SYLLABUS

Physics 0174
(CN=14286)

Fall Term 2008 (Term 2091)

Dr. Peter Koehler

Note: The information in this printed syllabus can also be found on the Web site maintained for this course under the CourseWeb address **http://courseweb.pitt.edu/**. This course is listed as **2091_14286 - PHYS 0174: Basic Physics, Science and Engineering 1 (Integrated)**. Please consult this Web site regularly throughout the term for the weekly homework assignments, reminders, special announcements, and any future revisions of this syllabus.

COURSE DESCRIPTION

Physics 0174, Basic Physics for Science & Engineering 1, is the first semester of an intensive two-term (8-credit) introductory physics course sequence. This section is restricted to freshman engineering students; the "Integrated" designation indicates that the choice of material and the order in which it is presented has been coordinated with the introductory courses in calculus, chemistry, and engineering which these students take concurrently. Some subjects that were traditionally taught in introductory physics courses will be taught instead as part of the chemistry and engineering courses. The subjects covered in Physics 0174 are: kinematics, the basic principles of classical (Newtonian) mechanics, wave phenomena, and the kinetic theory of gases. A detailed week-by-week course outline is given below.

COURSE MATERIALS

The textbook for this course is "Halliday/Resnick: Fundamentals of Physics" by Jearl Walker, 8th Edition, John Wiley & Sons (2008). The custom edition of this book that was prepared for the Department of Physics and Astronomy at the University of Pittsburgh does not include chapters 42-44 because this course does not cover that material. Bundled with this textbook you get a copy of "The Flying Circus of Physics" by Jearl Walker, a collection of real-world applications of basic physics.

You will need a reliable calculator with logarithmic, exponential, and trigonometric functions. The computer exercise sessions will utilize the PCs in the special computer classroom; you are free to copy assignments to your own PC or to other off-site computers for purposes related to this course, but you are not allowed to copy any software from the computers in that classroom.

LECTURES, COMPUTER EXERCISE SESSIONS, AND RECITATIONS

- The intensive character of this course is reflected in the fact that five contact hours are scheduled for each student each week: three hours are devoted to lectures for the entire class of up to 160 students in which new material is discussed, often with the help of illustrative demonstrations; in addition, each student will spend one hour per week doing computer exercises related to that week's course material in a special computer classroom that can accommodate up to 80 students at a time; finally, each student will spend one hour per week in a recitation, which provides an opportunity to ask questions about the lecture material and the homework problems in a setting of no more than 40 students. (The recitations are taught by graduate student Teaching Assistants.) At the end of most recitation sessions the TAs will give a short quiz that will be based on the homework assignment due that week. All of these quizzes will be graded.

The lectures, computer exercise sessions, and recitations for this section of Physics 0174 are scheduled and staffed as follows:

	Day	Time	Room	Instructor	CRN
Lectures	M, W, F	2:00-2:50pm	343 Alumni Hall	P. Koehler	14286
Computer Exercise Sessions	Mon Wed	3:00-3:50pm 3:00-3:50pm	138 Gardner Steel CC 138 Gardner Steel CC	P. Koehler & C. Huang P. Koehler & N. Nusran	14290 & 14596 14288 & 14598
Recitations	Mon Wed Fri Fr	3:00-3:50pm 3:00-3:50pm 3:00-3:50pm 3:00-3:50pm	106 Allen Hall 102 Thaw Hall 102 Thaw Hall 106 Allen Hall	N. Nusran C. Huang C. Huang N. Nusran	14288 14596 14290 14598

COURSE OBJECTIVES

Regardless of the engineering specialization you plan to pursue, you will be challenged to find practical solutions to real problems. In your future work you will be dealing with complex technical problems that can only be solved by methodical analysis and ultimately accurate calculations. The course objectives listed below have been established to help prepare you for a career in engineering:

(1) To understand the fundamental laws of physics that govern the behavior of the physical world in which we operate.
(2) To discover how the laws of physics explain the operation of common technical devices you use in daily life and many of the phenomena you encounter in the other natural sciences.
(3) To develop a systematic, analytical approach to solving problems.
(4) To learn to calculate accurate numerical solutions with the help of a computer.

MY APPROACH TO TEACHING THIS COURSE

In recent years research on the effectiveness of physics education has uncovered two surprising facts: (1) many students leave high school with significant misconceptions about how the physical world around them works, and (2) conventional introductory physics courses in college that rely largely on the transmission of information in the traditional lecture format are quite ineffective, regardless of the lecturer, in making the students let go of these misconceptions and replace them with correct ones. This research has also shown that a better way to get students to understand the important physics concepts correctly is to involve them actively during the lectures, forcing them to test the concepts they hold against experimental evidence. And students who have learned the correct conceptual framework will also discover that there is a more reliable and satisfying way to solving physics problems correctly than the "plug and chug" approach that relies on memorizing formulas. In light of these findings my approach to teaching this course will be different from what you may experience in your other courses: in my lectures I will NOT simply present the information that is contained in your textbook; **I expect you to have read the assigned sections in the textbook before you come to class.** (In order to make sure that you do this, I may periodically give a short quiz during lecture that is based on the textbook section(s) assigned for that day.) Instead of reciting the material that is found in the textbook I will use the lectures and the computer exercise sessions to elaborate on the important concepts, engage the students in predicting their consequences in certain situations, and test the predictions with a variety of demonstrations. (The lecture hall is equipped with an electronic Student Response System that enables me to pose questions and collect individual responses from each student in the class and display and/or record the results.) And as we go along in the course I will also show you by way of examples how to solve physics problems methodically and analytically.

If you want to succeed in this course you must not only attend all lectures, computer exercise sessions, and recitations, but also spend at least 10 additional hours each week reading the textbook and doing the assignments. Keep in mind that this is a 4-credit course!

COURSE OUTLINE

Caution: This outline is subject to modest adjustments as the course progresses.

Week #1	Aug 25 (M)	Lect 1: organizational details, course overview and objectives, teaching approach; the nature of physics;
	Aug 27 (W)	Lect 2: systems of units; dimensional analysis; measurement uncertainty and significant figures; scientific notation;
	Aug 29 (F)	Lect 3: mathematical tools - trigonometric functions; scalars and vectors; representation of vectors; vector addition/subtraction; illustrative examples;
Week #2	**Sep 01 (M)**	**Labor Day – no classes**
	Sep 03 (W)	Lect 4: motion in a straight line (1-D): variables used to describe motion - position, displacement, velocity; motion diagrams; illustrative examples;
	Sep 05 (F)	Lect 5: displacement vs. distance; velocity vs. speed; definition of acceleration; illustrative examples;

Week #3	Sep 08 (M)	Lect 6: mathematical description of 1-D motion – kinematic equations for constant acceleration; illustrative examples;
	Sep 10 (W)	Lect 7: generalization to motion in 2-D and 3-D; examples of 2-D motion with constant acceleration: projectiles;
	Sep 12 (F)	Lect 8: 2-D motion with non-constant acceleration: objects in uniform circular motion; relative motion; methodical approach to solving motion problems; illustrative examples;
Week #4	Sep 15 (M)	Lect 9: the concept of force; common types of forces; relationship between net force and motion: Newton's First Law; Newton's Second Law; definition of mass; finding the net force acting on an object;
	Sep 17 (W)	Lect 10: applications of Newton's Laws - illustrative 1-D examples of particles in equilibrium and particle dynamics; free-body force diagrams;
	Sep 19 (F)	Lect 11: generalization to problems in 2-D; choosing a coordinate system and decomposing forces; determining the magnitude and direction of the frictional force; illustrative examples; dynamics of circular motion – centripetal force;
Week #5	Sep 22 (M)	Lect 12: examples of uniform circular motion; interaction forces and Newton's Third Law; introduction to problems with two or more coupled objects;
	Sep 24 (W)	Lect 13: problems involving coupled systems: two ways of dealing with them; illustrative examples;
	Sep 26 (F)	Lect 14: the concepts of work and kinetic energy; definition of work as dot product of force and displacement; illustrative examples; the work-energy theorem; work done by a variable force; illustration: work done by a spring;
Week #6	Sep 29 (M)	Lect 15: definition of power; kinetic vs. potential energy; transformation of energy from one type into another; illustrations; gravitational potential energy and elastic potential energy;
	Oct 01 (W)	Lect 16: conservation of mechanical energy; using conservation of ME to solve problems; illustrative examples;
	Oct 03 (F)	Lect 17: conservative and non-conservative forces; general law of conservation of energy; pre-examination review;
Week #7	**Oct 06 (M)**	**1st hour-examination (material discussed in Lectures 1 through 15)**
	Oct 08 (W)	Lect 18: systems of particles; definition of center of mass; the concepts of impulse and linear momentum; the impulse-momentum theorem; the conservation of linear momentum law and when it applies;
	Oct 10 (F)	Lect 19: linear momentum of a system of particles; single collision problems in 1-D; elastic vs. inelastic collisions; illustrative examples;
Week #8	**Oct 13 (M)**	**Fall break – no classes (NOTE: Classes normally scheduled to meet on Oct 13 will meet on Oct 14; Tuesday classes will not meet this week.)**
	Oct 14 (T)	Lect 20: collision problems in 2-D and 3-D; illustrative examples;
	Oct 15 (W)	Lect 21: rotation of rigid bodies: angular position, angular displacement, angular velocity, and angular acceleration; examples of rigid body rotations; relationships between linear and angular kinematic variables;
	Oct 17 (F)	Lect 22: rotations with constant angular acceleration; illustrative examples; equations of motion for constant angular acceleration; the concept of moment of inertia; calculating the rotational inertia for objects of different shapes; the Parallel Axis Theorem;
Week #9	Oct 20 (M)	Lect 23: dynamics of rotational motion: the concept of torque; Newton's Second Law for rotational motion; illustrative examples;
	Oct 22 (W)	Lect 24: work and power in rotational motion; rotational kinetic energy; definition of angular momentum; the conservation of angular momentum law and when it applies; rolling motion; illustrative examples;
	Oct 24 (F)	Lect 25: conditions for equilibrium; center of gravity; examples of rigid-body equilibrium problems;

Week #10	Oct 27 (M)	Lect 26: Newton's Law of Gravitation; weight vs mass; gravitational potential energy;
	Oct 29 (W)	Lect 27: applications of Newton's Law of Gravitation – the motion of satellites and planets;
	Oct 31 (F)	Lect 28: Kepler's Laws and the motion of the Earth's planets;
Week #11	Nov 03 (M)	Lect 29: oscillations: periodic motion and simple harmonic motion: the equations used to describe SHM; example: mass on a spring;
	Nov 05 (W)	Lect 30: conservation of total mechanical energy in SHM; example of periodic motion – the simple pendulum;
	Nov 07 (F)	Lect 31: pre-examination review
Week #12	**Nov 10 (M)**	**2nd hour examination (material discussed in Lectures 16 through 28)**
	Nov 12 (W)	Lect 32: the physical pendulum; damped oscillations; forced oscillations and resonance phenomena; illustrative examples;
	Nov 14 (F)	Lect 33: mechanical waves – transverse vs longitudinal waves; mathematical description of a wave; speed of a transverse wave;
Week #13	Nov 17 (M)	Lect 34: waves on strings and sound waves; energy and power transmitted in wave motion; the wave equation;
	Nov 19 (W)	Lect 35: the principle of superposition; wave interference; standing waves;
	Nov 21 (F)	Lect 36: normal modes of a string; resonance; examples;
Week #14	Nov 24 (M)	Lect 37: sound waves – generation, speed, transmission, reception; sound intensity; interference patterns; beat frequency; the Doppler effect;
	Nov 26 (W)	**Thanksgiving break – no classes**
	Nov 28 (F)	**Thanksgiving break – no classes**
Week #15	Dec 01 (M)	Lect 38: temperature and thermal equilibrium; temperature scales; definition of heat; thermal expansion; specific heat; phase changes;
	Dec 03 (W)	Lect 39: heat and work; the First Law of Thermodynamics; four special cases of the First Law of Thermodynamics; heat transfer mechanisms;
	Dec 05 (F)	Lect 40: pre-final examination review of course material;

Week #16	**Dec 12 (F) 2:00 pm–3:50 pm (place to be announced)**	**Final Examination (all material covered in the course)**

COMPUTER EXERCISES, HOMEWORK, AND QUIZZES

The weekly computer exercises will be conducted in a specially designed computer laboratory (located in 138 Gardner Steel Conference Center) that can accommodate a maximum of 80 students at a time. Working in teams of up to three students per computer console, you will work on assignments given in the form of EXCEL files. With a powerful PC at your disposal, these problems tend to emphasize repeated numerical calculations to explore the functional dependence of one variable on another, making graphs that display such functional dependencies, and finding accurate numerical answers for more complicated situations than typical homework problems. The "peer teaching" that takes place among the students while they work on these exercises as a team has been found to be an important part of the learning process in this course. But **you will benefit from this only if you actively participate in your team's effort**. In order to obtain team credit for these exercises, the summary page of each assignment must be submitted in printed form by the specified deadline, with the names of all team members shown.

A weekly homework assignment consisting of conceptual questions and numerical problems will be announced at the beginning of the lecture every Monday and posted on the CourseWeb site. Instead of using problems given at the end of each chapter in the textbook we will be using LON-CAPA (Learning Online Network – Computer Assisted Personalized Assessment), a web-based system of homework problems that was developed and is being made available to us by physicists at Michigan State University. In order to find and work on a homework assignment, go to: http://nplq1.phyast.pitt.edu. A helpful site to get started with LON-CAPA is: http://fafnir.phyast.pitt.edu/LON/loncapa.msu.edu/student/getting_started.html

The system is "personalized" in that each student gets a unique version of an assigned problem, with a different correct answer. That forces each student to actually solve the problems instead of submitting answers worked out by someone else. The computer will tell you right away whether or not your answer is correct. The computer may provide a helpful hint if you have not found the correct answer after a few tries. But in order to discourage randomly guessing at the answer you are only allowed a maximum number of 7 tries before no further answers are accepted. For each assignment the instructor will set a due date and time after which no further answers will be accepted. The instructor also has access to your scores on each of these assignments. Shortly after the due date detailed solutions to the problems included in the latest homework assignment will be posted.

Working on the homework assignments conscientiously is the best way for you to determine whether or not you have really understood that week's material and to practice the analytical and methodical approach to problem solving that we are trying to get you to adopt. To get the most out of these assignments, you must honestly try to solve every problem before you go to your weekly recitation. Then you will know what question(s) to ask during the recitation. The recitation instructors are told to focus on those concepts that seemed to cause the most difficulties; they cannot discuss every problem on every assignment. At the end of most recitation sessions the TAs will give a short quiz that will be based on the homework assignment due that week. All of these quizzes will be graded. No make-up quizzes will be given. However, when we add up your scores for all of the quizzes given during the term, we will drop the lowest one.

WEEKLY READING AND HOMEWORK ASSIGNMENTS

WEEK	READING	HOMEWORK
#1	All of Chapter 1, Chapter 3 (Sect. 3-1 through 3-7), Appendices A, D, and E (first page);	HW Assignment #1 (due Week #2):
#2	Chapter 2 (Sect. 2-1 through 2-6);	HW Assignment #2 (due Week #3):

#3	Chapter 2 (Sect. 2-7 through 2-10), all of Chapter 4;	HW Assignment #3 (due Week #4):
#4	All of Chapter 5, all of Chapter 6;	HW Assignment #4 (due Week #5):
#5	Chapter 7 (Sect. 7-1 through 7-7);	HW Assignment #5 (due Week #6):
#6	Chapter 7 (Sect. 7-8 through 7-9), all of Chapter 8;	HW Assignment #6 (due Week #7):
#7	**Review all assigned sections in Chapters 1 through 7 for 1st exam** Chapter 9 (Sect. 9-1 through 9-10)	HW Assignment #7 (due Week #8):
#8	Chapter 9 (Sect 9-11 through 9-12), Chapter 10 (Sect. 10-1 through 10-7);	HW Assignment #8 (due Week #9):
#9	Chapter 10 (Sect.10-8 through 10-10), all of Chapter 11, Chapter 12 (Sect. 12-1 through 12-6);	HW Assignment #9 (due Week #10):
#10	All of Chapter 13;	HW Assignment #10 (due Week #11):
#11	Chapter 15 (Sect. 15-1 through 15-6); **Review all assigned sections in Chapters 8 through 13 for 2nd exam**	HW Assignment #11 (due Week #12):
#12	Chapter 15 (Sect. 15-7 through 15-9), Chapter 16 (Sect. 16-1 through 16-5;	HW Assignment #12 (due Week #13):
#13	Chapter 16 (Sect. 16-6 through 16-13);	HW Assignment #13 (due Week #15):
#14	All of Chapter 17;	Happy Thanksgiving!
#15	All of Chapter 18;	HW Assignment #14:

STUDY ASSISTANCE

Students who need additional help are **strongly encouraged** to see the lecturer and/or their recitation instructor during their regular office hours or make an individual appointment at a mutually convenient time. Do so as soon as you discover you need help. Do not wait until the day before an exam!

The Department of Physics and Astronomy maintains a **Resource Room** and **Exploration Center** for the benefit of the students in the introductory courses. They are both accessible through Room 312 on the third floor of Thaw Hall. The times during which the Resource Room will be staffed by a Teaching Assistant will be announced as soon as the scheduling arrangements have been completed. The simple laboratory set-ups that are provided in the Exploration Center during the course resemble the lecture demonstrations and are selected to help you develop a hands-on understanding of the key concepts presented in the lectures. You are strongly encouraged to experiment with them.

EXAMINATIONS

There will be two written hour-examinations (each 50 minutes long) during the term, each worth a maximum of 100 points. Both scores will be used in the calculation of your final course grade. Like the homework assignments, these examinations will consist of conceptual questions and numerical problems. The final examination will be worth a maximum of 200 points. (See the Course Outline above for the dates of and the material covered in these examinations.) **No make-up examinations will be given.**

LATE WORK AND MISSED EXAMINATIONS

As a general rule, assignments turned in after the specified deadline and missed examinations will be given zero points. Exceptions may be made at the lecturer's discretion only in documented cases of unforeseen circumstances that were clearly beyond the student's control. Such circumstances must be brought to the lecturer's attention as soon as they develop, whenever possible **before** the deadline or test.

COURSE GRADE DETERMINATION

At the end of the term we will add up the points you have earned in the following five performance measures, applying the weighting factors shown:

(1) Your attendance and participation in the lectures plus the sum of your lecture quiz (clicker) scores (maximum of <u>50 points</u>; 1/12 of your grade).

(2) Your attendance and participation in the recitation sessions, the points you earned for doing the homework assignments, plus the sum of your recitation quiz scores (maximum of <u>100 points</u>; 1/6 of your grade).

(3) The sum of your scores on the computer exercises (maximum of <u>50 points</u>; 1/12 of your grade).

(4) The sum of your scores on the two hour examinations (maximum of <u>200 points</u>; 1/3 of your grade).

(5) Your score on the final examination (maximum of <u>200 points</u>; 1/3 of your grade).

Your final letter grade will be based on the percentage of the maximum total score of 600 points that you achieve in this course. The translation of your overall course score into a final letter grade will take into account the average and the distribution of the overall course scores achieved by the entire class.

SPECIAL ACCOMMODATIONS FOR DISABILITY

If you have a disability for which you are or may be requesting an accommodation, you must notify both the lecturer for this course and the Office of Disability Resources and Services (DRS) no later than the 2nd week of the term. The DRS Office is located in the William Pitt Union, Room 216. Call (412) 648-7890 or (412) 383-7355 (TTY) to schedule an appointment. The Office of DRS will verify your disability and determine reasonable accommodations for this course. A comprehensive description of the services provided by DRS can be found at www.drs.pitt.edu.

ACADEMIC INTEGRITY

All students and instructors in these courses are expected to follow the University of Pittsburgh academic integrity guidelines. If you are not aware of the specifics, you should obtain a copy of these guidelines from the CAS Dean's Office, 140 Thackeray Hall, or look them up on page 9 of the CAS publication "*First-Year Viewpoint, 1999-2002*" or on the College of Arts and Sciences Web page. Violations of these guidelines by a student may result in a zero score for an examination or a failing grade for the entire course.

INSTRUCTIONAL STAFF

The lecturer is:

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