University of Maryland
Department of Physics

Spring 2018 Prof. Steven Anlage Physics 371

Title:
Physics 371: Modern Physics The fourth semester of the introductory sequence for physics majors. Introduces students to special relativity, thermodynamics and quantum mechanics at an introductory level. Credit only granted for: PHYS371 or PHYS420. This is a 3-credit course.

Prerequisite: PHYS273 and PHYS274.
Corequisite: PHYS373

Instructor:
Prof. Steven Anlage, Room 1363 (Physics/CNAM). You can find the CNAM either by 1) going through the blue door labeled "Center for Nanophysics and Advanced Materials" in the basement of the Toll physics building, or 2) entering from the plaza between the Math and Toll Physics buildings.
Phone: 5-7321, e-mail: anlage@umd.edu, web site: anlage.umd.edu

Schedule:
Two lectures weekly,
TuTh 9:30am - 10:45am (PHY 1204)

Required Texts:
1) Raymond A. Serway, Clement J. Moses, Curt A. Moyer, Modern Physics, 3rd Edition (ISBN-13: 978-0534493394, ISBN-10: 0534493394
2) Stephen J. Blundell and Katherine M. Blundell, Concepts in Thermal Physics, 2nd Edition (ISBN: 978–0–19–956210–7).

Although NOT required, additional material on relativity and modern physics can be found in this text:
Paul A. Tipler and Ralph A. Llewellyn, Modern Physics, 5th Edition (ISBN-13: 978-0-7167-7550-8, ISBN-10: 0-7167-7550-6). Note that this is NOT the latest edition!

Lectures:
You will be responsible for material presented in lecture that is not in the book. If you miss a lecture you are responsible for finding out from a classmate what we did in class.

Homework:
The homework assignments will be given on the class website. The assignment will be due at the beginning of class on Thursdays. Please staple papers and show your name, assignment number and date due. Two homework problems will be graded quantitatively (0-10) and the rest will be graded qualitatively (0-2). The choice of the two problems to grade quantitatively will be made *after* the homework is collected.

Doing the homework is a very important part of this course! Homework will be returned by the following week. Late homework will not be accepted. As compensation, the lowest homework grade from the semester will be dropped.

Quizzes:
There will be quizzes every week on the day that the homework is due. The quiz will be on a topic related to the homework turned in that week. There are NO makeup quizzes. As compensation, the lowest quiz grade from the semester will be dropped.

Exams:
There will be two "mid-term" exams and a final exam. All exams will be counted towards your final grade. Make-up exams (for any of the exams) must be requested well in advance of the exam; the reason for the absence must be documented and in accord with University policy (see p. 33 of http://www.umd.edu/catalog/0607/chapter4.pdf). If an exam is unexpectedly canceled (due to inclement weather, etc.) it is automatically rescheduled for the next class period.

In grading, we are looking more at the reasoning that you use, rather than the final number you arrive at. So remember to carefully set up the problem on paper, even if you cannot see the way through to the solution.

The final exam is Monday, May 14 from 8 to 10 AM.

Computers

Developing a working knowledge of computers in the context of physics problem solving is an important skill. You are encouraged to solve problems using programs such as Mathematica. Note that a student version of Mathematica is available for download from TERPware: http://terpware.umd.edu/Windows/Title/1837

Final Grade:

Based approximately on homework (~20%), quizzes (~15%), mid-terms (~40%), and final (~25%).

Academic Dishonesty (cheating):

Academic dishonesty is a serious offense that may result in suspension or expulsion from the university. In addition to any other action taken, the normal sanction is a grade of "XF", denoting "failure due to academic dishonesty," and will normally be recorded on the transcript of the offending student. Note that general university course policies are posted at http://www.ugst.umd.edu/courserelatedpolicies.html.

Undergraduate Policies and Rights

Here is a link to the Office of Undergraduate Studies Course Policies for Undergraduates http://www.ugst.umd.edu/courserelatedpolicies.html

Office Hours

You are strongly encouraged to attend office hours to ask questions, discuss the homework problems, and talk about physics in general. The office hours will be held 4:00-5:30 PM on Wednesdays, just before the homework is due.

Class Web Site:

http://www.physics.umd.edu/courses/Phys371/AnlageSpring18/

Tips For Doing Well In This Course:

1) Read the assignment in the book *before* and *after* the material is covered in lecture.

2) Freely ask questions in lecture, after lecture, and during office hours. Also discuss problems with your friends and classmates.

3) Work all of the homework questions and problems. You are allowed and encouraged to discuss homework with anyone you wish. However, in order to really learn, don't just copy solutions from somewhere or someone else; rather, work through them in detail yourself. Afterwards, make use of the solution sets, your TA's office hours, and me to make certain you understand all of the solutions. The exams will sometimes involve homework problems.

4) Seek help immediately if you do not understand the material or can't solve the problems. Help is available from your TA, and from me. Don't wait until just before the exams! If you are experiencing difficulties in keeping up with the academic demands of this course, contact the Learning Assistance Service (http://www.counseling.umd.edu/las/). Their educational counselors can help with time management, reading, note-taking and exam preparation skills.

5) Remember that you are responsible for material discussed in class, even if it does not appear in the textbook.

What Should You Learn in this Class?

The goal of this class is to discuss relativity, elementary thermodynamics, and quantum theory. We will discuss the experiments that revealed the limitations of classical mechanics and the conceptual revolutions that followed, leading to the creation of quantum mechanics. Although the treatment will not be as deep as those you will see in Phys 401, 402, 404 and 410, we will employ mathematical concepts to quantify the discussion whenever possible.

Physics GRE

There is an emphasis on special relativity, thermodynamics, historical aspects of quantum physics, as well as many general concepts from one-dimensional quantum mechanics on the Physics GRE exam. This class will be of great help in preparing for the all of these important topics. The more practice you have solving problems in relativity and quantum mechanics, the better you will do on the Physics GRE.

	TENTATIVE SCHEDULE FOR PHYSICS 371, SPRING 2018, Prof. Anlage						
Date	**Mtg.#**	**Serway, 3rd Ed**	**Tipler, 5th Ed**	**Blundell, 2nd Ed**	**HW Due**	**Topics**	
Week 1					**QUIZ**	**RELATIVITY**	
25-Jan	1	1.1-1.2	1-1			Introduction / Galilean Relativity	
Week 2							
30-Jan	2	1.3-1.4	1-2		0	Speed of light same all frames / Michelson-Morley and other experiments	
1-Feb	3	1.5	1-4		1	Time Dilation, Length Contraction, Notion of Space-Time	
Week 3							
6-Feb	4	1.6 - 1.7	1-3			Lorentz transformations and invariance of space-time interval	
8-Feb	5	1.5, 1.6	1-3, 1-5		2	Relativistic kinematics (velocity addition, Doppler effect)	
Week 4							
13-Feb	6	1.5	1-6			Relativistic Paradoxes	
15-Feb	7				3	4-vector notation	
Week 5							
20-Feb	8		2-1, 2-2			Energy-Momentum 4-vector	
22-Feb	9	2.1 - 2.4	2-3, 2-4		4	Relativistic Dynamics in Collisions and decays	
Week 6						**THERMODYNAMICS**	
27-Feb	10			Chaps 1 - 4		Thermodynamic Limit, Intensive and Extensive Variables, Heat, Temperature,	
1-Mar	11			Chap 11	5	State Functions, Work, Internal Energy, First Law of Thermo	
Week 7							
6-Mar	12			Chaps 12, 13		Isothermal, Adiabatic Processes, Second Law of Thermo, Carnot Engine	
8-Mar	13					**EXAM 1**	
Week 8							
13-Mar	14			Chaps 13, 14		Heat Engines, Refrigerators, Entropy	
15-Mar	15			Chaps 16, 28	6	Thermodynamic Potentials, Phase Transitions, Latent Heat	
		SPRING BREAK 19-23 March 2018					
Week 9						**QUANTUM MECHANICS**	
27-Mar	16	10.1		Chaps 26, 5, 6		Perfect Gas, van der Waals gas, Kinetic Theory	
29-Mar	17	3.1 - 3.3	3-1, 3-2		7	First Quantization, Blackbody spectra	
Week 10							
3-Apr	18	3.4	3-3			PhotoElectric effect and the notion of a photon	
5-Apr	19	3.5 - 3.6	3-4		8	Wavenumber and momenta of photon/Compton effect/Wave-Particle Duality	
Week 11							
10-Apr	20	4.1 - 4.5	4-1 to 4-5			Bohr atom and concept of discrete levels and atomic transitions	
12-Apr	21	3.6, 5.1	5-1		9	de Broglie hypothesis / particles as waves	
Week 12							
17-Apr	22	5.2	5-2, 5-3, 5.4			Davisson-Germer experiment/electron microscope,Probability interpretation of the wavefunction	
19-Apr	23	5.6 - 5.7, 6.1 - 6.3	6-1			Motivating the Schrodinger equation	
Week 13							
24-Apr	24					**EXAM 2**	
26-Apr	25	6.4 - 6.5	6-2, 6-3		10	The infinite square well	
Week 14							
1-May	26	6.6	6-5			Quantum harmonic oscillator	
3-May	27	5.4 - 5.5	5-5, 5-6, 5-7		11	Uncertainty principle at a qualitative level	
Week 15							
8-May	28	6.7 - 6.8	6-4, 6-6			Observables and Expectation Values, Tunneling	
10-May	29				12	Review	
14-May	30					**FINAL EXAM (8 AM to 10 AM)**	