

EEL 4712C Digital Design

Class periods: Monday, Wednesday, and Friday, Period 4, 10:40 am – 11:30 am

Location: LAR 0310

Academic Term: Fall 2019

Instructor:

Dr. Farimah Farahmandi

farimah@ece.ufl.edu

352-392-0910

Office Hours: Mondays & Wednesdays: 12:30-1:30 pm or by appointment, MAE 226C. Subject to change.

Laboratory Schedule @ NEB 213B:

- Mondays, Period E2 - E3 (8:20 PM - 10:10 PM) (John Kearney)
- Tuesdays, Period 9 - 10 (4:05 PM - 6:00 PM) (Carlos Matos)
- Wednesdays, Period 9 - 10 (4:05 PM - 6:00 PM) (Arvind Shankar)
- Thursdays, Period 11 - E1 (6:15 PM - 8:10 PM) (Arvind Shankar)
- Thursdays, Period E2 - E3 (8:20 PM - 10:10 PM) (John Kearney)
- Fridays, Period 6 - 7 (12:50 PM - 2:45 PM) (John Kearney)
- Fridays, Period 8 - 9 (3:00 PM - 4:55 PM) (Carlos Matos)

Teaching Assistants:

Please contact through the Canvas website

- Jonathan Cruz (jonc205@ufl.edu, Sections: XX, YY, Office Hours: Wednesdays & Thursdays: 9:00-10:00 am, NEB 211)
- Muhtadi Choudhury (muhtadichoudhury@ufl.edu, Sections: XX, YY, Office Hours: Tuesdays & Fridays: 2:00-3:00 pm, NEB 211)
- Carlos Matos (carlosm04@ufl.edu, Sections: XX, YY, Office Hours: Tuesdays 1:00-2:00 pm & Thursdays 5:00-6:00 pm, NEB 211)
- John Kearney (jkearney@ufl.edu, Sections: XX, YY, Office Hours: Mondays & Fridays: 9:00-10:00 am, NEB 211)
- Arvind Shankar (arvind.shankar@ufl.edu, Sections: XX, YY, Office Hours: Wednesdays & Tuesdays: 3:00-4:00 pm, NEB 211)

Course Description:

Catalog description: **Credits 4;**

Advanced modular logic, design languages, finite state machines and binary logic.

Course Pre-Requisites / Co-Requisites:

Digital Logic and Computer Systems (EEL 3701) with a minimum grade of C- is a prerequisite for Digital Design. To be successful in this class, you need to know binary logics, modular combinational and sequential logic, design languages, machine instructions, and finite state machines.

Course Objectives:

This course teaches the fundamentals of digital designs using descriptive hardware languages (e.g., VHDL). The course provides an overview of basic concepts in digital logics such as multiplexers, decoders, encoders, and arithmetic circuits. The course introduces students the techniques to model and implement complex combinational and sequential (e.g., processors) digital circuits using basic digital. The course also

emphasizes the synthesis of circuits and their implementation on Field Programmable Gate Arrays (FPGAs). The course will have intensive lab sessions to enable hands-on experience learning. In Digital Design course, students will also become familiar with verification, validation, and debugging of their designs to make sure that they have correctly implemented the specification from timing and functional aspects. To meet the objectives of the class, the students will need to invest a lot of their time and be ready to carry a lot of work.

Materials and Supply Fees

Equipment

- An FPGA-based laboratory board (will be provided to you)
- Digilent Analog Discovery (must be purchased):
<https://store.digilentinc.com/analog-discovery-100msps-usb-oscilloscope-logic-analyzer-limited-time/>

Professional Component (ABET):

Relation to ABET Student Outcomes:

Outcome	Coverage*
1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.	Medium
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.	High
3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	Medium
4. An ability to communicate effectively with a range of audiences	
5. 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.	
6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.	
7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty	High

Required Textbooks and Software

- Fundamentals of Digital Logic with VHDL Design, Brown, S. D. and Vranesic, Z. G., Third Edition, McGraw-Hill, 2009. ISBN: 978-0-07-352953-0.
- The textbook is not considered only as a reference for what is taught in class but also as a complement for the material presented in class. In particular, you will be asked to read tutorials, slides, and codes that supplement the material covered in class.
- Lecture slides are available online.
- Some of the materials are borrowed from Prof. Greg. Stitt.
- *Software*: Quartus (Lite/Prime/Pro) and Altera ModelSim

Recommended Materials

- Katz, Randy, and Gaetano Borriello. Contemporary Logic Design. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 2004. ISBN: 9780201308570.
- Digital Design Principles and Practices, John Wakerly, 5th edition. Pearson, 2017. ISBN 9780134460093.

Course Schedule

Week	Date	Topic
1	8-21-2019	Course Intro
	8-23-2019	VHDL Intro (guidelines, entity and architecture, basic mux implementation)
2	8-26-2019	VHDL Intro (if vs. case, priority encoder, structural architectures)
	8-28-2019	Arithmetic Operations
	8-30-2019	Lab1
3	9-2-2019	Holiday
	9-4-2019	Lab 2, Generics, Avoiding Latches, Testbenches
	9-6-2019	Testbenches, Carry-Lookahead Adders
4	9-9-2019	Lab 3, For-generate
	9-11-2019	Misc. VHDL (configurations, initialization of signals, advanced testbenches, generics, components, vho/vhd, package reference, Modelsim tricks)
	9-13-2019	Class canceled
5	9-16-2019	Sequential Logic
	9-18-2019	Sequential Logic, Cont. Finite State Machines
	9-20-2019	Finite State Machines, Cont. Lab 4
6	9-23-2019	Lab 4 Cont., Counters, Integers.
	9-25-2019	Midterm Review
	9-27-2019	Midterm 1
7	9-30-2019	FSMD
	10-2-2019	FSMD, FSM+D, Lab 5
	10-4-2019	Holiday
8	10-7-2019	FSMD, FSM+D, Lab 5, Cont.

	10-9-2019	Midterm 1 Solution, Lab 5
	10-11-2019	Lab 5 Extra Credit, FSMD done protocol, 2-process FSMD
9	10-14-2019	2-process FSMD, cont. Lab 6
	10-16-2019	Lab 6, cont.
	10-18-2019	FPGA Architectures
10	10-21-2019	FPGA Architectures, Cont.
	10-23-2019	FPGA Architectures, Cont. Midterm 2 Review
	10-25-2019	Midterm 2
11	10-28-2019	MIPS (Arrays, RAM, Register File)
	10-30-2019	MIPS (Register File, ALU, Datapath)
	11-1-2019	MIPS (Memory, I/O Ports, Instruction Fetch, Instruction Decode, Register Fetch)
12	11-4-2019	MIPS (I-type Instructions, Jump Instructions)
	11-6-2019	MIPS (Branch Instructions, MIF Files, Assembly Code)
	11-8-2019	Metastability, Clock-Domain Crossing
13	11-11-2019	Holiday
	11-13-2019	Midterm 2 Solution review
	11-15-2019	Metastability, Cont. Buses, Tristates
14	11-18-2019	Asynchronous Sequential Logic
	11-20-2019	Testing of Logic Circuits
	11-22-2019	Testing of Logic Circuits
15	11-25-2019	Formal Verification of Digital Designs
	11-27-2019	Holiday
	11-29-2019	Holiday
16	12-2-2019	Midterm 3 review
	12-4-2019	Midterm 3
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Attendance Policy, Class Expectations, and Make-Up Policy

On-time attendance in the class is mandatory. Sign-in sheets/Tophat software will be used during the class to verify your presence. Each missed class will cost 1 point (out of 100) from your overall course total. You will receive attendance bonus points if your attendance exceeds 90% over the whole semester.

There are no make-up exams/quizzes unless there is an acceptable reason (illness, serious family emergencies, UF-imposed curriculum requirement or activity, religious holiday, or jury duty). In those cases, a make-up exam will be organized. Students should contact the instructor ahead of the exam so that an alternate exam schedule can be found. Students missing exams for unpredictable family or medical reasons should notify the instructor ahead of the exam time. If you miss more than one test, you will need to contact the instructor to evaluate whether you should pursue the class further or receive an incomplete. Students missing an exam without giving advance notice to the instructor, or without providing a valid (documented) reason, will receive a grade of F for this exam. Make-up will not be given for computer assignments. If you believe that you have a valid exam conflict, please send the information at least eight days in advance to the instructor. Please specify the times of your conflict and then times immediately before or after the scheduled exam time when you are available.

To ensure a classroom environment conducive to success for everyone, please turn off all cell phones before class starts. If you must enter the classroom late, be considerate, and be as quiet as possible. Persistent disruptive behavior will result in grade deductions.

All use of electronic devices during an exam will be considered a violation of the student honor code (i.e., cheating). Laptop computer and tablets are welcome in class as long as they are used for class-related work. Surfing the web, checking email, making posts, etc., is strictly prohibited.

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Midterm 1	100	20%
Midterm 2	100	20%
Midterm 3	100	20%
Labs	100 each	30%
Final Project	100	10%
		100%

Grading Policy

You will receive numerical grades for your quizzes and exams. The final grade will be determined primarily by the curve. The break between “B” and “B-” will be approximately set at the average of total scores of students with a score of %50 or more. Letter grades will be monotonic in the total course scores. Your grade will be solely based on your performance in the course and not on outside factors such as your wish to graduate this semester or the possibility of losing a scholarship.

A “C-” will not be a qualifying grade for critical tracking courses. In order to graduate, students must have an overall GPA and an upper-division GPA of 2.0 or better (“C” or better). Note: a “C-” average is equivalent to a GPA of 1.67, and therefore, it does not satisfy this graduation requirement. For more information on grades and grading policies, please visit:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

The following grading scale is given as an example only.

Percent	Grade	Grade Points
93- 100	A	4.00
89 - 92.9	A-	3.67
84 - 88.9	B+	3.33
81 - 83.9	B	3.00
78 - 80.9	B-	2.67
74 - 77.9	C+	2.33
71 - 73.9	C	2.00
65.0 - 70.9	C-	1.67
63 - 65.9	D+	1.33
60 - 62.9	D	1.00
58 - 59.9	D-	0.67
0 - 57.9	E	0.00

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” CHEATING WILL NOT BE TOLERATED. With the use of software, lab assignments as well as computer assignments and projects will be checked for the violation of the honesty and identification of unauthorized aids. If you are caught cheating on any assignment, project, quiz or exam, you will be prosecuted. There will be no negotiations and your case will be reported to the honor court. There are no excuses and no exceptions. The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or

<http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling.

<https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.

<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.

<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.