

Physics 54: General Physics II

Duke University
February 17, 2006

Welcome

Welcome to Physics 54, the second part of the Physics Department's two-semester introductory survey course that is taken especially by students with interests in the life sciences (although the course welcomes students of all interests). Many of the lectures and labs discuss applications of physics to medicine and biology, and nearly all of the material is useful for understanding how biological organisms function or how the many experimental devices used by life scientists work. However, Physics 54 is foremost a physics course and its main goal is to introduce you to theoretical and experimental insights, and to teach related quantitative problem-solving skills, that are broadly useful to many areas of science, as well as to the life sciences. Fortunately, physics is also an interesting subject and most 54 students are pleasantly surprised to find that the course is genuinely rewarding in its own right, with many neat insights. For example, it is satisfying to understand "what is light", especially light's unexpected connection to oscillating electric and magnetic fields.

Throughout the semester, please feel free to ask any of us, at any time, questions that you have regarding the course or course material. All the instructors greatly like physics and would like this semester to be an enjoyable and rewarding experience for you.

The Physics 54 Blackboard Webpage: <https://courses.duke.edu>

The Physics 54 Blackboard webpage will be an essential source of information throughout the semester. You should look at this webpage several times each week, especially before each lecture or exam. Last-minute announcements, course documents, PowerPoint lecture files, answers for assignments and quizzes, sample exams with answers, local events such as visiting lecturers or nearby exhibits, interesting websites related to the lectures, and staff information will be posted on the course Blackboard website. Especially during the first week of the semester, you should explore the course site thoroughly to become familiar with available information and resources.

Personnel and Office Hours

The following table gives the contact information for the instructors of the course:

Professor	Role	Office	Phone	E-mail
Dipankar Dutta	Recitation Instructor	TUNL 422	660-2497	ddutta@tunl.duke.edu
Henry Greenside	Lecturer, recitation instructor, and course coordinator	Physics 097	660-2548	hsg@phy.duke.edu
Bill McNairy	Recitation instructor, course administrator, demos	Physics 142A	660-2689	mcnairy@phy.duke.edu
George Rogosa	Recitation instructor	Physics 186	660-2509	rogosa@phy.duke.edu
Werner Tornow	Lecturer and recitation instructor	TUNL 414	660-2637	tornow@tunl.duke.edu

Professors Dutta and Tornow have offices in TUNL, the Triangle Universities Nuclear Laboratory (www.tunl.duke.edu). This is the two-story concrete building behind and slightly to the right of the Physics Building, as you face the front of the Physics building.

Professor McNairy is the administrator for the course and is the person to contact if you have questions concerning course prerequisites, scheduling conflicts, and recorded grades. However, all questions about how homeworks, quizzes, or exams were graded should go first to your recitation instructor, not to Professor McNairy.

Questions about labs should be directed first to your lab Teaching Assistant. If the lab TA can not answer your question to your satisfaction, please contact Professor Mary Creason, the professor in charge of the 54 labs, at the email address labs@phy.duke.edu.

Office hours are by appointment. If you have any questions whatsoever about any part of the course, please do not hesitate to get in touch with your recitation instructor or with the lecturers by phone or by email. Most will be able to meet with you within a day after a request for a meeting. Professors Tornow and Rogosa are also available to meet with students on weekends.

Prerequisites and Requirements

To enroll, a student must have received a C- or higher in Physics 53 or its approved equivalent. Please contact Professor McNairy as soon as possible if you are not sure whether you satisfy this prerequisite or if you are not sure which of the several introductory physics courses to take.

To receive a grade for Physics 54, each student must register for a recitation-lab section, in addition to a lecture section.

Students need to know some elementary algebra and calculus at the level used in Physics 53. Students should know how to manipulate simple algebraic expressions, to solve two linear equations in two unknowns, to calculate and understand the meaning of dot products and cross products of vectors, to measure angles in radians, and to use the definitions of the basic trigonometric functions and of their inverses. Students also need to know calculus at an elementary level, e.g., how to evaluate derivatives and integrals of simple polynomials, of the trigonometric functions, and of exponential functions. They need to understand how an integral is obtained conceptually as the limit of a sum, and they need to know qualitatively how to deduce the form of a function that represents the derivative or integral of some other given function whose form is qualitatively known.

Students need to have three items for the semester:

1. **The required text**, which is *Physics for Scientists and Engineers, Third Edition, Volume 2*, by Douglas Giancoli (Prentice Hall, 2000). If you do not yet have a copy, we recommend that you purchase this text as a bundle through the Duke textbook store. The bundle includes a student study guide (which has many solved problems and sample questions, great for preparing for exams), a book called *Physlet Physics*, and a rebate coupon for a PRS transmitter that can be purchased at the Duke Computer Store in the basement of the Bryan Center.
2. **A PRS (“Personal Response System”) transmitter**. Although a small part of your course grade depends on your class participation as recorded by use of your transmitter, the real benefit of this transmitter is your ability to answer questions during lecture anonymously, and the ability of the professor to show the class in real time how well a particular question was understood. The in-class PRS questions are a valuable and fun part of the course since they give you a chance to meet and talk with other students during class, to see if you understand concepts that were just introduced or explained, and especially to participate actively during lectures.
3. **A scientific calculator**. For homework assignments and labs, you will need an inexpensive calculator capable of handling scientific notation (for example $-1.23\text{E}-5$ to represent the number -1.23×10^{-5}) and

common scientific functions such as sin, cos, log, and exp. A Texas Instrument TI-82 calculator is fine but overkill for this course, a \$10 calculator will do just fine. You will not be allowed to use your own calculator during quizzes and exams since modern calculators have become powerful enough to store, compute, and in some cases communicate all kinds of extra information that might give some students an unfair advantage. The recitation instructors will provide standard calculators during the quizzes and exams.

Lectures

Physics 54 will be taught using lectures, recitations and labs. The lectures will be given each Tuesday and Thursday from 10:05-11:20 AM (first lecture) and 11:40 AM-12:55 PM (the same lecture a second time) in Physics Room 128 (this was formerly Room 114). Professor Tornow will give all lectures during the first half of the semester and Professor Greenside will give all lectures during the second half.

The lectures will not cover in detail the required weekly reading since there is not enough time to do so. Instead, the lectures will introduce, motivate, and explain key ideas, work out representative examples on the white board with the opportunity for the class to ask questions, illustrate concepts and applications with occasional demos, and stimulate class discussion with PRS questions.

It is extremely important that you keep up with the weekly reading assignment in the text. You should read the recommended parts of the text *before* the lecture that discusses those parts.

The Teaching Resource Room and Other Opportunities for Help

Starting Sunday evening on January 22, you will be able to come to the Teaching Resource Room, Physics 150, for help from the Physics 54 Teaching Assistants for any aspect of the course. This Room will be available throughout the semester, Sundays through Wednesdays, from 8-10 PM. So that you can complete the homeworks on your own, the Teaching Assistants will not show you full solutions but instead will give hints or will work out related examples. Please take advantage of the Resource Room throughout the semester!

If you need help beyond that provided by the Teaching Resource Room, there are several possibilities. The recitation instructors and course lecturers are glad to meet with you throughout the semester, and are especially important people to talk with (the earlier the better!) if you are finding the course difficult. There are physics graduate students available as tutors (listed on the web page www.phy.duke.edu/ugrad/intro.ptml#tutors) but you will need to pay for their help. Finally, up to twelve hours of free help is available through Duke's Peer Tutoring Program, whose webpage is <http://aaswebsv.aas.duke.edu/skills/PTPwebsite/>.

How Your Final Grade Will Be Determined

For all aspects of this course, we expect students to abide by the Duke Community Standard. (See the webpage www.duke.edu/web/HonorCouncil/communitystandard.html for details about the Standard). Students violating the Standard on any part of the course will receive a zero for that part and administrative action will be taken. In some cases, the penalties can be severe such as obtaining an F for the course and being asked to leave Duke for a semester or more. Such consequences will not help you get into medical school.

The following are the different components of the course that contribute to your final grade:

1. **The final exam** will constitute 30% of the grade. This 3-hour exam is cumulative and comprehensive in that the questions will cover material from the entire semester, including topics mentioned in lectures, the textbook, labs, quizzes, homework assignments, and the midterm exams.
2. **Two in-class midterm exams** together will count 26% of the final grade. The best midterm score will count 16% and the other midterm score will count 10% toward your final grade. The midterms are not

cumulative in that they will test material covered since the previous midterm. However, you will need to understand material covered up to the first midterm exam to solve some of the problems on the second midterm.

3. **Weekly homework assignments will** constitute 15% of the grade. The lowest homework grade over the semester will be dropped before determining the final homework grade.
4. **Weekly recitation quizzes** will constitute 15% of the final grade. The lowest quiz grade over the semester will be dropped before determining the final recitation grade.
5. **The weekly labs** will constitute 10% of the final grade. The lowest lab grade over the semester will be dropped before determining the final lab grade. However, if a student misses a lab without a valid excuse, a zero grade will be entered that will not be dropped from the final lab grade.
6. **In-class PRS responses** will constitute 4% of the grade. The grade is based on participation, not on whether you answered the PRS questions correctly.

The different parts of the course are discussed separately further below.

There will be no make-up homeworks, quizzes, PRS questions, labs, or exams during the semester. Students who miss one of these without a valid excuse will receive a zero. Students who miss one of these with a valid excuse will have their grade based on the other parts of the course. A valid excuse usually means a formal “Dean’s excuse” arising from a Duke-sponsored event or from illness.

An overall course score will be deduced for each student based on the above weightings and then these scores will themselves be scaled to recommend a final course grade to each recitation instructor. The recitation instructor has the flexibility to make modest changes to the recommended final grade, allowing him or her to take into account personal knowledge of a student’s performance over the semester.

All questions concerning your grades should go first to your recitation instructor, since it is your instructor who will assign you midterm and final exam grades as well as your final course grade. Questions about possible errors in how grades were calculated or recorded should go to Professor McNairy.

Graded quizzes and midterm exams will be returned to you in recitation. If after looking over the answer sheet you believe there is an error in the grading of a midterm exam, you can ask for a regrade. You do this by returning your exam with a *written* regrade request to the course lecturer, in class, *no later than the Thursday lecture of the week after you get your exam back.* (This is a period of about six days after you get your graded exam.) After this Thursday lecture, you lose your right to request a regrade for that exam.

Your written request must list clearly and specifically which parts of your exam you believe were graded incorrectly and why. Be warned: once a request is handed in, you can not take it back. If an error is found that, when corrected, decreases your exam score, your exam grade may also decrease.

Recitations and Recitation Quizzes

Recitations provide an informal and valuable time for students to learn from each other as well as from the instructor while working on the weekly recitation problems. Each recitation is organized roughly as follows:

- At the beginning of each recitation, the instructor will answer questions from the students, review material from recent lectures, and possibly work out some illustrative examples. The recitation problems to be worked out that day will be written on the blackboard.
- Students will then divide up into small working groups of three to four to collaborate on the recitation problems. While students are working on the recitation problems, the instructor will walk around the class to provide encouragement and help (if help is needed).

- After about 45 minutes, the instructor will call on each group to send a representative to the front of the class to explain a problem solution to the rest of the class. No grade is recorded for these presentations. The next time that a group is called upon, a different person becomes the presenter.
- Each recitation will end with a 15-minute quiz on material covered since the previous recitation quiz and especially related to the recitation questions discussed that day. The quiz typically consists of a few multiple choice questions and a short-answer question. The graded quizzes will be returned at the beginning of your next recitation. Complete solutions to the recitation problems and to the quizzes will be posted on the BlackBoard site the week following the recitation.

The following table gives the section number, room number, time, and instructor for each weekly recitation:

Section	# enrolled	Day, Time (Room #)	Instructor	Lab (in 147)	Lab TA	TA Office
1	24	R 1:15 – 3:15 (154)	Dr. McNairy	T 1:15 – 3:15 pm	Adam Sokolow	274C Physics
2	24	R 1:15 – 3:15 (150)	Dr. Dutta	M 6:00 – 8:00 pm	Huidong Xu	070 Physics
3	24	R 3:30 – 5:30 (154)	Dr. Greenside	T 3:30 – 5:30 pm	Mary Kidd	412 TUNL
4	24	R 3:30 – 5:30 (150)	Dr. Rogosa	T 6:00 – 8:00 pm	Mary Kidd	412 TUNL
5	24	F 1:15 – 3:15 (154)	Dr. Tornow	M 1:15 – 3:15 pm	Rufus Phillips	274B Physics
6	24	F 1:15 – 3:15 (150)	Dr. Dutta	W 1:15 – 3:15 pm	Adam Sokolow	274C Physics
7	22	F 3:30 – 5:30 (154)	Dr. McNairy	M 3:30 – 5:30 pm	Adam Sokolow	274C Physics
8	20	F 3:30 – 5:30 (150)	Dr. Rogosa	W 6:00 – 8:00 pm	Rufus Phillips	274B Physics
9	18	F 3:30 – 5:30 (299)	Dr. Dutta	W 3:30 – 5:30 pm	Huidong Xu	070 Physics

The course policy is that only students who attend the entire recitation are allowed to take the quiz. There are no make-up sessions for recitations. If you can not attend your recitation long enough to take the quiz for a given week and can provide a valid excuse to your recitation instructor *before* the recitation, your recitation instructor will try to help you attend some other recitation that week. If you have a Dean's excuse and can not attend any recitations for a given week, submit the Dean's excuse form to your Recitation Instructor by the next recitation. Your recitation grade will then be based on the other recitations that you do attend.

Since Physics 54 has more than 200 students, recitations provide the only opportunity for students to get to know well a teacher (recitation instructor) and vice versa. This is important since recitation instructors are the ones who will assign final grades for their students, and who will write letters of recommendation at the end of the semester (if a student requests such letters).

Homework

Homework assignments will be posted each week on the Physics 54 BlackBoard site and ***will be due the following Tuesday by the beginning of the lecture that you are registered for.*** Make sure that your name and recitation section number are written down clearly on the front page of your homework and please staple the pages of your assignment together if there is more than one page. (The instructors are not responsible for lost loose pages; it is your responsibility to staple your pages together, not ours!) You should put your homework into the Physics 54 homework bin appropriate to your recitation section. These homework bins are located across from Room 147.

Each homework will count 10 points, and the lowest homework score will be dropped at the end of the semester before determining the final homework grade for the semester.

Late homework is not accepted.

Assignments may be done in collaboration with other students. However, it is extremely important that the work that you submit is written independently by yourself, in your own words, and with your own understanding. It is a violation of the Duke Community Standard, with potentially severe penalties, for you to copy answers from another student or from any other source. You will also lose the opportunity to understand how to solve the problems on your own if you rely too heavily on someone else for answers. This will not help you during quizzes and exams.

We expect collegiate quality work for your homework assignments. Please take the time to write in large legible print, leave plenty of space between successive problems, leave empty lines around mathematical equations so that your math is easily followed, leave some margins for the graders to leave comments, and give an explicit clearly identified answer so that the grader does not have to deduce what you intended for the answer. You must provide sentences or phrases that indicate clearly the steps that you took to deduce your answer. A brief answer such as “24 J” or “increases” or “1.2 C”, even if correct, will get zero credit unless you explain how you got your answer. **It is also important that you provide correct physical units for all scientific answers (meters, kilograms, newtons, coulombs, amperes, teslas, etc.) and that you give three significant digits for all answer to problems in this course whether or not the answers have one or two or three significant figures either online or in the text.**

The TAs who grade your homework are officially encouraged to mark down or give zero credit for homework assignments that they can not *easily* read.

The same guidelines hold for your written answers to quiz and exam problems as well as for lab write-ups: if the graders can not *easily* read your answers, then you will get reduced or zero credit.

Labs

The labs are an important part of the course since they provide your main opportunity to explore first hand many of the rather abstract concepts associated with electricity and magnetism such as currents, voltages, electric fields, magnetic fields, and fluxes.

Descriptions of each lab can be downloaded from the website

<http://www.acpub.duke.edu/web/physics/PHY054/Labs/>.

You should prepare for each lab by reading its instructions carefully ahead of time. This preparation will help your lab group finish the lab and complete the lab report during the lab period. Your lab group can also choose to submit the lab report after the lab, in which case the report is due 48 hours after your lab session ends. Reports should be turned into the grading box across from Room 147 in the slots labeled "54-XX LABS" next

to the "54-XX HW" slots. Please note: you will receive a **3-point deduction for putting your lab into the wrong slot.**

It is important that you arrive on time to your lab since your lab partners depend on you to complete the lab and to help with the learning experience. *If you arrive more than ten minutes after the lab begins, you will not be admitted to the lab.* In this case, you should immediately try to contact the lab TA of another section to see if you can attend that section. There are no make-up labs, so if you are unable to attend any other lab (which is likely since nearly all labs are full), you will get a lab grade of zero for that week. Please be on time!

Food and drink are not allowed in the labs. Please consume these before entering the lab.

The lab schedule is arranged to cover material as it is encountered in lectures and in the text. You should contact your Lab Teaching Assistant for all questions regarding labs including lab grades. You can also contact the Lab Director, Professor Mary Creason (email labs@phy.duke.edu) about any questions or concerns that you have about the labs.

The lowest lab grade will be dropped over the semester. However, if you miss a lab without a valid excuse, you will get a zero for that lab and that zero will not be dropped from the final lab grade. Since there are no make-up labs, a student who can not attend their scheduled lab can try to attend another lab section that same week provided there is room to accommodate an extra student. However, this is gamble since almost every lab section is filled to capacity.

PRS (“Personal Response System”) Questions

Please bring your PRS transmitter to each lecture since most lectures will ask one to four PRS questions. A good strategy is to respond within 15-20 seconds of the start of polling, and then to submit a different answer (if appropriate) toward the end of the polling period.

To allow students to become familiar with the technology, PRS responses during the first two lectures will not count towards the PRS grade.

Your final PRS score will be a 4.0 (an A) if you answer *at least* 80% of the total number of questions asked over the semester. The PRS grade then decreases linearly to 0 (an F) if you answer fewer than 60% of the total number of questions. This policy provide substantial leeway if you forget to bring your transmitter to class or choose to miss a class. Your PRS grade depends only on participation, not on whether you answers are correct or not.

There will be no make-up for PRS questions. If you forget to bring your transmitter to class, your PRS score will be zero for that day, even though you attended class. Attending a different lecture that same day will also result in a zero PRS score since the class rosters are unique to each lecture.

The Two Midterm Exams and the Final Exam

If for exams or quizzes you need to request accommodations under the Americans with Disabilities Act, please contact Dr. Emma Swain, Director of the Office of Services for Disabilities, at 684-5917 as soon as possible at the beginning of the term. Please also explain to your recitation instructor as soon as possible (no later than the first week of classes) any special needs that you might have.

The two in-class midterm exams will take place in the usual lecture room, Room 128, during the normally scheduled lecture time. You must use the calculators provided by the instructor during the midterm and final exams.

For the quizzes and exams, you will need to memorize and know how to use all appropriate formulas since no formula sheet will be provided. However, you will be given the values of all necessary physical parameters such as e , c , G , k , m_e , ϵ_0 , μ_0 , and so on.

If a student misses an in-class exam and provides a Dean's Excuse, that exam will be dropped from the final grade, which will then be based on the other parts of the course.

The Final Exam will be given on May 3, from 2:00 – 5:00 PM. Make-up final exams will NOT be offered.

The Physics 54 2006 Lecture Schedule

Day	Ch.	Topic Coverage	Omit Sect.	HW	Lab
R Jan 12	21	Intro to PHY54 and Electric Fields			
T Jan 17	21	Electric Fields (cont'd)		#1	Lab 0: PreAssessment
R Jan 19	21 22	Electric Fields (cont'd) Gauss's Law	4		
T Jan 24	22	Gauss's Law (cont'd)		#2	Lab1: Electrostatics
R Jan 26	23	Electric Potential			
T Jan 31	23 24	Electric Potential (cont'd) Capacitance	9	#3	Lab 2: Electric Field Hockey
R Feb 2	24	Capacitance (cont'd)	6		
T Feb 7	25	Electric Currents and Resistance		#4	Lab 3: Capacitance
R Feb 9	25	Electric Currents and Resistance (cont'd)	8, 9		
T Feb 14		EXAM 1 : Ch. 21-24		#5	
R Feb 16	26	DC Circuits	4, 5		
T Feb 21	26	DC Circuits (cont'd)		#6	Lab 4: DC Circuits
R Feb 23	27	Magnetism			
T Feb 28	27	Magnetism (cont'd)	8	#7	
R Mar 2	28	Sources of Magnetic Field			
T Mar 7	28 29	Sources of Magnetic Fields (cont'd) Induction and Faraday's Law	7, 9, 10 8	#8	Lab 5: Magnetism
R Mar 9	29	Induction (cont'd)			

Mar. 10-19		Spring Break			
T Mar 21	32	EM Waves and Polarization (Ch. 36-11)	1, 2, 9	#9	Lab 6: Induction/EKG
R Mar 23		EM Waves (cont'd)			
T Mar 28		EXAM 2 Ch. 25-29		#10	
R Mar 30	33	Light: Reflection and Refraction	8		
T Apr 4		Reflection and Refraction (cont'd)		#11	Lab 7: post- assessment
R Apr 6	34	Lenses and Optical Instruments	5, 8		
T Apr 11		Lenses (cont'd)		#12	Lab 8: Lenses and Optical Instruments
R Apr 13	35	Interference	5, 7, 8		
T Apr 18		Interference (cont'd)		#13	Lab 9: Interference and Diffraction
R Apr 20	36	Diffraction and Polarization	2, 3, 9, 10		
Sat Apr 22	***	MCAT EXAM!!!	***		
T Apr 25		Diffraction and Polarization (cont'd)		#14	Recitations meet during Lab Times
Apr 27-30		Reading Days			
W May 3		Final Exam, 2:00-5:00 PM			