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## ECE 8790 Section 001 FPGA Design and Applications

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**Class Location/Time:** MWF 1115-1205, Riggs 219

**Instructor:** Dr. Melissa C. Smith  
**Phone:** 864-656-2119

**Email:** [smithmc@clermson.edu](mailto:smithmc@clermson.edu)      **Office:** 304 Riggs Hall  
**Office Hours:** TBD (will be posted), or by appointment

**Teaching Assistant:** Brad Green  
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**Office and Office Hours:** 10 Riggs Hall (basement)

### Course Description

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Field Programmable Gate Arrays (FPGAs) are used in many areas of computing and signal processing. The goal of this course is to introduce the student to some of the emphasis areas where FPGAs are used and provide basic fundamentals principles and practice for using FPGA devices in those areas through class lectures and discussions, reading assignments, homework and lab experiments, and projects. Topics will include FPGA device architectures; VHDL and HLL design tools; general concepts in each of the selected emphasis areas; introduction to tools for each of the emphasis areas; and application case studies.

**Course webpage:** <https://clermson.instructure.com>  
**Prerequisites:** See below or consent of the Instructor

### Course Objectives

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Entering the class, the student is expected to know fundamentals of digital design including design technologies, design methodology and techniques, and design environments and tools; basic fundamentals of computer organization and architecture, including microprocessor datapath and control structures, data formats, and memory hierarchy; and experience in a HLL such as C. Experience with VHDL, Verilog, and/or Matlab are desirable.

### Required Materials

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**Text:** Readings from the literature

**Laptop with design tools installed or other access to design tools.**  
**4GB or larger micro SD card with USB adaptor. (phone compatible preferred over those used in cameras)**

## Topical Outline (subject to change)

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### I. General overview (< 1 week)

- Goals and motivations
- History, state of the art, future trends
- Basic concepts and related fields of study

### II. HDL overview (< 2 weeks)

- Controller/Datapath synthesis
- Logic minimization

### III. FPGA Architectures (< 1 week)

- Device characteristics
- Basic Quartus tool flow review
- Design strategies

### IV. OpenCL Introduction (< 2 weeks)

### V. Potential emphasis area topics (4 to 5 weeks each)

- FPGAs in Embedded Systems (SOC)
- FPGAs in Digital Signal Processing
- FPGAs in Computing
- FPGAs in Networking
- FPGAs in Deep Learning

In each emphasis area, discussions to include:

- Application overview
- Tools
- Examples
- Project &/or Paper Review

## Grading

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- Projects/Presentations: 50% (Date: TBD)
- Lab Exercises (smaller projects or exercises): 10%
- Quizzes: 10% (Date: TBD)
- Papers/Reports: 30%

**Examples/Tutorials/Labs:** Where appropriate, examples will be covered in class and/or assigned for students to complete for practice. These are essential to successful completion of the assigned projects.

**Projects/Presentations:** Students are expected to work individually unless specified by the instructor. Projects will be assigned for each of the topic areas to give students practice with the tools and experience with the use of FPGAs in that topic area. The culmination of each project will be a clear and concise technical report suitable for publication discussing project concepts, development, experiments, results, and analyses. The most important outcome of each project and report will be the research

results that are achieved, analyses rendered, and conclusions drawn with demonstrable insight. As time allows and depending on the number of students in the class, students will be asked to give presentations on one or more of the projects assigned in the class.

**Papers/Reports:** During the semester, students will be asked to research a selected topic related to the course material. The student must locate and read a minimum of 2 journal or top-tier conference papers related to the topic and write a paper on their findings.

**Grading Scale:** Final grade to be determined by curved average with the weighting indicated above of quizzes, assignments, and projects.

**Make-up Quiz Policy:** Missed quizzes cannot be made up, except in case of documented medical emergency.

## **Additional Policies**

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Students may leave after 10 minutes if the professor or guest lecturer does not arrive in that time. Attendance while not required is highly recommended. Students who regularly attend class and participate will receive special consideration if course average is borderline. Students are responsible for getting lecture notes, handouts, and homework assignments for missed classes from fellow students or from the class website when applicable.

Assignments are due on the day and time specified in the assignment instructions; late assignments will not be accepted. Zeros will be given for missed in-class graded activities. Make-ups for graded activities and homework assignments are possible *only* with a valid, written, medical or university excuse. It is the student's responsibility to give the professor the written excuse and to arrange for any makeup work to be done *before* the exam for that unit is taken. All makeup exams will be given on the last day of the semester, by appointment. Students are expected to complete all assignments independently unless the instructor specifies team collaboration is permitted.

It is recommended that students check their email daily for important announcements, assignments, and other class related information. It is preferred that you use your clemson.edu account and not forward to another account (e.g. hotmail, yahoo, etc.) as there is the potential for lost information with these systems.