EE 3300
Integrated Electronics
Fall 2024
COURSE INFORMATION

Room: Lecture -   1011 Coover
            Labs   -   2046 Coover

Time: Lecture -   MWF 12:05-12:55
            Laboratory - Sec 1 Tues   8:00-10:50
                    - Sec 2 Tues   11:00-1:50
                    - Sec 3 Fri   7:45-10:35

Instructors:

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Laboratory Instructors:

            Mathew Crabb   mjcrabb@iastate.edu
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Course Description:
Semiconductor technology for integrated circuits. Modeling of integrated devices
including diodes, BJTs, and MOSFETs. Physical layout. Circuit simulation. Digital building
blocks and digital circuit synthesis. Analysis and design of analog building blocks. Laboratory
exercises and design projects with CAD tools and standard cells.

Course Web Site:
        http://class.ee.iastate.edu/ee330   Homework assignments, lecture notes, laboratory
assignments, and other course support materials will be posted on this WEB site. Students will
be expected to periodically check the WEB site for information about the course.

Required Texts:

        CMOS VLSI Design – A Circuits and Systems Perspective, Fourth Edition
        by N. Weste and D. Harris, Addison Wesley, 2011

Reference Texts:

Fundamentals of Microelectronics (3rd Edition)
by B. Razavi, Wiley, 2021

Microelectronic Circuits (8th Edition)
by Sedra and Smith, Oxford, 2019

Microelectronic Circuit Design (6th Edition)
by Richard Jaeger and Travis Blalock, McGraw Hill, 2021

CMOS Circuit Design, Layout, and Simulation (3rd Edition)
Jacob Baker, Wiley-IEEE Press, 2019.

Analog Integrated Circuit Design (2nd Edition)
by T. Carusone, D. Johns and K. Martin, Wiley, 2011

CMOS Analog Circuit Design (3rd Edition)
by Allen and Holberg, Oxford, 2011.

The Art of Analog Layout (2nd Edition)
by Alan Hastings, Prentice Hall, 2005

Analysis and Design of Analog Integrated Circuits (6th Edition)
Gray, Hurst, Lewis and Meyer, Wiley, 2024

Grading:

Points will be allocated for several different parts of the course. A letter grade will be assigned based upon the total points accumulated. The points allocated for different parts of the course are as listed below:

3 Exams	100 pts each
1 Final	100 pts
Homework	100 pts total
Quizzes/Attendance	100 pts total
Lab and Lab Reports	100 pts total
Design Project	100 pts

Topics Covered:

1. **Practical Concepts**
- Opportunities in the microelectronics field
- Economics associated with design and manufacture of integrated circuits
- Physical properties of electronic materials

2. **Digital Electronic Systems (preliminary)**
- Basic gates
- Switch-level device models
- Complex logic gates and pass transistor logic

3. **Technology Files**
- Fabrication technology – front-end processing
- Interconnects
- Back-end processing

4. **Passive Devices**
- Resistor and Capacitor modeling

5. **Diodes and Diode Opeation**
- Diodes and diode models
- Diode Circuits

6. **MOSFET Operation**
- Square-law models
- Short-channel Devices
- BSIM Models

7. **BJT Devices and Operation**
- BJT Models
- BJT Circuits

8. **Small-Signal Circuits**
- Developing small-signal models
- Small-signal analysis
- Amplification
- Amplifier structures and analysis
- Amplifier Design
- High-frequency device models and parasitics

9. **Digital Circuits**
- Hierarchical Design
- Logic Families

- Logic Optimization
- Propagation Delay, Power Dissipationn, Logic Effort
- Sequential logic circuits, flip flops, Array Logic
- Digital Circuit and Digital System Design

Laboratory:

There will be weekly laboratory experiments.   An IC design project will be conducted in which student designs will be eligible for fabrication through the MOSIS program. A separate laboratory handout will be provided that will discuss laboratory policy and procedures. All laboratory experiments must be completed to be eligible for receiving a passing grade in this course per the "Attendance and Equal Access Policy" described below.

You will be using state of the art equipment and software in the laboratory. Please take the initiative to become familiar with how this equipment and software operates. Operator's manuals for all of the test equipment which discuss basic operation and the performance specifications are available on line.

Homework:

Homework assignments are due at the beginning of the class period on the designated due dates. Unless announced to the contrary, late homework will be accepted, without penalty, up until 11:59 p.m. on the due date. When homework is due near an exam date, the late homework option may not be available so solutions can be posted earlier.

Attendance and Equal Access Policy:

Participation in all class functions and provisions for special circumstances will be in accord with ISU policy. Attendance of any classes or laboratories, turning in of homework, or taking any exams or quizzes is optional however grades will be assigned in accord with described grading policy. No credit will be given for any components of the course without valid excuse if students choose to not be present or not to contribute. Successful demonstration of ALL laboratory milestones and submission of complete laboratory reports for ALL laboratory experiments to TA by deadline established by laboratory instructor is, however, required to be eligible to receive a passing grade in this course.

Laboratory Safety:

In the laboratory, you will be using electronic equipment that can cause serious harm or injuries, or even death, if inappropriately used. Fortunately, if this equipment is used as intended by the manufacturers and if good safety procedures are followed, the risks associated with using this equipment will be very small.

Your safety and the safety of fellow students and anyone else that may be in the laboratory is of utmost importance. Laboratory safety guidelines are posted in the laboratories you will be using. Please be aware of and conform to these guidelines. Your TA will go through a laboratory safety procedure and ask you to certify that you have participated in the laboratory

safety training.

Learning Objectives:

- Understand basic semiconductor processing steps and how they can be combined into a semiconductor process to provide useful circuits
- Understand how Diodes, MOS Transistors, Thyristors, and BJTs operate and are modeled
- Understand how basic thyristors circuits operate and how to design circuits incorporating thyristors
- Understand how basic amplifier circuits operate and are designed in both discrete and integrated environments and demonstrate ability to both analyze and design basic amplifier structures
- Understand how basic logic circuits operate and are designed in current semiconductor processes and demonstrate ability to both analyze and design basic logic circuits in these processes
- Understand how a CAD environment can be used to support the design of integrated circuits and demonstrate the ability to use a CAD environment in the design of integrated circuits
- Understand basic economic principles associated with the design of electronic systems and demonstrate ability to incorporate these principles into the design of basic electronic circuits and systems.

Additional Comments

     I encourage you to take advantage of the e-mail system on campus to communicate about any issues that arise in the course. I typically check my e-mail several times a day. Please try to include "EE 3300" in the subject field of any e-mail message that you send so that they stand out from what is often large volumes of routine e-mail messages.