COURSE SPECIFIC SYLLABUS
FPGA DESIGN AND APPLICATIONS
ECE 8790 SECTION 001

CLASS MEETING TIME AND PLACE: T/Th 1100-1215 Riggs 300

INSTRUCTOR:
Dr. Melissa C. Smith   Email: smithmc@clemson.edu   Office: 110 Riggs Hall
Phone: 864-656-2119   Office Hours: TBD (will be posted), or by appointment

TEACHING ASSISTANT:
Brad Green   Email: wbgreen@g.clemson.edu   Office and Office Hours: 10 Riggs Hall (basement)

TIME TO WAIT: Students may leave after 10 minutes if the professor or guest lecturer does not arrive in that time.

INFORMATION ON MODALITY: In-Person

IMPORTANT DATES:
Spring 2022 classes - Jan 12th – Apr 29th
Last Day to Drop without a W grade: Jan 26th
Last Day to Drop without final grade: Mar 18th
Exam: Wednesday, May 4th 3-530pm

COURSE DESCRIPTION

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.

PREREQUISITES AND REQUIRED TECHNICAL SKILLS

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; 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.

For technical assistance with the course site, students should contact ithelp@clemson.edu or visit CCIT's website.

ADDITIONAL COURSE POLICIES

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. 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 g.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.

REQUIRED MATERIALS

Text: No Text Required; Readings from the literature and Lecture notes

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)

MAJOR ASSESSMENT/GRADING ACTIVITIES

- Projects/Presentations: 45% (Date: TBD)
- Lab Exercises (smaller projects or exercises): 25%
- Quizzes: 10% (Date: TBD)
- Papers/Reports: 20%

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 at 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.

NOTIFICATION OF ABSENCE:

The Notification of Absence module in Canvas allows students to quickly notify instructors (via an email) of an absence from class and provides for the following categories: court attendance, death of immediate family member, illness, illness of family member, injury, military duty, religious observance, scheduled surgery, university function, unscheduled hospitalization, other anticipated absence, or other unanticipated absence. The notification form requires a brief explanation, dates and times. Based on the dates and times indicated, instructors are automatically selected, but students may decide which instructors will receive the notification. This does not serve as an "excuse" from class. It is a request for an excused absence and students are encouraged to discuss the absence with instructors, as the instructor is the only person who can excuse an absence. If students are unable to report the absence by computer, they may reach the Office of Advocacy and Success via 864.656.0935. Students with excessive absences who need academic or medical assistance can also contact the Office of Advocacy and Success.

Any exam that was scheduled at the time of a class cancellation due to inclement weather will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless contacted by the instructor. Any extension or postponement of assignments or exams must be granted by the instructor via email or Canvas within 24 hours of the weather-related cancellation.

TOPICAL OUTLINE (SUBJECT TO CHANGE)

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

UNIVERSITY POLICIES AND STUDENT SUPPORT, SYLLABUS 2021-22

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STUDENT SUPPORT

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⚡ ACADEMIC SUCCESS CENTER

The [Academic Success Center](#) (ASC) offers a variety of free learning and success services for all undergraduate students that include

- Mastery of course content
  - Tutoring – students can expect a 1:1 meeting with a trained undergraduate peer leader (who made an A or B in the course and was recommended by a faculty member) during which the student can share specific questions they have about course content with the tutor focused on helping the student, through questioning techniques and identification of helpful learning strategies, and master course concepts. Tutors do not help with homework or other class assignments.
  - Peer-Assisted Learning (PAL) – students can expect collaborative and active group learning and study sessions focused on mastery of course content and learning strategies that is facilitated by a trained undergraduate peer leader (who made an A or B in the course and was recommended by a faculty member). PAL leaders do not help with homework or other class assignments.

Learning and Success Strategies

  - Academic coaching - students can expect a 1:1 meeting with a trained professional academic coach during which the coach helps students see themselves, their skills, and their study habits from a fresh perspective through one-on-one sessions focused on learning and personal success strategies.
  - Success strategy workshops – students can expect 30-45 minute workshops on college success skills, time management and organizational skills, test-taking strategies, study strategies, finals preparation, life skills, and academic resources.
  - College success skills course (CU 1010) – students experiencing academic difficulty can expect a course focused on academic and personal skill building taught by instructors who wish to work with this student population

ASC services are designed to equip students with strategies and resources they can use to:

- Succeed in their courses
- Become more confident, independent, and skillful learners
- Engage in more productive and effective study and learning strategies
- Manage their time more effectively

CAMPUS LOCATION

The Class of 1956 Academic Success Center building is located in the center of campus adjacent to Cooper Library and the Watt Family Innovation Center.

PEER LEARNING SUPPORT SERVICES

An overview of the Center's peer learning support programs (tutoring and PAL) can be found at the ASC Courses page.

Please encourage your students to utilize one or more of our services. We welcome your feedback on how we can best serve your students.

ASC INCLUSION STATEMENT

We celebrate diversity in abilities, identities, and perspectives and invite Clemson students, faculty, and staff from all walks of life to participate in our programs, services, and employment. We believe that engaging with a variety of ideas and viewpoints results in deeper and more meaningful learning and creates the conditions for our students to thrive. We seek to be an active partner with Clemson students, faculty, and staff in creating an inclusive campus environment in which mutual respect and support are demonstrated for all members of our campus community.

ACADEMIC ADVISING

Academic advising is an ongoing educational process that connects the student to the University. Academic advising supports the University's mission of preparing the student for learning beyond the confines of the academy. Academic advisors represent and interpret University policies and procedures to the student and help the student navigate the academic and organizational paths of the institution.

COOPER LIBRARY

Do you need library sources but don't know where to start? Are you asking your students to search for a book, article, or data to support their argument? Not sure whether they know how to cite a source properly in their bibliography? Tell them to ask a librarian! Help is available in person at each of our locations: Cooper Library, Gunnin Architecture Library, and the Education Media Center. You can also chat with a librarian live from our website, by phone at 864.656.1557, or text 864.762.4884. Extended research assistance with librarians who specialize in subject areas is also available by appointment. A list of librarians and their areas of expertise are listed on the subject librarians page. Check the Library's Ask Us page for details. For

assistance with digital projects, the Adobe Digital Studio is located on the 5th floor and is staffed to support the needs of you and your students. You can [download Adobe Creative Cloud](#) for free.

COOPER LIBRARY AND TECHNICAL SUPPORT

If you are having hardware or software problems, CCIT's Service Desk may be able to help you. Contact them by emailing ITHELP@clemson.edu, calling or texting (864) 656-3494, or starting a live chat at ccit.clemson.edu. The help desk is located in Cooper Library.

GRADUATE STUDENT SUCCESS RESOURCES

The Graduate School maintains a [collection of grad student resources](#) applicable to graduate students for professional development, governance, the handbook, and thesis/dissertation resources). It has resources regarding education, student life, and health and safety as well.

MICHELIN CAREER CENTER

[The Michelin® Career Center](#), in the Center for Career and Professional Development, assists undergraduate and graduate students in selecting appropriate fields of study, learning effective job searching strategies, and making connections with employers. Career counselors are available to meet with students to explore career or educational options, develop résumés and cover letters, hone interviewing techniques, conduct searches for internships and full-time jobs, and ready themselves for interviewing with employers. In addition, students may utilize ClemsonJobLink, the Career Center's on-line recruiting system, to view part-time jobs, internships, and full-time job postings and to sign up for on-campus interviews.

THE CENTER'S INTERNSHIP PROGRAM

This program brings together students and employers to facilitate academically enriching and mutually beneficial work experiences. This program offers on-campus, off-campus and international internship options. Students may participate in either part-time or full-time internships. The Center's goal is to endow students with the skills and tools to find part-time jobs and internships while in school, as well as full-time jobs following graduation. Other information can be obtained from the [Career Center's website](#) or by calling 864-656-6000.

UPIC: UNIVERSITY PROFESSIONAL INTERNSHIP AND CO-OP

The University Professional Internship and Co-op (UPIC) Program offers students on-campus professional learning experiences. Students have the opportunity to work with Clemson faculty and staff on Clemson's main campus, as well as other sites across the state, while receiving an

academic internship notation on their transcripts. Enrollment in the appropriate INT course and payment of the corresponding fee is a requirement of the program (e.g. INT 1510). In order to be eligible for the program, a student must have completed at least one full semester at Clemson University and be an enrolled and matriculating undergraduate student in good standing. Available internships are typically listed in ClemsonJobLink halfway through the semester prior to the experience. Additional information is available at http://career.clemson.edu or by calling the program office at 864-656-0282.

COOPERATIVE EDUCATION

The Cooperative Education Program (or Co-op Program) is a rigorous engaged-learning program designed to provide students with the opportunity to learn under a mentor in their field of study. Companies partner with the program to host the co-op student for two, three or more rotations and this in-depth learning experience becomes an integral part of the student's education. The co-op student's experience is monitored and evaluated by the faculty and academic staff of the Co-op Program. Co-op students are paid by the host company.

REGISTRAR

The Registrar's office provides information about important deadlines, degree and program requirements, and other key information, including use of iROAR to add, drop, or withdraw from courses.

STUDENT ACCESSIBILITY SERVICES: ACCESSIBILITY STATEMENT

Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to this class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848, by emailing studentaccess@lists.clemson.edu, or by visiting Suite 239 in the Academic Success Center building. Appointments are strongly encouraged – drop-ins will be seen, if at all possible, but there could be a significant wait due to scheduled appointments. Students who have accommodations are strongly encouraged to request, obtain and send these to their instructors

through the AIM portal as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester.

You can access further information at the Student Accessibility website. Other information is at the university's Accessibility Portal.

Student Health Services, locally known as "Redfern" Health, strengthens Clemson University by providing quality medical and mental health care and the health, safety and well-being of the campus community. Student Health Services strives to be an innovative health care system providing integrated quality services that are responsive to the needs of the University community.

For information on who to contact for help in a crisis situation, visit the Student Health contact page and the emergency/crisis page for getting help.

CAPS: COUNSELING AND PSYCHOLOGICAL SERVICES

At Counseling and Psychological Services(CAPS), you are encouraged to be an active participant in your medical and mental health care. Which service is the right one for you hinges on your individual need, and CAPS will help you figure that out.

CAPS is committed to educating students, as well as offering "outreach services to faculty and staff members in order to improve the quality of their interactions with students and to promote a healthy work environment."

WRITING LAB

Clemson University's Writing Lab offers free one-on-one writing support for all Clemson students. Students can seek support at any stage of the writing process, from brainstorming to final revisions. Visit the Writing Lab's website for more information about their services or to make an appointment.

CLEMSON POLICIES

ACADEMIC CONTINUITY

Clemson has developed an Academic Continuity Plan for academic operations. Should university administration officially determine that the physical classroom facility is not available to conduct classes, class will be conducted in a virtual (online) form. The university issues official disruption notifications through email, website, text notification and Social Media. When notified, use one of the following links to navigate to Clemson Canvas where you will find important information about how we will conduct class:

- o Primary access link: http://www.clemson.edu/canvas
- o Secondary access link, if needed: https://clemson.instructure.com/
- o You can also use the Canvas Student App. Visit the downloads page for this app.

    Course activities will occur through the Canvas course.

ACADEMIC INTEGRITY

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a "high seminary of learning." Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.

All infractions of academic dishonesty by undergraduates must be reported to Undergraduate Studies for resolution through that office. In cases of plagiarism instructors may use the Plagiarism Resolution Form.

See the Undergraduate Academic Integrity Policy website for additional information and the current catalogue for the policy.

For graduate students, see the current graduate student handbook for all policies.

ACADEMIC GRIEVANCES

Undergraduate students are advised to contact the Ombuds' Office prior to filing an academic grievance. If the undergraduate academic ombudsman agrees that a grievable issue has occurred, students can contact Undergraduate Studies (656-3022) for assistance filing official paperwork within 30 days of the semester following the awarding of a disputed grade.

Graduate students follow the [Graduate Student Handbook](#) (per the catalogue, "grievances must be filed with the Graduate School within 60 days of the alleged act.")

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= **COMMITMENT TO DIVERSITY**

Clemson University aspires to create a diverse community that welcomes people of different races, cultures, ages, genders, sexual orientation, religions, socioeconomic levels, political perspectives, abilities, opinions, values and experiences.

THE CLEMSON UNIVERSITY TITLE IX STATEMENT REGARDING NON-DISCRIMINATION

The Clemson University Title IX statement: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. This [Title IX policy](#) is located on the Campus Life website. Ms. Alesia Smith is the Clemson University Title IX Coordinator, and the Executive Director of Equity Compliance. Her office is located at 223 Brackett Hall, 864.656.0620. Remember, email is not a fully secured method of communication and should not be used to discuss Title IX issues.

EMERGENCY PREPAREDNESS STATEMENT

Emergency procedures have been posted in all buildings and on all elevators. Students should be reminded to review these procedures for their own safety. All students and employees should be familiar with guidelines from the Clemson Police Department. [Visit here for information about safety.](#)

Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

1. Ensure you are signed up for [emergency alerts](#)
2. Download the [Rave Guardian app](#) to your phone (https://www.clemson.edu/cusafety/cupd/rave-guardian/)
3. Learn what you can do to [prepare yourself](#) in the event of an active threat (http://www.clemson.edu/cusafety/EmergencyManagement/)

ONLINE CONDUCT

Appropriate online academic conduct means maintaining a safe learning environment based on mutual respect and civility. All participants in Clemson courses are expected to behave professionally by adhering to these standards of conduct:

- Never transmit or promote content known to be illegal.
- Respect other people's privacy as well as your own.
- Forgive other people's mistakes.
- Never use harassing, threatening, embarrassing, or abusive language or actions.

Online communication that fails to meet these standards of conduct will be removed from the course. Repeated misconduct may result in being blocked from online discussions, receiving a grade penalty, or being dismissed from the course. Such misconduct in the online environment may also be reported to officials for appropriate action in accordance with University policy. If you ever encounter inappropriate content in our course, please contact me, the instructor, with your concerns.

PRIVACY POLICY

This course is designed with your privacy in mind. If, however, you feel that an assignment or technology tool undermines your right to privacy, please contact the instructor immediately. We will work together to determine an alternative assignment that will help you achieve the course learning outcomes.

🔍 RESEARCH

Please consult the Clemson research policies.   If a course includes the use of animals, IUCAC regulations must be followed.   If a course involves any human subjects research, this research will comply with campus IRB regulations. This includes research of the course itself, which, while it may fall under one of the exempt categories, needs IRB review.