PHYS 2P30

Lecture Notes
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The Class
Outline
Integrity
Calendar entry
Help

PHYS 2P30 course outline

Instructor: E.Sternin

What Brock calendar entry says:

> 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.
>
> Lectures, lab, 6 hours per week.
>
> Note: 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 timetable, in the applicable term.
>
> Completion of this course will replace previously obtained grade and credit in PHYS 2P31.

What do I need to bring into the course?

> *Prerequisites:* PHYS 1P21 or 1P91 (recommended); PHYS 1P22 or 1P92 (recommended); one MATH credit or permission of the instructor.

Textbook

> It is possible to take a class without a textbook, relying on the internet resources, or with any of the textbooks listed in the References. However, 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, or order 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

Tests 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.
Midterm	10%	An in-class written test: problems similar to homework, full marks require correct answers. If public health disallows in-person tests, there will be no midterm, and the weights of other grading components will be adjusted proportionately.

Final	30%	A written final: problems similar to homework, full marks require correct answers. 50% minimum to pass the course. If public health disallows in-person exams, the final will be conducted as an oral final via a videolink.
	8%	A 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**;
  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.
- 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 second year and beyond - 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! 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. Only one half of them have answers; you must learn to have enough confidence in your skills to solve even those problems where the answer is not known in advance. The odd-numbered problems will allow your to make sure, and the even-numbered ones will allow you to test yourself. 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. There is also a Physics Help Desk, with TAs available to help out. Find out where and when it is held, and come often. 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. Asking questions is a sign of active learning, not a sign of weakness.