

ROB-GY 6103 Advanced Mechatronics: HW 1

Problem 1: Connect an LED to P8 on an Arduino UNO using appropriate resistor. Write two programs to blink the LED at 1Hz using two different methods outlined below. Compare and comment on the differences in flash memory usage while using these two methods.

- Using pinMode(), digitalWrite(), and delay() functions
- Without using pinMode() and digitalWrite() functions, i.e., by directly manipulating the registers. First do the needful in the void setup() function to configure and initialize P8, without altering any other pins on the corresponding port. Next, in the void loop() function use only two lines of code: Line 1-a port manipulation instruction and Line 2- a delay instruction.

Problem 2: Connect 4 LEDs (LED 0,..., LED 3) to digital pins P8 to P11 of Arduino UNO using appropriate resistors. Next, connect 3 push buttons (BTN0,..., BTN2) in active high configuration to pins P5 to P7 of Arduino UNO. Write an Arduino program that simulates the truth tables for AND, OR and XOR gates. First, use BTN0 for toggling between the gates (first press: AND, second press: OR, third press: XOR, ...). Next, use BTN1 and BTN2 for providing inputs (first press: 0, second press: 1). Finally, use LED0, LED1, and LED2 to indicate the logic gate being simulated, and LED3 to show the output.

Problem 3: Connect a button in active high configuration to a digital I/O pin (P2—P12) of an Arduino UNO. Next, write an Arduino program to print the number of button-presses every time the button is pressed. Specifically, write a function that keeps track of the button presses without using any global variable. Use appropriate **variable keyword** to achieve this desired result.

Problem 4: First, connect LED0 and LED1 to pins P8 and P9, respectively, of an Arduino UNO using appropriate resistors. Next, connect a push button in active high configuration to pin P7 of the Arduino UNO. Write an Arduino program where pressing the button toggles between turning LED0 ON/OFF and LED 1 OFF/ON (button not pressed: LED0 ON-LED1 OFF; button pressed: LED0 OFF-LED1 ON). Use a single line of instruction in the loop() function to achieve the above result.

Problem 5: Connect an LED connected to a PWM pin of Arduino UNO and write an Arduino program to make the LED slowly get brighter and then dimmer using compound assignments and the analogWrite() command.

- Start with the LED off
- Make the LED get brighter step by step using x++
- When the LED is at full brightness, make it get dimmer step by step using x--
- Keep repeating this pattern
- Then try making the LED change faster by using += 5 (increases by 5 each time)
- Also try quickly cutting the LED brightness in half (>>=) or doubling it (<<=)

Problem 6: Create an Arduino program that uses bitwise operations to efficiently control an 8-bit shift register. Create a byte-sized variable to represent the shift register. Next, your program should:

- Set bits 0, 3, and 6 to HIGH
- Toggle bit 4 every second
- Clear bits 2 and 5 without affecting other bits

Properly comment your program explaining each bitwise operation used.

Problem 7: Create an Arduino program that launches a serial terminal (console) to ask for and receive from a user command characters “H” and “L” to turn ON and OFF, respectively, an LED connected to a digital I/O pin (P2—P12) of an Arduino UNO. The program should also respond on the serial console with a message “ON” and “OFF” when the LED is turned ON and OFF, respectively.