ECEN 5613 Spring 2022	Embedded System Design Lab #1 Signoff Sheet – Part 1&2 Elements	Week #1 1/10/2022

You will need to obtain the signature of your TA on the following items in order to receive credit.

The Part 1 & Part 2 Elements of Lab #1 should be completed and signed off by **Friday, Jan. 28, 2022** in order to give you time to complete the Part 3 Elements upon receipt of your parts kit. All signoffs are due by **Friday, Feb. 4, 2022**. You need to submit both of your signoff sheets and other required elements by **11:59pm Sunday, Feb. 6, 2022**. Labs completed after the signature due date or submitted after the submission due date will usually receive grade reductions, but there is leniency on Lab #1.

Print your name below and then demonstrate your working hardware/firmware in order to obtain the necessary signatures. All items must be completed to get a signature, but partial credit is given for incomplete labs. Receiving a signature on this signoff sheet does not mean that your work is eligible for any particular grade; it merely indicates that you have completed the work at an acceptable level.

Student Name: ABIJITH ANANDA KRISHNAN

Checklist

- ☐ Student demonstrates detailed knowledge of a simulator (including changing register values, editing data memory, using breakpoints, single stepping, uses /overlay option, etc.)
- ☐ Student assembly program works correctly
- ☐ Student demonstrates detailed knowledge of WinCUPL and WinSim, logic equations correct

Student Answers to Lab Questions

1. **How many bytes of code space does your program require?**
   (Show how you arrived at your answer.)
   Code Size? 89 bytes

2. **How long did your program take to execute for X=0x12 and Y=0x0A? Assume an 11.0592 MHz clock and include the instructions executed from the beginning until you reach the ENDLOOP label. Show the TA your detailed calculations on the code listing during your signoff.**
   Execution Time? 95.48 µs

SShankar 01/28/22

Instructor/TA Comments: ☐ ☐ ☐ **TA signature and date**

FOR INSTRUCTOR USE ONLY	Not Applicable	Poor/Not Complete	Meets Requirements	Exceeds Requirements	Outstanding
SPLD code	☐	☐	☐	☑	☐
Assembly Language Code Style	☐	☐	☐	☑	☐
Required Elements functionality	☐	☐	☐	☐	☐
Sign-off done without excessive retries		☐	☑		
Student understanding and skills	☐	☐	☐	☑	☐
Overall Demo Quality	☐	☐	☐	☑	☐

Comments:

NOTE: This submission sheet should be the top/first sheet of your submission.

Lab1 Part 1 & 2 Signoff

+ Well written assembly code
- 1 case not working when quotient = 0
+ Well written SPLD code.
+ Good schematic with nblocks for each part of circuit
+ Lab questions answered correctly

ECEN 5613
Spring 2022

Embedded System Design
Lab #1 Signoff Sheet – Part 3 Elements

Week #1
1/10/2022

Print your name below, answer the questions, and then demonstrate your working hardware in order to obtain the necessary signatures. All items must be completed to get a signature.

Student Name: ABIJITH ANANDA KRISHNAN

Checklist

- ☑ Schematic of acceptable quality, Student name on board in permanent ink
- ☑ Pins and signals labeled, decoupling capacitors, and two 28-pin wire wrap sockets present on board:
- ☑ Mounting hardware present (e.g. standoffs or an enclosure)
- ☑ Power switch and LED, voltage regulator functional, power jack present
- ☑ Power-on Reset (RC) and Run-time Reset (pushbutton), 8051 bypass cap is present
- ☑ RS-232 connector mounted, 74LS373 transparent latch wired
- ☑ Logic outputs correct (e.g. SPLD generation of /READ and /CSPERIPH; view SPLD code)
- ☑ Student displays good knowledge of oscilloscope
- ☑ Peak to peak noise measured across processor VCC and GND is < 800mV
- ☑ Oscillator functional (check for correct ALE/XTAL2 signals after power on-off cycles)
- ☑ ARM development board functional, student can demonstrate the basic software.

Student Answers to Lab Questions

1. **What voltage is present at the regulator input?** Use a digital multimeter. 7.63 V
2. **What voltage is present at the regulator output?** Use a digital multimeter. 5.01 V
3. **What peak to peak noise is present across the processor VCC and GND?** Use an oscilloscope.

   Measured value at processor package pins on top side of board: 160mV

   Measured value at wire wrap socket pins on bottom side of board: 160 mV
4. **How long is the processor held in reset after the run-time reset pushbutton is released?** Use an oscilloscope and try to measure the time between the release of the pushbutton and the time when noise from ALE is observed on the RST signal.

   Measured value: 82ms
5. **What frequency is present at the ALE pin?** Use an oscilloscope. 11.843 MHz

Instructor/TA Comments: ☐ ☐ ☐

Manao MD
2/5/22
TA signature and date

FOR INSTRUCTOR USE ONLY	Not Applicable	Poor/Not Complete	Meets Requirements	Exceeds Requirements	Outstanding
Schematics, SPLD code	☐	☐	☐	☐	☐
Hardware physical implementation	☐	☐	☑	☐	☐
Required Elements functionality	☐	☐	☑	☐	☐
Sign-off done without excessive retries		☐	☑	☐	☐
Student understanding and skills	☐	☐	☐	☑	☐
Overall Demo Quality	☐	☐	☐	☐	☐

Comments:

NOTE: This submission sheet should be the second sheet of your submission.

Lab1 Part3

(+) ARM code executed on STM32 board.

(-) Schematic missing decoupling caps, power connections

(+) SPLD code working, logic reflected on logic analyzer.

(-) Hardware requires some rework in soldering.

Submission Sheet

Instructions: Print your name below and sign the honor code pledge. Separate the signoff and submission sheets from the rest of the lab and turn in a scan (or clear picture) of these signed forms, the items in the checklist below, and the answers to any applicable lab questions in order to receive credit for your work. No cover sheet please. **Submit all items electronically via Canvas to reduce paper usage. Canvas is https://canvas.colorado.edu .**

In addition to the items listed on the signoff checklist, be sure to review the lab for additional requirements for submission, including:

- ❑ Scan of signed and dated Part 1 signoff sheet as the top sheet (No cover sheet please)
- ❑ Scan of signed and dated Part 3 signoff sheet as the second sheet
- ❑ Scan of submission sheet with signed honor code pledge as the third sheet
- ❑ PDF of complete and accurate final schematic of acceptable quality (all components shown).
- ❑ Fully, neatly, and clearly commented assembly code.
- ❑ Clear high-resolution pictures of the top and bottom sides of your 8051 board.

Make copies of your code, SPLD code, and schematic files and save them as an archive.

Student Name: ABIJITH ANANDA KRISHNAN

Honor Code Pledge: "On my honor, as a University of Colorado student, I have neither given nor received unauthorized assistance on this work. I have clearly acknowledged work that is not my own."

Student Signature: Abi.

1. **How much power is dissipated in the regulator, assuming a load current of 135mA?** Assume that the regulator is drawing the max quiescent current shown in the data sheet (use the correct data sheet for the regulator you have on your board). Neatly show all your work.

I/p Voltage = 7.63 V O/p voltage = 5.01 V

Voltage drops due to regulator = 7.63 − 5.01 = 2.62 V

Max Quiescent current = 8 mA

Load Current = 135 mA

Power dissipated = (2.62) [8 + 135] * 10^{-3}

= 0.374 W

Calculated value: 0.374 W

Comments:

NOTE: This submission sheet should be the third sheet of your submission.

Lab 1 submission

To-Do:

1. Write a single assembly language program to execute Z=(X*8)/Y (Part-1)
2. Using WinCUPL, develop code for the Atmel AT16V8C SPLD and generate two outputs (Part-1)
    a. /READ = /RD & /PSEN
    b. /CSPERIPH =! (A15 & A14 & A13 & A12).
3. Design schematic for the above simulated operations. (Part-2)
4. Solder and wire wrap the components on a bare PCB board and verify the working by checking the output voltages with the help of Digital Multimeter and output waveforms with the help of Logic Analyzer and digital storage oscilloscope. (Part-3)

Observations:

1. With the help of ASM51, the assembly program was compiled to provide a hex file. The hex file was executed on Emily52 emulator. Different test inputs were provided to verify whether specified registers were storing the calculated values post execution of assembly program. (Part-1)
2. Set the specified pins of the MCU as inputs and pins of the SPLD chip as output. The input and output waveforms were viewed on WinSim. (Part-1)
3. The schematic was designed with the help of EasyEDA online designer. (Part-2)
4. AT89C51RC2, ATF16V8C SPLD, 74LS373, Power jack, switch, LM7805 voltage regulator, 11.0592 MHz crystal oscillator, jumpers, diodes, capacitors, and resistors were soldered to the bare PCB.
    a. An output voltage of 5V was recorded at Voltage regulator output.
    b. $1/6^{th}$ of the crystal oscillator frequency was recorded at the ALE.
    c. Time for oscillator to start after pressing reset was recorded.
    d. The output waveforms were verified with the help of DSO and logic analyzer

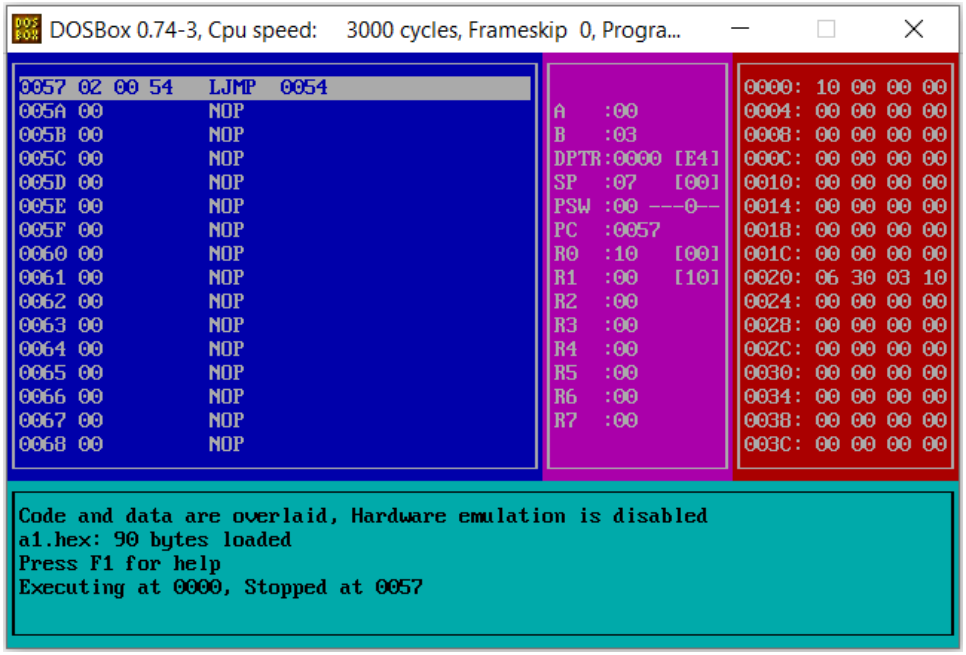

Fig 1: Emily52 output of assembly program after giving test values of X=6 and Y=3

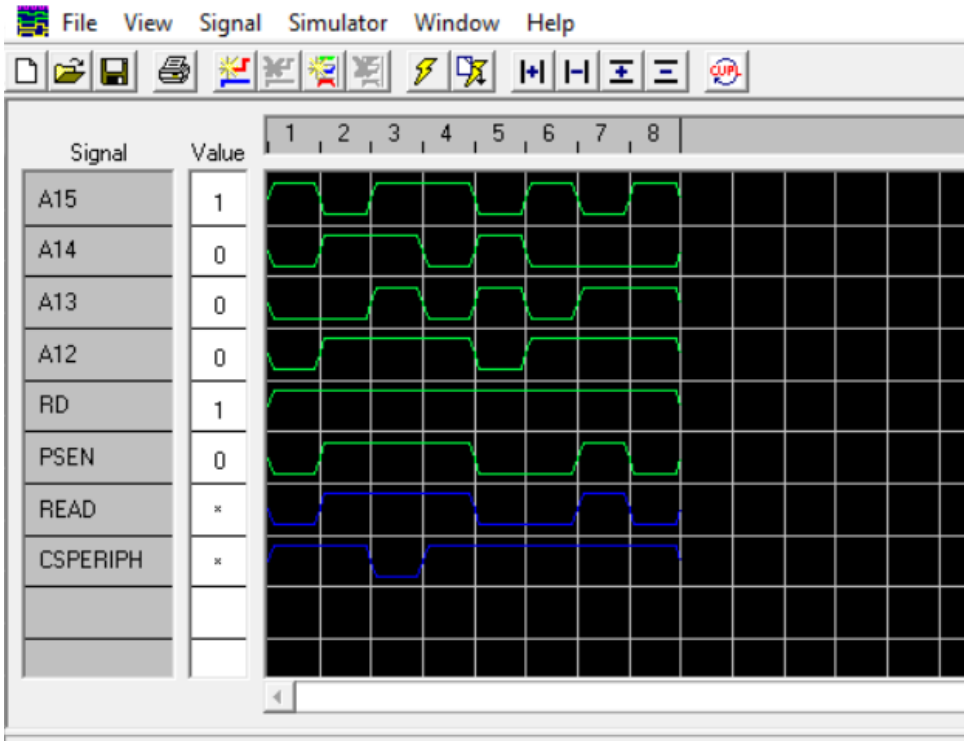

Fig 2: WinSim output

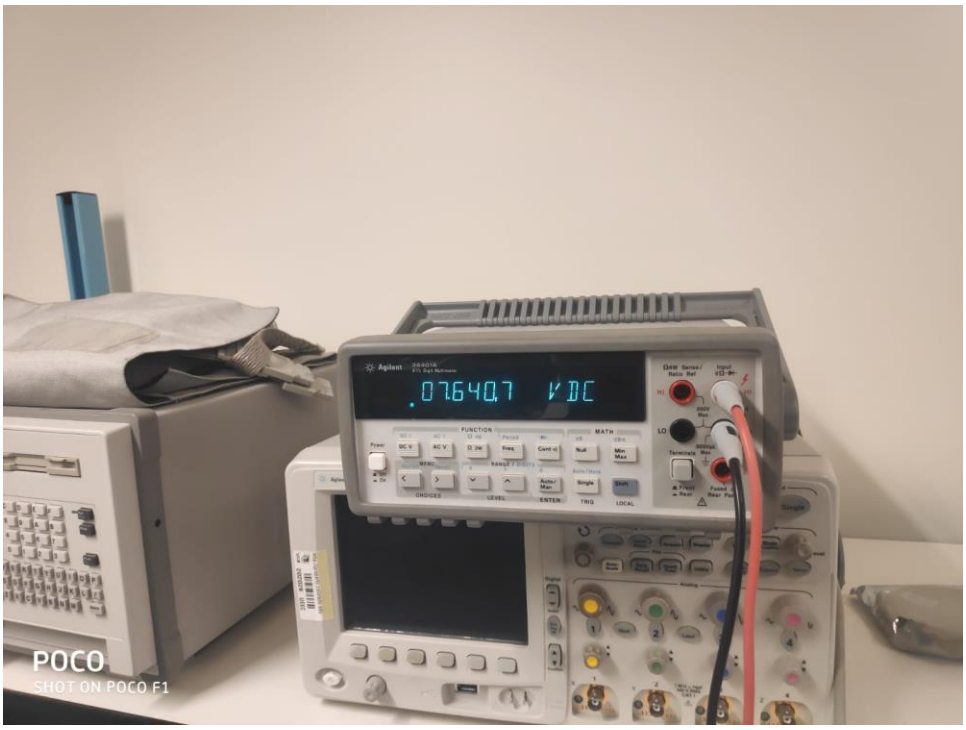

Fig 3: Voltage between regulator input and ground

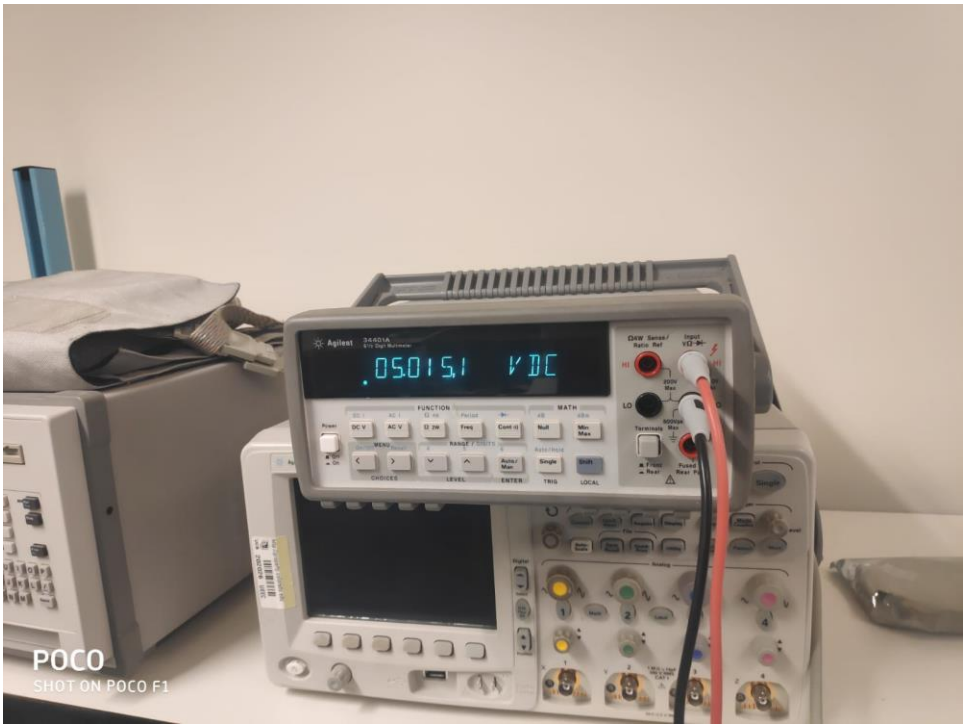

Fig 4: Voltage between regulator output and ground

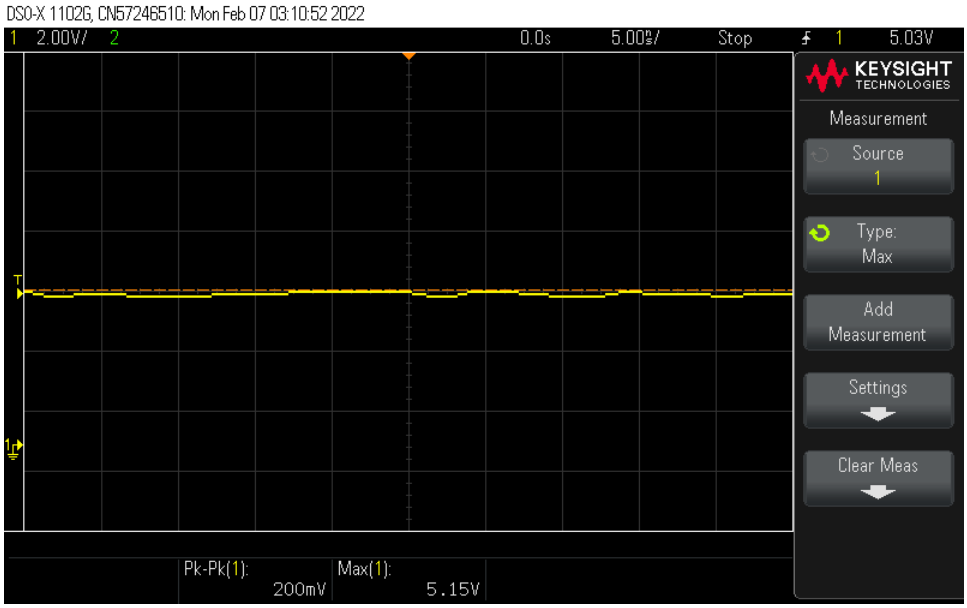

Fig 5: Peak to Peak noise between Vcc and ground

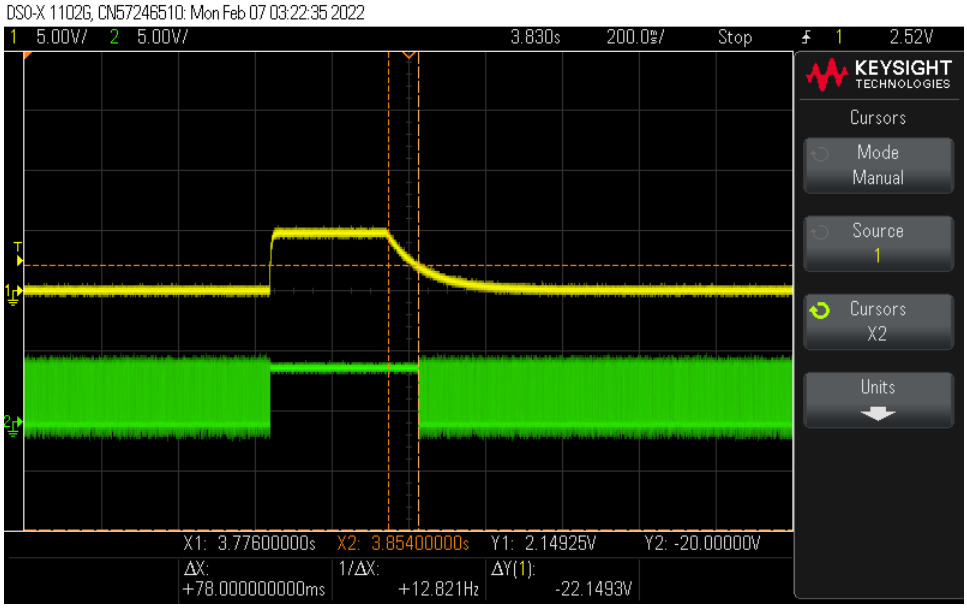

Fig 6: Time until processor is held in reset after reset button press

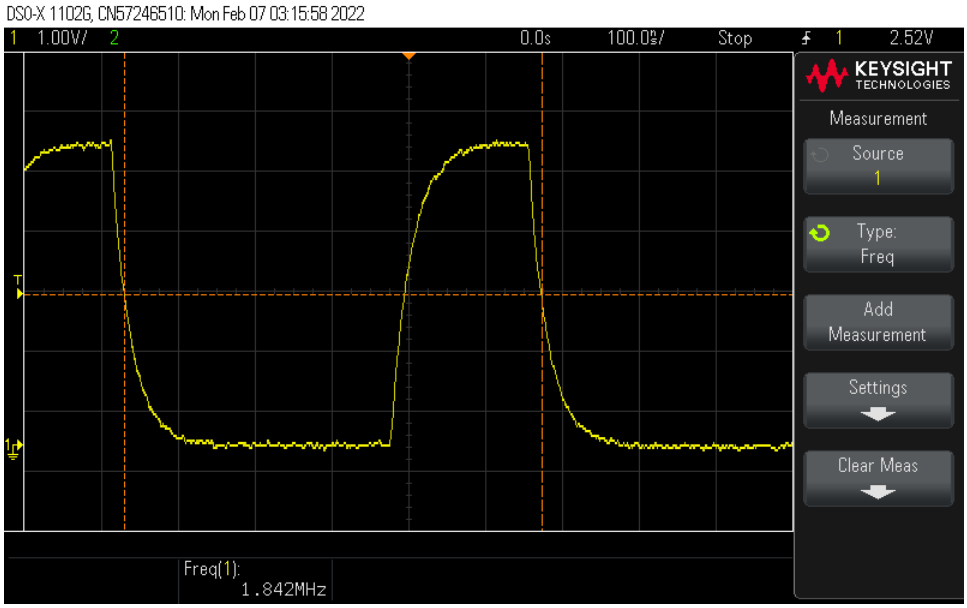

Fig 7: Frequency at ALE pin

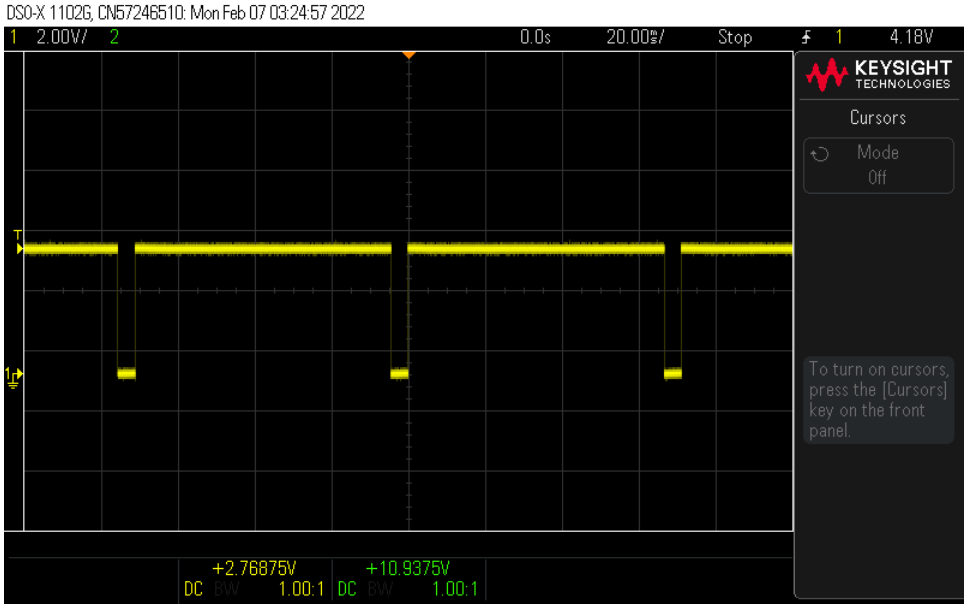

Fig 8: Output waveform at CS Peripheral

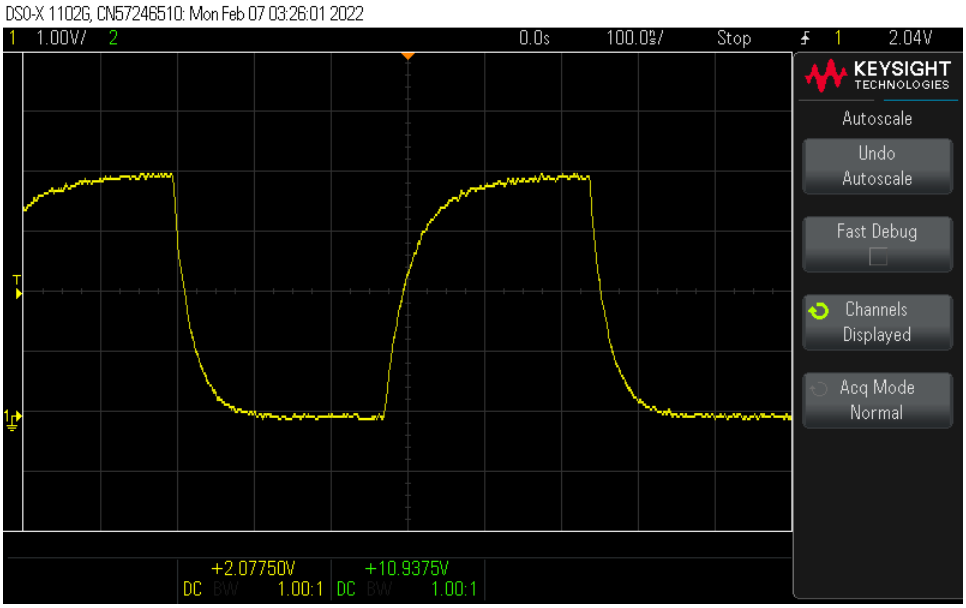

Fig 9: Output waveform at Read Pin

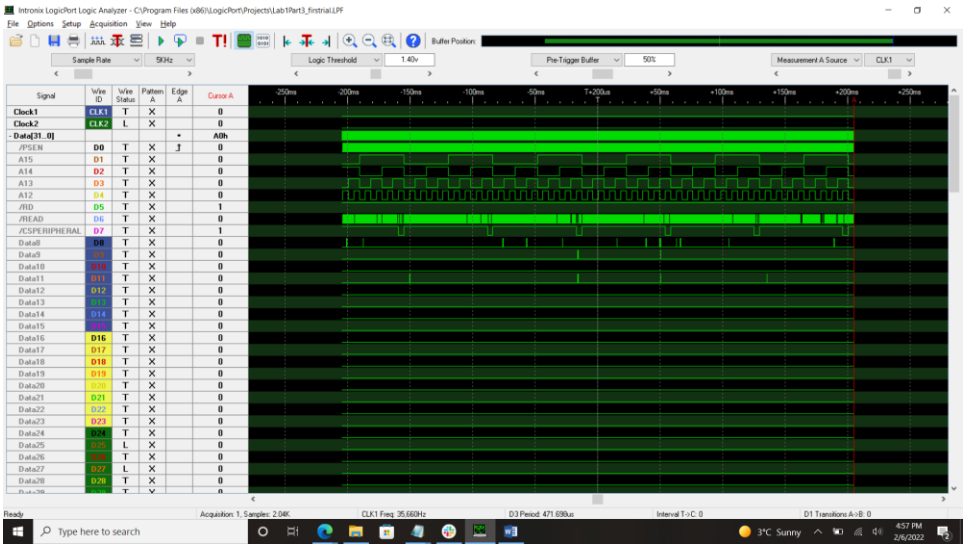

Fig 10: Output of the waveform via logic analyzer

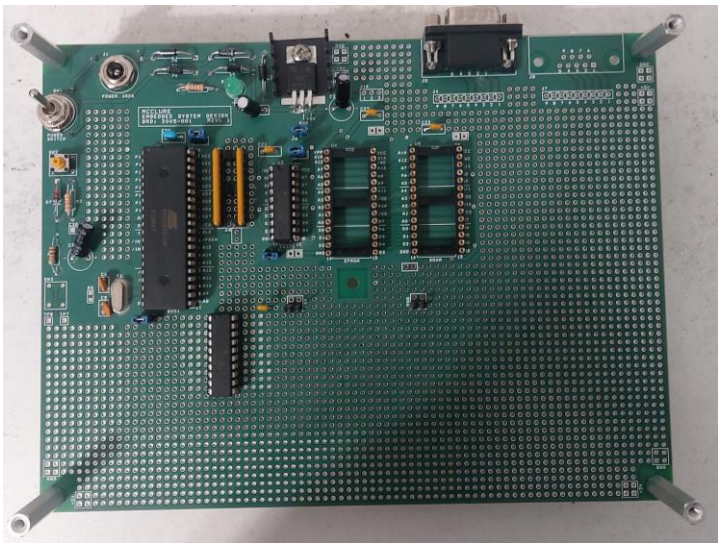

Fig 11: Top view of soldered PCB board

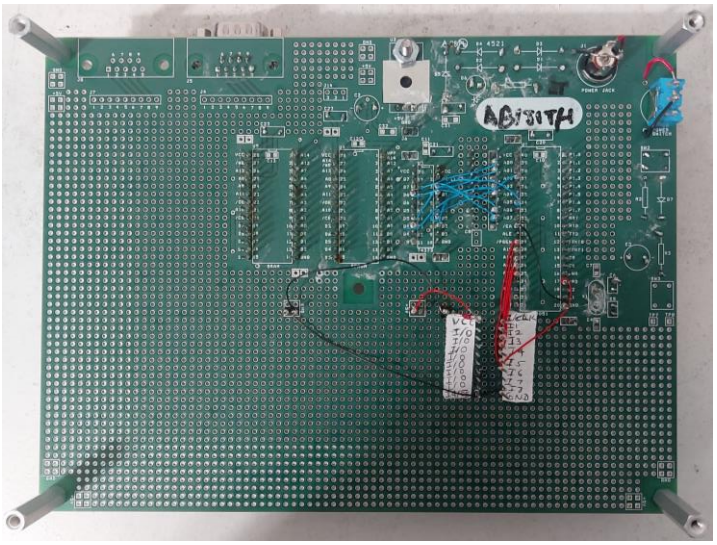

Fig 12: Bottom view of soldered PCB board

Inferences and Key Learnings:

1. I learnt 8051 assembly programming language.
2. The applications of ASM51 assembler and emily52 emulator. The assembler converts the assembly code file to .hex file. The emulator can run only on 16-bit machines. Since mine is a 64-bit machine, DosBox is additionally required to run this emulator. Emily52 executes the .hex file.
3. Debugging programs on Emily52 is easier with the help of debug and watch points. Line by line execution is possible with this application.
4. WinCupl is used to simulate SPLD functionality. Output waveforms can be obtained via WinSim which helps us provide desired inputs for specific pins of the chip.

5. EasyEDA is an amazing online tool which allowed me to design a circuit. The vast library allowed me to choose components of my choice. The pin names can be edited as per our choice and convenience.
6. Soldering and wire wrapping were a challenge. The use of wire wrap tool was completely new. Wire Wrap allows connection between different pins. I made mistakes while soldering by adding more solder to the pins. I even made extra turns while wire wrapping which were corrected post TAs comments during signoffs.