

# EEL 3744C: MICROPROCESSOR APPLICATIONS

<http://mil.ufl.edu/3744/> @eel3744 UF's Canvas

**INSTRUCTORS** Dr. Eric M. Schwartz MAEC 106 392-2541 [ems@ufl.edu](mailto:ems@ufl.edu) Office Hours: Wed: 3:00pm, Fri 1:55pm  
 Assistant Lecturers (and PIs, see below): Wesley Piard & Chris Crary (W/C)

**LECTURES** Tues 4<sup>th</sup> (10:40-11:30am) & Thur 4<sup>th</sup>-5<sup>th</sup> (10:40am-12:35am) in NEB 202

LAE	Mon			Tues			Wed			Thur			Fri		
	Cl/Sec	Start	PI*	Cl/Sec	Start	PI	Cl/Sec	Start	PI	Cl/Sec	Start	PI	Cl/Sec	Start	PI
(NEB 281)	12632/ 26AG	4:05pm		12595/ 112D	4:05pm		12630/ 1F98	8:30am		12597/ 1450	12:50pm		12600/ 1D35	10:40am	
<b>*PI = Peer Instructor (PI=UPI=Undergrad PI)</b>				12599/ 1D34	6:15pm		12633/ 26AH	6:16pm		12602/ 1F95	8:20pm		12631/ 26AF	12:50pm	
							12601/ 1F93	8:20pm							

## CATALOG DESCRIPTION

Elements of microprocessor-based systems; hardware interfacing and software design for their application. Laboratory.

## COURSE OBJECTIVES (ABET Design Content 50%) [Lab fee: \$112.04]

**Official:** Experience in the elements of microprocessor-based systems, hardware interfacing and software design for their application. Laboratory.

**Actual:** Students learn the functional and technological characteristics of microprocessor structures, memory components, peripheral support devices, and interface logic. Through laboratory experiments and examples, students learn how to integrate and apply microcomputer subsystems and components to common interfacing problems. Although the Atmel ATxmega128A1U microcontroller will serve as the vehicle for exploring these topics, students gain the experience to generalize the concepts to other microprocessors.

## TEXTBOOKS

F. Cady, *Microcontrollers and Microcomputers Principles of Software and Hardware Engineering*, Second Edition, Oxford University Press, New York, NY, 2009, ISBN13: 9780195371611, ISBN10: 0195371615. See <http://tinyurl.com/3744-ufl>.

## REFERENCES

- H. Lam & A. Arroyo, *Fundamentals of Computer Engineering*, Univ. Copy Center, Gainesville, FL 1995.
- Gene H. Miller, *Microcomputer Engineering—2<sup>nd</sup> edition*, Prentice-Hall, New Jersey, 1999.
- J. Peatman, *Design with Microcontrollers*, McGraw Hill, New York, 1988.
- K. Doty, *Fundamental Principles of MicroComputer Architecture*, Matrix Publishers, Inc., Oregon, 1979.

## OFFICE HOURS

You may go to any PI available (in NEB 281, if available; else NEB 222), not just the one teaching your lab section, as necessary, for help during their **office hours**. You are encouraged to use e-mail to communicate with the instructors and PIs. PIs will also hold a few help sessions (also shown at the above **office hours** link).

### PI Office Hours in NEB 281 (or NEB 222, when NEB 281 is not available)

Name	Wes Piard	Chris Crary	Brit Chesley	Nicholas Poindexter	John Kearney	Leslye Castillo
e-mail	<a href="mailto:wespiard@ufl.edu">wespiard@ufl.edu</a>	<a href="mailto:ccrary@ufl.edu">ccrary@ufl.edu</a>	<a href="mailto:bchesley97@ufl.edu">bchesley97@ufl.edu</a>	<a href="mailto:npoindexter@ufl.edu">npoindexter@ufl.edu</a>	<a href="mailto:jkearney@ufl.edu">jkearney@ufl.edu</a>	<a href="mailto:leslye.castillo@ufl.edu">leslye.castillo@ufl.edu</a>

## EXAM SCHEDULE

Our exams are administered in the evenings or during class time.

### Exam Help Sessions

DATE	TIME	LOCATION

### Tentative Exam Schedule

EXAM	DATE	TIME	LOCATION
1P	Tues, 26 Feb	8:20pm	
1L	Thur, 28 Feb (if possible)	10:40am	
2L	Thur, 18 Apr (if possible)	10:40am	
2P (Final)	TBD, 5 Dec	TBD	

## INSTITUTIONAL VALUES

- |  |   |  |  |
|--|---|--|--|
| 1. Always tell the truth.                      | 6. Be unselfish.  | 9. Recognize feedback as an opportunity to learn and improve.                    | 11. Be thankful for the opportunity that you have that many others wish that they had. |
| 2. Do not plagiarize.                          | 7. Work hard and consistently.                              | 10. Do not allow your judgement to become impaired when tired or under pressure. |  |
| 3. Do not cheat.                               | 8. Respect the privilege that goes with being a UF student. |  |  |
| 4. Attend all classes.                         |   |  |  |
| 5. Be on time and stay until the end of class. |   |  |  |

## SYLLABUS

Revision **TENTATIVE**

20-Dec-18

### HARDWARE PURCHASES

- The *National Instruments (NI) Analog Discovery 2 (NAD) board* or *Digilent Analog Discovery 2 (DAD) board* is required for this course (and many other ECE courses). Board ordering information for the NAD can be found at <https://tinyurl.com/NAD-UF-s19> (for \$183) and the DAD-2 at <https://tinyurl.com/DAD-UF-s19> for \$179. When purchasing the NAD, other discounted items can be found on the same website. If you are an EE student, I also recommend that you obtain the NI Multisim software (for analog circuit design and simulation). The UF bookstore has the NAD available, for those that want to use financial aid or want it right away. (Online it says that they have the NAD-2 for \$225.)
- Soldering Iron [purchases optional, but recommended]. We will have soldering irons in our lab.
- Wire cutters and needle-nosed pliers [purchases optional, but recommended]. A few of each may be available in lab.
- UF 3744 (AVR XMEGA)  $\mu$ PAD 2.0 board kit [required] was designed by *Out of the Box: Electronics and Robotics*, <http://ootbrobotics.com/>. The 3744-board kit is now included in your lab fees. Your parts kit comes with multiple printed circuit boards (PCBs) – the  $\mu$ PAD 2.0,  $\mu$ PAD Memory Base,  $\mu$ PAD Switch and LED Backpack,  $\mu$ PAD Robotics Backpack,  $\mu$ PAD Analog Backpack, and the  $\mu$ PAD EBI Base Board. **You probably cannot buy the kits separately, so please be careful as you design and construct your circuits this semester.**

*Weller* makes the recognized best soldering irons, e.g., WLC100 is a very good iron available for about \$50. A better soldering iron is the *Weller* WES51 (for \$90-\$120). *Lowes* and *Home Depot* sell soldering irons, but I don't think that the ones in stock are very good. *Home Depot* will sell you a WES51 for about \$90, the best price that I could find, by delivering it to the store for your pickup.

You **MUST** have and use your own laptop for this course, since there are no computers available in the 3744 lab. You will be given your UF 3744 board kit in your first lab meeting (Lab 0). This kit contains most of the additional hardware that you will add to your boards over the course of the semester. (You may also need to purchase some additional ICs or other components as the semester progresses.)

### MULTIMEDIA CLASS/AUDIENCE NOTES

Audience notes are normally posted on 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 are removed shortly after they are covered in class.

### CLASS AND EXAM BEHAVIOR

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, you will lose a significant number of points on this exam.

### SOFTWARE REQUIREMENTS

*Atmel Studio*, an integrated development environment (IDE) for developing and debugging Atmel ARM® Cortex™-M processor-based and Atmel AVR® microcontroller applications (including our XMEGA), will be utilized in our course.

*Quartus* (from Altera) has been now required for *EEL 3701C* and *EEL 4712C*, so many of you already have copies. Quartus is available to download, free of charge, from Altera's website and our website. Whatever version you have from 3701 should be sufficient. Some *EEL 3744C* homework and laboratory assignments will require the drawing or simulation of logic circuits. This program greatly simplifies such assignments. Since Quartus programs will be useful in other *ECE* courses (and *CpE* courses) (*EEL 4712*, *EEL 4713*, *EEL/CEN 3923 - Design 1*, and *EEL 4924/CEN 4914 - Design 2*), we recommended that you obtain a copy if you have not already done so.

### REFERENCE MANUALS (available on our class website)

- [XMEGA AU Manual](#) (Atmel doc8331)
- [XMEGA128A1U Manual](#) (Atmel doc8385)
- [Instruction Set](#) (Atmel doc0856)
- and others

Do **NOT** printout these entire documents. Selected pages should be printed and brought to class, lab, and exams. Other documents are available on the class website (<http://mil.ufl.edu/3744/software.html>) and on the Atmel website (<http://www.microchip.com/wwwproducts/en/ATXMEGA128A1U>). I intend to have the relevant pages of the document available later in the semester at a local copy center.

## COURSE GRADE DETERMINATION

I have found that attendance is directly correlated to grades. I assumed previously that students in 3744 had learned this already, but this is apparently not the case. Therefore, attendance is required, but it will **NOT** be worth positive points. Each missed class for which I take role (which will be done **randomly**) will result in a deduction of 1 point (out of 100) from your overall course total. There are no excuses for missed classes, but two classes can be missed without penalty. (Late arrival or early departure will count as an absence.)

Midterm Exam 1L	3%	
Midterm Exam 1P	25%	
Midterm Exam 2L	7%	
Midterm Exam 2P	25%	
Laboratory*	34%	(Note: All labs are not worth the same amount.)
Homework†/Quizzes	6%	
Total‡	100%	(90+ on <b>weighted average</b> of Exam 2L & 2P results in 5% grade bonus, e.g., 86% ⇒ 91%)

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.

\*A grade of 65% or better in Lab is **required** in order to obtain a passing grade. Your lowest lab 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 PIs) **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 Dr. Schwartz **prior** to your scheduled second missed lab or **as soon as possible after** your second missed lab. **There is no excuse that will allow you to reschedule your first missed lab other than an assembly exam in another course or an officially sanctioned academic event.** You must notify the professor **at least 8 days** prior to your assembly exam.

† 4 to 10 Homework. Although HW does not count much toward your grade, **not** doing it will likely have an effect on your quiz and exam scores.

‡ Attendance is required, but is **NOT** worth positive points. Each missed class results in a deduction of one point (out of 100) from your overall course total. There are no excuses for missed classes, but two classes can be missed without penalty.

## GRADING POLICY

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 PIs. **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. [90 → 100 (A), 86.6 → 89.9 (A-), 83.3 → 86.6 (B+), 80 → 83.3 (B), 76.6 → 79.9 (B-), 73.3 → 76.6 (C+), 70 → 73.3 (C), 66.6 → 69.9 (C-), 63.3 → 66.6 (D+), 60 → 63.3 (D), 56.6 → 59.9 (D-), and 0 < 56.6 (E)].

Part of your grade on tests, quizzes, labs, 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 programs that meet the given specifications, but one is an elegant, extensible 20-line solution, while the other is an obfuscated 100-line program that also meets the specifications but would be difficult to extend later. Just as your future employer would value the latter program 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>.

## COURSE REQUIREMENTS

1. Perform all laboratory experiments. A grade of 65% or better in Lab is **required** in order to obtain a passing grade. Your lowest lab will be dropped. **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 PIs 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 **Dr. Schwartz** (not a PIs) **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. **There is rarely an excuse that will allow you to reschedule your first missed lab other than an exam in another course.** You must notify the **Dr. Schwartz** at least **8 days** prior to your exam (or other) so that an alternate lab time might be arranged.
  - If you believe that you have valid university-related reason for missing a particular lab (e.g., Lab X), send an email to Dr. Schwartz with the following information (with subject: **3744: Conflict with Lab X**, where X is the lab number).
    - State the cause for missing your Lab X and provide associated documentation for this event.
    - Provide a list of each of the Lab X **days and periods** for which you have no conflict and could attend.
    - If this is for an exam in another course, **first** verify that there are no alternate exam times available. If none, then provide Dr. Schwartz (via email, with subject: **3744: Conflict with Lab X**, where X is the lab number) the course number and name, and also your teacher's name, email, and phone number.
  - Labs **must** be done at scheduled times (except as described above).
  - Students **must** be prepared to demo their lab when they enter. Students will be randomly selected for their demonstration times during their lab period.

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

But  
and

## SYLLABUS

Revision **TENTATIVE**

- An average lab grade of **65% or higher** is required to be **eligible** to **pass** the class!
2. Class attendance is mandatory. Roll will be taken. Each missed class when roll is taken will cost 1 points (out of 100) from your overall course total. Roll may be taken more than once in class; if you leave and a second roll is taken, this will be interpreted as an honor code violation.
    - **No excuses accepted, but two free drops.**
    - **Missed classes and quizzes cannot be made up.**
    - 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, you will lose a significant number of points on this exam.
    - If you miss the first two classes and do not notify me prior to your second missed class, you will be dropped from the course.
  3. Do all homework assignments and turn them in **through Canvas before** the time that they are due.
    - **Late homework will not be accepted.**
  4. Take all exams as scheduled.
    - **No makeup exams will be given except in cases of a medically documented incapacity, family emergency, or course conflict.**
    - If you believe that you have a valid exam conflict, please send me the info specified above for a lab conflict (again, at least **8 days** in advance), but with the subject: **3744: Conflict with Exam X**, where *X* is the exam number. Please specify the times of your conflict, the cause of your conflict, and then times immediately before or after the scheduled exam time when you **are available**.

### RECOMMENDATION

I recommend that you bring your laptop or tablet computer (or printed notes) to each class, so that you can easily augment these notes with your own notes. Historically, student that take good notes perform much better in this class then those who do not take notes (or take poor notes).

### STUDENTS REQUIRING ACCOMMODATIONS

The University of Florida is committed to providing academic accommodations for students with disabilities. Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)) by providing appropriate documentation. Once registered, a student should present his/her accommodation letter to me supporting a request for accommodations. The University encourages students with disabilities to follow these procedures as early as possible within the semester.

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 (HEALTH AND WELLNESS)

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.
- U Matter, We Care, <http://www.umatter.ufl.edu/>, umbrella organization for UF's caring culture and provides students in distress with support.

#### 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](mailto: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.
- Resources for Sexual Violence, [http://www.umatter.ufl.edu/sexual\\_violence](http://www.umatter.ufl.edu/sexual_violence), Immediate Response/Advocacy 392-5648 or 392-1111; Medical Care from Student Health Care Center, 392-1161.
  - University Police Department, 392-1111 (or 9-1-1 for emergencies), <http://www.police.ufl.edu/>.
  - Career Resource Center, <http://www.crc.ufl.edu/>, Reitz Union, 392-1601, career development assistance and counseling.

### ACADEMIC RESOURCES

- E-learning technical support, <https://lss.at.ufl.edu/help.shtml>, 392-4357, Learning-support@ufl.edu..
- Career Resource Center, <http://www.crc.ufl.edu/>, 392-1601. Reitz Union. Career development assistance and counseling.

- Library Support, <http://cms.uflib.ufl.edu/ask>.
- Teaching Center, <https://teachingcenter.ufl.edu/>, 392-2010. Broward Hall. General study skills and tutoring.
- Writing Studio, <https://writing.ufl.edu/writing-studio/>, 846-1138, 302 Tigert Hall.
- Student Complaints Campus: [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).
- Ombuds office, <http://www.ombuds.ufl.edu/>. Ombuds office exists to assist students in resolving problems and conflicts

### STUDENT PRIVACY

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

### 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 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/>.

### 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.

### TECHNOLOGY

The use of cell phones and **every other** technology device is strictly prohibited during exams. All use of an electronic devices during an exam will be considered a violation of the student honor code (i.e., cheating). See the *Honesty Policy* section below for the minimum penalties that are incurred for all cases of cheating in our course. 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 (**if distracting to others**) and will result in course grade deductions.

### COMMUNICAITION

Twitter is utilized for course announcements. You are also responsible for getting the tweets either with a Twitter account or with software that creates an email or text message from tweets. You are also responsible for regularly checking announcements and course-related postings on the class website, Canvas, and your UF email.

### 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.

### HONESTY POLICY

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. The following pledge is required for all work submitted for credit by University of Florida students: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” 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. UF students are bound also 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.”

**CHEATING WILL NOT BE TOLERATED.** We will actively search for cheaters; we have and will use excellent software to help us in the search. If you are caught, there will be no negotiations. You will earn a course grade penalty (often failure for the course) and get reported to the honor court. There are **no excuses and no exceptions**. You may talk to other students about assignments, but the final work **must** be your own. You must also report others (anonymously, if desired) that you suspect are cheating. If you are caught cheating on **any** assignment (homework, lab, or exam, etc.), you **will** be prosecuted. A meeting with the instructor (and, possibly, the UF honor court) will determine penalties, none of which are desirable or pleasant (i.e., cheating in this course always results in notification to the honor court, often results in a failing grade in the course, and can possibly result in suspension or expulsion from the university). If you know someone is cheating, **it is your responsibility to report it**. For more information about cheating, the UF Honor code, and the consequences of academic dishonesty, please refer to <https://sccr.dso.ufl.edu/students/student-conduct-code/>. If you have any questions or concerns, please consult with Dr. Schwartz.

## WORKING TOGETHER

You are encouraged to work with other students on assignments in a professional manner. Each person in the group should attempt to solve all problems **independently** and **only** then discuss the results with one's partner(s) to correct errors and resolve differences. Copying your partner's work constitutes cheating and should not be permitted. Matching your solution to your partner's, however, is acceptable, if, after independent study and work you are convinced your partner's solution is correct. All solutions should reflect your style of problem solving, even those you have changed to match your partner's solution. In other words, **verbatim copying or simple paraphrasing of your partner's solution is not an acceptable form of cooperative study**. Your name **and your partner's name(s) must be on your assignments**. You may **not** copy and submit old or new posted solutions as if they were your own.

Although you may **consult** with other students, PIs, or instructors for your assignments, you **must** do independent work. Consulting means **"seeking opinions or advice," not** getting working solutions, 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 find a solutions, construct a program, or design in a group constitutes cheating. (Solving homework are good practice for solving quizzes and exams, which are also **not** group activities.) **You should note that we have used and will continue to use software that can detect similar submissions.**

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

Failure to do your own work in lab will likely result in failure in these exams.

## 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 and why you think more credit is deserved. This request must be submitted **immediately at the end of the class in which the exam is returned**. If you do resubmit an exam, 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 re-grade unless a blatant grading error 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.

## EXAM SOLUTIONS, HW SOLUTIONS AND LAB SHELLS

We will post homework, lab, lab program shells and other class material on our class web site at: <http://mil.ufl.edu/3744/>, along with periodic postings of your grades and the class grade book statistics. Previous exams on the course material are also posted on our web site. Current exam solutions will be discussed and shown in class on the day the graded exam is returned to class, but will **not** be posted.

## HOMEWORK GRADING

You must submit homework is through Canvas by the assigned deadline. Unless other specified (sometimes additional files are requested), a **single pdf** document should be submitted for each homework. Scans are acceptable, but must be compressed and in a single document. *Fast Scanner* (available for Android and iPhone) is a cell phone app that works well. Unclear scans **will not** be accepted. Homework solutions are sometimes posted on our class web-site **before** they are due. It is **not** appropriate to copy the supplied solutions verbatim; this constitutes cheating. Homework will only be graded in a cursory fashion, i.e., Zen grading is used. The grades will be entered into the grade book as 0 (no significant effort or not submitted), 1 (half-hearted attempt) or 2 (significant attempt). The final course grades will be assigned with strict cuts between grades, but HW **could** push you above a cut. Also, the (pop) quizzes will come from the class material, the labs, **and** the homework. In addition, the exams will be partly based on the assigned homework. **Late homework will not be accepted.**

## 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 submitted through Canvas **BEFORE** the start of your lab.

Each circuit diagram, VHDL file, and assembly language program, and list file must have your name included at the top. **ALL** Quartus simulations should be clearly annotated. Quartus files should be sent in a **Quartus archive file**.

Some labs will count more than other labs. Grading emphasis will be placed upon your producing well documented, well-structured programs and hardware designs that realize 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 reports 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 result in you failing the course, honor court charges, and possibly expulsion from UF. We have software that will be used to look for plagiarized software. There may be a quiz at the beginning of some labs. If you are late for a lab, you will get a zero for the quiz.

## HANDOUTS

Most handouts are supplied on-line and can be downloaded from the class web site: <http://mil.ufl.edu/3744/>. Old graded non-lab assignments not picked up in class can be picked up from Dr. Schwartz for a few days, then they will be recycled..

## LABORATORY GUIDELINES

### LABORATORY OBJECTIVES

The purpose of this laboratory is to teach students hardware and software development of microprocessor based applications. The laboratory complements the lectures by providing hands-on experience with microprocessors, peripheral devices and the required hardware and software development tools.

### EQUIPMENT REQUIRED

1. UF 3701 toolbox including NAD/DAD and multimeter.
2. In your first lab (lab 0) you will also be given a “bag of goodies,” i.e., parts that you will use during the semester, including the UF 3744 board kit.

### LABORATORY ATTENDANCE

Laboratory attendance during scheduled times is mandatory. A **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 **Dr. Schwartz** (**not** your PI) about a makeup 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!** Note: **ALL** students **MUST** have everything working **BEFORE** coming to lab.

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

See the **COURSE REQUIREMENTS** section of this document for information.

### LABORATORY ENTRY

An PI will let you in at the start of your lab period. Your PI has the right to kick you out of the lab if you are not prepared, i.e., you have not uploaded the required Canvas submissions and turned in the required hardcopy document or have not built the required circuits. You may also be removed from lab if you are uncooperative or disruptive. You must be able to **demonstrate your understanding** of the design that you have built, the code that you submitted, and the lab topics in general. If you are not properly prepared, you will get a zero for the lab and will be asked to leave. You may **not** make-up this lab later. Therefore, **it is imperative that you come to lab prepared!**

### LABORATORY RULES

0. See the *Lab Rules and Policies* for **complete** information. The first several rules from that handout are repeated below.
1. Lab safety is rule #1. Please pay close attention to PI instructions about lab safety, which will occur during your first lab.
2. No food or drinks in the lab. (No smoking, i.e., keep the magic smoke inside the ICs.)
3. Students work **individually** on each lab project. Do not ask or answer questions from other students during your lab. Students **NOT** help each other **during** lab. During lab, all questions should be directed to the PI.
4. Unless otherwise told by the instructor or an PI, do **not** use another student’s PCB or other hardware at **any** time. Similarly, do **not** use another student’s designs or programs.
5. You can **not** use functions like printf, sprintf, or delay when writing in C, i.e., you must write **all the code** yourself (unless the functions are specifically provide to this semester’s students by the course instructor).
6. It is your responsibility to return all equipment and clean your work area before leaving the lab.
7. Students must attend labs during their assigned time.
8. Students must come prepared to the Lab. **No student will be admitted to the lab without the pre-lab work already submitted through Canvas, the required printouts in hand, and the required circuits constructed.** Your files must be submitted through Canvas **at least 15 minutes BEFORE the start of your scheduled lab.**
9. If you arrive more than **10 minutes** after your lab begins, you will **NOT BE ELIGIBLE** to take the lab quiz. If you arrive late, but prior to the 10-minute deadline, you may not get any directions for the quiz.
10. If you arrive more than **20 minutes** after your lab begins, you will **NOT BE ADMITTED**. Note that you may not be able to finish your lab if you arrive late.
11. An overall lab grade of 65% or better is **required** in order to be eligible to pass the course.
12. See the course syllabus for information about the **rare cases** when missed labs can be made up.
13. Most labs will have a quiz. Quizzes might take as long as 1 hour (but could be shorter). Quizzes will be graded on a quaternary (also known as a quinary) scale of 0, 1, 2 or 3. This will translate into values of 0, 15%, 20%, or 30%, respectively to account for up to 30% of the lab grade. Quizzes will cover information from the pre-lab material and previous labs and course work. The items permissible to use during a quiz vary; sometimes you will not be allowed any resources and other times you will be allowed access to your Atmel documents and possibly your own lab software. You will **not** be allowed to access the internet during quizzes.
14. Labs are precisely 115 minutes long (i.e., 2 periods plus the 15 minute break). You will be given **no** extra time. (All ECE labs, starting spring 2018, are 2 periods, not the 3 periods previously allocated.)

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

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## SYLLABUS

Revision **TENTATIVE**

15. Students **must** be prepared to demo their lab when they enter. Students are **randomly selected** to demonstrate her/his lab work at **any time after the lab quiz is over**. Each student has only a single attempt to demonstrate his/hers work, i.e., the PI will **not** come back to you later. There will be **NO** exceptions.
16. ...

### LABORATORY PREPARATION LIST

- Always compose, edit, assemble, and print your programs before your scheduled lab.**
  - This will save you considerable time and frustration and will improve your performance. In addition, you will have a legible working document.*
- Structure your program into functional modules and comment the modules as part of the coding.**
  - Each subroutine should perform just one function. If a subroutine extends beyond 40 instructions, it is probably doing more than one function and should be split into two or more smaller subroutines.*
- Devise means for testing each subroutine separately so that problem isolation (debugging) is easily accomplished. Assemble the entire program using our assembler.**
  - These tests should be made as part of your pre-lab preparation.*
  - Simulate your program with the simulator or debug it on your board before coming to Lab. Bring to your lab your **working** assembly code and circuit diagram file (if any) on your laptop. Bring a printout of the list file to the lab and circuit diagrams (if any). You will **not** be allowed in the Lab without a commented listing of your code and a circuit diagram (when relevant).**
- Arrive at the lab on time to give yourself adequate time.**

## EEL 3744 LABORATORY SCHEDULE

Lab	Start Date	Tentative Lab Topics (Lab in NEB 281)
0	Mon, 14 Jan	Introduction to lab rules and assembly of PCBs..
1	Mon, 28 Jan	Use Atmel Studio (IDE) to write an assembly program, simulate the program, download the program to the $\mu PAD$ , and emulate the program on the $\mu PAD$ .
2	Fri, 8 Feb	Delay loops, built-in GPIO Port utilization with LED and switch circuits, XMEGA timer/counter. Use DAD/NAD for timer testing.
3	Fri, 15 Feb	Timers and External Bus Interface (EBI) I/O Port Expansion (for SRAM, input port, and output port w/ expansion PCB). Bus Timing using DAD/NAD as LSA. .
4	Wed, 13 Mar	UART Asynchronous Serial Communication (SCI) in Assembly w/ interrupts. External interrupts w/ timers for debouncing.
5	Mon, 25 Mar	C programming. Convert Asynchronous Serial Communication to C, Synchronous Serial Communication (SPI) -connected IMU, and PWM RGB LED.
6	Wed, 3 Apr	ADC to sample CdS cell and DAD/NAD waveform. Output waveforms using DAC. Create music.
7	Thur, 11 Apr	Utilize DMA with ADC to create scope-like device.



**SYLLABUS**

Revision **TENTATIVE**

**EEL 3744 SCHEDULE (Part 1 of 2)**

WEEK/DAY	DATE	LAB #	Class #	Comments (Tentative Schedule)
1	M	7-Jan		<b>Classes Begin</b>
1	Tu	8-Jan	1	Topic: Syllabus, Web tour, Atmel Studio Installation
1	W	9-Jan		Topic: Intro to uP, XMEGA Architecture, GCPU review Intro to Assistant Lecturers (Wes and Chris)
1	Th	10-Jan	2-3	Topic: GCPU review, Assembly examples
1	F	11-Jan		<b>Drop/Add ends Tuesday at 11:59pm</b>
2	M	14-Jan	0	Topic: Atmel XMEGA Architecture
2	Tu	15-Jan	4	Topic: Addressing Modes, Instruction Set
2	W	16-Jan	0	Topic: Assembly, Simulation, Emulation (with demo)
2	Th	17-Jan	5-6	Topic: GPIO
2	F	18-Jan	0	Topic: Simplified Timer-Counter
3	M	21-Jan	No class	<b>Holiday: Martin Luther King Junior Day</b>
3	Tu	22-Jan	7	Topic: Program Structures
3	W	23-Jan		Topic: Data Structures, Stack
3	Th	24-Jan	8-9	Topic: Clock, Include file's BM, BP, GC
3	F	25-Jan		Topic: Address and Data Bus Timing (EBI)
4	M	28-Jan	1	Topic: Address and Data Bus Timing (EBI)
4	Tu	29-Jan	10	Topic: Interfacing, Interfacing Examples, Address Decoding
4	W	30-Jan	1	Topic: Hardware and Software Debugging
4	Th	31-Jan	11-12	
4	F	1-Feb	1	
5	M	4-Feb		<b>CISE Career Workshop: 6-10pm</b>
5	Tu	5-Feb	13	
5	W	6-Feb		<b>Career Showcase (Technical Day, Feb 6<sup>th</sup>)</b>
5	Th	7-Feb	14-15	
5	F	8-Feb	2	Topic: Basic Timers
6	M	11-Feb	2	
6	Tu	12-Feb	16	Topic: Resets & Interrupts
6	W	13-Feb	2	
6	Th	14-Feb	17-18	Topic: Parameter Passing, Keypad
6	F	15-Feb	3	Topic: SCI (Asynch Data Communications)
7	M	18-Feb	3	Topic: SCI (Asynch Serial Communications)
7	Tu	19-Feb	19	Topic: LCD
7	W	20-Feb	3	Topic: Basic Timers (XMEGA's RTC; RTI, TOF)
7	Th	21-Feb	20-21	
7	F	22-Feb		
8	M	25-Feb		Topic: SPI (Synch Serial Communications)
8	Tu	26-Feb	22	<b>EXAM 1P: Tues, 26 Feb, 8:20pm, in _____</b>
8	W	27-Feb		
8	Th	28-Feb	23-24	<b>EXAM 1L: Thur, 28 Feb, If possible: 10:40am-12:35pm, in _____</b>
8	F	1-Mar		
M - F	2-Mar – 10-Mar		No Class	<b>Spring Break</b>

**SYLLABUS**

Revision **TENTATIVE**

**EEL 3744 SCHEDULE (Part 2 of 2)**

WEEK/DAY	DATE	LAB #	Class #	Comments
M - F	2-Mar – 10-Mar		No Class	<b>Spring Break</b>
9 M	11-Mar			Topic: Signal Generation, PWM, & Output Compare System
9 Tu	12-Mar		25	Topic: Input Capture System
9 W	13-Mar	4		
9 Th	14-Mar	4	26-27	
9 F	15-Mar	4		
10 M	18-Mar	4		Topic: D/A and A/D Conversion, A/D Subsystem
10 Tu	19-Mar	4	28	Topic: Lookup Table
10 W	20-Mar			Topic: DMA and DAC
10 Th	21-Mar		29-30	
10 F	22-Mar			
11 M	25-Mar	5		Topic: Other microprocessors and microcontrollers
11 Tu	26-Mar	5	31	Topic: uP 2 and Real-time DSP Applications
11 W	27-Mar	5		
11 Th	28-Mar	5	32-33	
11 F	29-Mar	5		
12 M	1-Apr			
12 Tu	2-Apr		34	Topic: Multitasking
12 W	3-Apr	6		
12 Th	4-Apr	6	35-36	
12 F	5-Apr	6		
13 M	8-Apr	6		
13 Tu	9-Apr	6	37	Topic: Other microprocessors and microcontrollers
13 W	10-Apr			
13 Th	11-Apr	7	38-39	
13 F	12-Apr	7		<b>Drop Deadline: Mon, 12 Apr @ 11:59pm</b>
14 M	15-Apr	7		Topic: Applications of Microcontrollers to Robotics
14 Tu	16-Apr	7	40	
14 W	17-Apr	7		
14 Th	18-Apr		41-42	<b>EXAM 2L: Thur, 18 Apr, If possible: 10:40am-12:35pm, in</b>
14 F	19-Apr			
15 M	22-Apr			
15 Tu	23-Apr		43	
15 W	24-Apr			
15 Th	25-Apr		No Class	Reading Day
15 F	26-Apr		No Class	Reading Day
			Final	<b>EXAM 2P: TBD (Sat or Mon, 27 or 29 Apr)</b>