absences or tardiness will reduce the class participation grade. Some classes will include graded activities such as quizzes.

Homework

Problems will be assigned and collected weekly. Homework turned in late will not receive full credit. Ungraded exercises may be assigned daily; these will not be turned in, but working on them is a part of preparing for class and the instructor may check that they have been attempted for homework points.

Exams

Attendance is required for all exams. Excuses require verification by the Academic Dean's office, and will only be given for serious situations. The final exam will be comprehensive, with some emphasis on the last portion of the course.

Academic Honesty

At the heart of Spelman College's mission is academic excellence, along with the development of intellectual, ethical and leadership qualities. These goals can only flourish in an institutional environment where every member of the College affirms honesty, trust, and mutual respect. All members of the academic community of Spelman College are expected to understand and follow the basic standards of honesty and integrity, upholding a commitment to high ethical standards. Students are expected to read and abide by the Spelman College Code of Conduct (see the current Spelman College Student Handbook) and are expected to behave as mature and responsible members of the Spelman College academic community. Students are expected to follow ethical standards in their personal conduct and in their behavior towards other members of the community. They are expected to observe basic honesty in their work, words, ideas, and actions. Failure to do so is a violation of the Spelman College Academic Integrity Policy. Violators will be subject to the sanctions outlined in the Spelman College Bulletin.

Students are expected to help each other on homework and to work together on computer activities. What you turn in, however, must be your own work. For instance, if you collaborate with other students on solving problems, you must work through the solution yourself and write a solution in your own words. Copying or paraphrasing another student's work is not acceptable and constitutes plagiarism. Please consult the student handbook for the college's policies on plagiarism. All academic dishonesty will be punished according to the College's policy, as stated in the student handbook.

Students with Disabilities

Spelman College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements, or benefit from

the College's programs or services, you should contact the Student Access Center (SAC) as soon as possible. To receive any academic accommodation, you must be appropriately registered with SAC. The SAC works with students confidentially and does not disclose any disability-related information without their permission. SAC serves as a clearinghouse on disability issues and works in partnership with faculty and all other student service offices. For further information about services for students with disabilities, please call 404-270-5289 (voice), located in MacVicar Hall, Room 106.

Course Outline

Chapter 1—Vector Analysis—Incorporated as needed (partially covered in Physics 302)
Dot product and cross product; gradient, divergence, and curl; fundamental theorems; curvilinear coordinates; Dirac delta; numerical methods; permutation symbols.

Chapter 2: Electrostatics—Two weeks (partially covered in Physics 302)
Coulomb's law; Gauss' law; electric potential and energy; conductors.

Chapter 3: Potentials—Three weeks
Laplace's equation and uniqueness theorems; Poisson's equation; images; separation of variables and special functions; multipoles; relaxation.

Chapter 4: Electrostatic Fields in Matter—Two weeks
Atomic polarization; electric field and electric displacement; linear dielectrics and susceptibility; boundary value problems.

Chapter 5: Magnetostatics—Two weeks (partially covered in Physics 302)
Fields and forces; current density; Biot-Savart law; Ampere's law; vector potential; numerical methods.

Chapter 6: Magnetostatic Fields in Matter—One week
Magnetic moments; magnetic fields and auxiliary fields; susceptibility; ferromagnetism.

Chapter 7: Electrodynamics—Two weeks
Induction; Maxwell's equations.

Chapter 9: Electromagnetic Waves—One week (partially covered in Physics 302)
Wave equation; dielectrics; conductors; dispersion and atomic models; wave guides.

Chapter 11: Electromagnetic Radiation—One week
Dipoles; moving point charges; radiation reaction.

References

The following books are at or just below the level of this course.

Electromagnetism, Lorrain and Corson.
Electromagnetic Fields and Waves, Lorrain and Corson.
Foundations of Electromagnetic Theory, Reitz, Milford, and Christy.
Electromagnetic Fields, Wangsness.
The Feynman Lectures, vol. 2.

This book is the next step; it is commonly used for graduate courses.

Classical Electrodynamics, Jackson.

Physics 322: Thermal and Statistical Physics
Spelman College
Spring 2019

Instructor

Natarajan Ravi
Science Center 321
Office: (404) 270-5857
Cell: (678) 644-9742
Office email: nravi@spelman.edu
Personal email: aparnusha@gmail.com

Office Hours

M: 10:00 – 12:00 noon;
or by appointment

Class will meet in SCI 188
TR 2:25 – 4:05 pm

Text

An Introduction to Thermal Physics, Daniel V. Schroeder, Addison-Wesley, 2000.

Course Description

An intermediate course that considers the fundamental concepts of statistical mechanics and classical thermodynamics, focusing on: temperature, work, heat, entropy, the laws of thermodynamics, microstates and macrostates, multiplicity, probability distribution functions, ensembles, and macroscopic systems. Issues of the kinetic theory with applications to isolated, open, and closed systems are included. Four hours of class sessions per week. Four credits.

Course Rationale and Goals

The study of temperature, entropy, ensembles, and other microscopic and macroscopic quantities are undeniably required for in-depth understanding of the fundamental aspects of nature. This course, building on the basic material presented in the introductory physics courses, presents a subject omitted in those courses. The general course goals are to

- develop an appreciation for many-body systems, as described by statistical mechanics;
- establish the ensemble-averaging procedure, which is effective in providing macroscopically observable quantities;
- derive from a phenomenological point of view the laws of thermodynamics;
- provide the essential thermal-related material necessary for advanced and/or graduate courses in physics, chemistry, materials science, and engineering.
- promote critical thinking, problem solving, and computer use.

Course Objectives

Through successful completion of this course, the student will learn to

- improve skills in learning and applying physics;
- state, interpret, and apply the laws of thermodynamics;
- calculate energy exchanges and temperature changes for a variety of processes, including ideal gases, heat engines, and refrigerators;
- apply statistical principles to a variety of systems;
- define and apply macroscopic variables such as pressure, temperature, entropy, and chemical potential;
- discuss and apply the connections between microscopic and macroscopic variables, particularly as related to entropy;
- discuss and apply the different forms of free energy;
- justify, discuss, and apply the statistics of Boltzmann, Fermi-Dirac, and Bose-Einstein;

Course Outline

Energy in Thermal Physics (chapter 1): 2 weeks
The Second Law (chapter 2): 2 weeks
Interactions and Implications (chapter 3): 2 weeks
Engines and Refrigerators (chapter 4): 1 week
Free Energy (chapter 5): 2 weeks
Boltzmann Statistics (chapter 6): 2 weeks
Quantum Statistics (chapter 7): 2 weeks

Grading

The grade is based on the following

HW/Assignments	10%
Projects, tutoring	15%
Activities	15%
Mid-term Exam	20%
Final Exam (Comprehensive)	30%
Presentation & Paper	10%

The grade is assigned according to the following:

A	88 – 100%	A-	84 – 87%		
B+	80 – 83%	B	73 – 79%	B-	69 – 72%
C+	66 – 68%	C	58 – 65%	C-	56 – 57%
D+	53 – 55%	D	45 – 52%	F	< 45%

Homework/In class assignments & Activities:
Homework will consist of reading, problems, mathematical derivations, calculations, and questions that require detailed explanations. It will not only be graded on the final results, but also on the process by which these results were obtained. A reading list will be distributed during the first week of classes. In class activities may include pop quizzes.

Projects:
Two projects will be assigned to each student. The project will involve doing research using web sources to gather basic information on the topic. It will also involve performing pertinent calculations using appropriate software. Using the results obtained, the student should write a scientific article to be graded by the instructor. The article should show evidence of scientific argument and the student's understanding of the topic.

Presentations:
Each student will make an oral presentation based on chosen topic relevant to the biophysics field, in the format of a technical talk at a conference, at the end of the semester. Each student will also write a scientific paper on the researched topic. The paper should be written adhering to the format of a standard Physics Journal such as Physical Review or Journal of Chemical Physics. The paper and the presentation constitute 10% (5% for each) of the final course grade. The grade is based upon organization and clarity of the presentation, understanding of the material, and appropriate discussion of the significance and physical concepts involved in the topic.

Class Participation and Attendance
Each student is expected to actively participate in the classes. Participation includes asking and answering questions, as well as engaging in class discussions. Participation also includes preparing for class. Unexcused absences or tardiness will reduce the class participation grade.

Some class sessions will focus on guided, group activities such as solving complex problems, discussing questions, or programming computer simulations. These sessions may include written work. The grade on the written work and your active engagement count towards class participation.

Exams
Exams will consist of problems and discussion/essay questions that are at the same level as those on the assignments or those discussed in class. The exams are intended to measure whether the objectives of the course are being met.

Tentative Exam Schedule:
The exam dates/times are: Midterm – March 7, 2019; 2 – 5 PM.
Final Exam – May 7, 2019; 2 – 5 PM.

Oral Presentations May 2

Policies

Attendance and Tardiness:
You are required to attend all class on time, unless approved by the instructor prior to the class. Not complying will affect your class participation grade. Missed graded activities cannot be made up – you will receive a zero for unexcused absences or tardiness, or it will not count toward the grade for excused absences or tardiness.

Academic Integrity Policy:
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We emphasize that all sources must be referenced, including sources used for images and sources used to get ideas (written or verbal). Paraphrasing is not accepted without reference, and you must indicate any material taken verbatim. You do not need to reference the instructor.

There will be group work in this course. We also encourage you to seek help from the instructor, the DI (if any), and other students. However, for all individual work, you must write it independently **after** you work together or get help, not during. No two individual assignments can be identical or paraphrased.

Student Access Statement:
Spelman College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements, or benefit from the College's programs or services, you should contact Student Access Center (SAC) as soon as possible. To receive any academic accommodation, you must be appropriately registered with SAC. The SAC works with students confidentially and does not disclose any disability-related information without their permission. SAC serves as a clearinghouse on disability issues and works in partnership with faculty and all other student service offices. For further information about services for students with disabilities, please contact the SAC at 404-270-5289 (voice), located in MacVicar Hall, Room 106.

Late Assignments/Tardiness/Absences
No late assignments, tardiness, or absences will be accepted without a legitimate excuse as determined by the appropriate instructor (regular class and lab). Legitimate excuses must be

presented as soon as the student is aware of it, otherwise, it will not be accepted. See Course Structure above for more information about tardiness.

Missed work due to an absence can only be made up if there is a legitimate excuse approved by the appropriate instructor. Unless missed work is made up, a student will receive a grade of zero. As soon as possible, the student has the responsibility to communicate with the appropriate instructor to make up missed work in a timely fashion. **It is not the responsibility of the instructor to initiate a discussion about make ups.** Any delay in communicating with the appropriate instructor will result in the decision that the work cannot be made up.

Pregnancy
None of the activities in this course will involve strenuous physical activity, radioactive sources or other phenomena that may adversely affect a pregnancy. However, the College recommends that any student who is pregnant and enrolled in any laboratory and/or physical activity get written permission from her attending physician before participating in any laboratory and/or physical activity for the course. Please refer to the Student Handbook for the College's policy statement on Students with Serious Medical Conditions. Instructors will provide all students Material Safety Data Sheets and they will be made available for any hazardous materials used during the course.

Technology Usage Policy
Cell phones and calculators are not allowed in the lab. All computations in the lab must be done with a spreadsheet or computer program.

References

The textbook has a good list of references; many of those books are in Woodruff Library. The following list is a sample of books available at the library or from the instructor.

The following books are at or just below the level of this course.

Six Ideas That Shaped Physics--Unit T: Some Processes Are Irreversible, Thomas A. Moore.
Similar in approach to the textbook, but at a lower level.

Thermal Physics, Charles Kittel.
Starts with statistical physics.

Heat and Thermodynamics, Mark W. Zemansky and Richard H. Dittman.
A standard intermediate text, fairly comprehensive, that uses a more traditional approach (statistical physics appears late in the book).

An Introduction to Thermal Physics, C.J. Adkins.
Traditional approach.

Thermodynamics, J.P. Holman.
Traditional approach.

Thermodynamics, Enrico Fermi.
Short, without the statistical approach.

These books are more advanced.

Fundamentals of Statistical and Thermal Physics, F. Reif (McGraw-Hill, 1965).

Statistical Physics, Part 1, L.D. Landau and E.M. Lifshitz (Pergamon Press, third edition 1980).

Elementary Statistical Physics, Charles Kittel.

Statistical Mechanics, Donald McQuarrie

PHYSICS 411: Quantum Mechanics
Spelman College
Fall 2018

Instructor:
Derrick Hylton
Science Center 183
Office phone: (404) 270-5846
Cell: (678) 613-3313 (both texts and calls are fine)
Office email: dhylton@spelman.edu

Office Hours:

Tuesdays	8:00 – 9:15 AM
Wednesdays	10:00 AM – 12:00 PM
Thursdays	11:00 AM – 12 :00 PM

I have an open-door policy for office hours. I will see you whenever I am in the office. You make sure that I am there, if you do not want to take the chance, contact me to check or to tell me when you are coiming.

Online Course Information:
The syllabus and all course information and assignments are posted on Moodle. Moodle will send out emails to let you know when something has been posted. Check you profle in Moodle, if you are not getting emails from Moodle.

Textbook: *Quantum Mechanics*: *A Paradigms Approach*
by David H. McIntrye, McGraw-Hill (2012).

References:
The following texts are at or just above the level of this course:

- *Introductory Quantum Mechanics* , Richard Liboff
- *Introduction to Quantum Mechanics*, David J. Griffiths
- *Introduction to Quantum Mechanics,* John Townsend

This book is the next level and is commonly used in graduate courses:

- *Modern Quantum Mechanics,* J.J. Sakurai

Course Rationale
An introduction to the basic concepts, postulates, and principles of quantum mechanics, and to its experimental basis. The formalism includes a mathematical framework of linear operators, Hilbert spaces, probability interpretation, and perturbation theory. The basic principles include Schrödinger's equation and Heisenberg's Uncertainty Principle. The theory is applied to various systems such as a free particle, infinite and square wells, harmonic oscillator, and hydrogen atom; the results are used to explain experimental data. Four hours of class sessions per week.

Prerequisites - PHY 311 and MATH 214.

Course Objectives
The objectives of this course are:

1. To explain the need for quantum mechanics based on the inability of classical physics to explain some experimental results.
2. To introduce the postulates of quantum mechanics with interpretations based on experimental results.
3. To develop a mathematical framework needed to understand and apply quantum mechanics.
4. To apply quantum mechanics to various systems that may be used to model experiments, in order to promote a deeper understanding of modern physics.

Learning Outcomes
Upon completion of the course, the student should be able to:

1. Discuss historical aspects of quantum mechanics, including experimental evidence.
2. Explain the mathematical treatment of waves and wave packets.
3. Precisely explain the meaning and significance of each postulate of quantum mechanics and describe appropriate experiments that indicate its validity.
4. Justify Schrödinger's equation.
5. Solve Schrödinger's equation for a variety of one- and three-dimensional potentials, using different coordinate systems, using partial differential equations and Dirac's algebraic approach.
6. Interpret and use the Dirac notation, and explain the connection between the Dirac and Schrödinger formalisms.
7. Define a Hilbert space, and perform calculations within this mathematical framework.
8. Explain experimental results by applying quantum mechanics to physical models.
9. Explain the meaning of Heisenberg's Uncertainty Principle, and apply it to various phenomena.
10. Convert between quantum mechanics in momentum space and in ordinary space.
11. Apply quantum mechanics to identical particles.
12. Use time-independent perturbation theory.
13. Discuss the philosophical implications of quantum mechanics.

Course Outline/Topics
Please consult the table of contents of the textbook for further details regarding each outline topic. We will cover the first nine chapters of McIntyre. We will also address selected portions of the remaining chapters, emphasizing applications of quantum mechanics to certain systems.

The course is organized in terms of a series of questions that operate as projects. We may not go through the textbook in sequence, but as it becomes necessary to disuss a question or project. The list below will be covered in the course.

Question 1: Why the need for Quantum Mechanics? (3 class sessions)
Atomic spectra cannot be explained by Classical Mechanics
Stern-Gerlach experiment and Classical Physics

Questions 2: How can the above experiments be explained? (3 class sessions)
Old quantum theory
Basic postulates of Quantum Mechanics

1. Operators and Measurement
2. Schrodinger Time Evolution
3. Particle in a Box
4. Unbound States
5. Angular Momentum
6. Hydrogen Atom
7. Harmonic Oscillator
8. Spin ½ Particles
9. One Dimensional Wave Mechanics
10. The Uncertainty Principle

Class Sessions
The class sessions will be organized around a series of questions or projects. You will be given a list of activities for each question/project. Students will lead the class in working through these activities. The instructor will present lessons, include more activities, and answer questions, or give mini-lectures as they become necessary. At the end of each question/project, students will submit a paper that discusses the results.

Evaluation
The grade for the course is computed according to the following:

Class Work/Assignments	70%
Midterm Exam	10% (5% if less that final exam)
Final Exam	20% (25% if greater than midterm)

Class Work/Assignments
Class work is based on attendance, leading the class and worked turned in during class that may include computer work. You will be given a rubric for leading the class. Assigments include the paper for each question, reflections, answers/solutions to questions and problems. Everything will have a point walue and your grade for this component is based on the total points earned.

Attendance will be 5 points per class. There will be a deduction of 1 point for every 3 minutes unexcused tardiness.

For any unexcused absence, you must submit a written assignment before the next class that includes the following: 1) A summary of the word done during the missed class, and 2) a discussion of the importance of this work. This assignment is worth 20 points and it

is in addition to all other assignments, so that the total possible points for the course will have been increased for you. For any excused absence, you must see the instructor before the next class to make up the 5 points attendance.

Examinations
Exams will consist of questions and problems no greater than the level of all assignments. Exams are closed book and closed notes. Students arriving late to an exam will **not receive additional time** to complete it. All electronic equipment must be off during an exam. Excused absences for exams must be verified by the Dean's office, and provided promptly. The final exam will be comprehensive, but with an emphasis on the last third of the semester.

Date of midterm: Thursday, October 4 from 3:00 to 6:00 PM.
Date of final exam: See the schedule from the Registrar's Office. We will add one hour.

Scale

A	90 – 100
A-	87 – 89
B+	84 – 86
B	78 – 83
B-	73 – 77
C+	68 – 72
C	60 – 67
C-	59 – 59
D+	56 – 58
D	50 – 55
F	<50

Policies

- **Attendance** – On-time attendance is mandatory for all sessions. I will take attendance at the start of class periodically, and may administratively withdraw you if your cumulative absences exceed 20% of the course meetings. If you have an excused absence, you must coordinate making up any missed work with the instructor. Ultimately, it is your responsibility to get information from classmates after the class session is over or from Moodle. When possible, excusable absences should be discussed with an instructor ahead of time. Unacceptable excuses include personal travel, jobs, oversleeping, computer viruses, traffic, flight delays, routine appointments, etc. College-related travel must be discussed in advance with the instructor.
- **Late work** – I do not accept late work, unless approved ahead of time. You may submit work early either to me in my office for feedback. *I will not accept emailed assignments* unless prior arrangements have been made and confirmed at least 48 hours in advance of the due date.
- **FERPA** – Familiarize yourself with the Family Educational Rights to Privacy Act. In order to comply with Federal laws of privacy, there are some student requests that I cannot honor. For example, if you are absent when exams are

returned, you will need to meet with me. I cannot leave these items publicly available or give to another student.

Academic Honesty
The student should maintain a high standard of honor in her academic work, and should not engage in any form of scholastic dishonesty. During exams, you will be allowed a calculator and something to write with. Handheld computers are not acceptable. You cannot refer to any materials other than the exam itself. **Cheating will not be tolerated.** Cheating on quizzes will not be tolerated and will result in a warning and a grade of zero on the assignment (first offense). A second offense will result in communication with the Academic Dean's office. The college's policy on academic dishonesty will be enforced.

At the heart of Spelman College's mission is academic excellence, along with the development of intellectual, ethical and leadership qualities. These goals can only flourish in an institutional environment where every member of the College affirms honesty, trust, and mutual respect. All members of the academic community of Spelman College are expected to understand and follow the basic standards of honesty and integrity, upholding a commitment to high ethical standards. Students are expected to read and abide by the Spelman College Code of Conduct (see the current Spelman College Student Handbook) and are expected to behave as mature and responsible members of the Spelman College academic community.

Disability Statement
Any student who feels she may need an accommodation based on the impact of a disability should contact the Office of Disability Services (ODS) privately to discuss her specific needs. Please contact ODS 404-270-5289 to coordinate reasonable accommodations.

Pregnancy
None of the activities in this course will involve strenuous physical activity, radioactive sources or other phenomena that may adversely affect a pregnancy. Please refer to the Student Handbook for the College's policy statement on Students with Serious Medical Conditions.

PHY 415 Computational Physics
Syllabus – Fall 2012

Instructors:

Paul Camp
Science Center, Room 179
Office Phone: (404) 270-5864
Office email: pcamp@spelman.edu

Office Hours:
Mondays 2:00 – 4:00 PM
Wednesdays 12:00 – 1:30 PM
Fridays 12:00 – 1:30 PM

Derrick Hylton
Science Center, Room 183
Office Phone: (404) 270-5846
Office email: dhylton@spelman.edu

Office Hours:
Mondays 3:00 – 4:30 PM
Thursdays 1:30 – 3:00 PM
Fridays 1:00 – 1:55 PM

Course Description

This course engages the student in computational methods to solve physics problems and predict measurable quantities. It builds on computational modules in previous courses and familiarizes the student with tools, such as numerical integration, numerical solution to differential equations, simulation, and Monte Carlo methods. It also familiarizes the student with programming with a variety of platforms, such as MatLab, Maple, Mathematica, VPython, and C++. The student will use these tools and platforms to solve more advanced physics problems based on physics content from the core courses for physics majors. Lecture four hours per week. Prerequisites: CIS elective (programming language) and two of the following with a grade C or better: PHY 311, PHY 312, PHY 322, PHY 411.

This course is different from a numerical methods course in that it focuses on physics problems and how to choose appropriate tools to analyze them. Some of the appropriate tools will include learning numerical methods.

Required Textbooks:

1. Same required textbooks used in the two prerequisite courses from the following: PHY 311, PHY 312, PHY 322, and PHY 411.
2. *A First Course in Computational Physics*, 2nd Edition, by Paul L. DeVries and Javier E. Hasbun, Jones and Bartlett Publishers, Sudbury, MA, 2011.

References

1. *Computational Physics: Problem Solving with Computers*, 2nd Edition, by Rubin H. Landau, Manuel J. Perez, and Cristian C. Bordeianu, Wiley-VCH, Weinheim, 2007.
2. *Computational Physics*, 2nd Edition, by Nicholas J. Giordano and Hisao Nakanishi, Prentice Hall, NJ, 2006.
3. *Computational Physics*, by J. M. Thijssen, Cambridge University Press, Cambridge, 1999.
4. *An Introduction to Computational Physics*, 2nd Edition, by Tao Pang, Cambridge University Press, Cambridge, 2006.
5. *Numerical Recipes: The Art of Scientific Computing*, 3rd Edition, William H. Press, et.al., Cambridge University Press, Cambridge, 2007.

Goals

1. To become competent in applying computational methods and tools in solving complex physics problems that explain or predict experimental results, where these methods and tools will have a broad appeal in science and related careers.
2. To integrate computational analysis skills into qualitative and quantitative skills learned in previous courses.
3. To understand the role of computations in the nature and philosophy of science.
4. To continue to build quantitative skills and skills in technical reading and scientific communication.

Objectives

After completing this course, the student should be able to:

- Extend understanding of core physics concepts to problems that are not exactly soluble.
- Analyze physics problems by applying principles of physics and reducing the problem to numerical computations.
- Write code in different platforms to do numerical computations, platforms such as MatLab, VPython, C++, Fortran, Maple, and Mathematica.
- Numerically calculate an integral with an appropriate technique, such as trapezoidal rule, Euler's method, and Gaussian quadrature.
- Numerically solve a differential equation with an appropriate technique, such as Euler's method and various predictor-corrector methods.
- Research and apply an appropriate numerical method to perform numerical computations as necessary; these may include finding zeros of a function, approximations, splines, Monte Carlo methods, Fourier transform, finite differences, least squares methods, matrix algebra, differentiation, and simulations.
- Analyze the stability of a numerical method and understand errors and uncertainties in the method.
- Explain the role of computations in the process of science and its relation to experiment and theory.
- Derive fundamental equations of some numerical methods.
- Communicate results, either written or by oral presentation, in a manner acceptable by the physics community.

Class Sessions

Classes are two two-hour sessions per week. These sessions will consist of a variety of activities including:

- Small group or individual activity to solve a physics problem and translate it to a numerical solution.
- Working with software or hardware to learn it or use it to solve a physics problem.
- Discussions about solutions to problems or numerical techniques: small-group, class, or mini-lectures.
- Oral presentations.

Course Outline

Students will work on problems and apply the listed technique during the time scheduled for that technique. Problems will be drawn from the prerequisite physics courses and the content covered in those courses.

1. A First Numerical Problem (1 week)
   - Introduce the meaning of computational physics
   - Introduce issues in computations such as stability and errors
   - Method to solve a differential equation for mechanics
2. Numerical Integration (2 weeks)
   - Problems such as expectation value in quantum mechanics, physical pendulum in classical mechanics, magnetic field computation in situations of low symmetry
3. Solutions to Differential Equations (3 weeks)
   - Problems such as orbits and three-body problem.
   - Problems such as wave equations, heat equation, or Schrodinger's equation.
4. Matrices; Method of Least Squares (1 week)
   - Problems such as normal mode solutions of coupled oscillators, molecular models
   - Problems such as rotational motion, principle axes
   - Problems such as finding bound quantum states in momentum space
5. Randomized algorithms (2 weeks)
   - Problems such as Monte Carlo integration of high dimensional problems
   - Problems such as Monte Carlo and Random Walk methods applied to thermal problems such as diffusion and Ising model of magnetization
6. Simulation and Visualization (2 weeks)
   - Problems such as Brownian motion, phase transitions, out of equilibrium systems, fluctuations
7. Other Techniques such as Approximations, Splines, Interpolation (2 weeks)

Evaluation

The grade is based on a midterm exam, final exam, assignments, projects and class participation.

Assignments

Assignments will consist of readings and problems. The problems will involve basic physics questions to illustrate numerical methods and other questions that deal with physics content, coding and software.

Projects

The projects will be complex physics problems that the students choose based on given options and may be extensions of problems we work on in class. They will require application of the standard numerical methods and software or other numerical methods that must learned.

We anticipate about 4 such projects during the semester. For group projects, one person will submit a scientific paper, another person will give an oral presentation, and others will each submit a written narrative of her contribution and what she learned. The oral presentation should not be more than 20 minutes.

Class Participation

Class participation grade is based on attendance and active participation in all activities. Students must ask questions during all oral presentations. Class participation will be reduced based on tardiness or lack of effort in activities as well as lack of attention in oral presentations. Students will be given a warning for violations and be reduced for repeated offenses. You will be given a rubric.

Exams
The midterm and final exams will consist of question and problems similar to the assignments and issues dealt with during the projects. The exams may involve writing code to solve a physics problem. The midterm and final exams will be three to four hours long and they will be scheduled at a time convenient to all during the days allocated for these exams by the College.

Grade

Midterm Exam	15 %
Final Exam	15 %
Assignments	20 %
Projects	40 %
Class Participation	10 %

The final letter grade is calculated as follows:

90-100: A	87-89: A-	
83-86: B+	77-82: B	74-76: B-
71-73: C+	65-70: C	63-64: C-
58-62: D+	50-57: D	
Below 50: F		

Policies

Excuses
Only legitimate excuses will be accepted for absences, tardiness, or for not meeting due dates or other responsibilities. The legitimate excuse must be given to the instructor as soon as the student is aware of it; any delay in presenting the excuse will make it not legitimate. Acceptable reasons for legitimate excuses are determined by the instructor.

Attendance
Attendance is required for all classes and absences and tardiness will affect your class participation grade.

Late Assignments
No late assignments will be accepted. There will be no grace period unless there is a legitimate excuse (see above).

Academic Integrity
At the heart of Spelman College's mission is academic excellence, along with the development of intellectual, ethical and leadership qualities. These goals can only flourish in an institutional

environment where every member of the College affirms honesty, trust, and mutual respect. All members of the academic community of Spelman College are expected to understand and follow the basic standards of honesty and integrity, upholding a commitment to high ethical standards. Students are expected to read and abide by the Spelman College Code of Conduct (see the current Spelman College Student Handbook) and are expected to behave as mature and responsible members of the Spelman College academic community. Students are expected to follow ethical standards in their personal conduct and in their behavior towards other members of the community. They are expected to observe basic honesty in their work, words, ideas, and actions. Failure to do so is a violation of the Spelman College Academic Integrity Policy. Violators will be subject to the sanctions outlined in the Spelman College Bulletin.

Disability Statement

Spelman College is committed to ensuring the full participation of all students in its programs. If you have a documented disability (or think you may have a disability) and, as a result, need a reasonable accommodation to participate in class, complete course requirements, or benefit from the College's programs or services, you should contact the Office of Disability Services (ODS) as soon as possible. To receive any academic accommodation, you must be appropriately registered with ODS. The ODS works with students confidentially and does not disclose any disability-related information without their permission. ODS serves as a clearinghouse on disability issues and works in partnership with faculty and all other student service offices. For further information about services for students with disabilities, please contact the ODS at 404-270-5289 (voice), located in MacVicar Hall, Room 106.

Pregnancy Statement

This course does not contain any activity that will adversely affect a pregnancy. However, the College recommends that any student who is pregnant and enrolled in any laboratory and/or physical activity get written permission from her attending physician before participating in any laboratory and/or physical activity for the course. Please refer to the Student Handbook for the College's policy statement on Students with Serious Medical Conditions.