Stony Brook University

PHY335 – Electronics and Instrumentation Lab

Fall 2025

Organization

Classes:	L01: Tue/Thu 12:30PM-03:20PM L02: Mo/Wed 02:00PM-04:50PM
	Room A-127 + TBD
Professor:	Jan C. Bernauer Office hours: Online via email (24/7, I'll try to answer quickly) or zoom (by appointment via email). Email: jan.bernauer (at) stonybrook.edu
Teaching Assistants:	TBD
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.

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 partner's 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 and finals will be posted in the lab 1-2 weeks in advance.

Lab reports

Lab reports comprise 85% of each unit's grade. They should be prepared on a computer, e.g. with LaTeX or Word. I highly recommend LaTeX, for example using overleaf.com (which is free).

An example LaTeX document, including the Unit 0 report is available on overleaf here and as a zip file here.

If supplying a typeset report is a hardship, please come speak with me so we can find a solution. The reports should include:

- Introduction (25 points)
  - 1 to 2 pages
  - Describe the electronic components you are studying, and the studies you will perform
  - Include all relevant theory and equations (generally those found in bold at the top of the lab instructions)
- Data (20 points)
  - Describe the circuit you built, the raw measurements you took, and the procedures.
  - Present the data (generally, all data in the lab notebook should be also in the lab report)
  - Draw circuit diagrams!
  - Include error bars on plots and in data tables

- Analysis (30 points)
    - Describe the calculations that convert the raw measurements into the derived quantities that connect to the theory in your introduction.
    - Include a discussion of statistical and systematic errors
    - Does experiment agree with theory prediction?
    - Explain if the experiment was successful. If not, propose what one could do next (ie a way to correct a problem that was encountered).
- Short conclusion / summary (10 points)
    - Summarize the measurements you made and their relation to the theory.

The Introduction and conclusion must be your own work. If you collaborate with others on other sections, you may turn in identical texts, provided each copy notes clearly the names of all collaborators. Note that you are responsible for the material. You need to be able to explain each part of it alone without your lab partners support.

It is vital that you stay on top of things. Start writing your reports early!

Do not write nonsense
The text you write should remain specific and pertinent to the topic. Long asides about possible sources of error that do not plausibly come into play, vague assertions of the need for proper techniques and equipment, etc, contribute to unfocused, boilerplate-like text that I call slop. Be aware that LLMs like ChatGPT are particularly prone to this sort of text. There is no penalty for proposing, in good faith, a source of error that is not actually an issue, but points may be deducted for excessive slop in your reports.

Game plan

It is important to prepare!
Time in the lab is limited. You will struggle if you do not prepare. Look at the unit document before the unit starts. Visualize what you will need to do. Have expectations of what you will see. You are required to prepare a **game plan**, a note to yourself that contains:
The game plan will be inspected during the first session of each unit, so you should prepare it before class begins. The game plan should include:

- The equations you expect to need in order to derive key values and to take and assess data
- Circuit diagrams for all circuits you expect to build during the lab
- Listings of values for each circuit component you expect to use, in appropriate SI units, and the calculations/equations used to derive those.
- Layout of the data you intend to take, including what values you will record (e.g. 'Voltage at point B', 'Frequency'), what range of input values you expect to go over, and how many data points you intend to take across that range.
- You will not be penalized for incorrect values or diagrams that you have drawn in good faith. The purpose is to show that you have prepared for the unit before arriving.

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Lab notebook

Your notebook is a record and protocol of what you have done in lab, and you should add things to it during the course of each session. **Each student must have their own lab book**. They must contain:

- All circuits diagrams you build
- All calculations you perform, sketches of waveforms, notes about what went wrong, etc.
- All measurements you make must be there. (If you are taking a very large dataset (more than 5-10 measurements) you may record at least five measurements in the notebook and note that the rest are recorded in a google sheet or other web-accessible form.)
- You are welcome/encouraged to augment these notes with phone pictures etc., but those are not a substitute.
- You are may write in pen or pencil. If you make a mistake, do not erase or scribble out. Instead, cross out the error neatly, write what was wrong, and then write the correct version.

After finishing a unit you will turn in your lab notebook to your TA for grading. This can be either a single pdf containing legible photos of each page in your lab notebook, or else your physical lab notebook itself (in which case you should have a second lab notebook to use for the next unit). If you have additional data in digital format, you must provide a link or copy of that data as well.

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 with more than 30/100 score 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 0-57. 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 lectures are not enough to cover the required topics.

Syllabus

Note that the syllabus and dates might change.

UNIT	SUBJECT	LAB DATES [BOLD DATES FOR GAMEPLAN CHECK] MW TUTH	REPORT DUE ON	ADDITIONAL MATERIAL
0	Introduction	8/25 8/26		
1	Lab instruments, signals, resistors	8/27 8/28 (9/2) **9/3 9/4** 9/8 9/9	9/15 9/16	AoE Chapter 1.1 to 1.3
2	Capacitors, Inductors, RC filters	**9/10 9/11** 9/15 9/16 9/17 9/18	9/22 9/23	AoE: Chapter 1.4 to 1.5,1.7 (6)
3	Diodes and DC power	**9/22 9/23** 9/24 9/25	9/29 9/30	AoE Chapter 1.6
4	Simulation and PCB design	**9/29 9/30** 10/1 10/2	10/6 10/7	(no lab book required) Make sure software is downloaded and installed! This will replace the game plan.
5	Operational amplifiers	**10/6 10/7** 10/8 10/9 10/15 10/16 10/20 10/21 10/22 10/23	11/3 11/4	AoE Chapter 4
Midterms	Midterms, units 1-5	10/27 10/28		
6	Transistors and Transistor circuits	**10/29 10/30** 11/3 11/4	11/17 11/18	AoE Chapter 10,(11),12.1-12.3, 13.1-13.5 (13.5-13.14)

		11/5 11/6 11/10 11/11 11/12 11/13		
7	Digital electronics	**11/17 11/18** 11/19 11/20 11/24 11/25 12/1 12/2	12/8 12/9 [talk to your TA to arrange drop-off]	AoE Chapter 2,3
Finals	Units 1-7, focus on 6-7	12/3 12/4		

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 with and able to 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@stony-

brook.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 web-site: 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.