

Microprocessors and Microcontrollers (EE-231)

Lab-10

Objective

- Serial RX Communication in C
 - In Proteus
 - On 8051 development board

Serial Data Receiving

- In receiving bit via its RxD pin, 8051 goes through the following steps
 1. It receives the start bit, indicating that the next bit is the first bit of the character byte
 2. The 8-bit character is received one bit at time
 3. The stop bit is received
 4. When receiving the stop bit 8051 makes RI high (1), indicating that an entire character byte has been received and must be picked up before it gets overwritten by another incoming character
 5. By checking the RI flag bit when it is raised, we know that a character has been received and is sitting in the SBUF register
 6. We copy the SBUF contents to a safe place in some other register or memory before it is lost
 7. After the SBUF contents are copied into a safe place, the RI flag bit must be forced to 0

Programming Serial Data Receiving

- Follow these Steps
 1. TMOD register is loaded with the value 20H, indicating the use of timer 1 in mode 2 (8-bit auto-reload) to set baud rate
 2. TH1 is loaded to set baud rate
 3. The SCON register is loaded with the value 50H, indicating serial mode 1, where an 8-bit data is framed with start and stop bits
 4. TR1 is set to 1 to start timer 1 (**TR1=1**)
 5. RI is cleared (**RI=0**)
 6. The RI flag bit is monitored with the use of instruction **while(RI==0);** to see if an entire character has been received yet
 7. When RI is raised, SBUF has the byte. We move its contents to a safe place
 8. To receive the next character, go to step 5

Serial Data Receiving

Note that.....,

- By checking the RI flag bit, we know whether or not the 8051 received a
- character byte
- If we failed to copy SBUF into a safe place, we risk the loss of the received byte
- It must be noted that RI flag bit **is raised automatically by 8051** when it finish receive data
- It must be cleared by the programmer with instruction **RI=0;**
- If we copy SBUF into a safe place **before** the RI flag bit is raised, we risk copying garbage

Serial Data Receiving

- The RI bit can be monitored by
 1. The instruction (Today's Lab)
`while(RI==0);`
 2. Using an interrupt (Coming Lab)

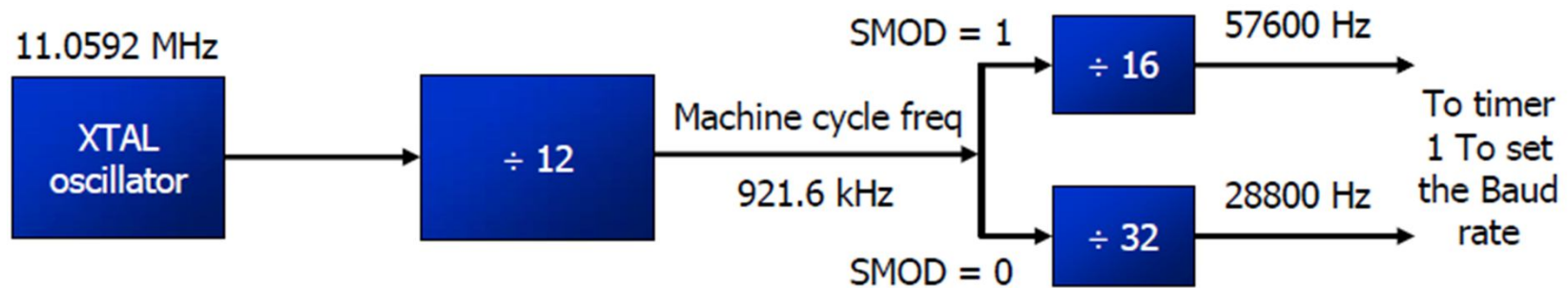
Doubling Baud rate

- There are two ways to increase the baud rate of data transfer
- To use a higher frequency crystal (Hardware way)
- To change a bit in the **PCON** register (Software way)
- **PCON** register is an 8-bit register
- When 8051 is powered up, **SMOD** is zero
- We can set it to high by software and thereby double the baud rate



- PCON is not bit-addressable, so how would you change its single bit ?
- $PCON = PCON \mid 0x80$ (80H = 10000000)

Doubling Baud rate



Baud Rate comparison for SMOD=0 and SMOD=1

TH1	(Decimal)	(Hex)	SMOD=0	SMOD=1
-3		FD	9600	19200
-6		FA	4800	9600
-12		F4	2400	4800
-24		E8	1200	2400

RX Programming

Example 10-17

Program the 8051 in C to receive bytes of data serially and put them in P1. Set the baud rate at 4800, 8-bit data, and 1 stop bit.

Solution:

```
#include <reg51.h>
void main(void) {
    unsigned char mybyte;
    TMOD=0x20;           //use Timer 1, mode 2
    TH1=0xFA;           //4800 baud rate
    SCON=0x50;
    TR1=1;              //start timer
    while (1) {         //repeat forever
        while (RI==0); //wait to receive
        mybyte=SBUF;    //save value
        P1=mybyte;     //write value to port
        RI=0;
    }
}
```

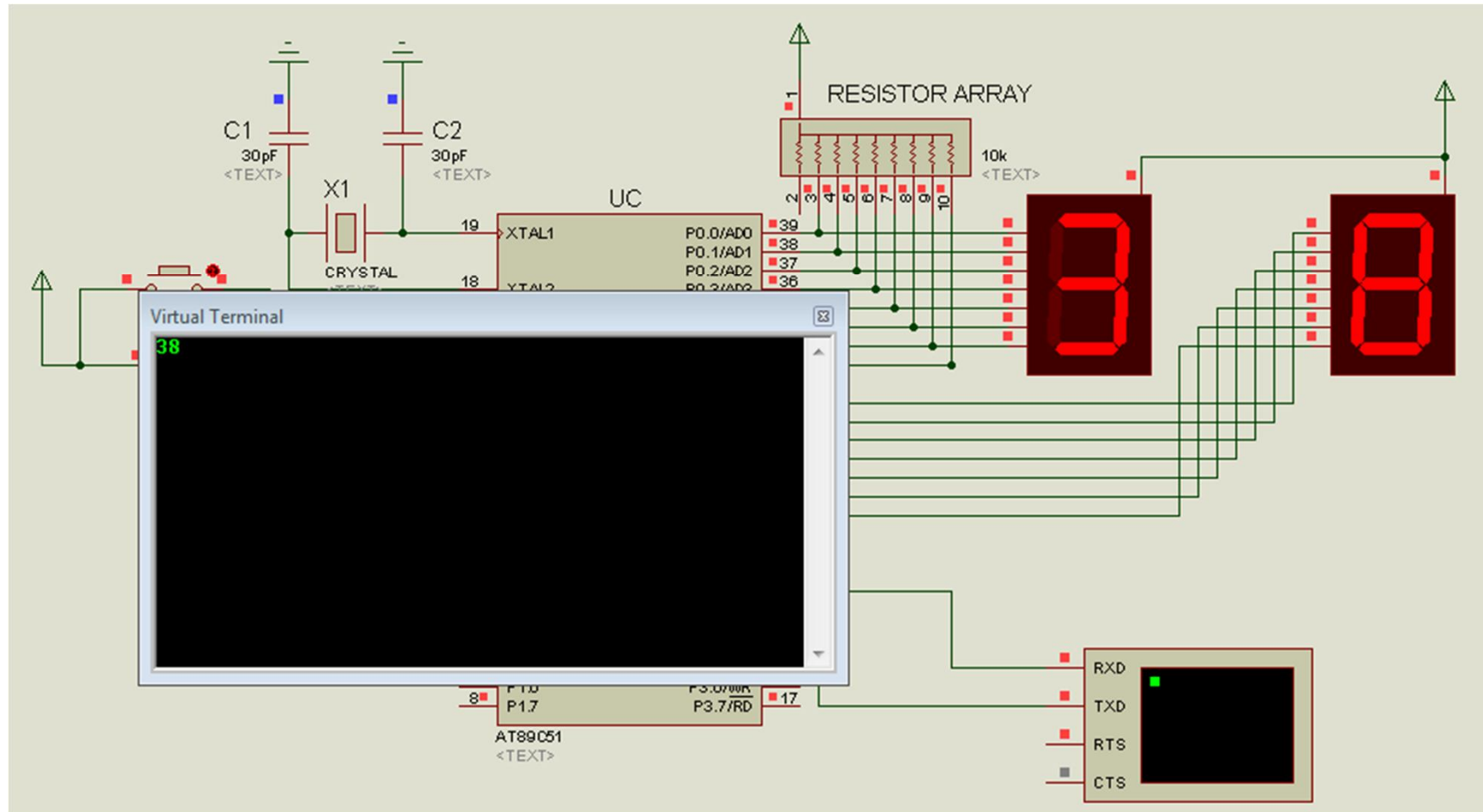
Today's Task 1

- Implement this in Proteus.
- Receive a Byte of data from virtual terminal.
- Display its half nibble on one Seven Segment connected to P0, and display its other nibble on the second Seven Segment connected to P2.

Task Code

```
1  #include <reg51.h>
2
3  void main(void) {
4      unsigned char x;
5      unsigned char Lookup[]={0xC0,0xF9,0xA4,0xB0,0x99,0x92,
6      0x82,0xF8,0x80,0x90,0xA0,0x83,0xA7,0xA1,0x84,0x8E};
7      TMOD=0x20; //use Timer 1, mode 2
8      TH1=-6; //4800 baud rate
9      SCON=0x50;
10     PCON=PCON | 0x80;//Double the baudrate i.e. 9600
11     TR1=1;
12     while(1)
13     {
14         while (RI==0);
15         x=SBUF;
16         RI=0;
17
18         ACC=x & 0x0F;
19         P2=Lookup[ACC];
20
21         ACC=x>>4;
22         P0=Lookup[ACC];
23     }
24 }
```

Proteus Simulation



Today's Task 2

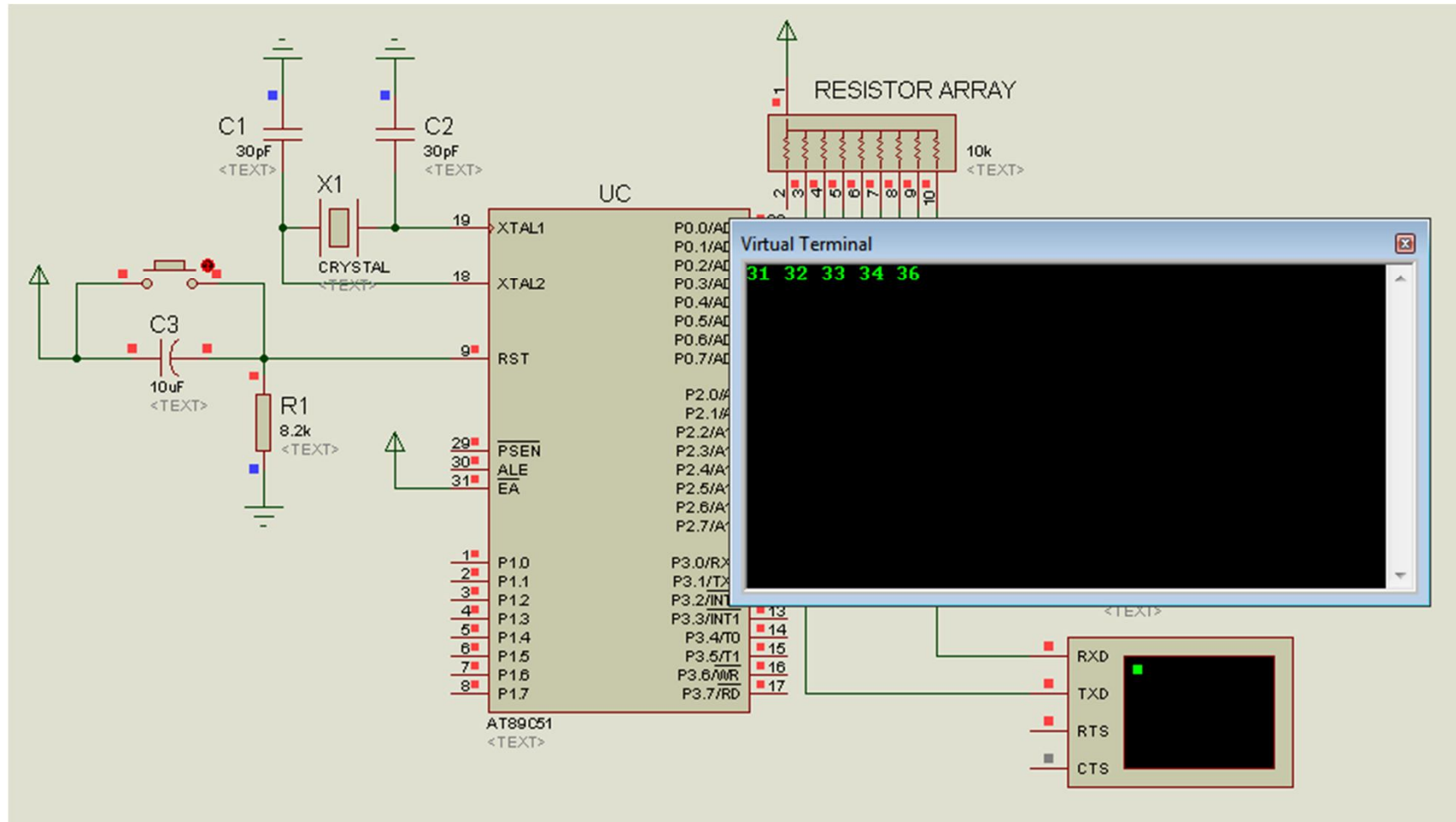
- Send **four** bytes of data from PC to 8051. The 8051 should calculate its **checksum byte** and then send it back to PC after calculating. Use **SMOD** to double the baud rate.
- There is no need to perform the verification. You know why?



Task Code

```
1 #include <reg51.h>
2 unsigned char RX(void);
3 void TX(unsigned char);
4 void main(void) {
5     unsigned char x,Checksum;
6     TMOD=0x20; //use Timer 1, mode 2
7     TH1=-6; //4800 baud rate
8     SCON=0x50;
9     PCON=PCON | 0x80;//Double the baudrate i.e. 9600
10    TR1=1;
11    //First Receive Data
12    Checksum=0;
13    for (x=0;x<4;x++)
14    {
15        Checksum=RX()+Checksum;
16    }
17    Checksum=~Checksum+1;
18    //Now send CheckSum
19    TX(Checksum);
20 }//*****End of Main Function*****//
21 unsigned char RX(void)
22 {
23     while (RI==0);
24     RI=0;
25     return SBUF;
26 }//*****End of RX Function*****//
27 void TX(unsigned char mydata)
28 {
29     SBUF=mydata;
30     while (TI==0);
31     TI=0;
32 }//*****End of TX Function*****//
```

Proteus Simulation



Today's Task 3

- Send a Phrase of about **less than** 30 characters to 8051 from your PC. Your 8051 should first receive it and store it in an array. And send it back in the **reverse order**. Use . (full stop) as the **end of string** character i.e. when 8051 receives a full stop it will stop receiving and start sending the stored data in reverse order.

- For example

Received by 8051 (sent by PC) : Hello Friend.

Sent back by 8051 (received by PC): .dneirF olleH

Task 3 Code

```
1 #include <reg51.h>
2 unsigned char RX(void);
3 void TX(unsigned char);
4 void main(void) {
5     unsigned char Mystring[30];
6     unsigned char x,y;
7     TMOD=0x20; //use Timer 1, mode 2
8     TH1=-6; //4800 baud rate
9     SCON=0x50;
10    PCON=PCON | 0x80;//Double the baudrate i.e. 9600
11    TR1=1;
12    //First Receive Data
13    for (x=0;x<30;x++)
14        {
15        Mystring[x]=RX();
16        if(Mystring[x]=='.')
17            break;
18        }
19    //Now send it backwards
20    for (y=x;y>0;y--)
21        TX(Mystring[y-1]);
22 }//*****End of Main Function*****//
23 unsigned char RX(void)
24 {
25 while (RI==0);
26 RI=0;
27 return SBUF;
28 }//*****End of RX Function*****//
29 void TX(unsigned char mydata)
30 {
31 SBUF=mydata;
32 while (TI==0);
33 TI=0;
34 }//*****End of TX Function*****//
```

Proteus Simulation

