DEPARTMENT OF
ELECTRONICS & COMMUNICATION ENGINEERING

LABORATORY MANUAL
FOR

MICROPROCESSORS & INTERFACING DEVICES

(III B.Tech. - II – Sem.)

BITS
NARSAMPET

BALAJI INSTITUTE OF TECHNOLOGY &SCIENCE

Laknepally, Narsampet, Warangal

BALAJI INSTITUTE OF TECHNOLOGY & SCIENCE

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Dept. of Electronics & Communication Engineering

LAB: - **MICRO PROCESSOR & INTERFACING DEVICES LAB**

REGULATION: R 13

List of Experiments:-

1. **Arithmetic operations(addition,subtraction,multiplication and division)**
2. **Addition of two BCD numbers**
3. **Ascendind order descending orderof an array of numbers**
4. **Finding lagest smallest number in an array of number**
5. **Generation of fibonacci series**
6. **Hexa decimal to decimal conversion**
7. **ASCII to decimal conversion**
8. **Program for sorting an array for 8086**
9. **Program for searching for a number of character in an array for 8086**
10. **Program for String Manipulations for 8086**

MASM PROGRAMING

1. **Arithmetic operations(addition,subtraction,multiplication and division)**
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8051 MICRO CONTROLLER

1.Arithmetic operations(addition,subtraction,multiplication and division)

2.Addition of two BCD numbers

3.Ascendind order descending orderof an array of numbers

4.Finding lagest smallest number in an array of number

5.Generation of fibonacci series

6.Masking of bits

7.Hexa decimal to decimal conversion

INTERFACING WITH 8086 MICRO PROCESSOR:

1.Stepper Motor Interfacing to 8086

2.Traffic light controller intrfacing to 8086

3.Elevatorsimulator intrfacing to 8086

4.Seven-segment display intrfacing to 8086

5.Tone generator intrfacing to 8086

6.interfacing ADC and DAC to 8086

7.SRAM and DRAM intrfacing to 8086

8.Digit key-interfacing to 8086.

1.Programs for 16 bit Arithmetic Operations fr 8086(Using Various Addressing Modes)

1.1) AIM: TO WRITE 8086 ALP TO ADD,SUB,MUL,DIV TWO 16-BIT NUMBERS.

APPARATUS:

1.8086 mp kit -1& Adopter-1

2. System-1

3. RS 232 Serial cable.

4.+5v Supply

5.86/88e Driver Software.

PROGRAM CODE:-

```
XOR AX,AX
MOV ES,AX
MOV DI,3000
 XOR BX,BX
XOR CX,CX
XOR DX,DX
MOV AX,5555
MOV BX,2222
ADD AX,BX
MOV [DI],AX
INC DI
INC DI
MOV AX,5555
SUB AX,BX
MOV [DI],AX
INC DI
INC DI
MOV AX,5555
MUL BX
```

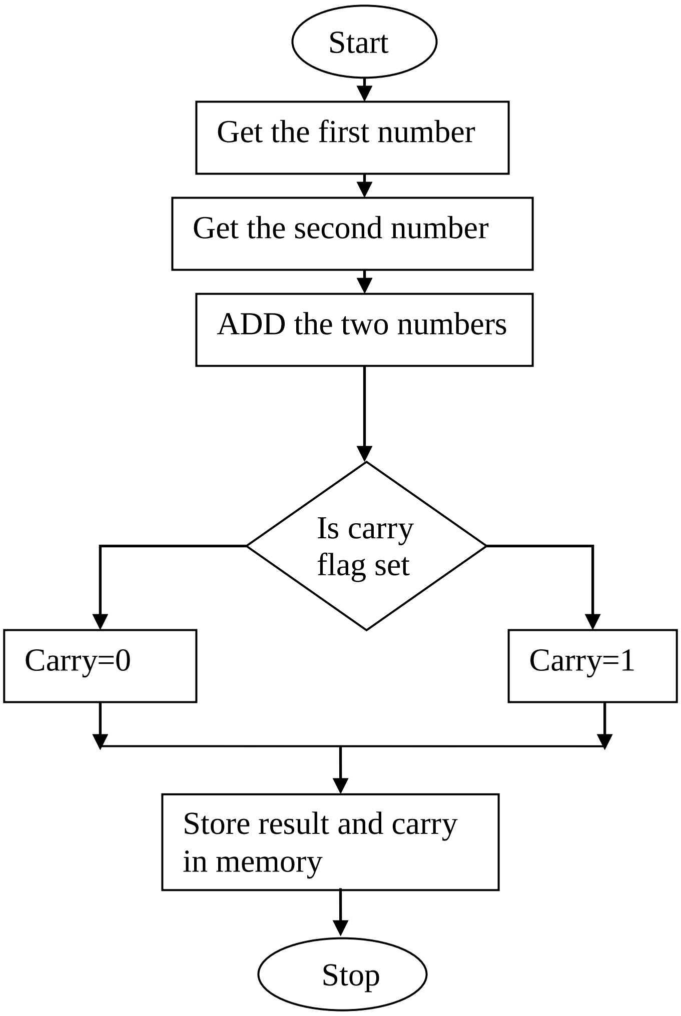
```
MOV [DI],AX
INC DI
INC DI
INC DI
INC DI
MOV AX,5555
XOR DX,DX
DIV BX
MOV [DI],AX
INC DI
INC DI
MOV[DI],DX
INT 03
```

```
I/P:AX=5555          BX=2222
O/P: ES:DI
      0000:3000 77
     0000:3001 77 } Add(AX)
      0000:3002 33}
      0000:3003 33} Sub(AX)
      0000:3004 4A}
      0000:3005 9F} AX
      0000:3006 60}
      0000:3007 0B } DX   MUL(AX,DX)

      0000:3008 02}
      0000:3009 00} AX Quotient}

      0000:300A 11}
      0000:300B 11} DX Reminder } DIV
```

Flow chart:


Start
Get the first number
Get the second number
ADD the two numbers
Is carry flag set
Carry=0
Carry=1
Store result and carry in memory
Stop

1.2 .MULTIPLICAION OF TWO 16-BIT DATA

AIM: To multiply two 16-bit data (Multibyte multiplication) using 8086 microprocessor.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
MOV AX,[0300]
MOV BX,[0302]
MUL BX
INT A5
```

RESULT:

Input Data (Before Execution)

```
0000:0300    44
0000:0301    44
0000:0302    11
0000:0303    11
```

Output Data (After Execution)

```
AL    44
AH    44

DL    00
DH    00
```

1.3. DIVISION OF TWO 16-BIT DATA

AIM: To multiply two 16-bit data (Multibyte division) using 8086 microprocessor.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
MOV AX,[0300]
MOV BX,[0302]
DIV BX
INT A5
```

RESULT:

Input Data (Before Execution)

0000:0300	44
0000:0301	44
0000:0302	22
0000:0303	22

Output Data (After Execution)

AL	22
AH	22
DL	00
DH	00

Program:1.4 MULTIPLICAION OF SIGNED NUMBERS

AIM: To multiply two signed numbers (8-bit data) using 8086 microprocessors.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
MOV AX,0200
MOV DS,AX
MOV AL,[1500]
NEG AL
MOV BL,[1501]
MUL BL
MOV [1505],AX
INT A5
```

RESULT:

Input Data (Before Execution)

```
2000:1500    10
2000:1501    15
```

Output Data (After Execution)

```
2000:1505    B0
2000:1506    13
```

2. ADDITION OF TWO 16-BIT BCD NUMBERS

AIM: TO WRITE 8086 ALP TO ADD TWO 16-BIT BCD NUMBERS.

APPARATUS:

1.8086 mp kit -1& Adopter-1

2. System-1

3. RS 232 Serial cable.

4.+5v Supply

5.86/88e Driver Software.

PROGRAM

```
DATA SEGMENT
MESS1 DB 0AH,0DH,'ENTER FIRST NUMBER:','$'
MESS2 DB 0AH,0DH,'ENTER SECOND NUMBER:','$'
MESS3 DB 0AH,0DH,'SUM OF TWO 16-BIT NUMBER IS:','$'
DATA ENDS
CODE SEGMENT
ASSUME CS:CODE,DS:DATA
START:MOV AX,DATA
MOV DS,AX
LEA DX,MESS1
MOV AH,09H
INT 21H
CALL READ
MOV BX,DX
LEA DX,MESS2
MOV AH,09H
INT 21H
CALL READ
MOV CL,00H
MOV AL,BL
ADD AL,DL
```

```
DAA
MOV BL,AL
MOV AL,BH
ADC AL,DH
DAA
JNC NEXT
INC CL
NEXT:MOV BH,AL
CALL DISP
MOV AH,4CH
INT 21H
READ PROC NEARPUBLIC READ
MOV CH,02H
R3:MOV AH,01H
INT 21H
MOV CL,04H
MOV DL,AL
SUB DL,30H
CMP DL,0AH
JC R1
SUB DL,07H
R1:SHL DL,CL
MOV AH,01H
INT 21H
SUB AL,30H
CMP AL,0AH
JC R2
SUB AL,07H
AND AL,0FH
R2:OR DL,AL
DEC CH
JZ R4
MOV DH,DL
JMP R3
```

```
R4:RET
READ ENDPDISP PROC NEARPUBLIC DISP
LEA DX,MESS3
MOV AH,09H
INT 21H
MOV DL,CL
ADD DL,30H
MOV AH,06H
INT 21H
MOV CH,02H
L3:MOV CL,04H
MOV DL,BH
SHR DL,CL
CMP DL,0AH
JC L1
ADD DL,07H
L1:ADD DL,30H
MOV AH,06H
INT 21H
AND BH,0FH
CMP BH,0AH
JC L2
ADD BH,07H
L2:ADD BH,30H
MOV DL,BH
MOV AH,06H
INT 21H
DEC CH
JZ L4
MOV BH,BL
JMP L3L4:RET
DISP END
PCODE END
SEND START
```

OUTPUT:

```
ENTER FIRST NUMBER : 6987
ENTER SECOND NUMBER : 3991
SUM OF TWO 16-BIT NUMBER IS : 10978
ENTER FIRST NUMBER : 9999
ENTER SECOND NUMBER : 8888
SUM OF TWO 16-BIT NUMBER IS : 18887
```

3.ASCENDING ORDER DESCENDING ORDER OF AN ARRAY OF NUMBERS

AIM: To write a program to sort a given string of a number in ascending/descending 8086 microprocessor programming.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
                MOV CX,0005
                DEC CX
Again           MOV DX,CX
                MOV SI,0200
Up              MOV AL,[SI]
                INC SI
                MOV BL,[SI]
                CMP AL,BL
                JLE/JGE         Next
                XCHG AL,BL
                MOV [SI],BL
                DEC SI
                MOV [SI],AL
                INC SI
Next            DEC DX
                JNZ             Up
                DEC CX
                JNZ             Again
                INT A5
```

RESULT

Input Data (Before Execution)

0000:0200	38
0000:0201	47
0000:0202	02
0000:0203	11
0000:0204	29

Output Data (After Execution)

	Ascending order	Descending order
0000:0200	02	47
0000:0201	11	38
0000:0202	29	29
0000:0203	38	11
0000:0204	47	02

4. FINDING LARGEST SMALLEST NUMBERS IN AN ARRAY OF NUMBERS

AIM: Write a Program to find smallest number from a given array of numbers.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
        XOR AX,AX
        MOV DS,AX
        MOV SI,5000
        MOV CL,06
        MOV AL,[SI]
L1:     INC SI
        MOV BL,[SI]
        CMP AL,BL
        JL 7014(L2)
        XCHG AL,BL
L2:     LOOP 700B(L1)
        INT 03
```

RESULT: The smallest number is given array of number is:

AX=009D FL=F097

4:2 To find the Greatest number

AIM: Write a Program to find Greatest number from a given array of numbers

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
        XOR AX,AX
        MOV DS,AX
        MOV SI,5000
        MOV CL,06
        MOV AL,[SI]
L1:     INC  SI
        MOV BL,[SI]
        CMP AL,BL
        JG  7014(L2)
        XCHG AL,BL
L2:     LOOP 700B(L1)
        INT 03
```

RESULT: The smallest number is given array of number is:

AX=007C FL=F006

5 GENERATION OF FIBONACCI SERIES

AIM: TO WRITE 8086 ALP TO GENERAT FIBONACCI SERIES.

APPARATUS:

1.8086 mp kit -1& Adopter-1

2. System-1

3. RS 232 Serial cable.

4.+5v Supply

5.86/88e Driver Software.

```
Assume cs: code
Code segment
Start: XOR AX,AX
XOR BX,BX
XOR CX,CX
XOR DX,DX
MOV CL,09
MOV DS,AX
MOV SI,3000
MOV AL,00
MOV [SI],AL
INC SI
MOV BL,01
MOV [SI],BL
 L1:ADD AL,BL
MOV DL,AL
INC SI
MOV [SI],DL
MOV AL,BL
MOV BL,DL
LOOP L1
INT 03
Code ends
End start
```

6. HEXADECIMAL TO DECIMAL CONVERSION

AIM: TO WRITE 8086 ALP TO CONVERT HEXADECIMAL TO DECIMAL

APPARATUS:

1.8086 mp kit -1& Adopter-1

2. System-1

3. RS 232 Serial cable.

4.+5v Supply

5.86/88e Driver Software.

PROGRAM:

```
DATA SEGMENT
    NUM DW 1234H
    RES  DB 10 DUP ('$')
DATA ENDS
START:
   MOV AX,DATA
   MOV DS,AX

   MOV AX,NUM

   LEA SI,RES
   CALL HEX2DEC

   LEA DX,RES
   MOV AH,9
   INT 21H

   MOV AH,4CH
   INT 21H
CODE ENDS
HEX2DEC PROC NEAR
   MOV CX,0
   MOV BX,10
```

```
LOOP1: MOV DX,0
       DIV BX
       ADD DL,30H
       PUSH DX
       INC CX
       CMP AX,9
       JG LOOP1

       ADD AL,30H
       MOV [SI],AL

LOOP2: POP AX
       INC SI
       MOV [SI],AL
       LOOP LOOP2
       RET
HEX2DEC ENDP

END START
```

7. ASCII TO DECIMAL

AIM: TO WRITE 8086 ALP TO CONVERT ASCII TO DECIMAL

APPARATUS:

1.8086 mp kit -1& Adopter-1

2. System-1

3. RS 232 Serial cable.

4.+5v Supply

5.86/88e Driver Software.

PROGRAM:

```
    MOV AX,DATA
  MOV DS,AX

  MOV AH,0
  MOV AL,NUM

  LEA SI,RES
  CALL HEX2DEC

  LEA DX,RES
  MOV AH,9
  INT 21H

  MOV AH,4CH
  INT 21H
CODE ENDS
HEX2DEC PROC NEAR
  MOV CX,0
  MOV BX,10

LOOP1: MOV DX,0
    DIV BX
```

```
        ADD DL,30H
        PUSH DX
        INC CX
        CMP AX,9
        JG LOOP1

        ADD AL,30H
        MOV [SI],AL

LOOP2: POP AX
        INC SI
        MOV [SI],AL
        LOOP LOOP2
        RET
HEX2DEC ENDP
```

8.PROGRAM FOR SORTING AN ARRAY FOR 8086

AIM: To find the sum of squares of data string by using 8086 assembly language program.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
                MOV SI,[0300]
                MOV CL,[SI]
                MOV DI,0220
                MOV BX,0000
                MOV AH,00
Up              INC SI
                MOV AL,[SI]
                MUL AL
                ADD [DI],AX
                DEC CL
                JNZ         Up
                INT A5
```

RESULT

Input Data

```
0000:0300    05
0000:0301    01
0000:0302    02
0000:0303    03
0000:0304    04
0000:0305    05
```

Output Data

BX 0037

8.2 SUM OF CUBES OF 'N' NUMBERS

AIM: To find the um of cubes of an array of size 10 by using 8086 assembly language program.

APPARATUS

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
                MOV SI,0200
                MOV DI,0220
                MO CL,0A
                MOV AX,0000
                MOV [DI],AX
                MOV AL,[SI]
                MOV BL,AL
                MUL AL
                MUL BL
                ADD [DI],AX
Up              INC SI
                DEC CL
                JNZ             Up
                INT A5
```

RESULT

```
        Input Data                                      Output Data

                0000:0200       01                      0220    D1
                0000:0201       02                      0221    0b
                0000:0202       03
                0000:0203       04
                0000:0204       05
                0000:0205       06
                0000:0206       07
                0000:0207       08
                0000:0208       09
                0000:0209       0A
```

9. Program for Searching A for A Number in a Sting for 8086.

AIM: PAM for searching a number or a character in a string.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
XORW AX, AX
XORW BX, BX
MOVW   DS,AX
MOVW   SI, 6000
MOVW CX, 0007
MOVB AL,09
MOVB BL,[SI]
CMP AL, BL
JZ : L1
INCW SI
LOOP   L2
MOV DX, SI
INT 03
```

RESULT:

Input Data (Before Execution)

```
0000:6000      26
0000:6001      86
0000:6002        95
0000:6003      09
0000:6004       48
0000:6005       43
0000:6006       91
```

Output Data (After Execution):register Contents:

```
AX=0009    BX=0009      CX=0004   DX=0000       SP=0100      SI=6003

FL=F046
```

RESULT: A PROGRAM FOR SEARCHING OF AN NUMBER (OR) CHARACTER IN A STRING HAS BEEN PERFORMED.

9.2 TO SEARCH A STRING USING SCAS-SCAN THE STRING.

AIM: WAP to find the required string (or) number from the given string using SCAS Required element is EE and mentions the address in the register 'DX'.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
XOR DX, DX
MOV AX, AX
MOV ES, AX
MOV DI, 6000
MOV CL, 07
MOV AL, 0EE
REPNZ
SCASB
DEC DI
MOV DX, DI
INT 03
```

RESULT:
Input Data (Before Execution)

```
0000:6000      - 55
0000:6001      - AB
0000:6002       -D5
0000:6003       -FD
0000:6004       - 9L
0000:6005      - EE
0000:6006       -34
0000:6007       -66
```

Here DX IS Not equal to zero and the required element is present in the register Dx having the Address 6005.

10. PROGRAM FOR STRING MANIPULATIONS FOR 8086 COMPARISION OF TWO STRINGS.

AIM: To compare two data stings using 8086 microprocessor programming

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
MOV AX,2000
MOV DS,AX
MOV ES,AX
MOV SI,0100
MOV DI,0200
MOV CX,0005
MOV BX,0000
CLD
REP CMPSB
JE Last
MOV BX,FFFF
INT A5
```

RESULT

Input Data (Before Execution)

DS:SI		ES:DI	
2000:0100	01	2000:0200	01
2000:0101	02	2000:0201	02
2000:0102	03	2000:0202	03
2000:0103	04	2000:0203	04
2000:0104	05	2000:0204	05

Output Data (After Execution)

BX FFFF

10.2 LENGTH OF A DATA STRING

AIM: To find the length of a given string of data using 8086 microprocessor programming.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
            MOV AX,2000
            MOV ES,AX
            MOV DI,0100
            MOV CX,0000
            MOV AL,00
            CLD
Again       SCASB
            JZ      Last
            INC CX
            JMP     Again
Last        INT A5
```

RESULT

Input Data (Before Execution)

```
2000:0100     44
2000:0101     67
2000:0102     49
2000:0103     20
2000:0104     00
```

Output Data (After Execution)

```
CX 0004
```

10.3 MOVING A STRING OF DATA

AIM: To move a sting or a block of data from one segment to the other segment using 8086 microprocessor programming.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
MOV AX,2100
MOV DS,AX
MOV AX,2200
MOV ES,AX
MOV SI,2000
MOV DI,0000
MOV CX,0005
CLD
REP MOVSB
INT A5
```

RESULT

Input Data (Before Execution)

```
2000:2000    23
2000:2001    45
2000:2002    21
2000:2003    78
2000:2004    69
```

Output Data (After Execution)

```
2200:0000    23
2000:0001    45
2000:0002    21
2000:0003    78
2000:0004    69
```

10.4 REVERSE OF A STRING

AIM: To write a program to reverse of a string 8086 microprocessor programming.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
                MOV AX,2000
                MOV DS,AX
                MOV CX,0005
                MOV SI,0200
                MOV DI,0209
Next            MOV AL,[SI]
                XCHG AL,[DI]
                MOV [SI],AL
                INC SI
                DEC DI
                JNZ          Next
                INT A5
```

RESULT

Input Data (Before Execution)		Output Data (After Execution)	
2000:0200	00	2000:0200	09
2000:0201	01	2000:0201	08
2000:0202	02	2000:0202	07
2000:0203	03	2000:0203	06
2000:0204	04	2000:0204	05
2000:0205	05	2000:0205	04
2000:0206	06	2000:0206	03
2000:0207	07	2000:0207	02
2000:0208	08	2000:0208	01
2000:0209	09	2000:0209	00

MASM PROGRAMMING

Introduction to MASM /TASM

MASM: (Microsoft assembler)

To Create Source File: An editor is a program which allows you to create a file containing the assembly language statements for your program. This file is called a **source file.**

Command to create a source file

```
C:\MASM\BIN> Edit filename. Asm
```

The next step is to process the source file with an assembler. When you run the assembler, it reads the source file of your program. On the first pass through the source program, the assembler determines the displacement of named data items, the offset labels, etc. and puts this information in a symbol table. On the second pass through the source program the assembler produces the binary code for each instruction and inserts the offsets, etc. that it calculated during first pass.

```
C:\MASM\BIN > Masm filename. asm X, Z
```

With this command assembler generates three files.

1. The first file (X) called the object file, is given the extension .OBJ.The object file contains the binary codes for the instructions and information about the addresses of the instructions.
2. The third file (Z) generated by this assembler is called the cross-reference file and is given the extension .CRF. The cross-reference file lists all labels and pertinent information required for cross – referencing.

NOTE : The Assembler only finds syntax errors : It will not tell you whether program does what it is supposed to do. To determine whether your program works, you have to run the program and test it.

Next step is to process the object file with linker.

```
C:\MASM\BIN>LINK filename. obj
Run File [Filename1.exe] : “filename1.exe”
```

List file [nul.map]: NUL

Libraries [.lib]: library name

Definitions File [nul.def]:

Creation of Library: Refer Modular Programming Section

A Linker is a program used to join several object files into one layer object file.

NOTE: On IBM PC – type Computers, You must run the LINK program on your .OBJ file even if it contains only one assembly module.The linker produces a link file with the .EXE extension (an execution file)Next Run **C:\MASM\BIN> filename**

1. Programs for 16 bit arithmetic operations for 8086 (using Various Addressing Modes).

a) Addition:
i) 16 bit addition:

AIM: - To write an assembly language program for Addition of two 16-bit numbers.

APPARATUS: 1. 8086 microprocessor kit/MASM ----1
2. RPS (+5V) ----1

PROGRAM:
i) By using MASM:

```
Assume cs: code

Code segment

Start: MOV AX, 4343

MOV BX, 1111

ADD AX, BX

INT 3

Code ends

End start
```

OUTPUT:

Input

output

Register Data

b) **Subtraction:**

i) 16 bit subtraction:

AIM: - To write an assembly language program for subtraction of two 16-bit numbers.

APPARATUS: 1. 8086 microprocessor kit/MASM ----1

2. RPS (+5V) ----1

PROGRAM:

k) By using MASM:

```
Assume cs: code
Code segment
Start: MOV AX, 4343
MOV BX, 1111
SUB AX, BX
INT 3
Code ends
End start
```

OUTPUT:

Input output Register Data Register Data

ii) 16 bit multiplication (signed numbers)

AIM: - To write an assembly language program for multiplication of two 16-bit signed numbers.

APPARATUS: 1. 8086 microprocessor kit/MASM ----1
2. RPS(+5V) ----1

PROGRAM: By using MASM:

```
Assume cs: code
Code segment
Start: MOV SI, 2000
MOV DI, 3000
MOV AX, [SI]
ADD SI, 02
MOV BX, [SI]
IMUL BX
MOV [DI], AX
ADD DI, 02
MOV [DI], DX
INT 3
Code ends
End start
```

OUTPUT:

Input

MEMORY LOCATION	**Data**
2000	E4(-28)
2001	E4(-28)
2002	3B(+59)
2003	3B(+59)

Output

MEMORY LOCATION	**Data**
3000	8C
3001	4C
3002	F5
3003	34

d) Division:

I) 16 bit division:

AIM: - To write an assembly language program for multiplication of two 16-bit numbers.

APPARATUS: 1. 8086 microprocessor kit/MASM ----1
2. RPS (+5V) ----1

PROGRAM:

A) By using MASM:

```
Assume cs: code

Code segment

Start: MOV AX,4343

MOV BX,1111

MUL BX

INT 3

Code ends

End start
```

OUTPUT:

Input	**Output**
Register Data	**Register Data**
AX 4343	AX EA73
BX 1111	DX 047B

RESULT: 16 bit arithmetical operations are performed by using different addressing modes.

2. ADDITION OF TWO 16-BIT BCD NUMBERS

AIM: - To write an assembly language program for Addition of two 16-bit Bcd numbers.

APPARATUS: 1. 8086 microprocessor kit/MASM ----1
2. RPS (+5V) ----1

Program:

```
DATA SEGMENT
MESS1 DB 0AH,0DH,'ENTER FIRST NUMBER:','$'
MESS2 DB 0AH,0DH,'ENTER SECOND NUMBER:','$'
MESS3 DB 0AH,0DH,'SUM OF TWO 16-BIT NUMBER IS:','$'
DATA ENDS
CODE SEGMENT
ASSUME CS:CODE,DS:DATA
START:MOV AX,DATA
MOV DS,AX
LEA DX,MESS1
MOV AH,09H
INT 21H
CALL READ
MOV BX,DX
LEA DX,MESS2
MOV AH,09H
INT 21H
CALL READ
MOV CL,00H
MOV AL,BL
ADD AL,DL
DAA
MOV BL,AL
MOV AL,BH
ADC AL,DH
DAA
```

```
JNC NEXT
INC CL
NEXT:MOV BH,AL
CALL DISP
MOV AH,4CH
INT 21H
READ PROC NEARPUBLIC READ
MOV CH,02H
R3:MOV AH,01H
INT 21H
MOV CL,04H
MOV DL,AL
SUB DL,30H
CMP DL,0AH
JC R1
SUB DL,07H
R1:SHL DL,CL
MOV AH,01H
INT 21H
SUB AL,30H
CMP AL,0AH
JC R2
SUB AL,07H
AND AL,0FH
R2:OR DL,AL
DEC CH
JZ R4
MOV DH,DL
JMP R3
R4:RET
READ ENDPDISP PROC NEARPUBLIC DISP
LEA DX,MESS3
MOV AH,09H
INT 21H
```

```
MOV DL,CL
ADD DL,30H
MOV AH,06H
INT 21H
MOV CH,02H
L3:MOV CL,04H
MOV DL,BH
SHR DL,CL
CMP DL,0AH
JC L1
ADD DL,07H
L1:ADD DL,30H
MOV AH,06H
INT 21H
AND BH,0FH
CMP BH,0AH
JC L2
ADD BH,07H
L2:ADD BH,30H
MOV DL,BH
MOV AH,06H
INT 21H
DEC CH
JZ L4
MOV BH,BL
JMP L3L4:RET
DISP END
PCODE END
SEND START
```

OUTPUT:

```
ENTER FIRST NUMBER : 6987
ENTER SECOND NUMBER : 3991
SUM OF TWO 16-BIT NUMBER IS : 10978
ENTER FIRST NUMBER : 9999
ENTER SECOND NUMBER : 8888
SUM OF TWO 16-BIT NUMBER IS : 18887
```

3.ASCENDIND ORDER DESCENDING ORDER OF AN ARRAY OF NUMBERS

AIM:-Program to sort the given numbers in ascending order

APPARATUS: 1. 8086 microprocessor kit/MASM ----1
2. RPS (+5V) ----1

PROGRAM:

A) By using MASM:

```
ASSUME CS: CODE
CODE SEGMENT
START: MOV AX, 0000H
MOV CH, 0004H
DEC CH
UP1 : MOV CL, CH
MOV SI, 2000
UP: MOV AL, [SI]
INC SI
CMP AL, [SI]
JC DOWN
XCHG AL, [SI]
DEC SI
MOV [SI], AL
INC SI
DOWN: DEC CL
JNZ UP
DEC CH
JNZ UP1
INT 3
CODE ENDS
END START
```

ii) DESCENDING ORDER

AIM:-Program to sort the given numbers in descending order

APPARATUS: 1. 8086 microprocessor kit/MASM ----1

2. RPS (+5V) ----1

PROGRAM:

A) By using MASM:

```
ASSUME CS: CODE
CODE SEGMENT
START: MOV AX, 0000H
MOV CH, 0004H
DEC CH
UP1 : MOV CL, CH
MOV SI, 2000
UP: MOV AL, [SI]
INC SI
CMP AL, [SI]
JNC DOWN
XCHG AL, [SI]
DEC SI
MOV [SI], AL
INC SI
DOWN: DEC CL
JNZ UP
DEC CH
JNZ UP1
INT 3
CODE ENDS
END START
```

RESULT: Program for sorting an array performed by using masm software and trainer kit.

I/p Memory location	Data	O/p Memory location	Data
2000	03	2000	07
2001	06	2001	06
2002	07	2002	04
2003	04	2003	03

4.FINDIND LARGEST& SMALLEST NUMBER OF AN ARRAY OF NUMBERS

AIM: To write an Assembly Language Program (ALP) to find the largest and Smallest number in a given array.

APPARATUS REQUIRED:

1. Microprocessor kit 8086 1
2. Power Supply +5 V dc 1

PROGRAM :

```
MOV SI,1200H
MOV CL,[SI]
INC SI
MOV AL,[SI]
DEC CL
L2 INC SI
CMP AL,[SI]
JNB L1 MOV AL,[SI]
L1 DEC CL
JNZ L2
MOV DI,1300H
MOV [DI],AL
HLT
 SMALLEST  :MOV SI,1200H
MOV CL,[SI]
INC SI
MOV AL,[SI]
DEC CL
L2 INC SI
CMP AL,[SI]
JB L1
MOV AL,[SI]
L1 DEC CL
JNZ L2
MOV DI,1300H
MOV [DI],AL
HLT
```

RESULT:

Thus largest and smallest number is found in a given array

5 GENERATION OF FIBONACCI SERIES

AIM: - To write an assembly language program for generation of fibonacci series.

APPARATUS:
1. 8086 microprocessor kit/MASM ----1
2. RPS (+5V) ----1

Program:

```
Assume cs: code
Code segment
Start: XOR AX,AX
XOR BX,BX
XOR CX,CX
XOR DX,DX
MOV CL,09
MOV DS,AX
MOV SI,3000
MOV AL,00
MOV [SI],AL
INC SI
MOV BL,01
MOV [SI],BL
 L1:ADD AL,BL
MOV DL,AL
INC SI
MOV [SI],DL
MOV AL,BL
MOV BL,DL
LOOP L1
INT 03
Code ends
End start
```

6. HEXADECIMAL TO DECIMAL CONVERSION

AIM: - To write an assembly language program to covert hexadecimal to decimal conertion
.

APPARATUS:
1. 8086 microprocessor kit/MASM ----1
2. RPS (+5V)

PROGRAM

```
DATA SEGMENT
    NUM DW 1234H
    RES  DB 10 DUP ('$')
DATA ENDS
START:
   MOV AX,DATA
   MOV DS,AX

   MOV AX,NUM

   LEA SI,RES
   CALL HEX2DEC

   LEA DX,RES
   MOV AH,9
   INT 21H

   MOV AH,4CH
   INT 21H
CODE ENDS
HEX2DEC PROC NEAR
   MOV CX,0
   MOV BX,10

LOOP1: MOV DX,0
```

```
        DIV BX
        ADD DL,30H
        PUSH DX
        INC CX
        CMP AX,9
        JG LOOP1

        ADD AL,30H
        MOV [SI],AL

LOOP2: POP AX
        INC SI
        MOV [SI],AL
        LOOP LOOP2
        RET
HEX2DEC ENDP

END START
```

PROGRAMMING WITH 8051

1 PROGRAMMING USING ARTHMETIC,LOGICAL AND BIT MANIPULATION INSTRUCTIONS OF 8051

1.1 ADDITION OF TWO NUMBERS

AIM: To add tow numbers by using 8051 microcontroller.

APPARATUS:

1. 8051 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE;

```
MOV A,#24
MOV F0,#42
ADD A,F0
RET
```

RESULT

Input Data

A	24
B	42

Output Data

A	66

1.2 SUBTRACTION OF TWO NUMBERS

AIM: To subtraction two numbers by using 8051 microcontroller

APPARATUS:

1. 8051 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE;

```
MOV A,#44
MOV F0,#37
CLR C
SUB A,F0
RET
```

RESULT

Input Data

A	44
B	37

Output Data

A	0D

1.3 MULTIPLICATION OF TWO NUMBERS

AIM: To multiply the given two numbers by using 8051 microcontroller

APPARATUS:

1. 8051 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE;

```
MOV A,#22
MOV F0,#11
MUL AB
RET
```

RESULT

Input Data

A	22
B	11

Output Data

A	42
B	02

1.4 DIVISION OF TWO NUMBERS

AIM: To multiply the given numbers by using 8051 microcontroller

APPARATUS:

1. 8051 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE;

```
MOV A,#22
MOV F0,#11
DIV A
RET
```

RESULT

Input Data

A	22
B	11

Output Data

A	02
B	00

1.5 USE OF SWAP INSTRUCTION

AIM: To show the use of SWAP instruction of 8051 microcontroller

APPARATUS:

1. 8051 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE;

```
MOV A,#50
SWAP A
MOV R0,A
RET
```

RESULT:

Input Data

A	50

Output Data

A	05

2 ADDITION OF TWO BCD NUMBERS

AIM: To find the addition of two bcd numbers using 8051 microcontroller.

APPARATUS:

1. 8051 Trainer kit
2. Key board
3. SMPS

PROGRAM:

```
mov r1,#46h
mov r2,#29h
mov psw,#00h
mov a,#99h
subb a,r2
add a,r1
da a
addc a,#00h
mov r0,a
end
```

3 ASCENDING ORDER/DESCENDING ORDER OF AN ARRAY OF NUMBERS

AIM: To arrange the given numbers in ascending order.

APPARATUS:

8051 Trainer kit
Key board
SMPS

PROGRAM CODE:

```
ORG 000H
        SJMP START
START : MOV R1,#05H
AGAIN    UP : INC R0
        MOV B,@R0
        CLR C
        SUBB A,B
        JC SKIP
        MOV B,@R0
        DEC R0
        MOV A,@R0
        MOV @R0,B
        INC R0
        MOV @R0,A
 SKIP : DJNZ R2,UP
        DJNZ R1,AGAIN
 STOP : SJMP STOP : MOV A,R1
        MOV R2,A
        MOV R0,#30H
        MOV A,@R0
```

DESCENDING ORDER

AIM: To arrange the given numbers in descending order.

APPARATUS:

8051 Trainer kit

Key board

SMPS

PROGRAM CODE:

```
MOV R6, #07H
START :       MOV R7, #07H
              MOV R0, #30H
              MOV A, #00H
BACK :        MOV A, @R0
              INC R0
             CJNE   A,@R0,CARRY
              SJMP DECREMENTC
CARRY :       JC DECREMENTC
              MOV B, @R0
              MOV @R0, A
              DEC R0
              MOV A, B
              MOV @R0, A
DECREMENTC :      INC R0
              DJNZ R7, BACK
              DJNZ  R6,START
              END
```

4 FINDIND LARGEST/SMALLEST NUMBERSIN AN ARRAY

SMALLEST OF TWO NUMBERS

AIM: To find the smallest of two numbers using 8051 microcontroller.

APPARATUS:

1. 8051 Trainer kit
2. Key board
3. SMPS

PROGRAM CODE:

```
        MOV R0,#05
        MOV R1,#08
        MOV A,R0
        CLR C
        SUBB A,R1
        JC          Down
        MOV A,R1
        RET
Down    MOV A,R0
        RET
```

RESULT:

Input Data

R0	05
R1	08

Output Data

A	05

LARGEST OF TWO NUMBERS

AIM: To find the largest of two numbers using 8051 microcontroller.

APPARATUS:

4. 8051 Trainer kit
5. Key board
6. SMPS

PROGRAM CODE:

```
        MOV R0,#05
        MOV R1,#08
        MOV A,R0
        CLR C
        SUBB A,R1
        JNC         Down
        MOV A,R1
        RET
Down    MOV A,R0
        RET
```

RESULT:

Input Data

R0	05
R1	08

Output Data

A	08

4. FIBONACCI SERIES

AIM: To write Fibonacci series using 8051 microcontroller.

APPARATUS:

1. 8051 Trainer kit
2. Key board
3. SMPS

PROGRAM:

```
BEGIN: MOV R1,30H

MOV R7,#40H

MOV @R7,#00H

INC R7

MOV @R7, #01H

MOV R5,#42H

DEC R1

DEC R1

DEC R7.

LOOP: MOV A, @R7.

INC R7

ADD A,@R7

MOV @R5,A
```

```
INC R5

DJNZ R1,LOOP

STOP: SJMP

STOP
```

6.MASKING OF BITS

AIM: To perform MASKING of bits.

APPARATUS:

8051 Trainer kit
Key board
SMPS

PROGRAM CODE;

```
Org 00h
 Mov a,#35h
 ANL A,#0FH
```

RESULT

```
35H     0011 0101
0FH     0000 1111
05H     0000 0101
```

7. HEXADECIMAL TO DECIMAL

AIM: To perform conversion of Hexadecimal number to decimal number.

APPARATUS:

8051 Trainer kit
Key board
SMPS

Program:

```
mov b,#100d
div ab
mov hun,a ;

 mov a,b ;
mov b,#10d ;
div ab
mov tens,a ;

 mov units,a ;
ret
```

INTERFACING WITH 8086 MICROPROCESSOR

1.STEPPER MOTOR INTERFACING TO 8086

AIM: Write a program to rotate stepper motor in clock wise direction.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS
4. Stepper motor interfacing kit

PROGRAM CODE:.

```
        MOV DX,8006
        MOV AL,80
        OUT DX,AL
        MOV CL,01
        MOV DX,8000
        MOV AL,88
        OUT DX,AL
        CALL        Delay
        ROR AL,CL
        JMP         Up
        INT A5
```

DELAY PROGRAM

```
Delay   MOV CX,FFFF
        INT AA
        RET
```

2 TRAFFIC LIGHT INTERFACING TO 8086

AIM: Write a program for traffic light interfacing.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS
4. Traffic light interfacing kit.

Program:

```
MODEL SMALL
.STACK 100
.DATA
CWR EQU 0FFC6 H
PORTA EQU 0FFC0 H
PORTB EQU 0FFC2 H
PORTC EQU 0FFC4 H
.CODE
START:
MOV AX,@DATA
MOV DS,AX
MOV AL,80H
MOV DX,CWR
OUT DX,AL
MOV AL,F3H
MOV DX,PORTC
OUT DX,AL
MOV AL,FFH
MOV DX,PORTA
OUT DX,AL
MOV AL,FFH
MOV DX,PORTB
```

```
OUT DX,AL
MOV CL,03H
CALL DELAY
TOP:
MOV AL,EEH
MOV DX,PORTA
OUT DX,AL
MOV AL,EEH
MOV DX,PORTB
OUT DX,AL
MOV CL,02H
CALL DELAY

MOV AL,FCH
MOV DX,PORTC
OUT DX,AL
MOV AL,7DH
MOV DX,PORTA
OUT DX,AL
MOV AL,57H
MOV DX,PORTB
OUT DX,AL
MOV CL,15H
CALL DELAY

MOV AL,E7H
MOV DX,PORTB
OUT DX,AL
MOV AL,FDH
MOV DX,PORTA
OUT DX,AL
MOV AL,EDH
MOV DX,PORTA
OUT DX,AL
```

```
MOV CL,02H
CALL DELAY

MOV AL,F7H
MOV DX,PORTB
OUT DX,AL
MOV AL,F0H
MOV DX,PORTC
OUT DX,AL
MOV AL,F1H
MOV DX,PORTA
OUT DX,AL
MOV CL,15H
CALL DELAY

MOV AL,FBH
MOV DX,PORTA
OUT DX,AL
MOV AL,FBH
MOV DX,PORTB
OUT DX,AL
MOV AL,50H
MOV DX,PORTC
OUT DX,AL
MOV CL,15H
CALL DELAY

MOV AL,FEH
MOV DX,PORTA
OUT DX,AL
MOV AL,FEH
MOV DX,PORTB
OUT DX,AL
MOV CL,03H
```

```
CALL DELAY

MOV AL,FFH
MOV DX,PORTA
OUT DX,AL
MOV AL,AFH
MOV DX,PORTC
OUT DX,AL
MOV AL,EEH
MOV DX,PORTA
OUT DX,AL
MOV AL,EEH
MOV DX,PORTB
OUT DX,AL
MOV CL,02H
CALL DELAY

MOV AL,BFH
MOV DX,PORTA
OUT DX,AL
MOV AL,BFH
MOV DX,PORTB
OUT DX,AL
MOV CL,15H
CALL DELAY
JMP TOP

DELAY:
MOV BX,10H
D1:
MOV CX,0FFFFH
D2:
LOOP D2
DEC BX
```

```
JNZ D1
INT 03H
END START
```

PROCEDURE:-

1. Connect power supply 5V & GND to both microprocessor trainer kit & Traffic light controller interfacing kit.

2. Connect data bus between microprocessor trainer kit & Traffic light controller interfacing kit.

3. Enter the program to control Traffic light.

4. Execute the program by typing GO E000:0B80 ENTER.

5. Observe the LED’s on traffic light controller PCB.

3 ELEVATOR CONTROLLER

AIM: Write a program for elevator controller.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS
4. Elevator controller interfacing kit.

Program:

```
CODE SEGME NT:0000H
FCODE EQU   2100H
FCLR EQU   2104H

MOV DX,0FFE6
MOV AL,82
OUT DX,AL
XOR AX,AX
LOOP1: MOV AL,AH
OR AL,0F0
MOV DX,0FFE0
OUT DX,AL
MOV DX,0FFE2
LOOP2: IN AL,DX
AND AL,0F
CMP AL,0F
JZ 2013
MOV SI,00
FINDF: ROR AL,1
JNC 2024
INC SI
JMP 201D
```

```
FOUND: MOV AL,[SI]2100
CMP AL,AH
JA 2038
JB 204F
CLEAR: MOV AL,[SI]2104
MOV DX,0FFE0
OUT DX,AL
JMP 2008
GOUP: CALL 2066
INC AH
XCHG AL,AH
OR AL,0F0
MOV DX,0FFE0
OUT DX,AL
AND AL,0F
XCHG AH,AL
CMP AL,AH
JNZ 2038
JMP 202E
GODN: CALL 2066
DEC AH
XCHG AH,AL
OR AL,0F0
MOV DX,0FFE0
OUT DX,AL
AND AL,0F
XCHG AL,AH
CMP AL,AH
JNZ 204F
JMP 202E
DELAY: MOV CX,0800
HR1: LOOP 2069
HR2: LOOP 206B
ORG 2100H
```

4. SEVEN SEGMENT DISPLAY INTERFACE

AIM: Write a program for seven segment dispaly interfacing.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS
4. 7-Segment Display interfacing kit.

Program:

```
DATA SEGMENT
PORTA EQU 120H
PORTB EQU 121H
PORTC EQU 122H
CWRD EQU 123H
TABLE DB 8CH,0C7H,86H,89H DATA
ENDS
CODE SEGMENT
ASSUME CS:CODE, DS:DATA
START: MOV AX,DATA
MOV DS,AX
MOV AL,80H
MOV DX,CWRD
OUT DX,AL
MOV BH,04
LEA SI,TABLE
NEXTDIGIT:MOV CL,08
MOV AL,[SI]
NEXTBIT: ROL AL,01
MOV CH,AL
MOV DX,PORTB
OUT DX,AL
```

```
MOV AL,01
MOV DX,PORTC
OUT DX,AL
DEC AL
MOV DX,PORTC
OUT DX,AL
MOV AL,CH
DEC CL
JNZ NEXTBIT
DEC BH
INC SI
JNZ NEXTDIGIT
MOV AH,4CH
INT 21H
CODE ENDS END
START
```

5 TONE GENERATOR

AIM: Write a program for tone Generator..

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS
4. Tone Generator interfacing kit.

Program:

```
MOV AX,0000
MOV ES,AX
MOV DX,0FFE6
MOV AL,80
OUT  DX,AL
GETKEY: CALLS 0FE00
MOV BX,0000
MOV SI,2500
CMP AL,41
JB 200B
CMP AL,50
JG 200B
MOV DX,0FFE4
SUB AL,41
MOV BL,AL
MOV CL,4F
FREQ: MOV AL,00
MOV DX,0FFE4
OUT DX,AL
MOV CH,[BX][SI]
NXTPL: NOP
NOP
NOP
```

```
NOP
DEC CH
JNZ 202F
MOV AL,0FF
OUT DX,AL
MOV CH,[BX][SI]
NXTPH: NOP
NOP
NOP
NOP
DEC CH
JNZ 203C
DEC CL
JNZ 2027
JMP 200B
```

6.INTERFACING ADCAND DAC TO 8086

AIM: To interface analog to digital converter with 8086 microprocessor through 8255 and display the digital equivalent of the analog input voltage.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS
4. CRO
5. Interfacing cable with probe

PROGRAM CODE:

```
                MOV DX,8807
                MOV AL,81
                OUT DX,AL
                MOV DX,8803
                MOV AL,00
                OUT DX,AL
                MOV DX,8807
                MOV AL,09
                OUT DX,AL
                MOV AL,08
                OUT DX,AL
                MOV AL,83
                OUT DX,AL
                INT AC
Repeat          MOV DX,8807
                MOV AL,0D
                OUT DX,AL
                MOV AL,0C
                OUT DX,AL
                MOV DX,8805
UP              IN AL,DX
```

```
                AND AL,02
                JNZ             Up
Again           IN AL,DX
                AND AL,02
                JZ              Again
                MOV AL,0B
                MOV DX,8807
                OUT DX,AL
                MOV DX,8803
                IN AL,DX
                MOV CL,AL
                MOV DX,8807
                MOV AL,0A
                OUT DX,AL
                INT AB
                MOV AL,02
                MOV DX,CX
                NOP
                MOV DH,00
                INT AE
                MOV AH,0B
                INT A1
                AND AL,FF
                JZ              Repeat
                INT A3
```

RESULT: 8255 PPI is interfaced with 8086 in mode 0 with port A, B, and C as output ports.

8255 address	PORT A	8801
	PORT B	8803
	PORT C	8805
	CWR	8807

Output:

8.DIGIT KEY INTERFACING

AIM: Write a program for digital key interfacing.

APPARATUS:

1. 8086 Trainer kit
2. Key board
3. SMPS
4. Keyboard interfacing kit.

Program:

```
DATA SEGMENT
PORTA EQU 120H
PORTC EQU 122H
CWRD EQU 123H
ARRAY DB '0123456789.+-*/%ACK=MMMM'
DATA ENDS
CODE SEGMENT
ASSUME CS: CODE,DS:DATA
START: MOV AX,DATA
MOV DS,AX ;initialise data segment
MOV AL,90H ;initialise 8255 porta as i/p and portc as o/p
MOV DX,CWRD
OUT DX,AL
REPEAT: MOV DX,PORTC ;make first row of the keyboard high through pc0
MOV AL,01
OUT DX,AL
MOV DX,PORTA
IN AL,DX ; input contents of porta and check if key is pressed-
CMP AL,00 ; in first row.
JZ NEXT
JMP FIRSTROW
NEXT: MOV DX,PORTC ;if key not found in first row, check if key is in
;second row
```

```
MOV AL,02
OUT DX,AL
MOV DX,PORTA IN
AL,DX
CMP AL,00
JNZ SECONDROW
MOV AL,04 ; if key not found then check for key closure in
;third row
MOV DX,PORTC
OUT DX,AL
MOV DX,PORTA IN
AL,DX
CMP AL,00H
JNZ THIRDROW
JMP REPEAT
FIRSTROW: CALL DELAY ;check all the keys one by onein first row
LEA SI,ARRAY
-30-
UP: SHR AL,1
JC DISPLAY ;if key found jump to the display subroutine
INC SI
JMP UP
JMP DISPLAY
SECONDROW:CALL DELAY
LEA SI,ARRAY+08H ;second row keys from array +08
UP1:SHR AL,1
JC DISPLAY ;if key found jump to the display subroutine
INC SI
JMP UP1
THIRDROW: CALL DELAY
LEA SI,ARRAY+10H ;third row keys from array +16(dec)
UP2: SHR AL,1
JC DISPLAY ;if key found jump to the display subroutine
INC SI
```

```
JMP UP2
JMP DISPLAY
DISPLAY: MOV DL,[SI]
CMP DL,97 ;24 in decimal. 8x3rows = 24keys
JZ EXIT
MOV AH,02H ; display key no in ascii
INT 21H
JMP REPEAT
DELAY: MOV BX,0FFFFH
L1: MOV CX,0FFFH L2:
DEC CX
JNZ L2
DEC BX
JNZ L1
RET
CODE ENDS
END START
EXIT:MOV AH,4CH
INT 21H
```