EECE-4740, EECE-5740: Advanced VHDL and FPGA Design
Syllabus - 2017

Course info

EECE-4740, EECE-5740: Advanced VHDL and FPGA Design, 3 credits
Prerequisites: EECE-2030, EECE-3015.
Lecture: TueThu, 5:30-6:45pm in Haggerty Hall, Room 388
Course webpage on D2L: http://d2l.mu.edu

Instructor

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Course description

Present the background, abstractions, and techniques for advanced digital circuits design and optimization. Emphasis is placed on specification and synthesis using VHDL and on prototyping using FPGAs of complex systems. Such systems represent examples from various application domains, including processors, image and video processing, filtering and other DSPs, and power electronics.

Textbook

Research papers, lecture notes, and other teaching materials will be distributed during classes. No specific textbook is required.

Course objectives

By the end of this course students should be able to perform the following tasks:

1. Describe Field Programmable Gate Array (FPGA) technologies.
2. Describe typical design methods of digital circuits implemented as FPGA circuits.
3. Utilize VHDL to specify complex circuits and synthesize these circuits with CAD tools (e.g., Altera and/or Xilinx tools).
4. Describe and utilize simulation tools for measuring and reporting performance of complex digital systems.
5. Conduct experiments using an evaluation board to confirm the analysis done in class.
6. Prepare informative and organized written and video reports that describe the methodologies employed, the results obtained, and the conclusions made in simulation and hardware experiments.
7. Prepare review-type reports of selected technical research articles.

Course policies

Grading: Grading is based on the following components:

- Paper presentations and in-class participation: 10%

- Homework assignments: 30%
- Several implementation projects: 45%
- EML Activities: 15%

Grading scale:
A [90-100]%; A/B [85-90)%; B [80-85); B/C [75-80)%; C [70-75)%; C/D [65-70)%; D [60-65)%; F <60%.

Homework policy: All assignments are due at the beginning of class unless otherwise specified. Late submissions will not be accepted. If you are absent from class or you know that you will be absent from class, you should as soon as possible arrange with the instructor for any missed work. It is the student's responsibility to contact the instructor in such a case. Arrangements made in advance of an absence (if approved) may allow full credit to be given for late work. Include your name only (no MUID) on all homework assignments, reports, exams, etc. Turn in solutions that are written clearly and neatly; turning in disorganized or esthetically-ugly solutions with scratched-out text, figures, and formulas, etc. is penalized by deducting grade-points even if the final answer is correct.

Attendance: Attendance is required, per engineering and university policies at:
http://bulletin.marquette.edu/undergrad/academicregulations/#attendance
There is no penalty for excused absences (must be pre-approved). After two unexcused absences, the final grade may be lowered by 2 percentage points per additional absence. Excessive absences (i.e., when more than 6 classes have been missed) may result in being dropped from the course.
In addition, all students must attend the Design Day in the College of Engineering on May 6 2016.

Class participation: You are expected to pro-actively participate in this course. Active participation means to study the assigned reading items before class, ask and answer questions, and participate in discussions during lectures. Proactive participation means to search and read – on your own – additional information (e.g., online articles, research papers, textbooks, etc.) related to the topics of this course and to share it with the other students and the instructor during outside or in class discussions.

Academic integrity: All submitted work should be your own. Instances of plagiarism and cheating will result in all students involved getting an automatic zero on the assignment/exam/project and potentially a failing grade based on the severity of the case. Please refer to the Marquette University's Academic honesty policies and procedures:
http://bulletin.marquette.edu/undergrad/academicregulations/#academichonestypolicy

Special needs: If you have a disability and require accommodations, please contact your instructor early in the semester so that you learning needs may be appropriately met. You will need to provide documentation of your disability to the Office of Disability Services (OSD). If you are unsure of what you need to qualify for services, visit the OSD website at http://www.marquette.edu/disability-services/forms.shtml or contact the Office of Disability Services at 414-288-1645. The Office of Disability Services is located in Marquette Hall 05.

Usage of media and electronic devices: Usage of cell phones, laptops, tablets, newspapers, magazines, etc. is not allowed during lectures unless instructed to do so by the instructor.

Paper presentations and discussions

Students will be required to read assigned technical research papers, to discuss, and to make in-class presentations. Each student will make one individual presentation and will be expected to participate in all paper discussions.

Projects

There will be several projects, which will require students to implement the components of a complex digital system using VHDL and FPGAs.

Graduate students

Graduate students enrolled in this course are expected to work on significantly more difficult project topics. In addition, graduate students may be required to work individually, as opposed to working in teams, on selected projects.

Entrepreneurial Minded Learning (EML) Activities

You must create and maintain an **individual reflective journal (IRJ)** as a document to which you will continuously add weekly entries throughout the semester. A weekly entry in the IRJ must contain three components (referred to as **the 3C's**).

1) *Curiosity component* (5%) – Describe activities that you've done within the last week, which can be characterized as **demonstrating curiosity**. Examples may include but are not limited to: you find an interesting recent article, which you share with the instructor and with the rest of the class; you ask questions in and outside the class; you are pro-active and try new/different design ideas, and then you bring and demo or share new design insights with the class, etc.
2) *Connections component* (5%) – Describe in your own words connections or associations that you identify between things you learn/do in this course (including those learned through activities in the first C) and everything else you know. How do these things **relate to your own plan** of achievements you want to get out of this class? Emphasize decisions that you made, especially through the perspective of assessing risk – in order to minimize it and be safe or not but with the potential of higher reward. For example, I can see that the serial controller implemented on FPGA in this course can be used in my senior design project; I implemented by re-using some VHDL code from Cris to reduce the risk of running out of time.
3) *Create value component* (5%) – **Reflect** on how you see that **value** has been created through what you have been doing or might be created if various courses of action would be pursued. The meaning of value here is more than the value you get out of strictly understanding the topics taught during lectures. Think like someone who wants to start a company. What idea or study or product could be created, and which would provide a solution to a problem that you identified? For example, if you created a website for videos sharing (e.g., youtube), what would be the value of it?

Please make sure you allocate plenty of time to it, come and ask questions, discuss with your colleagues, and be creative. The deliverable is a weekly PDF copy of your up to date IRJ, uploaded to D2L.

Outline

1. Introduction
2. Field Programmable Gate Array (FPGA) technologies
3. VHDL concepts and programming
4. Design methods for FPGA circuits
5. Specification, synthesis, and FPGA implementation of selected complex systems, e.g. digital camera, network-on-chip, video game, video encoders and decoders, processors, etc.