EE212-Microprocessors Keil Tutorial and General Rules for ARM Labs

Spring 2024

1 Tutorial

In tutorial you are going to learn how to use Keil MDK which is a development platform for embedded devices. In tutorial and projects, you are going to program FRDM-KL25Z board with C language. After the tutorial you should have no problem of;

- Loading the **tutorial code** to the Freedom board and making it work on the hardware setup.

- Debugging the code

- Writing basic functions using loops and conditional statements.

1.1 Preliminary Work for Tutorial

Before coming to tutorial session, you should have finished;

- Getting the FRDM-KL25Z board

- Installation of Keil MDK: **Installation Video Link**

- Checking the tutorial code in detail and completing the coding assignment (Assignment is given within the **tutorial code**)

- Answered the questions below before the deadline, uploaded the answers in PDF format.

2 Questions

Question 1: Assume you have a function that can give microsecond of delay. How you can adjust the brightness of an LED using the delay function?

Question 2: What are the ports connected to onboard LEDs (Port connected to Red, Green and Blue LEDs) on FRDM-KL25Z board?

Question 3: Assume we reduced the clock of the processor to 100 Hz and processor executes 1 instruction per clock. Given the function below, do you expect a precise 1-second delay? Explain why or why not.

```c
void Delay(volatile unsigned int time_del) {
  while (time_del--)
    {
  }
}

void main(){
  Delay(100);
}
```

Question 4: Explain pull-up and pull-down resistor. Why are they needed?

3   Notes

- Keil MDK only runs on Windows OS. It does not run on Macbooks with Windows. If you have no Windows OS installed computer, you are welcome to use the ones in laboratory.

- Tutorial is 2 pts of your overall grade. 1 point of this grade is attendance to the tutorial session and the other point is the answers of the questions.

4   Useful Links for Detailed Information

- For Debugging, Installation Details and Creating a New Project: **Supplementary Documents**

- For embedded C Programming examples on FRDM-KL25Z board: Freescale ARM Cortex-M Embedded Programming

- You can download the latest version of Keil from the **Download Link**

- It might take too long for Keil MDK to download. Therefore it is critical to download and install Keil MDK as in the **Installation Guide Link** before coming to tutorial.

- You may need to install PEmicro driver if computer doesn't see the board: **Download Link**

4.1   Tutorial Assignment

In the tutorial, you are expected to change the code and write simple functions. For this purpose, you are going to contol the onboard RGB LED of the FRDM-KL25Z board.

5 General Rules for ARM Labs

- Cheating and copying code is strictly prohibited. For those who cheat and plagiarize, disciplinary action will be taken.

- You will load the code from moodle and run that code on lab demos. Therefore, late submissions and modified code after deadline will not be tolerated.

- If you have any problem with the hardware or board, contact with TAs. Sharing circuits and demonstrating your work on other boards is not allowed.

- If you have any problem or questions about the labs 3 and 4, you should write a mail to the responsible TAs. *Don't hesitate to write, some small problems might take too long for you to solve but, if you share those problems with us we can solve them quickly together.*