Physics 408 Studio – General Physics II
Fall 2021

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Office Hours: TBD
Class Times: MWF 11:10am-1:00 pm

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COVID issues: My intention is that we will be back to normal . If someone **needs** to do the course online, I can accommodate that (it will mean watching the mini-lecture through Zoom, and working with their group through Zoom). But I want that to be an exception, rather than the norm. If you have a legitimate reason for needing to take the course online, email or talk to me about it, and we can work with that. But otherwise, I hope to see everyone there in-person. The class centers around direct interaction, which works much better face-to-face (even if we have to cover our faces with masks).

I. Goals of the Course – Physics 407 is a core building-block course, in that the focus of the entire semester is on "Newtonian mechanics" – learning how to examine the world with Newton's Laws. Physics 408, on the other hand, is often taught as more of a "survey course", spending a little bit of time on many topics – fluid mechanics, thermodynamics, oscillations, waves, electricity, circuits, and magnetism.

The problem with that approach is that usually so little time is spent on each subject that students can't really get a solid understanding of anything, or the ability to do anything practical with what they have learned. I prefer to spend more time on the subjects we cover, so you can develop a more functional understanding and the skills involved. That does mean though that we need to cut back on the breadth of material some.

We will start off the semester by applying our understanding of Newton's Laws to the study of fluids. We will then spend a few weeks studying waves. That will lead us up to the first exam. The remainder of the semester will be spent on electricity and magnetism, with a focus on practical applications. By the end of the semester, you should have an improved understanding of electric circuits, how electric motors and generators work, and so on.

II. Course Expectations - This is a difficult, calculus-based course, aimed at students who intend to enter science or engineering as a profession. Most students find the material in 408 to be more challenging than 407. That isn't to say that 407 is easy – very difficult problems can be crafted in the class. Rather, some of the concepts in 408 are more abstract (like electric fields), and there can be a good deal of calculus involved, as well as some new vector math.

As in 407, in 408 you are also learning how to do various things. Whenever you are learning how to do something, it takes practice on your part. **You** need to be the one doing it. The largest benefit of the studio format we will be using is that you will spend most of class time **doing** things yourself, with us here to help. But you will also need to practice outside of class – on the homework, and general reviewing.

I will post solutions to activities and homeworks on Canvas to help you review and learn the material – I strongly encourage you to go through these.

III. Pre-Requisites – Calculus I (Math 425) and Physics 407 are pre-requisites for the course, and Calculus II (Math 426) is a co-requisite. We will be doing quite a bit of integration in this course, so taking calculus II (Math 426) is extremely important. We will also be making extensive use of the material covered in Physics 407.

IV. Active Learning

In this course, we will use a "studio" format rather than pure lecture. Learning is an active process – we learn by being actively engaged in thinking about something, figuring things out, *doing* things. A traditional lecture is simply not conducive to that. You may sit through a one-hour lecture, but not *do* anything yourself with the material presented during the lecture until days later.

Much of our education system relies on "verbal indoctrination", in which students are expected to blindly accept, memorize, and later regurgitate information that has been presented to them. This is not how education should work. We do not learn that way, and that approach is contradictory to how science itself is practiced. Science is a process – not a collection of facts.

Becoming an engineer revolves around building skills – which you don't do by watching someone else. You learn how to do something by *doing* it, ideally with someone else there to offer you advice along the way. That is our role in this course. As you are learning how to do things, and figuring things out, I and the assistants are here to help you out.

We will meet two hours a day (MWF), and generally only about 10-20 minutes of class will be spent watching me lecture. The lecture time will be for pulling together things covered in the previous class's activity session, and introducing new ideas. **PLEASE TAKE NOTES DURING LECTURE. If something is important enough for me to lecture about it briefly, that's because it is something that you are going to be using later during that class.**

After the lecture, we will begin the groupwork portion of the class, for which we will head upstairs and split up between rooms 301 and 311. I'll assign you to a group before the semester starts, so you will know where to go.

PLEASE ASK FOR HELP – that's what we're there for. There is nothing wrong with asking for help. We will be doing some difficult things this semester that you probably haven't seen before. Asking for help isn't a sign of weakness – it's a sign that you are trying to learn, and taking your education seriously.

One of the most important skills future engineers need to develop is how to be an effective member of a team. In industry, you generally do not get to pick who you work with – so you need to learn how to work with whomever is in the team you are assigned to. That's one of the reasons I usually assign teams, instead of letting you pick.

IV. Book – No particular textbook is required for this course. I highly recommend having ***a*** textbook on introductory physics, but new texts are far more expensive than used ones, and the physics isn't any different. I can't justify requiring you to pay over $250 for a textbook when a used older edition for $20 is practically identical.

If you expect to remain in engineering and physical sciences, it is worthwhile to have a decent introductory textbook on calculus-based physics intended for engineering students. Just look for a used one – the physics hasn't changed anytime recently. Textbooks written in the past 10-15 years are easier to follow than ones written before that, as lessons from physics education research have allowed authors to anticipate common difficulties students have. Many students find the textbook written by Knight (the first one in the list below) to be particularly easy to follow compared to others. But the third edition costs around $250, and is practically identical to the second edition (which you can buy used through amazon

for about $25). Below is a list of a few books that I consider decent (there are plenty of others too). I strongly suggest getting a previous edition of one of them, to have available as a resource:

a. "Physics for Scientists and Engineers", by Knight
b. "Physics for Scientists and Engineers", by Giancoli
c. "Physics for Scientists and Engineers", by Serway (as you can tell, the authors are very imaginative when it comes to choosing a title)
d. "Physics for Scientists and Engineers", by Katz
e. "Fundamentals of Physics", by Halliday, Resnick, and Walker
f. "University Physics", by Bauer and Westfall

The activity book that we will use every day is one that I wrote specifically for this course. You do not need to buy it. We will give you a copy on the first day.

VI. In-Class Activities

The in-class activities that we will do are intended more as a learning tool than as an assessment tool. The activities serve various purposes, which all revolve around helping you learn the material. Since we will be spending considerable time on them, the in-class activities will contribute towards your grade some, but overall you should view them as a learning tool, not an assessment of what you know (since I and my assistants are available to help you out when you are having trouble).

An important facet of this style of class is to have the lecture well synchronized with the activities you are working on, which greatly aids your learning. Because of that, it is important that you do not fall behind. Students work at different paces though, which complicates the issue of when activities are due.

To address this - during each lecture I will let you know what activities we will be doing in the upcoming classes, and when things are due. The intent is that if you are falling behind some, you may need to finish up activities outside of class (on your own or preferably with other students) to make sure you are ready for the next class and activity.

Sometimes your group may not quite be able to finish an activity at the end of a class, and I may shift the due date to the beginning of the next class. **If I do that, everyone in your group needs to finish the activity, and turn it in by beginning of the next class. Do not plan on finishing it up in that class – since we will be moving on to the next activity. If you have trouble finishing it, let me know and we can find a time when I or one of the assistants can meet with you (likely online) to help you through it. What we're trying to avoid is having anyone fall behind, since that can have a snowball effect.**

I have office hours and can be available at other times (check with me), so that I can work with anyone who is having trouble with anything.

If you do have to finish up an activity outside of class, everyone in your group should make it clear what you worked on as a group in class, and what you worked on individually. This is because in-class group work will be graded differently than work you did individually.

Conversely, if your group is getting ahead of the class, you can work on the next activity, or homework, or extra credit activities (which are more challenging).

VI.a. Grading Activities

Since grading is a necessary evil in academia, we unfortunately need to do it. When it comes to grading the in-class activities, we will also grade in a way to encourage you to work together as a team. We will use a "group grading" approach, in which you will all do your own work (but helping each other, working as a team), and all turn in your own work. Each group of three students will have a folder specifically for that group – your work should be placed in that folder, which your TA will collect at the end of class each day. Graded work will also be returned in these group folders.

For each activity, your TA will pick the work of one group member (on a randomly rotating basis), and grade that member's work – ***and the entire group will get that same grade***. The intent of this is to encourage you to work together as a group, to help each other learn – and also to build teamwork skills – something highly valued in the engineering world.

If a group member is absent, that group member needs to work on the activity outside of class on their own, and indicate on their worksheet that they worked on it individually. That member's work will be graded separately and he or she will be given his own grade based on that work, instead of receiving the "group grade".

The purpose of group grading is that we want each group member to make sure that everyone in their group understands the material – we want you to communicate with each other. Education research repeatedly shows that when students discuss and explain things to each other, everyone gets a better understanding than when students work on material alone.

This does not mean that one person should do the work and the others just copy that work. You all need to *understand* what you are doing. The exams count for the a large portion of the grade in the course, and the activities are meant to help you learn the material. Therefore, during the activity time, you should focus on making sure you understand what is being done and why, don't just focus on getting the right answer written down so you can hand it in.

Additionally, you are all paying to be here to learn. If you do not feel like you fully understand something, we are here to help you. You have many people available to help you during class time – your group members, me, and lots of assistants. Please use us! I and all of the assistants actually really enjoy teaching, so we look forward to helping you out.

VII. Homework – We will only be doing hand-written homework in class since the online homework systems all suck. If you are having difficulty with a homework assignment, feel free to ask any of us for help. **We are here to help you learn.**

Also, the Physics Help Center (PHC) is available for help with the homework. I'll post the times for the PHC in an announcement. Everyone who works in the PHC will have access to the homework and solutions ahead of time, so they should be able to help you out.

Homework is not intended to be an assessment of what you already know, but rather a learning opportunity, for you to practice the skills we are building in class, and to sometimes try to extend your skills beyond what you have already done in class. Homeworks will also frequently include an activity aimed at helping build a reasoning skill (deductive, inductive, or spatial in particular). These are aimed at helping you build certain types of reasoning that are important for scientists and engineers.

Late homeworks, like late activities, will be lose 20% credit per day late (the weekend counts as one day) – unless you talk to me and have a valid justification

VIII. Tests – We will have three exams during the semester and a final exam at the end of the semester. Exams are the primary assessment tool in the course, so will constitute half of your grade. Homework and in-class activities are primarily learning tools, more so than assessment tools. They do count for some credit though. All exams (including the final) in the course are counted equally, and collectively are 55% of your final grade.

IX. Grading – I love teaching, but I hate grading. I accept that it's an unfortunate necessity. Grades provide an "extrinsic" (external) motivation – in other words, students are expected to do or learn something because their teacher requires them to.

After many years of being externally driven by grades, it becomes the primary driver for most students (schools that make education boring also contribute to that). That does not create a good learning environment. We learn much better when we are "intrinsically" (internally) motivated to learn something because we find it interesting, and are enjoying what we are doing. To that end, I continually try to improve how I teach. My hope is that we can make this class interesting enough that you will be

intrinsically motivated in what we are doing without needing to worry about how much each activity counts towards your grade.

We are still required to grade you though – I just don't want it be your primary motivation.

Grades will be based on tests (55%), homework (23%), and in-class activities (22%). I don't give pre-determined grading schemes (i.e. an A is 93-100, etc.), since I feel it is unrealistic to write tests such that average grades will work out well to a particular scheme. I will describe in class how I make the grading scale. Your lowest exam score will count half as much as the others (and the final exam is weighted the same as the other exams).

There will be some extra credit activities, including some engineering challenges (Bucket Challenge on the first day) and activities that go beyond the normal scope of the course, such as the Special Relativity one. I will discuss these more in class.

X. Academic Honesty

I feel that I have two roles as a physics instructor – trying to help you learn the material, and accurately assessing how well you have learned the material. I take both roles very seriously, and put a lot of effort into the courses I teach. I expect the same from you – that you take your role as a student seriously, put in significant effort, and that you are "academically honest" throughout the course.

Since much of the class-time will be spent doing "group work", and I encourage you to work in groups when doing the homework, it is important to clarify what exactly constitutes cheating. Working together with other students to figure things out collectively, and help each other learn the material is not cheating – I encourage this kind of group work because working with others, explaining things to each other, is a very effective way of learning (also, scientists and engineers routinely work together in groups – so you need to get used to doing this).

The key is that you need to make sure that you actually ***understand*** the things you write down on your activities, and the answers arrived at in class or on homework assignments. If you are working together with other students, your focus should be on ***understanding*** everything you are doing together. You are paying to be here to learn the material – copying someone else's work deprives you of that opportunity.

Exams are expected to be done individually though, so you should not be collaborating with anyone on those. So roughly half of your grade ends up being based on things you have to do individually, and half is based on things you can (and should) work on with others – the in-class activities, and the homeworks.

If another student in your group figures out how to do something, and you don't understand it – ask him or her to explain it and help you understand. That process of explaining things to each other is an extremely valuable learning process, for everyone involved (including the person doing the explaining).

Since you will not have the benefit of working in a group on exams, your focus should always be on making sure you understand what is going on in classroom activities and homework, not just that you get the "right answer" at that moment.

Normally cheating is extremely rare in my classes. When someone cheats on an exam, it is not fair to the students who are working hard and honestly – so I take it very seriously. But I hate having to deal with that situation, so please don't make me do it.

I think last semester I underestimated the impact on everyone of the quarantine, and didn't account for how difficult it became for people to focus on the course. And I think that contributed to the very high level of cheating on the exams. We're going to be taking some precautions this semester to try to prevent that, but hopefully changing a few other things about the course will help.

XI. Other issues

- If you are having any difficulties with anything – classwork, feeling isolated, depressed, whatever – please talk to me. I will always keep any personal problems you are having confidential, and if

you are feeling depressed, I would also recommend that you talk to someone at the Counseling Center. There is nothing wrong with reaching out for help.

- ***Please ask questions during lectures and activity work.*** The primary goal of this course is for you to learn the material – so if there is something you want clarification on, just ask (either during lecture or while working on group activities). I said this before, but it bears repeating: **asking for help is not a sign of weakness. It is a sign that you want to learn, and take your education seriously.**
  Also, asking questions helps me by letting me know what concepts are not entirely clear, so I can focus on those points. If *you* are unsure of something, there is a very good chance other students in the class are as well. So, bringing it up will likely help everyone.

- The University is committed to providing students with documented disabilities equal access to all university programs and facilities. If you think you have a disability requiring accommodations, you must register with Disability Services for Students (DSS). Contact DSS at (603) 862-2607. If you have received Accommodation Letters for this course from DSS, please provide me with that information privately, in my office, so that we can review those accommodations.

XII. Schedule – The dates are now correct, but as of 9/21 we are slightly behind schedule as far as activities.

Week	Date	Activity	Activity Due at EOC
1	8/30	1. "Bucket Challenge"	1
1	9/1	2. "Pressure"	
1	9/3	2. "Pressure", 3. "Liquids",	2, 3
2	9/6	Labor Day – UNH Closed	
2	9/8	4. "Buoyancy"	
2	9/10	4. "Buoyancy"	
3	9/13	4. "Buoyancy", 7. "Fluid Dynamics I"	4
3	9/15	7. "Fluid Dynamics I"	
3	9/17	8. "Fluid Dynamics II"	7
4	9/20	13. "Traveling Waves"	8
4	9/22	13, 14 "More Traveling Waves"	
4	9/24	14 "More Traveling Waves"	13
5	9/26	15 "Doppler Effect"	14
5	9/29	16. "Standing Waves" and review	15
5	10/1		16
6	10/4		
6	10/5	Exam 1	
6	10/6	20. "Electric Force"	
6	10/8	20. "Electric Force"	
7	10/11	Fall Break no classes	
7	10/13	21. "Electric Field from Point Charges"	
7	10/15	21. "Electric Field from Point Charges"	
8	10/18	21. "Electric Field from Point Charges"	
8	10/19	Tuesday Class! 23. "Electric Fields from Charge Distributions"	
8	10/20	23. "Electric Fields from Charge Distributions"	

8	10/22	23, 24 “More Charge Distributions”	
9	10/25	24 “More Charge Distributions”, 25. “Electric Potential Energy”	
9	10/27	25. “Electric Potential Energy”, 26. “Potential Energy and Potential (Voltage)”	
9	10/29	26, 27 “Electric Potential (Voltage)”	
10	11/1	27, 28 “E,F,V,U”	
10	11/3	30. “DC Circuits I” and 31 “DC Circuits II”	
10	11/5	31 “DC Circuits II”, 33 “More Circuit Analysis”	
11	11/8	34 “Applications of DC Circuits”	
11	11/10	34 “Applications of DC Circuits” (TUESDAY!)	
11	11/12	35 “More Circuit Analysis”	
12	11/15	35 “More Circuit Analysis”	
12	11/16	Exam 2 6-9 pm	
12	11/17	38 “Magnetic Force”	
12	11/19	38 “Magnetic Force”	
13	11/22	38 “Magnetic Force”, 39 “Measuring e/m”	
13	11/24	**Thanksgiving Break No Class**	
13	11/26	**Thanksgiving Break No Class**	
14	11/29	39 “Measuring e/m”	
14	12/1	40 “Magnetic Torque and Motors”	
14	12/3	40 “Magnetic Torque and Motors”	
15	12/6	41 “Magnetic Fields”	
15	12/8	41 “Magnetic Fields”	
15	12/10	42 “Generators and Motors”	