PHYS 3305

Modern Physics

Prof. S. Sekula

Course syllabus
Spring 2020

SMU | Dedman College of Humanities & Sciences

PHYS 3305

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by

Prof. S. Sekula

Course Syllabus
SPRING 2019

"The value of a college education is not the learning of many facts but the training of the mind to think, he [Einstein] said."
— Walter Isaacson, "Einstein: His Life and Universe," 2007

An electronic version of this document is available at
`https://www.physics.smu.edu/sekula/phys3305/syllabus.pdf`.

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Preface

I am very pleased to be teaching Modern Physics (PHYS 3305) in Spring 2020. I foster an active learning environment, in which students take direct ownership of the learning process. You will be immersed in physics learning: outside the classroom in readings, videos, and problem-solving; inside the classroom by learning how to setup and solve problems and engagement in the principles and implications of physics through experience with physical phenomena and inquiry-based learning, both at the individual and the group level. Learning synthesis will be assessed using a "Grand Challenge Problem": an open-ended, non-textbook problem that you will work to solve throughout the semester, culminating in a final project presentation.

I look forward to an incredible semester with all of you!

About Me

Prof. S. Sekula
Dallas, January 2020

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1

The University and Learning Context

1.1. University Curriculum Student Learning Outcomes

Students will be able to research, compile and present an assigned topic in the field of Modern Physics.

1.2. Goals of this Course

As described in the SMU Undergraduate Course Catalog:

> *For science and engineering majors. Covers vector kinematics, Newtonian mechanics, gravitation, rotational motion, special relativity, and structure of matter.*

The specific learning goals of this course are as follows. Upon successful completion of this course, students will be able to:

1. Explain why relativity and quantum mechanics and are needed to explain natural phenomena that are central to the modern world;
2. Apply their understanding of relativity and quantum mechanics to a range of problems that occur in areas as diverse as medicine, communication and computation;
3. Demonstrate the basic understanding of relativity, quantum mechanics and statistical mechanics required to pursue more advanced topics in each of these related areas.

2

Specifics of this Course

2.1. Course Information

When/Where?	The course is held in Fondren Science 158 on Tuesday and Thursday from 12:30pm-01:50pm
Instructor	Professor Stephen Sekula Office: Fondren Science 39 Phone: (214)-768-7832 E-mail: sekula@physics.smu.edu Facebook: stephensekula Twitter: drsekula Diaspora*: stephensekula@social.cooleysekula.net GNU Social: steve@chirp.cooleysekula.net Pump.io: steve@hub.polari.us
Office Hours	Where: **FOSC 39** When: These will be organized during the first two weeks of class and subscribable using Canvas. They will be by appointment only, but during predictable time slots. • **TBD** Cancellations of office hours, when unavoidable, will be announced. If you cannot make office hours, which are subscribable in Canvas, you need to schedule a separate time to meet with the instructor. It is your responsibility to do this. *If you need to request a meeting outside of regular office hours, please try to be courteous and request it in writing at least a day before your proposed meeting time to allow for scheduling.*
Prerequisite(s)	Prerequisite: PHYS 1304 or PHYS 1308

Textbook(s)	REQUIRED: Harris, Randy. "Modern Physics" RECOMMENDED: "Schaum's Mathematical Handbook of Formulas and Tables" (or similar) RECOMMENDED: Gates, J., Blitzer, F., Sekula, S. "Reality in the Shadows (or) What the Heck's the Higgs?". YBK Publishers. 2017.

2.2. Course Topics

In PHYS 3305 (Modern Physics), you will take the next big steps into the study of energy, matter, space, and time - the study of physics. The foundations you have explored in "Introductory Mechanics" and "Electricity and Magnetism" will be built upon in this course. This course is intended primarily for science and engineering majors. In broad terms, we will cover special relativity; elements of quantum physics; the structure of atoms, molecules and solids; nuclear physics; and elementary particles.

2.2.1. Approximate Sequence of Topics

While the exact details of the sequence of material will be produced and made available separately, and in much greater detail, here is a rough idea of the sequence of material in this course.

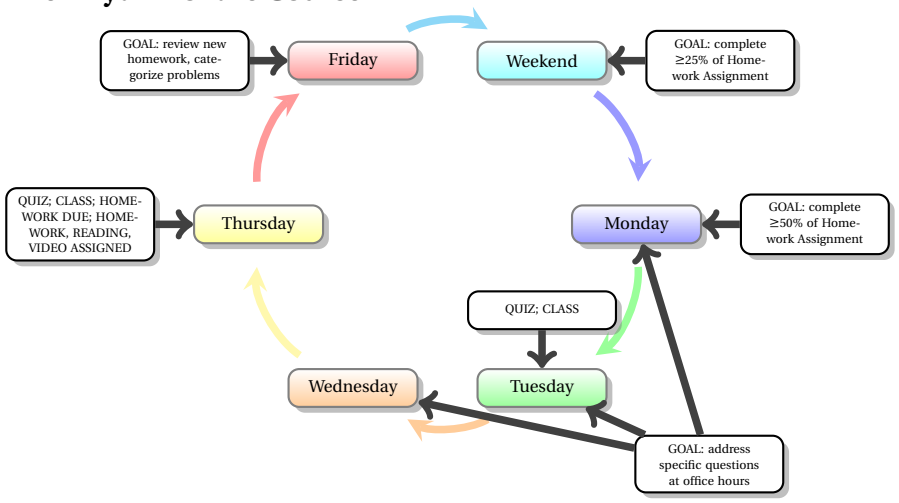
1. "Foundations I"
   (a) Newtonian Mechanics
   (b) Galilean Relativity
   (c) Electricity and Magnetism
   (d) Waves I
2. "Faster"
   (a) The Speed of Light
   (b) Revisiting Relativity
   (c) Special Relativity
   (d) Applications of Modern Relativity
   (e) First Steps into General Relativity
3. "Foundations II"
   (a) Heat Energy and the Laws of Thermodynamics
   (b) Waves II
4. "Smaller"
   (a) Particle Behaviors of Radiation
   (b) The Wave Nature of Matter
5. Faster and Smaller: Applications of Special Relativity and Quantum Mechanics
   (a) The Schroedinger Wave Equation and Quantum Mechanics

(b) Applications and Implications of Quantum Mechanics
(c) The atom and the nucleus
(d) Solids and quantum mechanics
(e) Unstable particles
(f) Grand Challenge Solution Presentations

Roughly speaking, the first two subjects ("Foundations I" and "Faster") will take up the first month of the course; the next two subjects ("Foundations II" and "Smaller") will take up the second month of the course; the last section ("Faster and Smaller") will take up the final month of the course. The first exam will cover "Foundations I" and "Faster"; the second exam will cover "Foundations II" and "Smaller"; the final exam will focus on (but not be limited to) the subject matter of the last part of the course, "Faster and Smaller".

2.3. Assessment Components

2.3.1. The Rhythm of the Course



A typical week (excluding those with exams and weeks with official university holidays) should look as follows:

1. Monday: you are finishing the reading and video lecture viewing assigned in the prior class period. You have taken notes on your reading and video lecture watching, with emphasis on key concepts, formulas and their meaning, and the implications of new ideas, as well as any means by which the key ideas have been established (e.g. experiments). A quiz will be assigned online to assess your absorption of this material. Once you begin this quiz, you have 5 minutes to complete it (see Section 2.3.3). You will also continue working on homework assigned the previous Thursday. By now, you should have tried to complete all of the problems and succeeded in completing something like 40-50% of them. You should have a list of concerns and questions to bring to office hours.

2. Tuesday: you come to class to engage in exercises, demonstrations of physical phenomena, and demonstrations of problem solving, based on the reading and lecture video. You will work alone

and with peers to engage in classroom activities. You will have access to the instructor(s) to answer questions. You will be assigned further reading and lecture video material for next class.

3. Wednesday: again, you should be finishing assigned reading and lecture viewing assigned on Tuesday, and taking the associated online quiz. You are also finishing up the homework assigned the prior Thursday. By this point, you should have completed at least 75% of the homework and be ready to finish the remainder to hand in the next day. Your solutions (see Sections 2.3.4 and Appendix A.1) should be nearly complete and ready for submission inr grading on Thursday morning.

4. Thursday: you come to class, submit your written solutions (this is usually done via Canvas), and engage in further exercises (as on Tuesday) focused on going more into the material from the reading and lecture video. New homework is assigned and due the following Thursday.

5. Friday: you review the homework problems and note which ones you think will be straight-forward for you, based on reading, lecture videos, and class exercises; you also note the ones that might give you more trouble. Try working on the ones that look more approachable, with the goal of completing up to 25% of the homework on Friday.

6. Weekend: use the weekend to review notes and class material and keep working on homework. Your goal is to get to the end of Monday with the sense that you've completed about half or more of the homework.

7. Repeat...

During exam weeks, no homework is due in order to facilitate review and study (homework will be due the week following the exam and will typically be longer as a result, so don't procrastinate too much).

This is a 3-credit hour course, which means we have 3 contact hours during the week (class periods) and you are expected to work 6-9 hours outside of class to further your study for the course (this includes reading, lecture video, and homework, as well as any other studying you need to do). This is typical of a serious and rigorous university physics course at this level.

2.3.2. Attendance and Participation

Your attendance in the class will be checked through the assignment of homework, your participation in quizzes, and through participation in classroom discussions and activities. Poor attendance will be reflected in your performance in the three areas. This course respects the University policies on excused absences; please see the relevant section below. Given the clear importance of attendance and participation in classroom activities to your learning, it is assessed as part of your grade.

If you have an excused absence, either due to an event covered by University policies or by enrollment (e.g. you were not enrolled in the first week of class), the attendance/participation grade for that day will be dropped *automatically* and will not count toward your final participation grade. Your two lowest participation/attendance grades are automatically dropped at the end of the course. Excused absences NEVER count against you.

2.3.3. Quizzes

There will be pre-class quiz assigned in the 24 hours before the class period for which material is used. For instance, if reading and a lecture video are assigned on a Tuesday, then from Wednesday through Thursday (until the start of class) you can take the pre-class quiz on that material.

Quizzes are timed, and *you must complete the quiz all at once and in the allotted time*. The quiz is to be taken alone, with no collaboration with anyone else. You can use notes or other resources from your studying of the reading and the video, but no one is to help you take the quiz. It is in your best interest to treat reading and video assignments as you would any standard lecture: take notes, review them, ask questions of peers or others before committing to take the quiz. Once you commit to taking the quiz, time is limited.

These quizzes will incrementally cover the reading and lecture video material assigned since the previous class, but may also draw on experience with earlier topics. Your two lowest quiz grades will automatically be dropped. The assigned reading and lecture videos will be your primary means of studying for the quiz.

The results of your quizzes will be used to influence learning during the next class period. Quizzes are not a chance for you to impress the instructor, but rather the opposite: the instructor will use them to identify "learning hot spots" that need attention, and class time will be used, in part, to address those "hot spots."

2.3.4. Homework

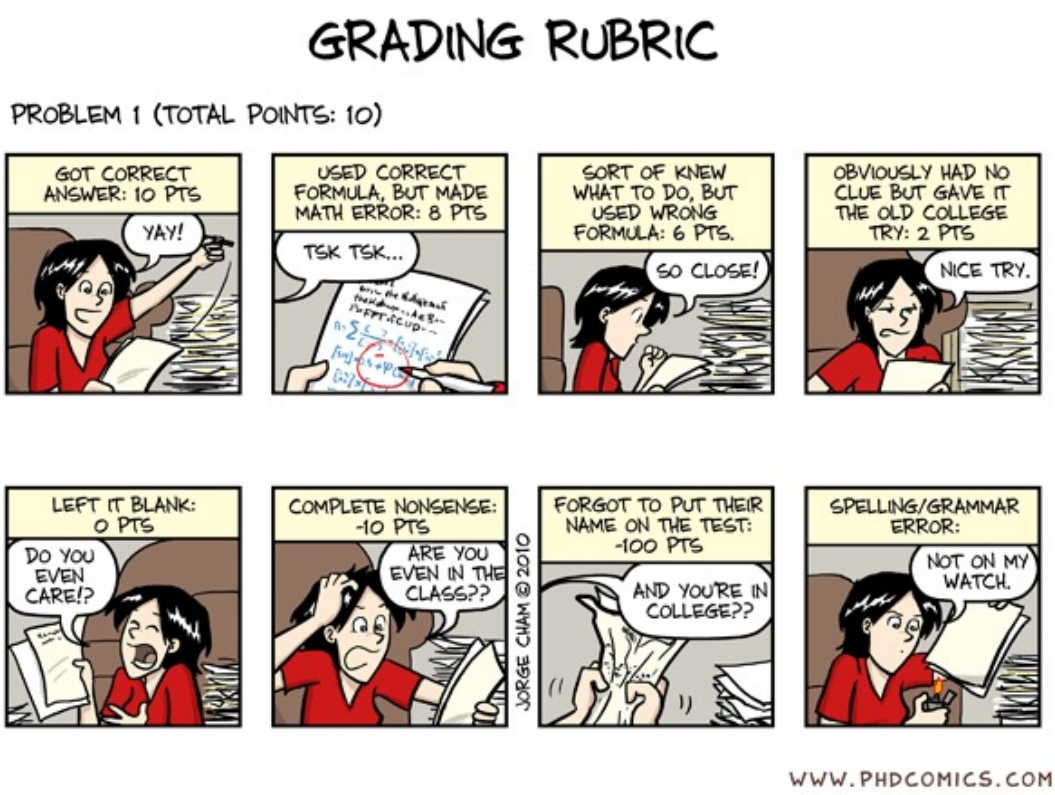


Figure 2.1: Homework is like the main course of a meal: best enjoyed over a period of time and with friends. Don't wait until the last minute to start homework... you have been warned. Images are copyright Jorge Cham, and available at `http://www.phdcomics.com/comics/archive.php?comicid=1319`

Homework problems will be assigned in class.

- Homework will typically be assigned on a Thursday and due the following Thursday
  - The lone exception to the above is the first day of class (a Tuesday), when homework will be assigned and due two days later.

Reduced credit (a maximum of 85% of the value of the assignment) will generally be given for late assignments, and no credit for missed assignments. An assignment is considered "late" if it is submitted even 1 second beyond the due date and time.[1] A formal written materials policy appears in the appendix of this

[1] The National Science Foundation and U.S. Department of Energy's Office of Science do not accept funding proposal submissions that are beyond the deadline, even from brilliant scientists. I expect you to adopt the mentality that the deadline means something... because deadlines mean something. Meeting a deadline is a basic sign of respect for a colleague or co-worker.

syllabus (Appendix A.1) .

2.3.5. Exams

There will be a series of in-class exams throughout the semester. **Please see the website of the course for the specific dates.** Those dates are fixed from the very beginning of the class, and the final exam period is fixed by the University.

Exams generally assess your learning on the section of material since the previous examination (for exam 1, the starting point is the beginning of the class), but can certainly include prior material as this class builds upon what is established, as does all scientific learning. The final exam will generally focus on material since the previous in-class exam. Exams are to be taken alone, with no consultation by any means with any other individual. You are encouraged to ask the proctor(s) questions during the exam, but we will not answer questions such as "Is this correct?" or "Can you tell me what to do next?" If you have a question of clarification of a word, phrase, or similar request, that is fine, but concepts and problem solving are up to you. You need to demonstrate to us the level of confidence you have in your own learning, and your ability to apply the material from the course. You may only use resources provided to you during the exam to help with the exam; you may be asked to bring your own calculator and writing implement, but that is usually all you are allowed to have during an exam.

Cheating during examinations: I cannot emphasize enough that ***cheating during an exam will result in expulsion from the exam room and an immediate "F" (score: 0%) on the exam, if not in the entire course*** (see Section 3.1 and Appendix A.1.3). In addition, your academic advisor will be contacted and an academic violation will be filed against you.

To help you understand what it means to cheat, here are a few examples of exam cheating. This list is by no means comprehensive - faculty have seen many different means of attempting to cheat during classes - and so if you devise some other means to commit an academic violation we are likely to detect it and the punishment is the same. Here are some examples:

- Leaving your papers (e.g. solutions) out in the open where others can see them - you are facilitating cheating when you do this, and are yourself guilty of cheating.
- Looking at another person's work or calculator during the exam. Keep your eyes down and on your own work at all times.
- Sharing a calculator with anyone in the class.
- Using any wireless communication device of any kind to interact with anyone at all during the exam.
- Using any other means of communication during class, such as passing messages in class or using bathroom breaks to do so. We note bathroom breaks and use data science to assess patterns in them, so beware of trying this.
- Bringing solutions or other reference material to use during the exam. (any non-approved material used during an exam is grounds for failing the exam)
- Sending another person to class to take the exam for you, or using another person's identity to take the exam.

Figure 2.2: Before you ask your instructor, "Will this be on the test?", think very, very, very carefully. Images are copyright Jorge Cham, and is available at `http://www.phdcomics.com/comics/archive.php?comicid=1875`.

2.3.6. The Grand Challenge Problem

A culminating event of this semester will be the completion of a Grand Challenge problem. This is a physics problem with no textbook solution. Rather, you will draw upon your own creativity, informed by the principles of physics you learned in PHYS 1303/1307, 1304/1308, and most importanly what you are learning in PHYS 3305, to address the question in as detailed a manner as possible. You will be graded on:

- your incremental progress on developing answers to the question;
- the creativity, originality, or novelty of the ideas that lead to your final answers;
- your ability to investigate the ideas through physics calculations and supporting material;
- and the reliability and accuracy of your calculations.

This is not purely a storytelling exercise; rather, you will engage in a mathematical and physical exercise where the math speaks, and you will describe what it says. The Grand Challenge process and solution will be a significant component of your final grade.

The Grand Challenge will be a team exercise. You will be randomly assembled into teams at the beginning of the semester. Your team will be expected to meet at least once a week outside of class to discuss the Grand Challenge and, in particular, how what you have learned that week might be used to explore a consequence of the theme of the Grand Challenge. Your team will meet with the instructor approximately 3-4 times during the semester to formally present the state of your thinking about the Grand Challenge and to discuss progress on your solutions.

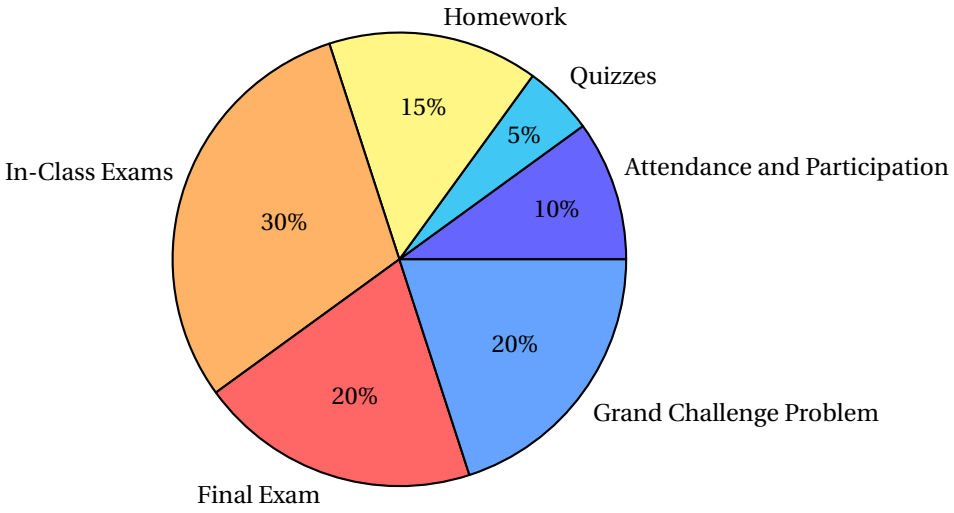
Reading and lecture video is how you are introduced to the physics concepts in this semester. Homework is how you learn to begin exercising those concepts. Exams are there to make sure that you as an individual have mastered the basic concepts of the course. The Grand Challenge is how you demonstrate that, as a team and individually, you can explore new ideas and generate predictions using physics and mathematics.

While the grand challenge problem is a team activity, your contributions to the overall exercise will be assessed using individualized presentations. Each member of the team will be assigned to present on a single part of the overall project. The presentation assignments will be made in consultation with the class instructor. This allows each student to be judged independently, while also judging the overall quality of the team's work.

A separate and detailed explanation of the entire Grand Challenge exercise will be made available by the instructor.

2.4. Grading

Your course grade is composed of the following pieces: attendance and participation (10%), quizzes to assess out-of-class learning of new material (5%), homework to assess basic mastery of material (15%), two in-class exams (15% each, for a total of 30%) to assess more comprehensive and incremental individual mastery of material, a final exam (20%) to assess final synthesis of material, and the "grand challenge problem" (20%).



The grading scale used in this course is standard and that recommended for courses at SMU. For the ranges, a "[" or "]" indicates the adjacent number is included in the range, while a "(" or ")" indicates the adjacent number is excluded from the range.

Name	Range	Interpretation	Comments
A	[94,100]	Excellent Scholarship	For all of these, you have done well in the course and can proceed to the next stage. For students who earn a grade in the C range, speak with me at the end of the course to develop a plan to address any deficiencies before proceeding to the next course.
A-	[90,94)	Excellent Scholarship	
B+	[87, 90)	Good Scholarship	
B	[84,87)	Good Scholarship	
B-	[80,84)	Good Scholarship	
C+	[77, 80)	Fair Scholarship	
C	[74,77)	Fair Scholarship	
C-	[70,74)	Fair Scholarship	
D+	[67, 70)	Poor Scholarship	These may prevent you from counting this course toward your major/minor. Consult your academic adviser.
D	[64,67)	Poor Scholarship	
D-	[61,64)	Poor Scholarship	
F	[0,61)	Fail	You will have to re-take the course for certain. See guidelines for first-year students and for other students in University Course Catalog.

3

University Policies

3.1. University Honor Code

The student honor code[1] can be found in the 2018-2019 student handbook[2]. All students will be expected to adhere to it. Any student found conducting a violation of the honor code - academic sabotage, cheating, fabrication, facilitating academic dishonesty, or plagiarism - will *at the very least* earn a zero for that work. In addition, a complaint will be filed through the Vice President for Student Affairs Office. If you are uncertain of the definition of academic misconduct (especially plagiarism) as it regards independent works of mathematical and physical computation, documentation, and demonstration, it is your responsibility to speak with the instructor. Ignorance of the definition of plagiarism, or any other academic violations, is not considered a viable excuse to avoid penalties for these acts.

3.2. Disability Accommodations

Students needing academic accommodations for a disability must first register with Disability Accommodations & Success Strategies (DASS). Students can call 214-768-1470 or visit `http://www.smu.edu/Provost/SASP/DASS` to begin the process. Once approved and registered, students will submit a DASS Accommodation Letter to faculty through the electronic portal DASS Link and then communicate directly with each instructor to make appropriate arrangements. Please note that accommodations are not retroactive and require advance notice to implement.

3.3. University Policy on Religious Observance

Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester, and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence (`https://www.smu.edu/StudentAffairs/Chaplain/ReligiousHolidays`).

[1] http://www.smu.edu/StudentAffairs/StudentLife/StudentHandbook/HonorCode
[2] http://www.smu.edu/StudentAffairs/StudentLife/StudentHandbook

3.4. Excused Absences for University Extracurricular Activities

Students participating in an officially sanctioned, scheduled University extracurricular activity should be given the opportunity to make up class assignments or other graded assignments missed as a result of their participation. It is the responsibility of the student to make arrangements with the instructor prior to any missed scheduled examination or other missed assignment for making up the work. (See 2019-2020 University Undergraduate Catalogue under "Excused Absences")

3.5. Student Academic Success Programs

Students needing assistance with writing assignments for SMU courses may schedule an appointment with the Writing Center through Canvas. Students wishing support with subject-specific tutoring or success strategies should contact SASP, Loyd All Sports Center, Suite 202; 214-768-3648; `https://www.smu.edu/sasp`.

A

Appendix

A.1. Homework and Written Materials Policy

"Written Material" refers to any document, electronic or hand-written, you submit to the instructor for assessment. This can include quizzes, homework, research papers, exams, and any other similar material, submitted in digital or analog formats.

Most of your homework will be handed in electronically through the WileyPLUS system. However, this course will test your ability to not only get the correct answer to a problem but also to demonstrate that you can correctly solve a problem and write clear, accurate solutions with all work shown. The following policy provides the strict guidelines covering any written material which you submit to the instructor for grading (e.g. written solutions to homework, or any solutions written up for an in-class engaged exercise).

As in the humanities, communication in science relies on clear, well-defined standards that enable the free flow of information between parties. My standards are designed with that free but structured flow of information in mind. If you have concerns about any of the below requirements, please discuss them with me during open office hours or by appointment.

A.1.1. Format

All written material submitted for grading must contain the following or will receive an automatic ZERO GRADE.

- **Your full name**
- **The name of the current assignment** (e.g. Homework 1, Reading Quiz 5, etc.)
- **The date on which you handed in the material**
- **The title of each problem requested for submission** (e.g. Problem 21.7, Problem SS-5, etc.) above the work associated with that problem.

All written material must have the following qualities, or will receive an automatic ZERO GRADE:

- **Writing must be legible.** If the instructor/grader cannot read your work to determine your method or approach, no partial credit can be assigned. A completely illegible assignment receives an automatic zero (small print, messy handwriting, etc.). You are always free to type your assignment using Microsoft Word (Office365), Google Docs, LibreOffice Writer, or a similar program.

- **Writing must be coherent.** Any written answer must be formatted with a clear sentence structure: subject, verb, and object. Writing must adhere to the guidelines of good English prose and Scientific Writing[1]: short, declarative sentences clearly explaining answers, ideas, etc. Flowery prose will get you nowhere. Mathematical solutions must also be coherent. The equations should flow like sentences, one building into the next with a clear path from your original equations to your final solutions. Show as many steps in your work as you can – the smaller the steps, the more likely you are to spot mistakes quickly. If you provide insufficient steps to demonstrate how and why you were able to solve the problem, we cannot give you full credit. Right answers without clear, mathematical justification or written explanations will almost always receive low/no credit.

In addition, if you are required to digitize your written work and submit it electronically (e.g. upload to Canvas or a similar system), the following are required (if not met, the assignment receives an automatic ZERO GRADE):

- **Scans/photos of work must be good quality.** Any digital image of written work needs to be bright enough to be read clearly on a screen. If a photo or scan of your assignment is hard for you to read on a screen (e.g. on your Laptop, iPad, etc.) then it will be even harder for us to read. Any document that is too faint, too dark, or has too poor contrast to be easily read, automatically fails this requirement.

- **Scans/photos of work must be in the correct orientation.** Often during photographing, devices like phones and iPads will automatically rotate images. If you upload them, they appear in an orientation other than upright and easily readable. All images/scans must be in the upright orientation, or they fail this requirement.[2]

A.1.2. Solutions and Answers

The formatting of good solutions is described further below, and examples are available on the web (`https://www.physics.smu.edu/sekula/phys3305/GoodHomeworkExample.png`). In addition to legible and coherent solutions, the answers to solutions must have the following qualities in order to receive full credit:

- **Answers must be boxed:** the final numerical or written answer to a problem must have a clear box drawn around it. This indicates your commitment to your solution and makes it clear to the grader what you intended as your final result. Failure to box your answer, even if it is correct, will result in a loss of credit.

[1] c.f. "The Scientist's Guide to Writing: How to Write More Easily and Effectively throughout Your Scientific Career" by Stephen B. Heard or "A Scientific Approach to Writing for Engineers and Scientists (IEEE PCS Professional Engineering Communication Series)" by Robert E. Berger.

[2] While we do not make specific software recommendations to address the orientation issue, students have had excellent success with the mobile app "CamScanner". This take camera images and generates a PDF file with the correct orientation for Canvas.

- **Numerical answers must have the correct units:** The importance of units cannot over over-emphasized. Satellites have crashed on Mars because somebody messed up units! Failure to put the correct units, or any units at all (where units apply), next to your numerical answer will result in a loss of credit.

- **Numerical answers must have the correct significant figures:** Numbers have limitations; no number derived from measurement can be known perfectly. Applying the rules of significant figures teaches you this limitation. Therefore, please review the rules of significant figures (`https://www.physics.smu.edu/sekula/phys3305/notes.html#Sigfigs`) and apply those rules to your answers. Failure to apply these rules correctly will result in a loss of credit.

A.1.3. Academic Honesty

You are encouraged to work together to solve problems. However, you must also follow the basic guidelines of academic ethics[3]. Please see the bullets below for some basic guidance on this, as well as for some positive ways you can adhere to these guidelines.

- **Written solutions to problems must be your own work, and not copied from anybody else.** While you are encouraged to collaborate to solve problems and learn from one another, copying each others' work WILL NOT BE TOLERATED. Any evidence of such behavior will result in proceedings in accord with the University Honor Code.

- **Numerical answers must be arrived at by your own work.** If evidence is obtained that suggests students in the class are sharing answers, steps will be taken in accord with the University Honor Code. Sharing of answers and failure to pursue your own solution, even based off collaboration on a problem, WILL NOT BE TOLERATED.

If you work together, please follow these simple guidelines to acknowledge your positive collaboration with your peers:

- **Write the names of your collaborators at the top of your submitted work.** Acknowledging collaboration is like citing sources in a research paper; it gives credit to those who help you and whom you help, while asserting that the work submitted it still a product of your effort.

- If you have arrived at a solution as a group, separate from one another and each work the problem independently to see that each member of the group can follow the approach and agrees that this is the correct solution. This will also result in independent write-ups of the solution to a given problem.

[3] Here, I make an important side comment. Heed it well. I am very much aware of the existence of student and instructor solution manuals (published by the book publisher) and online, internet-based solution sites and forums (where students trade solutions to problems from established physics textbooks). I make the following statements of caution regarding these resources. First, *copying solutions from any such sources is a violation of the Academic Honor Code of this University*. If caught, you are subject to the same proceedings as apply to plagiarism. Second, *my experience in using these resources to check my own solutions is that a fair amount of the time (maybe as high as 10%), the solutions are dead wrong*. If you do not learn physics, you will fall prey to the same trap that claims all people who forgo learning and critical thinking: the scam. Sites often charge money for access, and solution manuals cost money, so *caveat emptor*... ***buyer beware***. If you assume these solutions are all correct, you have already made a serious error in judgment. Always... ALWAYS... check the claims of others using your own brain. Third, *copying solutions from third-parties means you have likely failed to learn this material, and this will be reflected in your exam scores... which form the MAJORITY of the points earned in this course*. The summary: cheating has few upsides and a thousand downsides. Don't cheat. It's better to come to me and admit you are struggling with the material (after all, you've already paid for my help) than it is to suffer in silence and pay the price in your academic career.

A.1.4. Advice for Writing Good Solutions

Writing solutions is like writing an essay - you have to convince the reader that you have understood the question, applied the correct assumptions, and then demonstrate your solution with sufficient detail to defend the answer. Here, I outline some recommendations for writing high-quality solutions. Applying these guidelines will help you to focus your problem solving and communicate your understanding effectively.

1. State and Justify Your Assumptions

    - clearly state your assumptions and justify why you have chosen them. This will help your audience determine whether you have understood the question(s) being asked.
    - *Critical Question: ask youself, after restating the problem statement and listing your assumptions and justifications, "Does my restatement of the problem, my assumptions about facts in the problem or needed to solve the problem, align with information given in this problem statement?"*

2. Show Sufficient Work To Convince Your Audience You Understand the Process

    - show enough intermediate steps that your audience is convinced you not only understand the question, but that you understand how to answer the question. This includes showing how you apply your assumptions, highlighting any mathematical or physical tricks needed to simplify steps in the solution, and finally clearly showing the answer. In science, ***the process*** is the most important means by which you demonstrate the correctness of the answer. Showing your work clearly is the most important way to show that you understood the material.
    - *Critical Question: ask yourself, after writing up your work, the following question: "Does my solution represent the kind of high-quality work that would be required to serve as a standard for future students, or as a means to teach a peer how to solve the problem without having to ask me questions?"*

3. Comment on the Answer

    - Always comment on the answer when asked. If you are not asked to comment on the answer, but you have observed something interesting about the solution, please make a comment. This helps demonstrate that you not only understand the question but deeply understand the answer.
    - *Critical Question: at the end of your solution write-up, ask yourself this question: "Could a peer, given this write-up, understand the meaning and implications of the question and the answer to the question?"*

B

Professional Etiquette

The following rules apply to my classroom and beyond:

- You can use electronic devices during class if they are for supporting your learning (looking up information, participating in polls, performing calculations, etc.). If electronic devices are used instead to distract yourself or others (e.g. by engaging primarily in social media, shopping, etc.) then your participation for that class will be nullified and count as an unexcused absence. This is to help you learn that you must rule these devices; they must not be allowed to rule you.

- The time before class begins and after class ends is reserved for management of the class. For example, preparation for a physics class (during the time between class periods) requires the setup or disassembly of technology and equipment. Instructors are not to be bothered during this time; if you need to have a discussion, make an appointment (either using Canvas to book an office hour slot or, outside of office hours, make a request in writing). The instructor reserves the right to change this policy on a period-by-period basis if class setup or clean up is concluded promptly.

- The only appropriate time to speak with the instructor outside of class is during open office hours; you can subscribe to them on Canvas. An open office door is not an invitation for you to walk in and interrupt the ongoing research work of the instructor. If you would like to speak with the instructor outside of open office hours or an appointment, and intend to do so by dropping by their office, you should (a) knock on the door or door jamb, (b) wait for the instructor to acknowledge you, and (c) begin by asking, "Is this a good time to talk?" If the answer is "no," walk away and submit a request for an appointment in writing. An open office door is not the same as an open invitation to drop in. Do not linger awkwardly outside an office door; that can be distracting. If a meeting is already in progress in the instructor's office, do not disturb it.

- Being on-time is a key professional courtesy. This applies to showing up for class (arriving before class starts, leaving only after the official end of class time). This also applies to appointments with instructors. Do not arrive earlier than 1-2 minutes before an appointment begins. If you are 10 minutes (or more) late for an appointment, the appointment is automatically cancelled and must be rescheduled in writing.

- Do not use class time to engage with the instructor in conversation about homework, exams, or grades. Classroom time is for beginning to learn how to handle the basics of a new subject. Do not distract yourself or the instructors with other activities. For instance, it is inappropriate to use class time to ask the instructor questions like,
  - "Why did I lose points on X?"
  - "Can you explain the grading on problem Y?"
  - "Can we discuss my last test right now?"

  These topics are correctly discussed during an appointment. All such requests must be made in writing.
- We enjoy a friendly, engaging, and open classroom. Questions and discussion are welcome. However, in order to serve the larger goal of making sure all participating students have a chance to engage in the activities of the day, discussion and questions may be curtailed. For instance, students who find themselves asking a lot of questions or raising a lot of discussion items should ask themselves the following: "How important is this question or point and is it of generally broad interest to most of the students in the room?" If you are not sure, write the question down and make an appointment to discuss it with the instructor. A class is a balancing act between open inquiry and structured learning. Please respect that process.

C

Policy on Changes to Grading

You are free to challenge the grade you have received on a problem or on an assignment. ***These challenges must be presented in writing to the course instructor*** so that they can be discussed during an office hour. However, ***any additional student mistakes identified during the review of the grading will result in additional lost points consistent with those mistakes***. Just as in the review of any professional work, you therefore stand to potentially gain or lose during the process of a formal review.

C.1. Policy: Deadlines on Grade Change Requests

- The deadline to submit a challenge to the grading on an assignment is within 5 business days after the grade is posted.
- For the last assignment(s) of the semester (those due in the final week of the course), the deadline is 5 business days after the grade is posted or by the end of business on the reading day before final exams begins, whichever comes first.

By University policy, final course grades are due 72 hours after the end of the final exam. If you wish to challenge your final grade, you must do so in accordance with University policies[1].

[1] SMU Undegraduate Catalog, "Enrollment and Academic Records," "Grade Appeals" `https://catalog.smu.edu/content.php?catoid=33&navoid=2417`

D

Teaching Philosophy

Learning happens most efficiently when students grapple with a subject, especially an unfamiliar one. Learning is achieved primarily through intellectual struggle. The instructor's job is to present ideas and provide structure for that learning to occur; for individually addressing student-specific issues regarding learning methodologies and strategies; and assessing the student learning from a perspective of what is expected in the field of practice. Ultimately, the student is the person most responsible for the learning process (after all, it's their brain).

In accordance with the above philosophy, the following statements are true about the components of this course:

- Attendance and Participation: This is the bare minimum expected of all students (in service of your learning). You are expected to attend class periods and participate in learning activities. Doing well on this means you are executing the bare minimum.

- Quizzes: These are meant to check your progess on the next-to-minimum activity expected of all students (in service of your learning): to read assigned text and watch assigned lecture videos, take notes in a format appropriate to your learning process, and to use those notes to answer questions about the most basic ideas of the course. Quizzes cannot and do not assess your ability to solve problems using ideas; rather, they assess your basic understanding of the ideas themselves and see if you have grasped a concept forward and backward. Doing well on the quizzes only means that you are keeping up with assigned reading and lectures and curating good notes to which you can refer, as well as beginning to understand the basic concepts of the course.

- Homework: These are meant to give you your first foray, as individuals or in small working groups, into problem solving by synthesizing the physics concepts with the language of mathematics. Doing well on the homework means you are beginning to master the skills needed to combine physics and math to solve problems in the natural world. Your ability to deliver these by the given deadline is practice in meeting the deadlines that will be present in your future career. Repeatedly failing to meet deadlines on the homework is a red flag regarding your learning structure and plan.

- Exams: These are meant to assess your individual level of mastery of the subjects in the course, with the understanding that the time pressure of an exam adds a new dimension to the learning

process that is not present in the homework. Exams, and your performance on the exams, tells me about your synthesis of material and your ability to execute on the use the physics ideas in the course in combination with mathematics.

The following metaphor will suffice to put in context the pieces of the course. Throughout this course, you are building an intellectual house. Attendance and participation means that you show up to work every day, but it doesn't tell me that you're building anything. Doing well on the quizzes is equivalent to putting down the foundation of the house ("foundational learning"); it points to the strength of the base but doesn't tell me about the quality of the fully constructed house. Doing well on the homework ("structural learning") is equivalent to installing the electrical wiring and the plumbing and putting up the wooden framing; it's absolutely necessary for what happens next, but by itself is not fully telling of the final intellectual product. The exams are the rooms in the house ("total learning"), each building upon the last. The final exam is an evaluation of the whole house.

Even if you do well on exams, a weak foundation weakens the whole house. If you do well on quizzes and attendance, your foundation is in good shape but poor performance on exams means that what is built upon the foundation is unreliable. Doing well on the homework means the backbones of the house are in good shape, but if poor performance still happens on exams then your technique for translating foundational and structural learning into demonstration of total learning is ineffective, and needs work.

Weakness on any component is a reason to speak with the instructor, and sooner is better than later.

E

Important Dates

Below I have selected some of the more relevant dates for this term. They come from the official University Calendar[1], but are by no means a reliable replacement for the actual university calendar, which may be amended in some way since this syllabus was written. Always refer to the real University Academic Calendar.

- January 17, Friday: First day of classes.
- January 20, Monday: Martin Luther King, Jr. Day. University offices closed.
- January 24, Friday: Last day to enroll, add a course, or drop a course without tuition billing while remaining enrolled for the term. Last day to file for graduation in May.
- January 31, Friday: Last day to drop a course without academic record (tuition charges apply). Last day to withdraw from the university without academic record (withdrawal refund schedule applies). See Bursars website for more information.
- February 4, Tuesday: Last day to declare pass/fail or no credit grading options. Also, last day to request an excused absence for the observance of a religious holiday.
- February 24, Monday: Early intervention grades due for first-year undergraduate students.
- March 6, Friday: Last day for continuing undergraduate students to change their majors before April enrollment.
- March 16-22, Monday-Sunday: Spring break.
- March 24, Tuesday: Midterm grades due for first-year and sophomore students.
- April 7, Tuesday: Last day to drop a course (grade of W).
- April 10, Friday: Good Friday. University offices closed.
- April 29-May 4, WednesdayMonday: No final examinations or unscheduled tests and papers.

[1] https://www.smu.edu/EnrollmentServices/Registrar/AcademicCalendarsCourseCatalogs/AcademicCalendars/Calendar19-20

- May 4, Monday: Last day of classes.
- May 5, Tuesday: Reading Day.
- May 612, WednesdayTuesday: Examinations (No examinations scheduled for Sunday).