Physics 121 Spring 2021: Syllabus

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UPDATED: 25 Jan 2021

UNIVERSITY OF SOUTHERN MAINE
Learning Assistant Program

Welcome to Physics 121!

This is the first semester of a calculus-based introductory physics course that focuses on kinematics, dynamics, simple harmonic motion, gravity, fluids & elasticity, and (sometimes) thermodynamics. In this course, we will use calculus freely and frequently, so (ideally) you should have taken, or (less ideally) should be concurrently enrolled in, calculus. Lectures in this course will assume that you have read the text and will focus on concepts, problem solving and the clarification of important concepts in the text.

I am looking forward to helping you learn about the physical laws that describe how our universe works and also to develop habits of mind that will be useful in your life and future carreer. In addition, I hope to build your problem solving skills, your quantitative reasoning abilities, and to provide a knowledge base which will be useful no matter what your major may be. I will try to do whatever I can to show you the beauty of physics and to help you broaden your appreciation of the natural world by helping you understand not *why* it is as it is, but *how* it works.

I take teaching very seriously, and I will work hard to help you learn.

This document

Should you lose this syllabus, an electronic .pdf version of this file (with clickable hyperlinks) is available online at the course homepage which can be found at http://portlandphysics.me/phy121.

Instructor

Paul Nakroshis
252 Science (must go through rm 250 to get to my office/lab)
pauln@maine.edu http://portlandphysics.me
207.780.4158 (office)
207.449.7531 (cell; emergencies only)
Office hours: Tue: 10:15 - 11:00, Wed 1:00-2:00 pm, and by appointment.

Outside Help/Office Hours

In general, if my office door is open and I have time, I am happy to help you, so feel free to stop in and ask questions. My dedicated office hours are listed up above; if you cannot make this time, please talk with me and we'll make a time to meet.

Technology:

You may use a **scientific calculator** on the exams, but no cell phones or mobile devices may be used. There is no need to purchase an expensive graphing calculator (although they are fine if you have one) — a quick check on Amazon.com shows that you can purchase a scientific calculator sufficient for this course for under $10. Get one if you don't have one.

Electronics use during class: Unless you are a genius at speed typesetting of equations on a computer, I see no reason to use a laptop to take notes in class. I recommend that you put your computer away and take notes with pen and paper or a tablet (see this link if you need some evidence!). In any case, using a computer, cellphone, or tablet to check Facebook, Twitter, Instagram, etc, or to play games during class takes away from your ability to learn and distracts those sitting near you.

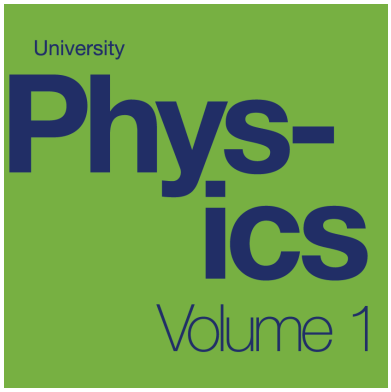

Figure 1: This text is available for free online.

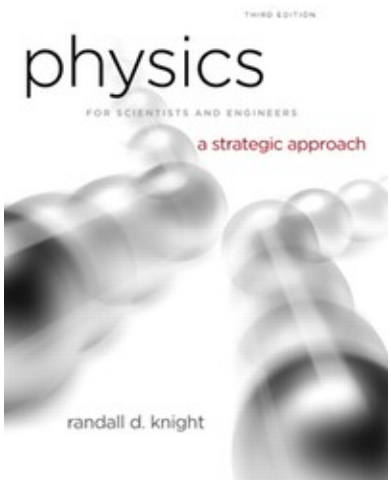

Figure 2: Another possible textbook: Physics for Scientists and Engineers, 3rd Edition, by Randall D. Knight

Attendance/Participation/Missed Exam Policy

I expect that all of you will attend class and actively participate. I try to make a class a valuable learning space, so it's to your advantage to attend. *If you are late to class or miss a class in which a quiz or test is given, you* **will not** *be given a makeup except in extraordinarily exceptional cases, or if you have prearranged due to a conflict.* Any quizzes will be given at the beginning of class, so be on time to lecture.

Textbook:

There is NO required PURCHASE of a textbook for the course, but I STRONGLY urge you download the OpenStax textbook: University Physics, Volume 1 from https://openstax.org/details/books/university-physics-volume-1. Of course, if you would rather use a different textbook, here are a few used textbook options you might want to consider—these can be purchased extremely cheaply from amazon.com:

($ 18) Physics for Scientists and Engineers, 3rd Edition, by Randall D. Knight
($ 10-$ 20) Halliday, Resnick and Walker: Fundamentals of Physics 7th ed (or earlier)
($ 15) Halliday and Resnick: Physics parts 1 and 2 (very old but good!)
($9) Douglas Giancoli, Physics for Scientists and Engineers, 3rd edition (or earlier)
($10 - $30) Serway and Jewett: Physics for Scientists and Engineers
($11 - $20) Paul Tipler, Physics of Scientists and Engineers, 5th edition (or earlier; I learned from the 2nd edition and it was great, it is still one of my favorite books)

Academic Integrity

I expect the utmost academic honesty. If I find that you have been cheating in any way, you will receive a failing grade, be asked to leave the course, and I will send a letter documenting the offense to the Office of Student Judicial Affairs and the Dean of Students.

Students with disabilities

At any point in the semester, if you encounter difficulty with the course or feel that you could be performing at a higher level, consult with me. Students experience difficulty in courses for a variety of reasons. The following resources are available on campus for students:

- For general physics questions or time management, you can make an appointment to see a student tutor at the Learning Commons located in both the Portland and Gorham libraries. For more information, visit http://www.usm.maine.edu/learningcommons.
- If you need accommodations due to a disability, please contact the Disability Services Center for confidential assistance and accommodation authorization. Timely notification of accommodations is essential. For more information, visit, http://usm.maine.edu/dsc University Health and Counseling Services is a student resource that promotes the health and well-being of the USM community. More information can be found at www.usm.maine.edu/uhcs.

Expectations:

What you can expect from me:

1. I will work hard to make class both interesting and useful to you (but I cannot do the work of learning for you!)

2. I will be open to feedback and constructive criticism about my teaching.
3. I will be available for assistance outside of the classroom and I look forward to meeting you.
4. I will be on time to class, and I will end class on time.
5. I will respond promptly to your emails received before 4pm. Emails after that time will be responded to on the next weekday.
6. If you have an *emergency* and need to contact me, you may **call** me at my cell phone: 207.449.7531
7. I will do my best to make sure examinations are fair and challenging.
8. I will grade and return examinations in a timely manner.

What I expect of you:

1. You have read this syllabus, understand the required workload, and meet the calculus co/pre-requisite.
2. You will be an active, engaged participant in class and class discussions, and are coming to class to learn, not just to satisfy a requirement.
3. You understand that you must accept responsibility for your own learning and take an active role in the learning process.
4. You will read and work through the relevant sections in the text **before** they are discussed in class. (Reading a physics textbook is an activity that involves taking notes and thinking and working through problems and examples with paper and pencil; it's not like sitting down to read a good novel.)
5. You will come to office hours and tutoring sessions if you need help; you will not wait until you are too far behind to do so.
6. You will effectively and clearly communicate your understanding on assignments and examinations; to do so you will always show your work and explain your reasoning.
7. You will construct a working *content* knowledge of the physics topics we discuss in class.
8. You will also have another goal to understand deeply the *underlying concepts* and be able to apply them to systems you have never seen before.
9. You should expect to spend 8-12 hours per week outside lecture on this course.

Assessment

Your grade in this course will be based on my subjective opinion of your level of understanding of the physics topics we discuss in this course. Your best way of being successful in achieving a good grade is to study the text and work to *understand* as many homework problems as possible so that you score well on the 3 exams and the final which together compromise 80% of your grade. Put these dates on your calendar—if you have another class with exams on the same date, please prepare accordingly.

Exams

Exams will include both *conceptual questions* where you have to explain your reasoning in proper English and *quantitative reasoning questions* where you will have to solve problems through the use of legible figures, proper English explanations that appeal to relevant physical concepts and laws, and valid mathematical reasoning.

- **I will drop your lowest of the three exam grades (not the final exam) and replace it with the average of all three of your exams.** This does not entirely negate a poor exam score, but it does help significantly; so you should try your best on each exam.
- No cell phone or mobile device use during exams. Please bring an inexpensive scientific calculator instead. There is no need for a graphing calculator, but they are allowed.
- The questions on the exams are a combination of quantitative problems and conceptual questions resembling the discussion questions and worksheets used in class.
- You may bring in one sheet (8.5" x 11") of crib notes for each exam.
- The examinations cover all the material in the text that has been assigned as reading (even if the subject was never discussed in class).

Here are the exam dates for the semester and the point values for each item:

Homework

Succeeding in physics entails struggling with and solving physics problems so that you build a clear and deep understanding of the laws that describe how nature works. You need to build a conceptual understanding of the principles, as well as a technical facility with the

Exam # 1	Tuesday, 16 Feb 2021 8:00–9:15 am	200 pts
Exam # 2	Tuesday, 16 Mar 2021 8:00–9:15 am	200 pts
Exam # 3	Tuesday, 13 Apr 2021 8:00–9:15 am	200 pts
Quizes, Problem Sets, & Attendance	throughout semester	200 pts
Comprehensive Final Exam	Thursday, 6 May 2021 8-10 am	200 pts
	TOTAL Points:	**1000 pts**

mathematics needed to solve the problems. I strongly urge you to keep a dedicated notebook in which you *neatly work out your homework problems* and include:

- A statement or at least a brief statement of the original question.
- A logical handwritten solution of the question, with your reasoning clearly laid out in both prose and equations.
- A figure to help explain the problem and solution will *almost* always be a component of a good solution.
- A clearly visually indicated final numerical solution value when appropriate.

I also encourage you to work together in groups on homework. Although I will not collect your homework notebooks, I can say from decades of experience that with few exceptions, there is an outstandingly good positive correlation between the quality and quantity of effort put into homework and the final course grade. If you do not put forth a serious effort into your homework, you will likely NOT do well in this class. You have to do the mental work of building up a model of how nature works, I can help with this, but the heavy lifting is your responsibility. The good news is that there is not a lot of memorization in physics, but there is a good deal of depth and subtlety in nature, so you'll never be bored studying physics.

Homework Assignments

The homework problems for the entire semester are listed at the end of this syllabus; they come from the third edition of Knight's textbook, and are available at the course homepage. You need to schedule time every day to work these problems; some of them are quite challenging! I encourage you to all work together in groups. This is a long list of problems, and I'd recommend that for each chapter, you start with a few of the low-numbers ones, and try your hand at some of the higher numbered (generally harder) problems. The text rates the difficulty of each problem (one, two, three bars in increasing difficulty) and reserves challenge problems for those of you bored by the "easy" ones.

Grading Scale

The table below shows the grading scale for the final semester grade.

Letter Grade	Numerical Percentage
A	93.0 -100
A-	90.0 - 92.9
B+	87.0 - 89.9
B	83.0 - 86.9
B-	80.0 - 82.9
C+	77.0 -79.9
C	73.0 - 76.9
C-	70.0 - 72.9
D+	67-69.9
D	63-66.9
D-	60.0 - 62.9
F	0 - 59.9

Advice

Learning any new subject involves learning to struggle with the inevitable confusion that accompanies the learning process. You may try to get around this by trying to memorize formulas, but this does not really constitute real learning. You have to spend the time to build a mental picture of how the concepts and varied principles that we study fit together, and I will try to help with this task in lecture by (a) showing you how I think about physics, and (b) by asking you questions to elicit a state of confusion. Then, with peer discussions and my guidance, I hope to help you get over your sense of confusion.

Reading the textbook and solving homework problems will constitute your work outside of class. In writing solutions to homework problems, you will also struggle with confusion — how to interpret the problem, figuring out any assumptions that you must make, and coming up with a method to reach a viable answer — all of these steps may prove challenging. My recommendation to you is to work together outside of class —perhaps a dormitory-based study group, or form your own group and work in room 250 or on the boards outside of room 250.

You will notice that almost all the homework problems assigned are odd numbered and therefore many have answers that you can look up in back of the book should you have a used copy of knight's third edition. There is also a student solutions manual available for the third edition of Knight's textbook that you might be able to find online. However, you will be doing yourself a *massive* disservice if you

leap to the solutions manual if your first attempt at a solution fails. You may go down a wrong path in solving a problem, but sometimes you need to do this to find the correct way to solve a problem.

However, after a good first, second, and maybe third attempt, if you are still confused, please seek help from me, from the Learning Commons, or from your Learning Assistants. The Learning Assistants for this course all made it though this course with top scores, and are familiar with the struggles you are facing. They're all as fascinated with physics as I am, and are eager to help you.

Strategies to avoid:

- giving up on a problem, finding instructor solutions, glancing at the solution, saying "oh, I get it" and then repeating this procedure with other homwework problems. You are fooling yourself to think you can learn physics in this way. You absolutely need to struggle with the problems and make errors and come to see me or our LA's to talk about the underlying conceptual issues.
- Memorization—the you get 1 page of crib notes anyway.
- Cramming to catch up just before the examinations—it will be **impossible** to assimilate all the material.
- Compulsively solving countless problems in hopes of learning by example can work, but can be very time-consuming and prevents you from putting the effort into understanding the underlying concepts.
- Waiting too long to ask for help—I cannot emphasize enough how important it is to make a serious first attempt at a problem on your own; but having done that, if you are still confused, please seek help immediately. All too often students wait too long to ask for help, and meanwhile we have progressed several chapters beyond where their confusion began.

TITLE IX

The University of Southern Maine is committed to making our campuses safer places for students. Because of this commitment, and our federal obligations, faculty and other employees are considered mandated reporters when it comes to experiences of interpersonal violence (sexual assault, sexual harassment, dating or domestic violence, and stalking). This means that **if you tell me about any incident of interpersonal violence, I must notify the University's Deputy Title IX Coordinator** who can help provide support and academic remedies for students who have been impacted.

For more information, please see the resources below:

- Information on the Campus Safety Project: http://usm.maine.edu/campus-safety-project or by contacting Sarah Holmes, USM's Title IX Coordinator: sarah.e.holmes1@maine.edu or 207-780-5767.

Confidential Contacts:

- University Counseling Services (207-780-4050)
- 24 Hour Sexual Assault Hotline (1-800-871-7741)
- 24 Hour Domestic Violence Hotline (1-866-834-4357).
- National suicide hotline is 1-800-273-8255 and the text line is 741741.

Final Words

Nothing worth knowing or achieving comes without effort. This course will likely be a lot of effort for many of you, but remember that pushing and challenging yourself is a good thing. Throughout all of this effort, I want to communicate to you the wonder and beauty that exists in the world, and that there is beauty in understanding that many phenomena can be understood via a very few physical concepts. Richard Feynman says it best:

> "I have a friend who's an artist and has sometimes taken a view which I don't agree with very well. He'll hold up a flower and say "look how beautiful it is," and I'll agree. Then he says
>
> > "I as an artist can see how beautiful this is but you as a scientist take this all apart and it becomes a dull thing,"
>
> and I think that he's kind of nutty. First of all, the beauty that he sees is available to other people and to me too, I believe. Although I may not be quite as refined aesthetically as he is ... I can appreciate the beauty of a flower. At the same time, I see much more about the flower than he sees. I could imagine the cells in there, the complicated actions inside, which also have a beauty. I mean it's not just beauty at this dimension, at one centimeter; there's also beauty at smaller dimensions, the inner structure, also the processes. The fact that the colors in the flower evolved in order to attract insects to pollinate it is interesting; it means that insects can see the color. It adds a question: does this aesthetic sense also exist in the lower forms? Why is it aesthetic? All kinds of interesting questions which the science knowledge only adds to the excitement, the mystery and the awe of a flower. It only adds. I don't understand how it subtracts"

Chapter	Problems	Topics	Week ending
1	8, 9, 23, 24, 33, 55	Metric System, Estimation, vectors	
2	1, 3, 5, 7, 9, 13, 15, 17, 19, 21, 23 25, 28, 29, 31, 33, 39, 43, 53, 63, 76, 77	1D Kinematics	
3	1, 3, 5, 7, 11, 13, 17, 19, 21, 23, 25, 27, 31, 37, 43	Vectors	5 Feb
4	5, 9, 11, 13, 15, 19, 21, 23, 25, 27, 29, 31, 35, 41, 43, 45, 49, 53, 61, 65, 79, 85	2D Kinematics, Uniform and non-uniform Circular Motion	12 Feb
5	1, 3, 7, 9, 11, 13, 15, 19, 25, 27, 31, 35, 41, 43, 54	Forces, Free-body Diagrams Newton's Laws of motion	19 Feb
6	1, 5, 7, 9, 11, 13, 17, 19, 21, 23, 25, 29, 31, 33, 35, 37, 45, 49, 51, 57, 69, 71, 75	Motion along a line	
7	1, 5, 7, 9, 11, 15, 17, 23, 27, 29, 31, 33, 36, 39, 55	Newton's Third Law Ropes & Pulleys	5 Mar
8	1, 5, 7, 9, 11, 13, 15, 25, 27, 31, 35, 37, 41, 45, 47, 59, 61	Motion in a plane, fictitious forces, Uniform & non-uniform circular motion	12 Mar
9	1, 3, 5, 7, 9, 13, 15, 17, 19, 21, 25, 29, 35, 39, 49, 61, 63	Momentum Conservation, Impulse, inelastic collisions and explosions	19 Mar
10	1, 7, 11, 15, 17, 19, 21, 25, 27, 29, 31, 33, 35, 45, 49, 59, 57, 71	Energy Conservation elastic collisions, potential energy	26 Mar
11	1, 3, 5, 7, 11, 15, 19, 23, 29, 31, 33, 39, 41, 43, 51, 53, 57, 61, 73	Work and KE theorem Potential energy, work by variable forces	2 Apr
12	1, 3, 5, 7, 9, 11, 13, 15, 19, 21, 25, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 51, 55, 57, 63, 65, 69, 71, 77, 83, 84	Rotational kinematics, rotational KE, torque, moment of inertia, center of mass, static equilibrium &rolling motion	9 Apr
13	1, 3, 5, 9, 13, 15, 17, 19, 21, 25, 27, 29, 31, 33, 39, 43, 45, 57	Newtonian Gravity, little g, big G, circular orbits, gravitational potential energy	16 Apr
14	1, 3, 5, 7, 9, 11, 13, 17, 19, 21, 23, 27, 31, 36, 51, 55, 57, 75	Simple Harmonic motion, energy and dynamics or Damped & Driven SHM, pendulums	23 Apr
15	1, 3, 5, 7, 9, 11, 13, 15, 19, 23, 25, 29, 33, 41, 45, 51, 63, 73	Fluids and Elasticity; pressure, Buoyancy, Elasticity	30 Apr