Physics 21 is the second half of introductory physics. It is meant for all engineers and scientists at Lehigh, except those who are biologically and environmentally oriented (they would normally take Physics 13). Subjects covered include electricity and magnetism, waves, optics and a brief introduction to quantum mechanics. The preparation you need for Physics 21 includes Physics 11 as a prerequisite; and Math 23 or 33 as a co-requisite, or 52 as a prerequisite. If you do not satisfy the pre- and co-requisites, drop Physics 21 and 22 or see Professor Radin about submitting a Waiver of Prerequisite Petition.

**Lecturer and Course Leader:**
Professor Shelden H. Radin

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**Phone:** (610) 758-3919

**User ID:** shr0@lehigh.edu

**Your Recitation Instructor:**

**Office:** 

**Phone:** 

**User ID:** 

**Class Meetings:** Lectures are on Tuesdays and Thursdays (9:20 AM or 10:45 AM in LL 270, as assigned by the Registrar), and Recitations are on Mondays and Wednesdays, at times assigned by the Registrar. Since physics is a very cumulative subject, keeping up-to-date is essential. Consequently, you are expected to attend all classes, lectures and recitations, and to do all assignments on time.

Students who neglect the course will be dealt with under the Attendance Regulations (see the Student Handbook). Evidence of neglect of the course includes, but is not limited to, missing or inadequately attempted homework, missing quizzes and tests, and poor attendance in lectures and/or recitations.

**Text:** University Physics, Revised Edition, by Harris Benson (John Wiley & Sons, 1996). You probably already have this book from Physics 11.

**Optional Video programs** are from The Mechanical Universe series of 52 video programs (each 27 minutes long), which cover the material of both Physics 11 and 21. They are available in the Media Center in Fairchild-Martindale Library. The Video Program numbers on the Schedule and Assignment sheet refer to the programs that best correspond to the material in that lecture; they are not assignments. The videos are well-done and include excellent animation. Students who learn visually often find them attractive and useful.

Reading assignments are to be completed before the lecture listed on the Schedule and Assignment sheet. This will make lectures more efficient and allow us some time during the lecture period to discuss and test our understanding of some of the basic concepts.

Homework assignments will be collected at the beginning of the recitation class listed on the Schedule and Assignment sheet. Note that most assignments include problems from both the last lecture and the one before it. You should take this into account when planning your study times.
missing homework will be given a grade of zero. The three lowest homework grades will be dropped (this is in lieu of excuses for late or missing homework).

The goal of the written homework is to develop your problem-solving ability and to extend the depth of your understanding of the conceptual material. You should start your thinking about a problem by identifying the basic concept behind the phenomena described. It takes practice to do this and the homework is meant to give you some, but not all, of that practice. Thus, it is very important in your solution to identify in words the concept behind each problem. It is also very important to draw sketches to help you visualize the situation. When we look at your homework, we will look for a clear identification of the concept, appropriate sketches, and a clearly presented solution.

You may, at your option, start the problem by writing out the question; this process can help you think about the problem and it can be very convenient to have when you go back to your homework later in your studying. A proper solution takes space; don’t skimp on paper! Keep in mind that you are communicating with the reader and so you must include enough to be clear about what you are doing. This becomes even more important on a test since the grader can only grade on what you have written, not on what may or may not have been in your mind but was not committed to paper. The Homework 1 solution from last fall is attached as an example of a useful format; we will expect you to use a similar, or equally effective, format.

**Homework Strategy:** The homework is usually most efficiently done in more than one work session. In your first session, if you get stuck on a problem for more than 10 or 15 minutes, put it aside and come back to it in your next work session. That will give you time to think about it subconsciously. If you still can’t get started in another 10 minutes in your second session, ask a friend or your instructor for a hint so that you can get started again. At this stage, small group discussions with your peers can be very effective. Don’t just copy someone else’s solution. To encourage you to show your best effort even if you know that it is wrong, your homework will be graded on an estimate of effort, not the correctness of your solution [but note that in most assignments we believe that a reasonable effort (including discussions with others) should result in at least half the solutions being done correctly].

**Homework Quizzes** on homework assignments will be given as listed on the Schedule and Assignment sheet. They will be closed book with no equation sheets, and will consist of a slightly modified homework problem from one of the assignments listed in parentheses. Homework quizzes will be graded on the quality of the solution. If you miss a homework quiz, you will be given a grade of zero. The two lowest homework quiz grades will be dropped (this is in lieu of excuses for missing quizzes).

**Additional Studying:** Homework problem assignments are meant only as an introduction to some important types of problems that illustrate the subject matter. They are not meant to be all-inclusive of what we expect you to learn. We want you to learn general concepts and how to apply them in new situations. You should test your understanding of the concepts by applying them to unassigned problems, from either this text or others.

An alternative strategy that helps you to concentrate on the basic concepts is to make up additional problems (i.e., physical situations), starting from a particular concept. If you have great difficulty making up a problem, start with a problem with which you are familiar, identify the basic concept associated with the problem, then modify the problem significantly (change geometry, change which variables are the unknowns, etc.; don’t just change the numbers). Repeat this process with the new problem and you will have a problem that bears little resemblance to the original problem but is still
described by the same basic concept. In this way, you think about the various ways that a particular concept manifests itself in nature and that, in turn, helps you to recognize the concept that is fundamental in understanding a particular physical phenomenon (in problem solving, this tells you the starting point). **This technique is particularly useful for preparing for tests since it helps you to recognize the starting point for a question.**

**Equation Sheets 1, 2, and 3** are included with this syllabus. The appropriate equation sheet(s) will be attached to your tests and the final examination. You may wish to use them while doing your homework so that you will be familiar with what is, and what is not, on them. You’ll notice that the equations on the equation sheets are the more fundamental ones associated with the basic concepts, not those that are derived for special cases. That is purposeful since the dual goals of physics are to describe nature with the fewest concepts possible and to learn to apply those concepts to describe whatever specific case is of interest at the time. The alternative of describing each specific case individually provides little lasting understanding and is overwhelming because of the infinity of physical situations.

**Tests:** Two one-hour tests are listed on the SCHEDULE and ASSIGNMENTS sheets. They are on the 4 o’clock test schedule. Room assignments will be announced in class. **If you miss an hour test, an appropriate part of the Final Examination will serve as a make-up test (also see Grading below).** The **Final Examination** will be scheduled by the Registrar during the Final Examination period.

**Grading:** Your numerical grade will be computed as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Hour Tests</td>
<td>200</td>
</tr>
<tr>
<td>Homework</td>
<td>50</td>
</tr>
<tr>
<td>Homework Quizzes</td>
<td>50</td>
</tr>
<tr>
<td>Final Examination</td>
<td>200</td>
</tr>
<tr>
<td>Numerical Grade</td>
<td>500</td>
</tr>
</tbody>
</table>

The Final Examination will cover the entire course. Two parts (there will also be a third part) will be identified as corresponding to the hour tests. Each of these two parts will be scaled to 100 and compared to your corresponding test grade; **if your scaled grade is greater, your test grade will be substituted for the original test grade.** We do this substitution because we feel that what you know at the end of the course is more important than what you knew while you were first studying the material. Of course, **we will not substitute a test grade for part of the final examination.**

Your **laboratory**, Physics 22, has a separate course number and you get a separate grade in it. However, Physics 21 and Physics 22 are intimately related. Take advantage of your laboratory experiences to understand the theory and applications we develop in Physics 21, and use Physics 21 to help you get real understanding from the experiments in Physics 22.

The **Getting to Know You** questionnaire attached to this syllabus is to be filled out and brought to your recitation instructor in your next recitation. It will help your recitation instructor get to know you faster. We can all work better together when we know each other well, so help your instructor get to know you, and you should get to know her or him as well. And don’t forget me, your lecturer and course leader, Professor Radin. Talk to me before or after lecture or in my office, LL 409. I probably won’t be able to get to know you as well as your recitation and laboratory instructors because they’ll see you in smaller settings, but we can try.