

Microprocessor Principles and Applications

Final Exam (Hands-on Test)

Name:

Fall 2024

ID:

The exam is 180 minutes long. The total score is 105 pts. Please read questions carefully.

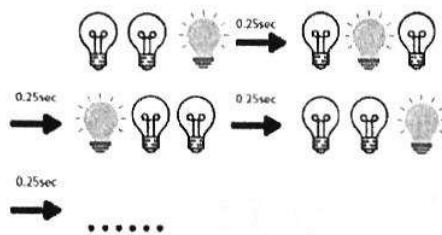
Note: We may change testcases when you demonstrate your programs to us.

● Question 1a (20%)

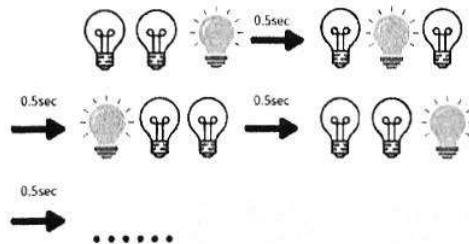
○ Description:

Design a device using three LED and a button, where the LEDs light up sequentially at fixed time intervals. The button can be used to change the time interval settings, with the following states:

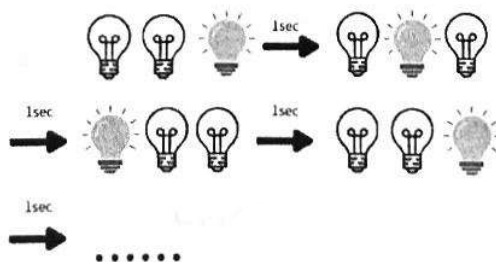
■ State 1: 0.25sec



■ State 2: 0.5sec



■ State 3: 1sec



○ **Flow:**

Start -> State1

Push the button -> State2

Push the button -> State3

Push the button -> State1

.....

● **Question 1b (15%)**

○ **Description:**

Input two numbers via UART, separated by a space, and perform the following actions when a newline is detected.

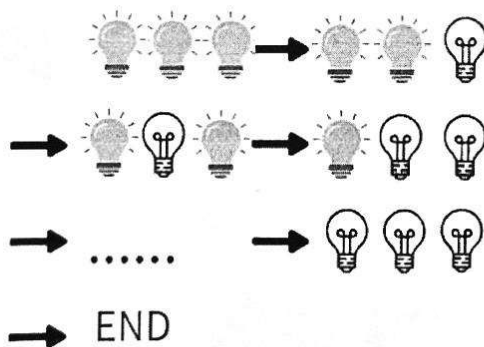
The first number represents the state, ranging from 1 to 3, with each state corresponding to a different time interval. The time interval of each state is the same as in 1a.

The second number represents the countdown starting point, ranging from 1 to 7, and the three LED representing the bits 0 to 2 of a 3-bit binary value, it will count down from 'n' to 0, with the time interval as described above, 'n' means the second input number

○ **For example:**

Input: 2 7

It means counting down from 7 to 0, with the LED changing every 0.5 seconds.



● **Question 2a (20%)**

○ **Description:**

A motor is programmed to operate in two distinct modes of motion:

- Mode 1: The motor rotates continuously from $+90^\circ$ to -90° and then directly reverses to rotate back to $+90^\circ$.
- Mode 2: The motor rotates continuously from $+90^\circ$ to 0° and then directly reverses to rotate back to $+90^\circ$.

The modes are toggled by pressing a button. Upon switching to a mode, the motor should immediately begin operation and execute its respective motion pattern repeatedly.

● **Question 2b (15%)**

○ **Description:**

Utilize a button to control motor rotation according to the following steps:

1. Set the initial position of the motor to X° , and the rotation direction is counterclockwise.
2. When the button is pressed, the motor should rotate 45 degrees.
3. When the button is pressed, the motor should rotate 90 degrees.
4. When the button is pressed, the motor should rotate 180 degrees.
5. Repeat steps 2 through 4.

Besides, once the motor reaches $+90^\circ$ or -90° , the rotation direction will be reversed.

○ **For example:**

If the initial position of the motor is -90° , the angle of the motor will be
 $-90^\circ \rightarrow -45^\circ \rightarrow +45^\circ \rightarrow -45^\circ \rightarrow \dots$

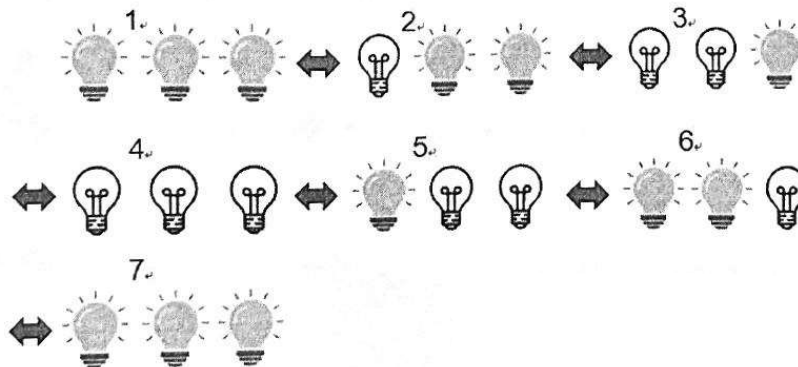
● **Question 3a (20%)**

○ **Description:**

Use a variable resistor and three LEDs to simulate a running light effect. As the variable resistor is rotated, the three LEDs will illuminate in sequence, simulating a 'running light' or 'marquee' effect. The direction of the running light changes based on the rotation of the variable resistor.

○ **For example:**

from Left to Right



● **Question 3b (15%)**

○ **Description:**

Use a variable resistor, three LEDs, and UART. Base on 3a, add two new functions.
 (Function_1 5% 、Function_2 10%)

1. When the LEDs' state changes, use 'L' and 'D' to represent 'light' and 'dark', respectively, and display the result in Putty. For example, if the system transitions to state 2, display

'DLL'. Ensure that each result is displayed on a new line.

2. After inputting an integer X and pressing 'Enter' on the keyboard to confirm it, the state counter will update by adding a buffer such that the new state becomes $(\text{state} + X) \% 7$, where $0 < X < 1,000,000,000$. The variable resistor should remain stationary while inputting the integer X.

○ **For example:**

rotate right -> rotate right -> enter '3' -> rotate right			
Correct	Wrong	Wrong	Wrong
LLL	LLL	LLLDLL	LLL
DLL		DLL
DDL	DLL		DDL
3		3 LLD.....
LLD			
LLL			