# Physics 270: Electromagnetism, Light, Relativity and Modern Physics
# Sections 0301 to 0304 — Professor Shawhan — Fall 2015

The most up-to-date version of the syllabus can always be found on
the course web site, reachable via **http://ter.ps/shawhan270**

## Contact information

Prof. Peter S. Shawhan, room 2120 in the Physical Sciences Complex (PSC) building,
pshawhan@umd.edu, 301-405-1580

Lectures: Mon,Wed,Fri 12:00-12:50 in room 1410 of the Physics Building

Office hours: normally Tuesdays and Thursdays 1:30-3:30, and
Wednesdays and Fridays 2:00-4:00. (Check course web site for exceptions)

*If you have a question or issue that can't be handled during office hours, please email or call.*

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## Overview

As you know, this is the third and final semester of the general physics sequence designed for engineers. This is when things get interesting! To some extent, we will build on basic concepts that were covered in the previous two semesters, such as force and motion, oscillations, and electrical circuits. However, this course is more about rich topics that bring us up to the modern era: electrodynamics, Maxwell's equations and electromagnetic waves, classical geometric optics, wave optics (interference and diffraction), relativity, and quantum mechanics. These things enable most of the technologies that make modern life what it is, and tell us most of what we know about the universe around us.

This course will move quickly, and it is important for you to keep up! I will expect you to read the textbook—I'll tell you what sections, and try not to give you more than necessary—and attend the lectures and your scheduled discussion sessions. Participation will be factored in when calculating your course grade. My lectures will not simply repeat things that you can read in the textbook, and will often be interactive—please come ready to think and respond, not just to take notes! Homework each week will be a combination of online work and written-on-paper problems that you'll turn in in class. To do well in the course, it is up to you to make sure you fully understand everything we cover. I and the TA will explain it as well as we can and help when you have questions, but real learning happens inside your head, not in front of your eyes.

Physics is fundamentally an experimental science—there is plenty of theory and mathematics, but everything is grounded in what happens in real life. The Engineering School and the Physics Department consider lab experiments to be an important part of your physics learning, but have organized them under a separate course number (PHYS 271) for scheduling flexibility. Both PHYS 270 and PHYS 271 must be taken in the same semester and the scores for the courses will be combined to calculate a single grade that will be entered for both courses. It is your responsibility to make sure that you are enrolled in both courses; note that total enrollment may be limited by the number of seats available in PHYS 271 even if there are seats available in PHYS 270. To pass, students must complete passing work in both PHYS 270 and PHYS 271. (If you are transferring a PHYS 271 score from a previous semester, let me know early in the semester.)

## Required course materials

You will need four things for this course: the textbook, a subscription to the MasteringPhysics online tutorial/homework system, a subscription to the Learning Catalytics (LC) interactive response system, and a device you can bring to class to use Learning Catalytics. The first three of those can be obtained all together as a bundle, or separately. Read the information below carefully for options and advice.

The required textbook for this course is "Physics for Scientists and Engineers with Modern Physics: A Strategic Approach" by Randall D. Knight, published by Addison-Wesley/Pearson. The book is currently in its third edition, and that is the version that the bookstore is selling. Actually, the second edition of Knight is an acceptable substitute in my course and you might be able to get one cheap. See below for how to purchase MasteringPhysics and LC access separately if you are starting with a used copy of either the second or third edition.

If you are starting from scratch and like having a printed book, the easiest way to get all the things you need for the course is to buy the standard bundle, which contains a new copy of the textbook and a MasteringPhysics access code card that also gives you access to LC (integrated with MasteringPhysics). The ISBN for this bundle is 9780321736086.

An alternative, if you don't feel you need a printed copy of the book, is to purchase MasteringPhysics with the eText option at masteringphysics.com. (This gives you integrated LC too.) The cost for that is $111.50 online. However, I don't find the MasteringPhysics eText very easy to navigate through, and the eText expires after a couple of years. (A printed book, on the other hand, can be sold if you don't want it any more.)

But if you took PHYS 161 and/or PHYS 260 here at UMD and used MasteringPhysics, then you probably already have a copy of the book and still have MasteringPhysics access, and you may not have to buy anything more. Try logging in at masteringphysics.com and joining the course with ID "SHAWHAN2015". If that succeeds and you're viewing the course home page, look along the right side for a "Learning Catalytics" link. Try clicking on that; if that gets you into LC, then you should be all set!

There are a couple reasons why that might not work for you. First of all, your MasteringPhysics access needs to be keyed to the Knight book, third edition, for you to be able to join the SHAWHAN2015 course; if you got your access code with some other book, including the second edition of Knight, it won't work with our course. Second, Learning Catalytics is integrated with MasteringPhysics only if you got the eText with your MasteringPhysics access. If you have MasteringPhysics but it does not have the eText and LC, then you can purchase a 6-month LC subscription for $12 at learningcatalytics.com.

Finally, if you have a copy of the textbook (e.g., a used printed copy, or a non-Pearson eBook) but do not have working MasteringPhysics/LC access, you can purchase MasteringPhysics access without the eText for $66 at masteringphysics.com and LC for $12 at learningcatalytics.com.

In any case, to use Learning Catalytics, you will need to bring a smartphone, tablet, iPod Touch or laptop to each class to use the service to participate in the questions and group activities.
(If you're not able to bring one of those devices to class, please contact me to discuss this.)

## Course grade calculation

Your scores from the different parts of Physics 270 will be combined as follows:

| | |
|---|---|
| 5% | Participation (lecture interactions, discussion attendance, end-of-semester survey) |
| 20% | Homework (including online and written-on-paper parts) |
| 45% | Midterm exams (15% each) |
| 30% | Final exam |

Participation scores will allow for missing up to three class sessions and one discussion meeting with no deduction, no excuse needed. However, please make sure I'm aware of any excused absences, e.g. for illness. (Don't just tell your TA – tell me.) No homework or midterm exam scores will be dropped—all will be used to calculate your grade.

Some Physics 271 (lab) TAs tend to give systematically high scores on lab reports. I will consult with the Physics 271 course staff at the end of the semester about how to interpret the total scores. I expect that we will make section-by-section score adjustments to take out grading systematics, and apply an overall curve so that the average score will correspond to a B/B+ for the lab portion.

Finally, I will combine your overall PHYS 270 and curved PHYS 271 scores, with weights of 75% and 25%, to calculate the letter grade that will be submitted for both courses.

## Course policies

**Late or missed work:**
Assignments must be completed and turned in when they are due unless you have a valid excuse according to university policy, *e.g.* illness or family emergency, in which case an extension will be granted. Please let **me** (not just your TA) know your situation as soon as possible, and I will tell you if I need documentation for the reason for your absence. In general, no credit will be given for work turned in late without a valid excuse, but contact me if there is some extenuating circumstance.

In the case of illness, we will follow the university policy posted at http://www.president.umd.edu/policies/v100g.html: The *first* time you miss a due date during the semester, I will accept a self-signed note from you (without a doctor's note) explaining the dates of your illness and stating that the information is true and correct. If illness causes you to miss more than one due date during the semester, or to miss an exam, I <u>will</u> require a doctor's note. If you do miss an exam, I will schedule a make-up time with you as soon as possible—it starts to cause problems if it's more than a few days later. In any case, whatever the reason for your absence, it is important that you contact me as soon as you reasonably can.

**Policy on collaborating:**
Working together with other students is part of the course, e.g. in the lectures, discussions, and PHYS 271 labs. Working together to study and figure out the homework is also encouraged, but you must do and turn in **your own work**! This simple rule applies: **Never look at someone else's written solution** (on paper, a blackboard, or a screen). That applies to your classmates as well as anything you might find on the web. Talking about how to work the problem is fine if it helps you to understand it better, but copying a solution is strictly forbidden (and will not enable you to succeed on the exams). Work that appears to have been copied will receive zero credit and may lead to an academic integrity referral (see below).

**Honor Code:**
The University of Maryland has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. I will ask you to sign the Honor Pledge on exams; I won't ask you to sign it on each homework assignment, but it should be understood that the Honor Code still applies to homework. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. Violations will be taken very seriously and may result in an XF grade for the course and possible suspension. As your teacher, I have an obligation to uphold the Honor Code and have had to submit some Academic Integrity Referrals over the past few years, unfortunately, which led to XF grades. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://shc.umd.edu/SHC/Default.aspx .

**Religious observances**:
If you need to miss class, discussion, a homework deadline, or an exam due to a religious observance, please notify me in advance—preferably at the beginning of the semester—so that we can make appropriate arrangements.

**Students with disabilities:**
Accommodations will be provided to enable students with documented disabilities to participate fully in the course. Please discuss any needs with me at the beginning of the semester so that appropriate arrangements can be made.

**Weather or emergency closures:**
If the University is closed due to weather or some emergency situation on a day when homework is due, then that homework must be turned in at the beginning of the next class when the University is open. If the University is closed on the scheduled date of an exam, then the exam will be given during the next class period when the University is open. If the University is closed on any non-exam day, including just before an exam, then the exam will still be given according to the original schedule.

If some calamity causes the University to be closed for an extended period, I will continue the course by recording video lectures and posting them on the web, and will ask you to watch them, read, and do homework assignments on your own. In these or other exceptional circumstances, I will attempt to send out information by email.

**Course announcements by email:**
If I need to send important information to the class, or to you in particular, I will send it to your **umd.edu** email address (unless I happen to know a better address for you and remember to use it). So, if you use some other email system, please make sure that mail sent to your umd.edu address is successfully forwarded to the address you use most regularly.

**Privacy:**
You have a right to privacy of your educational records, including the fact that you are enrolled in this course, but I hope you won't mind if the TA and I may call you by name in the presence of other students, and hand back graded papers in class. If that may be an issue or if you are ever uncomfortable with the class environment, please don't hesitate to let me know.

## Help Resources (in addition to discussion meetings and office hours)

I have created a Piazza online discussion forum for our course. As you may know, Piazza is a completely free service. If you have a question that you'd like to ask, I encourage you to post it on Piazza -- that way you can get a reply at any hour of the day or night. Naturally, if you see a question posted and have a good answer or comment to contribute, please do so! Just remember that the **Policy on collaborating** applies to online communications too, so don't give answers away, but discuss in a way that aids learning! Also, the TA and I might step in too if there is something we think we can clarify. You can even post anonymously if you want (though the TA and I will still know who made the post). We will also post announcements on Piazza from time to time, so it's important that you be registered.

The Slawsky Physics Clinic is staffed by volunteers who offer free assistance with studying and homework, typically Monday through Friday from 10:00 to 3:00. The Clinic is located in room 1214 in the Toll Physics Building.

If you are interested in hiring a private tutor, the Physics Department maintains a list of people who offer such services – see http://umdphysics.umd.edu/academics/academic-support.html .

***Note:*** Although you may get help in many forms, remember the **Policy on collaborating** described above! Please remind the people you are working with that they should explain and help you learn, not simply show you the answer to a problem, since you are not allowed to copy anyone else's written answer (and you wouldn't learn much, if anything, from it). Also, it is ultimately your responsibility to understand and arrive at (your own) correct answers. There is not much I can do if someone else gives you an ambiguous or incorrect line of reasoning, and even professionals make mistakes from time to time. Therefore, receive help with a healthy skepticism and cross-check your understanding to make sure it really holds together.

If you are experiencing difficulties in keeping up with the academic demands of this course and/or your overall course load, I encourage you to contact the Learning Assistance Service, 2202 Shoemaker Building, 301-314-7693. Their educational counselors can help with time management, reading, math learning skills, note-taking and exam preparation skills. All of their services are free to UMD students.

### Copyright Protection of Course Materials

I hope you get a lot out of this course, but not by taking and selling the course materials! ☺
Please understand that my lecture slides, handouts, homework and exam problems and solutions, and the lectures themselves (including any audio or video recordings) are copyrighted by me and/or by other people and may not be distributed or reproduced without explicit permission.

# Physics 270 Course Schedule

## Fall 2015 — Professor Shawhan

v2

| # | Homework due: Online | Homework due: Paper | Lecture | Lecture topic(s) | Book sections (Knight 3rd ed.) | (Knight 2nd ed.) |
|---|---|---|---|---|---|---|
| | | | Aug 31 | Course intro; Magnets | 32.1-2 | 33.1-2 |
| | | | Sep 2 | Magnetic force on charged particles | 32.7 | 33.7 |
| *Intro* | Sep 4 | | Sep 4 | Applications of magnetic force | 32.8-9 | 33.8-9 |
| *1* | Sep 6 | | Sep 7 | ** *Labor Day — No class* ** | | |
| | | Sep 9 | Sep 9 | Generation of magnetic field: Biot-Savart law | 32.3-5 | 33.3-5 |
| | | | Sep 11 | Calculation of magnetic field: Ampere's law | 32.6 | 33.6 |
| *2* | Sep 13 | Sep 14 | Sep 14 | Magnetic properties of materials | 32.10+lecture | 33.10+lecture |
| | | | Sep 16 | Magnetically induced currents | 33.1-3 | 34.1-3 |
| | | | Sep 18 | Faraday's Law and Lenz's Law | 33.4-6 | 34.4-6 |
| *3* | Sep 20 | Sep 21 | Sep 21 | Applications of induction; Transformers | 33.7 | 34.7 |
| | | | Sep 23 | Inductance & inductors; Review of circuits | 33.8, Ch. 31 | 34.8, Ch. 32 |
| | | | Sep 25 | RC, LC and LR circuits | 31.9, 33.9-10 | 32.9, 34.9-10 |
| *4* | Sep 27 | Sep 28 | Sep 28 | Review & Discussion | | |
| | | | Sep 30 | **Exam 1** | | |
| | | | Oct 2 | RLC circuits; AC circuit fundamentals | 35.1-4 | 36.1-4 |
| *5* | Oct 4 | Oct 5 | Oct 5 | AC driven RLC circuits | 35.5-6 | 36.5-6 |
| | | | Oct 7 | Maxwell's equations | 34.2-4 | 35.2-4 |
| | | | Oct 9 | Electromagnetic waves and their properties | 34.5-7 | 35.5-7 |
| *6* | Oct 11 | Oct 12 | Oct 12 | Foundations of relativity | 34.1, 36.1-4 | 35.1, 37.1-4 |
| | | | Oct 14 | Implications: time dilation, length contraction | 36.6-7 | 37.6-7 |
| | | | Oct 16 | Lorentz transform; Addition of velocities | 36.8 | 37.8 |
| *7* | Oct 18 | Oct 19 | Oct 19 | Relativistic momentum and energy | 36.9-10 | 37.9-10 |
| | | | Oct 21 | General relativity | lecture | lecture |
| *8* | Oct 23 | | Oct 23 | Review & Discussion | | |
| | | Oct 26 | Oct 26 | **Exam 2** | | |
| | | | Oct 28 | Light and reflections | 23.1-2, 23.8 | 23.1-2, 23.8 |
| | | | Oct 30 | Refraction and total internal reflection | 23.3-4 | 23.3-4 |
| *9* | Nov 1 | Nov 2 | Nov 2 | Lenses | 23.6-7 | 23.6-7 |
| | | | Nov 4 | Optical assemblies | 24.1-3 | 24.1-3 |
| | | | Nov 6 | Optical instruments | 24.4-5 | 24.4-5 |
| *10* | Nov 8 | Nov 9 | Nov 9 | Interference of light | 22.1-2 | 22.1-2 |
| | | | Nov 11 | Diffraction | 22.3-5 | 22.3-5 |
| | | | Nov 13 | Applications of interference and diffraction | 22.6 | 22.6 |
| *11* | Nov 15 | Nov 16 | Nov 16 | Breakdown of classical physics: radiation | 37.1-2 | 38.1,38.8 |
| | | | Nov 18 | The photoelectric effect | 38.1-3 | 39.1-3 |
| *12* | Nov 20 | | Nov 20 | Review & Discussion | | |
| | | Nov 23 | Nov 23 | **Exam 3** | | |
| | | | Nov 25 | The wave nature of matter particles | 38.4, 39.1-2, 39.5-6 | 39.4, 40.1-2, 40.5-6 |
| | | | Nov 27 | ** *Thanksgiving holiday — No class* ** | | |
| | | | Nov 30 | Schrödinger quantum mechanics | 40.1-2, 40.7 | 41.1-2, 41.7 |
| *13* | Dec 3 | Dec 4 | Dec 2 | Particles in potential wells | 40.3-6 | 41.3-6 |
| | | | Dec 4 | Quantum harmonic oscillator; Tunneling | 40.8, 40.10 | 41.8, 41.10 |
| *14* | Dec 10 | Dec 11 | Dec 7 | Atomic spectra and applications | 38.6-7, 41.6, 41.8 | 39.6-7, 42.6, 42.8 |
| | | | Dec 9 | Cosmology and nucleosynthesis | lecture | lecture |
| | | | Dec 11 | Course review and discussion | | |
| | | | Dec 16 | **Common Final Exam, 6:30-8:30 pm (to be confirmed)** | | |