33-121: Physics I for Science Students
Fall 2016

Our Goal

The world around us does not evolve at random. Rather, its behavior is governed by fundamental physical laws – in fact, not so many laws. Whether we look at a biological cell crawling across a surface, a baseball arcing in from the outfield, a computer hard disk spinning, or a beaker of solution boiling, we will begin to see why things work the way they do. Sometimes we will go further: We will learn how to make approximations so we can actually predict how some real life things will happen.

Our course will examine *matter* and *interactions*. We will explore the nature of matter: Gasses act like a collection of "widely" spaced particles, colliding with each other. In contrast, molecules and solids act as collections of masses on springs, vibrating about fixed relative positions. By observing how an object is moving and changing, we will explore how matter interacts, identifying the forces acting on the object and how energy is passing into and out of it. This ability to describe the atomic motions in matter and the interactions among different objects will be a critical skill to carry forward into your future majors and will help you appreciate everyday life more.

More specifically (and maybe a little too simplistically), four equations will describe almost every thing in this course:

momentum principle: $\Delta\vec{p} = \vec{F}_{net}\Delta t$

energy principle: $\Delta E_{sys} = W + Q + T_{light}$

angular momentum principle: $\Delta\vec{L} = \vec{\tau}_{net}\Delta t$

second law of thermodynamics: $\Delta S \geq 0$

We will define the variables as we go along. At the conclusion of the course, you should be able to (a) explain to any first year college student the physical meaning of these equations, (b) use them to solve, in detail, problems that are somewhat simplified to be at an appropriate level for this course, and (c) use them to identify the physical phenomena governing much more complex problems you will meet in your future majors and the things you observe in nature every day.

The Course

The course **staff** includes the instructors and a team of graduate and undergraduate students. The instructors contact information is:

Steve Garoff sg2e@andrew.cmu.edu
Wean Hall 7325 412-268-6877
http://www.cmu.edu/physics/people/faculty/garoff.html

George Klein klein@andrew.cmu.edu
Wean Hall 7311 412-268-1300
http://www.cmu.edu/physics/people/faculty/klein.html

You will meet other staff members in recitations and Course Center. Please do not hesitate to contact us if you need something

We will **communicate** assignments, solution sets, and other important material via a **Blackboard** site. You can access it through http://www.cmu.edu/blackboard/ and then clicking on the 'CMU Users' button. We will frequently post things on the site so be sure to check it regularly. If it is not working or seems to be missing something, please let us know.

In this course, we encourage you to **self-assess** how well you are learning the material and to **adjust** your approach accordingly. The course components described below (e.g., textbook, lectures, recitations, homeworks, quizzes, and exams) are not only opportunities for learning but for self-assessment. You can use the results – how well you performed or where you had difficulty – to **direct your own learning** so that you spend your time as efficiently and effectively as possible.

The central tool in our course will be the **textbook**, Matter and Interactions Volume 1 Modern Mechanics, 4th edition by Chabay and Sherwood (John Wiley & Sons, 2015). This text presents physics in a way that will be truly useful to you. It is not an easy text, but we will work together to get the most out of it. You need to read the assigned sections before we discuss them in lecture. The book has many helpful features: Try to answer the questions printed within the text as you read. They will help you self-evaluate if you are understanding the material. The summaries at the end of chapters will help you go back over the chapter contents, now seeing all the ideas in the chapter as a whole rather than separate pieces.

We will study much of the material in Chapters 1 to 12, with the specific sections to be investigated listed on Blackboard as the semester progresses. Whether or not we discuss a section in class, if it is assigned, you need to learn the material.

A word about **mathematics** in this course: Science is a quantitative endeavor and mathematics is our language. The math used in the course – algebra, vector equations, and derivatives – should become second nature to you. The latter two topics will be reviewed in class. Most important, you should become skillful at the math so that it enhances your ability to describe nature and solve problems and never gets in your way. Some extra effort to achieve this goal early in the course is well worth it.

Discussion/lectures are MWF 8:30AM to 9:20AM in Doherty Hall 2315. Since intellectual skills and knowledge cannot be developed by passive listening, these sessions will have some lecture but will include a lot of discussion. We will not be summarizing the text. Rather we will probe important concepts and problem solving techniques by discussion and ungraded “concept quizzes” that make you exercise and improve your understanding of the material.

To be ready to participate in the lecture, you most do the assigned reading. Then you will have seen the basic concepts before the lecture. Simple **reading questions** will appear after each reading assignment on Blackboard in the folder marked by the week in

which they are assigned, not when they are due. Your answers should be short – a couple of sentences. You may not just copy words from the text - put the ideas in your own words. You must complete these questions before 2AM on the day the reading is due. The goal of these questions is to get you to think about key issues and to self-monitor your understanding. Your work on these questions counts toward your final grade but no credit will be given if you just copy words from the text or you do not complete them on time.

Small-group **recitation sections** are held on Tuesdays and Thursdays in Doherty Hall A301D. Your recitation instructor will be available to help you by discussing specific problems. However, as in lecture, we want you to be actively thinking, not passively listening. Therefore, the majority of your recitation time will be spent working in groups on a variety of exercises including assigned recitation problems and computer labs. Lecture/discussion does not always precede recitation work or homework on a concept. Sometimes you will conquer material from your own reading and asking questions.

In-class activities and **responsibilities** include:

* Attending all classes. Attendance is mandatory. You may not realize how important it is to come to class. We have found in past semesters of this course that A and B students have a 95% attendance record. Students in the C range average 80% to 90% attendance. D students tended to miss nearly 50% of the classes. *There will be material on the exams that is only covered in lecture.*
* Bringing the textbook and a scientific calculator to every class. We will use them for discussion.
* Finding out what you missed, if you are unavoidably absent. Handouts and assignments may not always be posted to the course Blackboard.

Outside of class your **responsibilities** include::

* Studying the daily reading assignments and completing the reading questions *before* class. You don't have to understand everything in detail before class discussions but you need to read before lecture so you can participate in the those discussions.
* Doing the weekly assignments listed on Blackboard.
* Spending enough time on the course to meet your goals. To succeed in this class, students spend a total of 10 to 14 hours per week (5 to 9 hours outside of class). If you are below this range consistently, ask yourself if you getting all you want out of the course. If you are consistently above this range, see me or one of the staff for help.
* Keeping up on all reading, assignments, etc. That means working on this course almost daily outside of class – not leaving assignments and reading to the last minute.

Homework problems will be graded and will count toward the final course grade. Homework is due *at the start* of the specified class. (We must set some time for homework to be considered "on time". That time will be 8:30AM on the due date unless otherwise posted.) An assignment may receive half-credit if handed in by 8:30AM on the following day. After that time, homework can receive at most 20% of its original value.

Homework must be legible, clearly organized, stapled, and with your name and section noted or it will not be graded. Since we are seeking understanding of principles and not just correct numbers, complete answers, with your logic clearly shown are required. Complete answers are also required on all quizzes and exams.

We will assign **computer activities** and **lab exercises**, some of which will be done in class and some to be done outside class. These computer activities often include computer modeling of physical systems and are designed to deepen your understanding of the nature of the modeling process. Computer modeling is an important skill that is playing an increasingly critical role in all of the sciences. We will teach you the techniques you will need; no previous programming experience is assumed. If you have worked seriously for an hour trying without success to debug a malfunctioning computer program, STOP! Get help from an instructor or from another student before continuing. We do not want you to spend hours and hours struggling with computer problems!

We will use two types of **in-class quizzes** one to help both you and the staff evaluate whether you understand the material and the other to sharpen our discussions. One type of quiz will be written and will consist of a problem similar to those on exams – perhaps a little shorter. The other type, "concept" quizzes, will be a tool used in our lecture/discussions. You will record your answer to these quizzes using a "clicker". This device communicates with receivers installed in the classroom to record student responses. Student's individual response will remain confidential, but the class and instructor will be able to view the percentage of students who give the correct answer and the lecture discussions will be guided by the results. You need to purchase a clicker from the bookstore. These in-class quizzes also offer you the benefit of self-assessment because they indicate the particular areas of difficulty you need to focus on before the next exam.

The written quizzes will occur any time during our discussions and may cover any topic in the readings assigned up to and including that day. Therefore, you must do the reading before class. No make-up quizzes will be given. At the end of the semester, the quiz with the lowest score will be dropped so if you miss one quiz there is no problem.

Course Help

The **Course Center** is a great place to get help or work on the course. It is held in Doherty Hall A301D Monday through Thursday, 6-9PM. Bring your fellow classmates and use it as a place to work on your weekly assignments. We can answer questions as they come up and help prevent you from wasting time when you are stuck on a problem. When you are at course center, please be aware that the staff is there to assist you in learning for yourself, not to give you answers.

Academic Development, located in Cyert Hall Suite B5, provides a variety of tutoring and counseling for students. On Blackboard, click on "Help" in the left hand menu for a complete list of their services. We are also happy to meet with you. **Professor Klein** holds walk-in office hours at Academic Development on Mondays from 2 to 4 PM and Wednesdays from 3-5 PM. If you would like to speak to **Professor Garoff**, catch him after lecture or write to him and set up an appointment.

We strongly encourage you to use the sources of help listed above.

Scientists and engineers normally **work in groups**, and social interactions are critical to their work. Many good ideas grow out of discussions with colleagues. In this course, we want you to work with others. Study together, help your partners to get over confusions and ask each other questions. Teach each other! You can learn a great deal by teaching.

But after all the discussion is done, the homework, computer write-ups and reading questions must be your own. *Do the final composing of your answers independently.* Papers with identical solutions are not acceptable. Even in discussions, be a little careful, make sure you are not relying too heavily on your study partners. Make sure you work until you understand the material completely and can do the work independently.

While collaboration is the rule in technical work, evaluations of the individual also play an important role in science and engineering. Exams and quizzes are to be done without help from others. You may not wait until a classmate has tried a reading questions and the answer has appeared on Blackboard and then use that answer as your own. Cheating will be heavily penalized in accord with university regulations.

Seek **help** when you need it. You should ask lots of questions in class. Learn to self-assess how you are doing and if you are not satisfied, find someone on the course staff to get help. If you possibly can, formulate a specific question such as "Why is there still a change in momentum when an object moves around a circle at constant speed?" rather than something nebulous such as "I don't understand change in momentum." Preparing a specific question will help you pinpoint what is really bothering you and will allow us give you the most useful help.

If you fall behind for any reason, please let us know as soon as possible. The sooner we know about these situations, the better we can help you make up work. We will do what we can to help you complete the course satisfactorily. The course center is your most important tool for catching up. Use it! Ask the TA's and the TAA's for help if needed. Never be afraid to ask questions, what confuses you probably confuses others.

Evaluation

The staff and I are here to facilitate your learning. If you have any **suggestions** about how we can better help, let us know. We will take your suggestions seriously and try to implement change when we can.

In addition to quizzes, **exams** will help us evaluate your progress in the course. We will have four "hour" exams and one 3-hour comprehensive final exam. All exams are closed-book, but relevant formulas and constants will be provided where needed. Memorization of formulae is not needed. The first exam will be given 8:00AM-8:40AM on Wednesday, September 14. The remaining hour exams are given 8AM – 9:20AM on the following days:

Friday, September 30
Wednesday, October 26
Monday, November 21

The final exam day is not set until later in the semester but will be sometime between December 12th and 19st, inclusive. **DO NOT MAKE ANY TRAVEL PLANS FOR THESE DAYS!**

There will be no make-up exams. If you are too ill to take the exam, bring us a written doctor's excuse as soon as you can. If you must be away for a University approved activity or a religious holiday, you must inform us (with a written note from the faculty advisor) 2 weeks in advance so we can arrange for you to take the exam early. If you have an unexpected family emergency, contact us as soon as you can.

The emphasis in exams will be on understanding the physical concepts and principles and applying them to new situations. Our goal in these exams is not to replicate the physical situations you examine in a homework problem (e.g. a child on a merry-go-round) but to ask you to apply a principle which you have studied in a homework problem (e.g. conservation of angular momentum) to a new situation.

The **final grades** will be determined on the following basis:

24% Final exam 36% 4 hour exams 15% In-class written quizzes
25% Homework, lab and computer exercises

Letter grades are based on the following scale: A 88-100%, B 78-87%, C 65-77%, D 50-65%,and R 0-49%. Sometimes average exam scores turn out lower than we hope due to the structure of the test, not the abilities of the class. We will correct for this. Thus, the grade boundaries will never move up but may be lowered.

If your grade falls within 1% of a **border** between grades, you will be moved to the next higher grade if you have missed fewer than

5 lectures + recitations
5 reading question assignments
1 homework, lab or computer assignment.

If you have not participated in the course up to these standards, you will not be moved to the next higher grade no matter how close you are to the border.

Audio or video recording of the lectures or recitations in any way is prohibited.

Contact Information of Fellow Students

You should be able to contact someone in the class to get course information if you unavoidably miss a class. Please take moment in the first lecture and get this information from three people sitting near you.

Name _____ E-mail _____

Name _____ E-mail _____

Name _____ E-mail _____