ECE 4401/CSE 3350: Digital Design Laboratory

Credits and contact hours: 3 Credits (One 50-minute lecture and one 3-hour laboratory per week)

Instructor: John Chandy

Textbook: None

a. *Other supplemental materials*: The Designer's Guide to VHDL, Peter J. Ashenden, 2001.

***Specific course information*:**

a. *Catalog Description*: Digital designing with PLA and FPGA, A/D and D/A conversion, floating point processing, ALU design, synchronous and asynchronous controllers, control path; bus master; bus slave; memory interface; I/O interface, logic circuits analysis, testing, and troubleshooting, PCB; design and manufacturing.

b. *Prerequisite*: CSE 3302/ECE 3401 (Digital Systems Design)

c. *Required, elective, or selected elective:* Selected elective

***Specific goals for the course*:**

a. *Specific outcomes of instruction*: One of the course objectives is to familiarize students with digital design principles in realistic systems. Another objective is to introduce students to issues in embedded systems design and how embedded digital systems interact with other devices. They will be introduced to different devices such as interconnection buses, memories, keyboard interface, video display, etc. Students will also learn about FPGAs and how they can be used for prototyping digital systems. Students will be able to design small-scale digital systems and specify how to test and debug them. They will be able to apply design principles of the hardware descriptive language, VHDL for simulation, design, and synthesis of complex embedded systems.

b. *ABET Criterion 3 Student Outcomes addressed by the course*:

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
Students learn how to apply mathematical techniques such as Boolean algebra to engineering problems. Students learn how to design digital subsystems and building blocks to meet desired specifications.

(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
n/a

(3) an ability to communicate effectively with a range of audiences
Students learn how to communicate effectively through weekly design reports and a final project report and oral presentation.

(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
n/a

(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
n/a

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
Students learn how to design and conduct experiments through the design, testing, and debugging of weekly laboratory assignments. They are able to analyze and interpret testing and use the testing to improve their designs.

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
Students learn techniques, skills, and modern engineering tools necessary for engineering practice – such as the use of commercial computer-aided design tools such as Xlinx Vivado and ModelSim.

Topics covered:

- Review of VHDL and introduction to FPGAs
- ALU Design
- State Machines
- Use of SRAMs, DRAMs and how to implement in a FPGA
- I/O devices including PS/2 keyboards and mice
- Bus design for off-chip and on-chip communication
- Video controller principles
- D/A using pulse width modulation
- Integration of microprocessors with FPGA hardware
- System-on-chip design