OBJECTIVES

- Understand what is expected of you in this course.
- Get to know your (**U**ndergraduate) **P**eer **I**nstructor[1] (**UPI** or **PI**).
- Receive your 4744 uPAD lab kit (and DAD, if necessary). These will be returned either immediately after your Lab 8 demo or after Practical 2, whichever happens last.

The objective of this lab is to become familiar with the lab policies and to meet one of the course PIs (but likely not your PI for Labs 1 through 8). Prior to 2024, each student did some of the building of their PCBs; but during this semester, the PCBs will be entirely constructed elsewhere prior to you receiving them and the entire 4744 uPAD lab kit.

INTRODUCTION

Welcome to EEL4744C (otherwise known as *4744* and *µP*, pronounced micro-P)! In this course, a vast amount of fundamental microprocessor and microcontroller application concepts will be explored. Just as in any other course, the amount of knowledge received will be very positively correlated with the amount of effort put into learning the material. However, unlike many other courses, it is likely that *4744* shall prove to be challenging for all that are enrolled.

In general, this course is lab-driven. Primarily, course lectures will aim to provide a broad understanding of general concepts pertaining to a wide variety of microprocessors and microcontrollers, rather than provide specific details related to the lab material. We will present a few example applications in lectures, but we will not walk you through the labs. It is therefore the intention that labs will require students to explore material beyond what is discussed in lecture, just as you will be expected to accomplish when you are a practicing engineer/computer scientist. With an appropriate understanding of the above, along with motivation and consistent effort, most individuals can succeed in this course, as well as *gain superpowers in the realm of microprocessor applications* during the process.

Students in 4744 no longer solder in the course (an important skill for all electrical and computer engineers). The Appendix shows some examples of both good and bad electronics soldering joints. Several of the documents in § SUPPLEMENTAL MATERIALS are relevant for those wanting to learn how to solder. The soldering technique is described in *Electronic Assembly Technique Handout.*

LAB STRUCTURE

In this first lab, you will become familiar with what is expected of you. Before attending your assigned lab session, you will explore, understand, and agree to all lab rules and policies (in the Homework 0 Quiz). Then, within the lab, you will become formally introduced to your **U**ndergraduate **P**eer **I**nstructor, the individual responsible for hosting your (or other student) lab session. Beyond introductions, your Peer Instructor will identify if anything additional is expected of you throughout the semester.

REQUIRED MATERIALS

- *Lab Rules and Policies*
- *Pre-lab Report Submission Templ*ate *(Word or PDF)*
- *µPAD v2.0 Parts List* (*Excel* or *PDF*)

SUPPLEMENTAL MATERIALS

- Although not required, a multimeter may be helpful.
- A toolbox is advisable.
- **D**igital **A**nalog **D**iscovery (**DAD**) and *WaveForms* software installed on your computer.
  - If you don't have a DAD, you will be able to borrow a DAD-3. Details will be provided elsewhere.
  - You will need these for most of your labs and both practicals.
    - DAD Tutorial Info
    - Periodic signal frequency/period measuring
- Later in the semester, you'll need the following 3701 items for Lab 4 and Practical 1:
  - PLD PCB, the necessary USB cables, large prototyping bread board, wire kit, 8-element SPST switch DIP, 8 element LED DIP, two SIP resistors (one for each of the switch and LED DIPs or on SIP and one DIP resistor package).
    - If you do not have these items, information about buying them from ***OOTB***, a local store, is available on our syllabus. If you already have a large breadboard and wire kit, you can order the necessary items from OOTB with the URL https://www.ootbelec.com/store/p/4744partsonly. If you do not have a breadboard and wire kit, the link https://www.ootbelec.com/store/p/4744labkit has all of the items that you need for 4744 (including a breadboard wire kit, and the items in the prior link).
    - Note that the DE10-Lite PCB or the 3701 PLD PCB (from semesters prior to fall 2023) can be used. A DE10-Lite can be borrowed (at no direct cost) prior to your need for one in Lab 4.
  - Quartus installed on your computer.
- Although you will not solder/assembler your lab PCBs this semester, you might be interested in the process:
  - *Out of the Box (OOTB) µPAD 1.4 Assembly Guide*
  - *Hardware Assembly Video Tutorial*

[1] You may see or hear the term *Peer Instructor*, *PI,* or *UPI* (an abbreviation for *Undergraduate Peer Instructor*).

- Soldering, although no longer required in 4744, is described in *Electronic Assembly Technique Handout*
- Proper electronic soldering requires a temperature regulated soldering iron, solder, flux, desoldering braid (aka solder wick), and safety glasses.

PRE-LAB PROCEDURE

First and foremost, you must become fully aware of, as well as agree to, the lab rules and policies for this course.

1. As part of the Homework 0 Quiz, you should have already read, understood, and agreed to abide by all the items presented within in the *Lab Rules and Policies* document.

PRE-LAB EXERCISES

i. Can you drop any (single) lab if you would rather go to the beach? How about if a project for another class is due?
ii. Describe the lab makeup policy for a first missed (i.e., not submitted) lab.
iii. You **cannot** be late for your lab appointment time, but you can turn in your lab submissions late. How late, what are the penalties, and if so, how many times.
iv. What can I do if I miss my lab appointment, but I already submitted the lab document? What is the grade penalty?
v. Other than Labs 0, when are your pre-lab submissions due to Canvas, with respect to the earliest corresponding lab demo dates and lab quiz, i.e., how many days before or after the earliest lab or the quiz? Be specific.
vi. In your pre-lab report, what should be included with every measurement, screenshot, etc.?
vii. What is the minimum combined weighted lab average and lab quiz average required for you to be *eligible* to pass the course?
viii. In which section of your pre-lab report should any required screenshot be included?
ix. Describe the process of taking measurements with a system such as an oscilloscope or logic analyzer. Additionally, include details regarding when precise frequency measurements are of interest.

As mentioned above, during the first lab session, you will receive a lab kit containing several printed circuit boards. (PCBs), with the main processor PCB referred to as the ***µPAD*** (pronounced *micro-pad*). This PCB has a *Microchip/Atmel ATxmega128A1U* microcontroller. Several accompanying PCBs called either **backpacks** or **baseboards**, depending on where they are located with respect to the *µPAD*, extend the functionality of the microcontroller. (Backpacks are accompanying PCBs mounted on top of the *µPAD* and baseboards are PCBs mounted beneath the *µPAD*.)

NOTE: Prior to the last few years, wire wrapping was performed in *4744*. Wire wrapping is an alternative to soldering and is used to make an electrical and mechanical connection between two parts by wrapping wires around pins (see https://youtu.be/IXvEDM-m9CE). Wire wrapping is no longer performed in this course to save students many hours and frustration. However, later in this course, electrical connections will also be made with a breadboard, as in my sections of EEL3701C. Soldering is also no longer done in this course, but likely will be done in EE or CpE Design 1 and Design 2 courses.

2. This is **not required**, but I suggest that you read the *Electronic Assembly Handout* given on the course website and watch the *Hardware Assembly Video Tutorial*. Although you won't need it, it might help reading the*Out of the Box (OOTB) µPAD 1.4 Assembly Guide* might help you to become familiar with the components used in the course.
3. Create your *Pre-Lab Report* using something like MS Word. Use the format specified in the *Pre-lab Report Submission Template*. The report must be computer-generated (even if parts of it are from clean and easy to read scans). Ultimately, you will save this file as *Lab0.pdf* for submission on Canvas. You will have a *Pre-Lab Report* for **every** lab. In this lab, from part 5, only parts 5. i. a) – e) from the *Lab Rules and Policies* are relevant.

PRE-LAB PROCEDURE SUMMARY

1) Read and understand the *Lab Rules and Policies* document (as required in the Homework 0 Quiz).
2) Complete all pre-lab exercises.
3) Upload your lab report to the proper Canvas assignment. (This is **ALWAYS** required and will not be explicitly listed again.)
4) In all labs **EXCEPT** this one, you will also upload your zip file (with all your *Microchip/Atmel Studio* project folders for the lab) to the proper Canvas assignment. (This is **ALWAYS** required and will not be explicitly listed again.)

IN-LAB PROCEDURE

In your first lab session, you will do several things in preparation for the remainder of the semester. Initially, you will meet a Peer Instructor (PI), the individual in charge of hosting some lab sessions.

After this, your PI will provide you with your lab kit. Upon receiving this kit, you will be required to verify that it contains all the parts listed on the *µPAD v2.0 Parts List* (*Excel* or *PDF*), immediately notifying the PI if any components are missing. For documentation purposes (and before any assembly), take pictures (I suggest using *Adobe Scan* or equivalent software) of all the parts in your kit (each of the PCBs, the chips, etc.) and include these images in your **Lab 1** *Pre-Lab Report*.

If you do not already have a DAD (Digilent Analog Discovery), check one out from your PI. EE and CpE students will keep the borrowed DAD until they complete their last hardware-related course, probably Design 2 (or the second semester if IPPD). All other students will return the DAD at the end of the semester.

NOTE: After receiving the lab kit in this lab, verify that it is complete. After this lab, you will be responsible for any missing components.

IN-LAB PROCEDURE SUMMARY

1) Meet your PI and become familiar with their style of teaching.
2) Receive your lab kit and verify that all components are accounted for. If any parts are missing, immediately notify your PI.

APPENDIXES

A. 4744 UPAD LAB KIT IS BORROWED

Your 4744 uPAD Lab Kit will be checked-out to you for the semester **and returned at the end of the semester**. The check-in/out process will be managed by your section PI. You are responsible for this hardware; please return the parts in the same condition you got them.

Before returning our lab hardware, make sure you have all these items to turn in:

1. Box in which items were originally packaged
2. µPAD development board
3. Memory Base
4. Switch and LED Backpack
5. Analog Backpack
6. Robotics Backpack
7. 5V 2A AC/DC power supply
8. USB 2.0 cable (type A male to type B male)
9. 74HC573 DIP (8-bit 3-state transparent latch)
10. 74HC574 DIP (8-bit 3-state D flip-flop)

Throughout the semester, please handle it with care and transport it in a way that does not damage the unit. This means that the unit should always live in its bag/box until you need to use it and then return it to its bag. I suggest that you leave the USB type B connector plugged into the uPAD and just connect/disconnect the USB type A connector from your PC when needed. If your unit is damaged in some way when it's checked out to you, please return it to your PI for another.

B. SOLDERING

The following figures might be helpful to show some good (and bad) soldering examples.

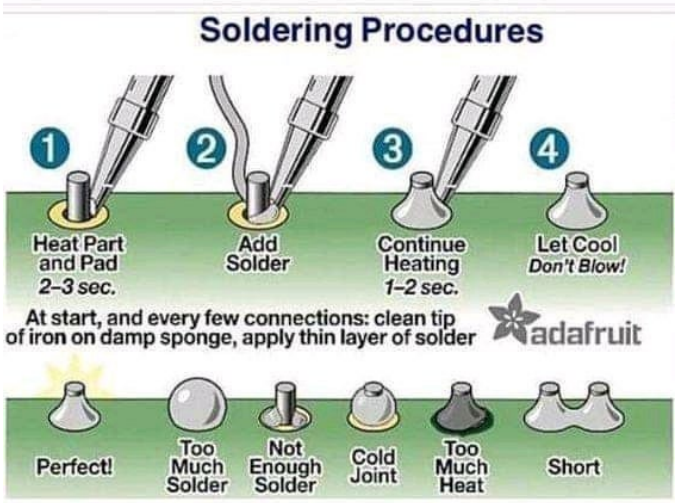

Figure A.1: Soldering examples.

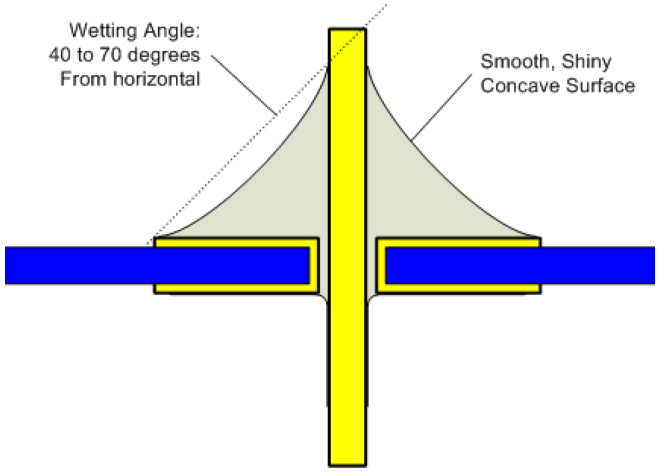

Figure A.2: Ideal solder joint.

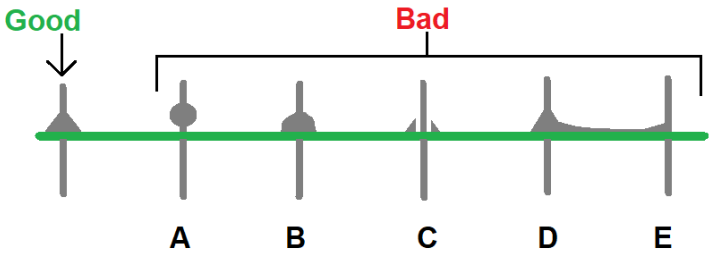

Figure A.3: Good and bad soldering examples.

A good solder should have the shape of a *Hershey's Kiss* (without the wrinkles). By the way, the first Hershey's Kiss was manufatured in 1907!

Figure A.4: Ideal solder joint.