

# **ECE4420 Course Syllabus**

## **ECE4420**

### **Digital Integrated Circuits (3-0-0-3)**

#### **CMPE Degree**

This course is Elective for the CMPE degree.

#### **EE Degree**

This course is Elective for the EE degree.

#### **Lab Hours**

0 supervised lab hours and 0 unsupervised lab hours

#### **Course Coordinator**

Mukhopadhyay, Saibal

#### **Prerequisites**

ECE 3040 [min C] or ECE 3030 [min C]

#### **Corequisites**

None

#### **Catalog Description**

Analysis and design of MOS digital integrated circuit families and their applications in modern electronic systems.

#### **Textbook(s)**

Hodges, Jackson, and Selah, *Analysis and Design of Digital Integrated Circuits* (3rd edition), McGraw-Hill, 2003. ISBN 0072283653 , ISBN 9780072283655 (required)

#### **Course Outcomes**

Upon successful completion of this course, students should be able to:

1. Analyze functionality of digital circuits including combinational, sequential, and memory.
2. Characterize speed, energy consumption, and robustness of combinational, sequential, and memory circuits.
3. Design combinational, sequential, and memory circuits to meet specified functionality, speed, energy, and robustness targets
4. Perform simulation of digital circuits, and write reports conforming to technical writing standards.

#### **Student Outcomes**

In the parentheses for each Student Outcome:

"P" for primary indicates the outcome is a major focus of the entire course.

"M" for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.

"LN" for "little to none" indicates that the course does not contribute significantly to this

outcome.

1. ( P ) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. ( LN ) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. ( LN ) An ability to communicate effectively with a range of audiences
4. ( LN ) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. ( LN ) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. ( P ) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. ( M ) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

## Topical Outline

- I. Integration Scales and Applications
- II. Device Modeling for Digital ICs
  - MOSFETs
  - Layout and fabrication related topics
- III. The Inverter
  - CMOS: DC and transient characteristics
- IV. Basic Logic Families
  - CMOS Logic Circuits
    - Combinational logic gates
    - Dynamic circuits and clocking
- V. Digital Logic Units
  - Sequential design and timing
  - Arithmetic logic circuits
  - Memories Cells and Arrays: SRAMs, DRAMs,
- VI. Applications to Practical Design Problems
  - Examples from current literature including microprocessors, co