JOINT INSTITUTE
交大密西根学院

Standard Undergraduate Course Profile

COURSE NUMBER: VE320	**COURSE TITLE: Introduction to Semiconductor Devices**
CREDIT: 4.0	**PREREQUISITES:** Advanced Mathametics
TEXTBOOKS/REQUIRED MATERIAL: **Semiconductor Physics and Devices: Basic Principles 4th ed. By Donald A. Neamen, Publishing house of electronic industry**	**PREPARED BY: Yaping Dan** **LAST UPDATED: Oct. 29th, 2020** **DATE OF DISCIPLINE GROUP APPROVAL:** **DATE OF UC APPROVAL:**
CATALOG DESCRIPTION (No more than 100 words): **This course is designed to introduce the principles and concepts for CMOS integrated circuits. The course will start with device principles of p-n junction diodes and metal-oxide-semiconductor field effect transistors (MOSFET). The course is then developed to introduce the digital circuit building block--- an CMOS inverter for converting "0" to "1" and "1" to "0". The time-delay, power consumption and layout area will be analyzed and optimized. More complicated circuits such as combinational logics, registers and memories will be discussed in the end. After the course, the students are expected to design and layout large-scale static logic integrated circuits independently such as calculators, multipliers and finite state machines. Labs and projects are specially designed to facilitate students to develop skills for software circuit design using Cadance.**	**COURSE TOPICS:** 1. **Introduction to Integrated Circuits** 2. **The Manufacturing Process** 3. **The PN Junction Diodes and MOSFET Transistors** 4. **CMOS Inverters** 5. **Designing Combination Logic Gates in CMOS** 6. **Designing Sequential Logic Circuits** 7. **The pn junction** 8. **The pn junction diode** 9. **Metal-semiconductor and semiconductor heterojunction** 10. **Metal-Oxide-Semiconductor Field Effect Transistors** 11. **Bipolar junction transistors**

COURSE STRUCTURE and CONTACT HOUR: e.g. 48 hours of Lecture/ 48 hours of Lab/ 4 hours of Discussion

COURSE OUTCOMES [Student Outcomes* in brackets] *for each course outcome, links to the Student Outcomes are identified in brackets.*	(The following is an example. Please delete it when you compose your own document.) 1. Understand the Moore's Law [1,2,6,7] 2. Understand the principle of PN junction diodes and CMOSFET transistors [1,6,7] 3. Have the knowledge of IC manufacture process.[2,3,4] 4. Be able to design and optimize the performance of inverters[1,2, 6,7] 5. Be able to read the layout and plot the circuit schematics from the layout.[1,6,7] 6. Be able to size the inverter chain to minimize the delay time.[1,2,] 7. Be able to design the circuit schematics from a given Boolean expression.[1,2, 6,7] 8. Be able to design the transistor size of combinational logic gates.[1,2, 6,7] 9. Understand the concept of logic effort and be able to size a chain of combination logic gates.[1,2,6,7] 10. Be able to design Master-Slave registers.[1,2,5, 6,7] 11. Be able to design read-only memories and plot schematics from the layout.[1,2,6,7] 12. Understand the principle of flash memories.[1,2,6,7] 13. Be able to design RAM memories.[1,2,6,7] 14. Understand the memory peripheral circuitry.[1,3,6,7]
COURSE OBJECTIVES [Course Outcomes in brackets] *for each course objective, links to the course outcomes are identified in brackets.*	(The following is an example. Please delete it when you compose your own document.) 1. Have a brief idea about digital circuit design. [1-13] 2. Understand the manufacturing process of CMOS integrated circuits.[3] 3. Study basic concepts about the diode and the MOS(FET) transistor.[2] 4. Develop understanding in CMOS inverters, combination logic gates, registers and memories.[4-14] 5. Develop skills to design and optimize combination logic gates, finite state machines, memories using commercial circuit design software.[4-14]

ASSESSMENT TOOLS [Course Outcomes in brackets] *for each assessment tool, links to the course outcomes are identified*	(The following is an example. Please delete it when you compose your own document.) 1. Homework 5% [2-12] 2. Quizzes 5% [1-12] 3. Midterm Exam #1 30% [1-6] 4. Project 30% [4-11] 5. Final Exam 30% [7-12]

ABET Student Outcomes* —— Apply to Engineering, Math, and Science Courses Only

1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2) 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) an ability to communicate effectively with a range of audiences

4) 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) 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) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies