ECE 56700 FPGA Designs for Signal Processing Applications

Course Information:

Course Number and Title: ECE 56700 FPGA Designs for Signal Processing Applications

Credit Hours 3

Course Description:

This course introduces methodologies of FPGA designs for signal processing applications. It provides system design experience using hardware description language (HDL) and commercial EDA tools. Topics covered include computer arithmetic, fixed-point vs floating point, FIR/IIR implementations, multirate signal processing, implementations of FFT, modulation/demodulation using FPGA. Literature readings from IEEE Xplore will be assigned to students. Students are required to complete a course project that implements and simulates a signal processing algorithm using FPGAs.

Prerequisites:

- Graduate standing and,
  - ECE 358 – Intro to VHDL or a demonstrated proficiency with synthesizable VHDL or Verilog
  - ECE 301 – Signals and Systems

Reference Textbook:


- Xilinx DSP Primer, 2011

Coordinator:

Guoping Wang, Associate Professor of Computer Engineering
Office Hours: TBD
http://engr.ipfw.edu/~wang

Schedule:

Two 75-minute lectures per week
**Topic Lecture**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction to FPGA</td>
<td>1</td>
</tr>
<tr>
<td>2. Computer Arithmetic</td>
<td>2</td>
</tr>
<tr>
<td>3. Finite Impulse Response Digital Filters</td>
<td>2</td>
</tr>
<tr>
<td>4. Infinite Impulse Response Digital Filters</td>
<td>2</td>
</tr>
<tr>
<td>5. Multirate Signal Processing</td>
<td>2</td>
</tr>
<tr>
<td>6. Fourier Transforms</td>
<td>2</td>
</tr>
<tr>
<td>7. Modulation and Demodulation such as ASK, PSK and FSK</td>
<td>2</td>
</tr>
<tr>
<td>8. Exams and Project Presentations</td>
<td>2</td>
</tr>
</tbody>
</table>

**Grading Distribution:**

Your course grade will be determined by a combination of homework, presentation, midterm, and final (tentative):

- Final Presentation: 10%
- Homework: 40%
- Final Exam: 50%

**Grading Scale:**

- 93-100 % = A
- 90-92 % = A-
- 87-89 % = B+
- 83-86 % = B
- 80-82 % = B-
- 77-79 % = C+
- 73-76 % = C
- 70-72 % = C-
- 60-69 % = D
- < 60% = F

**Course Objectives:**

To introduce the basic approaches and methodologies of FPGA design for signal processing systems

**Course Outcomes:**

A student who successfully fulfills the course requirements will have demonstrated:

1. an understanding of computer arithmetic such as binary multipliers, binary divider, floating-point vs fixed point, distributed arithmetic, CORDIC, etc
2. an understanding of the implementations of Finite Impulse Response filters, Infinite Impulse Response filters.
3. an understanding of the implementations of multirate signal processing.
4. an understanding of FFT implementations
5. an understanding of the implementations of modulation and demodulation.
**Presentation:**
Students will work in groups of two to present a presentation on a Signal Processing hardware topic. The list of topics will be given by the instructor during the course of the semester.

**Course Policies:**

**Homework:**
Homework is due before the start of the following class one week after it’s assigned. Credit for late homework will diminish at the rate of 10% per day.

**Attendance:**
Regular attendance is critical for the successful completion of the course work. Attendance will be recorded.

**Student Dishonesty:**
Student dishonesty (cheating or plagiarizing) will not be tolerated. Students are encouraged to inform their academic advisors of instances of cheating or plagiarizing.

**Plagiarism** is another form of cheating. Students are guilty of plagiarism when they present someone else’s work as their own. Examples are: asking a friend to write an assignment paper for you, or including portions of material from a book, journal, or computer file, without giving appropriate credit to the author.

**Penalties** for student dishonesty can include a grade of “F” in the course. However, if a student believes she/he has been unjustly accused of dishonesty, he or she may follow the Grade Appeal Procedure to request a review of the case.

**Policy Concerning Students with Disabilities:**
If you have a disability and need assistance, special arrangements can be made to accommodate most needs. Contact the Director of Services for Students with Disabilities (Walb Union, Room 113, telephone number 481-6658) as soon as possible to work out the details. Once the Director has provided you with a letter attesting to your needs for modification, bring the letter to me. For more information, please visit the web site for SSD at [http://www.ipfw.edu/ssd/](http://www.ipfw.edu/ssd/).