OBJECTIVES

- Understand what is expected of you in this course.
- Get to know your (**U**ndergraduate) **P**eer **I**nstructor[1] (**UPI** or **PI**).
- Complete the construction of your lab kit PCBs.

The objective of this lab is to become familiar with the lab policies and to meet one of the course PI (but perhaps not your normal lab PI). Prior to this semester, 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 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 sometimes 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.
- 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 switch DIP, 8 element LED DIP, two SIP resistors (one for each of the switch and LED DIPs).
    - Note that the DE10-lite PCB or the 3701 PLD PCB (from semesters prior to fall 2023) can be used.
    - If you do not have these items, information about buying them from ***OOTB***, a local store, will be available soon.
  - 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*
  - 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.

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

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. Other than Labs 0 and 8, when are your pre-lab submissions due to Canvas, with respect to the earliest lab demo dates, i.e., how many days before or after the earliest lab demo date? Be specific.
ii. What can I do if I miss my lab appointment, but I already submitted the lab document? What is the grade penalty?
iii. You **cannot** be late to 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. Can you drop any (single) lab if you would rather go to the beach? How about if a project for another class is due?
v. Describe the lab makeup policy for a first missed (i.e., not submitted) lab.
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 begin to solder and assemble a lab kit containing several printed circuit boards. Overall, this lab kit will contain 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. 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 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 1.3 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) Answer 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 *CamScanner* 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*.

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. SOLDERING

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

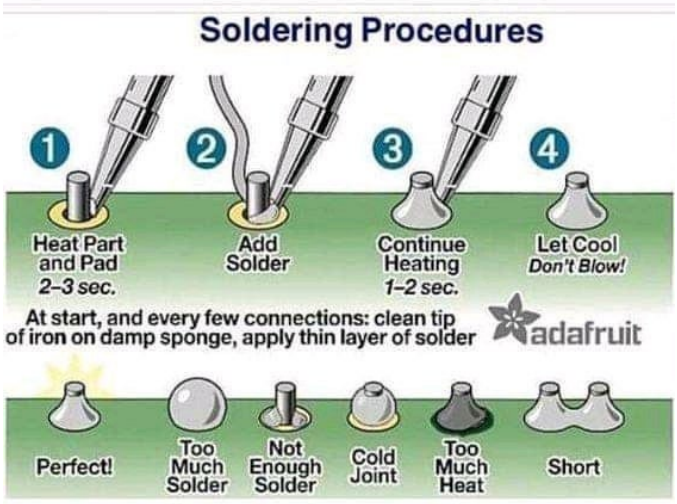

Figure A.1: Soldering examples.

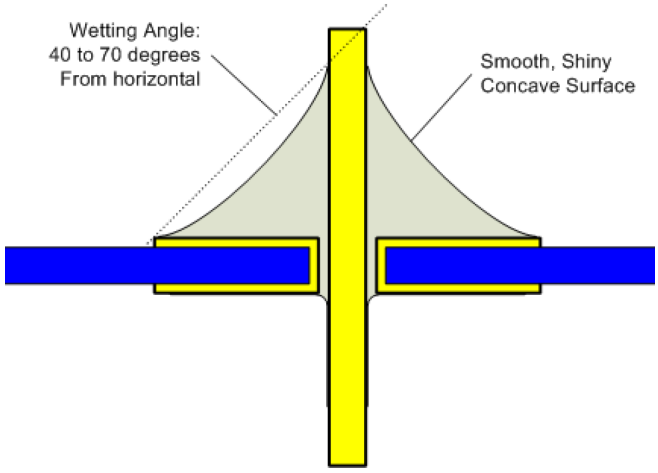

Figure A.2: Ideal solder joint.

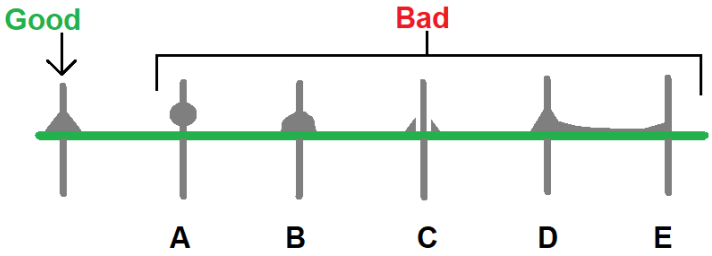

Figure A.3: Good and bad soldering examples.

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.