PHYS 2P30 - Introduction to Electronics
Course outline

Instructor: E. Sternin

About this course

What Brock Calendar entry says:

> **PHYS 2P30 - Introduction to Electronics**
> Conduction in metals and semi-conductors; circuit analysis; time-dependent currents, transients, AC circuits, filters, resonance; semi-conductor junction, diode and transistor; rectification, switching and amplification; operational amplifiers; combinatorial logic and circuits; sequential circuits, counters; analog-to-digital conversion; laboratory instruments.
>
> **Course Format:** Lectures, lab, 6 hours per week.
> **Prerequisite(s):** PHYS 1P21 or PHYS 1P91 or PHYS 1P95 (recommended); PHYS 1P22 or PHYS 1P92 or PHYS 1P96 (recommended); one MATH credit or permission of the instructor
> **Course Notes:** No previous course in electricity/magnetism/electronics is required. Secondary school algebra and some basic calculus will be used in the quantitative sections. Materials fee required. This course may be offered in multiple modes of delivery. The method of delivery will be listed on the academic

Textbook

In 2025-26 a new textbook is being introduced, students receive a copy free of charge. This is an unusual book, and the Preface and the first Chapter are posted so that the students can learn more about the style of the textbook, but the book is deliberately designed to be written in, and used during the flipped-classroom `lectures' and labs, and so other chapters will not be posted.

Additional sources of information are listed in the **References**. Among many excellent Electronics textbooks listed there, Robert E. Simpson, *Introductory Electronics*, 3rd ed. Allyn and Bacon, Inc., is highly recommended. It is an example of a "keeper" book, useful as a reference in later years. The book is out-of-print and cannot be ordered through the Campus Store. Students are encouraged to look for a used copy online. Several copies are available to borrow from the Physics Office, B210.

Topics to be covered

This is only an approximate listing, some topics may not get covered this year. As time allows, other topics not listed here may be included.

- **Basic physical concepts**
  - charge, voltage, current, resistance, power
- **DC circuits**
  - circuit reduction
  - Kirchhoff's rules
  - equivalent circuits
- **Transient currents**
  - capacitors, inductors
  - generalization of Ohm's Law
  - MATH: simple differential equations
  - resonance phenomena
- **Sinusoidal currents, simple AC circuits**
  - MATH: complex numbers
  - phasors
  - time- and frequency-domain descriptions of AC circuits
  - Fourier transform
  - resonant circuits and their analysis, *Q* factor
  - *RC* and *RL* circuits as filters; decibels
  - AC equivalent circuits
  - transformers
- **Non-linear circuit elements**
  - elementary physics of semiconductors, *pn*-junction
  - diodes and rectifiers

- » transistors and their use as switches and amplifiers
- » bipolar transistors and JFETs

» **Operational amplifiers**
- » general amplifier theory; feedback
- » op-amp concepts: virtual ground, summing point
- » simple op-amp circuits
- » math operations using op-amps
- » signal modulation and de-modulation
- » lock-in amplifier

» **Noise**

» **Mathematics of Digital Circuits**
- » binary and other encodings
- » Boolean algebra
- » truth tables
- » basic logic gates
- » logic families

» **Combinatorial Logic Devices**
- » encoders/decoders
- » bus drivers
- » 7-segment displays

» **Sequential Logic Devices**
- » flip-flops
- » synchronous and asynchronous counters

» **Digital I/O and Communications**
- » serial *vs.* parallel

» **Complex Digital Circuitry**
- » computer architecture
- » microprocessors
- » DSPs
- » Programmable Logic Arrays

» **Analog-to-Digital and Back**
- » A-to-D and D-to-A converters
- » sensors and transducers
- » control and time sequencing

» **Microcontroller-Based Devices**
- » microcontroller architecture
- » PIC microcontrollers
- » assembly-language programming

Grading and the grading scheme

Component	Worth	Comments
Homework	20%	Expect a homework assignment every week or so; full marks given for demonstrated effort. Late penalty is a sinking cap of 15%/day.
Labs	32%	*All* labs must be completed, and all lab reports submitted.
In-class work	8%	Attendance (70% min) and participation (70%min) in the in-class work.
Midterm	10%	An in-class written test: problems similar to homework, full marks require correct answers.
Final	30%	A written final: problems similar to homework, full marks require correct answers. 50% minimum to pass the course.
		A hands-on lab test: analysis of a "black-box" (unknown) circuit.

Expectations and responsibilities

Here is a summary of our expectations of you, which are your responsibilities. You are expected to:

- » attend each scheduled lecture and laboratory session;
- » do your work honestly and maintain academic integrity (see a separate section below for details);
- » complete each test, using only the materials that have been authorized for use, such as a non-graphics calculator and writing instruments;
- » attend labs having **prepared in advance** by reading relevant parts of the lab manual, and having completed the prelab problems.

And most important of all, you must take responsibility for your own learning. The lectures are there to guide you

and assist you, but only you can actually do the hard work of learning the course material. To get the most out of the course, work on it a little bit every day. Daily work is key for placing your learning in long-term memory, where it will be readily available to help you to advance your knowledge in subsequent years - and acing the final exam, of course. Cramming on the night before may place the material in your short-term memory and you might even do fine on a weekly test, where the amount of new material is relatively small, but this approach will fail miserably on the final exam.

Your instructor will provide weekly textbook chapter references; read through those section. The best way is to read them twice: once before the lectures, just to orient yourself in the material, to identify those parts that seem like they might need extra time and attention. Make a note of the questions that arise in your mind. The lecture should answer some of them, and if it does not, raise your hand and ask! Asking questions is a sign of active learning, not a sign of weakness. It is likely that many others have the same question. After the lecture, read the textbook again, with a pen and paper in hand, repeating all derivations on your own, trying every solved example before looking at the solution, then solving every follow-up questions at the end of the section. Sometimes, the answers to questions are available; use those to check up on the skills you are developing. But most of the time, the answers are not known, and you must learn to develop enough confidence in your skills to solve those. Both are integral to the learning process.

Use your time effectively. Study smart, instead of hard. Ask questions in class. Your instructor has an open-door policy, so outside of a few restricted hours, you are always welcome to come and ask a question one-on-one. Do not wait until you have a "worthy" pageful of questions - that's too long to let them fester unanswered. It is better to come three times with one or two questions than once with a list accumulated over the past several weeks, when things get too desperate.

Weekly Homework

» Assignment 1, due by 10:30 on January 19.
» Assignment 2, due by 10:30 on January 26.
» Assignment 3, due by 10:30 on February 9.
» Assignment 4, due by 10:30 on February 23.
» Assignment 5, due by 10:30 on March 9.
» Assignment 6, due by 10:30 on March 16.
» Assignment 7, due by 10:30 on March 23.
» Assignment 8, due by 10:30 on March 30.

Costs

See the Campus Store for textbook costs, if any.
This course requires an ancillary fee of $10 to cover Lab consumables/Printing Fee expenses.

Academic Integrity

Academic misconduct is a serious offence. The principle of academic integrity, particularly of doing one's own work, documenting properly (including use of quotation marks, appropriate paraphrasing and referencing/citation), collaborating appropriately, and avoiding misrepresentation, is a core principle in university study. Students should consult "Academic Misconduct" section in the Undergraduate Calendar to view a fuller description of prohibited actions, and the procedures and penalties. The University takes academic misconduct extremely seriously and will follow its strict procedures to the letter in all cases.

A helpful website explains Brock's Academic Integrity Policy. Please consult it, as all students are expected to know and abide by its provisions.

Courses may use `turnitin.com`, a phrase-matching software, to verify originality of your submitted lab reports and written assignments. If you object to uploading your assignmentsr to `turnitin.com` for any reason, please notify the instructor to discuss alternative submissions.

Be aware that it is the policy of the Department of Physics that any academic misconduct including (but not limited to) possessing, using or accessing unauthorized material in any form (including online) during final exams or assessments will *automatically* result in zero grade for the exam. Since most courses require a minimum passing grade on the final exam to complete the course, this will likely lead to a failure in the course.

FMS Penalties for Academic Misconduct

Unless otherwise specified, the Department of Physics follows the following minimum penalty guidelines for cases of academic misconduct in the Faculty of Mathematics and Science (FMS). Please be aware that the Associate Dean, Undergraduate Programs, may assign different penalties than those listed here, depending on the details of individual cases. Also note that cheating on exams carries significantly higher penalties.

First offence:
: Zero grade on the assignment, additional penalty of 100% of the weight of the assignment to be subtracted from the final grade, mandatory completion of the AZLS Academic Integrity workshop

Second offence:
: Zero grade on assignment, additional penalty of 100% of the weight of the assignment to be subtracted from the final grade, 4-month suspension

Third or additional offence:
Zero grade in the course, 1-year suspension, permanent removal from major program.

FMS Penalties for Misconduct in Final Exams

First Offense:
Zero grade in the course.
Second Offense:
Zero grade in the course, 4 month suspension.
Third Offense:
Zero grade in the course, 1 year suspension, permanent removal from major program
Fourth Offense:
Permanent Suspension, debarment.

FMS Academic Policies

Intellectual Property Notice

All slides, presentations, handouts, tests, exams, and other course materials created by the instructor in this course are the intellectual property of the instructor. A student who publicly posts or sells an instructor's work, without the instructor's express consent, may be charged with misconduct under Brock's Academic Integrity Policy and/or Code of Conduct, and may also face adverse legal consequences for infringement of intellectual property rights.

Use of Generative AI (GenAI)

In the age of GenAI (*e.g.*, ChatGPT), our expectation of you remains the same as it ever was: original academic work, following the instructions of the assignment determined by the instructor for this course for requirements, expectations, and parameters for completion and submission of your work for grading. Therefore, the use of GenAI tools and GenAI-generated content is not allowed (unless explicitly requested/instructed) as a resource or source for answers and discussion in submitted work. Unauthorized use of GenAI will be treated as an academic misconduct.

You probably won't find much use of GenAI in this course anyway, even when writing something like a lab report. Why? GenAI doesn't know what you did in the lab. GenAI may know a lot about the overall idea you were studying, but not how you demonstrated it. In your lab reports, your answers and discussion need to relate to what you did and the data you took.

Important dates

Please be aware of all the important dates, such as the first/last days of classes, snow days and reading week, as well as the deadline for withdrawal without academic penalty. For the current academic term, this information can be found here.

Relationship between attendance and grades

Unless the instructor announces otherwise, students are expected to attend all lectures, discussion groups, seminars, laboratory periods and examinations of the courses in which they are registered and must submit all assignments in order to pass this course.

Accommodations

The University is committed to fostering an inclusive and supportive environment for all students and will adhere to the Human Rights principles that ensure respect for dignity, individualized accommodation, inclusion and full participation. The University provides a wide range of resources to assist students, as follows:

a. If you require academic accommodation because of a disability or an ongoing health or mental health condition, please contact Student Accessibility Services at askSAS@brocku.ca or 905 688 5550 ext. 3240.
b. **Medical Self-Declaration Forms** (brief absence up to 72 hours)

   In the case of a short-term medical circumstance, if a student wishes to seek an academic consideration, please use the Medical Self-Declaration Form. The request is to be made in good faith by the student requesting the academic consideration due to a short-term condition that impacts their academic activities (e.g., participation in academic classes, delay in assignments, etc.). The period of this short-term medical condition for academic consideration must fall within a 72-hour (3 day) period. The form must be submitted to the instructor either during your brief absence or if you are too unwell, within 24 hours of the end of your 3 day brief absence.

   Medical Verification Form (extended duration)

   In cases where a student requests academic consideration due to a medical circumstance that exceeds 72 hours (three days) and will impact their academic activities (e.g., participation in academic classes, delay in assignments, etc.), or in the case of a final exam deferral, the medical verification form must be signed by the student and the health professional as per process set out in the Faculty Handbook III:9.4.1.

c. If you are experiencing mental health concerns, contact the Student Wellness and Accessibility Centre.

Good2Talk is a service specifically for post-secondary students, available 24/7, 365 days a year, and provides anonymous assistance. Follow the above link or call 1-866-925-5454. For information on wellness, coping and resiliency, visit: Brock University (Mental Health).

d. If you require academic accommodation on religious grounds, you should make a formal, written request to your instructor(s) for alternative dates and/or means of satisfying requirements. Such requests should be made during the first two weeks of any given academic term, or as soon as possible after a need for accommodation is known to exist.
e. If you have been affected by sexual violence, the Human Rights & Equity Office offers support, information, reasonable accommodations, and resources through the Sexual Violence Support & Education Coordinator. For information on sexual violence, visit Brock's Sexual Assault and Harassment Policy or contact the Sexual Violence Support & Response Coordinator at humanrights@brocku.ca or 905 688 5550 ext. 4387.
f. If you have experienced discrimination or harassment on any of the above grounds, including racial, gender or other forms of discrimination, contact the Human Rights and Equity Office at humanrights@brocku.ca.

For a full description of academic policies in the Faculty of Mathematics and Science, consult brocku.ca/mathematics-science/

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