EXPERIMENT 3

A. Addition of two 8-bit data

```
ORG 0000H        ; Set the starting address to 0000H
MOV A,30H        ; Move the value from memory location 30H into accumulator A
MOV B,31H        ; Move the value from memory location 31H into register B
ADD A,B          ; Add the contents of register B to the value in accumulator A. Result gets stored in A
MOV 32H,A        ; Store the result of the addition (SUM) into memory location 32H
JNC SKIP         ; If no carry occurs (CY=0), Jump to the label SKIP
MOV A,#01H       ; If carry occurs (CY=1), load the immediate value 01H into accumulator A
SJMP STOP        ; Unconditionally jump to the label STOP to terminate further processing
SKIP: MOV A,#00H  ; At label SKIP, load the immediate value 00H into accumulator A (no carry case)
STOP: MOV 33H,A  ; At label STOP, store the value of CARRY (either 00H or 01H) into memory location 33H
SJMP $           ; Infinite loop to stop program execution
END              ; End of the program
```

EXPERIMENT 3

B. Subtraction of two 8-bit data

```
ORG 0000H        ; Set the starting address to 0000H
MOV A,40H        ; Load the value from memory location 40H into accumulator A
MOV B,41H        ; Load the value from memory location 41H into register B
CLR C            ; Clear the carry flag (ensure no borrow occurs initially)
SUBB A,B         ; Subtract the contents of register B from A
MOV 42H,A        ; Store the result of the subtraction (DIFFERENCE) into memory location 42H
JNC SKIP         ; If no borrow occurs (CY=0), jump to the label SKIP
MOV A,#01H       ; If a borrow occurs (CY=1), load the immediate value 01H into accumulator A
SJMP STOP        ; Unconditionally jump to the label STOP to terminate further processing
SKIP: MOV A,#00H ; At label SKIP, load the immediate value 00H into accumulator A (no borrow case)
STOP: MOV 43H,A  ; At label STOP, store the value of BORROW (either 00H or 01H) into memory location 43H
SJMP $           ; Infinite loop to stop program execution (halts at the STOP label)
END              ; End of the program
```

EXPERIMENT 3

C. Multiplication of two 8-bit data

```
ORG 0000H     ; Set the starting address to 0000H
MOV A,50H     ; Load the value from memory location 50H into accumulator A
MOV B,51H     ; Load the value from memory location 51H into register B
MUL AB        ; Multiply the contents of A and B (A * B) and stored in A (lower byte) and B (higher byte).
MOV 52H,A     ; Store the lower byte of the multiplication result (from A) into memory location 52H
MOV 53H,B     ; Store the higher byte of the multiplication result (from B) into memory location 53H
SJMP $        ; Infinite loop to stop program execution (halts at this line)
END           ; End of the program
```

EXPERIMENT 3

D. Multiplication of two 8-bit data

```
ORG 0000H     ; Set the starting address to 0000H
MOV A,60H     ; Load the value from memory location 60H into accumulator A (dividend)
MOV B,61H     ; Load the value from memory location 61H into register B (divisor)
DIV AB        ; Perform division: divide the value in A by the value in B and quotient is stored in A, and the
               remainder is stored in B
MOV 62H,A     ; Store the quotient (result of division) from A into memory location 62H
MOV 63H,B     ; Store the remainder from B into memory location 63H
SJMP $        ; Infinite loop to stop program execution (halts here)
END           ; End of the program
```

EXPERIMENT 4

A. Interfacing of Switch and LED

```
#include <AT89S52.h>    // Include the header file for the AT89S52 microcontroller
#define SW P3_2          // Define SW as the pin P3.2, which acts as the switch input
#define LED P2_0         // Define LED as the pin P2.0, which controls the LED output

void main()
{
 SW = 1;                 // Set the switch pin (SW) to high (inactive state in a pull-up configuration)
 LED = 1;                 // Turn OFF the LED initially (assuming active-low LED configuration)
 while(1)                // Create an infinite loop to continuously check the switch state
 {
  if(SW == 0)            // Check if the switch is pressed (SW is active-low)
  {
   LED = 0;              // Turn ON the LED (active-low)
  }
  else                   // If the switch is not pressed
 {
  LED = 1;               // Turn OFF the LED (active-low)
 }
 }
}
```

EXPERIMENT 4

B. Interfacing of RGB LED

```
#include <AT89S52.h>              // Include the header file for the AT89S52 microcontroller
#define RLED P0_0                 // Define RLED as the pin P0.0, which controls the Red LED
#define GLED P0_1                 // Define GLED as the pin P0.1, which controls the Green LED
#define BLED P0_2                 // Define BLED as the pin P0.2, which controls the Blue LED

void delay(int c)                 // Function to introduce a delay
{
 int i, j;                        // Loop control variables
 for(i = 0; i < c; i++)            // Outer loop to control the delay duration
 {
  for(j = 0; j < 1275; j++)       // Inner loop to introduce a smaller time delay
  {}                              // Empty loop body used only for creating a time delay
 }
}

void main()
{
 RLED = 0; GLED = 0; BLED = 0;    // Turn OFF the Red LED, Green LED & Blue LED initially
 while(1)                         // Infinite loop to cycle through LED states
 {
  RLED = 0; GLED = 0; BLED = 0;   // Turn ON the Red LED and Ensure the Green LED & Blue LED is OFF
  delay(100);                     // Keep the Red LED on for some time
  RLED = 0; GLED = 0; BLED = 0;   // Turn ON the Green LED and Ensure the Red LED & Blue LED is OFF
  delay(100);                     // Keep the red LED on for some time
  RLED = 0; GLED = 0; BLED = 0;   // Turn ON the Blue LED and Ensure the Red LED & Green LED is OFF
  delay(100);                     // Keep the red LED on for some time
 }
}
```

EXPERIMENT 4

C. Interfacing of Buzzer

```
#include <AT89S52.h>              // Include the header file for the AT89S52 microcontroller
#define BUZZER P0_3               // Define BUZZER as the pin P0.3, which controls the buzzer output

void delay(int c)                 // Function for creating a delay
{
  int i, j;                       // Declare loop variables
  for(i = 0; i < c; i++)          // Outer loop to control the overall delay duration
  {
   for(j = 0; j < 1275; j++)      // Inner loop to create a smaller unit of delay
   { }                            // Empty loop body - used purely for time delay
  }
}

void main()
{
  BUZZER = 0;                     // Initialize the buzzer pin to low (buzzer off)

 while(1)                         // Infinite loop to continuously toggle the buzzer
 {
  BUZZER = 1;                     // Turn on the buzzer
  delay(100);                      // Call the delay function to keep the buzzer ON for some time
  BUZZER = 0;                     // Turn off the buzzer
  delay(100);                     // Call the delay function to keep the buzzer OFF for some time
 }
}
```

EXPERIMENT 5

Microcontroller "A" - Transmitter

```
#include <AT89S52.h>              // Include the header file for the AT89S52 microcontroller
#define SW P3_2                   // Define SW as the pin P3.2, which acts as an external switch input

// Define a data array containing hexadecimal values and a terminator ('$')
char data[] = {0x11, 0x22, 0x33, 0x44, 0x55, 0x66, 0x77, 0x88, 0x99, 0xAA, 0xBB, 0xCC, 0xDD, 0xEE, 0xFF, '$'};
char *ptr;          // Pointer to traverse through the data array
char count = 0;  // Counter variable (unused in this code)

void delay(int c)// Function to create a delay
{
 int i, j;             // Loop control variables
 for (i = 0; i < c; i++)      // Outer loop for total delay duration
 {
  for (j = 0; j < 250; j++)    // Inner loop to create a smaller unit of delay
  { }                          // Empty loop body to generate the delay
 }
}

void main()
{
 ptr = &data[0];              // Initialize the pointer to point to the start of the data array
 SW = 1;                      // Initialize the switch (SW) in its idle state (high level)
 SCON = 0x40;                 // Configure the Serial Control register for mode 1 (8-bit UART, variable baud rate)
 TR1 = 0;                     // Stop timer 1 (ensure it is not running initially)
 TMOD = 0x20;                 // Configure Timer 1 in mode 2 (8-bit auto-reload mode)
 TH1 = 0xFD;                  // Set reload value for Timer 1 to generate baud rate of 9600
 TL1 = 0xFD;                  // Load the same value into TL1 for initial operation
 TR1 = 1;                     // Start Timer 1 to enable baud rate generation
 IE = 0x90;                   // Enable interrupts: Enable serial interrupt and global interrupt
 SBUF = 0x00;                 // Initialize the Serial Buffer register with 0
 while (1);                   // Infinite loop to wait for interrupts
}
```

Microcontroller "A" - Serial Interrupt Service Routine (ISR)

```
void serial_isr(void) __interrupt(4)        // Interrupt vector 4 is dedicated to serial communication
{
 TI = 0;              // Clear the Transmit Interrupt flag
 while (SW == 1);          // Wait until the switch (SW) is pressed (active low)
 delay(1);                 // Debounce delay
 while (SW == 0);          // Wait until the switch (SW) is released (active high)
 if (*ptr != '$')          // If the current character in the data array is not the terminator ('$')
 {
  SBUF = *ptr;             // Load the current character into the Serial Buffer register for transmission
  *ptr++;                  // Move the pointer to the next character in the array
 }
 else                      // If the terminator ('$') is reached
 {
  ptr = &data[0];          // Reset the pointer to the start of the data array
  SBUF = 0x00;             // Transmit a NULL character (end of transmission)
 }
}
```

Microcontroller “B” - Receiver

```
#include <AT89S52.h>    // Include the header file for the AT89S52 microcontroller
#define LED P0          // Define LED as Port P0, which is connected to the LEDs

void main()
{
 LED = 0xFF;            // Initialize all LEDs to off (assuming active-low configuration)
 SCON = 0x50;           // Configure the Serial Control register for mode 1 (8-bit UART, variable baud rate)
 TR1 = 0;               // Stop Timer 1 initially
 TMOD = 0x20;           // Configure Timer 1 in mode 2 (8-bit auto-reload mode)
 TH1 = 0xFD;            // Set the reload value for Timer 1 to generate a baud rate of 9600
 TL1 = 0xFD;            // Load the same value into TL1 for initial operation
 TR1 = 1;               // Start Timer 1 to enable baud rate generation
 IE = 0x90;             // Enable interrupts (serial interrupt and global interrupt)
 while (1);             // Infinite loop; program runs indefinitely, waiting for interrupts
}
```

Microcontroller “B” - Serial Interrupt Service Routine (ISR)

```
void serial_isr(void) __interrupt(4)        // Interrupt vector 4 is dedicated to serial communication
{
 RI = 0;                // Clear the Receive Interrupt flag
 LED = ~SBUF;           // Invert the received byte (SBUF) and write it to 8-bit LED Array
}
```

EXPERIMENT 6

A. Interfacing of Stepper Motor – FULL STEP SEQUENCE

```
#include <AT89S52.h>              // Include the header file for the AT89S52 microcontroller
#define STEPPER_MOTOR P0          // Define STEPPER_MOTOR as the port P0, which controls the stepper motor

void delay(int c)                 // Function for creating a delay
{
 int i, j;                        // Declare loop variables
 for(i = 0; i < c; i++)           // Outer loop to control the total delay duration
 {
  for(j = 0; j < 250; j++)        // Inner loop to create a smaller unit of delay
  { }                             // Empty loop body - used solely to create a time delay
 }
}

void main()
{
 char pattern = 0x88;             // Initialize pattern for stepper motor. 0x88 represents the initial step position.
 STEPPER_MOTOR = 0x00;            // Set all pins of STEPPER_MOTOR to low (motor off initially)
 while(1)                         // Infinite loop to rotate the stepper motor continuously
 {
  STEPPER_MOTOR = pattern;        // Send the current pattern to the stepper motor port to activate specific coils
  delay(1);                       // Wait for a short time to allow the stepper motor to complete the step
  pattern = (pattern >> 1) | (pattern << 7);          // Rotate the bit pattern to activate successive coils
 }
}
```

EXPERIMENT 6

B. Interfacing of Stepper Motor – HALF STEP SEQUENCE

```
#include <AT89S52.h>            // Include the header file for the AT89S52 microcontroller
#define STEPPER_MOTOR P0        // Define STEPPER_MOTOR as port P0, which is connected to the stepper motor

void delay(int c)               // Function for creating a delay
{
 int i, j;                      // Declare loop variables
 for(i = 0; i < c; i++)         // Outer loop to control the total delay duration
 {
  for(j = 0; j < 250; j++)      // Inner loop to create a smaller unit of delay
  { }                           // Empty loop body - used solely to create a time delay
 }
}

void main()
{
 char pattern[9] = {0x08, 0x0C, 0x04, 0x06, 0x02, 0x03, 0x01, 0x09};      // Define the stepping pattern
  STEPPER_MOTOR = 0x00;         // Initialize the motor port to low (motor off initially)

 while(1)                       // Infinite loop to drive the stepper motor continuously
 {
  char k;                       // Declare a loop control variable for iterating through the pattern
  for(k = 0; k < 8; k++)        // Loop through all 8 patterns to complete one rotation cycle
  {
   STEPPER_MOTOR = pattern[k];          // Send the current pattern to the motor port to activate specific coils
   delay(1);                            // Wait briefly to allow the motor to complete the step
  }
 }
}
```