Phy 165 – Applied Physics – Spring 2016

Instructor: Dan Kabat
office: Gillet 131, office phone x8773
email: daniel.kabat@lehman.cuny.edu

Office hours: Monday and Wednesday, noon – 1pm

Textbooks:

Douglas Giancoli, *Physics,* seventh edition

Package options in the bookstore for Giancoli 7e + Mastering:
Looseleaf Book + Mastering Physics (ISBN 9780321929013): $221.25
Hardback Book + Mastering Physics (ISBN 9780321625915): $310.25

Online-only options (www.masteringphysics.com):
Mastering Physics + eBook: $115.95 (good for 24 months)
Mastering Phyiscs without eBook: $68.95 (good for 24 months)

Lab manual – available in the department office, or available on-line at http://www.lehman.cuny.edu/faculty/kabat/manuals.html

Grading: midterms 45%
final exam 25%
homework 10%
laboratory 20%

Midterms: there will be three midterm exams, tentatively scheduled for

Feb. 29 – March 30 – May 9

Exams are closed book and closed notes. You can bring one $8\frac{1}{2} \times 11$ sheet with formulas on it. Each midterm counts for 15% of your grade. There are no make-up exams except for documented medical emergencies.

Final: there will be a comprehensive final exam, date to be announced.

I expect you to do your own work on exams. It's not acceptable to copy someone else's work, or to let someone else copy from you. Calculators are allowed, but cell phones, laptops and all other devices are prohibited.

Homework: will be done through an online system called Mastering Physics. You'll probably save some money if you buy a book that comes with a Mastering Physics access code, rather than purchase the access code separately. I usually assign homework on Thursdays, due Sunday the following week. Homework is due on the date assigned. I don't accept late homework.

Laboratory: attendance at the weekly laboratory is mandatory. Department policy is that students who are absent from more than two labs will fail the course. Labs can only be made up for documented medical emergencies, and only during the week they're originally scheduled. If you miss a lab let me and your lab instructor know as soon as possible.

Grading policy

Letter grades will be assigned according to the guidelines

$$\begin{aligned} \text{A} &= 90 - 100 \\ \text{B} &= 80 - 90 \\ \text{C} &= 65 - 80 \\ \text{D} &= 50 - 65 \\ \text{F} &= \text{below } 50 \end{aligned}$$

The cutoffs for +'s and −'s will be decided at the end of the semester.

Tutoring

Tutoring is available in the Science Learning Center, Gillet 133. Textbooks and study questions are available. Hours for this course will be posted on the door.

Supplemental Instruction

Hyrjana Dibra will be providing supplemental instruction for this course. Hyrjana will provide more information about the SI program.

Learning objective

This course provides a one-semester survey of physics and its applications. It emphasizes the basic concepts of motion and energy and develops the techniques needed to understand electrical circuits. After taking this course you'll be able to analyze and solve quantitative physics problems involving mechanics, or objects in motion, and you'll be able to analyze and solve simple electrical circuits. In the associated laboratory you will work in groups to carry out experiments and make measurements to reinforce your understanding of the material.

Course outline and schedule

Here's a tentative schedule for the semester.

dates	topic	chapter	sections
2/1, 2/3	math review, units	1	1,3,4,5,6
2/8, 2/10, 2/17	velocity and acceleration	2	1,2,3,4,5,6,7
2/22, 2/24	vectors, projectile motion	3	1,2,4,5,6
2/29	exam 1	–	–
3/2, 3/7, 3/9, 3/14	Newton's laws	4	1,2,3,4,5,6,7,8
3/16, 3/21, 3/28	work and energy	6	1,3,4,6,7,8,10
3/30	exam 2	–	–
4/4, 4/6	electric charge, Coulomb's law	16	1,2,3,5,6,7,8
4/11, 4/13	electric potential	17	1,2,5,7,8,9
4/18, 4/20	current, Ohm's law	18	2,3,4,5
5/2, 5/4	circuits	19	2,3,6
5/9	exam 3	–	–
5/11, 5/16, 5/18	motion in 3-D	–	–

No class on 2/15, 3/23, 4/25, 4/27.

Attendance will be taken at each class. A sign-up sheet will be passed around.

Physics 305 - Electronics (Fall 2016)

December 13, 2016

1 Instructor and class times

Thomas Paul
thomas.paul@lehman.cuny.edu
Office : Gillet 335
Office hours : Monday 2-3 PM, or by appointment.

Classes are held Tuesdays from 2:00 - 2:50 and Fridays from 2:50-4:30 in Gillet 331. (Friday is nominally the lab day, since we have more time then.)

2 Course format

This is the first part of a 2-semester hybrid lecture/laboratory 2-semester course in electronics for the sciences. The course is meant to be suitable for undergraduate physics majors, students from other scientific disciplines who require some electronics background and students in fields that require computer programming who could benefit from a better understanding of what is "under the hood" of the devices they work with. The goal is to approach the subject in a no-nonsense style, focusing on practical ways to understand and design analog and digital electronics circuits. The first semester focuses mostly on analog devices, and the second focuses on digital electronics, including interfacing analog and digital devices. In principle, it's possible to take just the analog or just the digital section, though following the digital section alone will be more difficult without doing the analog section first. There won't be much emphasis on formal analysis of AC circuits or power engineering, since nowadays the most quickly evolving application of electronics is in dealing with information.

The idea is to proceed incrementally from rudimentary circuit design up to construction of a functioning microcomputer on a breadboard by the second semester, complete with communication between analog and digital devices. The course should also (eventually) make you comfortable with common laboratory equipment like oscilloscopes, function generators, power supplies, and so forth. You'll also get plenty of experience with common electronic components.

Though there is no way to treat the material with the rigor one would apply several terms of electrical engineering studies, the course should still provide you

with the tools needed to understand and design actual, useful circuits. Topics of purely academic interest will be avoided, in favor of focus on the types of analog and digital electronics circuits used by practicing scientists and engineers.

A course of this type can be rather time-consuming. You'll find yourself spending a fair amount of time pushing things into breadboards – but on the positive side, this can sometimes be welcome therapy after pondering a difficult problem. One of the skills a course like this usually helps to develop is troubleshooting capacity. Except for the simple circuits, nothing is going to work on the first try. You should work on developing a systematic approach to isolating problems. This kind of troubleshooting skill is also useful in debugging complex computer programs.

3 Text

The required text is "Learning the Art of Electronics" by Thomas C. Hayes (ISBN-13: 978-0521177238), which lists on Amazon for $64.59. This book is reasonably self-contained, with both explanations of the concepts as well as worked problems and the laboratory exercises we're planning to follow. If you want to really dig into the details, you could also consider picking up a copy of the colossal "The Art of Electronics" by Paul Horowitz and Winfield Hill (either the 2'nd or 3'rd edition). You might be able to get an inexpensive used copy of the 2'nd edition. The authors of these books have vast experience in the field and appear to know everything there is to know about electronics. The text "Practical Electronics for Inventors" by Paul Scherz and Simon Monk also has concise explanations of many of the concepts relevant to the course.

4 Grades

Grades will be based on two midterm exams (20% each) a final exam (30%), weekly homework assignments (15%) and a "general impression" grade (15%) which will depend on how dilligent you are trying the labs, and will involve keeping a lab notebook. See section 5 for more details on the lab notebook. Although this "general impression" counts only for 15% of the grade, you will have to actually show up on lab days and try the labs to actually pass the course.

If you have a serious conflict with the date of the final exam, you'll have to let me know at least 1 month prior in order to make arrangements for that.

5 Labs

Laboratory work should be conducted in groups of 2 to 3 students. Formal lab reports aren't required, since in practice scientists and engineers typically record notes about their day-to-day field work in a notebook, not a publication. Instead of lab reports, each student should keep a lab notebook with drawings of

the circuits built, brief explanations of the circuits and answers to the questions posed in the lab text. It doesn't need to be a work of art, but it should be coherent enough to go back to as your future self in case you need to remind yourself how a circuit works. I'd suggest buying a hatch-ruled notebook to record your notes. You can get one at the Lehman bookshop for about $4.

If possible, we'll have an open-door policy to the lab, such that you will be able to access the lab space if other classes are not in session there.

Your electronic equipment will be stored in the classroom. You should label you and your partner's breadboard, as some labs build on previous ones, and you may not necessarily want to disassemble all your circuitry at the end of each lab period.

It is absolutely imperative that you do your part to keep the lab space tidy. This classroom is used by other groups, so you cannot leave an unreasonable mess.. Components that you remove from your breadboards must be returned to the *correct* cabinet drawer, as a common courtesy. I know it's hard, but it must be done.

6 Approximate schedule

The course will nominally comprise one lecture and one lab per one-week period. Since some labs take longer than others, it might be necessary to shift the schedule to accommodate this. However the following deadlines always apply :

- Homework will be handed out on the lecture day and is due 1 week later. Late homework won't be graded.
- Exams can only be made up in case of an emergency. If you have to miss an exam, please notify me an advance if possible.

The provisional schedule is below. Note that during the class we might have to make a few course corrections depending on which labs/concepts are found to be more difficult or easy than expected. The goal is more to learn something than to stick exactly to the proposed schedule.

Analog Circuits (1'st semester)

Week 1	Friday	25 August	Course organization, introduction, voltage, current, resistance, voltage divider, input and output impedance, Thévenin equivalent
	Tuesday	29 August	Continuation of introductory material
	Friday	1 September	Lab
Week 2	Tuesday	5 September	capacitors and RC circuits, filters, coupling
	Friday	8 September	Lab

Week 3	Tuesday	12 September	diodes, rectifiers, LC circuits
	Friday	15 September	Lab
Week 4	Tuesday	19 September	bipolar transistors 1: emitter follower, input/output impedance, common emitter amplifier
	Friday	22 September	NO CLASS
Week 5	Tuesday	26 September	Lab
	Friday	29 September	NO CLASS
Week 6	Tuesday	3 October	bipolar transistors 2 : Ebers-Moll model, difference amplifier
	Friday	6 October	Lab
Week 7	Tuesday	10 October	review
	Friday	13 October	midterm 1
Week 8	Tuesday	17 October	Op amps 1 : golden rules, negative feedback, amplifiers
	Friday	20 October	Lab
Week 9	Tuesday	24 October	Op Amps 2 : op amp imperfections, integrator, differentiator, difference amplifier
	Friday	27 October	Lab
Week 10	Tuesday	31 October	Op Amps 3 : Positive feedback, relaxation oscillator, Schmitt trigger, 555 oscillator
	Friday	2 November	Lab
Week 11	Tuesday	7 November	Lab catchup (op amps)
	Friday	10 November	Lab catchup (op amps)
Week 12	Tuesday	14 November	PID motor control
	Friday	17 November	Lab
Week 13	Tuesday	21 November	MOSFETS
	Friday	24 November	NO CLASS
Week 14	Tuesday	28 November	Lab
	Friday	1 December	Lab
Week 15	Tuesday	5 December	review
	Friday	8 December	Midterm 2
Week 16	Tuesday	12 December	review
	Friday	NO CLASS	
Week 17	14-20	Finals week	

Physics 315 - Electronics (Spring 2017)

December 13, 2016

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Digital Circuits and Systems

Week 1	Tuesday Friday	30 January 3 February	Organization, MOSFET switches Lab
Week 2	Tuesday Friday	7 February 10 February	Logic gates Lab
Week 3	Tuesday Friday	14 February 17 February	NO CLASS NO CLASS
Week 4	Tuesday Friday	21 February 25 February	Counters Lab
Week 5	Tuesday Friday	28 February 3 March	Memory Lab

Week 6	Tuesday Friday	7 March 10 March	review Midterm 1
Week 7	Tuesday Friday	14 March 17 March	Analog to Digital, PLL Lab
Week 8	Tuesday Friday	20 March 24 March	Microprocessors 1 Lab
Week 9	Tuesday Friday	27 March 31 March	Microprocessors 2, I/O Lab
Week 10	Tuesday Friday	4 April 7 April	Microprocessors 3, timers, PWM Lab
Week 11	Tuesday Friday	11 April 14 April	NO CLASS NO CLASS
Week 12	Tuesday Friday	18 April 21 April	NO CLASS Lab open for catch up
Week 13	Tuesday Friday	25 April 28 April	Microprocessors 4, interrupts, ADC and DAC Lab
Week 14	Tuesday Friday	2 May 5 May	Microprocessors 5, serial busses Lab
Week 15	Tuesday Friday	9 May 12 May	review midterm 2
Week 16	Tuesday Friday	16 review 19 NO CLASSES	
Week 17	20-26 May	Finals week	

Phy 487 – Internship in Physics – Spring 2016

This course gives academic credit for carrying out an internship under faculty supervision.

PLEASE NOTE: you must meet with the internship coordinator, and you must have an approved internship lined up, before you will be given permission to register for this course.

Internship coordinator

Dan Kabat
office: Gillet 131, office phone x8773
email: daniel.kabat@lehman.cuny.edu
office hours: Monday and Wednesday, noon – 1pm

Grading

A grade will be assigned at the end of the course based on the following three components.

1. Students are required to maintain a daily log in which they keep a brief record of their work activities, including problems encountered and progress achieved.
2. A written report from the student is due at the end of the semester. A template for the report can be found on the next page.
3. At the end of the semester a written evaluation report will be solicited from your work supervisor.

Learning objective

In this course you gain real-world experience by conducting an internship at a public or private institution. You will make use of your classroom knowledge and you will develop the new skills required to successfully carry out your internship.

Internship in Physics Spring 2016

A typed written report is due at the end of the semester. It must be at least two pages long and must address the following topics.

1. Describe the location and job duties of your internship.

2. What did you achieve during your internship? What problems did you encounter?

3. What did you learn from your internship?

4. How has the internship affected your future plans?