



## PHYS 128, Fall 2020

### Waves and Quanta

**Modality:** MXD

Remote meeting on MS Teams;

In person, W only, E330 Innovation Hall (see attendance schedule below)

**Meeting Times:**

Lecture: MWF, 9:40-10:30, INNOVATION E330 and/or online

Lab: TBD, DISCOVERY W403



**Instructor**

Malcolm Sanders

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Office: E-203B Innovation Hall

Office Hours: R, 9:00-11:00 or by appointment

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**Course Description:** Topics covered include special and general relativity, particles and waves, introduction to quantum mechanics, atomic physics, statistical mechanics, molecules and solids. There will be three 50 minute lectures per week on Monday, Wednesday and Friday starting at 9:40 am. These lectures will be delivered via MS Teams, and the sessions will be recorded and made available on Blackboard after the lecture. I hope we can meet in person for lecture at least once a week, on Wednesdays, in INNOVATION 330. Please follow all UVM health advisories if you come to lecture in person. See Course Outline below for a weekly listing of topics, activities, and important dates. Laboratory activities are mandatory and they will take place in W403 Discovery. We'll work out individual lab schedules once the semester is underway. But the gist of it is that each student will need to block out a 2 hour chunk of time to complete the lab work. **Safety is a priority. During labs, negligent or deliberate misuses of the equipment will not be tolerated, and may result in an F for the assignment or entire course.** I recommend that you install Mathematica on a computer that you have access to. UVM has a site license for Mathematica, and it can be downloaded from the UVM Software Archive. (<http://www.uvm.edu/it/software/>)

**Prerequisite(s):** Math 121 (Calculus III), and either Physics 125 (Physics for Engineers II) or 152 (Fundamentals of Physics II).

**Credits:** 4

**Text:** *Modern Physics*, 2<sup>nd</sup> Edition

**Author:** Randy Harris; **ISBN-13:** 978-0-8053-0308-7

**Online Communication Resources:**

All students must have reliable access to the University of Vermont Blackboard course website. (bb.uvm.edu) This access requires internet connection, which is free of charge for all UVM students while on campus. You will need your UVM net ID and password to log into the Blackboard system

and MS Teams. All supplementary course materials, course updates and announcements will be made via the Blackboard system. **It is the student's responsibility to check his/her UVM email and Blackboard course website for updates at least once a day!**

**Materials:** Pocket calculator with trigonometric functions, scientific notation and exponential functions. Laboratory notebook. Desktop computer, tablet or laptop, with front facing webcam and microphone to participate in Teams, and to interact with LearningCatalytics during lectures. You may purchase a LearningCatalytics pass for a modest fee online (<http://www.learningcatalytics.com>).

You will also need to sign up for our course at [gradescope.com](https://gradescope.com) (no charge). You will submit your weekly homework assignments to gradescope.

### **Homework:**

Homework will be assigned during Wednesday class meetings and will be due the following Wednesday by the beginning of class, unless otherwise stated. The logical development of the theory and the problem solving depend heavily on what has come before. For this reason, it is imperative that you keep current; don't fall behind. Homework is considered to be late at the beginning of the class period when it is due. On all homework assignments, it is your responsibility to *clearly* express your solution to the problems. Any ambiguity in the handwriting or the logical progression of your solutions are open to interpretation and therefore may be considered wrong. It is not sufficient only to solve the problem correctly. You must also convince the reader that you have solved the problem correctly. Please either prepare your assignments on a computer, or else scan all handwritten pages of the homework assignment and submit as a single PDF file to the assignment dropbox on gradescope. The following policy will apply to the maximum possible score for each homework assignment:

On time	100%
One class session late	80%
More than one class session late	0%

### **Labs:**

There will be approximately weekly lab sessions in DISCOVERY W403. **Safety is a priority. During labs, negligent or deliberate misuses of the equipment will not be tolerated, and may result in an F for the assignment or entire course. Also, all students must follow the University guidelines for prevention and mitigation of COVID-19** Download and read the weekly lab instructions prior to arrival in lab. A pre-lab quiz will be on the Blackboard each week and must be completed before lab begins. Attendance in labs is mandatory and make-up sessions will only be granted for students with legitimate excused absences or for groups who identify problems with data gathered during scheduled lab sessions where full effort was given to the lab material. Catching honest mistakes is a very beneficial skill in experimental science. Lab reports should be typed, and contain computer-generated figures and tables. They should contain the following sections: Abstract, Introduction, Experimental Details, Results and Discussion, and Conclusion. Tables and figures should be labeled, and references to appropriate papers are always welcome. I highly recommend the use of L<sup>A</sup>T<sub>E</sub>X typesetting language. Please ask me for more information if you are interested in the free software compilers and some introduction. Lab reports are due by 9:40 AM on the Monday following the lab experiment, and must be submitted as a PDF file on Blackboard.

### Exams:

There will be two mid-term exams and one final exam. The mid-term exams will cover the most recent material preceding the exam, and the final will be cumulative with an emphasis on the content covered during the last four weeks of the semester. Final Exam will be on Thursday, Dec. 10, from 7:30 to 10:15 a.m.

### Class Meetings, Participation and Attendance:

Physics 128 is listed as a MIXD class this semester. What this means for us is that there will be a MS Teams meeting for every MWF lecture session. The lectures on Mondays and Fridays will be entirely remote, but you are welcome (but not required) to attend each Wednesday lecture in person in INNOVATION E330. If you attend in person, you must observe all the proper COVID-19 protocols. In person attendance for Lab is required.

The course will have daily group activities and concept questions delivered via LearningCatalytics(LC) Some of the LC questions will be conceptual, or trivia-based in nature and will be graded on participation. Some will be based on assigned reading and will be graded for correct answers. I will make the distinction as clearly as possible. Your LC responses will indicate your attendance in the class. I will not count your first three absences against your participation grade. Absence during a mid-term exam will result in a score of 0, unless written justification from a doctor, police officer, dean, coach, or other suitable authority figure is provided. In such cases, a date will be scheduled for a make-up exam. Absence during the final exam will result in a grade of 0. There will be no make-up opportunities for the final exam.

### Course Grades:

Each student will receive a total grade based on the grades of the exams, homework, laboratory work, and class participation. The individual components will be scaled and converted to letter grades according to:

Mid-terms	20% (10% each)
Final exam	20%
Laboratory work	25%
Homework	25%
Class participation (Learning Catalytics)	10%

A	=	90 - 100%
B	=	80 - 89.9%
C	=	70 - 79.9%
D	=	60 - 69.9%
F	=	59.9% or below

All grades will be posted on Blackboard to ensure privacy. It is each student's responsibility to verify the accuracy of the postings regularly. **Report any discrepancies promptly.**

### Academic Dishonesty Disclosure:

Academic dishonesty **will not be tolerated.** Perceived failures to abide by the standards of academic integrity will be prosecuted as set forth in the University of Vermont Code of Academic Integrity. The code states the four standards of academic integrity; that students may not plagiarize, fabricate, collude, or cheat. Note that there is a great but subtle difference between collusion

and collaboration. Collaboration is one of the greatest tools for learning and creativity in science, and is highly encouraged on homework assignments. This will help you to expand your perspective and your arsenal of problem solving techniques. Exams, however, will be a purely individual effort.

## Disability Services

In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact ACCESS, the office of Disability Services on campus. ACCESS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty to discuss the accommodations they plan to use in each course. A student's accommodation letter lists those accommodations that will not be implemented until the student meets with their faculty to create a plan. Contact ACCESS: A170 Living/Learning Center; 802-656-7753; access@uvm.edu; or www.uvm.edu/access.

## Course Outline

Week	Dates	Reading/Topic	Lab	Events
1	Aug. 31 - Sept. 4	Ch 2: Relativity	No Lab	
2	Sept. 7 - Sept. 11	Ch 2: Relativity	Orientation	Labor Day, Mon. Sept. 7 No Class
3	Sept. 14 - Sept. 18	Ch 2: Relativity	Speed of Light	Add/Drop Mon. Sept 9
4	Sept. 21 - Sept. 25	Ch 3: Waves & Particles 1	No Lab	<b>Midterm, Wed. Sept. 23</b>
5	Sept. 28 - Oct. 2	Ch 3 and Ch 4	Photoelectric Effect	
6	Oct. 5 - Oct. 9	Ch 4: Waves & Particles 2	Microwave Diffraction	
7	Oct. 12 - Oct. 16	Ch 5: Bound States	Electron Diffraction	
8	Oct. 19 - Oct. 23	Ch 5: Bound States	Bohr Model	
9	Oct. 26 - Oct. 30	Ch 6: Unbound States	No Lab	<b>Midterm, Wed. Oct. 28</b>
10	Nov. 2 - Nov. 6	Ch 7: Quantum Mechanics in 3D	Franck-Hertz	Last Day to Withdraw, Mon. Oct. 28
11	Nov. 9 - Nov. 13	Ch 8: Spin & Atomic Physics	Diodes	
12	Nov. 16 - Nov. 20	Ch 9: Statistical Mechanics	Hall Effect	
13	Nov. 23	Ch 10: Molecules & Solids	No Lab	Thanksgiving Break no classes W 11/25 and F 11/27
15	Nov. 30 - Dec. 4	Ch 10: Molecules & Solids	No Lab	<b>Final Exam, Thurs. 12/10 7:30 - 10:15am.</b>

## Homework Assignments

Assignment #	Date Assigned	Due Date	Problems
<b>1</b>	Aug. 31	Sept. 9	<b>Ch. 2:</b> 19, 22, 23, 26, 36, 37
<b>2</b>	Sept. 9	Sept. 16	
<b>3</b>	Sept. 16	Sept. 23	
<b>4</b>	Sept. 23	Sept. 30	
<b>5</b>	Sept. 30	Oct. 7	
<b>6</b>	Oct. 7	Oct. 14	
<b>7</b>	Oct. 14	Oct. 21	
<b>8</b>	Oct. 21	Oct. 28	
<b>9</b>	Oct. 28	Nov. 4	
<b>10</b>	Nov. 4	Nov. 11	
<b>11</b>	Nov. 11	Nov. 18	
<b>12</b>	Nov. 18	Dec. 2	
<b>13</b>	Dec. 2	Dec. 6	