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@mil.ufl.edu  Office Hours: Wed: 2:30-4:30pm

LECTURES
Tues & Thur 3rd-4th (11:00am-1:45pm) in MCCC 100

LAB SECTIONS (NEB 248)

<table>
<thead>
<tr>
<th>Lab</th>
<th>Time</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>711B</td>
<td>9:30-12:15pm (SK)</td>
<td>Sam Kerns</td>
</tr>
<tr>
<td>712B</td>
<td>9:30-12:15pm (SK)</td>
<td>Kevin French</td>
</tr>
<tr>
<td>713B</td>
<td>9:30-12:15pm (SK)</td>
<td>Rachel Johnson</td>
</tr>
<tr>
<td>714B</td>
<td>9:30-12:15pm (SK)</td>
<td>Austin Baylis</td>
</tr>
<tr>
<td>715B</td>
<td>9:30-12:15pm (SK)</td>
<td>Andre Marin</td>
</tr>
<tr>
<td>716B</td>
<td>9:30-12:15pm (SK)</td>
<td>Reinaldo Molina</td>
</tr>
<tr>
<td>717B</td>
<td>9:30-12:15pm (SK)</td>
<td>Divya Ramachandran</td>
</tr>
</tbody>
</table>

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

RECOMMENDED REFERENCE TEXTBOOK

EXAM SCHEDULE
The exams are given during class time.

Exam Schedule

<table>
<thead>
<tr>
<th>Exam</th>
<th>Date</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>Tues, 1 July</td>
<td>In Class</td>
<td>In Class</td>
</tr>
<tr>
<td>Exam 2</td>
<td>Tues &amp; Thur, 5 &amp; 7 Aug</td>
<td>In Class</td>
<td>In Class</td>
</tr>
</tbody>
</table>
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 your 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/discover-uf. 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 will carry 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.
- 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.
  - 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 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.

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 and will result in course grade deductions.
COMMUNICATION
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.

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

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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
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.

Exams are curved. The following rough distribution is used: 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. [86.6 \(\Rightarrow 89.9\) (A-), 83.3 \(\Rightarrow 86.6\) (B+), 76.6 \(\Rightarrow 79.9\) (B-), 73.3 \(\Rightarrow 76.6\) (C+), 66.6 \(\Rightarrow 69.9\) (C-), 63.3 \(\Rightarrow 66.6\) (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 more 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
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.

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 can not 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/sscr/process/student-conduct-honor-code/

WORKING TOGETHER
Error! Hyperlink reference not valid.
You are encouraged to work with other students on homework assignments, not 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 do 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

<table>
<thead>
<tr>
<th>Lab Number</th>
<th>Start Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Wed, 14 May</td>
<td>Build your CPLD board</td>
</tr>
<tr>
<td>1</td>
<td>Wed, 21 May</td>
<td>Introduction to equipment, software and parts</td>
</tr>
<tr>
<td>2</td>
<td>Wed, 28 May</td>
<td>Logic design and implementation</td>
</tr>
<tr>
<td>3</td>
<td>Wed, 4 June</td>
<td>MSI circuit design and implementation</td>
</tr>
<tr>
<td>4</td>
<td>Wed, 11 July</td>
<td>Arithmetic Logic Unit (ALU) design and implement</td>
</tr>
<tr>
<td>5</td>
<td>Wed, 18 June</td>
<td>Counter design and implementation</td>
</tr>
<tr>
<td>6</td>
<td>Tues, 8 July</td>
<td>ALU / CPU design and implementation</td>
</tr>
<tr>
<td>7</td>
<td>Tues, 15 July</td>
<td>State Machine design and implementation</td>
</tr>
<tr>
<td>8</td>
<td>Tues, 22 July</td>
<td>CPU with ROM-based instructions</td>
</tr>
<tr>
<td>9</td>
<td>Tues, 29 July</td>
<td>G-CPU simulation and assembly language programming</td>
</tr>
</tbody>
</table>
## EEL 3701 Schedule: Part 1 of 2

<table>
<thead>
<tr>
<th>WEEK/DAY</th>
<th>DATE</th>
<th>LAB #</th>
<th>Lecture #</th>
<th>Tentative Weekly Topics / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>12-May</td>
<td>1-2</td>
<td>Syllabus, web site</td>
</tr>
<tr>
<td>1</td>
<td>Tu</td>
<td>13-May</td>
<td>1-2</td>
<td>Digital Design, Basic logic, Number Systems, Math</td>
</tr>
<tr>
<td>1</td>
<td>W</td>
<td>14-May</td>
<td>0</td>
<td>Intro. to Quartus</td>
</tr>
<tr>
<td>1</td>
<td>Th</td>
<td>15-May</td>
<td>0</td>
<td>Mixed Logic</td>
</tr>
<tr>
<td>1</td>
<td>F</td>
<td>16-May</td>
<td>0</td>
<td>ICs, introduction to mixed, positive, and negative logic</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>19-May</td>
<td>0</td>
<td>Number Systems, Math</td>
</tr>
<tr>
<td>2</td>
<td>Tu</td>
<td>20-May</td>
<td>0</td>
<td>Number Systems, Math</td>
</tr>
<tr>
<td>2</td>
<td>W</td>
<td>21-May</td>
<td>1</td>
<td>Boolean Algebra</td>
</tr>
<tr>
<td>2</td>
<td>Th</td>
<td>22-May</td>
<td>1</td>
<td>Booleans</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>23-May</td>
<td>1</td>
<td>Booleans</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>26-May</td>
<td><strong>to Wed</strong></td>
<td>No class</td>
</tr>
<tr>
<td>3</td>
<td>Tu</td>
<td>27-May</td>
<td>1</td>
<td>Holiday: Memorial Day (Mon lab moved to Wed, different room)</td>
</tr>
<tr>
<td>3</td>
<td>W</td>
<td>28-May</td>
<td><strong>Mon 1</strong> 2</td>
<td>MSOP, MPOS, Simplification</td>
</tr>
<tr>
<td>3</td>
<td>Th</td>
<td>29-May</td>
<td>2</td>
<td>MSI: MUX, deMUX, decoder; K Maps</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>30-May</td>
<td>2</td>
<td>More MSI: encoder, adder, BCD 7-segment decoder, tristate buffer</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>2-Jun</td>
<td>2</td>
<td>Arithmetic Logic Unit (ALU)</td>
</tr>
<tr>
<td>4</td>
<td>Tu</td>
<td>3-Jun</td>
<td>2</td>
<td>Introduction to sequential circuits: Flip-flops</td>
</tr>
<tr>
<td>4</td>
<td>W</td>
<td>4-Jun</td>
<td>3</td>
<td>Flip-flops and next state/excitation tables</td>
</tr>
<tr>
<td>4</td>
<td>Th</td>
<td>5-Jun</td>
<td>3</td>
<td>Design with flip-flop, Counter design, Debouncing</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>6-Jun</td>
<td>3</td>
<td>Design with flip-flop, Counter design, Debouncing</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>9-Jun</td>
<td>3</td>
<td>IC Characteristics</td>
</tr>
<tr>
<td>5</td>
<td>Tu</td>
<td>10-Jun</td>
<td>3</td>
<td>RAM, ROM and memory expansion</td>
</tr>
<tr>
<td>5</td>
<td>W</td>
<td>11-Jun</td>
<td>4</td>
<td>MSI sequential circuits - Registers, counters</td>
</tr>
<tr>
<td>5</td>
<td>Th</td>
<td>12-Jun</td>
<td>4</td>
<td>Introduction to VHDL</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>13-Jun</td>
<td>4</td>
<td>Introduction to VHDL</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>16-Jun</td>
<td>4</td>
<td>ASM implementation, ASM design examples</td>
</tr>
<tr>
<td>6</td>
<td>Tu</td>
<td>17-Jun</td>
<td>4</td>
<td>ASM design implementations, ROM based designs &amp; others</td>
</tr>
<tr>
<td>6</td>
<td>W</td>
<td>18-Jun</td>
<td>5</td>
<td>ASM implementation, ASM design examples</td>
</tr>
<tr>
<td>6</td>
<td>Th</td>
<td>19-Jun</td>
<td>5</td>
<td>ASM implementation, ASM design examples</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>20-Jun</td>
<td>5</td>
<td>ASM implementation, ASM design examples</td>
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</tbody>
</table>

**Notes:**
- **LAB #** is not specified in the table.
- **Lecture #** is not specified in the table.
- **Comments:** Some comments are included for specific dates.
## EEL 3701 Schedule: Part 2 of 2

<table>
<thead>
<tr>
<th>WEEK/DAY</th>
<th>DATE</th>
<th>LAB #</th>
<th>Lecture #</th>
<th>Tentative Weekly Topics / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-F</td>
<td>23-27 Jun</td>
<td></td>
<td>No Class</td>
<td><strong>Summer Break</strong></td>
</tr>
<tr>
<td>7 M</td>
<td>30-Jun</td>
<td>5</td>
<td></td>
<td>EXAM 1: in class</td>
</tr>
<tr>
<td>7 Tu</td>
<td>1-Jul</td>
<td>5</td>
<td>25-26</td>
<td></td>
</tr>
<tr>
<td>7 W</td>
<td>2-Jul</td>
<td></td>
<td></td>
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<tr>
<td>7 Th</td>
<td>3-Jul</td>
<td>5</td>
<td>27-28</td>
<td></td>
</tr>
<tr>
<td>7 F</td>
<td>4-Jul</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 M</td>
<td>7-Jul</td>
<td>6</td>
<td></td>
<td>ASL design implementations, ROM based designs &amp; others</td>
</tr>
<tr>
<td>8 Tu</td>
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