EEL 3701C: DIGITAL LOGIC AND COMPUTER SYSTEMS

http://mil.ufl.edu/3701/   @eel3701 on twitter

INSTRUCTOR

Dr. Eric M. Schwartz   MAEB 321   392-2541   ems@ufl.edu   Office Hours: Wed: 2:30-4:30pm

LECTURES   Tues & Thur 5th - 6th (2:00-4:45pm) in NPB 1001

LAB SECTIONS
(NEB 248)
* Honors Section

9118 M 9:30am-12:15pm (AB)	74C8 M 12:30-3:15pm (ME)	7678 M 3:30-6:15pm (EL)	7287 M 7:00-9:45pm (EL)
7676 T 9:30am-12:15pm (JS)	7675 T 7:00-9:45pm (GD)	9122 W 9:30am-12:15pm (KH)	*74C9 W 12:30-3:15pm (AM)
7679 W 3:30-6:15pm (IV)	9472 W 7:00-9:45pm (GD)	73F6 R 9:30am-12:15pm (KH)	7677 R 7-9:45pm (GD)
71HB F 9:30-12:15pm (GD)	73GB F 12:30-3:15pm (GD)	71HC F 5-7:45pm (GD)	

REQIRED TEXTBOOK (Share, Borrow, Buy, or Rent one of the below. See website for more info)

- Charles H. Roth Jr., *Fundamentals of Logic Design, 7th edition*, Cengage Learning, Stamford, Connecticut, 2014. ISBN: 1133628478
- Charles H. Roth Jr., *Fundamentals of Logic Design, 6th edition*, Cengage Learning, Stamford, Connecticut, 2009. ISBN: 0495471690
- Charles H. Roth Jr., *Fundamentals of Logic Design, 5th edition*, Thomson Brooks/Cole Publishing, Belmont, California, 2004. ISBN: 0534378048

RECOMMENDED REFERENCE TEXTBOOK

Reprinted Chapters 1-7 from H. Lam, and J. O'Malley, *Fundamentals of Computer Engineering: Logic Design and Microprocessors, 1st edition*, 1988, John Wiley and Sons, New York, available at the Target Copy, 1412 W. University Ave., Gainesville, FL; Phone: 352-376-3826. http://target-copy.com [$18.26]

COURSE OBJECTIVES (ABET Design Content 50%) [Lab fee: $91.39]

To learn to: perform elementary manipulations of Boolean algebraic equations; simplify logic expressions; design combinational and sequential circuits; use a digital design and simulation package, use a hardware description language (HDL), analyze binary storage device behavior and applications, and to study the fundamentals of microprocessor architecture, including assembly language programming and the design of basic components of a microprocessor.

CLASS ATTENDANCE AND BEHAVIOR

Class attendance is not mandatory, but all classes are important. Missing a class may be hazardous to your grade. There will be pop (unannounced) quizzes. A missed quiz cannot be made up. (See *Course Requirements* below for policy on missed quizzes.)

Turn off all cell phones, beepers, laptop sound effects, and other noise making devices **before entering** our classroom. If a noise-making device goes off during class, I reserve the right to **lower your course grade**. If a noise-making device goes off during an exam, your will lose a significant number of points on this exam.

TA OFFICE HOURS

You may go to any TA available (in NEB 248 if no lab; else NEB 222), not just the one teaching your lab section. The instructor will hold office hours (posted above and on our web page) or by appointment. You are encouraged to use e-mail to communicate with the instructors and TAs. TA(s) will also hold afternoon help sessions: .

TA name	Gautam Dash	Khaled Hassan	Austin Baylis	Andre Marin	Ian Van Stralen	Ethan Lynch	Joseph Succar	Madison Emas
office hours	Help: T,W,R: 5-7pm; Saturday: 12-6pm	M: 2:30-430pm; F: 12:00-2:00pm	W: 9:30-11:30am	M: 12:30-2:30pm	M: 5-6; T: 8-9am	W: 12:30-1:30pm; W: 3:30-5:30pm; R: 8-9am	R: 9:30-11:30am	M: 9:30-11:30am F: 1:15–3:15pm
e-mail	gbdash@ufl.edu	khaledjhassan@ufl.edu	abaylis@ufl.edu	amarin92@ufl.edu	dsmos@ufl.edu	elynch93@ufl.edu	j.succar@ufl.edu	madisonemas@gmail.com

EXAM SCHEDULE

The exams are given during class time.

Exam Schedule

EXAM	DATE	TIME	LOCATION
Exam 1	Tues, 30 June	In Class	In Class
Exam 2	Tues & Thur, 4 & 6 Aug	In Class	In Class

REQUIRED HARDWARE

- A special *USB Blaster programming cable* (from Altera) is required for this course. The price for this cable is $60 plus tax. Until they run out, the cable is available at the UF bookstore; go to the counter in the computer area to request one. This device is also used in at least one other course (EEL 4744). More information about this required device will be provided in class. You will also need you **own laptop PC** (see link) for use in lab and possibly during the exams.
- The *Digilent Analog Discovery (DAD) board* is required for this course (and many other ECE courses). Board ordering information can be found at this link: http://tinyurl.com/discov-ufl. The discount price for students is $99 (no tax for Florida addresses), with a shipping price of $11-$13 for slowest shipping. The UF bookstore also sells the Analog Discovery ($132) and the BNC Adapter ($21.32) for those that want to use financial aid or want it right away.

COURSE REQUIREMENTS (IMPORTANT!!!)

- Perform all laboratory experiments. A grade of 65% or better in Lab is *__required__* in order to obtain a passing grade. Your lowest lab (**not including** lab **8**) will be dropped. But use this drop wisely, i.e., do **not** just skip a lab since all labs are important and your next missed lab may be unavoidable. If you need to miss a single lab, it's ok; you can **not** make up the missed lab. (You should do this lab on your own. If necessary, you may visit a TA during an office hour for help.) **If you have a valid reason for missing this lab, get documentation for your __first__ missed lab and __hold on to it.__** If you miss a **second** lab, you must show the **professor** (not the TA) **written documentation for BOTH your first and your second missed labs**. This documentation should be official and from a doctor, judge, etc., so that a make-up can be arranged. You must notify the professor **prior** to your scheduled second missed lab or **as soon as possible after** your second missed lab.
  - Labs **must** be done at scheduled times.
  - Students **must** be prepared to demo their lab when they enter. Students will be randomly selected for their demonstration times during their lab period.
  - An average lab grade of **65% or higher** is required to be **eligible** to **pass** the class!
  1. Do all homework assignments and turn them in ~~within the first 3 minutes of class (by email)~~ **by the time that they are due**.
     - *Late homework will __not__ be accepted.*
  2. A quiz can happen at any time, during any class, i.e., quizzes are generally not announced ahead of time. You should therefore not miss class.
     - *Missed quizzes __cannot be made up__.*
  3. Take **2** during-term exams. (Note that the there is **NO** final exam at the scheduled time.)
     - *No makeup exams will be given except for a medically documented incapacity or family emergency.*

STUDENTS WITH DISABILITIES

Students requesting classroom, laboratory or exam accommodations must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation. For optimal consideration, you must see the professor during the first week of classes.

UF COUNSELING SERVICES

Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:
- University Counseling & Wellness Center, http://www.counseling.ufl.edu, 3190 Radio Road, (352) 392-1575.
- SHCC mental Health, Student Health Care Center, http://shcc.ufl.edu/, Infirmary Building, 1 Fletcher Drive, 392-1161.
- Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161.
- Career Resource Center, http://www.crc.ufl.edu/, Reitz Union, 392-1601, career development assistance and counseling.

STUDENT PRIVACY

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments.

SOFTWARE USE

All faculty, staff and student 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.

TECHNOLOGY

The use of cell phones (and other technology devices) is strictly prohibited during exams. All use of an electronic device 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 Facebook posts, etc., is strictly prohibited if distracting to others and will result in course grade deductions.

COMMUNICAITION

You are responsible for checking announcements and course-related postings on the class website. Twitter is utilized for announcements, so you are also responsible for getting this information (either with a Twitter account or with software that creates and email or text message from tweets). You are also responsible for checking your UF email daily.

EXTRA CREDIT

Extra credit is sometimes offered during class (or on the web, by tweet, or by email). The amount of extra credit given is at the discretion of the faculty member unless specifically stated with the extra credit opportunity.

> All grades are **non**-negotiable **one week** after the grade is posted. Please don't come to me after the final grades have been posted with a hard-luck story.

HOMEWORK AND EXAM SOLUTIONS

Solutions to homework will be made available on our class web site. Practice exams (some with solutions) are also posted.

COURSE GRADE DETERMINATION

Midterm Exams (2@33%)	`66%`	(Exam 2 is comprehensive; 90 or better on final results in 5% grade bonus, e.g., 86% $\Rightarrow$ 91%)
Laboratory	`30%*`	(Lab values vary, i.e. it could count as 1/3 a lab, a single lab, a double lab, etc.)
Homework/Quizzes	`4%`	(5-10 homework and 0-5 quizzes)
Total	`100%`	(90+ on Exam 2 results in 5% grade bonus, e.g., 86% $\Rightarrow$ 91%)

* A grade of 65% or better in Lab is _**required**_ in order to obtain a passing grade. Your lowest lab (**not including** lab **8**) will be dropped. But use this drop wisely, i.e., do **not** just skip a lab since all labs are important and your next missed lab may be unavoidable. If you need to miss a single lab, it's ok; you can **not** make up the missed lab. (You should do this lab on your own.) **If you have a valid reason for missing this lab, get documentation for your first missed lab and hold on to it.** If you miss a **second** lab, you must show the **professor** (not the TA) **written documentation for BOTH your first and your second missed labs**. This documentation should be official, i.e., from a doctor, judge, etc., so that a make-up can be arranged. You must notify the professor **prior** to your scheduled second missed lab or **as soon as possible after** your second missed lab.

Note: All grading percentages are subject to change at professor's discretion. Students will be notified of any changes.

GRADING POLICY

UF grades are often distributed according to the following **rough** distribution: A: 10%   B: 35% C: 45% D&E: 10%. This usually works out to mean that if you make class average you will earn close to a "C+" or "B-" . If you score 10 percent above the class average, you will probably earn a "B." If you score 20 percent above class average, you will probably earn an "A**." This is not a contract on grading.** Rather, this information serves to provide you a rough understanding of your academic standing at any time during the semester. Grades are periodically posted on the class web site. **It is your responsibility to check your grades regularly** since mistakes often happen when dealing with a large number of students and TAs. **All grades are final one week after posting.** After curving exams as needed, course grades are assigned using the 60 (D), 70 (C), 80 (B), and 90 (A) cuts. [$86.\bar{6} \rightarrow 89.\bar{9}$ (A-), $83.\bar{3} \rightarrow 86.\bar{6}$ (B+), $76.\bar{6} \rightarrow 79.\bar{9}$ (B-), $73.\bar{3} \rightarrow 76.\bar{6}$ (C+), $66.\bar{6} \rightarrow 69.\bar{9}$ (C-), $63.\bar{3} \rightarrow 66.\bar{6}$ (D+), $0<59.9$ (E)].

Part of your grade on exams, labs, homework, quizzes, etc. is based not only on solving the problem you are presented with, but the manner in which you solve it. For example, there is a difference between two designs that meet the given specifications, but one is an elegant, modular 3-element solution, while the other is an obfuscated 5-element design that also meets the specifications but would be difficult to extend later. Just as your future employer would value the latter design less than the first, so will I in grading your assignments.

The UF grading policies for assigning grade points can be found on the following undergraduate catalog web page: https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx .

HOMEWORK GRADING

Homework is due by email in the classroom ~~at the start of any of our class periods~~ on or before the assigned deadline. A **single** pdf document should be submitted for each homework. (Sometimes additional files will be requested.) Scans are acceptable. Missed homework can**not** be made up, but your lowest homework (or quiz) is dropped.   When homework is returned, students should compare their solutions to the posted solutions since homework grading is only cursory. **Late homework will not be accepted**.

> All grades are **non**-negotiable **one week** after the grade is posted. Please don't come to me after the final grades have been posted with a hard-luck story.

IN-CLASS QUIZ GRADING

In-class quizzes will cover material previously covered in assigned readings, homework, class or lab. Quizzes may happen during any class; they are not generally announced beforehand. **Missed quizzes cannot be made up, but your lowest quiz (or homework) is dropped. Therefore, missing a single quiz will not hurt your grade.** See the Course Requirements above for the policy for missed quizzes.

MULTIMEDIA CLASS/AUDIENCE NOTES

Audience notes are normally available from the class web site every week or so for the subsequent week or more of classes. The notes consist of pdf versions of the class PowerPoint slides with some space for note taking. These notes are not required but are **highly** recommended. Check the class web site for information on exactly when the notes are available. **For optimal performance**, read the notes and examples for a class **before** that class and bring the **printed** class **notes and examples** to class to augment the printed material with your own notes. Notes will be removed shortly after they are covered in class.

EXAM RE-GRADE POLICY

If you believe an error has been made on an exam score you must make a **written** request to the instructor explaining where the misgrading or error occurred. This request must be submitted **immediately at the end of the class in which the exam is returned**. If you do resubmit an exam, however, the instructor reserves the right to scrutinize and grade the **entire** exam more closely. This definitely places your current score at risk. Consequently, it is not advisable to resubmit an exam for correction unless a blatant error, such as a miscalculation of total points, has been made. You **must** make it clear what writing you added to the exam (by clear indication, e.g., use a different color pen or pencil) after it was returned to you.

ACADEMIC HONESTY

All students admitted to the University of Florida have signed a statement of academic honesty committing them to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action.

This statement is a reminder to uphold your obligation as a student at the University of Florida and to be honest in all work submitted and exams taken in this class and all others.

CHEATING

*CHEATING WILL **NOT** BE TOLERATED*. We will actively search for cheaters. If you are caught, there will be no negotiations. You will fail the course and get reported to the honor court. There are **no excuses and no exceptions**. You may talk to other students about homework and lab assignments, but the final work **must** be your own. If you are caught cheating on **any** assignment (homework, lab, quiz or exam), the **smallest** penalty possible is failure of the course. During a recent semester many students were caught with partly copied lab assignments. If this happens this semester, all of the guilty students will earn an "E" in the course. A meeting with the instructor will determine *additional penalties*, none of which are desirable or pleasant (*i.e.,* cheating in this course will result in a failing grade in the course, initiation of honor court charges, and possibly expulsion from the university). If you know someone is cheating, **it is your responsibility to report it**. We have and will continue to prosecute cheaters by turning them over to the office of Student Judicial Affairs. For more information about cheating, the UF Honor code, and the consequences of academic dishonesty, please refer to https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/ and https://www.dso.ufl.edu/sccr/process/incident-report/.

WORKING TOGETHER

You are encouraged to work with other students on **homework** assignments, but in a professional manner. **You must do independent work on labs.** Although you may **consult** with other students, TAs, or Professors, you **must** do independent work. Consulting means **"seeking opinions or advice"** *not* getting working programs or designs, understanding them, and then modifying them to make them your own. The latter constitutes cheating (see above section). Working side-by-side to construct a program or design in a group constitutes cheating. (Solving labs are good practice for solving quizzes and exams, which are also *not* group activities.)

LABORATORY GRADING

You will not be admitted to the lab without a *Summary* document, as described in the *Lab Rules and Policies*. The *Summary* document and other files also **must** be **emailed** to **eel3701uf@gmail.com BEFORE** the start of your lab. (Do **NOT** send the email to your TA or the instructor.) **Proper subject headings are required**. You will receive a confirmation email. You will only get a response once every four days for email to this account. So if you send in two emails in less than a four day period, you will **NOT** get a response for the second (or subsequent) emails. If you do **NOT** receive the confirmation email (for a first email in four days), then your email did **NOT** get through. Check the email address and **send it again**. If you use the email address link provided on the website, you will always have the proper email address.

The subject should have the following information: Last First Section# Lab#, with each field separated. For example, Tebow Tim 1515 LAB1, is a possible subject line. There should be **NO OTHER characters**, in the subject. Each circuit diagram, VHDL file, and assembly language program must have your name (computer) printed at the top. **ALL** simulations should be clearly annotated using Quartus annotations. Quartus files should be sent in a **Quartus archive file**. Grading emphasis will be placed upon your producing well documented, well-structured design circuitry that realizes the functional requirements specified by the lab handout and the lab instructor. The remaining portion of your grade will result from observations by your lab instructor on such matters as your understanding of the lab, your lab techniques, your pre-lab preparation, your lab results and your cooperation and compliance with the rules. Having your design perform properly does **not** guarantee a grade of 100, but makes a 100 grade **possible**. Lab designs and/or software that are similar and/or identical to other student's work constitute cheating (see above) and will be given a grade of 0 and reported to the professor for further discipline (and may

result in failing the course, honor court charges, or expulsion). There will be a quiz at the beginning of most labs (worth up to 40% of your total lab score). If you are late for a lab, you will get a zero for the quiz.

RULES OF CONDUCT IN THE LABORATORY
1. Lab safety is rule #1. Play close attention to TA instructions about lab safety, which will occur during your first lab.
2. No food, drinks or smoking in the lab.
3. Students work *__individually__* on each lab project.
4. **It is the student's responsibility to return all equipment and clean her/his work area before leaving the lab.**
5. Students must attend labs during their assigned time. If you cannot attend your normal lab, this lab will be your single (free) dropped lab.
6. Students must come prepared to the Lab. *__No student will be admitted to the lab without the pre-lab work __in hand__*__, i.e., printout(s). Your files also must be submitted by email **BEFORE** the start of your lab.
7. You must show up within **30 minutes** of the lab starting time for check-in or you will not be admitted. If you are more than **10 minutes** late, you will get a zero for the lab quiz.
8. Quizzes might take as long as 1.5 hour (but could be shorter). Quizzes will be graded on a quinary scale of 0, 1, 2, 3, or 4. This will translate into values of 0, 10%, 20%, 30%, or 40%, respectively to account for up to 40% of the lab grade. Quizzes will cover information from the pre-lab material and previous labs and course work.
9. Labs are precisely 2 hours and 45 minutes long. You will be given no extra time.
10. The last 30 minutes of the lab is a time for student check-off and grading only, i.e., no questions for the TA.

LABORATORY ATTENDANCE

Laboratory attendance during scheduled times is mandatory. **Documented** personal or family emergency will be accepted as an excuse for absence for a **second** missed lab if documentation for a first missed lab is also provided. In such cases, consult your **instructor** (**not** your TA) about a make-up lab *as soon as possible*. See *Course Requirements* for more details. Students should make serious attempts on **all** labs. Grades less than 50% may be interpreted as not a serious attempt and may be **scaled to 0**.

You will **not** officially makeup your first missed lab. You should do this missed lab at home (or, if necessary, during a TA office hour) to be sure you understand the required material.

If you cannot finish the lab during the allotted time, you will lose at least 10% to 40% off your final score. You are expected to finish the labs on time. **The most successful students** generally get their labs to work **at home before their lab begins**.

LABORATORY TOPICS

Lab Number	Start Date	Topic
0	Wed, 13 May	Build your CPLD board
1	Wed, 20 May	Introduction to equipment, software and parts
2	Wed, 27May	Logic design and implementation
3	Wed, 3 June	MSI circuit design and implementation
4	Wed,10 June	Arithmetic Logic Unit (ALU) design and implementation
5	Wed, 17 June	Counter design and implementation
6	Tues, 7 July	ALU / CPU design and implementation
7	Tues, 14 July	State Machine design and implementation
8	Tues, 21 July	CPU with ROM-based instructions
9	Tues, 28 July	G-CPU simulation and assembly language programming

EEL 3701 Schedule: Part 1 of 2

WEEK/DAY		DATE	LAB #	Lecture #	Tentative Weekly Topics / Comments
1	M	11-May			Syllabus, web site
1	Tu	12-May		1-2	Digital Design, Basic logic, Number Systems, Math
1	W	13-May	0		Intro. to Quartus
1	Th	14-May	0	3-4	Mixed Logic
1	F	15-May	0		ICs, introduction to mixed, positive, and negative logic
2	M	18-May	0		Number Systems, Math
2	Tu	19-May	0	5-6	Number Systems, Math
2	W	20-May	1		Boolean Algebra
2	Th	21-May	1	7-8	
2	F	22-May	1		
3	M	25-May	1 to Wed	No class	**Holiday: Memorial Day (Mon lab moved to Wed, different room)**
3	Tu	26-May	1	9-10	MSOP, MPOS, Simplification
3	W	27-May	(Mon 1) 2		MSI: MUX, deMUX, decoder; K Maps
3	Th	28-May	2	11-12	More MSI: encoder, adder, BCD 7-segment decoder, tristate buffer
3	F	29-May	2		Arithmetic Logic Unit (ALU)
4	M	1-Jun	2		Introduction to sequential circuits: Flip-flops
4	Tu	2-Jun	2	13-14	Flip-flops and next state/excitation tables
4	W	3-Jun	3		Design with flip-flop, Counter design, Debouncing
4	Th	4-Jun	3	15-16	
4	F	5-Jun	3		
5	M	8-Jun	3		IC Characteristics
5	Tu	9-Jun	3	17-18	RAM, ROM and memory expansion
5	W	10-Jun	4		MSI sequential circuits - Registers, counters
5	Th	11-Jun	4	19-20	Introduction to VHDL
5	F	12-Jun	4		
6	M	15-Jun	4		ASM implementation, ASM design examples
6	Tu	16-Jun	4	21-22	ASM design implementations, ROM based designs & others
6	W	17-Jun	5		ASM implementation, ASM design examples
6	Th	18-Jun	5	23-24	
6	F	19-Jun	5		
	M-F	22-26 Jun		No Class	**Summer Break**

EEL 3701 Schedule: Part 2 of 2

WEEK/DAY		DATE	LAB #	Lecture #	Tentative Weekly Topics / Comments
	M-F	22-26 Jun		No Class	**Summer Break**
7	M	29-Jun	5		
7	Tu	30-Jun	5	25-26	**EXAM 1**: in class
7	W	1-Jul			
7	Th	2-Jul		27-28	
7	F	3-Jul			**Holiday: Independence Day**
8	M	6-Jul			TBD
8	Tu	7-Jul	6	29-30	Exam 1 Solutions / Regrade petitions submitted
8	W	8-Jul	6		ASM design implementations, ROM based designs & others
8	Th	9-Jul	6	31-32	Addressing modes, Data transfer instructions
8	F	10-Jul	6		Instruction set and assembly programming examples
9	M	13-Jul	6		Basic computer operation cycles and timing
9	Tu	14-Jul	7	33-34	Intro into computer architecture, registers, assembly & instructions
9	W	15-Jul	7		G-CPU, Memory Maps
9	Th	16-Jul	7	35-36	
9	F	17-Jul	7		
10	M	20-Jul	7		G-CPU, Special topics
10	Tu	21-Jul	8	37-38	
10	W	22-Jul	8		
10	Th	23-Jul	8	39-40	
10	F	24-Jul	8		
11	M	27-Jul	8		TBD
11	Tu	28-Jul	9	41-42	
11	W	29-Jul	9		
11	Th	30-Jul	9	43-44	
11	F	31-Jul	9		**DROP DEADLINE**
12	M	3-Aug	9		
12	Tu	4-Aug		45-46	**EXAM 2, Part 1**: in class
12	W	5-Aug			
12	Th	6-Aug		47-48	**EXAM 2, Part 2**: in class
12	F	7-Aug			