



Stony Brook University

PHY 335 Spring 2024

PHY 335: Electronics and Instrumentation Laboratory – Spring 2024

Organization

Classes: L01: Tue/Thu 01:00PM-03:50PM & L02: Mo/Wed 01:00PM-03:50PM

Room A-127 + TBD

Professor: Jan C. Bernauer

Office hours: Online via email (24/7, I'll try to answer quickly), zoom (by appointment via email), or skype (janbernauer).

Email: jan.bernauer (at) stonybrook.edu

Teaching Megan Hott

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Prerequisite: PHY 251 and WRT 102

Credits: 3

SBC: TECH

Description

Students will design, build and test basic DC and AC circuits which perform a useful function, as viewed by physicists, involving resistors, capacitors, transformers, diodes, transistors and operational amplifiers. Students will measure these circuits using digital multi-meters and digital oscilloscopes. Understanding of analog circuits will be stressed including negative feedback applied to operational amplifiers.

All material is divided into units, covering related topics. Each unit may occupy from 2 to 5 lab periods. In groups of 2 (rarely 3), you will perform lab assignments. The instructions are linked below. For preparation, read the material covering the upcoming lab in the textbooks, design circuits required for the lab assignments and perform calculations. The time in the lab is limited, and extensions will only be granted under exceptional circumstances.

Most lab periods will start with a short lecture. Please be on time.

You must have **two** lab books. These books will contain your notes and data taken in the lab. After finishing a unit you will submit your lab book to your TA for grading, and use the second book for the next unit. **Lab books must be on paper**, with a hard binding (not a print out, spiral books are OK, but nothing where it is easy to remove/add pages).

All students should make the best effort to participate equally in the experimental part. You will write separate lab reports after completion of each unit and submit them for grading along with your lab book. You may work on the report with your partner, but we require that both of you have ownership of the report — you need to be able to explain each part of it alone without your lab partners support. Any attempt to copy from other people's reports or to make up data is academic misconduct and will lead to a zero grade and possible further action.

Please keep the lab clean and bring back components to the part racks and sort them in correctly. If a workbench is found untidy after class, points *might* be deducted. If you throw away working parts to clean up faster, points **will** be deducted.

There will be *Midterm exam* during the semester, and a *final exam*. Exams include a practical part, where you have to complete experimental tasks in the lab, and a written part, where you have to explain the relevant theory (for example, derivation of essential formulas), and perform data analysis. Take notes at mini-lectures to prepare for this. Each exam will resemble the lab period and the writing of the report, all combined in the interval of 1/2 a lab period. The exams are given in two shifts, so that each student will have to work on the exam problems on his or her own. Active and equal participation in experimental work and study of the material covered in mini-lectures during the course will prepare you for the exams. Sign-up sheets for each shift of the midterm (12:30-2:30 pm and 3:00-5:00 pm) will be posted in the lab 2-3 weeks in advance.

Lab reports + Game Plan

Lab reports can be handwritten if the handwriting is good. Preferably, they are however prepared on a computer, e.g. with latex, or Word. I highly recommend latex, for example with overleaf. The reports should include:

- Introduction
 - 1 to 2 pages
 - Include all relevant theory and equations
 - i.e. generally those found in bold at the top of the lab instructions
- Data

- Data in the lab notebook should be also in the lab report. It is NOT enough to just show plots. Also include tables of the recorded data, for example in an appendix.
- Draw circuit diagrams!
- Include error bars on plots, and uncertainties in data tables
- Analysis
 - Must explain if the experiment was successful
 - Does experiment agree with theory prediction?
 - Include a discussion of statistical and systematic errors
- Short conclusion / summary

In addition to the lab report, you also need to write a **game plan**. This can be done either in the lab book, or on extra paper. The game plan has to be done by the first day of a new unit, and the TAs or I will sign them. Make sure that the TA have your game plan when they grade your returns.

For the game plan, read through the unit pdf and try to imagine what you will do during the lab time. What circuits will you construct/deconstruct? What formulas will you need? For some unit tasks, you can already calculate required part values like resistances/capacitances etc.

Note that the lab book will be part of the grading, so make sure that it contains all the data, schematics etc.

Grading

At least six units, the midterm and the final must be completed to pass this course. The grading is weighted as **60% Units + 20% midterm + 20% final** . If 7 units are submitted, the lowest grade will be dropped. Details of the grading might change. The basic grading scale is A 95-100; A- 90-94; B+ 86-89; B 83-85; C+ 75-78; C 71-74; C- 67-70; D+ 62-66; D 58-61; F 0-5. However, depending on class performance, thresholds might be modified.

Text books

There will be no specific reading assignments from the textbooks. However, you should look in the section with a topic similar to each lab, read it, and understand it. I highly recommend **Horowitz and Hill, The Art of Electronics (Cambridge University Press)** , either the 2nd or 3rd edition. The table below will contain pointers to the relevant chapters.

Other books include:

- Curtis A. Meyer, Basic Electronics: An Introduction to Electronics for Science Students
- Hayes and Horowitz, Student manual for the Art of Electronics (Cambridge University Press, 1989)
- Rizzoni, Principles and Application of Electrical Engineering
- Alexander and Sadiku, Fundamentals of Electric Circuits

- J. R. Cogdell, Foundations of Electrical Engineering

Find a book which style suits you. The mini-lectures are not enough to cover the required topics.

Syllabus

Note that the syllabus and dates might change.

UNIT	SUBJECT	LAB DATES	REPORT DUE ON	ADDITIONAL MATERIAL
0	Introduction	(Jan/22+23)		
1	Lab instruments, signals, resistors	(Jan/24+25), (Jan/29+30), (Jan/31+Feb/01)	(Feb/07+08)	AoE Chapter 1.1 to 1.3
2	Capacitors, Inductors, RC filters	(Feb/05+06), (Feb/07+08), (Feb/12+13)	(Feb/19+20)	AoE: Chapter 1.4 to 1.5, 1.7 (6)
3	Diodes and DC power	(Feb/14+15), (Feb/19+20)	(Feb/26+27)	AoE Chapter 1.6
4	Simulation and PCB design	(Feb/21+22), (Feb/26+27)	(Mar/04+05)	(no lab book required)
5	Operational amplifiers	(Feb/28+29), (Mar/04+05), (Mar/06+07), (Mar/18+19), (Mar/20+21)	(Apr/03+04)	AoE Chapter 4
Midterms	Midterms, units 1-5	(Mar/25+26)	Training on (Mar/20+21)	
6	Transistors and Transistor circuits	(Mar/27+28), (Apr/01+02), (Apr/03+04), (Apr/08+09), (Apr/10+11)	(Apr/22+23)	AoE Chapter 10,(11),12.1-12.3, 13.1-13.5 (13.5-13.14) Lecture (PDF)
7	Digital electronics	(Apr/15+16), (Apr/17+18), (Apr/22+23), (Apr/24+25), (Apr/29+30)	(May/01+02)	AoE Chapter 2,3
Finals	(Units 1-7, focus on 6-7))	(May/01+02)	Training on (Apr/29+30).	

Additional Material

Additional material is available in [this shared google drive folder](#)

Available:

- Gnuplot tutorial 1: [Video](#), [data file](#), [script file](#)
- LTSpice tutorial: [Video](#)
- KICAD tutorial: [Video](#)
- Soldering tutorial: [Video](#)

Learning outcome

Students who have completed this course should

- Be familiar and be able work with the basic components of electronics.
- Be able to perform measurements with DMM and Oscilloscope.
- Be able to analyze simple circuits.
- Perform basic data analysis including error propagation.
- Demonstrate an ability to apply technical tools and knowledge to practical systems and problem solving.
- Design, understand, build, or analyze selected aspects of the human-made world. The “human-made world” is defined for this purpose as “artifacts of our surroundings that are conceived, designed, and/or constructed using technological tools and methods.”

Student Accessibility Support Center Statement

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center. For procedures and information go to the following website: <https://ehs.stonybrook.edu//programs/fire-safety/emergency-evacuation/evacuation-guide-disabilities> and search Fire Safety and Evacuation and Disabilities.

Academic Integrity Statement

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Professions, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic

dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook. If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.
