ECE3020  Introduction to Electronics

Objectives: Learn the basics of analysis and design of modern electronics, mainly as preparation for advanced courses. Introduction to electronics lab and prototype projects.

Instructor: Steven B. Bibyk (bibyk.1@osu.edu) CL381 http://www.ece.osu.edu/~bibyk

Textbook: Microelectronic Circuits by Sedra/Smith 5th, 6th, 7th ed. etc.
Supplements: Online sites are on next page, even more useful than textbook.

Course Outline (based on 6th ed.):

1. Electronics Top-down Overview, Lab and Prototype methods: Chp. 1s, notes, edX MOOCs
2. RLC Circuits Review, Sec. 16.11.1 – basic principle of tuned MOS RLC (Top-down) amp
   Frequency Response Chapter 16 Filters, preview appropriate circuit sections MIT OCW
   Digital ICs MIT OCW content and ECE5020 online book sections
3. Op Amps Chapter 2, Secs. part of 2.1 – 2.4,
   Feedback (Op Amps) Chapter 10, Secs. 10.1 and 10.2, MIT OCW

Begin Bottom-up device approach to Electronics

4. Diodes Chapter 4, Secs. part of 4.1 – 4.5
5. MOS Transistors Chapter 5, Secs. 5.2 – 5.6, MIT OCW, Digital IC notes
6. BJT Transistors Chapter 6, Secs. part of 6.2 – 6.6
7. Analog ICs Chapter 7, Secs. 7.1, 7.2, 7.4 Current Mirrors
8. Diff. Pair Chapter 8, Secs. 8.1 - 8-5
9. Data Converters Online from textbook and Knovel websites

Deliverables and Grading:

Homework and some Quizzes – 18%

Midterm 1 – 27% Design Report – 20 % Final Exam – 35%

Homework & Quizzes are due in class on the due date. Without prior permission, other homework/quiz turn in times get partial or no credit.
This course is prerequisite for all the 5x2x courses, and sometimes some xx6x courses. This course should also help prototyping builds in 490x courses, but the prototyping skillset especially needs lab work, such as in correlating 3020 with 3027. Good prototyping examples are needed, such as the edX MOOC (Berkeley EE40LX) on Electronic Interfaces. There is also useful material in the edX MOOCs (MIT) on Circuits & Electronics, although this content is more convenient on the MIT OCW webpage. We will correlate this course with lab material to the degree possible, using the online manual for the TI Analog System Lab Kit Pro (used in ece3027).

Two main course objectives are in the online ece3020 Standard Syllabus.

1. Design of Electronic Circuits.
2. Simulation of Electronic Circuits.

Design has better descriptions when it is viewed as a Top-down work flow. Simulation, or analysis, has better descriptions when it is viewed as a Bottom-up work flow. Our main textbook is poor at describing Top-down vs. Bottom up tradeoffs in different domains of electronics, such as chip vs. board design, analog vs. digital design, etc. We will use supplemental material to make up for this shortcoming. Our textbook is quite good for prerequisite material for analog chip design. SPICE is a main CAD tool for analog chip design.

We’ll explore TopSpice manuals (free download) for the Art of analog design, which has two key strategies. One, use of approximate and partial solution techniques. Two, analog Top-down behavioral modeling via generalized port constructs.

OSU Library E-books has many good Circuits/Electronic books, many with chapter downloads:

https://library.osu.edu/find/collections/science-engineering-collection/ebooks/

In particular, we will use Knovel Catalog of Electronic Devices books (119 books).

For a clearer and better understanding of analog chip design:

*CMOS Analog Circuit Design (3rd ed.) by Allen and Holberg*

A better of picture of analog chip design helps delineate chip design from board (discrete) design. Sedra/Smith textbook is a reference for Allen/Holberg.

For a clearer and better understanding of a Top-down view of RLC circuits and Resonance:

*Understandable Circuits, by M. Wang*

Besides the Knovel Catalog, we will use online material for digital chip design at the CMOS VLSI websites, both the 3rd ed. textbook and the author’s (David Harris) website.

Digital design gives a clearer picture of the difference between Top-down vs. Bottom-up design. We would like to understand this difference for mixed signal (digital plus analog) also. Mixed signal top down design is quite challenging. The Table of Contents of the junior electronics textbook, *Understanding Microelectronics, by Maloberti*, gives a broad view of the difficulties. Unfortunately, this textbook struggles with the concepts of Top-down, mixed signal modelling.