

# **Lab 1 Manual**

## **EECE1195: Digital Electronics II**

### Objectives

Design and implement a **3-digit digital combination lock** using **only combinational logic circuits**.

The system compares a **user-entered 3-digit BCD code** (via DIP switches) with a **hard-wired secret code** (derived from your student ID).

When the entered code matches the secret and the **Test pushbutton** is pressed, the **lock opens**, indicated by both an **LED** and a **7-segment display**.

### Overview

Each student will design a **digital combination lock** that unlocks only when the correct **3-digit secret code** is entered.

The secret code corresponds to the **last three digits of your student ID** and is **hard-wired** into the circuit.

Each digit of the code is entered using a **4-bit DIP switch**, representing a **decimal digit (0–9)** in binary.

A **push button** is used to validate the entered code and simulate the unlock action.

### Functional Requirements

#### Inputs

1. **Three sets of 4-bit DIP switches (SW1, SW2, SW3):**
  - Each set represents one decimal digit (0–9) using binary encoding.  
Example:
    - 0101 = 5
    - 0111 = 7
2. **Test Push Button (PB1):**
  - Used to validate the entered code and trigger the unlock action.

#### Secret Code

- The secret code is **hard-wired** using logic constants (e.g., connected to VCC or GND).

- Each student's code equals the **last three digits** of their student ID.  
Example: If your student ID is **8799753**, your code is **753**.

## **Outputs**

1. **Match LED (LED1):**
  - **ON (1):** The entered 3-digit code matches the secret code.
  - **OFF (0):** The entered code does not match.
2. **Unlock LED (LED2):**
  - **ON (1):** The entered code matches, *and* the **Test Push Button** is pressed.  
This LED can also be used to **drive a relay or buzzer** (through a transistor if needed).
  - **OFF (0):** The code is incorrect, or the button is not pressed.
3. **7-Segment Display:**
  - Displays **"—"** when the system is locked or before validation.
  - Displays **"U"** (for "Unlocked") when the correct code is entered **and** validated by the push button.

## **Deliverables**

### **A) Simulation File**

1. Multisim (.ms14) or equivalent
2. Fully labeled schematic

### **B) Demonstration Video (1–3 minutes) (MUST with verbal description)**

Must include:

1. Incorrect code
2. Correct code before validation
3. Correct code after validation (Unlock)

### **C) Report (PDF)**

Must include:

1. **Circuit schematic** with labeled components.
2. **Truth table** for all logic outputs.
3. **Simplified Boolean expressions** for logic outputs.
4. **Simulation screenshots.**

**Due date is January 29, 2026.**

### **Bonus (+25%) — Hardware Implementation**

1. Build the complete circuit on a **breadboard or PCB**.
2. In this case, **two students may work together** on one physical prototype and submit one report.
3. You may use **any student ID** for the group's secret code.
4. **Optional:** Use the **Unlock LED output** to drive a **relay module** with **normally open (NO) contact**.
5. The relay will simulate the lock's opening or activation of an external circuit.
6. Ensure proper **transistor driver**, **base resistor**, and **flyback diode** are included.

## Extra Notes Paper

[illegible]