ÉCOLE NATIONALE
SUPÉRIEURE
D'INFORMATIQUE

LAB   N°01
Introduction to using and manipulating a microcontroller
(Arduino and sensors)

A. THEORY: (2 pages max)

1. Getting familiar with microcontrollers and highlighting the Harvard and Von-Neumann architectures (1/2 page max).
2. LED and Pushbutton, what they represent for a microcontroller.
3. Getting familiar with Arduino (provide a description). (1/2 page max)
   a) Hardware aspects (architecture, pin structure, memory type), particularly MKR10110.
   b) Structure of an Arduino program and explanation
   c) Libraries and functions
   d) LED and Pushbutton, what they represent for a microcontroller.

4. Installing and configuring the necessary tools for Arduino development (IDE, libraries and configuration). (1 /2 page max)
   a) Study, connection of Arduino with the "test lab," and testing.
   b) Connecting a Pushbutton/LED to digital IO
   c) Arduino protection
      o How to protect Input pins of Arduino.
      o How to protect output pins of Arduino.
      o How to protect LED and Pushbutton.
5. Introduction to microcontroller simulators. (1 /2 page max)

B. ACTIVITY: (3 pages max)

B-1 ARDUINO

Please note that during this part, it is necessary to explain the functions used and you have to comment on the program.

a) (Connecting a LED)

   • Read and understand how to load a program into Arduino, functions: **void setup()** and **void loop().**
   • Turn on the building LED.
   • Turn on an external LED.

In order to control the LED, you would need to connect the anode (the longer leg) to a digital output of the MKR and the cathode (shorter leg) to ground (0V).
Before using a digital port, it is necessary to configure it as input or output using the command.

Make sure to use appropriate resistors to limit the current for the OUTPUT PIN.

pinMode(pin, mode)

Where "pin" is the port number and "mode" can take values: OUTPUT (port as output), INPUT (port as input), etc.

Which mode should we specify to be able to control the LED, add this instruction to the Setup() function().

If the port is configured as an output (OUTPUT) with pinMode(), its voltage will be set using the instruction:

> **digitalWrite(pin, value)**

Where "pin" is the port number and "value" can take the values HIGH (**5 V** or **3.3 V** depending on the Arduino board) or LOW (0 V).

- Using this instruction and the delay(x) instruction which allows to wait for x milliseconds, program your MKR board to turn on the LED for 2 seconds at each iteration of the main loop.
- Try some other combinations.

b) Scan of wireless Wifi networks (Introduction)

It should be noted that the MKR1010 boards are equipped with NINA-W10 modules that implement Wi-Fi 802.1 1b/g/n technologies on the 2.4 GHz ISM band and Bluetooth v4.2 (Bluetooth and Bluetooth Low Energy) technology.

In order to set up and understand network communications through the TCP/IP stack, we will use the **WiFiNINA.h library.** This library implements some of the main protocols of the TCP/IP stack: IEEE 802.11 mainly, IP, UDP, HTTP, HTTPS, etc. It can serve as either a server accepting incoming connections or as a client making outgoing connections.

- Install the libraries
- Read and understand some functions, for example: void **scan_networks ()…**
- Show some examples:
  - -Using theses functions
  - - Using those related to memory management.

c) Memory Management

Based on the examples discussed in this lab, please provide a few instances of memory management on Arduino.

d) Simulation:

Repeat activity "**a) (related to the LED connection)**," using **the Proteus simulator.** Explain and provide all the steps, including those for installing the various libraries.

B-2 CONCLUSION (very important)