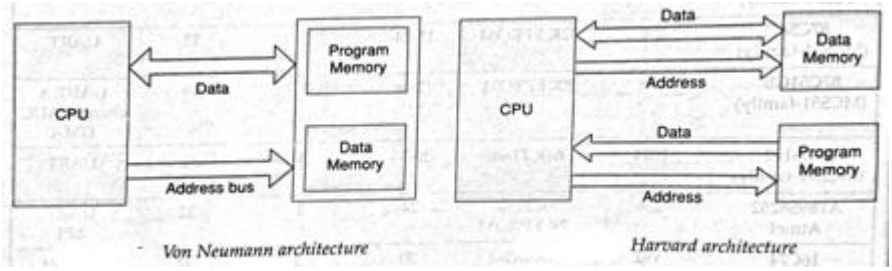
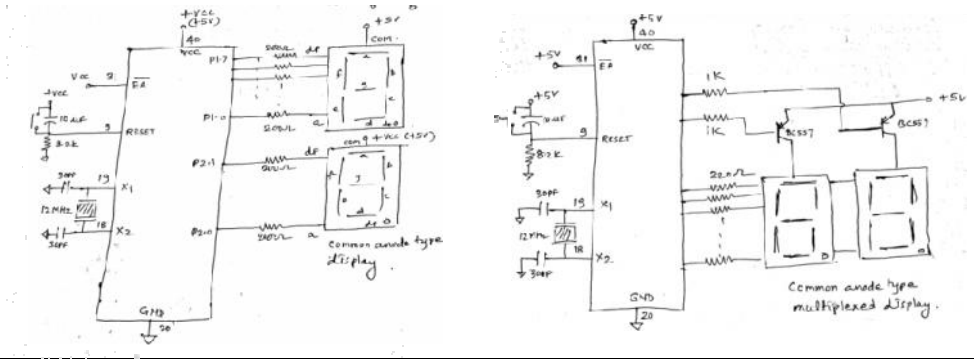
Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q1-A. Atempt any Three :	**12**
i) Draw the block diagram of Von-Neumann and Harvard architectures	**4** **2+2**



ii) Draw the interfacing of two seven segment display with 8051 microcontroller.	**4**



iii) Wri te C language program for 8051 microcontroller to toggle all 8 lines of port 0 with delay.	**4**

```
#include <REG51.H>
void delay(void);
void main(void)
{
    while(1)
    {
            P0= 0xaa;
            delay();
            P0 =0x55;
            delay();
    }
}
```

```
void delay(void)
{
    unsigned int count;
    for(count =0;count<1000;count++);
}
```

iv) Describe the function of PC and DPTR **4**

PC: Program counter **2+2**

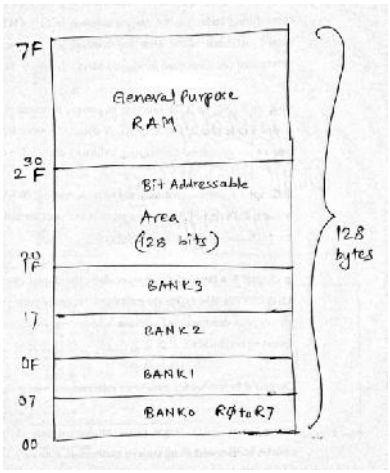
It is a 16 bit register in 8051. It points to the address of the next instruction to be executed. As the cpu fetches the opcode, contents of PC are incremented to point to next opcode fetch location. PC is not part of any instruction in 8051.

DPTR: Data Pointer

It is a 16 bit register. It is used to hold address of the internal and external program memeory and external data memory. It consists of two 8 bit registers: DPH(high order byte) and DPL(low order byte)

Q1 B) Attempt any one **6**

i) Draw and describe the internal RAM memory organisation of 8051 microcontroller **4+2**



The internal RAM of 8051 is of 128 bytes (00-7F). It is divided in following sections:

1) Four register banks: Each register bank has eight registers(R0-R7) of 8bits each. Any one register bank is active at a given time. A register bank can be selected by using RS0,RS1 registers in PSW register.
2) Bit addressable memory area: Memory address 20H-2FH is called as bit addrresable memory. There are 128 addressable bits. The bit address ranges from 00H-7FH.
3) General purpose area: Memory address 30H to 7FH is general purpose scratch pad area of the RAM. This area is used to store temporary variables, for initializing stack pointer etc.

ii) Write an assembly language program to find largest number out of five numbers. Data is stored in internal RAM memory location 10 H onwards. Store the result at 20 H. (Credit to any suitable and logical program) **6**

```
        ORG  0000h
        LJMP MAIN
        ORG 0030H
MAIN:   MOV R0,#10h     ; intialize start address
        MOV R1,#05h     ; init counter to 5
        MOV 0F0H,#00H  ;initialize B reg as largest
LOOP:   MOV A,@R0       ; transfer data to acc
        CJNE A,0F0H,CHK ; compare with B register
        SJMP SKIP       ; if equal do nothing
CHK:    JC SKIP         ; if less do nothing
        MOV 0F0H,0E0H   ;if ACC is greater then transfer to B
SKIP:   INC R0          ;point to next address
        DJNZ R1,LOOP    ; decr r1 and loop back
        MOV 20H,0F0H    ;transfer largest to 20h
        END
```

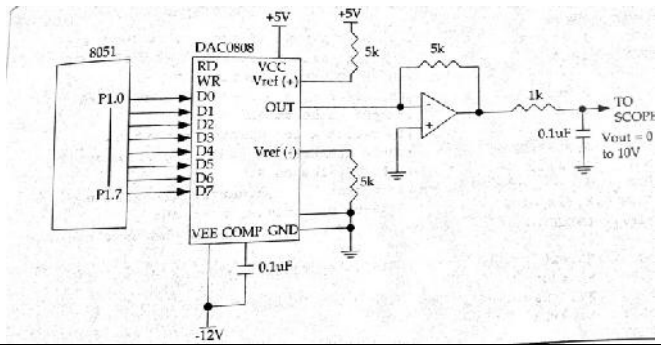
Q2. Attempt any two:	**16**
a. Describe the addressing modes of 8051 microcontroller with one example.	**8**

1 each

1) **Immediate addressing** mode: Data is provided as part of the instruction. The data follows the instruction opcode
   Example: MOV A,#0AH
2) **Register addressing** mode: It involves use of registers to hold the data.
   Example: MOV A,R0
3) **Direct adrresing** mode: 8 bit direct address of the internal RAM of 8051 is specified in the instruction.
   Example: MOV A, 40H
4) **Indirect addressing** mode: It uses registers to hold the address of the memory location to access. Registers R0, R1 are used to point to internal memory and DPTR is used to point to external data memory.
   Example: MOV A, @R0, MOVX A, @DPTR
5) **Indexed addressing** mode: It uses 16bit registers PC and DPTR to hold the base address. And accumulator to hold the offset which is relative to the base address.
   Example: MOVC A,@A+DPTR
6) **Relative addresing Mode:** It is used with conditional jump instructions.
   Example: SJMP NEXT (NEXT is calculated relative to preset location)
7) **Absolute Adressing mode:** It is used by ACALL and AJMP instructions. They are two byte instructions with 11bit address specified in instruction opcode. The upper 5 bits are taken from PC. It can branch to anywhere in 2Kbyte page of the program memory. Example: ACALL LOOP1
8) **Long addressing mode:** It is used by LCALL LJMP instruction. These are 3 byte instructions in which 16 bit direct address is specified. It can jump any where in the entire 64K program memory.
   Example: LJMP MAIN

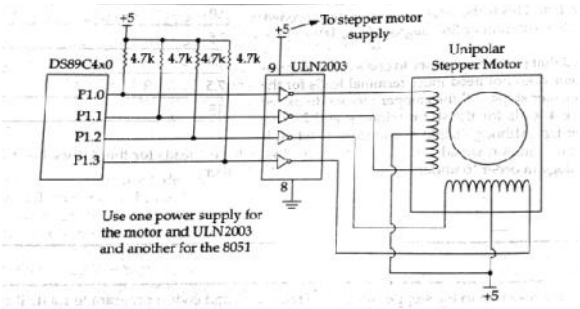
b. Draw the interfacing of DAC 0808 with 8051 microcontroller. Write C language program to generate triangular waveform by using DAC 0808.	**8**

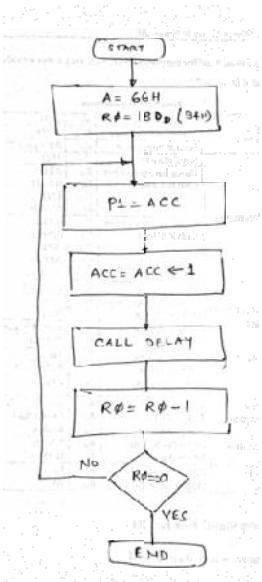
4+4



```
/* Program to generate triangular wave */
#include <REG51.H>
sfr DACDATA = P1;
void main(void)
{
    unsigned char wavevalue[12] = { 0, 8,16,32,64,128,255,128,64,32,16,8};
    unsigned char x;
    while(1)
    {
        for(x=0;x<12;x++)
        {
            DACDATA = wavevalue[x];
        }
    }
}
```

c. Draw the interfacing of stepper motor with 8051 microcontroller. Draw a flow chart to rotate stepper motor through 360° in anticlock wise direction. **8** **4+4**





Assume that :

The stepper motor is uniploar type. The four leads of motor are controlled by P1.0 to P1.3 of 8051.

Motor Step angle = 2^0

Steps per revolution = 180

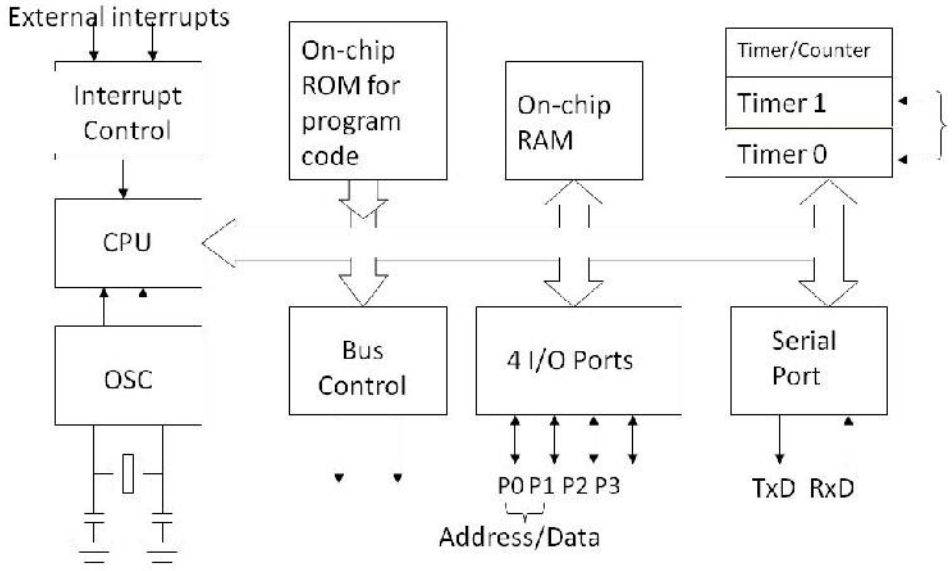
Four step sequence for anticlock wise movment as shown in folllwing table:

Step	A	B	C	D
1	0	0	1	1
2	0	1	1	0
3	1	1	0	0
4	1	0	0	1

One four step sequence = 8^0.

No of four step sequneces required for 360^0 = 45 i.e. 180 steps

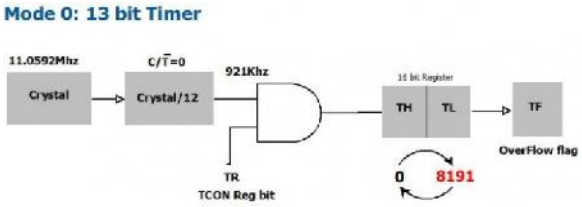
Q3. Attempt any Four	**16**
a. Draw the block diagram of internal architecture of 8051 microcontroller.	**4**



b. Describe the four timer modes of8051 microcontroller with suitable diagram. **4**

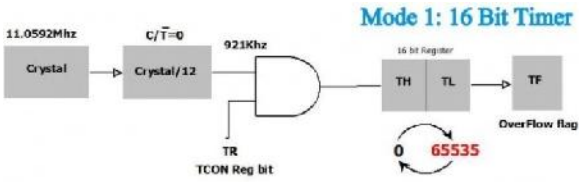
1 each

Timer mode 0: 13 bit timer mode



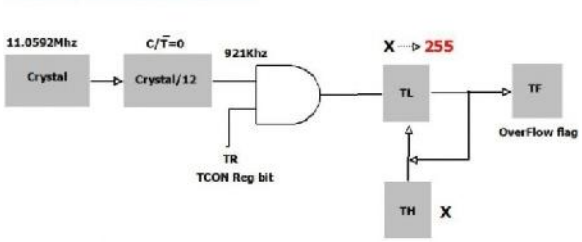
Internla clock pulses are counted by (THx-8bits and TLx-5bits). When the count rolls over to 0 after 8191 counts (2^{13}), TFx bit is set.

Timer mode 1: 16 bit timer mode



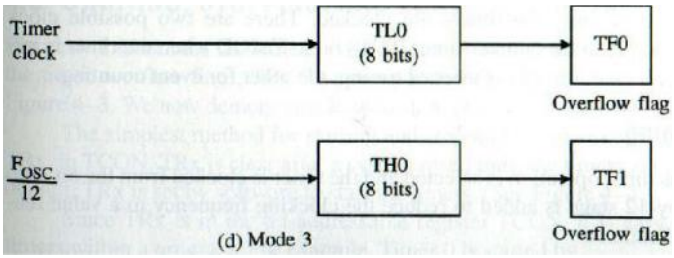
Internal clock pulses are counted by (THx-8bits and TLx-8bits). When the count rolls over to 0 after 65535 counts (2^{16}), TFx bit is set.

Timer mode 2: 8 bit auto reload mode



TLx acts as 8 bit timer. The reload value is stored in THx register. When TLx register rolls over from FF to 0, the reload value stored in THx is loaded into TLx register.

Timer Mode 3: split timer mode



Splits Timer 0 into two 8-bit timers
- TL0 sets TF0
- TH0 sets TF1

c. Wri le C language program for 8051 microcontroller to read data from port 1 and send it to port 3. **4**

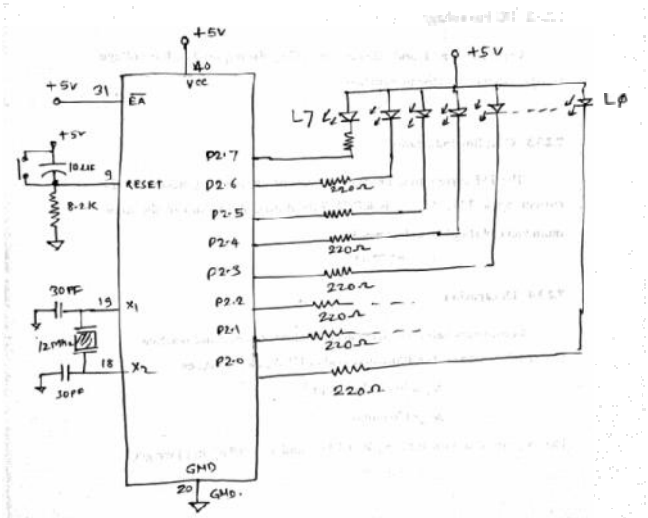
```
#include <REG51.H>

void main(void)
{
        Unsigned char portdata;
        While(1)
        {
                portdata = P1;
                P3 = portdata;
        }
}
```

d. Distinguish between microprocessor and microcontroller (any four points). **4**

Micoprocessor	Micocontroller
A mircoprocessor does not have on-chip memory	Has program as well as data memory on-chip
A microprocessor does not have on-chip timer, I/O ports	Timers, I/O ports, serial ports are on-chip.
It is mainly used for computing purpose.	Use of microcontroller is for mainly for device control.
Memeory and other peripheral deveices need to be connected externally to make complete computer	It is a computer on-chip with small computing power required for device control
Cost of the system is higher as compared to microcontroller .	Results into a cheaper solution for the given application
Circuit size becomes larger.	Small circuit size

e. Draw the interfacing of 8 LEDs to port 2 of8051 microcontroller. Write C language program to (turn ON and OFF LEDs of port 2 with delay.	**4** **2+2**

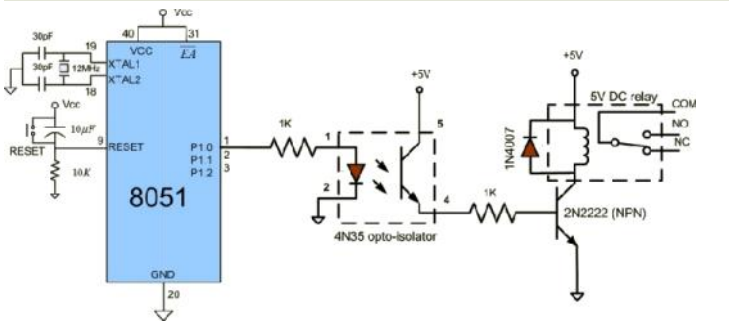



```
#include <REG51.H>

void delay(void);
void main(void)
{
        while(1)
        {
                P2 = 0xff;
                delay();
                P2 = 0x00;
                delay();
        }
}

void delay(void)
{
        unsigned int cnt;
        for(cnt=0;cnt<2000;cnt++);
}
```

4. A) Attempt any three:	**12**
i) Draw the interfacing of relay and optoisolatorwith 8051 microcontroller	**4**



ii) What is bus ? Describe the function of address, data and control bus. **Bus is bunch of wires running from one device to other** for communicating information. **Address Bus:** It holds binary address of the device connected in system. **Data Bus:** It carries data from device toCPU or vice versa **Control Bus:** It carries control signals such as clock signals, chip select signals, Read/Write signals, interrrupt request signals	**4**

iii) Write the instruction for following using C operator: **4**

a) Bit wise shift data left 4 times. **2+2**

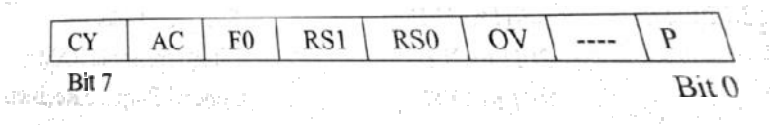
b) Bit wise shift data right 4 times.

```
unsigned char x,y;

x = y<<4;   //left shift 4 times

x = y>>4;  //right shift 4 times
```

iv) Draw the format of PS W register of8051 microcontroller and describe the function of any two flags. **4**



Parity Flag: It is set when number of 1s in ACC are odd and reset when number of 1s are even

Carry Flag: This flag is set whenever there is a carry out from the D7 bit. This flag bit is affected after an 8-bit addition or subtraction. It can be also set or reset by using SETB C, CLR C instructions.

Auxiliary carry flag: If there is a carry from D3 to D4 during an ADD or SUB operation, this bit is set; otherwise, it is cleared.

OV flag: It is overflow flag. It is set when there is carry from D6 to D7 but no carry from D7 or carry from D7 but no carry from D6 to D7.

B. Attempt any one: **6**

i) Write an assembly language program for 8051 microcontroller to find average of ten 8-bit numbers stored in internal RAM location 20 H onwards. Store the result at 30 H. **6**

```
        ORG 0000h
        LJMP MAIN
        ORG 0030H
MAIN:   MOV R1,#0AH     ;LOAD COUNTER OF 10
        MOV R0,#20H
        XRA A           ; CLEAR ACC AND CY FLAG
NEXT:   ADD A,@R0       ;ADD NUMBAR TO ACC AND STORE SUM IN ACC
        INC R0
        DJNZ R1,NEXT
        MOV B,#0AH
        DIV A,B
        MOV 30H,A
        RET
```

ii) Draw the format of TMOD register of 8051 microcontroller. Describe the function of each bit. **6**

3+3

(MSB) (LSB)

GATE	C/T	M1	M0	GATE	C/T	M1	M0
Timer 1				Timer 0			

TMOD register is divided in two sections lower 4 bits are for timer T0 and upper 4 bits are for timer T1

GATE: Gating control when set. Timer/counter is enabled only while the INTx pin is high and the TRx control pin is set. When cleared, the timer is enabled whenever the TRx control bit is set.

C/T : Timer or counter selected cleared for timer operation (input from internal system clock). Set for counter operation (input from Tx input pin).

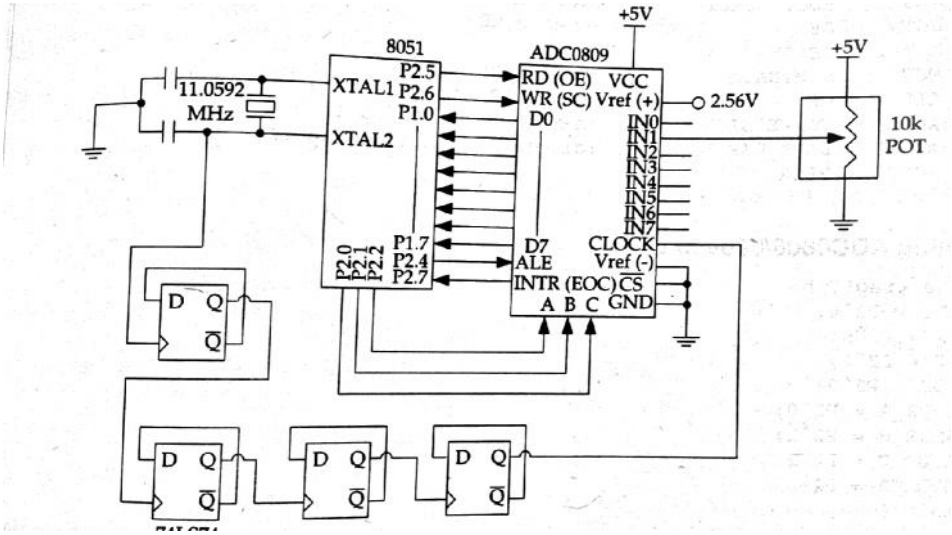
M1 : Mode bit 1

M0 : Mode bit 0

Q5. Attempt any two: **16**

a. Draw the interfacing of ADC 0809 with 8051 microcontroller. Write C language program to read the data at channel O of ADC 0809 and store it to 10 H memory location. **8**

4+4




```
#include <reg51.h>
sbit ALE = P2^4;
sbit OE = P2^5;
sbit SC = P2^6;
sbit EOC = P2^7;
sbit ADDR_A = P2^0
sbit ADDR_B = P2^1
sbit ADDR_C = P2^2
Sfr MYDATA = P1;
char idata result _at_ 0x10;
void main()
{
unsigned char value;
MYDATA = OxFF;
EOC = 1;
ALE = 0;
OE = 0;
SC = 0;
while(1)
    {
ADDR_C = 0;
ADDR_B = 0;
ADDR_A = 0;
MSDelay(1);
ALE = 1;
MSDelay(1);
SC = 1;
MSDelay (1);
ALE = 0;
SC = 0;
while(EOC==l);
while(EOC==0);
 OE = 1;
MSDelay(1);
value = MYDATA;
OE = 0;
result = value;

    }
}
```

b. Describe the following assembler directives with example. **8**
i) DB ii) ORG iii) EQU iv) END. **2 each**

DB: The DB directive is the most widely used data directive in the assembler. It is used to define the 8-bit data. When DB is used to define data, the numbers can be in decimal, binary, hex, or ASCII formats.

Example:
DATA1 DB 28 (decimal data stored as 1C hex)
DATA2 DB 01010101B (Binary data)
DATA3 DB 5Fh
Text DB "ABCDE" ASCII character array named as Text

ORG: The ORG directive is used to indicate the beginning of the address. The number that comes after ORG can be either in hex or in decimal. If the number is not followed by H, it is decimal and the assembler will convert it to hex.

Example:
```
        ORG 0000H
        LJMP main
        ORG 0030H
MAIN:   ….
```

EQU: This is used to define a constant without occupying a memory location. When the label appears in the program, constant value will be substituted for the label.
Example:
```
        NUMBER  EQU  25H

        MOV R3,#NUMBER      ; R3 = 25H  as 25H will be substituted for NUMBER
```

END: This indicates to the assembler the end of the source (asm) file. The END directive is the last line of an 8051 program, meaning that in the source code anything after the END directive is ignored by the assembler

c.

i)Write C language program for 8051 microcontroller to add five 8-bit numbers **8**
4+4

```
#include <REG51.H>
void main(void)
{
        unsigned char num [5], i;   // declare five element array and counter i
         unsigned int sum;       // to store result;

        for(i=0;i<5;i++)
        {
                sum = sum + num[i];
        }
}
```

iii) State any four C data types with their range of value.
1) **unsigned char** 0 -255 2) **char** -128 to 127 3) **unsigned int** 0 -65535 4) **int** 32767 to -32768

Q6. Attempt any Four **16**

a. Distinguish between 8051 and 8052 microcontrollers (any four points). **4**

8051	8052
4 KB program memory	8 KB program memory
128 bytes internal RAM	256 bytes internal RAM
Two timers	Three timers
Five interrupt sources	Six interrupt sources

b. Write C language program for 8051 microcontroller to transmit message'WELCOME'serially at baud rate 9600,8-bit data, 1 -stop bit Assume crystal frequency is 11.0592 MHz. **4**

```
#include <REG51.H>
void main(void)
{
        unsigned char text[] = “WELCOME”;
        unsigned char i;
        TMOD = 0x20;
        TH1 = 0xFD;
        SCON = 0x50;
        TR1 = 1;
        while(1)
        {
                for(i =0;i<7;i++)
                {
                        SBUF= text[i];
                        while(TI ==0);
                        TI = 0;
                }
        }
}
```

c. Write an assembly language program for 8051 microcontroller to transfer 10 bytes starting from 20 H onwards to 30 H onwards. **4**

```
        ORG 0000H
        LJMP MAIN
        ORG 0030H
MAIN:   MOV R0,#20H
        MOV R1,#30H
        MOV B,#0AH
NEXT:   MOV A,@R0
        MOV @R1,A
        INC R0
        INC R1
        DJNZ B,NEXT
        END
```

d. Describe alternative functions of port 3 of8051 microcontroller. **4**

P3 Bit	Function	Pin
P3.0	RxD	10
P3.1	TxD	11
P3.2	$\overline{INT0}$	12
P3.3	$\overline{INT1}$	13
P3.4	T0	14
P3.5	T1	15
P3.6	$\overline{WR}$	16
P3.7	$\overline{RD}$	17

e. Draw the interfacing diagram for temperature measurement using 8051 microcontroller and adc 0809. **4**