Physics 490 Senior Seminar: Capstone Spring 2025

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Class Mtgs: MWF 8:30-9:30 (TREX 272)
Office Hrs: T/Th 2:00-3:30
(15 min appts via calendly.com/daniel_robb)

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Course Description:

This is a capstone course that captures the essence of what a Physics major is expected to know. The following is taken from the Roanoke College mission statement for students majoring in physics: *"Students majoring in physics are provided with a curriculum that emphasizes a balance of breadth and depth of knowledge of the field. Physics students learn to address real-world problems through a curriculum that provides a balance between sound theoretical frameworks and practical expertise. Graduates are well prepared for traditional and non-traditional career paths and are capable of contributing broadly to the global scientific community."*

Textbooks:

- *Physics for Scientists and Engineers (with Modern Physics),* by Serway and Jewett, 9th edition *[or an equivalent intro textbook including modern physics]*

Purpose of the Course:

The purpose of the course is to review and synthesize your knowledge of introductory physics, to work as a team on a meaningful demonstration project, and to become acquainted with the physics research literature.

Specific Goals of the Course:

1) To be conversant with the laws of physics and to be able to apply them to solve problems.
2) To design and demonstrate understanding of the laws of physics through experimentation.
3) To learn to read and discuss selected articles from the physics research literature.

Feedback and Evaluation:

I will assign numerical grades to all your work. I *may* curve your final grades (upward), but otherwise you can expect to receive an A for a 93-100 numerical semester average; A- for 90-92; B+ for 87-89; B for 83-86; B- for 80-82; C+ for 77-79; C for 73-76; C- for 70-72; D+ for 67-69; D for 60-66; F for 0-59. These are the categories and percentages that will be used:

Review Material (group):	20%
Oral Exam (individual):	10 %
Demo project (group):	20 %
MCSP reflections/Resume (ind.):	10 %
Article presentation (group):	20 %
Article discussions (individual):	5 %
Final Paper (individual):	15 %

Review Material will consist of groups presenting (teaching) the introductory topic(s) for the day to the rest of the seminar class. You will be divided into teams of 2-3 students. You must all participate in explaining the material to the class, and in engaging the class in some relevant activity (problem-solving, question and answer, discussion, etc.). Note you do not have to cover every detail or subtopic of the day's material from the textbook, but you should cover the main ideas well.

The Oral Exam will consist of a 30-45 minute individual session with at least two of the physics professors, in which we ask you to solve and explore several introductory problems on the board. You can expect one problem from mechanics, one problem from electricity and magnetism, and one problem from modern physics. If you get stuck on something, we will prompt and assist you.

Demo project After changing groups into new groups of 2-3, you will conceive of and build a piece of demonstration equipment to illustrate a physics concept. You'll first turn in a proposal for approval by me, then work together to build and troubleshoot the piece of equipment, and finally demonstrate it to the rest of the class near the end of the semester.

MCSP Reflections/Resume The MCSP department offers a series of talks that appeal to a broad range of interests related to math, computer science and physics. Members of this class are invited to attend all these talks; however, attendance for **at least two** of these talks is mandatory. Within **one week** of attending a talk you must submit (via a link on Inquire) a full-page single-spaced paper reflecting on the discussion. (Note that for recorded talks, you may submit your reflection beyond the one-week deadline.) This should be not only a summary of the content, but in addition a personal contemplation of the experience. You will also be expected to create a draft of your resume as part of our discussion of career options for physics majors.

Article presentation After changing groups a second time, again into groups of 2-3, you will choose a recent research article from a group of articles I will supply to you. You will work as best you can to understand the article, and then lead a discussion of the article with the rest of the class.

Article discussion You are expected to participate actively in the discussion of the articles led by other groups. In order to participate, **you are responsible for reading the articles being presented by other groups before their presentation.**

Final paper: For your final paper, you will write a report in which you explain and explore one of the articles presented by a different group in the class. The final paper should be 4-5 pages in length, should be double-spaced, and should attempt to connect the physics in the article with the introductory physics we have reviewed this semester to the greatest extent possible.

Policy on Late Work:

It benefits you, especially as you move toward employment or further studies in graduate school, to be timely and punctual with your work. Assignments will be due at the start of class on the due date. I will grade an assignment with a 10% lateness deduction if turned in by 5:00PM on the due date. Following that, assignments will receive a further 20% lateness deduction for each successive school day late (with days considered to end at 5:00 PM). Assignments more than three days late will receive no credit.

Attendance Policy:
You must notify me in advance if you must miss class for a valid reason (an excused absence). For each unexcused absence past the third, two points will be deducted from your final semester average.

Expected Hours of Work
In this course, you are expected to spend at least 12 hours per week inside and outside of class.

Academic Integrity:
To ensure fairness in grading across the class, the College academic integrity policies are enforced. You should work solely within your group (and potentially with me or a Writing Center tutor) on group projects, and on your own (and potentially with me or a Writing Center tutor) for all other assignments. If you are in doubt about whether a specific collaboration is allowed, please ask me.

Regarding the use of generative AI tools such as ChatGPT, since a central goal of college courses like this one is to help you become independent and critical thinkers, you are discouraged from the extensive use of generative AI tools to create text as part of your work. If you do use AI-generated content in your assignments, you must clearly indicate via citation what work is yours and what part is generated by the AI. In such cases, no more than 20% of your work should be generated by AI. Any AI-generated work not cited and/or used for more than 20% of your assignment will be treated as though it were plagiarized. If any part of this policy on generative AI use is confusing or uncertain, please reach out to me for a conversation before submitting your work.

Accessible Education Services:
Accessible Education Services (AES) is located in the Goode-Pasfield Center for Learning and Teaching in Fintel Library. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Dustin Persinger, Assistant Director of Academic Services for Accessible Education, at 540-375-2247 or by e-mail at aes@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Dustin Persinger at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

Writing Center:
The Writing Center @ Roanoke College, located on the Lower Level of Fintel Library (Room 15), offers free tutorials focused on writing projects and oral presentations for students working in any field. Writers and presenters at all levels of competence may visit the Writing Center at any point in their process—including brainstorming, drafting, organizing, editing, or polishing presentation skills—to talk with trained peer tutors in informal, one-on-one sessions. The Writing Center is open Sunday through Thursday from 4 to 9 PM. Simply stop in, or schedule an appointment at www.roanoke.edu/writingcenter. Questions? Email writingcenter@roanoke.edu or call 540-375-4949.

Week	Date	Topic	Assignments due
1	13-Jan	Introduction and overview	
	15-Jan	Review PSE Ch 1-3 (1-d motion, vectors)	
	17-Jan	Review PSE 4-6 (2-d motion, Newton's Laws)	
2	20-Jan	MLK Day: No class	
	22-Jan	Review PSE 7-9 (conserv. energy, linear momentum)	
	24-Jan	Review PSE 10-12 (rotation, ang. momentum, statics)	
3	27-Jan	Review PSE 13-15 (gravity, fluids, oscillations)	
	29-Jan	Review PSE 16-18 (sound waves, standing waves)	
	31-Jan	Review PSE 19-20 (1st law and gases)	
4	3-Feb	Review PSE 21-22 (engines and entropy)	List of demo project ideas
	5-Feb	Review PSE 23-25 (electric fields and potential)	
	7-Feb	Review PSE 26-28 (capacitance, resistance, DC circuits)	List of physics careers
5	10-Feb	Review PSE 29-31 (magnetic fields, Faraday's Law)	
	12-Feb	Resume building with Career Center	
	14-Feb	No class	
6	17-Feb	Review PSE 32-34 (inductance, AC circuits)	
	19-Feb	Review PSE 39 (relativity)	Resume/CV draft
	21-Feb	Review PSE 40 (intro quantum physics)	
7	24-Feb	Review PSE 41 (quantum mechanics)	
	26-Feb	Review PSE 42 (atomic physics)	Demo project abstract
	28-Feb	Demo project draft presentation	
8	3-Mar	**Spring Break No classes**	
	5-Mar		
	7-Mar		
9	10-Mar	Oral Exams / Demo Project Work	
	12-Mar	Oral Exams / Demo Project Work	
	14-Mar	Oral Exams / Demo Project Work	
10	17-Mar	Oral Exams / Demo Project Work	
	19-Mar	Oral Exams / Demo Project Work	
	21-Mar	Overview of physics research literature	
11	24-Mar	Selection of research articles by groups	
	26-Mar	Work on article reading/presentations	
	28-Mar	Article 1 presentation/discussion	
12	31-Mar	Article 2 presentation/discussion	
	2-Apr	Article 3 presentation/discussion	
	4-Apr	Final paper work/Demo project work	Final paper topic
13	7-Apr	Final paper work/Demo project work	
	9-Apr	Final paper work/Demo project work	
	11-Apr	Final paper work/Demo project work	
14	14-Apr	Demo Project Presentations	Rough draft of final paper
	16-Apr	Demo Project Presentations	
	18-Apr	**GOOD FRIDAY: NO CLASS**	
15	21-Apr	Receive commented drafts	Demo project documentation
	22-Apr	No class	
16	24-Apr	Final Paper Due (No Written Final Exam)	

Note: Chapters indicated as PSE are from Physics for Scientists and Engineers, Serway/Jewett, 9th Ed.