Stony Brook University

PHY335 – Electronics and Instrumentation Lab – Fall 2024

PHY 335: Electronics and Instrumentation Laboratory – Fall 2024

Organization

Classes:	L01: Tue/Thu 12:30PM-3:20PM & L02: Mon/Wed 2:00PM-4:50PM
	Room A-127
Professor:	Ross Corliss Office: C-103 Office hours: Wed 10-12:00. Online via email, or zoom by appointment Email: ross.corliss (at) stonybrook.edu
Teaching Assistants:	James Caputi Email: james.caputi (at) stonybrook.edu Gannon Lawley Email: gannon.lawley (at) stonybrook.edu
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. Two three-hour laboratories per week. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

The course is arranged in units which cover related topics. Each unit will span multiple lab periods. For preparation at the start of each unit, read the unit instructions (linked below) and the material covering the listed topics. In groups of 2 (rarely 3), you will perform lab assignments. Time in the lab is limited, and extensions will be only be granted in exceptional circumstances.

You should make a best effort to participate equally in the experimental work, including making sure you are giving your lab mate the opportunity to participate. You will write separate lab reports after each unit, and submit them for grading along with your lab book. You may work on these reports with your lab mate, but you are responsible for all contents of your submission: You should be able to explain all parts of it without your 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.

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

You should make a best effort to participate equally in the experimental work, including making sure you are giving your partner the opportunity to participate. 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 all parts of it 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.

Laboratory Etiquette

You will be working in a lab space shared with other students. Please keep the lab clean and return components to the correct parts containers when finished with them. If your workbench is found untidy after class, points *may* be deducted. If you throw away working parts to clean up faster, points **will** be deducted.

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

- Introduction (30 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 (5 points)
  - Summarize the measurements you made and their relation to the theory.

The Introduction 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.

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 "blather". 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 points for excessive blather in your reports.

Lab Notebooks

Lab notebooks comprise 15% of the grade for each unit. **You must have a physical, paper lab notebook. It must be of a type where is not easy to add/remove pages.** These books will contain your notes and data taken in the lab. After finishing a unit you must 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).**

You are welcome to 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.

The lab book will be part of the grading, so make sure that it contains all the data, schematics etc. You should make a **game plan** before coming to class: determine the parts you believe you will need, write the equations you believe you will use, draw the circuits you believe you will buildand circuit diagrams (with all components labeled with values or part numbers), etc, into your lab notebook **before** you arrive in class for the first day of each unit. The TA or the Professor will sign below the text on the first day of the unit (make sure that it is signed before you leave!). and it will be graded along with the report by the TAs. You will not be penalized for errors in the circuit diagrams you present at the start of class.

Exams

There will be *Midterm exam* during the semester, and a *final exam*. Exams include a practical part, where you will have to complete experimental tasks in the lab, and a written part, where you will have to explain the relevant theory, design circuits, and analyze or otherwise derive results for given circuits. 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.

Grading

The grade for each of the units will be based on lab books (15 points) and lab reports (85 points). At least six units, the midterm, and the final must be completed to pass this course. Your base grade will be based on the six highest unit grades, while the seventh will be converted to bonus points (at a discounted rate).

Assessment/Assignment/Exam	Points or Percentage
Units, including **lab book** and **lab report**	10 x 6 = 60
Midterm exam	20
Final exam	20
Total	**100**

The grading is weighted as **60% Units + 20% midterm + 20% final**. The grading scale is A 95-100; A- 90-94; B+ 86-89; B 83-85; B- 79-82; C+ 75-78; C 71-74; C- 67-70; D+ 64-66; D 60-63; F 0-59. These thresholds are a general guideline, and may be modified depending on class performance.

Late Work Policy: Reports are due to the TAs on the calendar day listed below. You have a total of 10 grace days. Late submissions will be accepted at no penalty, but for every calendar day late a submission is, I will deduct a grace day. If you do not have enough grace days remaining, the unit will be graded as normal, but will be capped at a B-.

If you have an exceptional situation and will be late beyond this, come talk to me. Note, however, that a very busy week is not an exceptional situation. Budget your grace days accordingly.

Text books

There is no specific required textbook, but note that reading a textbook section covering the topic of each lab section is **extremely highly recommended**, since in-class lectures will not cover all details of the material.

I recommend **Horowitz and Hill, The Art of Electronics** (Cambridge University Press, 2nd or 3rd edition). This book is an excellent, concise resource, and has a great deal of material beyond what will be covered in this course. Rizzoni, Principles and Applications of Electrical Engineering (McGraw-Hill), often has more examples and more mathematical detail. You should find a textbook style that suits you. Suggested readings are given as AoE 3rd edition chapters. If you are using a different text, you can use https://artofelectronics.net/the-book/table-of-contents/ to find the comparable chapters.

Other textbooks include:

- Curtis A. Meyer, Basic Electronics: An Introduction to Electronics for Science Students
- Hayes and Horowitz, Student Manual for the Art of Electronics
- Alexander and Sadiku, Fundamentals of Electric Circuits
- R. Cogdell, Foundations of Electrical Engineering

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

Course Schedule

Note that the syllabus and dates might change. Readings are based on Art of Electronics 3rd edition. If you are using a different text, you can use https://artofelectronics.net/the-book/table-of-contents/ to find the comparable chapters.

Dates (MW,TuTh)	Unit	Topic	Lab Notebook Check	Report Due	Reading and Additional Material
8/26, 8/27	0	Introduction	buy one.		
8/28,8/29,(9/3),9/4,9/5, 9/9,9/10	1(pdf)	Lab Instruments, Signals, Resistors	9/06, 9/07	9/16, 9/17	AoE ch 1.1-1.3
9/11,9/12, 9/16,9/17,9/18,9/19	2	Capacitors, Inductors, RC Filters	9/11, 9/12	9/25, 9/26	AoE ch 1.4,1.5,1.7
9/23,9/24,9/25,9/26	3	Diodes and DC power	9/23, 9/24	10/02, 10/03	AoE ch 1.6
9/30,10/1,10/2,10/3	4	Simulation and PCB Design	9/30, 10/1	10/9, 10/10	Download and try out LTSpice, KiCAD
10/7,10/8, 10/9,10/10,10/16,10/17, 10/21,10/22,10/23,10/24	5	Operational Amplifiers	10/7, 10/8	11/04, 11/05	AoE ch 4
10/28, 10/29	Midterms	Exam on units 1-5			Review will take place on 10/23, 10/24
10/30,10/31, 11/4,11/5,11/6,11/7, 11/11,11/12,11/13,11/14	6	Transistors	11/4, 11/5	11/20, 11/21	AoE ch 2 and 3
11/18,11/19, 11/20,11/21,11/25,11/26, 12/2,12/3	7	Digital Electronics	11/18, 11/19	12/9.	AoE ch 10,(11),12.1-12.3,13.1-13.5, (13.5-13.14)
12/04, 12/05	Finals	Exam on units 1-7, focus on 6-7			Review will take place on 12/2,12/3

Additional Material

Professor Bernauer has made several helpful tutorials which may be of interest:

- Gnuplot tutorial 1: Video , data file , script file
- LTSpice tutorial: Video
- KICAD tutorial: Video
- Soldering tutorial: Video

Learning outcome

By the end of the semester, students will be able to apply technical tools and knowledge to practical systems and problem-solving:

- Describe the function and uses of basic electronic components
- Design and construct simple circuits for a variety of purposes
- Perform measurements with a DMM and oscilloscope
- Analyze the performance of simple circuits
- Perform basic data analysis including error propagation

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.

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