COURSE: EECS 311. **TITLE:** Electronic Circuits. **PREREQUISITES:** EECS 215 and EECS 320	**ELECTIVE**

TEXTBOOK: R. Jaeger and Blalock, *Microelectronic Circuit Design*, 2nd ed., McGraw-Hill

CATALOG DESCRIPTION: Circuit models for bipolar junction and field-effect transistors; nonlinear elements; small-signal and piecewise analysis of nonlinear circuits; analysis and design of basic single-stage transistor amplifiers: gain, biasing, and frequency response; digital logic circuits; memory circuits (RAM, ROM). Design projects. Lecture and laboratory.

COURSE OBJECTIVES:

1. To teach students non-idealities (finite input and output resistances, finite gain and bandwidth, input offset voltage and current) in op-amps, and their effects on op-amp performance;
2. To teach students nonlinear circuit elements such as transistors, diodes, and junction capacitors;
3. To teach students analysis techniques (small-signal analysis) for nonlinear circuits and devices;
4. To teach students basic mixed-signal (analog and digital) circuits, such as oscillators and mixers;
5. To teach students how to use basic simulation software for analog circuit analysis and design;
6. To teach students how to design multi-transistor analog amplifiers meeting specifications such as: gain, bandwidth, input and output resistances, linearity and saturation limits.

COURSE OUTCOMES [Program Outcomes Addressed]

1. Ability to analyze feedback circuits containing non-ideal op-amps; [1,11]
2. Ability to reduce a nonlinear circuit to its small-signal equivalent and analyze it; [1,11,13]
3. Ability to determine the small-signal (hybrid-pi) model of a transistor from its data sheet and lab measurements using oscilloscopes, signal generators, and semiconductor parameter analyzers; [2]
4. Ability to design a digital ring oscillator with a voltage-controllable frequency meeting a given frequency specification; [3,4,5,11]
5. Ability to design and physically implement a transistor amplifier having a stable biasing circuit and meeting given design specifications such as gain, bandwidth, and node impedances. [2,3,4,5,11]

PROGRAM OUTCOMES ADDRESSED: 1,2,3,4,5,11
PROFESSIONAL COMPONENT ADDRESSED: 13
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CLASS/LABORATORY SCHEDULE:
LECTURES: 3 per week @ 50 minutes.
LABORATORY: 5 in 1st half of term;
2 design projects during 2nd half of term.

TOPICS COVERED:

1. Nonlinear circuit elements
2. Non-ideal op-amps and circuits
3. Small-signal modeling of nonlinear circuit devices
4. Gain, bandwidth, impedance
5. Transistor amplifier biasing
6. Small-signal analysis of nonlinear analog circuits
7. Piecewise-linear analysis of nonlinear analog circuits
8. Single-transistor amplifiers
9. Multi-transistor amplifers
10. Mixed-signal analog & digital

ASSESSMENT (Course outcomes)

1. 10 problem sets [1,2]
2. 5 laboratories [1,2,3]; students work in pairs; written reports
3. 2 design projects; students work in teams to meet specs [4,5]
4. 3 exams (with design) [1,2,3,4,5]

COURSE DESCRIPTION: University of Michigan, College of Engineering, ELECTRICAL ENGINEERING PROGRAM