ECE2031 Course Syllabus

ECE2031

Digital Design Laboratory (1-0-3-2)

CMPE Degree

This course is Required for the CMPE degree.

EE Degree

This course is Required for the EE degree.

Lab Hours

3 supervised lab hours and 0 unsupervised lab hours

Course Coordinator

Collins,Thomas R

Prerequisites

(ECE2020/2030 and (ECE 2035* or ECE 2036*)) or CS 2110 [all courses min C]
* Prerequisites indicated with an asterisk may be taken concurrently with ECE2031

Corequisites

None

Catalog Description

Design and implementation of digital systems, including a team design project. CAD tools, project design methodologies, logic synthesis, and assembly language programming.

Textbook(s)

Collins, & Twigg, *ECE 2031 Lab Manual* (2nd edition), Kendall/Hunt Publishing Company. ISBN 9780757571572 (required) (comment: This lab manual is revised frequently and must be purchased new. Required assignments from the manual must be torn from the book and turned in for grading.)

Hamblen, Hall, & Furman, *Rapid Prototyping of Digital Systems, SOPC Edition*, Springer Publishers. ISBN 9780387726700 (required) (comment:)

Perelman, Paradis & Barrett, *The Mayfield Handbook of Technical Scientific Writing*, Mayfield Publishing, 1998. ISBN 9781559346474(optional) (comment: This handbook is available FREE on-line at http://www.mhhe.com/mayfieldpub/tsw/home.htm)

258608, *Wire Jumper Kit "NO RETURNS"*, XX Supply. ISBN 2818440011900 (required)

Course Outcomes

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

1. implement combinational logic circuits both with TTL devices on a protoboard and within a complex PLD.
2. analyze the timing of digital circuits with oscilloscopes and logic analyzers.
3. design and implement state machines to meet design specifications.
4. design circuits with a graphical schematic CAD editor.

5. simulate circuits within a CAD tool and compare to design specifications.
6. design, implement, and simulate circuits using VHDL.
7. implement a simple computer within a PLD.
8. write machine language programs and assembly language programs for the simple computer.
9. use a complex sequential logic circuit as part of a solution to an open-ended design problem.
10. write laboratory reports and documentation conforming to technical writing standards.
11. work effectively as team members to develop and write a group report.
12. work effectively as team members to design an approved project.

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. (M) 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. (P) 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. (M) 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

Laboratory projects will use a PC-based CAD environment that supports schematic capture, logic simulation, and HDL-based logic sysnthesis on FPGAs (field-programmable gate arrays). Small-scale integrated circuits will be used for early labs, then HDL-based logic synthesis on FPGA-based design boards will be used for more advanced design implementations, including exposure to mixed design-entry methods. The semester will culminate with design projects specified and undertaken by teams of three to five students. Technical writing skills are developed through laboratory reports, project documentation, and an oral presentation.

Topics

1. CAD Tools
2. Logic Synthesis using an HDL
3. HDL models of basic gates and logic operations
4. Combinational design using multiple methods: primitive gates, schematic capture for FPGAs, and VHDL
5. HDL based simulation and synthesis with FPGAs
6. Examination of real timing issues on hardware using timing simulation, oscilloscope, and logic analyzer
7. State machine specification, design, and simulation

8. State machine implementation with multiple methods
9. Design verification with logic analyzer
10. HDL models of data storage elements
11. ROM and RAM implementations on FPGA boards
12. Hardware design of a simple computer with ALU, registers, control unit, memory, instructions, and I/O
13. HDL-based simple computer simulation and implementation on FPGA board
14. Machine language and assembly language programming for the simple computer
15. Simulation and implementation of programs on the FPGA board
16. Final design project problem specification (examples: video game, control application, robot, or contest)
17. Hardware and tools available to solve the final design project problem
18. Project engineering issues: top-down vs. bottom-up design, hierarchical decomposition, and modularity