Quick links:

Contact Information

- Instructor: Dr. Walter Freeman, wafreema@syr.edu, Physics Building room 215
- Class meetings: Tuesdays and Thursdays, 9:30-10:50 AM or 11 AM-12:20 PM, Stolkin Auditorium
- Help sessions: Tuesdays, 5:10-6:50, and Fridays, 9:30-11:30, in the Physics Clinic – or just drop by my office
- Course website: http://walterfreeman.github.io/phy211/
- Recitation TA's:
  - Andrew Ballard, alballar@syr.edu
  - Harris Bernstein, hcbernst@syr.edu
  - Avinay Bhat, avbhat@syr.edu
  - Lindsay DeMarchi, ldemarch@syr.edu
  - Julian Georg, jsgeorg@syr.edu
  - Francesco Serafin, fserafin@syr.edu (lead TA)
  - Kyle Spurgeon, klspurge@syr.edu
  - Tie Zheng, tzheng01@syr.edu

Textbooks

- *Physics for Scientists and Engineers*, by Randall Knight, 2nd, 3rd, or 4th edition; either the complete book or only Volume 1
  - href="https://www.amazon.com/Physics-Scientists-Engineers-Strategic-Approach/dp/0134110684/">4th edition
  - href="https://www.amazon.com/Physics-Scientists-Engineers-Strategic-Approach/dp/0321752910/">3rd edition
  - href="https://www.amazon.com/Physics-Scientists-Engineers-Strategic-Approach/dp/0805327363/">2nd edition
- E-texts of any of the above will suffice.
- No access codes, online homework programs, etc. are required.

Course philosophy

0. Physics is simple!

This is the simplest class you will take in your university career. It is rather accurate to say that the content of this class consists of Newton's law of motion $\vec F=m\vec a$, along with a little math (algebra, simple trigonometry, extremely simple calculus). That's it.

This class won't be easy, of course; the difficult aspect of this course will be learning to use these simple tools –

the elementary principles governing forces and motion – to understand situations that vary from how to drive safely on ice, how to measure the speed of a bullet, how to aim a cannon to hit a target, and so on.

Physics is a science of simplicity. It is the most reductionist of the sciences; the aim of physics is to reduce the world around us to its simplest parts, understand how they work, and then put them back together to understand the things they make up. Physics is difficult because understanding how these simple pieces combine to determine the behavior of larger systems requires cleverness, ingenuity, and problem-solving skills. The most difficult aspect of this course is learning to solve problems with simple tools. It's like building things out of Legos: you're supposed to build a rocketship, or a statue of Yoda, and all you have are these little bricks!

This is very different than the life sciences, where the difficulty lies in complexity: nature has built very complicated machines called "lizard" and "tree" and "physicist", and it is up to biology to try to make sense of the complexity behind her creations. Biology is hard because you have to understand all of the different pieces that make up lizards and trees and physicists. But physics isn't like that: in this class we have only objects and forces that act on them, and from that foundation you have to build up the solution to many different situations. That's the power of physics: simple laws in combination drive everything around us.

So, if you're stuck on a problem, think simple; that's how physics works.

1. Reasoning and synthesis, not memorization

This course is emphatically not a class where you will come to lecture, sit there and listen to a presentation of some facts, and then repeat them back to me on exams. The laws of mechanics are very simple, and you could memorize them in an hour if you wanted. The challenging aspect of this class is the *application* of those principles to understand the motion of physical systems – to take the principles of nature and, using mathematics
as a tool, synthesize them into an understanding of how a particular system behaves.
You are not going to be learning a list of currently-accepted facts; you are going to be practicing skills and learning to see the universe as scientists see it.

2. Ask for help, early and often

Since the difficult part of the course is the problem-solving aspect, it's only natural that we are going to give you lots of help in solving problems, especially at first. Learning physics is most similar to learning to play
a sport or learning a musical instrument: it requires practice and the guidance of a coach. I do not expect that you can do all of the homework problems on your own; it is crucial that you ask for help in doing your homework. If you're stuck on a homework problem, you can:

- Come to my office hours and ask, or make an appointment, or drop by my office (room 215)
- Go by the Physics Clinic; you are likely to find a TA, other students, or me there to help you.
- Ask a question in the lecture: if you're stuck on something your peers probably are too, and will welcome your question. I *always* have time in lecture to answer questions; don't be intimidated by the size of the class.
- Ask your TA or coaches during recitation
- Ask your peers for help (and insist that they help you understand how to think about the problem, not just give you the answer)
- Ask for help on the class Facebook group
- Write me, your coaches, or your TA an email.

Again: it is intended that you will get stuck, just like no pianist plays a difficult piece perfectly the first time. The problem-solving skills in this course are things you have to practice, and we expect you to have some trouble at first; come ask us for help.

3. Learn from your work

As you look at problems – whether you're solving them the first time or reviewing for an exam – remember: it's not enough to know the answer. You likely won't see the same problems again.

It's also not enough to know how to get the answer. Knowing how to get the answer – looking through the solution and understanding how each step follows logically from the last – is also not enough.

Instead, you should make sure you know how you know what to do to solve the problem. After you complete a problem, take just a few minutes to look back over it and ask yourself: what about this problem led me to the solution? Make sure you're aware of what aspects of the problem make it solvable in a particular way. This will help you build a flexible toolkit of problem-solving skills, tools that will serve you well on the exams and in life.

I've chosen to give you only six to ten homework problems per week. I could give you more, and in fact if you want more practice problems there are more available in your textbook. This is because I intend for you to spend more time thinking about what each problem entails, and learning from them; my experience has shown that students who have to slog through 25 homework problems per week are less likely to actually think about the skills they've applied in each one, since homework becomes a grueling endurance challenge rather than an opportunity to learn physics. I'd much rather have you do the latter.

4. This is not a math class

In this class, you will use mathematics, but it is only a tool. Do not let yourself become a thrall to mathematics; this class is no more about mathematics than a class on Shakespeare is a class about words.

The laws of physics are written in the language of mathematics, but they describe things beyond math: the physical interactions between objects.

If you are stuck, resist the temptation to go leafing through your textbook looking for ``the right equation to use''. Physics isn't about equations; it's about ideas and the ability to solve problems. Instead, put your pencil down and think: what is going on here? What principles are at work in this problem? How do I expect the system to move (or not move)? What things do I know, and what other things can I figure out from them? What does my intuition tell me should happen? What forces act on the objects? If you still can't figure out how to proceed after thinking for a while and consulting your notes on problem-solving approaches, it's a good time to ask for help.

The mathematics you will need for this class are:

- Algebra:
  - You will need the ability to solve a system of N equations for N unknowns, using substitution
  - You will need to know how to use the quadratic formula to find the intersection of two parabolas
  - There is guaranteed to be one problem on the first exam where you will need to use the quadratic formula
- Trigonometry:
  - You will need to know how to compute the legs of a right triangle given knowledge of its hypotenuse and one of its angles
  - You will need to know how to compute the angles of a right triangle and the length of its hypotenuse given the lengths of the legs
- Calculus:
  - You need to know the concepts of "derivative" (rate of change) and "integral" (cumulative effect / area under curve). If you are just now in Calculus I, don't worry; it is no accident that Newton developed both mechanics and calculus, and I will teach you what you need to know. You won't have to do any difficult derivatives or integrals.

That's it.

5. This is your class, too

As part of this philosophy of inquiry and questioning, I welcome your input. If there is some aspect of physics that inspires or fascinates you, please ask; if you have feedback for me that will help you enjoy the class more, then please let me know.

Course Material

In this class, you will learn:

1. **How to describe motion precisely:** how the language of calculus and vectors allow us to frame precise, rigorous descriptions of how things move.

2. **How forces cause motion:** the care and feeding of Newton's second law $\vec F = m\vec a$, some of the forces that exist in nature, and how to use their properties to determine how they will make objects move

3. **Conservation laws:** the peculiar feature of the laws of physics that certain mathematical quantities, called "energy" and "momentum", are not changed by many different processes; how to use these conservation laws to analyze systems that would otherwise be quite difficult

4. **Rotational motion:** how to incorporate objects that rotate, as well as move from place to place, into our physical understanding

5. **Waves, resonance, acoustics, and music:** at the end of the term, we will study the properties of waves, how waves trapped in a cavity create resonant vibrations, and the physics of music.

Course Activities

Readings

Reading the text is an essential part of this physics class! I encourage you to read the assigned sections on the calendar ahead of time, as that way the presentation of the material in class will serve as reinforcement and enrichment rather than be the first time you see something.

Class Meetings

In the auditorium, we will alternate between presentation and practice. I will first introduce you to the new ideas we are studying, asking questions and getting your answers using colored cards. (These take the place of clickers.) If you have done the reading ahead of class, these presentations will serve as review and enrichment. Questions during the presentation are encouraged and welcome! I will also demonstrate for you the analytic processes involved in solving problems. I may also distribute short tutorials for you to work in class, or ask you to answer
short questions on note cards and pass them in at the end of the class.

At any time during class, feel free to interrupt me and ask questions. If you do not understand something, ask. I don't care how many students are in the auditorium – I almost certainly have time for your question.

Classroom Etiquette

Please…

- … arrange to come to class on time and stay until the end; the slamming of the auditorium doors is very annoying to your classmates.

- … do not throw vegetables or fruit at Professor Freeman, except for grapefruit and apples, which he fancies
- … do not catch Pidgeys in class; yes, I know there's a Pokestop outside the building
- … do not use your cellphones for anything else, either
- … use pencil and paper, rather than computers, to take notes, unless you have a disability that requires the use of a computer

Homework

Homework in this class is designed as a tool to help you develop the problem-solving skills needed to understand physical situations on your own.

You will have an assignment due each week (more or less), which you will hand in to your recitation TA. I do not intend for you to work on these problems by yourself without help. The Physics Clinic is a great place to come to do your homework; you will likely find many of your peers there as well. You are also welcome to come to my office hours and sit and work, asking questions as they arise. Doing the homework thoughtfully and with an eye toward understanding "So how did I know what to do here?", and asking for help is the single best thing you can do to help yourself in this class.

When writing your homework solutions, you must describe what you are doing in words, even if these descriptions are brief; your solutions should not consist only of equations. Show us what you are thinking and why you are doing what you're doing; this will both help you learn and help us give you more partial credit if you understand what you're doing but mess up the math. **If you do not describe what you are doing and why, you may not get full**
credit for a solution, even if it is correct.

Submit each problem on a separate page; this is to help us grade your work more easily, and will give the TA's more time to use to answer your questions – which is what both you and I would rather have them do!

Two problems will be graded fully (out of ten points); the rest will be quickly graded for completeness out of two.

Labs

You are enrolled in a lab. It is a separate course. Do not ask me anything about the lab; I don't know anything about it. Ask your lab TA or Sam Sampere (smsamper@syr.edu). (You may, of course, ask me questions about the
physics of things you do in lab, but don't ask me if there is lab this week, where your lab is held, etc.)

Help Sessions

These help sessions are opportunities for you to interact with me and the rest of the teaching team in small groups or individually. (Some folks call them "office hours".) If you have questions or suggestions, need help with your homework or with studying, or just want to chat, this is a great opportunity. They will be held in the Physics Clinic, room 112, or elsewhere as announced.

Grading and Exams

Item	Date	Points
Homework	Due throughout	25
Exam 1	7 February	15

Exam 2	9 March	15
Exam 3	18 April	15
Final Exam	13 December	30
Attendance and participation	Throughout the semester	10
Group practice exams		15

The lowest of your exam grades will be dropped, giving a total of 110 points. If your final exam grade is lower than any of your three midterm exam grades, then the final exam will instead only count for 15 points.

This value will then be converted to a percentage (by dividing by 1.1), and grades will be assigned as follows:

- A : >88
- A-: 80-88
- B+: 75-80
- B : 70-75
- B-: 65-70
- C+: 62-64
- C : 58-62
- C-: 55-58
- D : 50-55
- F : less than 50

Exams

There will be three exams and a final on the dates shown on the course schedule. You may bring one side of handwritten notes, a calculator of any type that does not have network connectivity, and writing implements. Students who do not speak English as their first language may bring a translation dictionary. **Cellphones, smartwatches, and the like may not be used during exams for any reason. Using these devices is presumptive evidence of academic dishonesty. If, due to an emergency situation, you require an exception to this, notify me or a proctor before the exam starts.**

Makeup exams will not be given except in extreme circumstances involving serious disabling illness (not just a cold), family emergency, or events of singular importance to your personal life that occur on inflexible dates (e.g. your sibling is getting married). If you must miss an exam for such a reason, notify Dr. Freeman as far in advance as possible. I may ask for documentation. I may either:

- assign a time for a makeup exam, written or oral, which will likely be on the following weekend
- replace your missed exam grade with your grade on the portion of the final corresponding to the same material

Incompletes: A grade of “incomplete” may be given to any student who is unable to complete the course material by to the end of the semester due to unavoidable problems outside his or her control. This is a “grade pending” status that allows you to finish up the course in the future and then receive a grade. In general, any student who is unable to meaningfully participate in class for a period of two

weeks or more due to

- serious illness or injury, physical or mental;
- caregiving for the serious illness of a family member;
- legal involvement or proceedings;
- or international issues

is eligible to take an incomplete in the course. If you think that you may need to take an incomplete, please contact me as soon as possible.

Academic integrity

While you are encouraged to discuss your homework with your peers, all work you submit must reflect your own understanding. You are not allowed to communicate with or collaborate with anyone other than teaching staff during exams. Consulting a cellphone for any reason during an exam without permission will be considered presumptive evidence of
academic dishonesty.

Syracuse University's academic integrity policy reflects the high value that we, as a university community, place on honesty in academic work. The policy defines our expectations for academic honesty and holds students accountable for the integrity of all work they submit. Students should understand that it is their responsibility to learn about course-specific expectations, as well as about university-wide academic integrity expectations. The university policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of participation in class activities. The policy also prohibits students from submitting the same written work in more than one class without receiving written authorization in advance from both instructors. The presumptive penalty for a first instance of academic dishonesty by an undergraduate student is course failure, accompanied by a transcript notation indicating that the failure resulted from a violation of academic integrity policy. The presumptive penalty for a first instance of academic dishonesty by a graduate student is suspension or expulsion. SU students are required to read an online summary of the university's academic integrity expectations and provide an electronic signature agreeing to abide by them twice a year during pre-term check-in on MySlice. For more information and the
complete policy, see http://academicintegrity.syr.edu/.

Students with disabilities

If you believe that you need accommodations for a disability, please contact the Office of Disability Services (ODS)
at http://disabilityservices.syr.edu">disabilityservices.syr.edu, located in Room 309 of 8047 University Avenue, or call (315) 443-4498, TDD: (315) 443-1371 for an appointment to discuss your needs and the process for requesting accommodations. ODS is responsible for coordinating disability-related accommodations and will issue students with documented Disabilities Accommodation Authorization Letters, as appropriate. Since accommodations may require early planning and generally are not provided retroactively, please contact ODS as soon as possible.

More generally, if there is anything I can do to help you, whether it is related to a disability, a medical condition, or anything else, please let me know. I have an excellent working relationship with ODS and will do anything in my power to make your experience in my class a good one.

Religious observances

(The following is common to all SU classes)

SU's religious observances notification and policy, found at http://hendricks.syr.edu/spiritual-life/index.html, recognizes the diversity of faiths represented among the campus community and protects the rights of students, faculty, and staff to observe religious holidays according to their tradition. Under the policy, students are provided an opportunity to make up any examination, study, or work requirements that may be missed due to a religious observance provided they notify their instructors before the end of the second week of classes. An online notification process is available for students in My Slice / StudentServices / Enrollment / MyReligiousObservances / Add a Notification.

(The following is specific to Physics 211)

Events of equal solemnity to major religious observances, occurring on inflexible dates, will be given the same deference as religious observances. In particular, travel to Washington, DC, on the first weekend of class for the purpose of participating in political activity will be given this deference.
This includes weddings and commitment ceremonies of immediate family members, funerals, caregiving duties for sick family members, and the like. If you need to miss class for such a reason, please notify Dr. Freeman as far in advance as practical to discuss arrangements.