PHYS 203: Modern Physics
Syllabus - Spring 2022

Location: Miller Hall 012 (starting Jan. 31)
Instructor: Dr. Daniel Hickox-Young
Office Hours: MWF 1:00-3:00pm;
Also available via Zoom as needed

Time: MWF 12:00-1:00pm
E-mail: hickoxyoung@roanoke.edu
Office: Trexler 266B
Phone: (540) 375-4975

Virtual Classroom:
https://roanoke-edu.zoom.us/j/85765802500?pwd=dy8wNVl2MnY2THdrZzY0czdCTHBaUT09

Meeting ID: 857 6580 2500
Passcode: PHYS203

Masks: The College has issued a mask mandate for the start of the semester that requires masks to be worn in indoor common spaces such as our classroom. You must wear a mask in this class. If you arrive without a mask, you will not be allowed to stay and may lose credit for attendance or in-class work. The Bookstore sells masks if you need to make a quick purchase. If the mandate is extended, you will be required to continue to wear a mask.

Office Hours: Office hours will be held in-person in Trexler 266B. If you are unavailable during office hours, feel free to stop by any time my door is open. I'm also happy to meet by appointment via zoom using the link provided below (also linked on Inquire) if you prefer.
https://roanoke-edu.zoom.us/my/hickoxyoung
Meeting ID: 848 844 3643
No Passcode is required.

If you are unable to meet during office hours, I'm also happy to meet by appointment. To schedule a meeting, either send me an email (especially if you need to meet outside normal working hours) or use this link: https://calendly.com/hickoxyoung

Course textbook:
Modern Physics for Scientists and Engineers (4th ed.) by Thornton and Rex,
ISBN-13: 978-1133103721

Other required materials: You will need a writing utensil and paper as well as a working scientific calculator for class sessions, assignments, and exams. You will also need a bound notebook with graph paper pages for the lab section of this class (see the lab syllabus for more details).

Course Description: Special relativity, particle properties of waves, wave properties of particles, Heisenberg uncertainty principle, Bohr theory, elementary quantum theory and its application to the hydrogen atom. We will also survey selected applications of special relativity and quantum mechanics.

Learning Outcomes: Upon successful completion of the course, students will:

- Attain a clear understanding of the main concepts of special relativity and quantum mechanics.
- Appreciate the problems within classical physics that led to the development of these theories.
- Understand the relevance of the two theories to modern science and technology.

Required Laboratory Course: You must be enrolled in the laboratory portion *PHYS 203L* of this course. Although PHYS 203L operates as a separate course, it counts as 25% of the course grade for PHYS 203. Please refer to the lab course syllabus for important information about the lab specifics and final grade. Note that if any lab experiment is not completed by the end of the semester, your course grade will be reduced by one whole letter grade.

Attendance Policy: If you have a temperature of 100.4 or higher or other COVID symptoms, don't come to class. Call Health Services IMMEDIATELY. Do not come to class or go to any public area on campus. In order for your absence to be excused, you must give Health Services permission to notify me that you have consulted them about COVID symptoms. If Health Services informs you that you should isolate and not attend class for multiple days, inform me so that we can make a plan to keep you current in the course. All absences caused by consultation with Health Services about coronavirus symptoms or isolation ordered by Health Services will be excused but you will need to do the work and graded assignments even if we extend a deadline for you.

Formal attendance will not be taken in this class. However, I will be assessing your participation in the course based on your engagement with the practice problems we engage with during each class. You are fully responsible for the material that was covered and for any announcements made during class meetings. As with problem sets (details below), in order to receive participation credit for a class you have to be absent for, you must discuss the details with me either in person or via email at least 24 hours in advance.

Feedback and Evaluation:
Letter grades will be assigned at the end of the semester according to the following scale

A-	90-92	A	93-100		
B-	80-82	B	83- 86	B+	87-89
C-	70-72	C	73- 76	C+	77-79
D-	60-62	D	63- 66	D+	67-69
F	<60				

Grades *may* be curved at the end of the semester (only upward, never downward) but otherwise you should expect your grade to follow the scale above. You should expect to spend at least 12 hours inside and outside of class each week on this course. You will be assessed according to the following categories:

Preparation:	10%	Participation:	15%
Problem Sets:	25%	Tests:	20%
Final Exam (Presentation):	10%	Lab:	20%

Preparation will consist of watching a pre-recorded lecture, and will be evaluated via straightforward quizzes given at the beginning of selected class periods. Preparation is important

because it enables you to participate actively in the collective group problem-solving (see next item).

Participation will consist mainly of collective group problem-solving on several problems per class. I will be lecturing very little during class, and relying on your viewing of the pre-recorded lectures and your collective work on these problems to absorb the material. You will rotate through groups of two or three as the semester progresses, getting to work with all (or nearly all) other members in the class – valuable experience in learning to work with others with different problem-solving styles and personalities. You are not required to solve each problem in the time allotted, but to put in a strong effort, at which point the solution will be revealed and discussed. Note that MCSP write-ups (see below) also form a portion of the participation grade (5 of the 15%).

Problem sets will be due at the start of class, and should reflect your individual effort, with collaboration only at the level of general concepts. Every effort will be made to return them within one week, and solutions will be posted online.

The three tests will involve problems similar in difficulty to those in the problem sets. They will include several conceptual questions, in short-answer format, as well as several calculation questions.

The final exam will consist of an oral presentation on an extension of course material to an advanced topic in modern physics (likely drawn from the later chapters in our textbook), in four groups of either of students. One week (three class days) will be devoted to researching the project, and the final class day to preparing the presentation. Each group member should speak approximately an equal amount during the presentation, which takes place during our final exam period.

MCSP Conversation Series/Extra Credit: You are required to attend AT LEAST TWO talks in the MCSP Conversation Series which (schedule available at https://www.roanoke.edu/inside/a-z_index/math_cs_and_physics/conversation_series/spring_2022) and submit a well-written reflection on the talk within one week of the presentation (with the exception of recorded talks, which can be reflected on at any time throughout the semester). The submission must present a brief summary of the key ideas of the talk and include a description of the parts of the presentation that were interesting, confusing, and relevant to this course. Your work must be grammatically-correct, typed, double-spaced, and approximately one page in length. Note that a simple summary of the talk is not sufficient to receive credit. A guided reflection form is available on Inquire to help you decide what to write about.
Your reflection on the MCSP talk will contribute to your participation grade. For extra-credit, you may attend additional MCSP talks during the semester, and the submitted reflection(s) will contribute to your overall grade.

Use of Electronic Devices: Laptops or tablets may be used for note-taking during regular class sessions, if this seems useful to you. Scientific calculators can also be used during class when needed and during exams. Use of laptops, tablets, or cell phones during exams is prohibited.

While in class, your phones must be on silent mode and out of reach to limit distractions and must be turned off during exams.

Subject Tutoring: located on the lower level of Fintel Library (Room 5), is open 4-9 PM, Sunday-Thursday. Subject Tutors are highly trained, current students who offer free, one-on-one (and small group) tutorials in over 80 courses taught at Roanoke College. Check out all available subjects and schedule 30- or 60-minute appointments at www.roanoke.edu/tutoring. If you have a question, feel free to stop by, or contact us at subject_tutoring@roanoke.edu or 540-375-2590. See you soon!

Accessible Education Services (AES): 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 Becky Harman, 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 Becky Harman at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.

Academic Integrity: Your learning and integrity are at the core of your RC education. For this reason, you must follow the rules outline in the College's AI policies. See https://www.roanoke.edu/inside/a-z_index/academic_affairs/academic_integrity. Collaboration is an important skill that you will be asked to develop in class and in lab, and I would encourage you to extend this practice beyond the classroom as you work on problem sets. However, all specific problem-solving work turned in for a grade must be your own. Please familiarize yourself with the College's academic integrity policies.

Policy on Late Work: For problem sets, 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 10% lateness deduction for each successive school day late (with days considered to end at 5:00 PM). You may receive an exception to this policy by requesting an extension at least 24 hours prior to the due date.

Make-up Tests: Make-up tests may be given only under unusual circumstances. If you miss a test, and have an official college excuse for that absence, then I will generally be willing to arrange for a make-up test.

Class Environment: I consider this classroom to be a place where we will treat one another with respect, creating an environment that welcomes individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records.

PHYS 104: Fundamental Physics II, Spring 2022- Daily Schedule

The following schedule outlines the tentative timeline for the covered topics and exam dates:

Day	***Topic***	***Reading***	***Due***	***Laboratory (On Tuesdays)***
UNIT 1: Unexpected Experiments				
19 Jan	Introduction to the course	--		HPS 1: Imagination and Creativity
21 Jan	Classical physics	1.1-1.3		
24 Jan	Atomic theory, & unresolved questions	1.4-1.6		
26 Jan	The Electron and Its Charge	3.1-3.2		Lab 1: e/m ratio
28 Jan	Line spectra	3.3-3.4		
31 Jan	Blackbody radiation	3.5		
02 Feb	Photoelectric effect	3.6	PS 1	HPS 2: Robert Millikan, in perspective
04 Feb	Compton effect	3.8		
07 Feb	Rutherford scattering	4.1-4.3		
09 Feb	The Bohr model	4.4-4.5	PS 2	Lab 2: Photoelectric Effect
11 Feb	Review/catchup			
14 Feb	**TEST 1**			
UNIT 2: Quantum Theory				
16 Feb	De Broglie waves and scattering	5.1-5.3		HPS 3: Planck and Bohr, in perspective
18 Feb	The Uncertainty Principle	5.4-5.6		
21 Feb	Probability and wavefunctions	5.7-5.8		
23 Feb	The Schrodinger equation	6.1		Lab 3: Young's 2 Slit (w/ Error Analysis)
25 Feb	Expectation values	6.2		
28 Feb	Infinite square wells	6.3, 6.5		
02 Mar	Barriers and tunneling	6.7	PS 3	HPS 4: Interpretations of QM
04 Mar	Alpha decay and scanning microscopes	6.7		
07-11 MAR – SPRING BREAK				
14 Mar	The hydrogen atom	7.1-7.2		
16 Mar	Quantum numbers	7.3		Lab 4 Function Generator/Oscilloscope
18 Mar	Magnetic effects and intrinsic spin	7.4,7.5	PS 4	
21 Mar	Review/catchup			
23 Mar	**TEST 2**			Lab 5: Circuits/Oscillators/Oscilloscopes
UNIT 3: Special Relativity				
25 Mar	The ether and Michelson-Morley	2.1-2.2		
28 Mar	Einstein postulates; Lorentz transformation	2.3,2.4		
30 Mar	Time dilation and length contraction	2.5,2.6		HPS 5: Einstein and Michelson-Morley
01 Apr	Experimental verifications	2.7		
04 Apr	The twin paradox and spacetime	2.8,2.9		
06 Apr	Relativistic momentum and energy	2.11,2.12		Lab 6: Speed of Light I and II
08 Apr	Relativistic collisions	2.11,2.12	PS 5	
11 Apr	Review/catchup			
13 Apr	**TEST 3**			Speed of Light Labs (cont'd)
15 APR – GOOD FRIDAY – NO CLASS				
18 Apr	Research on final topic in groups			
20 Apr	Research on final topic in groups			Lab 7: Radioactivity, Electron
22 Apr	Research on final topic in groups			Diffraction, Oil Drop Experiment
25 Apr	Research on final topic in groups			
26 Apr	Preparation of final presentations			
02 May	***2:00pm-5:00pm***	***Final Presentation***		