Syllabus – Intermediate Modern Physics

PHY 3101-0001, Spring 2020 – Mon. & Wed., 8:40 to 9:55 in UPL 101

Note: see revised grading statement regarding S/U grades at top of page 3

Important notice: attendance at the first class on Monday January 6th is mandatory; failure to attend will likely result in being dropped from the course.

Instructor	Room	Phone	Office Hours	Email Address
Prof. Stephen Hill	310 Keen B121 NHMFL	645-8793 644-1647	M/W 10 – 11 am in Keen 310	shill@magnet.fsu.edu

Course Description: Intermediate Modern Physics (3 credits), covering special relativity, quantum properties of light and matter, and nuclear & particle physics. Finally, this is the course you have been waiting for. To get to this point, you have sweated through courses in mechanics, electricity and magnetism, including a smattering of thermodynamics, kinetic theory, optics, *etc*. Now that you are familiar with the classical laws that govern just about everything we see around us in our daily lives, you will be amazed at how different things can be in the limits of extreme relative velocity and small dimensions. For example: an astronaut who travels at high speeds to a distant star and back will return to find that he has aged less than his twin; and, under special conditions, large assemblies of certain types of particle may form an unusual state of matter (a superfluid) in which all resistance to flow is lost, i.e., the fluid loses its viscosity. Some of the great scientists we will encounter along the way include Planck, Einstein, Curie, Rutherford, Bohr, Pauli, Dirac, Schrödinger, Heisenberg, Fermi, Feynman, and Schrieffer. Nobel prizes will be discussed frequently. In particular, you will learn about connections between the FSU physics department and some of the major breakthroughs in modern physics. You may consider this course as preparation for reading and understanding the kinds of articles published in *Scientific American*.

Prerequisite: PHY 2048/49C with a grade of C- or better, or the consent of the instructor, Prof. Hill. This course consists of two 1 hour and 15 minute lectures per week. Final grades will be determined on the basis of class participation, and performance on weekly assignments and exams; there are no separate laboratory or recitation components. **Calculus will be used frequently.** Passing this course (with C- or better) as a sequence with General Physics A and B (PHY 2048/49) entitles you to a Minor in Physics!

Text Book: We will use ***Modern Physics – Sixth Edition***, by Paul A. Tipler and Ralph A. Llewellyn, originally published by W. H. Freeman and Company. **Important:** this book is out of print! Therefore, you will probably not be able to purchase a new copy. However, used copies and earlier editions are perfectly fine. The lecture notes are based mostly on the *Fourth Edition*. Note also that you can find pdf copies online.

CANVAS: Consult the PHY3101 CANVAS site on a regular basis. A link to the homework (see below), lecture notes, solutions to exams, and important announcements will be posted there.

LONCAPA online homework: Homework assignments will be managed via LONCAPA (loncapa.fsu.edu); access will begin on Jan. 6th. A link within the PHY3101 CANVAS site will take you directly to LONCAPA, bypassing the login page. There is no fee for using LONCAPA, i.e., it is completely free, so you should not purchase any bundled online homework software with the textbook. Critical information for using LONCAPA will be provided during the first class meeting on Jan. 6th, although it is likely many in the class have used it before.

iClickers: Starting in the 2nd week of the semester, short quizzes will frequently be given in class using the iClicker system. Unless you already have one, you should purchase an iClicker transmitter. These can be purchased from the bookstore and registered via the link provided in the PHY3101 CANVAS course menu. Alternatively, you can download the "iClicker Reef" app on your cellphone, which is free, but you will have to purchase a subscription "per semester" to use it. More details will be given in the first class.

Class meetings: Mon. and Wed., 8:40 to 9:55 in UPL101. Classes will involve discussion of the main concepts and techniques used in the course, worked examples, and some great demonstrations. We will spend the first half of the semester discussing the foundations of modern physics, i.e., relativity and quantum mechanics. The remainder of the semester will be devoted to applications of these theories in areas such as atomic, statistical, solid state, nuclear and particle physics. The course should be fun! It is very much a survey-type course. To fully do justice to the topics covered, one could easily spend a year or more on each. Consequently, the pace will be fast, with approximately one chapter covered each week, particularly towards the end of the semester. There will not be much time for worked examples in class, so you will have to devote time outside of class to practice solving problems; use Dr. Hill's office hours.

With the exception of the final, all exams will be given in class (see schedule below). As already noted, there will be frequent quizzes in the lectures using the iClicker system. Registers of students attending class will be noted. In order to successfully complete the homework assignments and prepare for examinations, it is expected that you read all of the assigned sections of the textbook and keep up with the material covered in lectures. Summaries of lectures, with reference to the assigned sections of the textbook (6^{th} edition), will be posted online via the PHY3101 CANVAS site. **Not** all sections/chapters in the textbook will be covered. You will obviously not be required to learn material that is not assigned. However, it does no harm to read outside of the material covered in lectures. Dr. Hill is always happy to discuss these other topics with students, as are all of the physics professors.

Examinations: There will be **three in-class exams (1-hour & 15-minute), and one final exam (2-hours)**; see schedule at the end of this syllabus for dates/times. The subject of each exam may include **any** previously assigned material. Unlike PHY2048/49, all exam scores will count towards your final grade (see grading Table below), i.e., you do not get to drop any exam scores. Solutions to the in-class exams will be posted on the CANVAS course site, as will your exam scores. Discuss any problem which would cause you to miss an exam with Prof. Hill **well before the exam**, unless of course the problem could not be anticipated, in which case it MUST be brought to the attention of Dr. Hill as soon as possible. Below are a few rules and answers to common questions about these exams.

- Three in-class (1-hour & 15-minute) exams will be given during the semester (see schedule).
- A 2-hour final exam will be given during finals week (see schedule).
- In-class exams will begin promptly at the start of the class period.
- Students arriving late to exams will be required to finish at same time as the rest of the class.
- All exams will be hand graded, including the final; a graduate TA will assist with the grading.
- Exams will cover any previously assigned material covered in lectures. Although it is intended that the exams test the same concepts as those on the homework, do not expect to see exact copies of homework problems on the exams.
- Each student is responsible for bringing a working calculator.
- Required formulas from the text book will be provided. However, you are expected to know basic mathematical relations (trigonometry, geometry) and fundamental laws such as $F = ma$.
- **All students should bring their FSU ID card with them to all exams.**
- Any grading questions should be resolved with Prof. Hill **within 3 weeks of an exam**.

Three in-class exams (12% each)	36%
Final Examination	24%
iClicker answers/attendance	10%
LONCAPA homework	30%
Total	**100%**

Grade	**Score**	**Grade**	**Score**
A or S	100 – 86	C+ or S	69.9 – 66
A- or S	85.9 – 82	C or S	65.9 – 62
B+ or S	81.9 – 78	C- or S	61.9 – 58
B or S	77.9 – 74	D or U	57.9 – 50
B- or S	73.9 – 70	F or U	49.9 – 0

Completion of Course and Grading: The course grade will be calculated using component scores from the LONCAPA homework, the iClicker quizzes, the three in-class exams, and the two-hour final. These components will then be weighted according to the left-hand table above. Your total course score will then be converted into a letter grade; the right-hand table above is a guide for determining your final grade. **Students who do not attempt the final exam will automatically receive a grade of "F" for the course. In response to FSU Guidance related to the move to online instruction for the spring semester, students who opt for the S/U grading option must receive an overall course score of 58 or above, corresponding to a letter grade of C- or better, in order to receive a "satisfactory" (S) grade. Students scoring below 58 will receive a U grade (see right-hand Table above).**

FSU Academic Honor Policy: The Florida State University Academic Honor Policy outlines the University's expectations for the integrity of students' academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process. Students are responsible for reading the Academic Honor Policy and for living up to their pledge to "... be honest and truthful and... [to] strive for personal and institutional integrity at Florida State University." (the Florida State University Academic Honor Policy, found at fda.fsu.edu/Academics/Academic-Honor-Policy.)

University Attendance Policy: Excused absences include documented illness, deaths in the family and other documented crises, call to active military duty or jury duty, religious holy days, and official FSU sponsored activities. **Documentation must be provided** to the course leader, Stephen Hill. Absences will be accommodated in a way that does not arbitrarily penalize students who have a valid excuse. Consideration will also be given to students whose dependent children experience serious illness.

Resources for Students:

Resources are available to help you with this and other physics courses. Please take advantage of them.

- **Lectures:** You may not realize it at the time, but what you learn and retain from these classes may surprise you and serve you well during exams. Please do not hesitate to ask questions if anything in class is unclear. Student participation in the lectures is encouraged. Indeed, the instructor likes to engage the class in discussion.
- **Course Information on the Web:** This syllabus and other information related to the course (lecture notes, exam solutions, a link to LONCAPA, etc.) will be posted via the course website (go to **my.fsu.edu** and select the CANVAS icon). In order to attempt the LONCAPA assignments you must have access to the internet. There are numerous computer labs on campus. The LONCAPA web page is loncapa.fsu.edu/ and instructions are available online.
- **Office hours:** Prof. Hill has scheduled office hours to help students with homework problems and other matters that may arise during the semester. These times are posted at the beginning of this syllabus, and other meeting times may also be arranged. Prof. Hill will also try to answer emails. Although a prompt reply cannot always be guaranteed, email is monitored regularly.

Free Tutoring from FSU: On-campus tutoring and writing assistance is available for many courses at FSU. For more information, visit the Academic Center for Excellence (ACE) Tutoring Services' comprehensive list of on-campus tutoring options – see ace.fsu.edu/Tutoring or contact tutor@fsu.edu. Tutoring is available by appointment and on a walk-in basis. These tutors are trained to encourage the highest level of individual academic success while upholding personal academic integrity.

Individual Tutors: If you would like to hire a tutor, check with Dr. Brian Wilcoxon in the Physics Graduate/Undergraduate Office on the 3rd floor of the Keen Building (KEN 304). He can also be reached either by e-mail (ugrad@physics.fsu.edu) or by calling 644-3245. Dr. Wilcoxon has a hardcopy list of physics graduate students who are happy to work (for pay) as tutors.

Americans with Disabilities Act: Students with disabilities needing academic accommodations should: (1) register with and provide documentation to the Student Disability Resource Center; and (2) bring a letter to the instructor indicating the need for accommodation and what type. **This should be done during the first two weeks of the semester, or as soon as you receive approval for accommodations.**
This syllabus and other class materials are available in alternative format upon request. For more information about services available to FSU students with disabilities, contact the:

Student Disability Resource Center
874 Traditions Way 108
108 Student Services Building
Florida State University
Tallahassee, FL 32306-4167

(850) 644-9566 (voice)
(850) 644-8504 (TDD)
sdrc@fsu.edu
https://dos.fsu.edu/sdrc/

Some Sensible Advice: Below are a few tips to help you through this course.

- **Physics is *based on understanding*, not memorization.** The homework sets have been designed to prepare you for exams. The instructor is well aware that solutions to many homework problems can be found online or shared among students via social media. Simply copying these solutions to score highly on the homework will not prepare you for the exams, which are worth 60% of the overall course grade. Moreover, online solutions are often incorrect!
- Doing well on exams involves development of problem solving skills. This requires understanding underlying physical principles, an ability to interpret problems, and the insight to combine information and understanding so that you can derive an answer. Only practice makes perfect. If someone gives you a solution, you have missed out on the important part of the exercise, i.e., the problem solving aspect. **Memorization does not work** because the exam questions will always be different, even if they appear at first sight to be very similar to a previous homework problem.
- Physics and math are intimately related. Refresh and apply your math skills.
- Use the textbook. Try to find time to look over a chapter before and after it is covered in class.
- Don't give up or sit for hours trying to do the homework. Discuss your solution with Dr. Hill during office hours. Often you will be much closer than you think to being able to solve a problem.
- Find a study partner. *Students are encouraged to study and learn together.* However, when making final preparations for exams, make sure you understand and can do all of the homework problems on your own. If you have time, test yourself on additional problems.
- In answering a question, always ask yourself "Is this answer sensible?" Always check through your solution and don't forget to include the units.
- If you attend all classes and **seek help from your instructors during office hours**, you should be able to score close to 100% on the LONCAPA assignments. This will, in-turn, help you on the exams. You will not succeed in this course if you do not take these assignments seriously.

Daily Schedule and Assignments:

Date	Schedule and Assignments	Assignment
M 6-Jan T 7-Jan W 8-Jan	Class 1: Welcome/Intro. – **Mandatory attendance!** Class 2: Ch. 1 – Time dilation and Lorentz contraction	
M 13-Jan T 14-Jan W 15-Jan	Class 3: Ch. 1 – The Lorentz transformations Class 4: Ch. 1 – Twin paradox and other surprises	Homework set 1 (11:59pm)
M 20-Jan T 21-Jan W 22-Jan	**MLK Day – no classes** Class 5: Ch. 2 – Mass/energy conversion ($E = mc^2$)	 Homework set 2 (11:59pm)

M 27-Jan T 28-Jan W 29-Jan	Class 6: Ch. 2 – Finish Relativity Class 7: Ch. 3 – Quantization of charge and Planck's law	 Homework set 3 (11:59pm)
M 3-Feb T 4-Feb W 5-Feb	Class 8: Ch. 3 – The photoelectric effect **In-Class Exam 1**	 Review 1
M 10-Feb T 11-Feb W 12-Feb	Class 9: Ch. 4 – Atomic spectra & nuclear models Class 10: Ch. 4 – Bohr model	 Homework set 4 (11:59pm)
M 17-Feb T 18-Feb W 19-Feb	Class 11: Ch. 5 – de Broglie hypothesis Class 12: Ch. 5 – Wave mechanics	 Homework set 5 (11:59pm)
M 24-Feb T 25-Feb W 26-Feb	Class 13: Ch. 5 – Probability & Schrödinger equation Class 14: Ch. 6 – 1D infinite square well & tunneling	 Homework set 6 (11:59pm)
M 2-Mar T 3-Mar W 4-Mar	Class 15: Ch. 6 – 1D potentials continued **In-Class Exam 2**	 Review 2
M 9-Mar T 10-Mar W 11-Mar	Class 16: Ch. 7 – 3D Schrödinger eqn. & particle in a box Class 17: Ch. 7 – Spherical potentials, hydrogenic atoms	 Homework set 7 (11:59pm)
Mar 16-20	**Spring Break – no classes**	
M 23-Mar T 24-Mar W 25-Mar	Class 18: Ch. 7 – Atomic physics Class 19: Ch. 7/8 – Exclusion Principle, Bosons/Fermions	 Homework set 8 (11:59pm)
M 30-Mar T 31-Mar W 1-Apr	Class 20: Ch. 8 – Statistical physics Class 21: Ch. 10 – Solid state physics	 Homework set 9 (11:59pm)
M 6-Apr T 7-Apr W 8-Apr	Class 22: Ch. 12 – Particle physics Class 23: Ch. 12 – The Standard Model	 Homework 10 (11:59pm)
M 13-Apr T 14-Apr W 15-Apr	Class 24: Ch. 11 – Nuclear physics **In-Class Exam 3**	 Review 3
M 20-Apr T 21-Apr W 22-Apr	Class 25: Ch. 11 – Radioactive decay Class 26: Ch. 13 – Wrap-up (some review, if time)	 Homework 11 (11:59pm)

Note: the topics listed for each class are tentative and are subject to change; in particular, the schedule after Spring Break is very tentative.

Final Exam: Friday, May 1st, **time TBA** in UPL101

Syllabus Change Policy

Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.