GOPALAN COLLEGE OF ENGINEERING AND MANAGEMENT

Bangalore-560048

DEPARTMENT OF ELECTRONICS AND COMMUNICATION

MICROPROCESSOR LABORATORY (10ECL68)

VI SEMESTER- ELECTRONICS AND COMMUNICATION ENGINEERING

LABORATORY MANUAL

ACADEMIC YEAR 2017 – 2018

MICROPROCESSOR LAB

Subject Code	: **10ECL68**	IA Marks	25
No. of Practical Hrs/Week: 03		Exam Hours	03
Total no. of Practical Hrs. 42		Exam Marks	50

I. Programs Involving

1 Data transfer instructions like:

1.1 Byte and word data transfer in different addressing modes.

1.2 Block move (with and without overlap)

1.3 Block interchange

2 Arithmetic & logical operations like:

2.1 Addition and Subtraction of multi precision nos.

2.2 Multiplication and Division of signed and unsigned Hexadecimal nos.

2.3 ASCII adjustment instructions

2.4 Code conversions

2.5 Arithmetic programs to find square cube, LCM, GCD, factorial

3 Bit manipulation instructions like checking:

3.1 Whether given data is positive or negative

3.2 Whether given data is odd or even

3.3 Logical 1's and 0's in a given data

3.4 2 out 5 code

3.5 Bit wise and nibble wise palindrome

4 Branch/Loop instructions like:

4.1 Arrays: addition/subtraction of N nos., Finding largest and smallest nos., Ascending and descending order

4.2 Near and Far Conditional and Unconditional jumps, Calls and Returns

5 Programs on String manipulation like string transfer, string reversing, searching for a string, etc.

6 Programs involving Software interrupts

note: programs to use DOS interrupt INT 21H function calls for reading a character from keyboard, buffered keyboard input, display of character/ string on console

II. Experiments on interfacing 8086 with the following interfacing modules through DIO (Digital Input/Output-PCI bus compatible) card

a. Matrix keyboard interfacing

b. Seven segment display interface

c. Logical controller interface

d. Stepper motor interface

III. Other Interfacing Programs

a. Interfacing a printer to an X86 microcomputer

b. PC to PC Communication

List of Experiments

A. INTRODUCTION TO 8086 MICROPROCESSOR

8086 Internal Block diagram

8086 is a 16-bit processor having 16-bit data bus and 20-bit address bus. The block diagram of 8086is as shown. (Refer figures 1A & 1B). This can be subdivided into two parts; the Bus Interface Unit (BIU) and Execution Unit (EU).

Bus Interface Unit:

The BIU consists of segment registers, an adder to generate 20 bit address and instruction prefetch queue. It is responsible for all the external bus operations like opcode fetch, mem read,mem write, I/O read/write etc. Once this address is sent OUT of BIU, the instruction and data bytes are fetched from memory and they fill a 6-byte First in First out (FIFO) queue.

Execution Unit:

The execution unit consists of: General purpose (scratch pad) registers AX, BX, CX and DX; Pointer registers SP (Stack Pointer) and BP (Base Pointer); index registers source index (SI) & destination index (DI) registers; the Flag register, the ALU to perform operations and a control unit with associated internal bus. The 16-bit scratch pad registers can be split into two 8-bit registers. AX □ AL, AH ; BX □ BL, BH; CX □ CL, CH; DX □ DL, DH.

Figure 1A

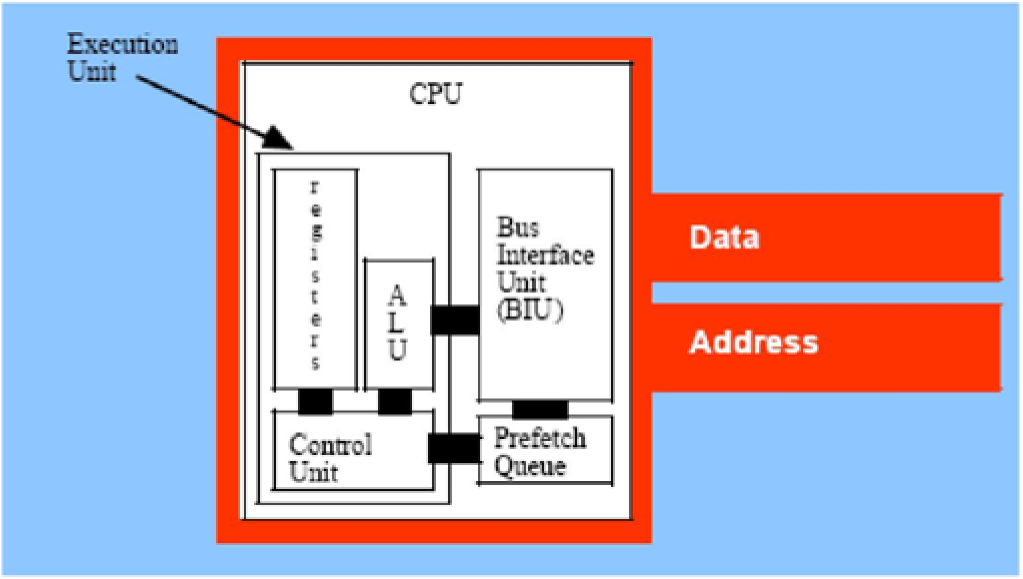
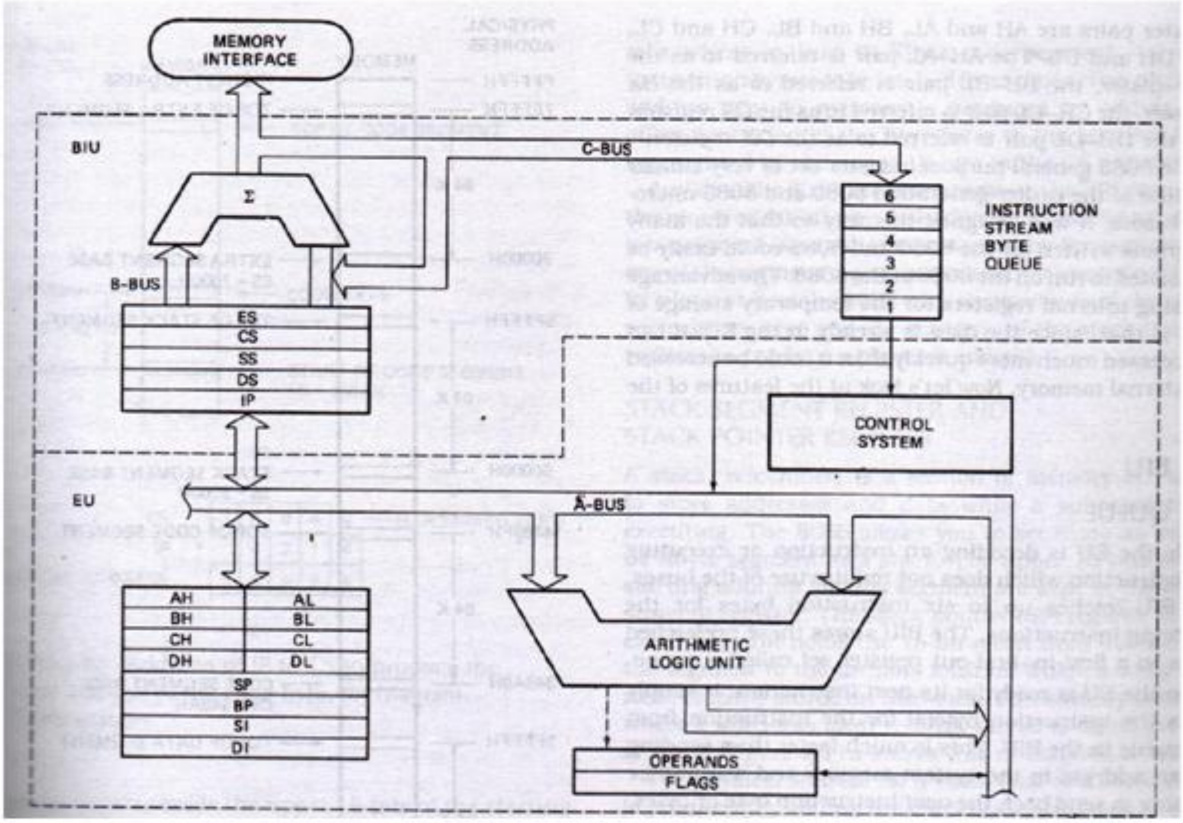


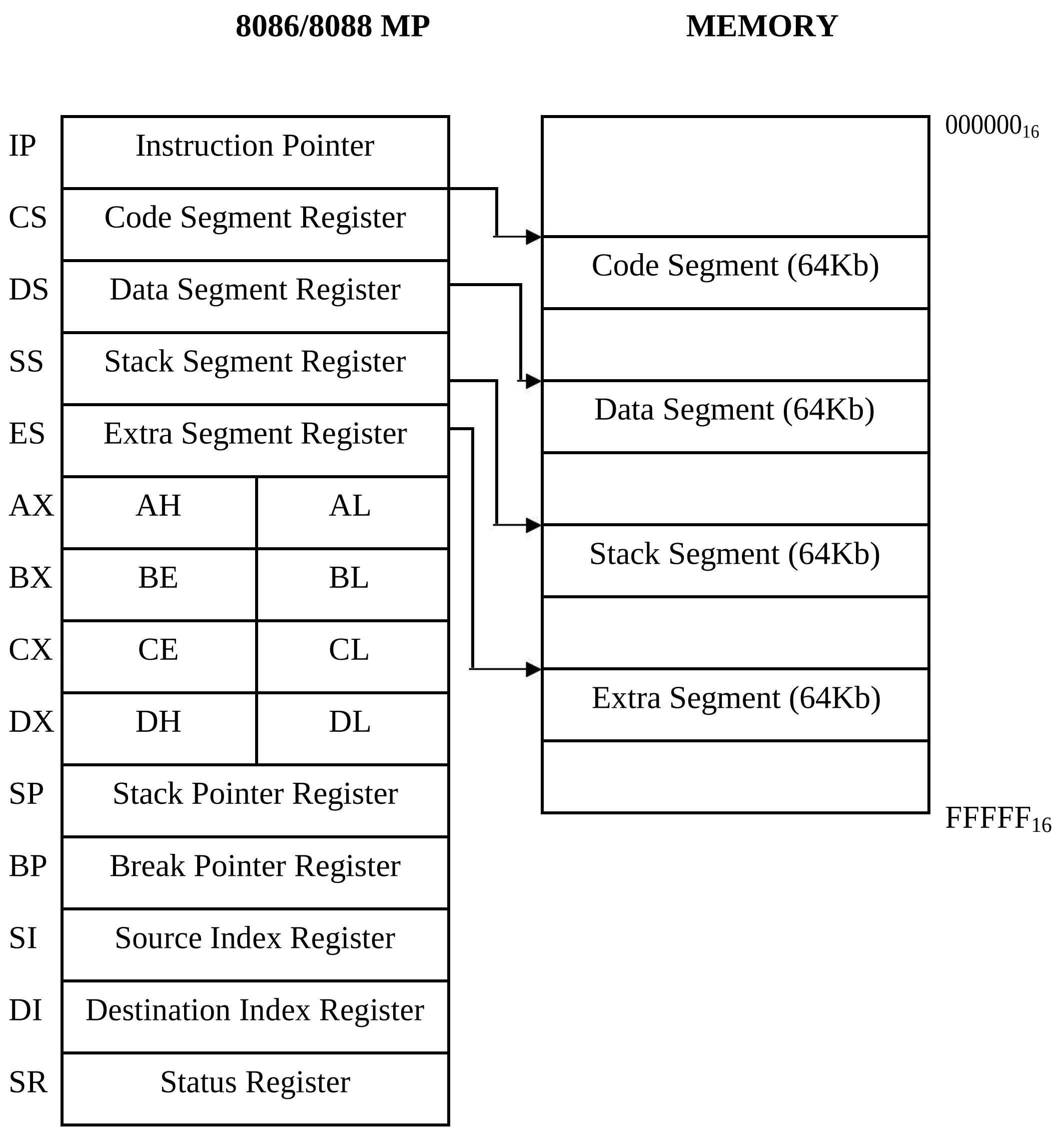
Figure 1B



Note: All registers are of size 16-bits

Different registers and their operations are listed below:

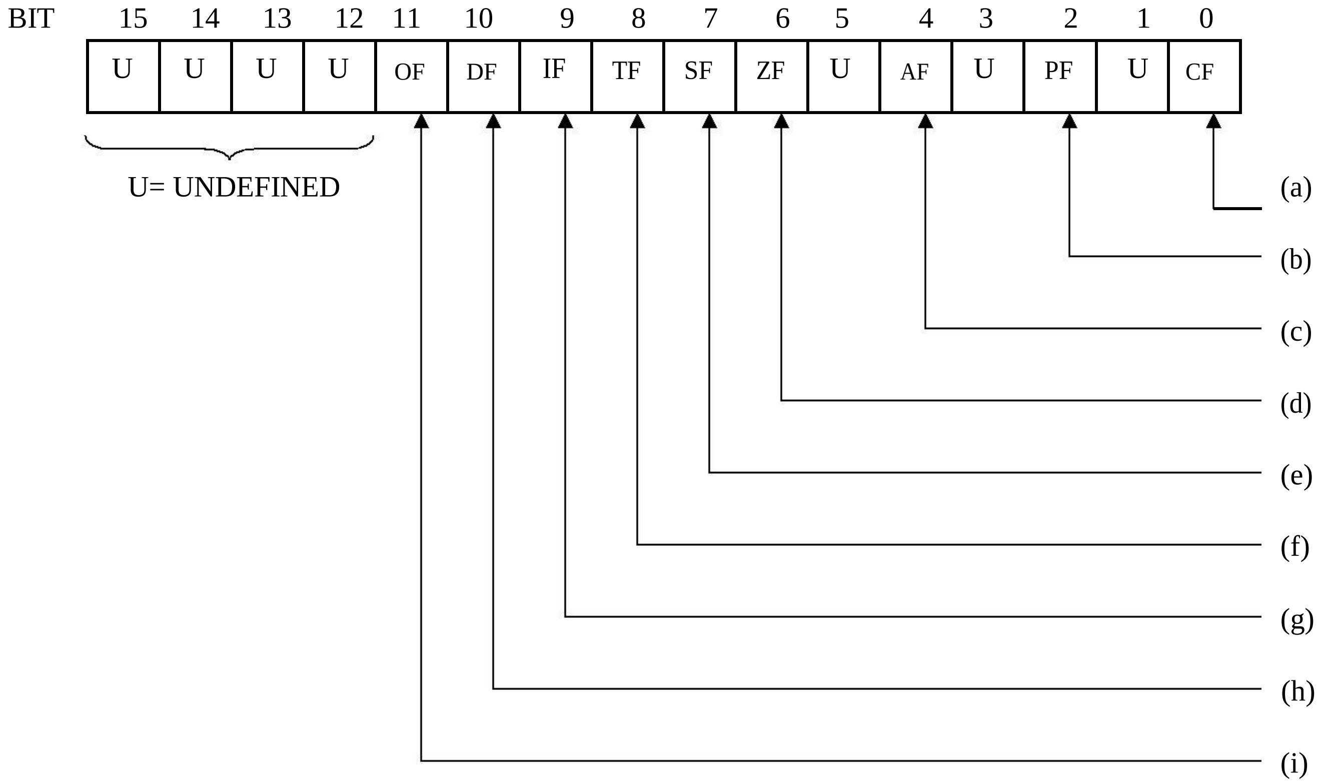
Register	Uses/Operations
AX	As accumulator in Word multiply & Word divide operations, Word I/O operations
AL	As accumulator in Byte Multiply, Byte Divide, Byte I/O, translate, Decimal Arithmetic
AH	Byte Multiply, Byte Divide
BX	As Base register to hold the address of memory
CX	String Operations, as counter in Loops
CL	As counter in Variable Shift and Rotate operations
DX	Word Multiply, word Divide, Indirect I/O


8086/8088 MP
MEMORY
IP
Instruction Pointer
CS
Code Segment Register
DS
Data Segment Register
SS
Stack Segment Register
ES
Extra Segment Register
AX
AH
AL
BX
BE
BL
CX
CE
CL
DX
DH
DL
SP
Stack Pointer Register
BP
Break Pointer Register
SI
Source Index Register
DI
Destination Index Register
SR
Status Register
000000_{16}
Code Segment (64Kb)
Data Segment (64Kb)
Stack Segment (64Kb)
Extra Segment (64Kb)
$FFFFF_{16}$

Execution of Instructions in 8086:

The microprocessor sends OUT a 20-bit physical address to the memory and fetches the first instruction of a program from the memory. Subsequent addresses are sent OUT and the queue is filled up to 6 bytes. The instructions are decoded and further data (if necessary) are fetched from memory. After the execution of the instruction, the results may go back to memory or to the output peripheral devices as the case may be.

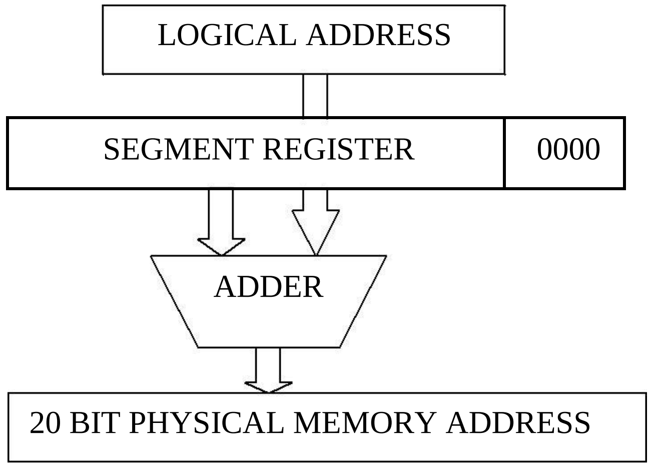
8086 Flag Register format



BIT	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	U	U	U	U	OF	DF	IF	TF	SF	ZF	U	AF	U	PF	U	CF

(a) : CARRY FLAG – SET BY CARRY OUT OF MSB
(b) : PARITY FLAG – SET IF RESULT HAS EVEN PARITY
(c) : AUXILIARY CARRY FLAG FOR BCD
(d) : ZERO FLAG – SET IF RESULT = 0
(e) : SIGN FLAG = MSB OF RESULT
(f) : SINGLE STEP TRAP FLAG
(g) : INTERRUPT ENABLE FLAG
(h) : STRING DIRECTION FLAG
(i) : OVERFLOW FLAG

Generation of 20-bit Physical Address:



Programming Models:

Depending on the size of the memory the user program occupies, different types of assembly language models are defined.

TINY □ All data and code in one segment

SMALL □ one data segment and one code segment

MEDIUM □□ one data segment and two or more code segments

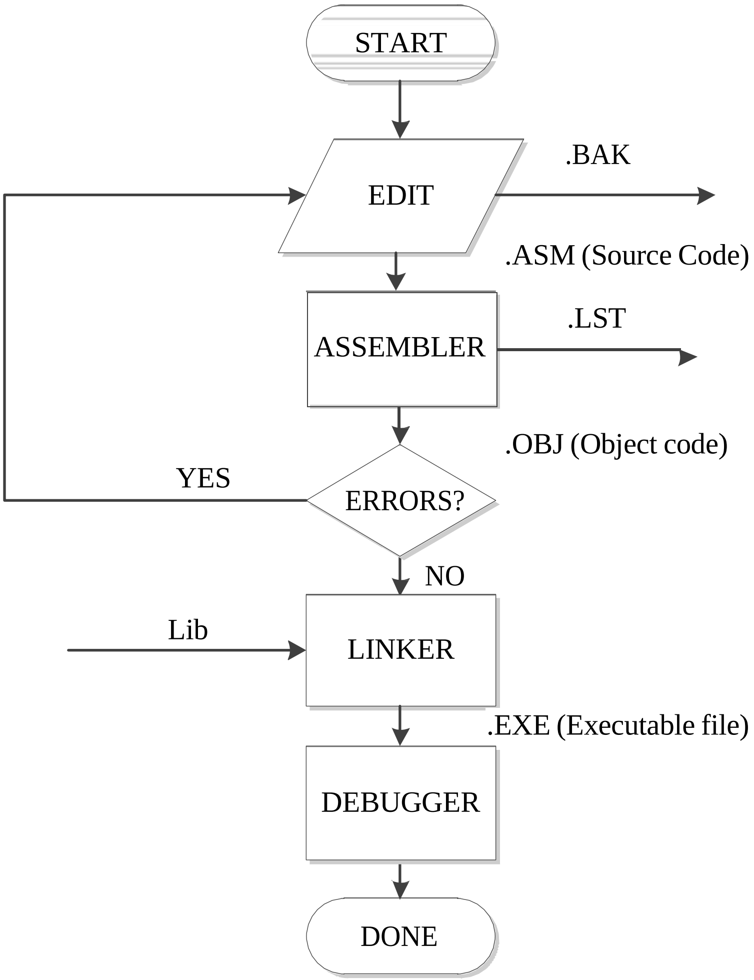
COMPACT□ □ one code segment and two or more data segments

LARGE □ □ any number of data and code segments

To designate a model, we use ".MODEL" directive.

B. TUTORIALS - Creating source code

The source code consists of 8086/8088 program memories, appropriate pseudo-Opcodes and assembler directives. The first is created with a text editor and is given an extension ASM. The text editor may be any word processor (ex., EDLIN, NE) that can produce standard ASCII code.



Assembling the program

To assemble the program two assemblers are available for the IBM-PC. They are: Microsoft Macro

Assembler (MASM) and

Borland Turbo Assembler (TASM).

Besides doing the tedious task of producing the binary codes for the instruction statements, an assembler also allows the user to refer to data items by name rather by numerical addresses. This makes the program much more readable. In addition to program instructions, the source program contains directives to the assembler. Pseudo instructions are assembler directives entered into the source code along with the assembly language.

Once the program written completely, it can be assembled to obtain the OBJ file

by executing MASM. The assembly language program file name should be mentioned along with the command.

MASM<file name.ASM>

The <file name.ASM> file that contains the assembly language program is assembled.
The assembler generates error messages if there are any error (Syntax errors).

These errors are listed along with the line number. If there are no errors then .OBJ file is created. To obtain the .EXE file the user has to LINK the .OBJ file.

LINK <file name>; or TLINK <file name>;

If a file is smaller than 64K bytes it, can be converted from an execution file to a command file (.COM). The command file is slightly different from an execution file (.EXE).

In a command file the program must be originated at location 100H before it can execute. This means that the program must be no longer than (64K-100H) in length. The command file requires less space in memory than the equivalent execution file. The system loads .COM file off the disk into the computer memory more quickly than the execution file. To create a .COM file from a .EXE file, we need the EXE2BIN converter EXE2BIN converts .EXE file to .COM or binary file.

Example: **EXE2BIN <filename><file name.com>**

The <filename> with an EXE extension is converted to <filename> with .com extension with the above command.

Test and Debug

The executable program can be run under DOS or DUBUG. As a thumb rule a program under DOS only when there is no error or it produces some not visible or audible result. If the program result is stored in registers or in memory, the result is visible. Hence it should be run using DEBUG or TD (Turbo Debugger) or code-view only. .EXE file can be loaded into memory using DEBUG.

Example: **DEBUG<filename.EXE>**

Using DEBUG it is possible to find the bugs in the program. After loading it into the memory it is possible to check and correct the errors using different commands in DEBUG. Some of the commands are as follows:

G-GO

Format:G[offset][, offset]

Action: Executes a program starting at the current location offset values are temporary breakpoints. Upon encounter of a breakpoint instruction the processor stops and displays registers and flag contents.

T – TRACE

Format: T [Instruction count]

Action: Executes one or more instructions and displays register and flag values for each of them.

Example: T: Executes only the next instructions

T5: Executes the next 5 instructions

P- PTRACE

Format: P [instruction count]

Action: Same as Trace, but treats subroutine calls, interrupts, loop instructions, and repeat String instructions as a single instruction

Q-QUIT

Format: Q

Action: Exists to dos.

N-Name the program

Format: N <filename>

Action: Name the program

W-Write the file to disk

Format: W

Action: Bytes the starting from the memory location whose address is provided by IP addresses and written as a .COM file to the disk. The number of bytes that are to be stored is indicated by the contents of the CX Register. The name of the file is to be specified by means of the N command prior to executing the W command.

R-Register

Format: R <register file name>

Action: The contents of register are displayed additionally, the register content can replace by the value entered by the user. If no register name is provided, the contents of all the register are displayed

A-Assemble

Format: A<CS: offset>

Action: This command allows us to enter the assembler mnemonics directly.

U- Unassemble

Format: U<CS: offset>

Action: This command lists a program from the memory. The memory start location is specified by CS: offset.

L-Load

Format: L[address][drive][first sector][number]

Action: Reads sectors from the disk into memory. The memory start address is provided in the command

E-Enter

Format: E<address> [list]

Action: It enables us to change the contents of the specified memory location.

List is an optional data that has to be entered.

A program can be written and debugged using the following additional techniques.

1. Very carefully define them program to solve the problem in hand and work out the best algorithm you can.
2. If the program consists of several parts, write, test and debug each part individually and then include parts one at a time.
3. If a program or program section does not work, first recheck the algorithm to make sure it really does what you want it to. You might have someone else look at it also.
4. If the algorithm seems correct, check to make sure that you have used the correct instructions to implement the algorithm. Work out on paper the effect that a series of instructions will have on some sample data. These predictions on paper can later be compared with the actual results producer when the program section runs.

5. If you don't find a problem in the algorithm or the program instruction use debugger to help you localize the problem. Use single step or trace for short program sections. For longer programs use breakpoints. This is often a faster technique to narrow the source of the problem down to a small region.

Program Development

The first step to develop a program is to know "What do I really want this program to do?" As you think about the problem, it is good idea to write down exactly what you want the program to do and the order in which you want the program to do it. At this point, no program statement is written but just the operation in general terms.

Flowcharts are graphic shapes to represent different types of program operations. The specific operation desired is written by means of graphic symbols. Flowcharts are generally used for simple programs or program sections.

Steps to convert an algorithm to assembly language:

1. Set up and declare the data structure for the algorithm you are working with.
2. Write down the instructions required for initialization at the start of the code section.
3. Determine the instructions required to implement the major actions taken in the algorithm, and decide how dada must be positioned for these instructions.
4. Insert the instructions required to get the data in correct position.

Assembler Instruction Format

The general format of an assembler instruction is

Label: Opcode & Operand, Mnemonic Operand, Operand; comments

The inclusion of spaces between label Opcode, operands, mnemonics and comments are arbitrary, except that at least one space must be inserted if no space would lead to anambiguity (e.g.. between the mnemonic and first operand). There can be no spaces within a mnemonic or identifier and spaces within string constants or comments will be included as space characters. Each statement in program consists of fields.

Label: It is an identifier that is assigned the address of the first byte of the instruction in which it appears. The presence of a label in an instruction is optional, but, if present, the label provides a symbolic name that can be used in branch instruction to branch to the instruction. If there is no label, then the colon must not be entered. All labels begin with a letter or one of the following special character: @, $,' – or?. A label may be any length from 1 to 35 characters. A label appears in a program to identify the name of memory location for storing data and for other purposes.

Opcode and Operands: The Opcode field is designed to hold the instruction Opcode. To the right of Opcode field is the operand field, which contains information used by the Opcode.

Mnemonic: All instructions must contain a mnemonic. The mnemonic specifies the operation to be executed.

Operand: The presence of the operands depends on the instruction. Some instructions have no operands; some have one operand, and some two. If there are two operands, they are separated by a comma.

Comments: The comment field is for commenting the program and may contain any combination of characters. It is optional and if it is deleted the semicolon may also be deleted. A comment may appear on a line by itself provided that the first character on the line is a semicolon.

Program Format and assembler Directives

The typical assembler program construct for 8086/8088:

```
Line 1 MODEL SMALL          ; Select small model
Line 3 Data                 ; Indicates data segment.
        ……
        ……   }  Data declaration
        Line k .code        ; indicates start of code segment
        …….
        ……..}  Program body
Line n End                  ; End of file
```

The MODEL directive selects a standard memory model for the assembly language program. A memory model may be thought of a standard blue print or configuration, which determines the way segments are linked together. Each memory model has a different set of restrictions as to the maximum space available for code and data. But the most important thing to know about model is that they affect the way that subroutines and data may be reached by program.

This table summarizes the different types of models.

Model	Description (Memory Size)
Tiny	Code and Data combined must be <=64K
Small	Code <=64K; Data<=64K
Medium	Data<=64K; Code any size
Compact	Code<=64K; Data any size
Large	Both code and data may be>64K
Huge	same as the large model, except that arrays may be Large than 64k

A program running under DOS is divided into 3 primary segments (point to by CS) contains program code; the data segment (pointed to by DS) contains the program variables, the stack segment (pointed to by SS) contains the program stack.

″ .DATA" directive (line 2) indicates the start of the data segment. It contains the program variables.

″ .CODE" directive (line k) indicates the start of the code segment. The end directive (line n) indicates the end of the program file.

Another program construct for 8086/8088

```
DATA-HERE         SEGMENT
...... }
...... }  Data declaration
DATA-HERE ENDS
CODE-HERE SEGMENT
        ASSUME CS: CODE-HERE, DS: DATA-HERE
...... }
...... }  Body of the program
CODE-HERE ENDS
END
```

User can use code view to debug the program by following the steps given below:

- Write the program in a file with .ASM extension using an editor [PRETEXT Editor which saves it in ASCII].
  Ex: EDIT TEST1.ASM
- Assemble the program using the command MASM/ZI file name;
  Ex: MASM TEST1.ASM
- Link the program using the command LINK/CO file name;
  Ex: LINK TEST1.OBJ
- To debug use
  DEBUG FILENAME.EXE

F1 – Step by step, F2 – Step by Procedure, F4 - Help

CMD > MO A ON

Switch between DOS screen and AFDEBUG screen using F6

Note: F1, F2, F4, F6 are Function Keys in Keyboard

All the command of debug can be used to display the program. You have an advantage to see the result of the program typing the variable name, instead of using dump command. The variable name is provided using "?".

Experiment No.1.1.   Date:

AN ALP TO MOVE A BLOCK OF DATA WITHOUT OVERLAP

Aim:
To Write an ALP to Move a Block of Data without Overlap

Software Required:
Masm 16 Bit

Algorithm:
1. Define block of data
2. Save memory for block transfer as block2
3. Load block1 into SI
4. Load block2 into DI
5. Initialize counter
6. Move first data into DI
7. Repeat step 6 until counter is zero
8. End

Program:

```
.MODEL SMALL
.DATA
          BLK1 DB 01,02,03,04,05,06,07,08,09,0AH BLK2 DB 10
          DUP (?)
         COUNT DW 0AH
.CODE
         MOV AX,
         @DATA MOV
         DS, AX MOV ES,
         AX
         MOV SI, OFFSET BLK1;
         MOV DI, OFFSET BLK2
         MOV CX, COUNT
AGAIN:  CLD

         REP MOVSB
         MOV
```

Pre Viva Questions:

1. List all the modern microprocessor
2. Name some 16 bit Processor (8086, 80286, 80386L, EX)
3. Name some 32 bit processors (80386DX, 80486, PENTIUM OVERDRIVE)
4. Name some 64 bit processor (Pentium, Pentium pro, Pentium II, Xeon, Pentium III, and Pentium IV)
5. List the address bus width and the memory size of all the processor

```
==================================================================================
OUTPUT:
  BEFORE EXECUTION
  ================

  AX 159F   SI 0000   CS 159E   IP 0005   Stack +0 9FB8          FLAGS 3200
  BX 0000   DI 0000   DS 159F                   +2 8E15
  CX 002E   BP 0000   ES 158E   HS 158E         +4 8ED8     OF DF IF SF  ZF AF PF CF 0
  DX 0000   SP 0000   SS 159E   FS 158E         +6 BEC0      0  0  1  0       0  0  0
  +-----------------------------------------------------------------------------
  ¦CMD >                                                 ¦1          0  1  2  3  4  5  6  7
  +------------------------------------------¦ DS:0000               00 FC F3 A4 B4 4C CD 21
  0003  8ED8          MOV   DS,AX            ¦ DS:0008     01 02 03 04 05 06 07 08
  0005  8EC0          MOV   ES,AX            ¦ DS:0010     09 0A 00 00 00 00 00 00
  0007  BE0800        MOV   SI,0008          ¦ DS:0018     00 00 00 00 0A 00 00 00
  000A  BF1200        MOV   DI,0012          ¦ DS:0020     00 00 00 00 00 00 00 00
  000D  8B0E1C00      MOV   CX,[001C]        ¦ DS:0028     00 00 00 00 00 00 00 00
  0011  FC            CLD                    ¦ DS:0030     00 00 00 00 00 00 00 00
  0012  F3A4          REP   MOVSB            ¦ DS:0038     00 00 00 00 00 00 00 00
  0014  B44C          MOV   AH,4C            ¦ DS:0040     00 00 00 00 00 00 00 00
  0016  CD21          INT   21               ¦ DS:0048     00 00 00 00 00 00 00 00
  -----------------------------------------------------------------------------


  AFTER EXECUTION
  ===============

  AX 4C9F   SI 0012   CS 159E   IP 0016   Stack +0 9FB8          FLAGS 3200
  BX 0000   DI 001C   DS 159F                   +2 8E15
  CX 0000   BP 0000   ES 159F   HS 158E         +4 8ED8     OF DF IF SF  ZF AF PF CF 0
  DX 0000   SP 0000   SS 159E   FS 158E         +6 BEC0      0  0  1  0       0  0  0
  +-----------------------------------------------------------------------------
  ¦CMD >                                                 ¦1          0  1  2  3  4  5  6  7
  +------------------------------------------¦ DS:0000               00 FC F3 A4 B4 4C CD 21
  0014  B44C          MOV   AH,4C            ¦ DS:0008     01 02 03 04 05 06 07 08
  0016  CD21          INT   21               ¦ DS:0010     09 0A 01 02 03 04 05 06
  0018  0102          ADD   [BP+SI],AX       ¦ DS:0018     07 08 09 0A 0A 00 00 00
  001A  0304          ADD   AX,[SI]          ¦ DS:0020     00 00 00 00 00 00 00 00
  001C  050607        ADD   AX,0706          ¦ DS:0028     00 00 00 00 00 00 00 00
  001F  0809          OR    [BX+DI],CL       ¦ DS:0030     00 00 00 00 00 00 00 00
  0021  0A01          OR    AL,[BX+DI]       ¦ DS:0038     00 00 00 00 00 00 00 00
  0023  0203          ADD   AL,[BP+DI]       ¦ DS:0040     00 00 00 00 00 00 00 00
  0025  0405          ADD   AL,05            ¦ DS:0048     00 00 00 00 00 00 00 00
  -----------------------------------------------------------------------------
  2          0  1  2  3  4  5  6  7    8  9  A  B  C  D  E  F ¦
  DS:0000    00 FC F3 A4 B4 4C CD 21   01 02 03 04 05 06 07 08 ¦.....L.!  ........
  DS:0010    09 0A 01 02 03 04 05 06   07 08 09 0A 0A 00 00 00 ¦........  ........
  DS:0020    00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00 ¦........  ........
  DS:0030    00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00 ¦........  ........
  DS:0040    00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00 ¦........  ........
  -----------------------------------------------------------------------------
  ================================================================================
```

Result:

The Block Of Data Defined In The Program Is Moved From Source To Destination Without Overlap Successfully.

Verification And Validation:

Output Is Verified For Different Bytes Of Data And Is Successfully Moved From Default Source Address To Destination Address Without Overlap.

Conclusion:
The Block Of Data Defined In The Program Is Moved To Destination Without Overlap And Output Is Verified.

Post Viva Questions:

1. The Memory Map Of Any Ibm Compatible Pc Consists Of Three Main Parts, Name Them [Transient Memory Area, System Area, Extended Memory System]
2. The First I Mb Of The Memory Area Is Called As …………… (Real Memory Area)
3. What Does The Tpa Hold (Interrupt Vectors, Bios, Dos, Io.Sys, Msdos, Device Drivers, Command.Com)
4. The System Area Contain Programs In …………Memory(Rom)
5. What Are The Main Two Parts Of 8086 Internal Architecture.(Biu,Eu)
6. Name The Registers In Biu (Cs, Ds, Es, Ss, Ip)

Experiment No.1.2.   Date:

Write An Alp To Move Block Of Data With Overlap

Aim:
To Write An Alp To Move Block Of Data With Overlap

Software Required:
Masm 16 Bit

Algorithm:
1. Define block of data
2. Reserve memory for block transfer as block2
3. Move block1 address to SI
4. Move block2 address to DI
5. Initialize counter
6. Point DI to block+ n
7. Move block1 data to block2
8. Repeat step 7 until counter is zero
9. End

Program:

```
.MODEL SMALL
.DATA
        BLK1 DB 01,02,03,04,05,06,07,08,09,0AH
        BLK2 DB 10 DUP (?)
.CODE
        MOV AX, @DATA               ; MOV THE STARTING ADDRESS
        MOV DS, AX
        MOV ES, AX
        MOV SI, OFFSET BLK1         ;  SET  POINTER  REG  TO  BLK1
        MOV DI, OFFSET BLK2         ;  SET  POINTER  REG  TO  BLK2
        MOV CX, 0AH                 ; SET COUNTER
        ADD SI, 0009H
        ADD DI, 0004H
AGAIN:
        MOV   AL,   [SI]
        MOV   [DI],   AL
        DEC SI
        DEC DI
        DEC CL                      ; DECREMENT COUNTER
        JNZ AGAIN                   ; TO END PROGRAM
        MOV AH, 4CH
        INT 21H
        END
```

Pre Viva Questions:

1. Name the registers in EU.(AX, BX, CX, DX, SP, BP, SI, DI)
2. Name the flag registers in 8086. (O, D, I, T, S, Z, A, P, C)
3. How is the real memory segmented?
4. What is the advantage of segmentation?
5. Name the default segment and offset register combinations.

```
================================================================================
OUTPUT:
BEFORE EXECUTION
================
                0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000        B4  4C  CD  21  01  02  03  04    05  06  07  08  09  0A  00  00
DS:0010        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
                0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000        B4  4C  CD  21  01  02  03  04    05  01  02  03  04  05  06  07
DS:0010        08  09  0A  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
```

Result:
The Block Of Data Defined In The Program Is Moved From Source To Destination With Overlap Successfully.

Verification And Validation:
Output Is Verified For Different Bytes Of Data And Is Successfully Moved From Default Source Address To Destination Address With Overlap.

Conclusion:
The Block Of Data Defined In The Program Is Moved To Destination With Overlap And Output Is Verified.

Post Viva Questions:

1. What is the relocatable program.
2. Name the three main addressing modes in 8086.
3. Name the data addressing modes. And the program addressing modes. Give examples
4. Explain MOV AL, ‘A’, MOV AX, NUMBER, MOV [BP], DL, MOV CH,[1000], MOV[BX+SI],SP, MOV ARRAY[SI],BL, MOV DH,[BX+DI+10H]

Experiment No.1.3. Date:

Program To Interchange A Block Of Data

Aim:
To Program To Interchange A Block Of Data

Software Required:
Masm 16 Bit

Algorithm:

1. Define two sets of data.
2. Load address of src to SI
3. Load address of dst to DI
4. Initialize counter
5. Interchange data in src and dst
6. Repeat step 5 until counter = 0.
7. End

Program:

```
.MODEL SMALL
.DATA
        SRC DB 10H,20H,30H,40H,50h
        DST DB 06,07,08,09,0AH  COUNT
        EQU 05
.CODE
        MOV AX, @DATA                 ; INITIALIZE THE DATA REGISTER
        MOV DS, AX
        LEA SI, SRC
        LEA DI, DST
        MOV CL, COUNT                 ; INITIALIZE THE COUNTER
BACK:
        MOV AL, [SI]
        MOV BL, [DI]
        MOV [SI], BL                  ; INTERCHANGE THE DATA
        MOV [DI], AL
        INC    SI
        INC   DI
        DEC CL
        JNZ BACK                      ; REPEAT UNTIL COUNTER BECOMES ZERO
        MOV AH, 4CH
        INT 21H
        END
```

Pre Viva Questions:

1. Name the programme memory addressing modes. (Direct, relative, indirect)
2. What is an intersegment and intrasegment jump?
3. Differentiate near and short jumps (+_32k and +127to_128 bytes)
4. Differentiate near and far jumps.

```
=================================================================================
OUTPUT:
BEFORE EXECUTION
================
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      10  20  30  40  50  06  07  08    09  0A  00  00  00  00  00  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      06  07  08  09  0A  10  20  30    40  50  00  00  00  00  00  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
```

Result:
Program Is Executed Without Errors And The Output Is Verified

Verification And Validation:
Output Is Verified And Is Found Correct

Conclusion:
The Blocks Of Data Defined In The Program Is Interchanged And Output Is Verified

Post Viva Questions:

1. Differentiate push and pop instructions.
2. Explain PUSH word ptr [BX], POP F.
3. JMP TABLE[BX]
4. Explain the following : ASSUME,DB,DD,DW,DQ,END

Experiment No.2.1.A. Date:

Write An Alp To Add 2 Multibyte No.s

Aim:
To Write An Alp To Add 2 Multibyte No.s

Software Required:
Masm 16 Bit

Algorithm :

1. Initialize the MSBs of sum to 0
2. Get the first number.
3. Add the second number to the first number.
4. If there is any carry, increment MSBs of sum by 1.
5. Store LSBs of sum.
6. Store MSBs of sum.

Program:

```
.MODEL SMALL
.DATA
        N1 DQ 122334455667788H          ; FIRST NUMBER
        N2 DQ 122334455667788H          ; SECOND NUMBER
        SUM DT ?
.CODE
        MOV AX, @DATA                   ; INITIALIZE THE DATA REGISTER
        MOV DS, AX
        LEA SI, N1                      ; POINTER TO FIRST NUMBER
        LEA DI, N2                      ; POINTER TO SECOND NUMBER
        LEA BX, SUM
        MOV CL, 04H                     ; COUNTER FOUR WORD
        CLC
BACK
:       MOV AX, [SI]                    ;MOVE FIRST WORD
        ADC AX, [DI]
        MOV [BX], AX
        INC SI
        INC    SI
        INC   DI
        INC   DI
        INC  BX
        INC  BX
        DEC CL
        JNZ BACK                        ; REPEAT UNTIL COUNTER BECOMES ZERO
        JNC OVER
        MOV AX, 0001H
        MOV [BX], AX

OVER:   MOV AH, 4CH
        INT 21H
        END
```

Pre Viva Questions:

1. 1.Give the opcode format for 8086 instructions. (op(1-2b),(mode,reg,rem),(displacement-0-2b))

2. Explain LES BX, LEA AX, DATA, LDS DI, LIST
3. Explain how the string instructions are executed.
4. List some string instructions
5. Explain the significance of REP Prefix.

```
==============================================================================
OUTPUT:
BEFORE EXECUTION
================
                0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000        88  77  66  55  44  33  22  01    88  77  66  55  44  33  22  01
DS:0010        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
                0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000        88  77  66  55  44  33  22  01    88  77  66  55  44  33  22  01
DS:0010        10  EF  CC  AA  88  66  44  02    00  00  00  00  00  00  00  00
DS:0020        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
```

Post Viva Questions:

1. Explain XCHG, LAHF, SAHF, XLAT
2. What are the two types of I/O addressing modes. (fixed port ,variable port)
3. What do you mean by segment override prefix.
4. Explain the following directives. NEAR ,FAR,BYTE PTR,ORG,OFFSET,ORG

Differentiate END, ENDP, ENDM

Result:
Program Is Executed Without Errors And The Output Is Verified

Verification And Validation:
Output Is Verified And Is Found Correct

Conclusion:

The Addition Of Two Multibye Data Is Done And The Output Is Verified

Experiment No.2.1.B. Date:

Write An Alp To Subtract Two Multibyte Numbers

Aim:

To Write An Alp To Subtract Two Multibyte Numbers

Software Required:

MASM 16 BIT

Algorithm :

1. Initialize the MSBs of difference to 0
2. Get the first number
3. Subtract the second number from the first number.
4. If there is any borrow, increment MSBs of difference by 1.
5. Store LSBs of difference
6. Store MSBs of difference

Program:

```
.MODEL SMALL
.DATA
        N1 DQ 122334455667788H          ; FIRST NUMBER
        N2 DQ 111111111111111H          ; SECOND NUMBER
        RESULT DT ?
.CODE
        MOV AX, @DATA                   ; INITIALIZE THE DATA REGISTER
        MOV DS, AX
        LEA SI, N1                      ; POINTER TO FIRST NUMBER
        LEA DI, N2                      ; POINTER TO SECOND NUMBER
        LEA BX, RESULT
        MOV CX, 04H                     ; COUNTER FOUR WORD
        CLC
BACK
:       MOV AX, [SI]                    ; MOVE FIRST WORD
        SBB AX, [DI]
        MOV [BX], AX
        INC SI
        INC SI                          ; MOVE SI, DI CONTENTS
        INC DI
        INC DI
        INC BX                          ; INCREMENT BX TO STORE RESULTS
        INC BX
        LOOP BACK
        MOV AH, 4CH
        INT 21H
        END
```

STORE THE CARRY

STOP

```
================================================================================
OUTPUT:
BEFORE EXECUTION
===============
               0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000       43  E2  F2  B4  4C  CD  21  00    88  77  66  55  44  33  22  01
DS:0010       11  11  11  11  11  11  11  01    00  00  00  00  00  00  00  00
DS:0020       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
```

```
AFTER EXECUTION
===============
               0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000       43  E2  F2  B4  4C  CD  21  00    88  77  66  55  44  33  22  01
DS:0010       11  11  11  11  11  11  11  01    77  66  55  44  33  22  11  00
DS:0020       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

================================================================================
```

Result:
Program Is Executed Without Errors And The Output Is Verified

Verification And Validation:
Output Is Verified And Is Found Correct

Conclusion:
The Subtraction Of Two Multibye Data Is Done And The Output Is Verified

Experiment No.2.2.A Date:

Write An Alp To Multiply Two 16-Bit Numbers

Aim:
To Write An Alp To Multiply Two 16-Bit Numbers

Software Required:
Masm 16 Bit

Algorithm:

1. Get The Multiplier.
2. Get The Multiplicand
3. Initialize The Product To 0.
4. Product = Product + Multiplicand
5. Decrement The Multiplier By 1
6. If Multiplicand Is Not Equal To 0,Repeat From Step (D) Otherwise Store The Product.

Program:

```
.MODEL SMALL
.STACK
.DATA

        MULTIPLICAND DW 00FFH; FIRST WORD HERE
        MULTIPLIER DW 00FFH; SECOND WORD HERE
        PRODUCT DW 2 DUP(0); RESULT OF MULIPLICATION HERE
.CODE
START:
        MOV AX, @DATA
        MOV DS, AX
        MOV AX, MULTIPLICAND
        MUL MULTIPLIER
        MOV PRODUCT, AX
        MOV PRODUCT+2, DX
        MOV AH, 4CH
        INT 21H
        END START
```

```
==============================================================================
OUTPUT:
BEFORE EXECUTION
================
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      16  0E  00  B4  4C  CD  21  00    FF  00  FF  00  00  00  00  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      16  0E  00  B4  4C  CD  21  00    FF  00  FF  00  01  FE  00  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
```

```
DS:0030      00  00  00  00  00  00  00  00     00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00     00  00  00  00  00  00  00  00
=================================================================================
```

Result:
Program Is Executed Without Errors And The Output Is Verified

Verification And Validation:
Output Is Verified And Is Found Correct

Conclusion:
The Multiplication Of Two 16 Bit Data Is Done And The Output Is Verified

Experiment No.2.2.B. Date:

Write An Alp To Divide Two Numbers

Aim:

To Write An Alp To Divide Two Numbers

Software Required:

Masm 16 Bit

Algorithm:

1. Get the dividend
2. Get the divisor
3. Initialize the quotient to 0.
4. Dividend = dividend – divisor
5. If the divisor is greater, store the quotient. Go to step g.
6. If dividend is greater, quotient = quotient + 1. Repeat from step (d)
7. Store the dividend value as remainder.

Program:

```
.MODEL SMALL
.DATA
        W1 DW 02222H
        W2 DW 1111H
        Q DW ?
        R DW ?
.CODE
        MOV AX, @DATA
        MOV DS, AX                  ; INITIALIZE DATA SEGMENT
        MOV AX, W1                  ; GET DIVIDEND
        MOV BX, W2                  ; GET DIVISOR
        DIV BX                      ; DIVIDE
        MOV Q, AX                   ; STORE QUOIENT
        MOV R, DX                   ; STORE REMAINDER
        MOV AH, 4CH
        INT 21H
        END                         ; END PROGRAM
```

```
==============================================================================
OUTPUT:
BEFORE EXECUTION
================
             0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      00  89  16  10  00  B4  4C  CD    21  00  22  22  11  11  00  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
             0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      00  89  16  10  00  B4  4C  CD    21  00  22  22  11  11  02  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
```

```
==================================================================================
```

Result:
Program Is Executed Without Errors And The Output Is Verified

Verification And Validation:
Output Is Verified And Is Found Correct

Conclusion:
The Division Of Two Numbers Is Done And The Output Is Verified

Experiment No.2.3.A. Date:

Write An Alp To Multiply Two Ascii No.S

Aim:

To Write An Alp To Multiply Two Ascii No.S

Software Required:

Masm 16 Bit

Program:

```
.MODEL SMALL
.STACK 100
.DATA
        NUM1 DB "4"                 ; NUMBER 1 (SINGLE DIGIT)
        NUM2 DB "9"                 ; NUMBER 2 (SINGLE DIGIT)
        PRODUCT DB 00, 00           ; MEMORY FOR PRODUCT
.CODE
        MOV AX, @DATA
        MOV DS, AX                  ; INITIALIZE DATA SEGMENT
        MOV DL, NUM1                ; GET NUMBER 1
        AND DL, 0FH                 ; MASK THE HIGHER NIBBLE TO GET ONLY NUMBER
        MOV AL, NUM2                ; GET NUMBER 2
        AND AL, 0FH
        MUL DL                      ; MULTIPLY TWO NUMBER
        AAM                         ; CONVERT IT IN TO ASCII FORMAT  OR
        AL, 30H
        MOV PRODUCT, AL             ; SAVE THE LOWER DIGIT
        OR AH, 30H
        MOV PRODUCT+1, AH           ; SAVE THE HIGHER
        MOV AH, 4CH
        INT 21H
        END                         ; END PROGRAM
```

```
===============================================================================
OUTPUT:
BEFORE EXECUTION
================
             0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000     00  B4  4C  CD  21  00  34  39    00  00  00  00  00  00  00  00
DS:0010     00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020     00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030     00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040     00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
             0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000     00  B4  4C  CD  21  00  34  39    36  33  00  00  00  00  00  00
DS:0010     00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020     00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030     00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040     00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00


===============================================================================
```

Result:
 Program Is Executed Without Errors And The Output Is Verified

Verification And Validation:
Output Is Verified And Is Found Correct

Conclusion:
 The Multiplication Of Two Ascii Data Is Done And The Output Is Verified

EXPERIMENT NO.2.4.A. DEVELOP AND EXECUTE AND ASSEMBLY LANGUAGE PROGRAM TO PERFORM THE CONVERSION FROM BCD TO BINARY

AIM: TO **DEVELOP AND EXECUTE AND ASSEMBLY LANGUAGE PROGRAM TO PERFORM THE CONVERSION FROM BCD TO BINARY**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
            BCD_INPUT DB 61H                ; BCD
            NUMBER IN_VALUE DB (?)
.COD
E           MOV AX, @DATA
            MOV DS, AX                      ; INITIALIZE DATA SEGMENT
            MOV AL, BCD_INPUT
            MOV BL, AL                      ; MOVE NUMBER TO AL
            REGISTER AND BL, 0FH
            AND AL, 0F0H
            MOV CL, 04H
            ROR AL, CL
            MOV BH, 0AH
            MUL BH
            ADD AL, BL
            MOV IN_VALUE, AL              ; STORE THE BINARY EQUIVALENT
            NUMBER MOV AH, 4CH
            INT 21H
            END                             ; END PROGRAM
```

```
==========================================================================
OUTPUT:
BEFORE EXECUTION
================
                 0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000         61  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0010         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
                 0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000         61  3D  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0010         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00


==========================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE CONVERSION OF NUMBER FROM BCD TO BINARY IS DONE AND THE OUTPUT IS VERIFIED

EXPERIMENT NO.2.4.B. WRITE AN ALP TO CONVERT BINARY TO BCD

AIM: TO **WRITE AN ALP TO CONVERT BINARY TO BCD**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        BIN DB 0FFH                   ; BINARY INPUT
        BCD DB 2 DUP (0)              ; STORE BCD VALUE
.CODE
        MOV AX, @DATA
        MOV DS, AX                    ; INITIALIZE DATA SEGMENT
        MOV AL, BIN                   ; MOVE BINARY NOMBER INTO AL REGISTER
        MOV BL, AL                    ; MOVE NUMBER TO AL REGISTER
        MOV CX, 0000H                 ; CLEAR CX REGISTER
        CONTENT  CMP AL, CL
        JE NEXT1
        MOV AL, 00H
BACK:
        INC CL                        ; INCREMENT CL REGISTER
        CONTENT  ADD AL, 01H
        DAA                           ; DECIMAL ADJUST AFTER ADDITION
        JNC NEXT2
        PUSH AX
        MOV  AL,  00H
        ADC  AL,  00H
        DAA
        ADD CH, AL
        POP AX
NEXT2:
        CMP BL, CL
        JNZ BACK
NEXT1:
        MOV BCD, AL                   ; STORE THE BCD INPUT VALUE
        MOV BCD+1, CH
        MOV AH, 4CH
        INT 21H
        END                           ; END PROGRAM
```

==

OUTPUT:

BEFORE EXECUTION

```
================
               0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000       CD  21  FF  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0010       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
```

AFTER EXECUTION

```
===============
               0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000       CD  21  FF  55  02  00  00  00    00  00  00  00  00  00  00  00
DS:0010       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040       00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
```

==

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE CONVERSION OF NUMBER FROM BINARY TO BCD IS DONE AND THE OUTPUT IS VERIFIED

EXPERIMENT NO.2.5.A. **WRITE AN ALP TO FIND THE SQUARE OF A NUMBER**

AIM: TO **WRITE AN ALP TO FIND THE SQUARE OF A NUMBER**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.STACK
.DATA
        X DB 08H                    ; NUMBER TO BE SQUARED
        SQR DW (?)                  ; LOCATION TO STORE NUMBER
.COD
E       MOV AX, @DATA               ; INITIALIZE DATA SEGMENT
        MOV DS, AX
        MOV AL, X
        MUL AL
        MOV SQR, AX                 ; SQUARE THE
        NUMBER MOV AH, 4CH
        INT 21H
        END                         ; END PROGRAM
```

```
=============================================================================
OUTPUT:
BEFORE EXECUTION
================
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      21  00  08  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      21  00  08  40  00  00  00  00    00  00  00  00  00  00  00  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

=============================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE SQUARE OF THE GIVEN NUMBER IS FOUND AND OUTPUT IS VERIFIED

EXPERIMENT NO.2.5.B. WRITE AN ALP TO FIND THE CUBE OF A NUMBER

AIM: TO **WRITE AN ALP TO FIND THE CUBE OF A NUMBER**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
          X DB 02H                        ; NUMBER TO BE SQUARED
          CUB DW (?)                      ; LOCATION TO STORE NUMBER
.COD
E         MOV AX, @DATA                   ; INITIALIZE DATA SEGMENT
          MOV DS, AX
          MOV AL, X                       ; STORE THE NUMBER IN AL REGISTER
          MUL AL
          MOV BL, AL
          MOV AL, X
          MUL BL
          MOV CUB, AX                     ; SQUARE THE
          NUMBER MOV CUB+2, Dx
          MOV AH, 4CH
          INT 21H
          END                             ; END PROGRAM
```

```
=============================================================================
OUTPUT:
BEFORE EXECUTION
================
               0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000        E3  A3  0D  00  8C  1E  0F  00    B4  4C  CD  21  02  00  00  00
DS:0010        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
               0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000        E3  A3  0D  00  89  16  0F  00    B4  4C  CD  21  02  08  00  00
DS:0010        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040        00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00


=============================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE CUBE OF THE GIVEN NUMBER IS FOUND AND OUTPUT IS VERIFIED

EXPERIMENT NO.2.5.C. **WRITE AN ALP TO FIND THE LCM OF TWO 16BIT NUMBERS**

AIM: TO **WRITE AN ALP TO FIND THE LCM OF TWO 16BIT NUMBERS**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        VALUE DW 0005H, 000FH       ; INITIALIZE DATA MEMORY LOCATIONS FOR THE
        OPERANDS LCM DW 2 DUP (?); AND THE CALCULATED RESULT
.CODE
        MOV AX, @DATA               ; INITIALIZE DATA SEGMENT
        MOV DS, AX
        MOV DX, 0000H               ; CLEAR DX REGISTER
        MOV AX, VALUE               ; LOAD THE FIRST NUMBER
        MOV BX, VALUE+2             ; LOAD THE SECOND
AGAIN NUMBER
:
        PUSH AX                     ; SAVE BOTH THE NUMBER ON TOP OF THE STACK
        PUSH DX
        DIV BX                      ; DIVIDE FIRST NUMBER BY THE SECOND
        CMP DX, 0000H               ; IS THERE A NUMBER?
        JE EXIT                     ; NO, TERMINATE THE PROGRAM
        POP DX                      ; YES, POP THE DATA STORED
        POP AX
        ADD AX, VALUE               ; ADD THE FIRST NUMBER TO THE CONTENTS OF AX
        JNC NOINCDX                 ; IF THE RESULT IS GREATER THAN 16-BITS INCREMENT
                                    ; DX REGISTER
        INC DX
NOINCDX:
        JMP AGAIN                   ; REPEAT TILL THE REMAINDER IS ZERO
EXIT:
        POP LCM+2                   ; POP THE LCM VALUE FROM THE TOP OF THE STACK
        POP LCM
        MOV AH, 4CH
        INT 21H
        END                         ; END PROGRAM
```

==

```
OUTPUT:
BEFORE EXECUTION
================
             0  1  2  3  4  5  6  7    8  9  A  B  C  D  E  F
DS:0000      05 00 0F 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0010      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0020      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0030      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0040      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00

AFTER EXECUTION
===============
             0  1  2  3  4  5  6  7    8  9  A  B  C  D  E  F
DS:0000      05 00 0F 00 0F 00 00 00   00 00 00 00 00 00 00 00
DS:0010      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0020      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0030      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0040      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
```

==

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE LCM OF TWO GIVEN NUMBERS IS FOUND AND OUTPUT IS VERIFIED

EXPERIMENT NO.2.5.D. **WRITE AN ALP TO FIND THE GCD OF TWO 16BIT UNSIGNED NUMBERS**

AIM: TO **WRITE AN ALP TO FIND THE GCD OF TWO 16BIT UNSIGNED NUMBERS**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
         NUM1 DW 0005H                  ; INITIALIZE DATA
         NUM2 DW 000FH
         GCD DW (?)                     ; INITIALIZE MEMORY FOR THE RESULT
.CODE
         MOV AX, @DATA                  ; INITIALIZE DATA SEGMENT
         MOV DS, AX
         MOV AX, NUM1                   ; LOAD THE FIRST NUMBER
         MOV BX, NUM2                   ; LOAD THE SECOND NUMBER
AGAIN
:        CMP AX, BX                     ; ARE THEY EQUAL?
         JE EXIT                        ; YES, SAVE THE GCD
         JB EXCH                        ; NO, IS AX<BX? ELSE YES, EXCHANGE THE NUMBERS

BACK:    MOV DX, 0000H
         DIV BX                         ; CHECK WHETHER AX IS DIVISIBLE BY BX
         CMP DX, 0000H                  ; IS THERE A NUMBER?
         JE EXIT                        ; YES, SAVE GCD
         MOV AX, DX                     ; MOVE THE REMAINDER AS NUM1 DATA
         JMP AGAIN                      ; REPEAT THE PROCEDURE TILL THERE IS NO REMAINDER

EXCH     XCHG AX, BX                    ; LOAD HIGHER NUMBER IN AX AND
         JMP BACK                       ; LOWER NUMBER IN DX AND CONTINUE

:        MOV GCD, BX                    ; SAVE THE GCD
         NUMBER  MOV AH, 4CH
         INT 21H
EXIT:    END                            ; END PROGRAM
```

```
================================================================================
OUTPUT:
BEFORE EXECUTION
================
                 0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000         93  EB  EF  89  1E  10  00  B4    4C  CD  21  00  05  00  0F  00
DS:0010         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
                 0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000         93  EB  EF  89  1E  10  00  B4    4C  CD  21  00  05  00  0F  00
DS:0010         05  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

================================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE GCD OF TWO GIVEN NUMBERS IS FOUND AND OUTPUT IS VERIFIED

EXPERIMENT NO.2.5.E. **WRITE AN ALP TO FIND THE FACTORIAL OF A GIVEN NUMBER USING RECURSIVE PROCEDURE**

AIM: TO **WRITE AN ALP TO FIND THE FACTORIAL OF A GIVEN NUMBER USING RECURSIVE PROCEDURE**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        NUM DW 8
        RESULT DW (?)               ; INITIALIZE MEMORY FOR THE RESULT
.COD
E
MAIN PROC
        MOV AX, @DATA               ; INITIALIZE DATA SEGMENT
        MOV DS, AX
        MOV AX, 01                  ; INITIALIZE RESULT AS 01 IF THE NUMBER IS 0
        MOV CX, NUM                 ; INITIALIZE NUMBER
        CMP CX, 00                  ; CHECK WHETHER NUMBER IS 0
        JE LOOP1                    ; YES, TERMINATE PROGRAM
        MOV BX, CX                  ; SAVE THE NUMBER IN BX
        CALL FACT                   ; CALL FACTORIAL PROCEDURE
LOOP1
:       MOV RESULT, AX              ; SAVE FACTORIAL RESULT
        MOV AH, 4CH
        INT 21H
MAIN ENDP                           ; END MAIN PROCEDURE


FACT PROC
        CMP BX, 01
        JZ LOOP2
        PUSH BX
        DEC BX
        CALL FACT                   ; CALL FACTORIAL
        PROCEDURE POP BX
        MUL BX
        RET                         ; RETURN CALLED PROGRAM
LOOP2
:       MOV AX, 01                  ; INITIALIZE AX REGISTER TO 01
        RET                         ; RETURN CALLED PROGRAM
FACT ENDP                           ; END FACTORIAL PROCEDURE

        END                         ; END PROGRAM
```

```
==============================================================================
OUTPUT:
BEFORE EXECUTION
================
              0  1  2  3  4  5  6  7     8  9  A  B  C  D  E  F
DS:0000      08 00 00 00 00 00 00 00    00 00 00 00 00 00 00 00
DS:0010      00 00 00 00 00 00 00 00    00 00 00 00 00 00 00 00
DS:0020      00 00 00 00 00 00 00 00    00 00 00 00 00 00 00 00
DS:0030      00 00 00 00 00 00 00 00    00 00 00 00 00 00 00 00
DS:0040      00 00 00 00 00 00 00 00    00 00 00 00 00 00 00 00

AFTER EXECUTION
===============
              0  1  2  3  4  5  6  7     8  9  A  B  C  D  E  F
DS:0000      08 00 80 9D 00 00 00 00    00 00 00 00 00 00 00 00
```

```
DS:0010        00  00  00  00  00  00  00  00     00  00  00  00  00  00  00  00
DS:0020        00  00  00  00  00  00  00  00     00  00  00  00  00  00  00  00
DS:0030        00  00  00  00  00  00  00  00     00  00  00  00  00  00  00  00
DS:0040        00  00  00  00  00  00  00  00     00  00  00  00  00  00  00  00
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE FACTORIAL OF A GIVEN NUMBER IS FOUND AND OUTPUT IS VERIFIED

POST VIVA QUESTIONS:

1. **Explain XCHG, LAHF, SAHF, XLAT**
2. **What are the two types of I/O addressing modes. (fixed port ,variable port)**
3. **What do you mean by segment override prefix.**
4. **Explain the following directives. NEAR ,FAR,BYTE PTR,ORG,OFFSET,ORG**

Differentiate END, ENDP, ENDM

EXPERIMENT NO.3.1. WRITE AN ALP TO SEPARATE ODD AND EVEN NUMBERS

AIM: TO **WRITE AN ALP TO SEPARATE ODD AND EVEN NUMBERS**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        ARRAY DB 12H, 98H, 45H, 83H, 28H, 67H, 92H, 54H, 63H, 76H  ARR_EVEN DB
        10 DUP (?)
        ARR_ODD DB 10 DUP (?)
.COD
E       MOV AX, @DATA              ; INITIALIZE THE DATA SEGMENT
        MOV DS, AX
        MOV CL, 0AH                ; INITIALIZE THE COUNTER
        XOR DI, DI                 ; INITIALIZE THE ODD POINTER
        XOR SI, SI                 ; INITIALIZE THE EVEN POINTER
        LEA BP, ARRAY

BACK    MOV AL, DS:[BP]            ; GET THE NUMBER
:       TEST AL, 01H               ; MASK ALL BITS EXCEPT LSB
        JZ NEXT                    ; IF LSB = 0 GOT TO NEXT

        LEA BX, ARR_ODD
        MOV [BX+DI], AL
        INC DI                     ; INCREMENT THE ODD
        POINTER  JMP SKIP

        LEA BX, ARR_EVEN
NEXT    MOV [BX+SI], AL
:       INC SI                     ; INCREMENT THE EVEN POINTER

        INC BP                     ; INCREMENT ARRAY BASE POINTER
        LOOP BACK                  ; DECREMENT THE
SKIP:   COUNTER  MOV AH, 4CH
        INT 21H
        END                        ; END PROGRAM
```

PRE VIVA QUESTIONS:

11. Differntiare PROC AND

2. What are the two basic formats used by assemblers. E. 3. Where are they used. (Models, full segment definition)

4. Explain ADD BYTE PTR (.model tiny (64kb), .model small(128 kb), .model huge.

5. Explain ADD BYTE PTR [DI], 3, SBB BYTE PTR [DI],5, CMP[DI], CH IMUL BYTE PTR [BX], IDIV SI, CWD, CBW.

DAA, (ONLY ON AL), AAA, AAD, AAM, AAS.

```
===============================================================================
OUTPUT:
BEFORE EXECUTION
================
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      12  98  45  83  28  67  92  54    63  76  00  00  00  00  00  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      12  98  45  83  28  67  92  54    63  76  12  98  28  92  54  76
DS:0010      00  00  00  00  45  83  67  63    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00


===============================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE ODD AND EVEN NUMBERS ARE SEPERATED AND OUTPUT IS VERIFIED

EXPERIMENT NO.3.2. WRITE AN ALP TO SEPARATE POSITIVE AND NEGATIVE NUMBERS

AIM: TO **WRITE AN ALP TO SEPARATE POSITIVE AND NEGATIVE NUMBERS**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
         ARRAY DB 12H, -98H,-45H,83H,-28H, 67H, 92H, -54H, -63H, 76H NEGI DB 10
         DUP (?)
         POSI DB 10 DUP (?)
.COD
E        MOV AX, @DATA                ; INITIALIZE THE DATA SEGMENT
         MOV DS, AX
         MOV CL, 0AH                  ; INITIALIZE THE COUNTER
         XOR DI, DI                   ; INITIALIZE THE POINTER FOR NEGATIVE NUMBER
         XOR SI, SI                   ; INITIALIZE THE POINTER FOR POSITIVE NUMBER
         LEA BP, ARRAY

BACK     MOV AL, DS:[BP]              ; GET THE NUMBER
:        TEST AL, 80H                 ; MASK ALL BITS EXCEPT MSB
         JZ NEXT                      ; IF LSB = 0 GOT TO NEXT
         LEA BX, NEGI
         MOV [BX+DI], AL
         INC DI                       ; INCREMENT THE NEGATIVE
         POINTER JMP SKIP

         LEA BX, POSI
NEXT     MOV [BX+SI], AL
:        INC SI                       ; INCREMENT THE POSITIVE POINTER

         INC BP                       ; INCREMENT ARRAY BASE POINTER
         LOOP BACK                    ; DECREMENT THE
SKIP:    COUNTER MOV AH, 4CH
         INT 21H
         END                          ; END PROGRAM
```

```
=========================================================================
OUTPUT:
BEFORE EXECUTION
================
               0  1  2  3  4  5  6  7    8  9  A  B  C  D  E  F
DS:0000        12 68 BB 83 D8 67 92 AC   9D 76 00 00 00 00 00 00
DS:0010        00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0020        00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0030        00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0040        00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00

AFTER EXECUTION
===============
               0  1  2  3  4  5  6  7    8  9  A  B  C  D  E  F
DS:0000        12 68 BB 83 D8 67 92 AC   9D 76 BB 83 D8 92 AC 9D
DS:0010        00 00 00 00 12 68 67 76   00 00 00 00 00 00 00 00
DS:0020        00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0030        00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0040        00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00

=========================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE POSITIVE AND NEGATIVE NUMBERS ARE SEPERATED AND OUTPUT IS VERIFIED

EXPERIMENT NO.3.3. WRITE AN ALP TO FIND LOGICAL ONES AND ZEROS IN A GIVEN DATA

AIM: TO **WRITE AN ALP TO FIND LOGICAL ONES AND ZEROS IN A GIVEN DATA**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        NUM DB 0FAH
        ONES DB 0
        ZEROS DB 0
.CODE
START
:       MOV AX, @DATA               ; INITIALIZE THE DATA SEGMENT
        MOV DS, AX
        MOV AL, NUM                 ; GET BYTE
        MOV CX, 08H                 ; SET COUNTER

BACK:   ROR AL, 1                   ; MOVE MSB IN CARRY
        JNC ZERINC                  ; CHECK BYTE FOR 0 AND 1
        INC ONES                    ; IF 1, INCREMENT ONE COUNT
        JMP NEXT
ZERINC:
        INC ZEROS                   ; IF 0, INCREMENT ZERO COUNTER
NEXT
:       DEC CX                      ; REPEAT UNIT CX = 0
        JNZ BACK
        MOV AH, 4CH
        INT 21H
        END START
        END                         ; END PROGRAM
=========================================================================
OUTPUT:
BEFORE EXECUTION
================
             0  1  2  3  4  5  6  7    8  9  A  B  C  D  E  F
DS:0000      21 00 FA 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0010      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0020      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0030      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0040      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00

AFTER EXECUTION
===============
             0  1  2  3  4  5  6  7    8  9  A  B  C  D  E  F
DS:0000      21 00 FA 06 02 00 00 00   00 00 00 00 00 00 00 00
DS:0010      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0020      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0030      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00
DS:0040      00 00 00 00 00 00 00 00   00 00 00 00 00 00 00 00

=========================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE NUMBER OF ONES AND ZEROS IN A GIVEN DATA ARE FOUND AND OUTPUT IS VERIFIED

EXPERIMENT NO.3.4. WRITE AN ALP TO FIND WHETHER THE GIVEN CODE BELONGS 2 OUT OF 5 CODE OR NOT

AIM: TO **WRITE AN ALP TO FIND WHETHER THE GIVEN CODE BELONGS 2 OUT OF 5 CODE OR NOT**

CODE OR NOT

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        N DB 03H
        MSG2 DB 'YOUR CODE IS 2 OUT OF 5 CODE $', 0AH, 0DH MSG3 DB
        'YOUR CODE IS NOT 2 OUT OF 5 CODE $', 0AH, 0DH
.COD
E       MOV AX, @DATA                  ; INITIALIZE THE DATA SEGMENT
        MOV DS, AX
        MOV AL, N
        MOV BL, AL
        AND AL, 0E0H
        JNZ NOT_CODE
        MOV BL, 00H
        MOV AL, N
        MOV CX, 0005H

BACK    ROR AL, 1
:       JNC SKIP
        INC BL

        DEC CX
SKIP:   JNZ BACK
        CMP BL, 02 JNZ
        NOT_CODE
        MOV DX, OFFSET MSG2
        MOV AH, 09
        INT 21H
        JMP EXIT
NOT_CODE:
        MOV DX, OFFSET MSG3
        MOV AH, 09
        INT 21H
EXIT:
        MOV AH, 4CH
        INT 21H
        END                            ; END PROGRAM
```

==

OUTPUT:

```
;C:\8086> ENTER THE FILE NAME

; YOUR CODE IS 2 OUT OF 5 CODE
```

==

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE GIVEN NUMBER IS 2 OUT OF 5 CODE AND THE OUTPUT IS VERIFIED

3.5.A. WRITE AN ALP TO CHECK BITWISE PALINDROME OR NOT

AIM: TO **WRITE AN ALP TO CHECK BITWISE PALINDROME OR NOT**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.STACK 100
        PRINTSTRING MACRO MSG
        MOV AH, 09H                 ; MACRO TO DISPLAY THE
        MESSAGE MOV DX, OFFSET MSG
        INT 21H
        ENDM
.DAT
A       NUM DB 0FFH
        TABLE DB 81H, 42H, 24H, 18H
        MSG1 DB 'THE NUMBER EXHIBITS BITWISE PALINDROME:$'
        MSG2 DB 'THE NUMBER DOESNOT EXHIBITS BITWISE PALINDROM:$'

.CODE   MOV AX, @DATA               ; INITIALIZE THE DATA SEGMENT
        MOV DS, AX
        LEA SI, TABLE
        MOV CX, 0004H               ; SET COUNTER
        XOR AX, CX                  ; CLEAR AX REGISTER

L1:     MOV AL, NUM
        AND AL, [SI] JPE
        NEXT
        PRINTSTRING MSG2            ; DISPLAY MESSAGE 2
        JMP SKIP

NEXT    INC SI                      ; INCREMENT POINTER
:       DEC CX                      ; DECREMENT
        COUNTER JNZ L1
        PRINTSTRING MSG1            ; DISPLAY MESSAGE 1

        MOV AH, 4CH
SKIP:   INT 21H
        END                         ; END PROGRAM
```

==

OUTPUT:

```
;C:\8086> ENTER THE FILE NAME

; THE NUMBER EXHIBITS BITWISE PALINDROME
```

==

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE GIVEN NUMBER EXHIBITS BITWISE PALINDROME

3.5.B. WRITE AN ALP TO CHECK WHETHER THE GIVEN NUMBER IS NIBBLEWISE PALINDROME OR NOT

AIM: TO **WRITE AN ALP TO CHECK WHETHER THE GIVEN NUMBER IS NIBBLEWISE PALINDROME OR NOT**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        DAT DW 8989H
        TEMP DW 0
        MSG1 DB 10,13,'THE NUMBER IS NIBBLEWISE PALINDROME:$'
        MSG2 DB 10,13,'THE NUMBER IS NOT A NIBBLEWISE PALINDROME:$'
.CODE
START
:       MOV AX, @DATA           ; INITIALIZE THE DATA SEGMENT
        MOV DS, AX
        MOV DX, DAT             ; GET THE WORD
        MOV BX, DX              ; MAKE A COPY OF THE WORD
        MOV CH, 02H             ; INITIALISE ROATATION COUNTER

BACK:   MOV CL, 04H             ; INITIALISE ITERATION COUNTER
        ROL DX, CL
        MOV TEMP, DX
        AND DX, 0FH
        MOV AX, BX
        AND BX, 0FH
        CMP BX, DX
        JNZ TER                 ; IF NO CARRY SKIP TOTHE NEXT INSTRUCTION
        MOV BX, AX              ; RESTORE THE CONTENTS OF BX
        MOV DX, TEMP
        ROR BX, CL              ; ROTATE THE CONTENTS OF BX RIGHT BY 4
        DEC CH                  ; DECREMENT ITERATION
        COUNTER JNZ BACK
        MOV AH, 09H             ; FUNCTION TO DISPLAY MESSAGE 1
        LEA DX, MSG1
        INT 21H
        JMP LAST

TER:    MOV AH, 09H
        LEA DX, MSG2            ; SET POINTER TO MESSAGE 2
        INT 21H

LAST:   MOV AH, 4CH
        INT 21H
        END START
        END                     ; END PROGRAM
```

==

OUTPUT:

```
;C:\8086> ENTER THE FILE NAME


;THE NUMBER IS NOT A NIBBLEWISE PALINDROME
```

==

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE GIVEN NUMBER IS NOT A NIBBLEWISE PALINDROME AND OUTPUT IS VERIFIED

POST VIVA QUESTIONS:

1. **Name the logical instructions. How can we invert number .(XOR WITH 1s)**
2. **Differentiate TEST and CMP, and NOT& NEG, SAR & SHR, RCL & ROL, SCAS & CMPS, REPE SCASB &REPNE &SCASB**
3. **Which are the flags affected. JA(Z=0 C=0), JB(C=0), JG (Z=0 S=0), JLE(Z=1 S<>0)**
   LOOP, LOOPNE, LOOPE LOOPZ
4. **Differentiate NEAR & FAR CALL, NEAR RET & FAR RET**

EXPERIMENT NO.4.1. **WRITE AN ALP TO FIND LARGEST NO FROM THE GIVEN ARRAY**

AIM: TO **WRITE AN ALP TO FIND LARGEST NO FROM THE GIVEN ARRAY**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.STACK 100
.DATA
          NUM DB 12H, 37H, 01H, 36H, 76H                   ; INITIALISE DATA
          SMALL DB (?)                    ; TO STORE LARGEST NUM
.CODE
          MOV AX, @DATA                   ; INITIALIZE THE DATA SEGMENT
          MOV DS, AX
          MOV CL, 05H                     ; SET COUNTER
          MOV AL, 00H
          LEA SI, NUM                     ; POINTER TO NUMBER
LOOP1
:         CMP AL, [SI]                    ; COMPARE 1ST AND 2ND
          NUMBER  JNC LOOP2
          MOV AL, [SI]

LOOP2 INC SI
:         DEC CL
          JNZ LOOP1
          MOV SMALL, AL
          MOV AH, 4CH
          INT 21H
          END                             ; END PROGRAM
```

PRE VIVA QUESTIONS:

1. **Explain, maskable, non maskable, vectored, non vectored, software & Hardware Interrupts.**
2. **What are interrupt vectors. (4 byte no. stored in the first 1024 bytes of memory. There are 256 interrupt vectors. Each vector contains value of CS & IP, 32 vectors are reserved for present and future. 32 to 255 are available for users.**
3. **Name the interrupt instructions. (INT, INT0, INT3)**
4. **Give significance of INT0, INT3.**

==

OUTPUT:

```
BEFORE EXECUTION
================
                 0    1    2    3    4    5    6    7      8    9    A    B    C    D    E    F
DS:0000         12   37   01   36   76   00   00   00     00   00   00   00   00   00   00   00
DS:0010         00   00   00   00   00   00   00   00     00   00   00   00   00   00   00   00
DS:0020         00   00   00   00   00   00   00   00     00   00   00   00   00   00   00   00
DS:0030         00   00   00   00   00   00   00   00     00   00   00   00   00   00   00   00
DS:0040         00   00   00   00   00   00   00   00     00   00   00   00   00   00   00   00

AFTER EXECUTION
===============
                 0    1    2    3    4    5    6    7      8    9    A    B    C    D    E    F
DS:0000         12   37   01   36   76   76   00   00     00   00   00   00   00   00   00   00
DS:0010         00   00   00   00   00   00   00   00     00   00   00   00   00   00   00   00
DS:0020         00   00   00   00   00   00   00   00     00   00   00   00   00   00   00   00
DS:0030         00   00   00   00   00   00   00   00     00   00   00   00   00   00   00   00
DS:0040         00   00   00   00   00   00   00   00     00   00   00   00   00   00   00   00

================================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE LARGEST NUMBER IN THE GIVEN ARRAY IS 76 AND OUTPUT IS VERIFIED

EXPERIMENT NO.4.2. **WRITE AN ALP TO FIND SMALLEST NO FROM THE GIVEN ARRAY**

AIM: TO **WRITE AN ALP TO FIND SMALLEST NO FROM THE GIVEN ARRAY**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.STACK 100
.DATA
        NUM DB 12H, 37H, 01H, 36H, 76H             ; INITIALISE DATA
        SMALL DB (?)                   ; TO STORE SMALLEST NUM
.CODE
        MOV AX, @DATA                  ; INITIALIZE THE DATA SEGMENT
        MOV DS, AX
        MOV CL, 05H                    ; SET COUNTER
        MOV AL, 0FFH
        LEA SI, NUM                    ; POINTER TO NUMBER
LOOP1
:       CMP AL, [SI]                   ; COMPARE 1ST AND 2ND
        NUMBER  JC LOOP2
        MOV AL, [SI]

LOOP2 INC SI
:       DEC CL
        JNZ LOOP1
        MOV SMALL, AL
        MOV AH, 4CH
        INT 21H
        END                            ; END PROGRAM
==============================================================================
OUTPUT:
BEFORE EXECUTION
================
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      12  37  01  36  76  00  00  00    00  00  00  00  00  00  00  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

AFTER EXECUTION
===============
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      12  37  01  36  76  01  00  00    00  00  00  00  00  00  00  00
DS:0010      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00

==============================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE SMALLEST IN THE GIVEN NUMBER IS 01 AND OUTPUT IS VERIFIED

EXPERIMENT NO.4.3. WRITE AN ALP TO SORT A GIVEN SET OF 16BIT UNSIGNED INTEGERS INTO ASCENDING ORDER USING BUBBLE SORT ALGORITHM

AIM: TO **WRITE AN ALP TO SORT A GIVEN SET OF 16BIT UNSIGNED INTEGERS INTO ASCENDING ORDER USING BUBBLE SORT ALGORITHM**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
           A DB 23H, 45H, 55H, 22H, 64H              ; INITIALISE DATA
        SIZE1 DW ($-A)                      ; CALCULATE SIZE OF NUMBERS
.COD
E       MOV AX, @DATA                       ; INITIALIZE THE DATA SEGMENT
        MOV DS, AX
        MOV BX, SIZE1                       ; THE NO. OF DATA BYTES IS INITIALIZE IN BX

        DEC BX
OUTLOOP:
        MOV CX, BX                          ; SAVE COUNTER IN CX REGISTER
        MOV SI, 00                          ; INITIALISE POINTER
INLOOP:
        MOV AL, A[SI]                       ; LOAD THE DATA INTO AL POINTED BY SI
        INC SI                              ; INCREMENT THE POINTER
        CMP AL, A[SI]                       ; IS CONTENT OF AL<SI POINTED
        JB NEXT                             ; YES, GO NEXT
        XCHG AL, A[SI]                      ; NO, EXCHANGE TWO DATA
        MOV A[SI-1], AL                     ; MOVE TILL END OF
        MEMORY
NEXT
:       LOOP
        INLOOP  DEC
        BX
        JNZ
        OUTLOOP
        MOV       AH,
        4CH INT 21H
        END                                 ; END PROGRAM
```

==

OUTPUT:

BEFORE EXECUTION

================

```
                 0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000         B4  4C  CD  21  23  45  55  22    64  05  00  00  00  00  00  00
DS:0010         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
```

AFTER EXECUTION

===============

```
                 0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000         B4  4C  CD  21  22  23  45  55    64  05  00  00  00  00  00  00
DS:0010         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0020         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0030         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
DS:0040         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00
```

==

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE GIVEN NUMBERS ARE ARRANGED IN ASCENDING ORDER AND THE OUTPUT IS VERIFIED

POST VIVA QUESTIONS:

1. **Give the significance of IRET instruction how is it different from RET.**
2. **(Like far RET retrieves 6 bytes from stack, two for IP, two for CS and two for flags.)**
3. **Explain the operation of real mode interrupt.**
4. **Explain the protected mode interrupt.**
5. **Explain how the interrupt flag bit IF and TF are used during an interrupt**
6. **Name the hardware and soft ware interrupt of 8086, explain about them. (NMI, INTR are hardware interrupts. INT, INT0, INT3, BOYND, are the software interrupts)**

EXPERIMENT NO.5.1. WRITE AN ALP TO TRANSFER OF A STRING IN FORWARD DIRECTION

AIM: TO **WRITE AN ALP TO TRANSFER OF A STRING IN FORWARD DIRECTION**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
            SRC DB ">CITY ENGINEERING
            COLLEGE"  DST DB 25 DUP(?)
.COD
E        MOV AX, @DATA                ; INITIALIZE THE DATA SEGMENT
         MOV DS, AX
         MOV ES, AX
         LEA SI, SRC
         LEA DI, DST
         MOV CX, 19H
         CLD                          ; CLEAR THE DIRECTION FLAG
         REP MOVSB                    ; TRANSFER THE STING BYTE TILL CX=0
         MOV AH, 4CH                  ; TERMINATE THE
         PROGRAM  INT 21H
         END                          ; END PROGRAM
```

PRE VIVA QUESTIONS:

1. **How can you expand the interrupt structure. (using 74LS 244 7 more interrupts can accommodated. Daisy chained interrupt is better as it requires only one interrupt vector.)**
2. **Give a general description of 8259 interrupt controller.**
3. **Explain the above pins of 8086 TEST, READY, RESET, BHE/S7, MN/MX, ALE, DT/R, DEN, HOLD, HLDA, SO, RO/GT1, LOCK, QS1-QS0.**
4. **Name the maximum mode pins.**
5. **Name the minimum mode pins.**

```
===============================================================================
OUTPUT:
BEFORE EXECUTION
================
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      19  00  FC  F3  A4  B4  4C  CD    21  00  3E  43  49  54  59  20  ¦......L.      !.>CITY
DS:0010      45  4E  47  49  4E  45  45  52    49  4E  47  20  43  4F  4C  4C  ¦ENGINEER      ING COLL
DS:0020      45  47  45  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦EGE.....      ........
DS:0030      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦........      ........
DS:0040      00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦........      ........

AFTER EXECUTION
===============
              0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000      19 00 FC F3 A4 B4 4C CD           21 00 3E 43 49 54 59 20 ¦......L.          !.>CITY
DS:0010      45 4E 47 49 4E 45 45 52           49 4E 47 20 43 4F 4C 4C ¦ENGINEER          ING COLL
DS:0020      45 47 45 3E 43 49 54 59           20 45 4E 47 49 4E 45 45 ¦EGE>CITY           ENGINEE
DS:0030      52 49 4E 47 20 43 4F 4C           4C 45 47 45 00 00 00 00 ¦RING COL          LEGE....
DS:0040      00 00 00 00 00 00 00 00           00 00 00 00 00 00 00 00 ¦........          ........

===============================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE GIVEN STRING IS TRANSFERRED IN FORWARD DIRECTION

EXPERIMENT NO.5.2. **WRITE AN ALP TO REVERSE STRING**

AIM: TO **WRITE AN ALP TO REVERSE STRING**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
          X DB "AKANAK"                          ; GIVEN STRING
          Z DW (Z-X)                             ; STRING LENGTH
          Y  DB (Z-X) DUP (?),'$'                ; REVISED STRING
.COD
E         MOV AX, @DATA                          ; INITIALIZE THE DATA SEGMENT
          MOV DS, AX
          LEA SI, Z-1                            ; POINTER TO LAST CHARACTER
          LEA DI, Y                              ; POINTER TO REVERSE
          CHARACTER  MOV CX, Z

L1:       MOV   AL,   [SI]
          MOV   [DI],   AL
          DEC SI
          INC   DI
          DEC
          CX
          JNZ L1
          LEA DX, Y                              ; DISPLAY THE REVERSED STRING ON THE SCREEN
          MOV AH, 4CH                            ; TERMINATE THE
          PROGRAM  INT 21H
          END                                    ; END PROGRAM
```

```
================================================================================
OUTPUT:
BEFORE EXECUTION
================
                 0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000         CD  21  41  4B  41  4E  41  4B    06  00  00  00  00  00  00  00  ¦.!AKANAK    ........
DS:0010         24  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦$.......    ........
DS:0020         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦........    ........
DS:0030         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦........    ........
DS:0040         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦........    ........


AFTER EXECUTION
===============
                 0   1   2   3   4   5   6   7     8   9   A   B   C   D   E   F
DS:0000         CD  21  41  4B  41  4E  41  4B    06  00  4B  41  4E  41  4B  41  ¦.!AKANAK    ..KANAKA
DS:0010         24  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦$.......    ........
DS:0020         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦........    ........
DS:0030         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦........    ........
DS:0040         00  00  00  00  00  00  00  00    00  00  00  00  00  00  00  00  ¦........    ........

================================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE GIVEN STRING IS REVERSED AND OUTPUT IS VERIFIED

POST VIVA QUESTIONS:

1. **Differentiate between MACRO and PROCEDURE.**
2. **What are the conditional statements used in a MACRO. (REPEAT, WHILE)**
3. **What are the different methods of reading the keyboard using DOS function calls.**
4. **How can we use XLAT instruction for look up tables.**
5. **What are the two methods of interfacing I/O (memory mapped I/O and I/O mapped I/O)**

EXPERIMENT NO.6.1. WRITE AN ALP TO SEARCH A CHARACTER IN A STRING

AIM: TO **WRITE AN ALP TO SEARCH A CHARACTER IN A STRING**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.STACK 100
.DATA
        STRING DB "COLLEGE"
        CHARACTER DB 'E'
        RESULT DB (?)
        COUNT EQU 07H
.COD
E       MOV AX, @DATA              ; INITIALIZE THE DATA SEGMENT
        MOV DS, AX
        MOV CX, COUNT              ; INITIALIZE COUNTER
        LEA SI, STRING
        MOV AL, CHARACTER          ; LOAD THE CHARACTER TO BE SEARCHED

BACK    CMP AL, [SI]               ; COMPARE EACH CHARACTER OF STRING TO THE
:       CHARACTER
                                   ; TO BE SEARCHED
        JE STROBE1
        INC SI
        DEC CX
        JNZ BACK
        JMP STROBE
STROBE1:
        MOV AL, 01H
        MOV RESULT,
        AL  JMP LAST
STROBE:
        MOV AL, 00H
        MOV RESULT,
        AL
LAST:
        MOV AH, 4CH                ; TERMINATE THE
        PROGRAM  INT 21H
        END                        ; END PROGRAM
```

PRE VIVA QUESTIONS:

1. **Name the difference between 8086,8088.**
2. **Name the difference between 8085 and 8086.**
3. **Name the types of memory used in microprocessor based system.**
4. **What is the function of the 8288 controller**
5. What are the various signals in a RAM and ROM memories.

```
================================================================================
OUTPUT:
BEFORE EXECUTION
================
              0   1   2   3   4   5   6   7    8   9   A   B   C   D   E   F
DS:0000      06  90  B0  00  A2  14  00  B4   4C  CD  21  00  43  4F  4C  4C ¦........      L.!.COLL
DS:0010      45  47  45  45  00  00  00  00   00  00  00  00  00  00  00  00 ¦EGEE....      ........
DS:0020      00  00  00  00  00  00  00  00   00  00  00  00  00  00  00  00 ¦........      ........
DS:0030      00  00  00  00  00  00  00  00   00  00  00  00  00  00  00  00 ¦........      ........
DS:0040      00  00  00  00  00  00  00  00   00  00  00  00  00  00  00  00 ¦........      ........


AFTER EXECUTION
===============
              0   1   2   3   4   5   6   7    8   9   A   B   C   D   E   F
DS:0000      06  90  B0  00  A2  14  00  B4   4C  CD  21  00  43  4F  4C  4C ¦........      L.!.COLL
DS:0010      45  47  45  45  01  00  00  00   00  00  00  00  00  00  00  00 ¦EGEE....      ........
DS:0020      00  00  00  00  00  00  00  00   00  00  00  00  00  00  00  00 ¦........      ........
DS:0030      00  00  00  00  00  00  00  00   00  00  00  00  00  00  00  00 ¦........      ........
DS:0040      00  00  00  00  00  00  00  00   00  00  00  00  00  00  00  00 ¦........      ........

================================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE GIVEN STRING IS SEARCHED AND FOUND AND OUTPUT IS VERIFIED

EXPERIMENT NO.6.2. WRITE AN ALP TO GIVEN STRING IS PALINDROME OR NOT

AIM: TO **WRITE AN ALP TO GIVEN STRING IS PALINDROME OR NOT**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        X DB "RACECAR"              ; GIVEN STRING
        z  DW (Z-X)                 ; LENGTH OF STRING
        Y DB (Z-X) DUP (?)          ; STORE REVERSED STRING
        M1 DB "NOT PALINDROME",'$'
        M2 DB "PALINDROME",'$'
.COD
E       MOV AX, @DATA               ; INITIALIZE THE DATA SEGMENT
        MOV DS, AX
        MOV ES, AX
        LEA SI, Z-1                 ; POINTER TO LAST CHARACTER IN
STRING:
        LEA DI, Y                   ; POINTER TO REVERSED STRING
        MOV CX, Z                   ; COUNTER
LOC1:
        MOV AL, [SI]                ; MOV A FIRST CHARACTER
        MOV [DI], AL
        DEC SI
        INC DI
        DEC CX
        JNZ LOC1
        LEA DX, Y
        JNZ LOC2
        LEA SI, X
        LEA DI, Y
        MOV CX, Z
        CLD                         ; CLEAR THE DIRECTION FLAG
        REPE CMPSB                  ; COMPARE THE STRING
        BYTE  JE PALIN
        LEA DX, M1
LOC2:
        MOV AH, 09H
        INT 21H
        MOV AH, 4CH
        INT 21H
PALIN:
        LEA DX, M2
        JMP LOC2
        END
```

==

OUTPUT:

```
;C:\8086> ENTER THE FILE NAME

;PALINDROME
```

==

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE GIVEN STRING IS A PALINDROME AND THE OUTPUT IS VERIFIED

POST VIVA QUESTIONS:

1. **Name the following. 8255, 8155, 8259, 8253, 8257, 8251**
2. **Give the format of control word register.**
3. **Explain the PPI you know.**
4. **Explain the modes of 8255.**
5. **Explain the basic function of 8279.**
6. **How are the delays obtained in a microprocessor based system.**
7. **What is an arithmetic coprocessor, What are its functions. (multiply, devide, ad, subtract, square root, calculate partial tangent, partial arctangent and logarithms)**

EXPERIMENT NO.7.1. WRITE AN ALP TO READ A CHARACTER FROM KEYBOARD

AIM: TO **WRITE AN ALP TO READ A CHARACTER FROM KEYBOARD**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.CODE
        MOV AX, @DATA           ; INITIALIZE THE ADDRESS OF DATA
        MOV DS, AX              ; SEGMENT IN DS
BACK
:       MOV AH, 01H             ; LOAD FUNCTION NUMBER
        INT 21H                 ; CALL DOS INTERRUPT
        CMP AL,'0'
        JZ LAST                 ; DISPLAY THE KEYS UNTIL 0 KEY IS PRESSED
        JMP BACK

LAST:   MOV AH, 4CH             ; TERMINATE THE
        PROGRAM INT 21H
        END                     ; END PROGRAM
```

==

OUTPUT:

```
;C:\TEST>ENTER THE FILE NAME AND TYPE KEYS, PRESS ZERO TO EXIT THE PROGRAM
```

==

7.2. WRITE AN ALP TO READ BUFFERED INPUT FROM THE KEYBOARD USING DOS INTERRUPTS

```
.MODEL SMALL
.DATA
        MSG DB "KEYBOARD WITH BUFFER:",'$'     ; MESSAGE FOR THE INPUT
        BUFF DB 25
        DB 00
        DB 25 DUP (?)
.COD
E       MOV AX, @DATA                 ; INITIALIZE THE ADDRESS OF DATA
        MOV DS, AX                    ; SEGMENT IN DS
        MOV AH, 09H
        MOV DX, OFFSET MSG            ; FUNCTION TO DISPLAY
        INT 21H
        MOV AH, 0AH
        MOV DX, OFFSET BUFF           ; FUNCTION TO TAKE BUFFERED
        DATA  INT21H
        MOV AH, 4CH                   ; TERMINATE THE
        PROGRAM  INT 21H
        END                           ; END PROGRAM
```

PRE VIVA QUESTIONS:

1. **What is the clock frequency of the 8086.**
2. **How are the address and data buses are separated.**

```
==================================================================================
OUTPUT:

;C:\8086> ENTER THE FILE NAME

;KEYBOARD WITH BUFFER: CITY ENGINEERING COLLEGE

==================================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE KEYBOARD FUNCTIONS ARE EXECUTED AND OUTPUT IS VERIFIED

7.3. WRITE AN ALP TO DISPLAY SINGLE CHARACTER

AIM: TO **WRITE AN ALP TO DISPLAY SINGLE CHARACTER**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.CODE
        MOV AH, 02H                 ; CALL DISPLAY CHARACTER FUNCTION
        MOV DL, 'S'                 ; MOVE THE CHARACTER TO DL
        REGISTER  INT 21H
        MOV AH, 4CH                 ; TERMINATE THE
        PROGRAM  INT 21H
        END                         ; END PROGRAM
```

```
==============================================================================
OUTPUT:

;C:\8086> ENTER THE FILE NAME DIRECTLY

; S

==============================================================================
```

7.4. WRITE AN ALP TO DISPLAY STRING ON CONSOLE

AIM: TO **WRITE AN ALP TO DISPLAY STRING ON CONSOLE**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        MSG DB 10, 13, "CITY ENGINEERING COLLEGE", '$'
.COD
E       MOV AX, @DATA               ; INITIALISE DS REGISTER
        MOV DS, AX
        LEA DX, MSG                 ; LOAD EFFECTIVE ADDRESS
        MOV AH, 09H
        INT 21H
        MOV AH, 4CH                 ; TERMINATE THE
        PROGRAM  INT 21H
        END                         ; END PROGRAM
```

```
==============================================================================
OUTPUT:

;C:\8086> ENTER THE FILE NAME

;CITY ENGINEERING COLLEGE

==============================================================================
```

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE STRING CHARACTER IS DISPLAYED AND OUTPUT IS VERIFIED

POST VIVA QUESTIONS:

1. **What do you mean by modular programming, how is it accomplished in 8086.**
2. **what are libraries.**
3. **Differentiate between MACRO and PROCEDURE.**
4. **What are the conditional statements used in a MACRO. (REPEAT, WHILE)**
5. **What are the different methods of reading the keyboard using DOS function calls.**
6. **How can we use XLAT instruction for look up tables.**

==

EXPERIMENT NO.8.1. SCAN 4*4 KEYBOARD FOR KEY CLOSURE AND DISPLAY THE CORRESPONDING KEY CODE

AIM: TO **SCAN 4*4 KEYBOARD FOR KEY CLOSURE AND DISPLAY THE CORRESPONDING**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
INITDS MACRO
        MOV AX,
        @DATA MOV
        DX, AX
ENDM

INIT8255 MACRO
        MOV     AL,
        CW      MOV
        DX, CR  OUT
        DX, AL
ENDM

INPA MACRO
        MOV DX, PA
        IN AL, DX
ENDM

OUTPC MACRO
        MOV DX, PC
        OUT DX, AL
ENDM

DISPLAY MACRO MSG
        LEA DX, MSG
        MOV AH, 09H
        INT 21H
ENDM

PRINT MACRO NUM
        MOV AL, NUM
        AAM
        MOV BX, AX
        MOV BX, 3030H

        MOV DL, BL
        MOV AH, 02H
        INIT 21H
        MOV DL, BH
        MOV AH, 02H
        INT 21H
END
M

EXIT MACRO
        MOV AH, 4CH
        INT 21H
ENDM
--------------------------------------------------------------------------------
```

```
--------------------------------------------------------------------------------
.MODEL SMALL
.DATA
          PA EQU 0D400H                    ; PORT A : INPUT PORT
          PC EQU 0D402H                    ; PORT C : OUTPUT PORT
          CR EQU 0D403H
          CW EQU 90H
          MSG1 DB 10, 13, 'ROW NO $'  MSG2
          DB 10,13 , 'COL NO $'
          MSG3 DB 10, 13, 'CODE OF THE KEY PRESSED $'  ROW
          DB 0
          COL DB 0
          KEY DB 0
.COD
E         INITDS
          INIT8255
          CALL SCAN
          DISPLAY
          MSG1  PRINT
          ROW  DISPLAY
          MSG2  PRINT
          COL  DISPLAY
          MSG3  PRINT
          KEY  EXIT

--------------------------------------------------------------------------------

SCAN PROC
START:
          MOV BH, 80H
          MOV ROW, 00H
          MOV COL, 00H
          MOV KEY, 00H
          MOV BL, 03H
NXTROW:
          ROL BH, 01H
          MOV AL, BH
          OUT PC
          MOV CX, 08H
          IN PA
NXTCOL:
          ROR AL, 01H  JC
          QUIT
          INC KEY
          INC COL
          LOOP NXTCOL
          INC ROW
          MOV COL, 00H
          DEC BL
          JMP
          NXTROW
          JMP START
QUIT:
          RET
          SCAN ENDP
          END
```

PRE VIVA QUESTIONS:

1. **How does IN and OUT instruction work?**
2. **What do you mean by control word of 8255 and how do you calculate?**

3. **What is the port size supported by 8255?**
4. **How many ports we can be accessed on interfacing 8255?**

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE PROGRAM IS EXECUTED AND KEYBOARD IS SCANNED AND OUTPUT IS VERIFIED

POST VIVA QUESTIONS:

1. **Explain different modes of operation of 8255.**
2. **How do you switch between ports while programming?**
3. **In 8x3 keyboard interface, which port points to X axis and which one to Y axis?**
4. **How is each key numbered in 8x3 Keyboard interface?**
5. **How to find the position of a bit in a byte data?**
6. **How to perform arithmetic operation using 8x3 keyboard interface?**

==

EXPERIMENT NO. 8.2. PROGRAM FOR SEVEN SEGMENT LED DISPLAY THROUGH 8255 (PCI BASED)

AIM: TO WRITE A **PROGRAM FOR SEVEN SEGMENT LED DISPLAY THROUGH 8255 (PCI BASED)**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        PORTA EQU 0D400H          ; PORT A : OUTPUT PORT
        PORTC EQU 0D402H          ; PORT C : OUTPUT PORT
        CR    EQU 0D403H
        FIRE DB 79H, 77H, 06H, 71H, 00, 00 HELP DB 00,
        00, 73H, 38H, 79H, 76H
.CODE
        MOV AX,
        @DATA MOV
        DS, AX MOV
        AL, 80H MOV
        DX, CR OUT DX,
        AL MOV CX,
AGAIN 02H

:       MOV DI, 50

DISP1:  LEA  SI,  FIRE
        CALL
        DISPLAY  DEC
        DI
        JNZ DISP1
        MOV DI, 50
DISP2:
        LEA  SI,  HELP
        CALL
        DISPLAY  DEC
        DI
        JNZ DISP2
        LOOP AGAIN
        MOV AH, 4CH
        INT 21H
DISPLAY PROC
        MOV AH, 0
BACK
:       MOV AL, AH
        MOV DX,
        PORTC OUT
        DX, AL LODSB
        MOV DX,
        PORTA OUT
        DX, AL CALL
        DELAY INC AH
        CMP AH, 6
        JNZ BACK
        RET
DISPLAY ENDP
DELAY PROC
        PUSH BX
        PUSH CX
        MOV BX, 0FFH
LOOP2   : LOOP1:
```

```
            MOV CX, 0FFFH

            LOOP LOOP1
            DEC BX
            JNZ LOOP2
            POP CX
            POP BX
            RET
    DELAY ENDP
    END
```

PRE VIVA QUESTIONS:

1. **What is the control work for the 7 segment display?**
2. **How do you calculate the 7 segment code?**
3. **How do you identify each 7 segment module in the interface kit?**
4. **What is the relevance of delay between each character display?**
5. **How does XLAT instruction work?**

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE 7 SEGMENT DISPLAY IS PROGRAMMED SUCCESSFULLY AND OUTPUT IS VERIFIED

POST VIVA QUESTIONS:

1. **Value stored in Port C is pointing to what?**
2. **Value sent through Port A is displayed in which 7 segment?**
3. **Explain the programming logic of content flashing alternatively.**
4. **Explain the programming logic of content in rolling fashion.**
5. **Explain the programming logic of content in bi-directional rolling fashion.**
6. **Explain the logic of converting a hexadecimal value to decimal equivalent.**

==

EXPERIMENT NO.8.3.A. **READS STATUS OF 8 INPUT FROM THE LOGIC CONTROLLER INTERFACE AND DISPLAY COMPLEMENT OF INPUT ON THE SAME INTERFACE**
;"AND GATE OUTPUT"

AIM: TO **READS STATUS OF 8 INPUTS FROM THE LOGIC CONTROLLER INTERFACE AND DISPLAY COMPLEMENT OF INPUT ON THE SAME INTERFACE**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        CR EQU 0D403H
        PA EQU 0D400H               ; PORT A : OUTPUT PORT
        PB EQU 0D401H
        PC EQU 0D402H               ; PORT C : INPUT PORT
.COD
E       MOV AX,
        @DATA MOV
        DS, AX

        MOV AL, 8AH
        MOV DX, CR
        OUT DX, AL

        MOV DX, PB
        IN AL, DX
        MOV BL, AL

        MOV DX, PC
        IN AL, DX

        AND AL, BL
        MOV DX, PA
        OUT DX, AL

        MOV AH, 4CH
        INT 21H

DELAY PROC NEAR
        PUSH CX
        PUSH BX
        MOV BX, 01000H
B2:
        MOV CX, 01000H
B1:
        LOOP B1
        DEC BX
        JNZ  B2
        POP BX
        POP
        CX
        RET
DELAY ENDP
END
```

==

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE LOGIC CONTROLLER IS PROGRAMMED SUCCESSFULLY AND OUTPUT IS VERIFIED

==

EXPERIMENT NO.8.3.B. READS STATUS OF 8 INPUT FROM THE LOGIC CONTROLLER INTERFACE AND DISPLAY COMPLEMENT OF INPUT ON THE SAME INTERFACE

AIM: TO **READS STATUS OF 8 INPUTS FROM THE LOGIC CONTROLLER INTERFACE AND DISPLAY COMPLEMENT OF INPUT ON THE SAME INTERFACE**

;"RING COUNTER"

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        CR EQU 0D403H
        PA EQU 0D400H                   ; PORT A : OUTPUT PORT
        PB EQU 0D401H
        PC EQU 0D402H
.COD
E       MOV AX,
        @DATA MOV
        DS, AX MOV
        AL, 80H MOV
        DX, CR OUT DX,
        AL

        MOV AL, 01H
        MOV CX, 0AH
BACK
:       MOV DX, PA
        OUT DX, AL
        CALL DELAY
        ROR AL, 01
        LOOP   BACK

        MOV AH, 4CH
        INT 21H

DELAY PROC NEAR
        PUSH CX
        PUSH BX
        MOV BX, 0FFFFH
B2:
        MOV CX, 0FFFFH
B1:
        LOOP B1
        DEC
        BX  JNZ
        B2  POP
        BX
        POP
        CX
        RET
DELAY ENDP
END
```

==

PRE VIVA QUESTIONS:

1. **Value stored in Port C is pointing to what?**
2. **Value sent through Port A is displayed in which 7 segment?**
3. **Explain the programming logic of content flashing alternatively.**
4. **Explain the programming logic of content in rolling fashion.**
5. **Explain the programming logic of content in bi-directional rolling fashion.**
6. **Explain the logic of converting a hexadecimal value to decimal equivalent.**

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: : THE LOGIC CONTROLLER IS PROGRAMMED SUCCESSFULLY AND OUTPUT IS VERIFIED

POST VIVA QUESTIONS:

1. **Explain the logic of programming logic controller.**
2. **Can I make B port as output port and display information?**
3. **What is the relevance of delay in the program?**
4. **Explain the programming logic of Johnson's counter**

==

EXPERIMENT NO. 8.4. PROGRAM TO ROTATE THE STEPPER MOTOR IN CLOCK-WISE DIRECTION (8 STEPS)

AIM: TO **PROGRAM TO ROTATE THE STEPPER MOTOR IN CLOCK-WISE DIRECTION (8 STEPS)**

SOFTWARE REQUIRED: MASM 16 BIT

PROGRAM:

```
.MODEL SMALL
.DATA
        CR  EQU  0E803H
        PA  EQU  0E800H
        PB EQU 0E801H
        PC EQU 0E802H                   ; PORT C : OUTPUT PORT
.COD
E       MOV AX,
        @DATA MOV
        DS, AX MOV
        AL, 80H MOV
        DX, CR OUT DX,
        AL

        MOV AL, 88H
        MOV CX, 200
BACK
:       MOV DX, PC
        OUT DX, AL
        CALL DELAY
        ROR AL, 01
        LOOP BACK
        MOV AH, 4CH
        INT 21H

DELAY PROC NEAR
        PUSH CX
        PUSH BX
        MOV BX, 01FFFH
B2:
        MOV CX, 1FFFH
B1:
        LOOP B1
        DEC
        BX  JNZ
        B2  POP
        BX
        POP
        CX
        RET
DELAY ENDP
END
```

==

PRE VIVA QUESTIONS:

1. **Explain the internals of a stepper motor.**
2. **Explain the programming logic of a stepper motor.**
3. **How do you initiate a clock-wise rotation in stepper motor? What is logic in sending the value to port?**

4. **How do you initiate anti clock-wise rotation?**

RESULT: PROGRAM IS EXECUTED WITHOUT ERRORS AND THE OUTPUT IS VERIFIED

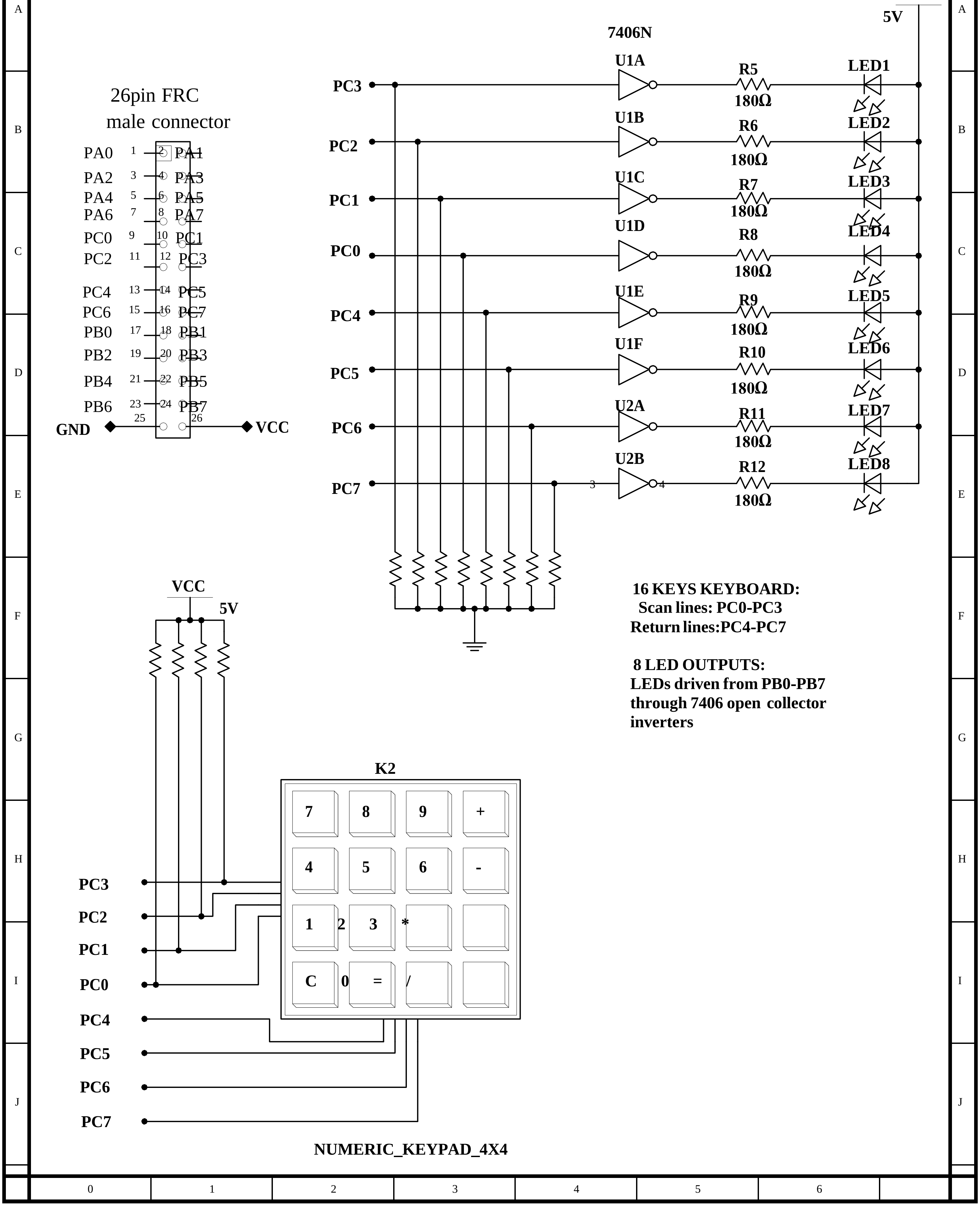
VERIFICATION AND VALIDATION: OUTPUT IS VERIFIED AND IS FOUND CORRECT

CONCLUSION: THE STEPPER MOTOR IS PROGRAMMED SUCCESSFULLY AND OUTPUT IS VERIFIED

POST VIVA QUESTIONS:

1. **How do you initiate anti clock-wise rotation?**
2. **What is relevance of delay in stepper motor?**
3. **Mention few application of stepper motor.**
4. **How many ports we can be accessed on interfacing 8255?**
5. **Explain different modes of operation of 8255.**
6. **How do you switch between ports while programming?**

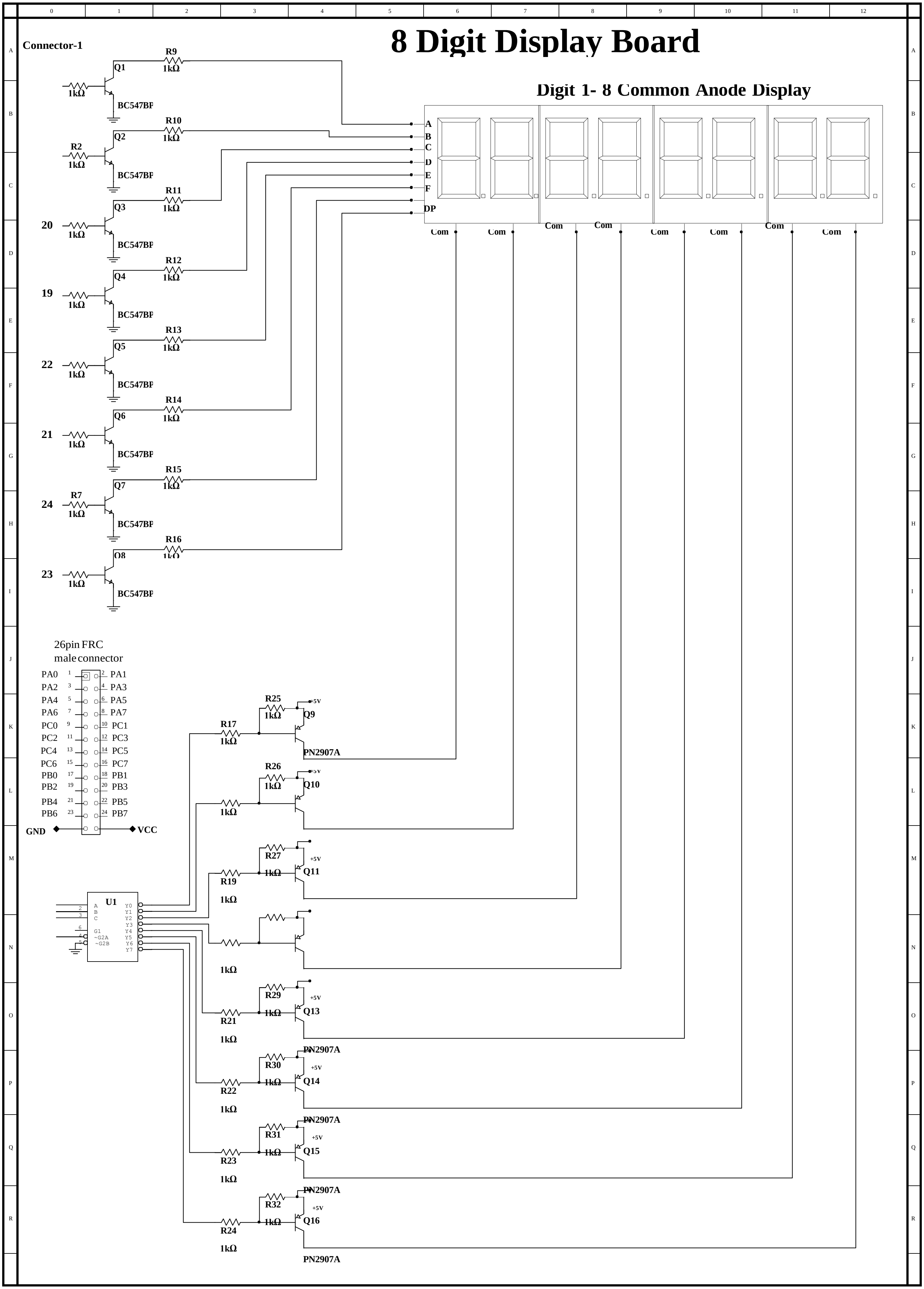
KEYBOARD CUM CALCULATOR INTERFACE CARD



16 KEYS KEYBOARD:
Scan lines: PC0-PC3
Return lines:PC4-PC7

8 LED OUTPUTS:
LEDs driven from PB0-PB7
through 7406 open collector
inverters

8 Digit Display Board



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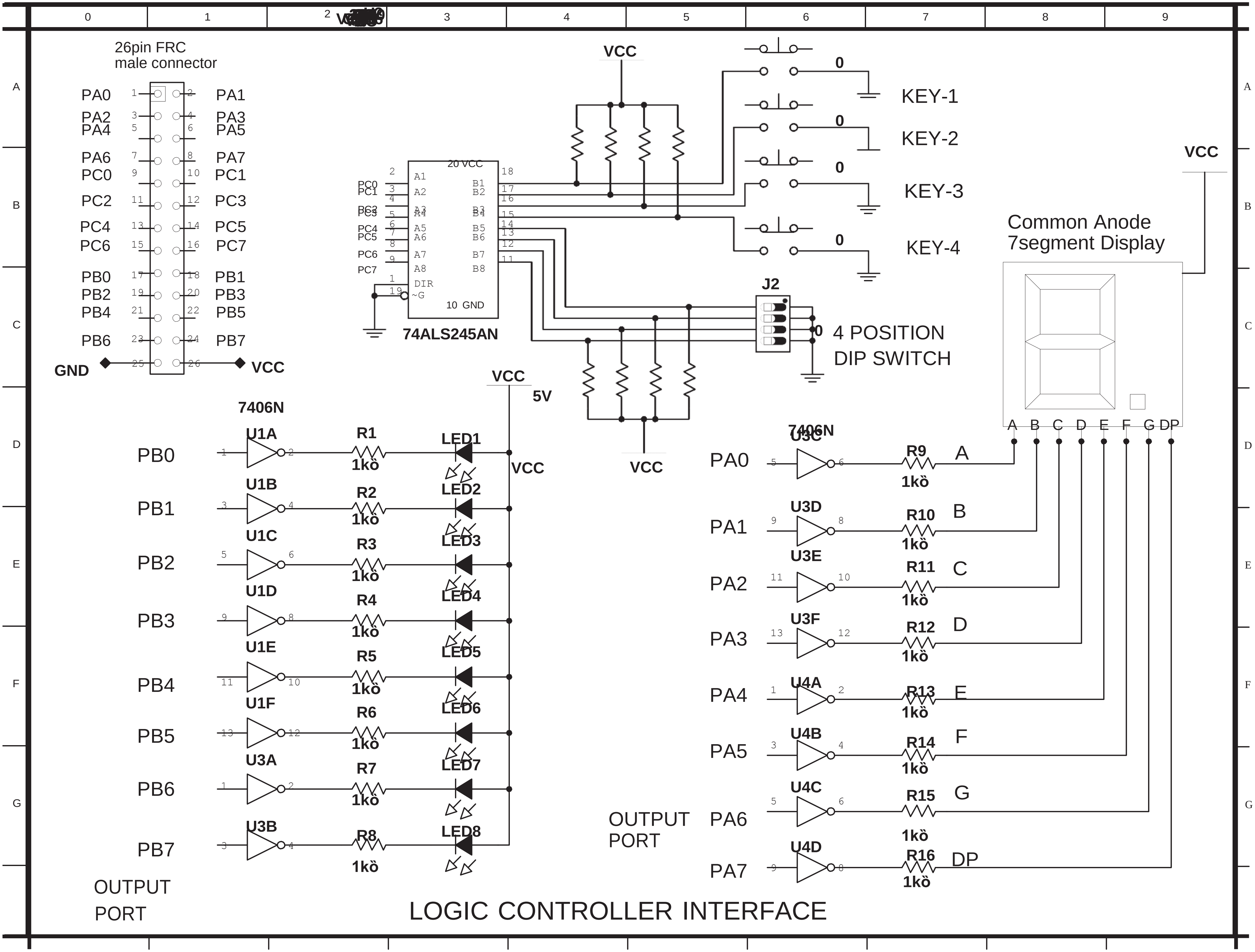

LOGIC CONTROLLER INTERFACE