



# USC

## PHYS 151: Fundamentals of Physics I Mechanics and Thermodynamics

Units: 4

**Term—Day—Time:**

- Fall 2022
- Monday, Wednesday, Friday  
from 10.00 am to 10.50 am
- Three 50 minutes classes per week, 15 weeks

**Location:**

- In-Person: SLH 200 (Stauffer Science Lecture Hall)
- And Online (live session):  
<https://usc.zoom.us/j/94366542393>  
(check our Blackboard page for the passcode)

**Instructor:**

- Dr. Marcin Abram
- e-mail: [mjabram@usc.edu](mailto:mjabram@usc.edu)

**Supplemental Instruction (SI) Program Leader:**

- Ross Clark
- e-mail: [mmclark@usc.edu](mailto:mmclark@usc.edu)

**Grader:**

- Rahul Vikhe
- e-mail: [vikhe@usc.edu](mailto:vikhe@usc.edu)

**Students Hours (also known as Office Hours):**

- Wednesday 2-3 pm
- Online: <https://usc.zoom.us/j/8934576028> (check the meeting passcode on our Blackboard page)
- Everybody is welcome!
- Drop-in, drop-out style. It means you don't have to make an appointment. Just join the session and ask your questions.

**Piazza:**

- <https://piazza.com/usc/fall2022/phys151/home>

## Course Description

Physics 151L is the first course in the Physics sequence intended for physical science and engineering majors. The subject material is Classical Mechanics and Thermodynamics. The goal of the course is to teach you how to approach and solve physical problems, and to develop an intuition for the important physical properties that affect a given situation. Following this course, you should be able to analyze such diverse phenomena as looping roller coasters, satellite orbits, and why spray cans get cold as you use them.

The sequence of courses 151-153 should be considered as one whole course, and not as three independent nonintersecting courses. In 152 and 153 you will be expected to be able to freely make use of the material covered in this course.

## Learning Objectives

At the end of this course, you will be able to:

1. Construct an abstraction (a mathematical model) of real-time physical situations.
2. Describe (quantitatively and qualitatively) the dynamics of macroscopic objects.
3. Describe physical systems using Newton's formulations of mechanics.
4. Apply single-variable and multivariable calculus to solve a range of classical physics problems, including pendulums, oscillators, systems in noninertial reference frames, systems of particles (gases), etc.
5. Explain outcomes of physical experiments. Test scientific hypotheses. Find the relation between different observed phenomena.

## Prerequisite(s)

I have constructed the course with the understanding that you have completed (or you are familiar with the content of):

- ★ One of the following: MATH 125, or MATH 126, or MATH 226, or MATH 129, or MATH 229.

## Co-Requisite(s) or Concurrent Enrollment

None.

## Recommended Preparation

To succeed with this class, review the information from:

- ★ Calculus (you should be able to solve single-variable and multivariable equations).
- ★ Mathematical Analysis (you should be able to solve simple integrals and know basic methods of solving linear differential equations).
- ★ Algebra (you should be familiar with complex numbers and matrix calculus)

## Course Notes

This course will be comprised of:

- ★ lectures,
- ★ weekly problem sets,

- ★ two midterms,
- ★ a final exam.

In addition, you will have to attend physics laboratory sessions. Please consult the documentation received from the Lab Director regarding the labs for this semester. Complete details about lab grading and make-up policies are provided on the laboratory section's Blackboard site. Other questions concerning the laboratory should be referred to the Lab Director, Gökhan Esirgen, [esirgen@usc.edu](mailto:esirgen@usc.edu).

The course will ordinarily be taken for a letter grade. Documents, including lecture notes, and homework assignments will be distributed online via the course Blackboard site.

You are expected to buy/rent just one book, "Physics for Scientists and Engineers with Modern Physics" by Raymond A. Serway and John W. Jewett. You do not need any subscription to the Cengage platform. All other required or recommended readings will be available free of charge either from the USC libraries, <https://libraries.usc.edu/>, or they will be uploaded to the Blackboard site of our class.

## Description and Assessment of Assignments

### Laboratory

You will receive information about the labs from the lab director for physics labs.

### Quizzes (Midterms)

Quiz sections will only be used for the two midterms in this course.

- ★ The *first* quiz (midterm) is on Wednesday, September 28, 2022, from 5.00 pm to 6.20 pm PDT.
- ★ The *second* quiz (midterm) is on Wednesday, November 2, 2022, from 5.00 pm to 6.20 pm PDT.

You can find the full schedule in the "Course Schedule: A Weekly Breakdown" section on page 9.

### Weekly problem sets

Each Friday (except a few in late November), I will publish a problem set. Typically, it will be composed of questions that will require you to write down solutions to various quantitative physical problems. Each problem set will be worth 12 points. There will be 12 problem sets in total. You will all have approximately 7 days to complete each problem set. Unless you require special accommodation, the solutions should be uploaded on our Blackboard page in a pdf format (you can either write the solutions in LaTeX or you can write them by hand, scan the papers and create a pdf). The deadline for uploading the solutions is always the following Friday at 11.59 pm PT. Specifically,

- ★ The deadline for the *first* problem set is on Friday, September 2, 2022, at 11.59 pm PDT
- ★ The deadline for the *second* problem set is on Friday, September 9, 2022, at 11.59 pm PDT.
- ★ ...
- ★ The deadline for the *twelfth* problem set is on Friday, November 18, 2022, at 11.59 pm PST.

You can find the full schedule in the “Course Schedule: A Weekly Breakdown” section on page 9.

Note, that in those written assignments, the completeness and the clarity of your solution (your calculations or derivations) will matter as much as the final correct answer. Sending just a single final value (even if correct) is not enough. See the table below:

Grade Component	Meets Expectations (75%-100%) For Problem Sets: 9-12 points	Approaches Expectations (50%-75%) For Problem Sets: 6-9 points	Needs Improvement (0%-50%) For Problem Sets: 0-6 points
<b>Completeness (25%)</b>	All questions are answered. All cases are considered.	Most questions are answered. The most obvious cases are considered (for example non-zero forces are examined, but the student didn't consider a special case when $F=0$ ).	The main question is not addressed.  The answer is irrelevant to the task.  The analysis of the issues and events is either vague or incomplete.
<b>Clarity (25%)</b>	A non-expert (e.g., a fellow student) can understand the solutions. All concepts and used techniques are defined and explained. Whenever it is applicable, the solution is accompanied by illustrative plots. The plots are explained and interpreted. There are references to sources.	The teacher (or another professional physicist) can understand the solution but a non-expert might have some trouble doing so. The solution has some minor shortcuts or some non-explained assumptions. Not every step of the analysis is explained, but it is still possible to follow the author's logic. Some references are missing.	It is hard to follow the solutions. The solution has some major shortcuts or hidden assumptions. There are no references in the texts. The analysis or evaluations of the issues and events are vague. It is either hard or impossible to understand or verify the correctness of the calculations.
<b>Validity (50%)</b>	All calculations are correct. The final values (or plots) are correct and the final interpretation or conclusions are probable.	Small mistake in the answers and/or calculations (e.g., a wrong sign, a missing constant). The final answer is close to the correct value (e.g., it differs by a small factor - twice too large or twice too small; however, the general trend is correct).	Major mistakes in the calculations and/or in the analysis. The final values and/or conclusions are incorrect.

### Final Exam

You will be asked to solve similar problems as those that are included in the weekly problem sets. The official date for our exam is Monday, December 12 from 4.30 to 6.30 pm PST, see <https://classes.usc.edu/term-20223/finals/>.

### Technological Proficiency and Hardware/Software Required

None required.

### Required Readings and Supplementary Materials

We will mainly follow Raymond A. Serway and John W. Jewett, *Physics for Scientists and Engineers with Modern Physics* (10th edition, 2018). If you happened to have an earlier edition, you can use it as well. Just be mindful that the numbering of the chapters can be different. You might be also asked to read additional reading materials (distributed on our Blackboard site of our class).

You can also read other physics textbooks. It might help you to better learn the subject if you read about certain topics from different perspectives. Different textbooks have also different style, you might like how mechanics and thermodynamics is explained in one textbook more than in another. Check what is offered by the USC library - most books offer free electronic access. Go to <https://libraries.usc.edu/>, and search for keywords, such as *Physics*, *Mechanics*, *Thermodynamics*, etc.

## Grading Breakdown

Your final course grade will be based upon four major components

Course Element	Weight
Homework (Problem Sets)	15%
Quiz 1 (Midterm 1)	20%
Quiz 2 (Midterm 2)	20%
Final Exam	25%
Laboratory	20%
<b>TOTAL</b>	<b>100%</b>

In order to receive a passing grade in the course (D or above) you must receive a passing grade in both the lecture and the laboratory portions. Specifically, you must earn a minimum score of 70% on the laboratory portion of the course. Failure to do so will result in an automatic F in the course.

If you miss a lab session due to some emergency, make sure to arrange a lab make-up session as soon as possible with your lab TA.

Additionally, you must turn in at least 75% of all homework assignments (9 out of the 12 assignments that are due). In other words, you can only miss a maximum of three homework assignments. It does not matter how well you will solve the problem set, but a failure to turn in at least 75% of the assignments will result in an automatic F in the course.

## Grading Scale

Both PHYS 151 sections (50380R and 50382R) will have the same laboratory projects, the same midterms, and the same final exam. Therefore, the final grading scale will be determined by the lead instructor of each section as well as the lab director at the end of the semester.

For general information on the grading scale and grading criteria, check the Office of Academic Records and Registrar <https://arr.usc.edu/faculty-staff/grades/grading-correction-of-grades/>, as well as the information included in [the Grade Handbook](#).

## Assignment Submission Policy

Late solutions to problem set solutions will not be graded. The reason is, that after the deadline, we will be posting the solutions to the problems on Blackboard. You will be also allowed to discuss solutions to the problem on our Piazza or using other channels of communication. Thus, if you sent me late work, I won't be able to determine whether your solution is original or not. Therefore, every late submission will automatically receive 0 points. The only benefit is that those

late homework assignments will be treated as “submitted” for the purpose of calculating whether you turned 75% of homework assignments in or not (see the 75% rule above, in the “Grading Breakdown” section).

## Grading Timeline

We will make every effort to grade and return homework within 10 days after it is received. Homework solutions will be either described during the lectures or posted on Blackboard.

## Academic Integrity

You will get an individual grade at the end of this course, thus you shall write answers to any assignments individually as well. As long as the submission period for the problem set is open, you shall not share your solutions. Specifically, on Piazza, before the deadline is due, you are forbidden to explicitly discuss the solutions to the problems. However, if you see that somebody is stuck, you can help your colleague by giving a hint, explaining the concept your colleague struggle with, or suggesting a helpful resource. If you are uncertain whether a particular hint or help is allowed, ask and we will be happy to assess the situation for you.

The fact that I’m asking you to submit individual answers does not mean that you cannot work with other students in the class. On the contrary, I recommend students work together, if possible, in deciding how to solve problems. Of course, working together does not mean simply copying solutions from each other. At the end of the process, each person should write an individual solution.

If you happened to find a solution to a problem in a textbook, on the internet, or in some other resources, you are obligated to acknowledge this by providing a proper citation. You should also clearly indicate which portion of your solution was inspired by some sources (or people) and what is your individual contribution. We acknowledge that it is hard to unseen things that you have seen, so if you happened to find a similar problem with a solution, you should say so. We will not punish honest behavior. However, if we find that you copied a part of your solution without providing an appropriate acknowledgment or citation, we will see this as a violation of academic integrity. Note, that using sources without proper citations is a form of plagiarism and as such, it is a major violation of the university academic integrity standards and will be reported to the Office of Student Judicial Affairs and Community Standards at USC. See the detailed description of what a violation of academic integrity is at <https://sjacs.usc.edu/students/academic-integrity/> and to have an overview of the sanctions and penalties, check [the Appendix A: Academic Dishonesty Sanction Guidelines](#).

I myself would like to acknowledge, that the course description and the course schedule were copied from the syllabus prepared by Dr. Nicolas Moure. Also when writing the above sections, I was heavily inspired by his syllabus. To make sure that the grading policy in our sections is similar, whenever applicable I have copied sentences from his syllabus, adding my own explanations. I also adopted the Additional Policies section from the syllabus of Prof. Allison Hartnett. Finally, I copied the layout of this syllabus from the previous syllabi that I prepared for DSCI 552 and PHYS 304.

## **Additional Policies**

### **Names, Gender:**

If you have a name and/or pronouns that differ from those in your official USC records, please let me know.

If I am mispronouncing your name, please correct me. I am highly empathetic on this point because my given name (Marcin) is pronounced [ˈmɑrtʃɪn] [using the International Phonetic Alphabet](#) and is often mispronounced in the US.

### **Mental Health:**

If you feel that experiences outside of class are impacting your course performance, please come and talk to me. If you would rather consult someone outside the classroom, you might contact the USC Counseling and Mental Health (<https://studenthealth.usc.edu/counseling/>) or the Academic Counseling (<https://undergrad.usc.edu/services/counseling/>) services.

### **Faculty Liaisons:**

All classes in the Department of Physics & Astronomy have an assigned Faculty Liaison (previously called “Course Ombudsman”) to serve students as a confidential, neutral, informal, and independent resource when they wish to discuss issues concerning their course without directly confronting their instructor. The Faculty Liaison for this class is Dr. Jack Feinberg, e-mail: [feinberg@usc.edu](mailto:feinberg@usc.edu), phone 213-740-1134. You can also find him in the SSC 327 (room 327 in the Seaver Science Center).

### **Equity and Diversity and Title IX:**

The Office of Equity and Diversity (OED) and the USC Title IX Office works with faculty, staff, visitors, applicants, and students around issues of protected class: <https://eetix.usc.edu/>. Incidents of bias, hate crimes, and microaggressions can be confidentially reported to: <https://studentaffairs.usc.edu/bias-assessment-response-support/>.

### **Accommodations:**

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. If you have registered accommodations with the Disability Services and Programs Office (<https://dsp.usc.edu/>), please communicate those to me at your earliest convenience so we can discuss your needs in this course. For those on or near campus, DSP is located in STU 301 and is open from 8.30 am to 5.00 pm, Monday through Friday. They can be contacted online or by phone at (213) 740-0776 (Phone), (213) 740-6948 (TDD only), or via email, [ability@usc.edu](mailto:ability@usc.edu).

### **Statement for observance of religious holidays**

USC’s policy grants students excused absences from class to observe religious holidays: <http://orsl.usc.edu>. In this case, please contact your instructor in advance (at least a week in advance) to agree on alternative course requirements.

### **Hybrid Classroom Policies**

Sadly, the pandemic is not over. We should be mindful of the various risks and challenges present this year. By all means, we should protect our health and the health of other people. While the official recommendation of the university is that we should have classes in person, I will do everything possible to offer you a choice, whenever it is possible. While laboratory sessions must be attended in person, I have designed this lecture so it can be delivered in a hybrid format. You are encouraged to attend our in-person classes. However, whenever you feel like your physical presence could put you or others at risk (e.g., you feel like you had a potential exposure - for example, you had a potential exposure, you feel unwell or you had felt unwell sometime in the last 10 days; you have any conditions that puts you at higher risk, etc.), you can also choose to participate remotely. I will stream live our lectures, so you will be able to attend them remotely, in a synchronous way. The setup of the classroom will allow you to not only watch the lecture live but also ask questions, receive answers and interact with other students (via video and via voice). I will do my best to make sure that your learning experience is the same regardless of whether you are in the same room as me, or your participation is remote. All assignments are compatible with the asynchronous learning principles. It means, that even if you must self-isolate, you will have a chance to complete all assignments. If you happened to be in a different time-zone, tell me. Students for whom our course time falls outside the reasonable learning hours<sup>1</sup> in their time zone, don't have to attend our live sessions (Your sleep is important). Instead, you will be able to watch the recorded sessions. You will be able to find the recordings on the Blackboard page of our class.

### **Special Accommodations**

If you need any special accommodations, tell me.

If you are in a situation that prevents you from attending the lectures (either in person or remotely), e.g., the time of the lectures collides with your work or with other obligations (e.g., you are a primary caregiver for a child, elderly parents, or other dependants), please let me know.

### **Camera Policy (For Those Attending Remotely)**

The official Camera Policy can be found at

<https://www.provost.usc.edu/policy-and-guidelines-for-asynchronous-learning/>.

If you attend the class remotely, please know that seeing your faces can help me to gauge if the tempo of the lectures is adequate. Therefore, it would be a great help if you keep your cameras turned on. However, I acknowledge that there might be many reasons why you might wish to keep your privacy. You might also face bandwidth limitations that prevent you from using the camera. Therefore, I encourage the use of virtual backgrounds and earphones/headsets whenever it is possible to mitigate privacy concerns.

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<sup>1</sup> See <https://www.provost.usc.edu/policy-and-guidelines-for-asynchronous-learning/>, specifically the section on the Class Participation and Attendance in Synchronous Sessions.



## Course Schedule: A Weekly Breakdown

	Topics	Readings	Deliverables
Week 1 August 22 August 24 August 26	Dimensional Analysis, Estimation, Vectors and Coordinate Systems, Concepts of Motion, Math Review	Chapters 1 and 3	---
Week 2 August 29 August 31 September 2	1-D Kinematics	Ch. 2	Problem Set 1 (September 2)
Week 3 — September 7 September 9	2-D Motion, Projectile Motion, Circular Motion, Relative Velocity	Ch. 4	Problem Set 2 (September 9)
Week 4 September 12 September 14 September 16	Newton's Laws, Free-Body Diagrams, The Force of Gravity	Ch. 5 and 6	Problem Set 3 (September 16)
Week 5 September 19 September 21 September 23	Applications of Newton's Laws: Multiple bodies, Strings and Pulleys, Friction, Dynamics of Circular Motion	Ch. 5 and 6	Problem Set 4 (September 23)
Week 6 September 26 September 28 September 30	Work and Energy	Ch. 7	<a href="#">Quiz 1 (September 28)</a>  Problem Set 5 (September 30)
Week 7 October 3 October 5 October 7	Conservation of Energy	Ch. 8	Problem Set 6 (October 7)
Week 8 October 10 October 12 —	Momentum and Collisions	Ch. 9	Problem Set 7 (October 12)
Week 9 October 17 October 19 October 21	Rotational Kinematics, Rotational Dynamics	Ch. 10 and 11	Problem Set 8 (October 21)
Week 10 October 24 October 26 October 28	Statics, Gravitation	Ch. 12 and 13	Problem Set 9 (October 28)
Week 11 October 31 November 2 November 4	Pressure, Temperature, Ideal Gases, Calorimetry, Kinetic Theory of Gases	Ch. 18 and 20	<a href="#">Quiz 2 (November 2)</a>  Problem Set 10 (November 4)
Week 12 November 7 November 9 —	Pressure, Temperature, Ideal Gases, Calorimetry, Kinetic Theory of Gases	Ch. 18 and 20	Problem Set 11 (November 11)
Week 13 November 14 November 16 November 18	Thermodynamic Processes, First Law of Thermodynamics	Ch. 19	Problem Set 12 (November 18)
Week 14 November 21	Entropy and the Second Law of Thermodynamics	Ch. 21	

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Week 15 November 28 November 30 December 2	<i>Entropy and the Second Law of Thermodynamics</i>  <i>Review</i>	Ch. 21	
Final Exam December 12	Official Examination Day is Monday, December 12 from 4.30 to 6.30 p.m.  <i>(Final Grading Period ends on December 20)</i>	Ch. 21	

## Student Hours (also known as Office Hours)

I will host an additional 60-minute meeting, on Wednesday from 2 pm to 3 pm. You can access it via Zoom: <https://usc.zoom.us/j/8934576028> (the meeting passcode you will find on our course page on Blackboard). Those Student Hours (also known as Office Hours) are a dedicated time when you can come to ask questions and resolve confusion about course material, as well as discuss career and educational goals as they relate to this course.

No special appointment is needed, however, if you sent me an email a day earlier, announcing a type of question you have, I might be able to prepare a better answer for you in advance. If you have any sensitive questions, you can also contact me via mail, [mjabram@usc.edu](mailto:mjabram@usc.edu) and we can schedule a 1-on-1 meeting via Zoom outside the student hours period. If you attend in-person meetings, you can also chat with me after the class.

## Piazza

We will use Piazza to facilitate discussion between you and your peers and to provide a platform where you can ask questions about homework assignments, midterms, exams, and physics in general. I encourage you to frequently visit <https://piazza.com/usc/fall2022/phys151/home>, if you are confused about something, it is likely that somebody already asked a similar question. We will make effort to promptly answer all your questions.

## Support Systems

*Counseling and Mental Health - (213) 740-9355 – 24/7 on call*

[studenthealth.usc.edu/counseling](https://studenthealth.usc.edu/counseling)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call*

[suicidepreventionlifeline.org](https://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention and Services (RSVP) - (213) 740-9355(WELL), press "0" after hours – 24/7 on call*

[studenthealth.usc.edu/sexual-assault](https://studenthealth.usc.edu/sexual-assault)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED)- (213) 740-5086 | Title IX – (213) 821-8298*

[equity.usc.edu](http://equity.usc.edu), [titleix.usc.edu](http://titleix.usc.edu)

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following *protected characteristics*: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations. The university also prohibits sexual assault, non-consensual sexual contact, sexual misconduct, intimate partner violence, stalking, malicious dissuasion, retaliation, and violation of interim measures.

*Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298*

[usc-advocate.symplicity.com/care\\_report](http://usc-advocate.symplicity.com/care_report)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

*The Office of Disability Services and Programs - (213) 740-0776*

[dsp.usc.edu](http://dsp.usc.edu)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Support and Advocacy - (213) 821-4710*

[uscса.usc.edu](http://uscса.usc.edu)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity at USC - (213) 740-2101*

[diversity.usc.edu](http://diversity.usc.edu)

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

*USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu), [emergency.usc.edu](http://emergency.usc.edu)

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

*USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu)

Non-emergency assistance or information.