Syllabus, GENERAL PHYSICS I, SPRING, 2009

Catalog Description: This is the first of three semesters of the traditional calculus based physics sequence for scientists and engineers. This course covers motion and Newton's laws, energy, momentum, rigid-body mechanics, gravitation, simple harmonic motion, and waves. Prerequisite: MAT 145 or permission of the instructor. Three hours lecture. Three hours laboratory. Laboratory fee: $15. Four units per semester.

Faculty: Dr. Don Petcher, Ph.D., Professor of Physics

Textbooks: *Physics, for Scientists and Engineers*, by Paul M. Fishbane, Stephen Gasiorowicz and Stephen T. Thornton, 3rd ed, *The Soul of Science*, Nancy Pearcey and Charles Thaxton.

I. Course Objectives

Upon completion of the course, the student will be expected to be able to

A. articulate as well as utilize Newtons three laws of motion to solve calculus-based static and kinematic (including rotational) problems.

B. use the conservation of energy and momentum to solve dynamical problems.

C. understand the relationship between forces, work, and energy.

D. understand the basic properties of oscillatory behavior.

E. have a conceptual understanding of the above physical principles.

F. present laboratory results in a written report commensurate with conventions of the physics community, including appropriate error analysis.

G. begin to articulate a Christian worldview on an area in physics or mathematics.

II. Methods

A. **Classroom:** The course will be taught using an interactive method, whereby lecture-discussions and video clips are followed by thought questions and student discussion. Three 50 minute periods per week.

B. **Laboratory:** About 10 Laboratory experiments will be performed over the course of the semester, each in a three hour period, generally with 2 students working together. Laboratory assignments are aimed not simply to verify known results, but rather to teach the students the complexities of doing laboratory experimentation well, including understanding the limitations of experimentation using a particular set of equipment. To this end, an understanding of experimental error analysis is emphasized.

C. **Homework:** Students work independently or in groups through problems assigned on the subject matter of each chapter.

D. **Writing assignment: Lab reports:** Students write weekly lab reports, in order to learn how to present scientific material. This semester focuses on the various elements of writing reports suitable for reporting scientific findings.

E. **Writing assignment: paper:** Students write a five to six page paper on a aspects of *The Soul of Science*. The papers will be discussed in class.

III. Means of Assessment

A. Class participation, quizzes, and homework (0%). This addresses objectives A-E.

B. Labs (25%). This addresses objectives A-F.

C. Tests and Final Exam (70%). This addresses objectives A-E,G.

D. Paper (5%). This addresses objective G.

Information and Policy Sheet
GENERAL PHYSICS, PHY231

Location: Mills Hall 310

Time: MWF, 2:00 PM, Lab: Tuesday, 1:00 – 3:50 PM

Class Time: The course will be taught using various class techniques of instruction including lectures, demonstrations, and video clips, followed by thought questions and student discussion. *Only if each student has done the appropriate reading before coming to class* will our time in class time be most fruitful. The amount of material in the textbook is too great to cover in class in its entirety, and although students should make an effort to learn as much as possible, the tests will typically emphasize the subjects covered in class. If you find any material in the textbook that you don't understand and would like to discuss in class, please feel free to bring it up.

Readings: The list of readings below are meant as a guide for what will take place in class. *You should attempt to have each section read before coming to class on the date it is listed.* Class discussion will often be more understandable if you have read the material.

Grading: The final grade for the course will be based on tests, labs, a written exercise, and the final exam. Tests and the final exam will determine 70%, labs will determine 25%, and the written exercise will determine 5% of the grade. An answer key to all problems in the textbook is on reserve in the library, and also in the Physics commons: Mills 360.

Tests: During the semester, four tests will be given, approximately three weeks apart as indicated on the schedule. In addition a final exam will be given which will serve as an additional test, which in part will be comprehensive. The lowest grade of the five tests will be dropped, and the remaining tests will count 70% of the grade. If you miss a test for whatever reason, that test will be dropped. Only in cases with an obviously legitimate excuse, or where two or more tests are missed *for legitimate reasons* will makeup tests be granted. Tests will typically consist of 20 multiple choice questions along the lines of both conceptual questions and less involved ("level 2" or below) homework problems.

Homework: For each day, a few representative problems of homework are listed in the schedule. These should be viewed as a minimum number of problems to work out in detail for practice in working with the material of the chapter. The solutions manual to all problems in the text is on reserve in the library, and a copy is also in the physics commons – Mills 360, so after you have worked out the homework (or possibly you have run out of ideas) you can check the answers in the solutions manual. Homework problems are to be viewed as an opportunity to learn, in preparation for the tests, more advanced courses, and ultimately, your vocation. To that end you are encouraged to work together or to solicit whatever outside help you need, in order to *understand* the problems. You will derive little benefit from simply passively consulting solutions in the solutions manual without making an effort to solve the problems yourself beforehand. You can work on the homework while reading the material (before it is discussed in class) or after our class discussion, whichever works best for you. Beyond that, you are encouraged to discuss the problems further with the

instructor or tutors during office hours or by appointment whenever you do not understand.

Labs: Nine laboratory experiments will be performed during the course of the semester. For each lab, a separate lab report will be required. The reports are designed with two purposes in mind: first, to teach how to communicate scientific results as is done in the literature, and second, to learn how to typeset such reports in the mathematical typesetting program called LaTeX. Thus the reports will begin with a more rudimentary style, along with LaTeX exercises, and gradually over the course of two semesters, the reports will become more like scientific papers, following an appropriate format for such presentation. Each lab report should also include a cover sheet, which will be available through the LaTeX lab report format. Note: in writing up your labs *you may collaborate with your partner (or any other student) on ideas and on such things as how to make tables, how to do calculations, and on graphs when they are computer generated, but* ***you must write independent lab reports in your own words.*** Lab reports will be due on the next Tuesday classes are held following the day the lab is performed in which we do not have a test, and should be turned in by 6:00 PM on that day (with three days grace). After the grace period, points will be deducted according to the rubric for the lab. A perfect score for a lab report is 10 points. If a lab is performed but no report is handed in, 3 points will be awarded. The first lab will be graded only according to whether the student has done all that was asked. Errors will be noted but with zero points taken off. Subsequent errors of similar nature will result in 1/2 point deducted, and if the same error is repeated again, a full point with be deducted in subsequent labs. So the student is advised to pay careful attention to all comments on graded labs. Missed labs may not be made up without prior notification of the instructor that a lab will be missed, except in exceptional cases such as severe illness, a death in the family, or other reasons the student is prevented from attended the lab through no desire on the part of the student. Labs count 25% of the grade. Further information concerning labs can be found in handouts in the first few lab sessions of the course. These handouts will also be made available on the physics web site.

Paper: Students will write a paper summarizing the first four chapters of *The Soul of Science* and then responding to either chapters 6 and 7 on mathematics or chapters 8 and 9 on physics. Instructions concerning the paper will be posted on the web site.

Attendence: Although class attendance is not required as a formal part of the grade, experience shows that there is a very strong correlation between class attendance and grades. Therefore you would be advised not to miss class unless absolutely necessary. (Note though that attendance at the discussion of the paper on the Soul of Science is required in order to obtain full credit for the paper. Lab attendance is also required.)

Office Hours: Generally you are welcome to stop by anytime I am in my office. Designated office hours will be announced on my office door and on the physics web site. Also by appointment.

Physics Web Site: The physics web site is `http://www.covenant.edu/physics/`. You will find a link to the course web page there, which will have a link to this syllabus and other information related to the course.

Schedule

Tuesday	Jan. 13	**Lab 1:** Scientific Method, Rudimentary Error Analysis
Wednesday	Jan. 14	Introduction
Friday	Jan. 16	Diagnostic Test
Monday	Jan. 19	Units, Dimensions, and Vectors Read: Chapter 1 Sections 2, 4 and 6
Tuesday	Jan. 20	**Lab 2:** Acceleration down an Incline
Wednesday	Jan. 21	More Vectors
Friday	Jan. 23	Displacement, Speed, and Velocity Read: Chapter 2 Sections 1–2 (*HW Ch 1:45,52,56,58,60)*
Monday	Jan. 26	Acceleration; Constant Acceleration Read: Chapter 2 Sections 3–4 (*HW Ch 2:2,4,8,14,18)*
Tuesday	Jan. 27	**Lab 3:** Projectile Motion
Wednesday	Jan. 28	Freely Falling Objects Read: Chapter 2 Sections 5–6 (*HW Ch 2:22,26,32,40,56)*
Friday	Jan. 30	Position, Displacement, Velocity, and Acceleration Read: Chapter 3 Sections 1–2 (*HW Ch 2:50,70) (HW Ch 3:6,14)*
Monday	Feb. 2	Constant Acceleration and Projectile Motion Read: Chapter 3 Sections 3–4 (*HW Ch 3:20,28,34,44)*
Tuesday	Feb. 3	**Lab 4:** Centripetal Force
Wednesday	Feb. 4	Uniform Circular Motion; Relative Motion Read: Chapter 3 Sections 5–6 (*HW Ch 3:50,58,62,67)*
Friday	Feb. 6	Forces and Newton's Laws 1 and 2 Read: Chapter 4 Sections 1–2 (*HW Ch 4:6,10,20)*
Monday	Feb. 9	Newton's 3rd Law Read: Chapter 4 Sections 3–4 (*HW Ch 4:24,28,34,36)*
Tuesday	Feb. 10	*DAY OF PRAYER*
Wednesday	Feb. 11	Using Newton's Laws Read: Chapter 4 Sections 5–6 (*HW Ch 4:42,52,56,58)*
Friday	Feb. 13	Types of Forces; Friction Read: Chapter 5 Sections 1–2

Monday	Feb. 16	Drag Forces; Centripetal Force Read: Chapter 5 Sections 3–4 (*HW Ch 5:4,12,14,22)*
Tuesday	Feb. 17	**Test**: Chapters 1–3
Wednesday	Feb. 18	Fundamental Forces Read: Chapter 5 Section 5 (*HW Ch 5:26,40,56,64)*
Friday	Feb. 20	Kinetic Energy and Work; Constant Forces Read: Chapter 6 Sections 1–2 (*HW Ch 6:6,14,28,36)* Read: Soul of Science, Chapters 1–4
Monday	Feb. 23	Forces That Vary with Position; Conservative and Non-conservative Forces Read: Chapter 6 Sections 3–4 (*HW Ch 6:40,42,48,50)*
Tuesday	Feb. 24	**Lab 5:** Force Table
Wednesday	Feb. 25	Power and Relativistic Effects Read: Chapter 6 Sections 5–6 (*HW Ch 6:54,66,72,81)*
Friday	Feb. 27	Potential Energy, Conservative Forces, and Energy Conservation Read: Chapter 7 Sections 1–2 (*HW Ch 7:2,6,24,26,28)*
Monday	Mar. 2	More on Energy Conservation Read: Chapter 7 Sections 3–4 (*HW Ch 7:32,36,42,46)*
Tuesday	Mar. 3	**Test**: Chapters 4–6
Wednesday	Mar. 4	Momentum Conservation, Collisions, and Impulse Read: Chapter 8 Section 1–2 (*HW Ch 8:6,8,10,18)*
Friday	Mar. 6	Inelastic and Elastic Collisions Read: Chapter 8 Sections 3–4 (*HW Ch 8:28,33,38)*
	Mar. 7-15	SPRING BREAK
Monday	Mar. 16	Multidimensional Elastic Collisions; Center of Mass Read: Chapter 8 Sections 5–6 (*HW Ch 8:48,52,58,64)*
Tuesday	Mar. 17	**Lab 6:** Friction
Wednesday	Mar. 18	Rockets; High Energy Momentum Transfer Read: Chapter 8 Sections 7–8 (*HW Ch 8:74,79)*
Friday	Mar. 20	Simple Rotations; Rotational Kinetic Energy Read: Chapter 9 Sections 1–2 (*HW Ch 9:8,14,20,22)*

Monday	Mar. 23	Rotational Inertia and Torque Read: Chapter 9 Sections 3–4 (*HW Ch 9:24,34,40,44)*
Tuesday	Mar. 24	**Lab 7:** Momentum Conservation
Wednesday	Mar. 25	Angular Momentum Conservation; Rolling Read: Chapter 9 Sections 5–6 (*HW Ch 9:50,52,56,62)*
Friday	Mar. 27	Generalizations of Angular Momentum and Torque Read: Chapter 10 Sections 1–2 (*HW Ch 10:2,4,8,10,16)*
Monday	Mar. 30	Angular Momentum Conservation, Rotational Work and Energy Read: Chapter 10 Sections 3–5 (*HW Ch 10:22,24,28,32)*
Tuesday	Mar. 31	**Lab 8:** Torque
Wednesday	Apr. 1	Parallels to Linear Motion; Quantization; Precession Read: Chapter 10 Sections 6–8 (*HW Ch 10:34,40,45,54)*
Friday	Apr. 3	Statics 1 Read: Chapter 11 Sections 1–2 (*HW Ch 11:4,8,12)*
Monday	Apr. 6	Statics 2 Read: Chapter 11 Sections 3-4 (*HW Ch 11:19,25,26,35,63,65)*
Tuesday	Apr. 7	**Test**: Chapters 7–9
Wednesday	Apr. 8	Planetary Motion and Newton's Inverse Square Law Read: Chapter 12 Sections 1–2 (*HW Ch 12:2,8,10,16)*
Friday	Apr. 10	*GOOD FRIDAY* (no class)
Monday	Apr. 13	*EASTER BREAK (no class)*
Tuesday	Apr. 14	ASSESSMENT DAY — No Class
Wednesday	Apr. 15	Planets, Satellites, and Gravity on Extended Objects Read: Chapter 12 Sections 3–4 (*HW Ch 12:20,24,38,44)*
Friday	Apr. 17	More Gravitation; Einstein's Theory Read: Chapter 12 Sections 5–6 (*HW Ch 12:48,54,60)* Paper on *Soul of Science* due
Monday	Apr. 20	Simple Harmonic Motion Read: Chapter 13 Sections 1–3 (*HW Ch 13:8,12,20,34)*
Tuesday	Apr. 21	**Test**: Chapters 10–12
Wednesday	Apr. 22	Energy in Simple Harmonic Motion and the Pendulum Read: Chapter 13 Sections 4–6 (*HW Ch 13:38,44,58,64)*
Friday	Apr. 24	Damped and Driven Harmonic Motion Read: Chapter 13 Sections 7–8 (*HW Ch 13:68,78,82)*

Monday	Apr. 27	Soul of Science discussion
Tuesday	Apr. 28	**Lab 9:** Hooke's Law
Wednesday	Apr. 29	Reading/Snow Day
Thursday	Apr. 30	Reading/Snow Day
Tuesday	May 5	**Final Exam**: 4:30–6:30 PM