

## Syllabus – Intermediate Modern Physics

### PHY 3101, Spring 2012 – M, W, F, 9:05 to 9:55 in UPL 101

**Important notice: attendance at the first class on Wednesday January 4<sup>th</sup> 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<br>C115 NHMFL | 645-8793<br>644-1647 | M, W, 10-11 am<br>in Keen 310 | <a href="mailto:shill@magnet.fsu.edu">shill@magnet.fsu.edu</a> |

**Course Description:** Intermediate Modern Physics (3 credits), covering special relativity, quantum properties of light and matter, and origins of the universe. 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. You could consider this course as preparation for reading and understanding the kinds of articles published in *Scientific American*. You will also learn about connections between the FSU physics department and some of the major breakthroughs in modern physics.

**Prerequisite:** PHY 2049C with a grade of C- or better, or the consent of the instructor, Prof. Hill. This course consists of three 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 – Fifth Edition*, by Paul Tipler and Ralph Llewellyn, published by W. H. Freeman and Company [NOTE: if you own the 4<sup>th</sup> edition, you should be OK].

**WebAssign online homework:** Homework assignments will be managed via WebAssign (access will begin on Jan. 4<sup>th</sup>). A link within the PHY3101 Blackboard site will take you directly to the PHY3101 WebAssign Class without any need for further login. Note that it may take 48 hours for this link to work if you register during the first week of classes. There is a fee of \$28.95 for using WebAssign. However, you will be able to access the site without charge up to Jan. 17<sup>th</sup>. The fee should be paid by credit card via the PHY3101 WebAssign page. There may be other methods of payment, but please use the link in Blackboard or ask Prof. Hill if you are unsure what to do. Before purchasing, it is strongly recommended that you attend the first class, or consult the online notes for the first class via Blackboard; additional critical information for using WebAssign will also be provided at the first class meeting.

**iClickers:** Unless you already have one, you will need to purchase an [iclicker](http://www.iclicker.com) transmitter and register it at <http://www.iclicker.com> using your official FSU email address (Blackboard login + '@fsu.edu').

**Class meetings: Mon., Wed. and Fri., 9:05 to 9:55 in UPL101.** Classes will involve discussion of the main concepts and techniques used in the course, worked examples, and some 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 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.

With the exception of the final, all exams will be given in class (see schedule below). In addition, there will be short quizzes 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 (5<sup>th</sup> edition), will be posted online via the PHY3101 Blackboard site. Not all sections/chapters in the textbook will be covered during the semester. 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:** During the semester, there will be **six short mini-exams, two in-class 50 minute exams, and one final exam.** The subject of each exam may include **any** previously assigned material. With the exception of the final, all exams will be given in class (see schedule below). Only your best five mini-exam scores will be counted (see below), representing a very significant fraction (25%) of your final grade and a very important component of the course. Solutions to the exams (except for the final) will be posted on Blackboard. Your exam scores will also be available during the semester via your WebAssign account. 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. Below are a few rules and answers to common questions about these exams.

- Six 20 minute mini-exams will be given during the semester, all on Fridays (see schedule below).
- Two 50 minute in-class exams will be given: one on Feb. 29<sup>th</sup>, the other on Apr. 13<sup>th</sup>.
- In-class exams will begin promptly at the start of the class period.
- In addition to the in-class exams, there will be a 2 hour cumulative final exam.
- 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 or in the textbook. Although it is intended that the exams test the same concepts as those on the homework, do not expect to see verbatim homework problems on the exams.
- Your final mini-exam total will be based on your five best scores.
- 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.**

**Completion of Course and Grading:** The course grade will be calculated using component scores from the WebAssign problem sets, the *iclicker* problems, your top five mini-exam scores, two 50 minute in-class exams, and a two-hour final exam. These components will then be weighted according to the left-hand table below. Your total course score will then be converted into a letter grade; the right-hand table below is a guide for determining your final grade.

|                                    |             |
|------------------------------------|-------------|
| Best 5 of 6 mini-exams             | 25%         |
| <i>iclicker</i> answers/attendance | 10%         |
| In-Class Exams (10% each)          | 20%         |
| Final Examination                  | 20%         |
| WebAssign homework                 | 25%         |
| <b>Total</b>                       | <b>100%</b> |

| <b>Grade</b> | <b>Score</b> | <b>Grade</b> | <b>Score</b> |
|--------------|--------------|--------------|--------------|
| A            | 100 – 86     | C+           | 69.9 – 66    |
| A-           | 85.9 – 82    | C            | 65.9 – 62    |
| B+           | 81.9 – 78    | C-           | 61.9 – 58    |
| B            | 77.9 – 74    | D            | 57.9 – 50    |
| B-           | 73.9 – 70    | F            | 49.9 – 0     |

Students who do not attempt the final exam will automatically receive a grade of “F” for the course.

**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." (Florida State University Academic Honor Policy, found at <http://dof.fsu.edu/honorpolicy.htm>.)

**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 University activities. These 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:**

We want you all to do well in this course. There are resources available to help you towards this goal. 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.
- **On the Web:** This syllabus, summaries of lectures, and other information (exam solutions, etc.) related to this course will be posted on the PHY3101 Blackboard site. In order to attempt the homework assignments you must have access to the internet. There are numerous computer labs on campus and in the libraries. The Physics Department also has a number of computers that may be used for online homework. You can link directly to the WebAssign homework assignments from the Blackboard PHY3101 site. There, you will also find instructions for subscribing to, as well as using WebAssign. You should also consult the online notes from the first lecture.
- **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.
- **Physics Department consultation sessions:** After the 2<sup>nd</sup> or 3<sup>rd</sup> week of classes a graduate student will be available to assist you with your homework and in keeping up your average score on the exams. These times are given below (TBA).

| <b>Consultant</b> | <b>Day</b> | <b>Time</b> | <b>Room</b> |
|-------------------|------------|-------------|-------------|
| TBA               | TBA        | TBA         | TBA         |

**Free Tutoring from FSU:** For tutoring and writing help in any course at Florida State University, visit the Academic Center for Excellence (ACE) Tutoring Services' comprehensive list of tutoring options - see <http://ace.fsu.edu/tutoring> or contact [tutor@fsu.edu](mailto:tutor@fsu.edu) for more information. High-quality tutoring is available by appointment and on a walk-in basis. These services are offered by tutors 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 Melissa Adams in the Physics Graduate/Undergraduate Office on the 3<sup>rd</sup> floor of the Keen Building (Room 304). She can also be reached either by e-mail ([ugrad@physics.fsu.edu](mailto:ugrad@physics.fsu.edu)) or by calling 644-3245. Ms. Adams 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 accommodation 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 week of class.

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

Student Services Building

Florida State University

Tallahassee, FL 32306-4167

(850) 644-9566 (voice)

(850) 644-8504 (TDD)

[sdrc@admin.fsu.edu](mailto:sdrc@admin.fsu.edu)

<http://www.disabilitycenter.fsu.edu/>

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

- Physics is *based on understanding*, not memorization. Only you can truly know whether you really understand something or not. Test yourself on additional problems. If, after reading additional problems, you have no idea how to solve them, then you have not understood the concepts and you should go and talk to Prof. Hill. *Do not simply regurgitate the answers.*
- Physics and math are intimately related. Refresh and apply your math skills to solve the problems.
- If you attend all classes and seek help from Prof. Hill during office hours, you should be able to score 90-100% on the homework assignments. This will, in-turn, help you on the exams. You will be throwing away easy credit, and will almost certainly not succeed in this course if you do not take these assignments seriously.
- In order to prepare for the exams make sure you understand and can do ***all*** of the homework problems on your own. You are strongly encouraged to do extra problems. Do not simply memorize the homework solutions.
- In answering a question, always ask yourself “Is this answer sensible?” Always check through your solution and don't forget to put the units in!
- Use the textbook. Try to find time to look over a chapter before and after it is covered in class.
- Find a study partner. *Learning together in groups is strongly encouraged.*
- Finally, don't give up or sit for hours trying to do the homework. Discuss your solution with a study partner or see Prof. Hill. Often you will be much closer than you think to solving a problem.
- If you are thinking of dropping the course at any point, please come and talk to Prof. Hill first.

### Daily Schedule and Assignments:

| Date     | Schedule and Assignments                                  | Exam/Assignment          |
|----------|---|--------------------------|
| W 4-Jan  | Class 1: Welcome/intro. – <b>Mandatory attendance!</b>    |                          |
| F 6-Jan  | Class 2: Ch. 1 – Michelson/Morley & Einstein’s postulates |                          |
| M 9-Jan  | Class 3: Ch. 1 – The Lorentz Transformation               |                          |
| W 11-Jan | Class 4: Ch. 1 – Twin paradox and other surprises         | Homework set 1 (11:59pm) |
| F 13-Jan | Class 5: Ch. 2 – Relativistic energy and momentum         | <b>Mini Exam 1</b>       |
| M 16-Jan | <b>Martin Luther King day – no classes</b>                |                          |
| W 18-Jan | Class 6: Ch. 2 – Mass/energy conversion ( $E = mc^2$ )    | Homework set 2 (11:59pm) |
| F 20-Jan | Class 7: Ch. 2 – More examples                            |                          |

|                |   |                                  |
|----------------|---|----------------------------------|
| M 23-Jan       | Class 8: Ch. 3 – Quantization of charge               |                                  |
| W 25-Jan       | Class 9: Ch. 3 – Blackbody radiation and Planck's law | Homework set 3                   |
| F 27-Jan       | Class 10: Ch. 3 – The photoelectric effect            | <b>Mini Exam 2</b>               |
| M 30-Jan       | Class 11: Ch. 4 – Rutherford's nuclear model          |                                  |
| W 1-Feb        | Class 12: Ch. 4 – The Bohr atom                       | Homework set 4                   |
| F 3-Feb        | Class 13: Ch. 4 – More Nobel prizes                   |                                  |
| M 6-Feb        | Class 14: Ch. 5 – De Broglie's hypothesis             |                                  |
| W 8-Feb        | Class 15: Ch. 5 – Waves and uncertainty               | Homework set 5                   |
| F 10-Feb       | Class 16: Ch. 5 – Heisenberg's uncertainty principle  | <b>Mini Exam 3</b>               |
| M 13-Feb       | Class 17: Ch. 6 – The 1D Schrödinger equation         |                                  |
| W 15-Feb       | Class 18: Ch. 6 – Particle in a box                   | Homework set 6                   |
| F 17-Feb       | Class 19: Ch. 6 – Quantum tunneling and other effects |                                  |
| M 20-Feb       | Class 20: Ch. 6/7 – Pauli's exclusion principle       |                                  |
| W 22-Feb       | Class 21: Ch. 7 – The Schrödinger equation in 3D      | Homework set 7                   |
| F 24-Feb       | Class 22: Ch. 7 – Quantization of angular momentum    | <b>Mini Exam 4</b>               |
| M 27-Feb       | Class 23: Review                                      |                                  |
| W 29-Feb       | Class 24: Exam  | <b>In-Class Exam 1 (50 mins)</b> |
| F 2-Mar        | Class 25: Finish Ch. 7 and/or start Ch. 8             |                                  |
| <b>Mar 5-9</b> | <b>Spring Break – no classes</b>                      |                                  |
| M 12-Mar       | Class 26: Ch. 8                                       |                                  |
| W 14-Mar       | Class 27: Ch. 8                                       | Homework set 8                   |
| F 16-Mar       | Class 28: Ch. 8                                       |                                  |
| M 19-Mar       | Class 29: Ch. 10                                      |                                  |
| W 21-Mar       | Class 30: Ch. 10                                      | Homework set 9                   |
| F 23-Mar       | Class 31: Ch. 10                                      | <b>Mini Exam 5</b>               |
| M 26-Mar       | Class 32: Ch. 11                                      |                                  |
| W 28-Mar       | Class 33: Ch. 11                                      | Homework set 10                  |
| F 30-Mar       | Class 34: Ch. 11                                      |                                  |
| M 2-Apr        | Class 35: Ch. 11/12                                   |                                  |
| W 4-Apr        | Class 36: Ch. 12                                      | Homework set 11                  |
| F 6-Apr        | Class 37: Ch. 12                                      | <b>Mini Exam 6</b>               |
| M 9-Apr        | Class 38: Ch. 12                                      |                                  |
| W 11-Apr       | Class 39: Review                                      | Homework set 12                  |
| F 13-Apr       | Class 40: Exam  | <b>In-Class Exam 2 (50 mins)</b> |
| M 16-Apr       | Class 41: Ch. 13                                      |                                  |
| W 18-Apr       | Class 42: Ch. 13                                      | Homework set 13                  |
| F 20-Apr       | Class 43: Ch. 13 and final review                     |                                  |

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

**Final Exam: Friday, April 27<sup>th</sup>, 7:30 - 9:30 am (!!) 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.