Physics 4210
Bennington College
Spring 2025

Special Relativity

(2 credits)

Class Times: Monday/Thursday 1:40pm – 3:30pm *(First 7 weeks)*

Me

Hugh Crowl Office: Dickinson 104 Phone: x4481 Email: hcrowl@bennington.edu

Office Hours: Tuesdays 2-3:30pm, Wednesday 1-2:30pm, *or by appointment*

Text: *Spacetime Physics* (2nd edition) by Taylor & Wheeler (https://www.eftaylor.com/spacetimephysics/)

Course Page: Course material will be posted at https://crowl.bennington.edu/sr/

Course Overview: Classical physics describes the motions of large things moving at slow speeds. That description of the universe, which physicists used to describe the motion of objects from apples to planets for hundreds of years, does not hold for objects moving very fast. In this class, we will look at how traveling close to the speed of light affects the physical properties of objects. Amazingly, simple quantities such as length, time, and mass change dramatically when an object is traveling a significant fraction of the speed of light.

Course Goals: After taking this course, you should have a good understanding of the basics of Special Relativity. Additionally, you will have a more general understanding of the modern picture of physics and how advances in our understanding have supplanted older ideas. This course is an upper-level survey, in that it should serve as a rigorous introduction to the subject and provide an entry point for more detailed work in this area.

Problem Sets: You will be assigned a problem sets roughly weekly. I will accept any problem set as "on time" if it is in to me by the time I start grading that problem set (I will not start grading before the date/time noted on the top of the problem set). They can be turned in either in person to me or to the tray on the wall outside my office door. In general, I will not accept late work. Please see me in extraordinary circumstances *before the problem set deadline*. Failure to turn in one problem set will significantly affect your grade; failure to turn in more than one may result in you not passing the class.

Problem sets in this course are intended to give you a chance to work with the (generally quantitative) aspects of the course. They are also designed to allow you to demonstrate to me that you understand the material. As such, you are required to **show your work** on the problem sets. This allows me to award partial credit where warranted, and to know that you understand the steps you took to reach the answer.

A note on collaboration: With the exception of occasional Individual Problems, collaboration on problem sets is welcome and, in fact, encouraged. One of the best ways to learn something difficult is to work through it with others. However, you should ensure that the work you turn in is your own. Distinguishing between these two different aspects of work can be challenging. A good rule of thumb is to work together to get to the right answer, but then write up the problem set on your own, using your own words. It may take some extra time, but it's a way to minimize the chance of plagiarism and also gives you another chance to really understand the material. If you have any questions, ***please ask.***

Quizzes/Exams: There will be two quizzes during the course and a cumulative exam at the end of the course. The quizzes will generally be short (~30 minutes) and will cover material that we have covered since the last quiz.

Class Participation: There is a huge amount of educational research showing that lecture alone is ineffective in ensuring a deep understanding. In the last couple decades, interactive lecturing has found its way into large lecture classrooms. We're really lucky here at Bennington that we don't need to figure out how to lecture to 200-person classes, but it still makes sense to employ many of the techniques used for those larger classes.

Voting Cards
I will give you a card at the beginning of the term, which allows you to represent one of four choices. There will be several opportunities to vote and confer with your neighbors. These discussions and participating in class voting are an important part of your class participation grade.

In-class Problems
Throughout the course, we will work on problems in class together. This will help you understand how to approach the problems from both a mathematical and conceptual way.

Active Participation in Class
This is a small, upper-level class. I expect everyone in class to ask questions, participate in discussions, help to work on problems, and generally contribute to a positive classroom environment. I recognize that some students are more comfortable doing this than others, but my expectations are that you will contribute to the best of your ability.

Please note that *class attendance is mandatory*. This is particularly important in a 7-week class. Missing even one class can seriously affect your class participation grade. Missing more than 2 classes during the semester may lead to you failing the class. Please see me in extraordinary circumstances.

Please **do not use laptops, tablets, phones, etc.** in class. Taking physics notes using a keyboard is close-to-impossible and these devices can be a distraction. I'm open to individual exceptions where appropriate; please come talk to me.

Academic Accommodations: Bennington College provides reasonable accommodations to students with documented disabilities when such accommodations are requested and necessary to ensure equal access to College programs and facilities. If you believe you are entitled to an accommodation speak with Katy Evans, the Academic Services and Accommodations Advisor, about any disability-related needs. If approved, you will receive a memo detailing your specific accommodations; it is your responsibility to provide me with the memo and discuss the implementation of accommodations. Note that I will not be aware of your needs if you do not share this memo with me. Accommodations are not retroactive, so the sooner we meet to discuss your needs, the better. Also, students experiencing mental and/or physical health challenges that are significantly impacting their academic work are encouraged to speak with their faculty advisor and member of Academic Services (academicservices@bennington.edu or 440-4400) about the impact and to connect with resources through health and psychological services (440-4426 or 440-4451).

Evaluation/Grading (subject to tweaking)**:**
Quizzes: 25% Exam: 25% Problem Sets: 35% Class Participation: 15%

Tentative Schedule (likely to change)

Week of	Topic	Reading
February 17	Spacetime	Ch. 1 & 2
February 24	Spacetime (cont.)	Ch. 1 & 2
March 3	Frames	Ch. 3
March 10	Lorentz Transformations (*No Thursday Class*)	Ch. "L"
March 17	Lorentz Transformations (cont.) /Twin Paradox	Ch. 4 & 5
March 24	Regions of Spacetime/Momenergy	Ch. 6, 7, & 8
March 31	Basics of General Relativity / Exam (Thursday, April 3)	Ch. 9