Mechanical Physics


left: Gateway Arch, St. Louis (1963); right: Tacoma Narrows bridge collapse (1940)

What you and this course will do

Why do bridges and buildings stay up? Why do bridges and buildings fall down? How should buildings be built in an earthquake or a hurricane zone? What are some of the forces that bring them down? What *is* a force?

Physics can describe *everything* that we see around us, when we know how to look! An airplane flying is a study in pressure and drag; a collision turns into a problem in momentum; a rainbow becomes an awesome show of refraction and dispersion; an earthquake illustrates shear forces and flexibility; bridge construction is about heat and expansion; a concert hall is the interplay of reflection and interference.

This class will give you the tools with which to approach these and many more exciting problems relevant to your world. Training yourselves as physicists, you will see the world as a complex interplay of forces and principles. You will learn and understand fundamental principles of physics. With the fundamental knowledge base that you gain, you will learn how to apply concepts, and then use equations to solve physics problems. The answers to the questions above will be in your grasp!

By the end of this course, you will:

- Build a foundational framework of concepts including static forces, kinematics, heat, waves, and optics
- Engage creatively in the subject matter
- Develop problem-solving abilities
- Improve textbook reading skills
- Enhance group problem-solving skills and learn to work in a team
- Develop conclusions based on experimental evidence
- Clearly communicate scientific ideas
- Share your knowledge of physics by making a short video
- Gain confidence in your ability to learn and use physics!

How you will get there

Learning physics is hard. However, with the guidance of this course, it is possible! The components of the course are designed to help you learn, but in order to succeed, you need to take a great deal of responsibility. You will struggle with understanding concepts, but do not be discouraged! *Not understanding something the first time does not mean failure*. Einstein himself asked questions over and over while struggling to learn. Also, discoveries in physics are most often made by groups of scientists. It is essential to share ideas with others in order to move forward. Here are a few suggestions for success in learning:

- Ask questions (of each other, of your instructor, or your text and resources), think about the answers, and ask more questions.
- Read all assignments carefully and complete assignments to the best of your ability.
- Come to class prepared to be active members of the class as a whole and your problem-solving team.
- Work together in formal problem sessions and in informal groups.

Class Participation
(5%) The classroom and laboratory are where the majority of your learning will happen. Here, you will enhance problem-solving skills while learning to work in a team. Although you will work hard outside of class on reading, homework and projects, in class you will actively think about the new ideas you have been introduced to in your reading. Your instructor will guide you in solidifying these ideas, and you will help each other think about and solve problems. You will work in small groups for portions of the class, and every one of you is essential for the smooth operation of the class. Therefore, class participation is very important, not only for you, but for your classmates.

Reading Review
(5%) Reading our textbook and other resources will build your foundation of concepts. You will be asked to reflect on assigned readings before class. Thinking about the class material before getting to class will make it possible for you to work with the ideas and help each other during class. You will participate in a Moodle discussion forum by posting a short, one paragraph comment on what was clear, confusing, and surprising in the reading. There will be approximately 30 opportunities to post responses, and to receive full credit, you must post 25 times during the semester. You are required to post these by 10 am before class; a late posting will receive no credit.

Homework Assignments
(20%) Learning physics happens through solving problems! Homework assignments help us reach many of our course objectives, primarily developing problem-solving abilities and increasing your confidence in your physics ability. There is joy in *understanding* a problem, *applying* the appropriate concepts to it, and *evaluating* a numeric or conceptual solution. As we develop our subject material, we will build a framework within which to read problems and apply the knowledge we have gained. Through homework sets due twice a week, we will develop the skills necessary to achieve the satisfaction of solving problems. Some of these

problems will be from the textbook and some will not. Homework assignments will be due approximately twice a week, on Monday and Thursday.

You are strongly encouraged to work with each other on problem sets. In order to develop a team environment, we will have weekly problem sessions led by a peer tutor. While working with each other is essential, you must demonstrate in your homework that you have understood and completed the material. This means that you write all assignments yourself and not copy directly from another student. The final evaluation of whether you have understood your assignments is in your ability to solve problems on exams.

Digital Media Team Project
(15%) A final video project will show you that you can clearly communicate ideas in physics, and have fun doing it! For this project, you will work in groups of two to create a short (5 minute) digital media presentation that addresses a fascinating question in physics. This presentation is intended to be able to teach your friends and family about some aspects of physics, so will include basic physics content. It will also give you an opportunity to show your friends your excitement about what you are learning and how physics is a part of our everyday world. Detailed instructions will follow later in the semester.

Exams
(50%) Exams represent the exciting culmination of what you have learned during a segment of the class or the course as a whole. They are an opportunity to demonstrate what you know, and to apply your knowledge to new situations. We will have two exams (15% each) during the semester and a final exam (20%).

Laboratory
(5% of course grade) Learning through experimentation and observation is a foundational part of science. Some of the theories that we learn in this class are known to be true only because they are observed, not because they were deduced. Our laboratory experiments will teach us to use evidence to develop conclusions. In our laboratory sessions, we will (hopefully) directly observe that the things that we have learned in class are true, and make new conclusions. We will also learn how to reach conclusions based on observations. Writing and reporting clearly are another important part of learning science. In lab reports, you will learn to clearly describe what you did, make observations about what happened, and explain your results. Although you have registered separately for the laboratory section, it operates as an integrated part of the class.

Details you need to know

Instructor
Catherine Herne
Ho 315, x6069
Office hours: Tuesday and Thursday 2:00-4:00

Class Sessions
MWRF 11:20-12:10, Ho 238

Physics 105
Catherine Herne
Colgate University Syllabus

Laboratory Sessions
Monday 1:20-4:20, Ho 105

Textbook
Physics for Architects, by Yehuda Salu. The text is available in the bookstore.

Special needs
As much as I am able, I would like to create an inclusive classroom environment that works for all students. If you feel you may need an accommodation based on the impact of a disability, please contact me privately to discuss your specific needs. If you have not already done so, please contact Lynn Waldman, Director of Academic Support and Disability Services. Lynn coordinates reasonable accommodations for students with documented disabilities. Her office is in the Center for Learning, Teaching and Research (315-228-7375). She reviews documentation to determine and help coordinate reasonable and appropriate accommodations for students with any kind of disability or special need.

Course Timeline (in progress – just an idea of format)

Date	**Topics**	**Assignments/ Readings**	**Lab**
	Theme 1: How can we use mathematical techniques to describe angles and forces?		
Aug. 27			
Aug. 29			
Aug. 30			
Aug. 31			
	Theme 2: If you shoot a gun on the moon, will the bullet travel around and hit you?		
Sept. 3			Crater formation
Sept. 5			
Sept. 6			
Sept. 7			
Sept. 10			Terminal velocity
Sept. 12			
Sept. 13			
Sept. 14			
	Theme 3: Why do the cables on a suspension bridge hang a certain way?		
			Trusses
	Etc…		Archimedes
			Harmonic motion
			Avalanche
			Bungee
			Heat conduction