PHYS 120.01, Engineering Physics I
Syllabus—Fall 2011

Catalog Description

PHYS 120 Engineering Physics I (3-0-3), fall. Mechanics of particles, rigid bodies, fluids, and wave motion. Concurrent enrollment in PHYS 121 is required. Prerequisite: calculus or concurrent enrollment in MATH 185.

ACU Mission Statement

ACU's mission is to educate students for Christian service and leadership throughout the world.

Departmental Vision Statement

The vision of the ACU Physics Department is to be the premier physics department for the preparation of students for Christian service and leadership throughout the world.

Instructor

Dr. Josh Willis, Assistant Professor
Email: josh.willis@acu.edu (preferred means of contact)
Phone: 674-2527 (office), 672-1646 (home, before 9 PM)
Office: 317 Foster Science Building
Office Hours: 2–5 PM W, 1–5 PM R

Text

Six Ideas That Shaped Physics: Unit C (2nd ed) by Thomas Moore
Six Ideas That Shaped Physics: Unit N (2nd ed) by Thomas Moore

Other Materials

A green or purple ink ***pen***, lots of paper clips, and a straight edge and possibly protractor.

Course Description

Engineering Physics I is an introductory calculus based physics course directed principally towards physics, engineering, mathematics, and chemistry majors. In this course we focus on Newtonian mechanics and its applications to contemporary physics, engineering, and astronomy.

Web Site

The syllabus, course schedule, and instructor contact information will be placed on the Blackboard site for this course. You will also find it extremely useful to consult the web site for the textbook, at:

`http://www.physics.pomona.edu/sixideas/`

In particular, this web site contains computer programs that you will need both for viewing homework solutions, and for completing some problems. There are versions available for Windows, Mac, and Linux.

There is one password used to access all problems this semester, as they become available; it is **IwantACUep1ans** (capitalization matters).

An Analogy

Research into how we best learn physics—and perhaps your own experience as well—show that it has very little to do with memorizing a set of facts. Rather, it is more like learning a sport or a musical instrument: merely watching someone else (me!) do it will have very little impact on acquiring new skills.

This course is structured with that in mind. Daily readings and homework, as well as our class sessions, are like "practice," and I and your lab TA's and tutors are more like coaches. This means you can't learn physics by cramming right before an exam any more than you could skip practice all season and expect to do well at a big meet by training really hard for two days. The course policies set out in this syllabus are designed to reinforce this approach to learning.

Competencies and Assessment

Competency	**Measurement Instrument**	**Measurement Standard**
The student can apply conservation laws to the solution of realistic problems	Homework, Quizzes and Unit C Exams	1. The student will model the essential objects of a problem and identify the interactions between them. 2. The student can choose a system that on physical grounds is effectively isolated, and justify that effective isolation. 3. The student can correctly apply whichever conservation laws are useful to that system, deriving a set of master equations that form the basis for a solution. 4. The student can correctly solve the resulting mathematical model, and evaluate the plausibility of the answer obtained.
The student can apply Newton's laws to determine the forces acting on an object when its motion is known.	Homework, Quizzes, and Unit N Exams	1. The student can identify the kinds of forces acting on an object and draw a free-body diagram illustrating those forces. 2. The student can correctly distinguish between second and third law pairs of forces. 3. The student can construct motion diagrams for objects whose motion is specified. 4. The student can calculate forces acting on objects undergoing specified classes of motion: static, linearly constrained, coupled, and circular.
The student can apply Newton's laws to determine the motion of an object when the forces acting on it are known.	Homework, Quizzes, and Unit N Exams	1. The student can construct reverse motion diagrams for objects experiencing known but varying forces. 2. The student can analytically construct the reverse kinematic chain for objects in projectile motion, simple harmonic motion, and circular orbits. 3. The student can apply Kepler's laws to deduce the motion of objects subject to a Newtonian gravitational force, and classify their orbits as elliptical, parabolic, or hyperbolic.

COURSE GOALS

1. To have a comfortable and detailed knowledge of basic physical principles from mechanics.
2. To model real-world problems and apply basic principles to solve those problems using a "top down" approach.
3. To understand how the topics we cover fit into the larger scheme of physics, and something about the scientific inquiry which has led to their adoption.

Roughly speaking, conceptual knowledge in any of the goals above is assessed through quizzes, the basic homework problems (labeled with a "B" in the text), and the final. Your application of modeling and problem solving skills (the second goal above) will be measured through "S" and "R" homework problems and the unit exams. Detailed information on grading is given below.

COURSE MEETINGS

Our class time together will ***always*** assume that you have read the assigned readings; all of these are in the schedule attached to this syllabus (the chapters are in bold in the upper right corner of each day). In class, we will devote much of our time to active learning activities that help you practice what you have read about.

HOMEWORK

With only very few exceptions (indicated on the schedule) **you have homework due every day!** On days when you have been assigned to read a new chapter before coming to class, you will have two homework problems due from that assigned chapter. This is to help you practice the concepts you are reading about. On days where we recap what we have learned, you will have four harder problems due from the preceding chapters.

All homework is due at the beginning of class time; if you come in late your work will not be accepted.

Each **problem** that you turn in should be on its ***own sheet*** (or sheets) of paper; all problems for a set **must** be paper-clipped together. Work should be neat, edges of spiral paper trimmed, and your work should be turned in on blank paper (not the back of something else, a napkin from the Bean, etc.). Each problem should have your name on it. **Work failing to meet any of these conditions will not be graded.**

Each problem you turn in will be graded according to the following ten-point scale:

Complete (3 points) Points awarded as:

3 = All parts present and fully developed
2 = Some parts incomplete
1 = Major sections missing
0 = Little meaningful work done

Clear (2 points) Points awarded as:

2 = Model (physical reasoning) clear to grader
1 = Some parts of model unclear
0 = Model completely unclear

Plausible (1 point) One point awarded if the result's magnitude, sign, and/or units are plausible, ***or if you recognize that your result is not reasonable, and explain (correctly) how you know.***

Initially OK (1 point) If the solution is initially OK (full credit in all other sections) the first time the problem is turned in, then you get this extra point.

Correct (3 points) Points awarded as:

3 = no modeling *or* algebraic errors

2 = some modest errors

1 = fundamental errors

0 = almost nothing correct

On Monday, you will receive back your graded homework from the week before. At your option, you may **correct any of those problems (from the week before)**, to be turned in to the box outside the Physics Office by ***5 PM on Friday***. Your corrections must be in green or purple ***ink***, on the original paper you turned in. **You may only earn additional points in the "Clear" and "Correct" categories**. If you failed to do a problem originally, you may turn in "corrections," but the maximum possible number of points you could earn is 5 (the total of the clear and correct categories).

What do the above categories mean? "Complete" means you made a full attempt at ***all*** things that are necessary for a full solution: that is, there is a translation step, a model step, setting up some master equation, solving, and evaluation. "Correct" addresses how well you did each of those things. In the "Clear" category, we are interested in how clear your physical reasoning is: how have you modeled the problem, what assumptions have you made and why, what physical principles are you starting from and why; though it should be possible to follow your math (of course) this is really not about showing extra lines in your algebraic solution.

In summary, there will be very, very few problems (a few of the "basic skills" problems, at most) where you can get by with just a sequence of equations leading up to a number. Usually a solution of that form will lose points in both the "Complete" (because you have omitted important steps like translation, modeling, or evaluation) and "Clear" categories (because your* physical *reasoning is unclear). At the very least you should have a sentence or two explaining your strategy and physical reasoning, though for many problems that will* not *be sufficient.

On Friday at noon, solutions will become visible using the "ProbViewer" program available from the **textbook** website—***see the first page for the password***. These solutions are for the problems turned in that week (i.e., those you turn in corrections for the following Friday; you have the solutions to assist you in making corrections). Note that verbatim copying of posted solutions will not be accepted: the point is to correct what *you* did initially. And while you may collaborate with other students in working problems initially and for corrections, each of you must turn in your own work: copying is a violation of ACU's academic integrity policy.

Your lowest ***ten (10)*** **problems** will be dropped when computing your average. This is designed to allow you flexibility to cope with roommate-induced insomnia, illness, family emergencies, and the like. For this reason, no late homework will be accepted for any reason, including excused absences (see below). If you know in advance you will be gone **for an excused absence** then you may turn in an assignment early, but never late.

Quizzes and Exams

There are ten quizzes and four exams, as well as a comprehensive final. The four unit exams are listed on the schedule at the end of this syllabus; the final will be given during the final exam period scheduled by the university.

Quizzes are allotted ten minutes each and are conceptual in nature; any calculations should be quick and almost immediate. They are closed note, closed book, closed neighbor, and calculators and iThings are not allowed. They are most similar to the two minute problems we will frequently do in class. Your lowest two quiz scores are dropped in computing your quiz average.

The exams probe your ability to work longer problems. You are allowed to bring one 3 inch by 5 inch paper with anything you want written on it, but you may not use any optical magnification

devices to look at it. You may bring a calculator, but it must not contain any stored formulas or other information.

Makeup quizzes and exams are given ***only*** when missed for an excused absence. Makeup quizzes and exams will be different from the exam missed, and must be taken on the first school day you return after missing an exam, even if that is not a day this class normally meets. When scheduling the makeup quiz or exam, only class conflicts will be considered: you are responsible for making alternate arrangements for work or other extra-curricular activities. You must always contact the instructor ***before*** you miss a quiz or exam, even if that is only a phone call the morning of the exam. Per university regulation, you may not take the final exam early for any reason, including excused absence.

If you miss an exam for medical reasons, you must provide a note from a licensed health-care professional stating that you were **medically unable** to take the exam; a note confirming that you kept an appointment is ***not*** sufficient. You are medically excused only if you had an urgent health situation; routine visits should be scheduled so as not to conflict with class time.

GRADING SCALE

Grades will be assigned based on the following scale for your overall average:

A	90-100%
B	80–89%
C	70–79%
D	60–69%
F	$< 60\%$

The weighting for the final average is:

Homework	25%
Quizzes	25%
Unit Exams	10% each
Final	10%

ATTENDANCE & CONDUCT

Attendance is checked primarily through daily homework; as already noted it is never accepted late, for any reason. Also as noted, quizzes and exams can only be made up when missed for an excused absence; these are times when you must miss class because of illness, death in your immediate family, or travel on an ACU sponsored activity. The absence will not be excused until you have provided the instructor documentation in writing. Following university regulation, you will be dropped from the course with a failing grade if you miss more than 20% of the class meetings.

Our class time together will consist of active learning activities (as noted), but that does not mean that you (or I) can be disruptive or disrespectful to each other. In particular, you may not sleep, do other work, or be otherwise distracted. The latter includes in particular ***any*** use of cell phones, text messaging, iThing®, laptop computers, music players, and the like; make sure all such devices are turned off before you enter the classroom. You also may not distract the class by preparing to leave early; if you have a valid reason for needing to leave before the scheduled 10:50 dismissal time you must inform the instructor and obtain his consent prior to the start of class. If you fail to heed these warnings, your assignment for that day will receive a zero that you cannot correct and that will not be part of the lowest ten dropped from your homework average.

ACADEMIC INTEGRITY

As ACU students you are expected to embody honesty in all aspects of your life. Students found to be cheating on a quiz or exam (whether giving or receiving help) will receive a zero for that activity. A second such offense results in a failing grade in the course. If your cheating occurs on the homework, then you on the first offense you will receive a zero for all problems

assigned that week (or the eight problems including and preceding that problem, if there are fewer than eight in that week), as well as a the loss of **all** of your dropped homework privilege. This will also mean that any further cheating of any kind will result in your failing the course. Finally, note that verbatim copying of a posted solution for homework also counts as a violation of the academic integrity policy, and the same penalty as above for cheating on your initial attempt at a problem applies. If you are found to be using a cell phone or other communication device during a quiz or exam, you will be **presumed** to have cheated, until you prove otherwise to my sole satisfaction. Such devices may **not** be used as calculators even in situations where calculators are permitted. You are also bound by the ACU academic integrity policy, found in the student guide; the required excerpt from that policy is below:

Violations of academic integrity and other forms of cheating, as defined in ACU's Academic Integrity Policy, involve the intention to deceive or mislead or misrepresent, and therefore are a form of lying and represent actions contrary to the behavioral norms that flow from the nature of God. Violations will be addressed as described in the Policy. While the university enforces the Policy, the most powerful motive for integrity and truthfulness comes from one's desire to imitate God's nature in our lives. Every member of the faculty, staff and student body is responsible for protecting the integrity of learning, scholarship and research. The full Policy is available for review at the Provost's office web site (http://www.acu.edu/campusoffices/provost) and the following offices: provost, college deans, dean of campus life, director of student judicial affairs, director of residential life education and academic departments.

Engineering Physics I Schedule
Fall 2011
All problems are **due** on the date shown below

AUG	29 Course Introduction	31 **C1** Interactions C1B.1, C1B.2	2 **C2** Vectors C2B.6, C2B.9
SEPT	5 **C3** Momentum Transfer C3B.5, C3B.8	7 Recap C1S.3, C1R.4, C2S.6, C3S.2	9 **C4** Particles and Systems ***Quiz C1-C3*** C4B.1, C4B.5
	12 **C5** Momentum Conservation C5B.4, C5B.6	14 **C6** Energy C6B.2, C6B.4	16 Recap C5S.3, C5S.7, C6S.4, C6R.2
	19 **C7** Potential Energy ***Quiz C4-C6*** C7B.4, C7B.7	21 **C8** Force and Energy C8B.4, C8B.5	23 Recap C7S.7, C7S.9, C8S.5, C8R.2
	26 **C9** Rotational Energy C9B.2, C9B.4	28 ***Exam C1-C8***	30 **C10** Thermal Energy ***Quiz C7-C9*** C10B.5, C10B.8
OCT	3 **C11** Energy in Bonds C11B.8, C11B.9	5 Recap C9R.2, C10S.5, C10S.7, C11S.10	7 **C12** Collisions ***Quiz C10-C11*** C12B.5, C12B.6
	10 **C13** Angular Momentum C13B.2, C13B.3	12 **C14** Conservation of Ang. Momentum C14B.2, C14B.3	14 Recap C12S.10, C13S.8, C14S.8, C14R.2
	17 **N1** Newton's Laws ***Quiz C12-C13*** N1B.6, N1B.8	19 ***Exam C9-C13***	21 **Fall Break**
	24 **N2** Vector Calculus N2B.3, N2B.6	26 **N3** Forces from Motion N3B.1, N3B.8	28 Recap N1R.1, N2S.7, N3S.8, N3S.9
NOV	31 **N4** Motion from Forces ***Quiz N1-N3*** N4B.2, N4B.3	2 **N5** Statics N5B.3, N5B.4	4 **N6** Linear Motion N6B.2, N6B.3
	7 Recap N4S.7, N4S.9, N5S.5, N6R.2	9 **N7** Coupled Objects ***Quiz N4-N6*** N7B.2, N7B.6	11 **N8** Circular Motion N8B.2, N8B.4
	14 **N10** Projectile Motion N10B.1, N10B.4	16 Recap N7S.1, N7S.6, N8S.10, N10R.2	18 **N11** Oscillatory Motion ***Quiz N7-N10*** N11B.1, N11B.4
	21 **N12** Orbits N12B.3, N12B.4	23 **Thanksgiving**	25 **Holiday**
	28 Recap N11S.7, N11S.9, N12S.5, N12S.10	30 ***Exam N1-N8***	2 **N13** Planetary Motion ***Quiz N11-N12*** N13B.2, N13B.5
DEC	5 **N13** Recap N13S.9, N13R.2	7 Review ***Quiz N13***	9 ***Exam N10-N13***