CHANNABASAVESHWARA INSTITUTE OF TECHNOLOGY. GUBBI

MICROPROCESSORS LAB MANUAL (10CSL48)

IV SEM CSE

BY: CHETAN BALAJI

ASSOCIATE PROFESSOR

DEPT OF CSE

2015-16

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

QMP 7.1 D/F

Channabasaveshwara Institute of Technology

(An ISO 9001:2008 Certified Institution)

NH 206 (B.H. Road), Gubbi, Tumkur – 572 216.Karnataka.

Department of Computer Science & Engineering

MICROPROCESSORS LAB

10CSL48

B.E - IV Semester

Lab Manual 2015-16

Name :______________________________________

USN :______________________________________

Batch : ___________________ Section : ___________

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NH 206 (B.H. Road), Gubbi, Tumkur – 572 216.Karnataka.

Department of Computer Science & Engineering

MICROPROCESSORS LAB

Version 1.0

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DEPT OF CSE

Channabasaveshwara Institute of Technology

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NH 206 (B.H. Road), Gubbi, Tumkur – 572 216.Karnataka.

SYLLABUS

MICROPROCESSORS LABORATORY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Subject Code : 10CSL48	I.A. Marks : 25
Hours/Week : 03	Exam Hours : 03
Total Hours : 42	Exam Marks : 50

PART – A

Note:

- *Develop and execute the following programs using an 8086 Assembly Language. All the programs to be executed using an assembler like MASM, TASM etc.*
- *Program should have suitable comments.*
- *The board layout and the circuit diagram of the interface are to be provided to the student during the examination.*

1. **a)** Search a key element in a list of 'n' 16-bit numbers using the Binary search algorithm.
   b) Read the status of eight input bits from the Logic Controller Interface and display 'FF' if it is even parity bits otherwise display 00. Also display number of 1's in the input data.

2**. a)** Write two ALP modules stored in two different files; one module is to read a characterfrom the keyboard and the other one is to display a character. Use the above two modules to read a string of characters from the keyboard terminated by the carriage return and print the string on the display in the next line.
b)Implement a BCD Up-Down Counter on the Logic Controller Interface.

3. **a)** Sort a given set of 'n' numbers in ascending order using the Bubble Sort algorithm.
   b) Read the status of two 8-bit inputs (X & Y) from the Logic Controller Interface and display X*Y.

4. **a)** Read an alphanumeric character and display its equivalent ASCII code at the center ofthe screen.
   b) Display messages FIRE and HELP alternately with flickering effects on a 7-segment display interface for a suitable period of time.Ensure a flashing rate that makes it easy to read both the messages (Examiner does not specify these delay values nor it is necessary for the student to compute these values).

5. **a)** Reverse a given string and check whether it is a palindrome or not.
   b) Assume any suitable message of 12 characters length and display it in the rolling fashion on a 7-segment display interface for a suitable period of time. Ensure a flashing rate that makes it easy to read both the messages. (Examiner does not specify these delay values nor it is necessary for the student to compute these values).

6. **a)** Read two strings, store them in locations STR1 and STR2. Check whether they are equal or not and display appropriated messages. Also display the length of the stored strings.
   b) Convert a 16-bit binary value (assumed to be an unsigned integer) to BCD and display it from left to right and right to left for specified number of times on a 7-segment display interface.

7. **a)** Read your name from the keyboard and display it at a specified location on the screen in front of the message what is your name? You must clear the entire screen before display.

b)Scan a 8 x 3 keypad for key closure and to store the code of the key pressed in a memory location or display on screen. Alsodisplay row and column numbers of the key pressed.

8. **a)** Compute the factorial of a positive integer 'n' using recursive procedure.

b)Drive a Stepper Motor interface to rotate the motor in specifieddirection (Clockwise or counter-clockwise) by N steps (Directionand N are specified by the Examiner).Introduce suitable delaybetween successive steps. (Any arbitrary value for the delay maybe assumed by the student).

9. **a)** Read the current time from the system and display it in the standard format on the screen.
   b) Generate the Sine Wave using DAC interface (The output of the DAC is to be displayed on the CRO).

10**. a)** Write a program to simulate a Decimal Up-counter to display 00- 99.

b) Generate a Half Rectified Sine wave form using the DAC interface. (The output of the DAC is to be displayed on the CRO).

11. **a)** Read a pair of input co-ordinates in BCD and move the cursor to the specified location on the screen.
b) Generate a Fully Rectified Sine waveform using the DAC interface. (The output of the DAC is to be displayed on the CRO).

12. **a)**Write a Program to create a file (input file) and to delete an existing file.
b) Drive an elevator interface in the following way:

i. Initially the elevator should be in the ground floor, with all requests in OFF state.

ii. When a request is made from a floor, the elevator should move to that floor, wait there for a couple of seconds, and then come down to ground floor and stop. If some requests occur during going up or coming down they should be ignored.

Note: In the examination each student picks one question from a lot of all 12 questions

1. INDEX PAGE

Sl. No	Name of the Experiment	Date			Manual Marks (Max . 25)	Record Marks (Max. 10)	Signature (Student)	Signature (Faculty)
		Conduction	Repetition	Submission of Record				
Average								

Note: If the student fails to attend the regular lab, the experiment has to be completed in the same week. Then the manual/observation and record will be evaluated for 50% of maximum marks.

INSTRUCTIONS TO THE CANDIDATES

1. Students should come with through preparation for the experiments to be conducted.
2. Students will not be permitted to attend the laboratory unless they bring the practical record fully completed in all respects pertaining to the experiment conducted in the previous class.
3. Experiment/Execution should be started only after the staff-in-charge has checked the circuit diagram/coding
4. All the calculations should be made in the observation book. Specimen calculations for one set of readings have to be shown in the practical record.
5. Wherever graphs are to be drawn, A-4 size graphs only should be used and the same should be firmly attached to the practical record.
6. Practical record should be neatly maintained.
7. They should obtain the signature of the staff-in-charge in the observation book after completing each experiment.
8. Theory regarding each experiment should be written in the practical record before procedure in your own words.

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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MASM COMMANDS:

C :/>cd foldername

C:/foldername>edit filename.asm

After this command executed in command prompt an editor window will open. Program should be typed in this window and saved. The program structure is given below.

Structure of Program:

.model tiny/small/medium/large

.Stack <some number>

```
.data
        ; Initialize data
        ; which is used in program.
.code
        ; Program logic goes here.
        ;
end
```

To run the program, the following steps have to be followed:

C:/foldername>masm filename.asm

After this command is executed in command prompt if there are no errors in program regarding to syntax the assembler will generates an object module as discuss above.

C:/foldername>link filename.obj

After verifying the program for correct syntax and the generated object files should be linked together. For this the above link command should be executed and it will give an EXE file if the model directive is small as discuss above.

C:/foldername>debug filename.exe

After generating EXE file by the assembler it's the time to check the output. For this the above command is used and the execution of the program can be done in different ways. It is as shown below:

__ g ; complete execution of program in single step.

__ t ; Stepwise execution.

__d ds: starting address or ending address ; To see data in memory locations

__p ; Used to execute interrupt or procedure during stepwise execution of program

__ q ; To quit the execution.

SAMPLE PROGRAMS:

1. Write an ALP to move the data between the Registers.

```
.model tiny
.data
        num1 db 50h
        num2 dw 1234h

.code
        mov ax,@data
        mov ds,ax       ;DATA SEGMENT INITIALIZATION

        mov al,num1
        mov ah,al
        mov bh,ah
        mov bl,al       ;MOVES BYTE LENGTH OF DATA FROM REG.AL TO REG.BL

        mov cx,num2
        mov dx,cx
        mov si,ax
        mov di,si       ;MOVES WORD LENGHT OF DATA FROM REG.CX TO REG.DX

        int 3           ;TERMINATES THE PROGRAM EXECUTION


end
```

2. Write and ALP to move immediate data to Registers.

```
.model tiny
.code
          mov al,10h
          mov ah,10
          mov cl,50h
          mov ch,50       ;MOVES IMMEDIATE VALUE TO 8 BIT REGISTER

          mov bx,1234h
          mov dx,1234     ;MOVES IMMEDIATE VALUE TO 16 BIT REGISTER

          mov si,4000h
          mov di,2000h

          int 3           ;TERMINATE THE PROGRAM EXECUTION
end
```

3. Write an ALP to add two numbers and to store the result in the specified destination.

```
.model small

.data
        num1 db 05h
        num2 db 06h
        num3 dw 1234h
        num4 dw 0002h
        sum db ?
        sum2 dw ?

.code
        mov ax,@data
        mov ds,ax               ;INITIALIZES DATA SEGMENT

        mov al,num1
        mov bl,num2
        add al,bl               ;ADD THE 2 BYTES
        mov sum,al              ;STORES THE RESULT IN MEMORY

        mov cx,num3
        add cx,num4             ;ADD THE 2 WORDS
        mov sum2,cx             ;STORES THE RESULT IN MEMORY

        int 3                   ;TERMINATE THE PROGRAM EXECUTION

        align 16                ;DS STARTS FROM PAGE BOUNDARY
end
```

4. Write and ALP to multiply two 16-bit numbers and to store the result in the specified location.

```
.model small

.data
          num1 dw 1234h
          num2 dw 0ffffh
          res dw 5 dup(0)

.code
          mov ax,@data
          mov ds,ax        ;INITIALIZATION OF DATA SEGMENT
```

```
        mov ax,num1
        mov dx,num2
        mul dx              ;MULTIPLIES 2 16-BIT NUMBERS

        mov res,ax
        mov res+2,dx    ;STORES THE IN MEMORY

        int 3               ;TERMINATE THE PROGRAM EXECUTION
        align 16            ;DS STARTS FROM PAGE BOUNDARY
end
```

5. Write an ALP to divide a 32-bit Unsigned number by a 16-bit Unsigned number and to store the quotient and remainder in the specified location.

```
.model small

.data
      dvd dd 12345678h
      dvr dw 0ffffh
      quot dw ?
      remd dw ?

.code
        mov ax,@data
        mov ds,ax       ;INITIALIZATION OF DATA SEGMENT

        mov si,offset dvd
        mov ax,word ptr[si]
        mov dx,word ptr[si+2]

        mov cx,dvr
        div cx

        mov quot,ax
        mov remd,dx

        int 3           ;TERMINATES THE PROGRAM EXECUTION
        align 16        ;DS STARTS FROM PAGE BOUNDARY
end
```

6. Write an ALP to illustrate the operation of AAA instruction. Use Macros

```
.model small

.data
read macro              ;Start of a macro
mov ah,01h              ;read a single key stroke
int 21h
endm                    ;end of macro

.code
        mov ax,@data
        mov ds,ax       ;INITIALIZATION OF DATA SEGMENT

        read            ;CALL MACRO READ
        mov bl,al       ;STORE THE READ KEY IN BL REGISTER

        read
        mov cl,al

        add al,bl       ;ADD AL WITH BL AND STORES THE RESULT IN AL.

        mov dl,al
        mov ah,0
        aaa             ;ADJUST THE AL VALUE TO UNPACKED BCD

        mov si,ax

        int 3           ;TERMINATES THE PROGRAM EXECUTION
end
```

LAB PROGRAMS:

Program No.01.A. **Date:**

BINARY SEARCH

AIM:

Search a key element in a list of 'n' 16-bit numbers using the Binary search algorithm.

```
.model small

.data                                        ;start of the data segment

        arr   dw 0111h,0112h,0113h,0114h,0115h   ; 'n' elements to be searched
        len   dw ($-arr)/2
        key   equ 0116h                          ; key element to be searched
        msg1  db "found$"
        msg2  db "not found$"

.code                                        ; start of the code segment

        mov ax,@data                         ;initialization of data segment
        mov ds,ax

        mov bx,00                            ; first data position to bx.
        mov dx,len                           ; last data position to dd.
        mov cx,key

again:  cmp bx,dx
        ja notfnd

        mov ax,bx
        add ax,dx
        shr ax,1                             ;Get the middle element of array
        mov si,ax
        add si,si

        cmp cx,arr[si]                       ;compare the key with middle
        jae big                              ; element of array


        dec ax
        mov dx,ax                            ;last element of new array to dx
        jmp again
```

```
big:     je found
         inc ax

         mov bx,ax
         jmp again


found:   lea dx,msg1          ;content of the string to be displayed.
         jmp displ

notfnd:  lea dx,msg2          ;content of the string to be displayed.

displ  : mov ah,09h
         int 21h
         int 3                ; Terminates the execution
end                           ;end of program
```

Conclusion:

This program performs a search for a key element in an array. If the search element is found it will display a message '**found**'. As the search element (key element in program) is not present in the given array it will display a message '**not found**'.

Date: **Signature of the staff**

Program No.01. B. **Date:**

LOGIC CONTROLLER-ODD AND EVEN PARITY

AIM:

Read the status of eight input bits from the Logic Controller Interface and display FF if it is even parity bits otherwise display 00.

```
.model small
.data
        pa      equ 0d800h          ; Port address
        pb      equ 0d801h
        pc      equ 0d802h
        ctrl    equ 0d803h          ; control Register address
.code
start:  mov     ax, @data
        mov     ds, ax              ; Initialization of data segment

        mov     dx, ctrl
        mov     al, 82h             ; move the control word to 'al' register
        out     dx, al              ; move the control word to control register

        mov     dx, pb              ; Get the input data form 'pb'
        in      al, dx              ; Get the input data to AL register
        mov     bl, 00h
        mov     cx, 08              ; number of rotations
up:     rcl     al,1
        jnc     down                ; after each rotation check for the carry flag
        inc     bl                  ; If there is a carry, increment the 'BL' register
down:   loop    up                  ; Repeat rotation for '08' times

        test    bl,01h              ; perform 'AND' operation to check for even or odd   parity
        jnz     oddp                ; If the result of the 'AND' is not zero, it is odd parity

        mov     al,0ffh             ; If even parity display 0ffh
        jmp     next
oddp:   mov     al,00h              ; If odd parity display 00h
next:   mov     dx,pa
        out     dx,al               ; put the result to the ports

        int     3

        End start
```

Conclusion:

The program reads port B of 82C55A which is an input port. If input contains an odd number of 1's (that is the number of LED's at logic 1) then the output will be 00 at port A, which is an output port, indicating input is odd parity and after some delay the number of 1's present in input will be displayed through port A on the output.

Similarly If input contains an even number of 1's (that is the number of LED's at logic 1) then the output will be FF at port A, which is an output port, indicating input is even parity and after some delay the number of 1's present in input will be displayed through port A on the output.

Date: **Signature of the staff**

Program No.02.A. **Date:**

Read and Write using Macros

AIM:

Write two ALP modules stored in two different files; one module is to read a character from the keyboard and the other one is to display a character. Use the above two modules to read a string of characters from the keyboard terminated by the carriage return and print the string on the display in the next line.

```
.model small
.data
        String  db 30 dup (?)
.code
include c:\masm\read.mac
include c:\masm\write.mac

start:  mov     ax, @data
        mov     ds, ax                  ; Initialization of data segment

        mov     si, 00h

again:  read                            ; CALL MACRO READ
        cmp     al, 0dh                 ; compare the data in 'AL' reg with enter Key
        je      down
        mov     string[si], al          ; Move  the data in 'AL' reg to destination.
        inc     si
        jmp     again

down:   mov     cx, si
        mov     si, 00h

        write   0dh                     ; '13','10' , To go to next line
        write   0ah

back:   write   string[si]              ; Call write macro to write the data
        inc     si
        loop    back                    ; Repeat the writing
        int     3                       ; Termination of the program
        end     start
```

read.mac

```
read    macro
        mov     ah, 01h         ; Dos command  to read a data from keyboard
        int     21h
        endm
```

write.mac

```
write   macro x
        mov     dl, x
        mov     ah, 02h         ; Dos command  to write a data to the O/P screen
        int     21h
        endm
```

Conclusion:

This program reads the character entered through the Key board and stores in the consecutive specified memory locations. This process repeats till the ENTER Key (carriage return) is pressed. Once the ENTER key (carriage return) is pressed the character stored in the consecutive memory locations will be displayed on the next line.

Date: **Signature of the staff**

Program No.02.B. **Date:**

Logic controller- BCD Up-Down Counter

AIM:

Implement a BCD Up-Down Counter on the Logic Controller Interface.

```
.model small
.data
pa equ 0d800h
pb equ 0d801h
pc equ 0d802h
ctrl equ 0d803h

.code
       mov ax, @data
       mov ds, ax

       mov al, 80h
       mov dx, ctrl
       out dx, al

           mov cx, 0Ah
           mov al, 00h
Next:  mov dx, pa
            out dx, al
           call delay
           inc al
           loop Next

          mov cx, 0Ah
          mov al, 09h
 rpt:    mov dx, pa
          out dx, al
           call delay
           dec al
           loop rpt

          int 3h

         delay proc

       push cx
       push bx

  L1:  mov cx, 0ffffh
```

```
L2:  mov bx, 8fffh
     dec bx
     jnz L2
     loop L1

     pop bx
     pop cx

     ret
     delay endp
     end
```

Conclusion:

The program performs the up-down counter based on the input data given on logic controller read through port B. If the input is zero then it performs down counter starting from 99 down to 00 and if other than zero is the input then it performs up counter starting from 00 down to 99. And the counting will continue until a key ‘q’ is pressed in the key board, after displaying the count on logic controller every time it checks whether a key ‘q’ is pressed or not.

While observing the output of down counter or up counter if the input changes then from that point the counting will also changes. Suppose if the input is zero then it perform down counting from 99 to 00 after some time when the output is 50 then if we change the input other than zero then from that point it will start up counting that is form 50, 51, 52. and so on.

Date: **Signature of the staff**

Program No.03.A. **Date:**

Ascending order using Bubble Sort

AIM:

Sort a given set of 'n' numbers in ascending order using the Bubble Sort algorithm.

```
.model small
.data
        arr1    db 5h, 89h, 3h, 56h, 1h     ; The numbers to be sorted
        len1    equ $-arr1

.code
start:  mov     ax, @data
        mov     ds, ax

        mov     ch, len1-1                  ; no of iterations

agn1:   mov     cl, ch                      ; no of comparisions

        mov     si, offset arr1

rept1:  mov     al, [si]                    ; Get the first data of the array
        inc     si                          ; Increment the array
        cmp     al, [si]                    ; Compare the first and second data
        jbe     next1                       ; Check, if the 1st data is less than 2nd
        xchg    al, [si]                    ; If the 1st data is greater than the 2nd,
        mov     [si-1], al                  ; Swap the two data.

next1:  dec     cl                          ; dec the no of comparisons
        jnz     rept1                       ; check for zero
        dec     ch                          ; dec the no of iterations
        jnz     agn1                        ; check for zero

        int     3                           ; Terminate the program
        end     start
```

Conclusion:

This program will sort the given numbers in ascending order. The sorted numbers will be stored directly in the **data Segment**. To view the data segment the following code must be used.

-d ds: 0

Date: **Signature of the staff**

Program No.03.B. **Date:**

Logic Controller- 8 bit Multiplication

AIM:

Read the status of two 8-bit inputs (X & Y) from the Logical Controller Interface and display X*Y.

```
.model small
.data
pa equ 0d800h
pb equ 0d801h
pc equ 0d802h
ctrl equ 0d803h

.code
        mov ax,@data
        mov ds,ax

        mov al,82h   ; Control word (PB as input port and PA as output port)
        mov dx, ctrl
        out dx, al

        mov dx, pb
        in al,dx     ; Read the first 8 bit number
        mov bl,al    ; Store the first number

top:    mov ah,1     ; Read a character from the key board
        int 21h
        cmp al,13    ; Compare the character with the "ENTER" key, cmp al,0dh
        jnz top

        mov dx, pb   ; Read the Second 8 bit number
        in al,dx     ; Store the first number
        mul bl       ; Multiply bl*al

        mov dx, pa
        out dx, al    ; Display the result
        int 3
        end
```

Conclusion:

The program performs the multiplication between two bytes and gives the result. First byte is read from the port B of logic controller (user has to provide) and waits for enter key to be pressed and once enter key is and it reads the Second byte and multiplies and displays the result through Port A.

Date: **Signature of the staff**

Program No.04.A. **Date:**

Read alphanumeric character and display its ASCII code

AIM:

Read an alphanumeric character and displays its equivalent ASCII code at the center of the screen.

```
.model small
.data
          alpha   db ?
          ascii   db ?, ?, "$"
.code
start:    mov     ax, @data
          mov     ds, ax                      ; Initialization of data segment

          mov     ah, 01h                     ; READ A CHARACTER FROM KEY BOARD
          int     21h

          mov     alpha, al
          mov     cl, 04                      ; Store the character in the memory
          shr     al, cl                      ; Shift right the data by 4 times
          cmp     al, 09h                     ;l compare the shifted data with 09h
          jbe     add30
          add     al, 07h
add30:    add     al, 30h
          mov     ascii, al

          mov     al, alpha                   ; Get back the character
          and     al, 0fh                     ; And ( to mask the higher nibble)
          cmp     al, 09h
          jbe     add30h
          add     al, 07h
add30h:   add     al, 30h
          mov     ascii+1, al

          mov     cx, 30h*90                  ;CLEAR THE SCREEN
          mov     dl, ' '
          mov     ah, 02
back:     int     21h
          loop    back

          mov     ah, 02h                     ;Set the cursor position
          mov     bh, 00                      ; to desired location
          mov     dl, 30                      ;column no.
```

```
mov     dh, 15                  ;row no.
int     10h
mov     dx, offset ascii        ; display the ascii code
mov     ah, 09h
int     21h

mov     ah, 01h                 ; PRESS ENTER KEY
int     21h
int     3
end     start
```

Conclusion:

This program reads the character from key board by using the DOS function 01H and finds its ASCII equivalent number.

First it clears the entire screen and places the cursor to the specified location using BIOS function 02H. After, it will display the ASCII value where cursor is placed. In order to observe the output on the screen the program is not been terminated until enter key is pressed.

Date: **Signature of the staff**

Program No.04.B. **Date:**

7-Segment display- FIRE and HELP

AIM:

Display messages FIRE and HELP alternately with flickering effects on a 7-Segment display interface for a suitable period of time. Ensure a flashing rate that makes it easy to read both the messages.

```
.model small
.stack 100
.data
        pa      equ 0d800h              ; Port address
        pb      equ 0d801h
        pc      equ 0d802h
        ctrl    equ 0d803h              ; Control word address
        str1    db 8eh, 0f9h, 88h, 86h  ; Hexa values for "FIRE"
        str2    db 89h, 86h, 0c7h, 8ch  ; Hexa values for "HELP"
.code
start:  mov     ax, @data
        mov     ds, ax                  ; data segment Initialization

        mov     al, 80h                 ; control word
        mov     dx, ctrl
        out     dx, al

again:  mov     bx, offset str1
        call    display                 ; Jump to display procedure
        call    delay                   ; Jump to delay procedure
        mov     bx, offset str2
        call    display
        call    delay

        mov     ah, 06h                 ; direct console input or output
        mov     dl, 0ffh
        int     21h                     ;get character from keyboard buffer (if any)
        cmp     al, 'q'
        jne     again

        int     3                       ; Terminate the program

display proc
        mov     si, 03h                 ; To get the last byte
up1:    mov     cl, 08h
        mov     ah, [bx+si]             ; Load the data bit to 'ah'
```

```
up:      mov   dx, pb
         rol   ah, 1                    ;Rotate each bit in the data by one
         mov   al, ah
         out   dx, al                   ; Out the first bit

         call  clock
         dec   cl
         jnz   up                       ; repeat the steps '08' times
         dec   si
         cmp   si, -1
         jne   up1
         ret                            ; return back to main program
display  endp

clock    proc
         mov   dx, pc
         mov   al, 01h                  ; rising edge of clock pulse
         out   dx, al
         mov   al, 0                    ; falling edge of the clock pulse
         out   dx, al
         mov   dx, pb
         ret
clock    endp

delay    proc
         push  cx
         push  bx
         mov   cx, 0ffffh
d2:      mov   bx, 8fffh
d1:      dec   bx
         jnz   d1
         loop  d2
         pop   bx
         pop   cx
         ret
delay    endp

         end   start
```

Conclusion:

This program displays "FIRE" and "HELP" on seven segment display interface recursively one after the other with some delay till key 'q' is pressed on key board. It's not going to read any data from interface device. The data which has to be displayed is provided in the program itself.

Date: **Signature of the staff**

Program No.05.A. **Date:**

Check a string for a Palindrome

AIM:

Reverse a given string and check whether it is a palindrome or not.

```
.model small
.data
        str1    db "alam"               ; String to be checked for palindrome
        slen    equ ($-str1)
        str2    db 40 dup(0)
        msg1    db "Palindrome$"
        msg2    db "Not Palindrome$"
.code
start:  mov     ax,@data
        mov     ds,ax
        mov     es,ax                   ; Initialize extra segment

        mov     cx,slen                 ; Length of the string
        lea     si, str1
        add     si,slen – 1             ; get the last byte of the data
        lea     di, str2

up:     mov     al,[si]
        mov     [di],al                 ; load the byte from [Si] to [Di]
        dec     si
        inc     di
        loop    up                      ; Repeat the process

        lea     si, str1
        lea     di, str2
        mov     cx,slen
        cld                             ; Clear the direction flag
repe    cmpsb                           ; compare the string bytes present in SI & DI
        jne     down                    ; Jump if the strings are not equal

        lea     dx, msg1
        jmp     down1
down:   lea     dx, msg2
down1:  mov     ah,09h
        int     21h
        int     3                       ; Terminate the program
        end     start
```

Conclusion:

This program reverse the string provided in data segment by keeping the original string as it is and compares both the strings. It will check each and every character. If all the characters are same then the given string is said to be as palindrome and it will display a message “**palindrome**” on screen otherwise the given string is not palindrome and it will display a message “**not palindrome**” on screen.

Date: **Signature of the staff**

Program No.05.B. **Date:**

7-segment Display- Rolling Fashion

AIM:

Assume any suitable message of 12 characters length and display it in the rolling fashion on a 7-Segment display Interface for a suitable period of time. Ensure a flashing rate that makes it easy to read the message.

```
.model small
.stack 100
.data
        pa      equ 0d800h
        pb      equ 0d801h
        pc      equ 0d802h
        ctrl    equ 0d803h
        str1    db 0c0h,0f9h,0a4h,0b0h,99h,92h,83h,0f8h,80h,98h,0c0h,0f9h
.code
start:  mov     dx, @data
        mov     ds, dx                  ; Initialize the data segment

        mov     al, 80h                 ; Control word
        mov     dx, ctrl
        out     dx, al

again:  mov     bx, offset str1         ; Get the offset address of the string
        call    display
        call    delay
        mov     ah, 06h                 ; direct console input or output
        mov     dl, 0ffh                ; get the character for the key-board
        int     21h
        cmp     al, 'q'                 ; compare the character with 'q'
        jnz     again
        int     3                       ; terminate the program

display proc
        mov     si, 0bh                 ; Load [Si] with 12 (0dh)

up1:    call    delay
        mov     cl, 08h                 ; To get the last byte
        mov     ah, [bx+si]             ; Load the data bit to 'ah'

up:     mov     dx, pb
        rol     ah, 1                   ; Rotate each bit in the data by one
        mov     al, ah
```

```
            out     dx, al                      ; Out the first bit

            call    clock
            dec     cl
            jnz     up                          ; repeat the steps '08' times

            dec     si
            cmp     si, -1
            jne     up1                         ; repeat the steps '12' times
            ret
display     endp

clock   proc
            mov     dx, pc
            mov     al, 01h                     ; Rising edge of the clock pulse
            out     dx, al
            mov     al, 0                       ; Falling edge of the clock pulse
            out     dx, al
            mov     dx, pb
            ret
clock       endp

delay       proc
            push    cx
            push    bx

            mov     cx, 0ffffh
d2:         mov     bx, 8fffh
d1:         dec     bx
            jnz     d1
            loop    d2

            pop     bx
            pop     cx
            ret                                 ; Return back to main program
delay       endp
            end     start
```

Conclusion:

This program displays a message of 12 characters in rolling fashion on seven segment display. The message is stored in data segment. It will continue of rolling the message until 'q' is pressed in keyboard. But it will check for a key press event only after displaying the complete string. Till then it will just keep on displaying the characters.

Date: **Signature of the staff**

Program No.06.A. **Date:**

Compare two strings for equality

AIM:

Read two strings; store them in locations STR1 and STR2. Check whether they are equal or not and display appropriated messages. Also display the length of the stored strings.

```
.model small
.data
        str1    db 30 dup(0)
        str2    db 30 dup(0)
        len1    dw 1  dup(0)
        len2    dw 1  dup(0)
        msg1    db 13,10, "Enter the 1st string : $"
        msg2    db 13,10, "Enter the 2nd string : $"
        msg3    db 13,10, "String are not equal $"
        msg4    db 13,10, "Strings are equal $"
        msg5    db 13,10, "The length of the first string is : "
        slen1   db ?, ?
        msg6    db 13,10,"The length of the second string is : "
        slen2   db ?, ?,13,10,'$'
.code
read    macro                               ; create a macro for read operation
        mov     ah, 01
        int     21h
        endm

disp    macro x                             ; create a macro for display the string
        mov     dx, offset x
        mov     ah, 09
        int     21h
        endm

start:  mov     ax,@data
        mov     ds,ax
        mov     es,ax                       ; Initialize Data and extra segment

        disp    msg1                        ; READ FIRST STRING
        mov     si,0h

up1:    read                                ; Read a character from Key-board
        cmp     al,0dh                      ; compare the key with Enter Key.
        je      down1
```

```
        mov   str1[si],al           ; Store the key in the location
        inc   si
        jmp   up1
down1:  mov   len1,si

        disp  msg2                  ; READ SECOND STRING
        mov   si,0h
up2:    read                        ; Read a character from Key-board
        cmp   al,0dh                ; compare the key with Enter Key.
        je    down2
        mov   str2[si],al           ; Store the key in the location
        inc   si
        jmp   up2

down2:  mov   len2,si

        mov   cx,len1
        cmp   cx,len2               ; Check whether the strings are equal or not
        jne   noteq
        mov   si,offset str1
        mov   di,offset str2
        cld                         ; Clear direction flag
        repe  cmpsb                 ; repeat the comparisons if
                                    ; the strings are equal
        jne   noteq

        disp  msg4
        jmp   next

noteq:  disp  msg3
next:   mov   al,byte ptr len1
        aam
        add   ax, 3030h             ; Display the length of the 1st String
        mov   slen1, ah
        mov   slen1+1, al

        mov   al,byte ptr len2
        aam
        add   ax, 3030h             ; Display the length of the 2nd String
        mov   slen2, ah
        mov   slen2+1, al

        disp  msg5
        int   3                     ; Terminate the program
        end   start
```

Conclusion:

This program reads two strings from user and compares both the strings. First it checks the length of the strings and if lengths are equal then it will check each and every character. If all the characters are same then the given strings are said to be equal and it will display a message "strings are equal" along with length of both the strings on screen. **Else** will display as "strings are not equal".

Date: **Signature of the staff**

Program No.06.B. **Date:**

7-segment Display – Binary to BCD conversion

AIM:

Convert a 16-bit binary value(assumed to be an unsigned integer) to BCD and display it form left to right and right to left for specified number of times on a 7-Segment display Interface.

```
.model small
.data
        pa      equ 0d800h
        pb      equ 0d801h
        pc      equ 0d802h
        ctrl    equ 0d803h
        bin     dw 000Fh
        bcd     db 4 dup(0)
        count   db 02
        disptbl db 0c0h, 0f9h, 0a4h, 0b0h, 99h,
                db 92h, 82h, 0f8h, 80h, 98h      ; Look up table
.code
start:  mov     ax, @data
        mov     ds, ax

        mov     al, 80h                          ; All ports are output ports
        mov     dx, ctrl
        out     dx, al

        mov     bx, 10                           ; To perform BCD division
        mov     cx, 04                           ; Divide 04 times
        mov     ax, bin                          ; Load the number to be divided
back:   mov     dx, 0
        div     bx
        push    dx                               ; store the result in the stack.
        loop    back                             ; Repeat the division
        lea     si, bcd
        mov     cx, 04

back1:  pop     dx
        mov     [si], dl                         ; Get the result from the stack
        inc     si
        loop    back1

        mov     bx, offset disptbl
disp:   call    display1
```

```
        call    delay
        call    display
        call    delay
        dec     count
        jnz     disp
        int     3

display proc
        mov     si, 00
nxtchar:mov al, bcd[si]
        xlat                                ; Translate a byte
        mov     ah, 8
nxtseg: mov     dx, pb
        rol     al, 01
        out     dx, al
        mov     ch, al

        call    clock
        mov     al,ch
        dec     ah
        jnz     nxtseg

        inc     si
        cmp     si,4
        jne     nxtchar
        ret
display endp

display1        proc
                mov     si, 03
nxtchar1:       mov     al, bcd[si]
                xlat
                mov     ah, 8

nxtseg1:        mov     dx, pb
                rol     al, 01
                out     dx, al
                mov     ch, al

                call    clock
                mov     al,ch
                dec     ah
                jnz     nxtseg1

                dec     si
```

```
                cmp     si,-1
                jne     nxtchar1
                ret
display1        endp

clock   proc
        mov     dx, pc
        mov     al, 01h
        out     dx, al
        mov     al, 0
        out     dx, al
        mov     dx, pb
        ret
clock   endp

delay   proc
        push    cx
        push    bx

        mov     cx, 0ffffh
d2:     mov     bx, 8fffh
d1:     dec     bx
        jnz     d1
        loop    d2

        pop     bx
        pop     cx
        ret
delay   endp

        end     start
```

Conclusion:

This program converts a 16-bit number provided in data segment into BCD. Then it will displays the BCD number on seven segment display interface form left to right and right to left for specified number of times.

Date: **Signature of the staff**

Program No.07.A. **Date:**

Name Display

AIM:

Read your name from the keyboard and displays it at a specified location on the screen in front of the message "What is your name?" you must clear the entire screen before display.

```
.model small
.data
        msg1    db "Enter the name $"
        x       db 10
        y       db 20
        msg2    db "What is your name ? "
        str     db 30 dup(0)
.code
disp    macro z                         ; macro to display a string
        mov     dx, offset z
        mov     ah, 09
        int     21h
        endm

start:  mov     ax,@data
        mov     ds,ax

        disp    msg1
        mov     si,0h
up:     mov     ah, 01                  ; read the character from the keyboard
        int     21h
        cmp     al,0dh
        je      down
        mov     str[si],al
        inc     si
        jmp     up
down:   mov     str[si],'$'

        mov     cx, 29h*50h             ; To clear the screen
        mov     dl, ' '
        mov     ah, 02
back:   int     21h                     ; Get DOS functions
        loop    back
        mov     dl, x                   ; Row number
        mov     dh, y                   ; Column number
        mov     bh, 00h
```

```
mov     ah, 02
int     10h                         ; To move the cursor to the location
disp    msg2
mov     ah,01
int     21h
int     3                           ; Termination of the program
end     start
```

Conclusion:

This program will reads a string and displays the same string on the screen at the desired position after clearing the screen.

Date: **Signature of the staff**

Program No.07.B. **Date:**

Matrix Keypad- Key Scan

AIM:

Scan a 8x3 keypad for key closure and to store the code of the key pressed in a memory location and display on screen. Also display row and column numbers of the key pressed.

```
.model small
.stack      100
.data
            pa      equ 0d800h
            pb      equ 0d801h
            pc      equ 0d802h
            ctrl    equ 0d803h
            ASCIICODE   db "0123456789.+-*/%ack=MRmn"     ; look up table
            str     db 13,10,"press any key on the matrix keyboard$"
            str1    db 13,10,"Press y to repeat and any key to exit $"
            msg     db 13, 10,"the code of the key pressed is :"
            key     db ?
            msg1    db 13,10,"the row is "
            row     db ?
            msg2    db 13,10,"the column is "
            col     db ?,13,10,'$'
.code
disp        macro x                         ; Display  a string
            mov     dx, offset x
            mov     ah, 09
            int     21h
            endm                            ; End of a macro

start:      mov     ax,@data
            mov     ds,ax

            mov     al,90h                  ; Port 'A' is input port
            mov     dx,ctrl
            out     dx,al

again1:     disp    str
            mov     si,0h

again:      call    scan
            mov     al,bh                   ; Row number
            add     al,31h
```

```
        mov     row,al

        mov     al,ah                   ; Column number
        add     al,31h
        mov     col,al
        cmp     si,00
        je      again
        mov     cl,03
        rol     bh,cl
        mov     cl,bh
        mov     al,ah
        lea     bx,ASCIICODE            ; Address of the look up table
        add     bl,cl
        xlat                            ; Translate a byte in AL
        mov     key,al

        disp    msg
        disp    str1
        mov     ah, 01                  ; Read a string
        int     21h
        cmp     al,'y'
        je      again1
        int     3
scan    proc
        mov     cx,03
        mov     bh,0
        mov     al,80h

nxtrow: rol     al,1
        mov     bl,al
        mov     dx,pc
        out     dx,al
        mov     dx,pa
        in      al,dx
        cmp     al,0
        jne     keyid

        mov     al,bl
        inc     bh
        loop    nxtrow
        ret
keyid:  mov     si,1
        mov     cx,8
        mov     ah,0
```

```
agn:    ror     al,1
        jc      skip                ; check for the carry
        inc     ah
        loop    agn
skip:   ret                         ; Return to main program
scan    endp
        end     start
```

Conclusion:

This program reads the data from the 8*3 key interface board. It will display its value on the screen. It will also display the row number and column number of the key pressed.

Date: **Signature of the staff**

Program No.08.A. **Date:**

Compute nCr using recursive procedure

AIM:

Compute nCr using recursive procedure. Assume that 'n' and 'r' are non-negative integers.

```
.model small
.stack  20
.data
        n       db 08h
        r       db 05h
        ncr     db ?
.code
start:  mov     ax,@data
        mov     ds,ax
        mov     ncr,00h
        mov     al,n
        mov     bl,r
        call    encer
        int     3
encer   proc
para1:  cmp     al,bl                   ; compare 'n','r' for equality
        je      para8
para2:  cmp     bl,00h                  ; compare 'r' with 00
        je      para8
para3:  cmp     bl,01h                  ; compare 'r' with 01h
        je      para10
para4:  dec     al                      ; decrement 'n'
        cmp     bl,al
        je      para9
para5:  push    ax                      ; Push 'n' to the stack
        push    bx                       ; Push 'r' to the stack
        call    encer
para6:  pop     bx                      ; Get 'r' and 'n' from the stack
        pop     ax
        dec     bl
        push    ax
        push    bx
        call    encer
para7:  pop     bx
        pop     ax
        ret
para8:  inc     ncr
```

```
        ret
para9:  inc     ncr
para10: add     ncr,al
        ret
encer   endp
        end     start
```

Conclusion:

This program performs nCr using recursive procedure. Output is stored in data segment. To observe the output in data segment we have to search for our given **'n'** and **'r'** values as program is written to store the result after the given data in data segment.

Date: **Signature of the staff**

Program No.08.B. **Date:**

Stepper Motor

AIM:

Drive a Stepper Motor interface to rotate the motor in specified direction (clockwise or counter-clockwise) by N steps (Direction and N are specified by the examiner).Introduce suitable delay between successive steps. (Any arbitrary value for the delay may be assumed by the student).

```
.model small
.data
        pa      equ 0d800h
        pb      equ 0d801h
        pc      equ 0d802h
        ctrl    equ 0d803h
        nstep   db 2
.code
start:  mov     ax, @data
        mov     ds, ax

        mov     al, 80h              ; All ports are output ports
        mov     dx, ctrl
        out     dx, al

        mov     bh, nstep
        mov     al, 88h

again1: call    step
        rol     al, 1    ; for counter-clock wise direction
                         ; Replace rol al,1 with ror al,1 for clock wise direction
        dec     bh
        jnz     again1

        int     3

step    proc
        mov     dx, pa
        out     dx, al

        push    cx
        push    bx

        mov     cx, 0ffffh
d2:     mov     bx, 8fffh
```

```
d1:     dec     bx
        jnz     d1
        loop    d2

        pop     bx
        pop     cx

        ret
step    endp
        end     start
```

Conclusion:

This program drives a stepper motor interface to rotate by 8 steps in anti-clockwise direction. After each rotation a delay is introduced to observe the rotation. After completing the rotations the execution will get stopped.

Date: **Signature of the staff**

Program No.09.A. **Date:**

Display the system time

AIM:

Read the current time from the system and display it in the standard format on the screen.

```
.model small
.data
        msg     db "The time is: "
        hrs     db ?,?,' : '
        mins    db ?,?,' (hh:mm) ',10,13,'$'
.code
start:  mov     ax,@data
        mov     ds,ax


        mov     ah,2ch                  ; DOS function to read system time
        int     21h

        mov     al,ch                   ; load the hours to 'al'
        aam                             ; ASCII adjust after multiplication
        add     ax, 3030h
        mov     hrs, ah
        mov     hrs+1, al

        mov     al,cl                   ; load the seconds to 'al'
        aam
        add     ax, 3030h
        mov     mins, ah
        mov     mins+1,al

        lea     dx,msg                  ; Display the time
        mov     ah,09h
        int     21h
        int     3
end     start
```

Conclusion:

This program displays the present system time. Our program displays only the hours and minutes in the format HH: MM.By using the same ***DOS function*** we can also display the seconds and milliseconds.

Date: **Signature of the staff**

Program No.09.B. **Date:**

Generate a SINE wave using DAC

AIM:

Generate a Sine Wave using the DAC interface. (The output of the DAC is to be displayed on the CRO).

```
.model small
.data
        pa      equ 0c400h
        pb      equ 0c401h
        pc      equ 0c402h
        ctrl    equ 0c403h
        table   db 128,132,137,141,146,150,154,159,163,167,171,176,180,184,188
                db 192,196,199,203,206,210,213,217,220,223,226,229,231,234,236
                db 239,241,243,245,247,248,250,251,252,253,254,255
                db 255,254,253,252,251,250,248,247,245,243,241,239,236,234,231
                db 229,226,223,220,217,213,210,206,203,199,196,192,188,184,180
                db 176,171,167,163,159,154,150,146,141,137,132,128
                db 123,119,114,110,105,101,97,93,88,84,80,76,72,68,64,60,56,52,49
                db 45,42,39,36,33,30,27,24,22,19,17,15,11,9,7,6,5,4,3,2,1,0
                db 0,1,2,3,4,5,6,7,9,11,15,17,19,22,24,27,30,33,36,39,42,45,49,52,56
                db 60,64,68,72,76,80,84,88,93,97,101,105,110,114,119,123
.code
start:  mov     ax,@data
        mov     ds,ax

        mov     al,80h                  ; All the ports are out put ports
        mov     dx,ctrl
        out     dx,al

again:  mov     bx,05h
up:     mov     cx,164                  ; Load 164 values
        mov     si,00h
        mov     dx,pa

again1: mov     al,table[si]            ; Load each value from Look-up-table to al
        out     dx,al
        inc     si
        loop    again1

        dec     bx
        cmp     bx,00
        jne     up
```

```
mov  ah,06h        ; direct console input or output
mov  dl,0ffh       ; Read the character from the keyboard
int  21h
jz   again
int  3
end  start
```

Conclusion:

This program generates a sine wave of having amplitude of 5V. Output will be seen in CRO. It will be continues wave. It stops execution as soon as any key is pressed from the key board.

Date: **Signature of the staff**

Program No.10.A. **Date:**

To simulate a Decimal Up-counter to display 00- 99

AIM:

Write a program to simulate a Decimal Up-counter to display 00- 99.

```
.model small
.data
        string  db "the count is "
        nors    db ?,?,'$'
.code
start:  mov     ax,@data
        mov     ds,ax

        mov     ah,03h              ; get cursor position and size.
        mov     bh,00h              ; page number.
        int     10h

up:     mov     cl,00h
up1:    mov     al,cl
        aam
        add     ax, 3030h
        mov     nors, ah
        mov     nors+1, al
        push    dx

        mov     ah,02h              ; set cursor position
        mov     bh,00h              ; page number
        int     10h

        mov     dx,offset string    ; Display the string
        mov     ah,09h
        int     21h
        inc     cl
        call    delay

        mov     ah,06h              ; direct console input or output.
        mov     dl,0ffh             ; get character from keyboard buffer
        int     21h

        cmp     al,'q'
        je      exit
        pop     dx
        cmp     cl,100
```

```
        je      up
        jmp     up1
exit:   int     3                       ; Terminate the program


delay   proc                            ; Delay procedure
        push    cx
        push    bx

        mov     cx, 0ffffh
d2:     mov     bx, 8fffh
d1:     dec     bx
        jnz     d1
        loop    d2

        pop     bx
        pop     cx
        ret                             ; Return back to main program

        delay       endp
        end     start
```

Conclusion:

This program counts decimal values from 00 to 99. Count will continue until a key is pressed in key board.

Date: **Signature of the staff**

Program No.10.B. **Date:**

Generate a half rectified SINE wave using DAC

AIM:

Generate a Half Rectified Sine wave form using the DAC interface. (The output of the DAC is to be displayed on the CRO).

```
.model small
.data
        pa      equ 0c400h
        pb      equ 0c401h
        pc      equ 0c402h
        ctrl    equ 0c403h
        table   db 128,132,137,141,146,150,154,159,163,167,171,176,180,184,188
                db 192,196,199,203,206,210,213,217,220,223,226,229,231,234,236
                db 239,241,243,245,247,248,250,251,252,253,254,255,254,253,252
                db 251,250,248,247,245,243,241,239,236,234,231,229,226,223,220
                db 217,213,210,206,203,199,196,192,188,184,180,176,171,167,163
                db 159,154,150,146,141,137,132,128  ; Look_up_table
.code
start:  mov     ax,@data
        mov     ds,ax

        mov     al,80h              ; All the ports are out put ports
        mov     dx,ctrl
        out     dx,al

again3: mov     bx,05h
up:     mov     cx,83               ; Load 83 values
        mov     si,00

again4: mov     dx,pa
        mov     al,table[si]        ; Load each value from Look-up-table to al
        out     dx,al
        inc     si
        loop    again4

        mov     cx,83
        mov     al,128
next:   out     dx,al
        loop    next
        dec     bx
        cmp     bx,00h
        jnz     up
```

```
        mov     ah,06h          ; direct console input or output
        mov     dl,0ffh         ; Read the character from the keyboard
        int     21h
        jz      again3
        int     3               ; Terminate the program
end     start
```

Conclusion: This program generates a half - rectified sine wave of 5V amplitude. Output will be seen in CRO. It stops execution as soon as any key is pressed from the key board.

Date: **Signature of the staff**

Program No.11.A. **Date:**

Move the Cursor to specified Location on the screen

AIM:

Read a pair of input co-ordinates in BCD and move the cursor to the specified location on the screen.

```
.model small
.data
            x       db ?
            y       db ?
            msg1    db 13, 10, "Enter the y co ordinate (00 - 19)$"
            msg2    db 13, 10, "Enter the x co ordinate (00 - 50)$"
.code
read        macro                               ; Macro to read the character
            mov     ah, 01h
            int     21h
            endm                                ; End of Macro

start:      mov     ax,@data
            mov     ds,ax

            mov     dx,offset msg1              ; Display the first message
            mov     ah,09h
            int     21h

            read                                ; Read a character
            mov     cl, 04h
            shl     al, cl
            mov     bl,al

            read                                ; Read a character
            and     al,0fh
            or      al,bl
            mov     y,al

            mov     dx,offset msg2              ; Display the first message
            mov     ah,09h
            int     21h

            read                                ; Read a character
            mov     cl,04h
            shl     al,cl
            mov     bl,al
```

```
        read                        ; Read a character
        and     al,0fh
        or      al,bl
        mov     x,al


        mov     ah,02h              ; Clear the screen
        mov     cx, 19h*50h
        mov     dl, ' '
back:   int     21h
        loop    back

        mov     ah,02h              ; Set the cursor to the specified location
        mov     bh,00h
        mov     dh,y
        mov     dl,x
        int     10h

        read
        int     3
end     start
```

Conclusion:

This program reads X and Y coordinates from key board and takes the cursor to the specified location after clearing the screen and it will remains at the same position until a key pressed.

Date: **Signature of the staff**

Program No.11.B. **Date:**

Generate a fully rectified SINE wave using DAC

AIM:

Generate a Fully Rectified Sine waveform using the DAC interface. (The output of the DAC is to be displayed on the CRO).

```
.model small
.data
        pa      equ 0c400h
        pb      equ 0c401h
        pc      equ 0c402h
        ctrl    equ 0c403h
        table   db 128,132,137,141,146,150,154,159,163,167,171,176,180,184,188
                db 192,196,199,203,206,210,213,217,220,223,217,220,223,226,229
                db 231,234,236,239,241,243,245,247,248,250,251,252,253,254,255
                db 254,253,252,251,250,248,247,245,243,241,239,236,234,231,229
                db 226,223,220,217,213,210,206,203,199,196,192,188,184,180,176
                db 171,167,163,159,154,180,146,141,137,132,128
        count   dw 83
.code
start:  mov     ax,@data
        mov     ds,ax

        mov     al,80h          ; All the ports are out put ports
        mov     dx,ctrl
        out     dx,al

agn :   mov     bx,05
back1:  mov     cx,count        ; Load 83 values
        mov     si,00h

back:   mov     al,table[si]    ; Load each value from Look-up-table to al
        mov     dx,pa
        out     dx,al
        inc     si
        loop    back

        dec     bx
        cmp     bx,00
        jnz     back1

        mov     ah,06h          ; direct console input or output
        mov     dl,0ffh         ; Read the character from the keyboard
```

```
        int     21h
        jz      agn
        int     3
end     start
```

Conclusion:

This program generates a fully rectified sine wave of 5V amplitude. Output will be seen in CRO. It stops execution as soon as key is pressed from the key board.

Date: **Signature of the staff**

Program No.12.A. **Date:**

Program to create a file (input file) and to delete an existing file

AIM:

Program to create a file (input file) and to delete an existing file.

```
.model small
.data
        string  db "Enter the file name for the file to be created",13,10,'$'
        msg1    db 13,10,"The file cannot be created",13,10,'$'
        msg2    db 13,10,"File created successfully",13,10,'$'
        str1    db 40 dup(0)
        string1 db "Enter the file name to be deleted",13,10,'$'
        msg3    db 13,10,"The file cannot be deleted",13,10,'$'
        msg4    db 13,10,"File deleted successfully",13,10,'$'
        str2    db 40 dup(0)
.code
disp    macro x                                 ; Display macro
        lea     dx, x
        mov     ah, 09h
        int     21h
        endm

start:  mov     ax,@data
        mov     ds,ax
        disp    string                          ; Display String
        mov     bx,00h

up:     mov     ah,01h                          ; Read the character from the keyboard
        int     21h
        cmp     al,0dh
        je      exit
        mov     str1[bx],al
        inc     bx
        jmp     up

exit:   mov     str1[bx],'$'
        mov     ah,3ch                          ; Create or truncate file
        mov     cx,00h                          ;  File Attributes
        mov     dx,offset str1
        int     21h

        jc      down
        disp    msg2
```

```
        jmp     down1

down:   disp    msg1

down1:  disp    string1
        mov     bx,00h
up1:    mov     ah,01h
        int     21h
        cmp     al,0dh
        je      exit1
        mov     str2[bx],al
        inc     bx
        jmp     up1

exit1:  mov     str2[bx],'$'
        mov     ah,41h                  ; delete file .
        mov     dx,offset str2
        int     21h
        jc      down2                   ; CF set on error, AX = error code.

        disp    msg4                    ; if successful, CF will be clear,
                                        ; and the value of AX is cleared
        jmp     down3
down2:  disp    msg3
down3:  int     3
end     start
```

Conclusion:

This program creates a file in current root directory. If creation of file success it will display a message "file created successfully". After that it will delete the file from the current directory. If deletion of file is success then it will display a message "file deleted successfully".

Date: **Signature of the staff**

Program No.12.B. **Date:**

ELEVATOR

AIM:

Drive an elevator interface in the following way:

i. **Initially the elevator should be in the ground floor, with all requests in OFF state.**

ii. **When a request is made from a floor, the elevator should move to that floor, wait there for a couple of seconds (approximately), and then come down to ground floor and stop. If some requests occur during going up or coming down they should be ignored.**

```
.model small
.data
        pa equ 0c800h           ;define port addresses
        pb equ 0c801h
        pc equ 0c802h
        ctrl equ 0c803h         ;define control word address
.code
Start:  mov ax, @data
        mov ds, ax              ;initialize data segment

        mov al, 82h             ;initialize port A as output and port B as input port
        mov dx, ctrl
        out dx, al

        mov bl, 0               ; Initially display lift in ground floor

                                ; PRESS ANY KEY TO EXIT
S1:     call delay
        mov ah, 06h
        mov dl, 0ffh
        int 21h
        jz proceed              ;if none of the key is pressed then jump to location proceed
        int 3                   ;else terminate program execution

; PLACE LIFT IN GROUND FLOOR
proceed:call delay
        mov al, bl              ;take floor number to AL
        or al, 0f0h             ;set upper nibble of the number
        mov dx, pa
        out dx, al
        cmp bl, 0               ;check whether the lift is in ground floor or not
        jnz down                ;if not in then jump to location down to move lift to ground floor
```

```
        jmp fchk                ;else jump to location fchk to check the request from any floor
down:   dec bl
        jmp proceed

;CHECK REQUEST FROM ANY FLOOR
fchk:   call chk                ;call procedure chk to check is there request from any floor
        shr al, 01              ;shift right the request by 1 position
        jnc gfr                 ;if carry is not set then request will be from ground
                                ; floor and jump to location gfr
        shr al, 01              ;else shirt right the request by 1 more position
        jnc ffr                 ;if carry is not set then request will be from 1st floor and
                                ;jump to location ffr
        shr al, 01              ;else shirt right the request by 1 more position
        jnc sfr                 ;if carry is not set then request will be from 2nd floor
                                ;and jump tp location sfr
        shr al, 1               ;else shirt right the request by 1 more position
        jnc tfr                 ;if carry is not set then request will be from 2nd floor
                                ;and jump tp location sfr
        jmp start               ;else jump to start

gfr:    call delay
        mov al, 0e0h            ;data to disable ground floor request
        mov dx, pa              ;load port A address to DX reg.
        out dx, al              ;send data to port A
        jmp S1                  ;to repeat the process jump to location start

ffr:    call delay
        mov bl, 3
        call floor
        mov al, 0d3h
        mov dx, pa
        out dx, al
        jmp S1

sfr:    call delay
        mov bl, 6
        call floor
        mov al, 0b6h
        mov dx, pa
        out dx, al
        jmp S1

tfr:    call delay
        mov bl, 9
        call floor
```

```
        mov al, 79h
        mov dx, pa
        out dx, al
        jmp S1

chk     proc
        mov dx, pb
        in al,dx                ;read data from port b
        or al,0f0h              ;set upper nibble of the data
        cmp al,0ffh             ;check is there any request or not
        jz chk                  ;if no request then jump to location chk
        ret                     ;else return to main program
chk     endp                    ;end of procedure

floor   proc

mov cl, 0

floor1: inc cl
        mov al, cl
        or al, 0f0h
        mov dx, pa
        out dx, al
        call delay
        cmp cl, bl
        jnz floor1
        ret
floor   endp

delay   proc
delay     proc
          push   cx
          push   bx

          mov    cx, 0ffffh
d2:       mov    bx, 8fffh
d1:       dec    bx
          jnz    d1
          loop   d2

          pop    bx
          pop    cx
          ret
delay     endp
end     start
```

Conclusion:

This program does the operation of lift as follows: always the lift will be in ground floor. When a request comes from any other floor then the lift will go to that floor and waits for some time and returns to ground floor. While executing the first request, other requests are not recognized

Date: **Signature of the staff**

References:

1. The Intel Microprocessors: Eighth Edition: Bary B. Brey.
2. Microprocessors and Interfacing: Second Edition: D V Hall.
3. Advanced Microprocessors and Peripherals: A K Ray.

ANNEXURES:

Instruction Set:

Instructions	Operands	Description
MOV	**REG, memory** **memory, REG** **REG, REG** **memory, immediate** **REG, immediate** **SREG, memory** **memory, SREG** **REG, SREG** **SREG, REG**	**Copy operand2 to operand1.** The MOV instruction cannot: • Set the value of the CS and IP registers. • Copy value of one segment register to another segment register (should copy to general register first). • Copy immediate value to segment register (should copy to general register first). **Algorithm: operand1 = operand2** Ex: **Mov AX,BX ;Copy contents of BX to AX** **Mov si,00h ;load Si with 00h**
MUL	**REG** **Memory**	**Unsigned multiply.** Multiply the contents of REG/Memory with contents of AL register. **Algorithm:** When operand is a **byte**: AX = AL * operand. When operand is a **word**: (DX: AX) = AX * operand.
CMP	**REG, memory** **memory, REG** **REG, REG** **memory, immediate** **REG, immediate**	**Compare.** **Algorithm:** ***operand1 - operand2*** Result is not stored anywhere, flags are set (OF, SF, ZF, AF, PF, CF) according to result.
JMP	**Label**	**Unconditional Jump.** Transfers control to another part of the program. *4-byte address* may be entered in this form: 1234h: 5678h, first value is a segment second value is an offset. **Algorithm:** always jump
JA	**Label**	**Jump If Above.** Short Jump if first operand is Above second operand (as set by CMP instruction). Unsigned. **Algorithm:** if (CF = 0) and (ZF = 0) then jump

JAE	**Label**	**Jump If Above Or Equal** Short Jump if first operand is Above or Equal to second operand (as set by CMP instruction). Unsigned. **Algorithm:** if CF = 0 then jump
JB	**Label**	**Jump If Below.** Short Jump if first operand is Below second operand (as set by CMP instruction). Unsigned. **Algorithm:** if CF = 1 then jump
JBE	**Label**	**Jump If Below Or Equal** Short Jump if first operand is Below second operand (as set by CMP instruction). Unsigned. **Algorithm**: if CF = 1 then jump
JC	**Label**	**Jump If Carry** Short Jump if Carry flag is set to 1. **Algorithm:** if CF = 1 then jump
JE	**Label**	**Jump If Equal.** Short Jump if first operand is Equal to second operand (as set by CMP instruction). Signed/Unsigned. **Algorithm:** if ZF = 1 then jump
JG	**Label**	**Jump If Greater** Short Jump if first operand is Greater then second operand (as set by CMP instruction). Signed. **Algorithm:** if (ZF = 0) and (SF = OF) then jump

JGE	**Label**	**Jump If Greater Or Equal.** Short Jump if first operand is Greater or Equal to second operand (as set by CMP instruction). Signed. **Algorithm:** if SF = OF then jump
JL	**Label**	**Jump If Less than.** Short Jump if first operand is Less then second operand (as set by CMP instruction). Signed. **Algorithm:** if SF <> OF then jump
JLE	**Label**	**Jump If Less Or Equal.** Short Jump if first operand is Less or Equal to second operand (as set by CMP instruction). Signed. **Algorithm:** if SF <> OF or ZF = 1 then jump
JNZ	**Label**	**Jump If Non Zero.** Short Jump if Not Zero (not equal). Set by CMP, SUB, ADD, TEST, AND, OR, XOR instructions. **Algorithm:** if ZF = 0 then jump
JZ	**Label**	**Jump If Zero.** Short Jump if Zero (equal). Set by CMP, SUB, ADD, TEST, AND, OR, XOR instructions. **Algorithm:** if ZF = 1 then jump
LEA	**REG, memory**	**Load Effective Address.** **Algorithm:** • REG = address of memory (offset)
LOOP	**Label**	**Decrease CX, jump to label if CX not zero.** **Algorithm:** • CX = CX - 1 • if CX <> 0 then

		○ jump else ○ no jump, continue
ADD	**REG, memory memory, REG REG, REG memory, immediate REG, immediate**	**Add.** **Algorithm:** operand1 = operand1 + operand2
AND	**REG, memory memory, REG REG, REG memory, immediate REG, immediate**	Logical AND between all bits of two operands. Result is stored in operand1. These rules apply: **1 AND 1 = 1; 1 AND 0 = 0** **0 AND 1 = 0; 0 AND 0 = 0**
OR	**REG, memory memory, REG REG, REG memory, immediate REG, immediate**	Logical OR between all bits of two operands. Result is stored in first operand. These rules apply: **1 OR 1 = 1; 1 OR 0 = 1** **0 OR 1 = 1; 0 OR 0 = 0**
SUB	**REG, memory memory, REG REG, REG memory, immediate REG, immediate**	**Subtract.** **Algorithm:** operand1 = operand1 - operand2

DAA	**No Operands**	**Decimal adjust After Addition.**
		Corrects the result of addition of two packed BCD values.
		
		Algorithm:
		if low nibble of AL > 9 or AF = 1 then:
		
		• AL = AL + 6
		• AF = 1
		
		if AL > 9Fh or CF = 1 then:
		
		• AL = AL + 60h
		• CF = 1

DAS	**No Operands**	**Decimal adjust After Subtraction**.
		Corrects the result of subtraction of two packed BCD values.
		
		Algorithm:
		if low nibble of AL > 9 or AF = 1 then:
		
		• AL = AL - 6
		• AF = 1
		
		if AL > 9Fh or CF = 1 then:
		
		• AL = AL - 60h
		• CF = 1

INC	**REG** **memory**	**Increment.** **Algorithm:** operand = operand + 1
DEC	**REG** **Memory**	**Decrement.** **Algorithm:** operand = operand – 1
DIV	**REG** **Memory**	**Unsigned divide.** **Algorithm:** when operand is a **byte**: AL = AX / operand AH = remainder (modulus) when operand is a **word**: AX = (DX AX) / operand DX = remainder (modulus)
SHL	**memory, immediate** **REG, immediate** **memory, CL** **REG, CL**	**Shift Left.** Shift operand1 Left. The number of shifts is set by operand2. **Algorithm:** • Shift all bits left, the bit that goes off is set to CF. • Zero bit is inserted to the right-most position.
SHR	**memory, immediate** **REG, immediate** **memory, CL** **REG, CL**	**Shift Right.** Shift operand1 Right. The number of shifts is set by operand2. **Algorithm:** • Shift all bits right, the bit that goes off is set to CF. • Zero bit is inserted to the left-most position.

ROL	**memory, immediate** **REG, immediate** **memory, CL** **REG, CL**	**Rotate Left.** Rotate operand1 left. The number of rotates is set by operand2. **Algorithm:** Shift all bits left, the bit that goes off is set to CF and the same bit is inserted to the right-most position.
ROR	**memory, immediate** **REG, immediate** **memory, CL** **REG, CL**	**Rotate Right.** Rotate operand1 right. The number of rotates is set by operand2. **Algorithm:** Shift all bits right, the bit that goes off is set to CF and the same bit is inserted to the left-most position.
RCL	***memory, immediate*** ***REG, immediate*** ***memory, CL*** ***REG, CL***	Rotate operand1 left through Carry Flag. The number of rotates is set by operand2. **Algorithm:** Shift all bits left, the bit that goes off is set to CF and previous value of CF is inserted to the right-most position. **Example:** STC ; set carry (CF=1). MOV AL, 1Ch ; AL = 00011100b RCL AL, 1 ; AL = 00111001b, CF=0. RET C O r r OF=0 if first operand keeps original sign.
CALL	**procedure name** **label**	Transfers control to procedure, return address is (IP) pushed to stack.
RET	**No operands** **Or even immediate date**	Return from near procedure. **Algorithm:** • Pop from stack: ○ IP if immediate operand is present: SP = SP + operand
IN	**AL, im.byte** **AL, DX** **AX, im.byte** **AX, DX**	Input from port into **AL** or **AX**. Second operand is a port number. If required to access port number over 255 - **DX** register should be used.
OUT	**AL, im.byte** **AL, DX** **AX, DX**	Output from **AL** or **AX** to port. First operand is a port number. If required to access port number over 255 - **DX** register should be used.

POP	**REG** **SREG** **memory**	Get 16 bit value from the stack. Algorithm: Operand = SS : [SP](top of stack) SP = Sp + 2.
PUSH	**REG** **SREG** **memory**	Store 16 bit value in the stack. **Algorithm:** • SP = SP - 2 • SS:[SP] (top of the stack) = operand
XOR	**REG, memory** **memory, REG** **REG, REG** **memory, immediate** **REG, immediate**	Logical XOR (Exclusive OR) between all bits of two operands. Result is stored in first operand. These rules apply: **1 XOR 1 = 0; 1 XOR 0 = 1** **0 XOR 1 = 1; 0 XOR 0 = 0**
XCHG	**REG, memory** **memory, REG** **REG, REG**	Exchange values of two operands. **Algorithm:** operand1 < - > operand2
XLAT	**No Operands**	Translate byte from table. Copy value of memory byte at DS:[BX + unsigned AL] to AL register. **Algorithm:** AL = DS:[BX + unsigned AL]

AAA	**No Operands**	**ASCII Adjust after Addition.**
		Corrects result in AH and AL after addition when working with BCD values.
		
		Algorithm:
		
		if low nibble of AL > 9 or AF = 1 then:
		
		• AL = AL + 6
		• AH = AH + 1
		• AF = 1
		• CF = 1
		
		else
		
		• AF = 0
		• CF = 0
		
		in both cases:
		clear the high nibble of AL.

<table>
<tr><td></td><td></td><td>Example:
MOV AX, 15 ; AH = 00, AL = 0Fh
AAA ; AH = 01, AL = 05</td></tr>
<tr><td>AAS</td><td>No Operands</td><td>ASCII Adjust after Subtraction.
Corrects result in AH and AL after subtraction when working with BCD values.

Algorithm:

if low nibble of AL > 9 or AF = 1 then:

• AL = AL - 6
• AH = AH - 1
• AF = 1
• CF = 1

else

• AF = 0
• CF = 0

in both cases:
clear the high nibble of AL.

Example:
MOV AX, 02FFh ; AH = 02, AL = 0FFh
AAS ; AH = 01, AL = 09</td></tr>
<tr><td>AAM</td><td>No Operands</td><td>ASCII Adjust after Multiplication.
Corrects the result of multiplication of two BCD values.

Algorithm:

• AH = AL / 10
• AL = remainder

Example:
MOV AL, 15 ; AL = 0Fh
AAM ; AH = 01, AL = 05</td></tr>
</table>

INTERRUPTS:

Interrupt INT 21h:

INT 21h calls DOS functions.

Function 01h - Read character from standard input, result is stored in AL. If there is no character in the keyboard buffer, the function waits until any key is pressed.

Invoked by: **AH** = 01h
Returns: **AL** = character entered.

Example:

```
Mov AH, 01h
INT 21h
```

Function 02h - Write a character to standard output.
INT 21h
Invoked by: **DL** = character to write.
AH =02h
After execution AL = DL.

Example:

```
Mov AH, 02h
Mov DL, ’a’    ; Character to be displayed on screen must be stored in DL reg.
INT 21h
```

Function 02h- set cursor position.

INT 10h / AH = 2 - set cursor position.
input:
DH = row.
DL = column.
BH = page number (0..7).

Function 03h- get cursor position and size.

INT 10h / AH = 03h -
input:
BH = page number.
return:
DH = row.
DL = column.

CH = cursor start line.
CL = cursor bottom line.

Function 06h – **Direct console for input/output.** If DL = 0FFH on entry, then this function reads the console. If DL = ASCII character, then this function displays the ASCII character on the console video screen.

Invoked by: Parameters for O/P: **DL** = 0…255
Parameters for I/P: **DL** = 255.

Returns: for O/P: **AL** = **DL**.
For I/P: **ZF** set if no character available & **AL** = 0
ZF clear if character available & **AL** = character.

Example:

```
mov ah, 6
mov dl, 'a'
int 21h       ; output character.

mov ah, 6
mov dl, 255
int 21h       ; get character from keyboard buffer (if any) or set ZF=1.
```

Function 09h - Write a string to standard output at DS: DX.
String must be terminated by '**$**'. The string can be of any length and may contain control characters such as carriage return (0DH) and line feed (0AH).

Invoked by: **DS** = string to write.
AH = 09h

Example:

```
Mov AH, 09h
Mov DX, offset str     ; Address of the string to be displayed
INT 21h
```

Function 2Ch - Get system time.

Invoked by: **AH** =2Ch
Return: **CH** = hour. **CL** = minute. **DH** = second. **DL** = 1/100 seconds.

Example:

```
Mov AH, 2ch
INT 21h
```

Function 3Ch - Create or truncate file.

Invoked by: **CX** = file attributes:

```
 mov cx, 0       ;  normal - no attributes.
 mov cx, 1       ;  read-only.
 mov cx, 2       ;  hidden.
 mov cx, 4       ;  system
 mov cx, 7       ;  hidden, system and read-only!
 mov cx, 16      ;  archive
mov cx, 0BH    ;  Volume label
mov cx, 10H   ;   Subdirectory
```

DS: DX -> filename. ; **AH** =3Ch

Returns:

CF clear if successful, **AX** = file handle.
CF set on error **AX** = error code.

Example:

```
Mov AH, 3ch
Mov CX, 01
Mov DX, offset Filename
INT 21h
```

Function 41h - Delete file (unlink).

Invoked by: **DS: DX** -> ASCIZ filename (no wildcards, but see notes).
AH=41h

Return:

CF clear if successful, **AX** destroyed.
CF set on error **AX** = error code.

Example:

```
Mov AH, 41h
Mov DX, offset Filename
INT 21h
```

Function 4Ch – Terminate a process.

Invoked by: **AH** = 4ch
Return: returns control to the operating system.

Example:

```
Mov AH, 4Ch
INT 21h
```

Interrupt INT 10h:

INT 10h calls the BIOS functions. This interrupt often called the video services interrupt as it directly controls the video display in a system.

Function 02h - Set cursor position.

Invoked by: **DH** = row; **DL** = column; **BH** = page number (0...7); **AH**=02h.

Example:

```
MOV AH, 02h
MOV BH, 00
MOV DH, 06
MOV DL, 10
INT 10h
```

Function 03h – Get cursor position.

Invoked by: **BH** = page number. (In general 0)
AH = 03h

Return: **DH** = row number; **DL** = column number; **CH** = cursor start line;
CL = cursor bottom line.

Example:

```
Mov BH, 0
Mov AH, 03h
INT 10h
```

Function 06h – Scroll up window

Invoked by: **AL** = number of lines by which to scroll. (00h = clear the entire screen.)
BH = attribute used to write blank lines at bottom of window.
CH, CL = row, column of window's upper left corner.
DH, DL = row, column of window's lower right corner.

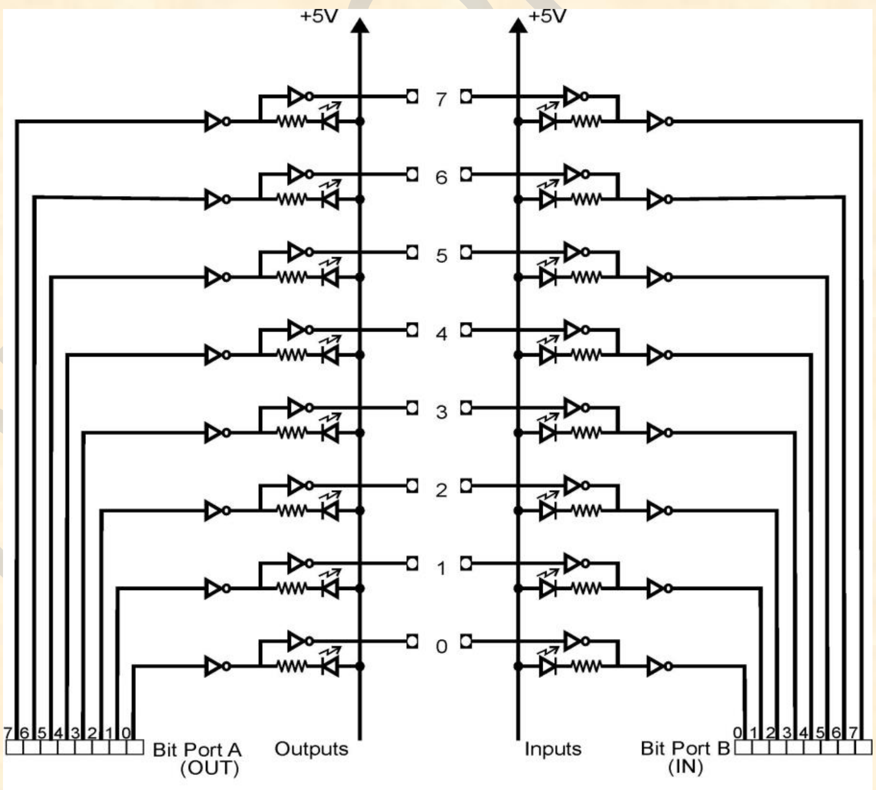
Circuit diagrams of interfacing devices

1. Logic Controller Interface

Logic controllers find extensive application in industries for the programming of processes. The nature of control would range from a simple ON/OFF type of control ro complex systems implementing sophisticated control algorithms while accepting multiple inputs and actuating multiple outputs. A controller would typically, accept a number of inputs from transducers like sensors/limit switches, key inputs etc.. perform a sequence of logical and arithmetic opertaions on them and use the result to maitain the process within specified safe operating conditions while providing information on the status of the process at any instant of time.The logic controller interface consits essentially of two 8 bit ports, an input and an output port. The inputs and outputs are connected to the user systems. The logic state fo each input and output is indicated by LEDs and all signals are TTL compatible. The input signals are connected to port B of 82C55A while output lines are driven from port A.

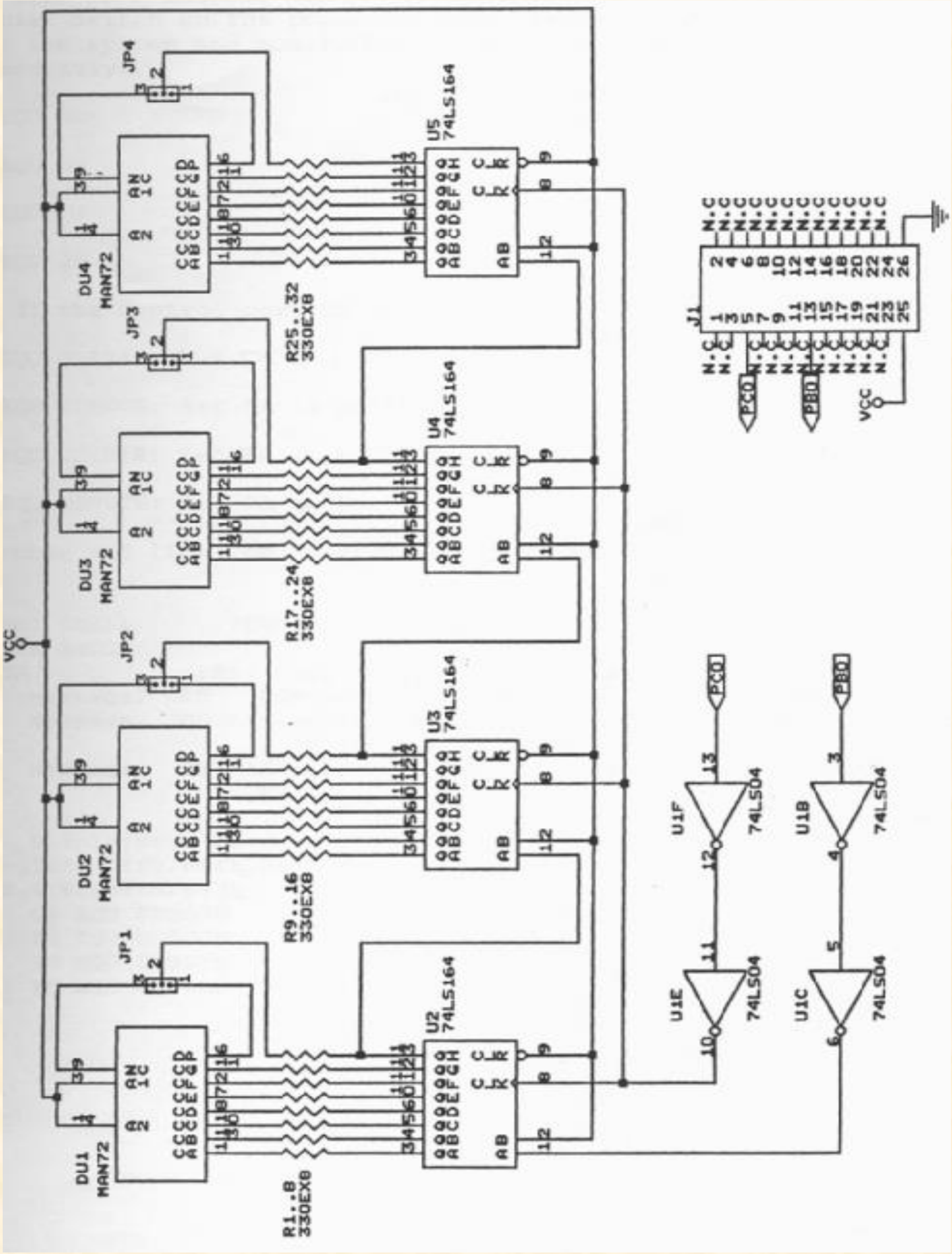
Some of the cpabilities of theis interface are:

a. Programmable Counter   b. Sequential Counter c. Combinational Controller.



Schematic of a Logic Controller

2. Seven Segment Display



The hardware uses four shift register ICs 74164. 74164 is an 8-bit serial in-parallel out shift register with asynchronous reset and two input pins. It requires 8 clock cycles at “CLK” pin to shift the serial data from input to 8 parallel outputs. After 8 shifts, the first serial bit will be in output QH, and only now the data at output is valid. To cascade more 74164 shift register IC need to connect the last output QH to the input of second shift register.

The output is connected to the cathode of the LEDs in the 7 segment display and thus common anode displays are used. The anode is connected to $+V_{cc.}$ The last output of the first sift register is connected to input of the 2nd shift register and the last output o f 2^{nd} shift register to input of 3^{rd} and so on. Thus the shift register are serial in parallel out and they are connected to displays, in such a way that output 0A is connected to display segment ‘a’ and 0B to ‘b’ and so on up to 0H; through 330 ohm resistors.

The shifting of data bit takes place for each clock cycle. 7404 IC used provides isolation and the interface board gets 5V through port bit.

Pin 1 is used as data pin and pin 2 is used as other input to Vcc. The clock signal is generated at a port bit which will be connected to the clock of the shift register.

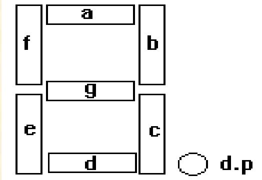
PB0 is used for data bit; and PC0 for clock through which a falling edge has to be sent.

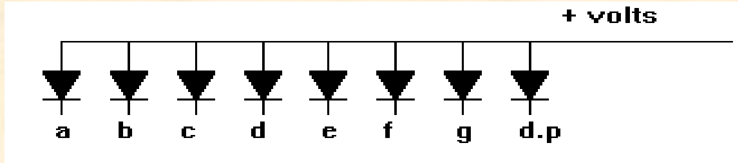
The microprocessor stores the display information in a RAM. Each time a display has to be updated the microprocessor fetches all bytes one by one from RAM and outputs corresponding display codes serially that is bit by bit to display. Hexadecimal code is stores in the RAM. The code conversion from hexa to 7 segment is done just before the display is updated.

The 7 segment display is used as a numerical indicator on many types of test equipment. It is an assembly of light emitting diodes which can be powered individually. There are two important types of 7-segment LED display.
In a **common cathode** display, the cathodes of all the LEDs are joined together and the individual segments are illuminated by HIGH voltages.
In a **common anode** display, the anodes of all the LEDs are joined together and the individual segments are illuminated by connecting to a LOW voltage.

Display code

Since the outputs of shift registers are connected to cathode sides of displays, low input must be given to segments for making them glow and high inputs for making them blank. Each display has 8 segments (a, b, c, d, e, f, g, h) as shown. For displaying any character the corresponding segment must be given low inputs.





The one shown above is a common anode display since all anodes are joined together and go to the positive supply. The cathodes are connected individually to zero volts. Resistors must be placed in series with each diode to limit the current through each diode to a safe value. The **d.p** represents a decimal point.

The following table shows how to form characters: '0' means that pin is connected to ground. '1' means that pin is connected to Vcc.

	d.p	g	f	e	d	c	b	a	Hex. value
0	1	1	0	0	0	0	0	0	C0
1	1	1	1	1	1	0	0	1	F9
2	1	0	1	0	0	1	0	0	A4
3	1	0	1	1	0	0	0	0	B0
4	1	0	0	1	1	0	0	1	99
5	1	0	0	1	0	0	1	0	92
6	1	0	0	0	0	0	1	0	82
7	1	1	1	1	1	0	0	0	F8
8	1	0	0	0	0	0	0	0	80
9	1	0	0	1	1	0	0	0	98
F	1	0	0	0	1	1	1	0	8e
I	1	1	1	1	1	0	0	1	F9
R	1	0	0	0	1	0	0	0	88
E	1	0	0	0	0	1	1	0	86

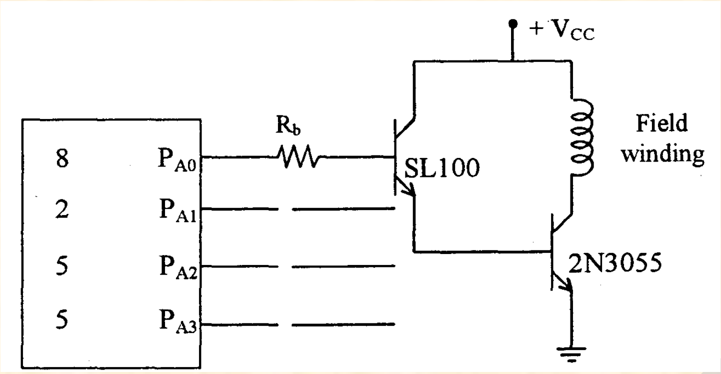
3. Stepper Motor:

A stepper motor is a widely used device that translates electrical pulses into mechanical movement. In applications such as disk drives, dot matrix printers, and robotics, the stepper motor is used for Position control.

Every stepper motor has a permanent magnet rotor (also called the shaft.) surrounded by a stator. The most common stepper motors have four common stator windings that are pairs with a center-taped common. This type of stepper motor is commonly referred to as a four-phase stepper motor.

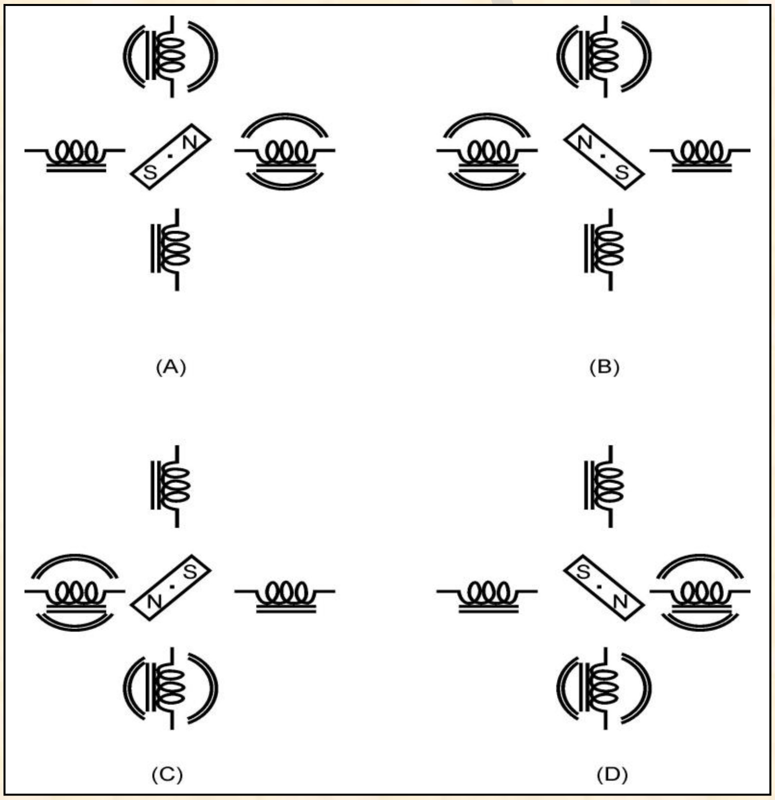
A Stepper motor is stepped from one position to the next by changing the currents through the fields in the motor. Common step sizes for stepper motors range from 0.9 degrees to 30 degrees.

82C55A is used to provide the drive signals that are used to rotate the armature of the motor in either the right-hand or left-hand direction.

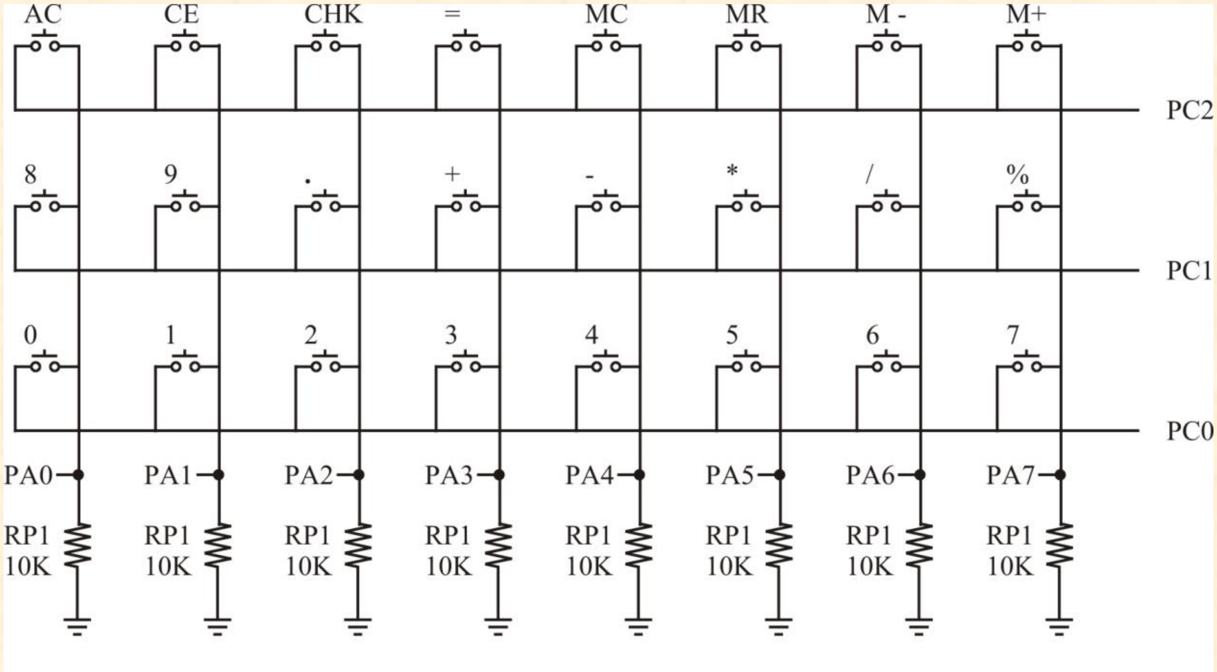


The power circuit for one winding of the stepper motor is as shown in figure above. It is connected to the port A (P_{A0}) of 82C55A. Similar circuits are connected to the remaining lower bits of port A (P_{A1}, P_{A2}, P_{A3}). One winding is energized at a time. The coils are turned ON/OFF one at a time successively.

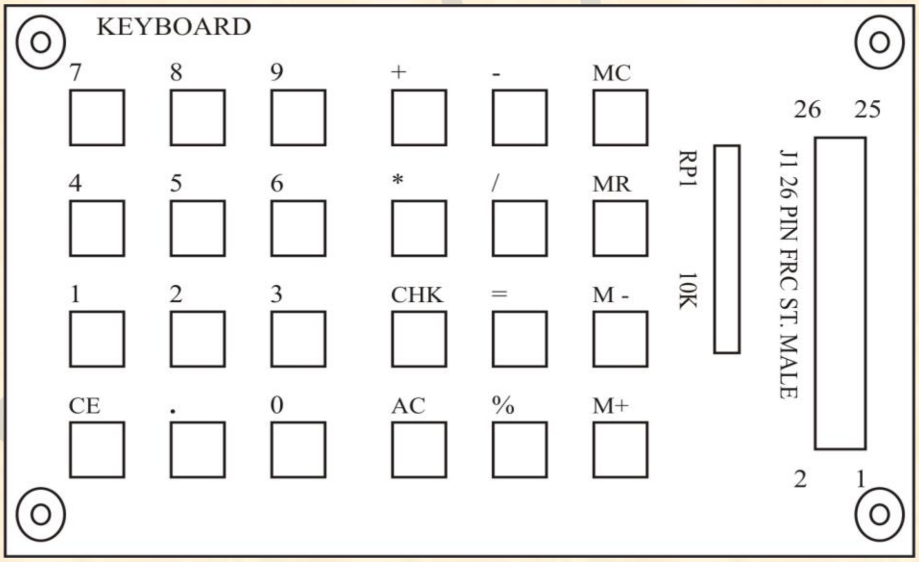
The stepper motor showing full-step operation is shown below.
(A) 45-degrees. (B) 135-degrees (C) 225-degrees (D) 315-degrees.



4. **Matrix Keyboard Display:**



8 x 3 Matrix keypad



The rows are connected to an output port and the columns are connected to an input port. If no key has been pressed, reading the input port will yields 0s for all columns since they are all connected to ground. If all the rows are high and a key is pressed, one of the columns will have 1 since the key pressed provides the path to high. It is the function of the microprocessor to scan the keyboard continuously to detect and identify the key pressed.

Label on the keytop	Hex code
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
.	0A
+	0B

Label on the key top	Hex code
-	0C
X	0D
/	0E
%	0F
AC	10
CE	11
CHK	12
=	13
MC	14
MR	15
M	16
M+	17

Process of identifying the key pressed:

To detect a pressed key, the micro processor set high all rows by providing 1 to the output latch, then it reads the columns. If the data read from the columns is PA0-PA7 = 00000000, no key has been pressed and process continues until a key press is detected.
If one of the column bits has a high, this means that a key press has occurred.

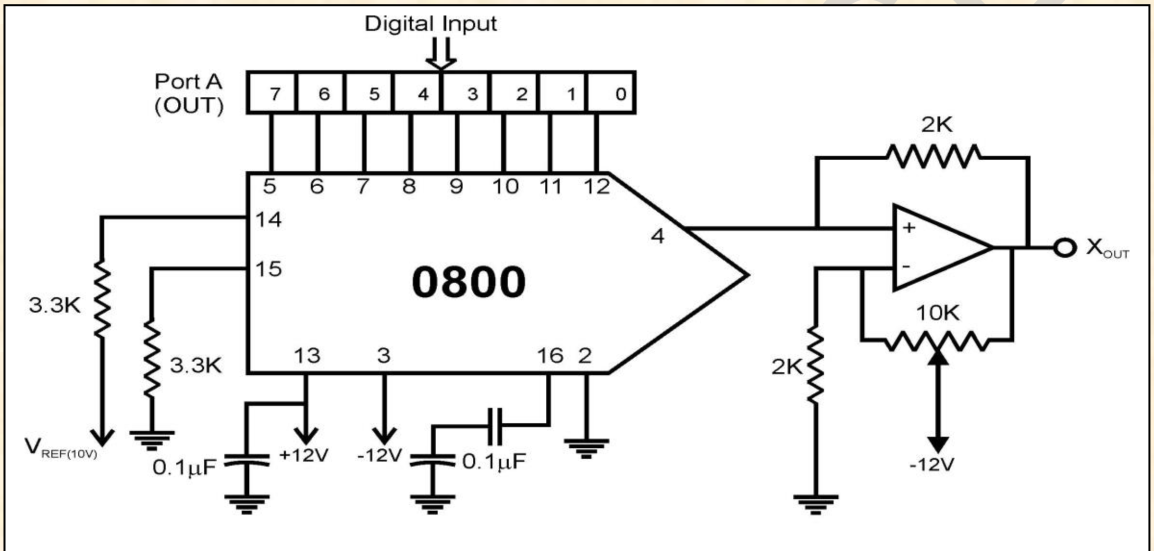
For example, if PA0-PA7 = 00001000, this means that a key in the PA4 column has been pressed.

After a key press is detected, the micro processor will go through the process of identifying the key. Now micro processor sets each row to ground then it reads the columns. If the data read is all 0s, no key in that row is activated and the process is moved to next row. It grounds the next row, reads the columns, and checks for any 1. This process continues until the row is identified. After identification of the row in which the key has been pressed, the next task is to find out which column the pressed key belongs to.
To identify the key press, it rotates the column bits, one bit at a time, into the carry flag and checks to see if it is high. Upon finding the 1, it pulls out the ASCII code for that key from the look-up table; otherwise, it increments the pointer to point to the next element of the look-up table.

5. DAC INTERFACE

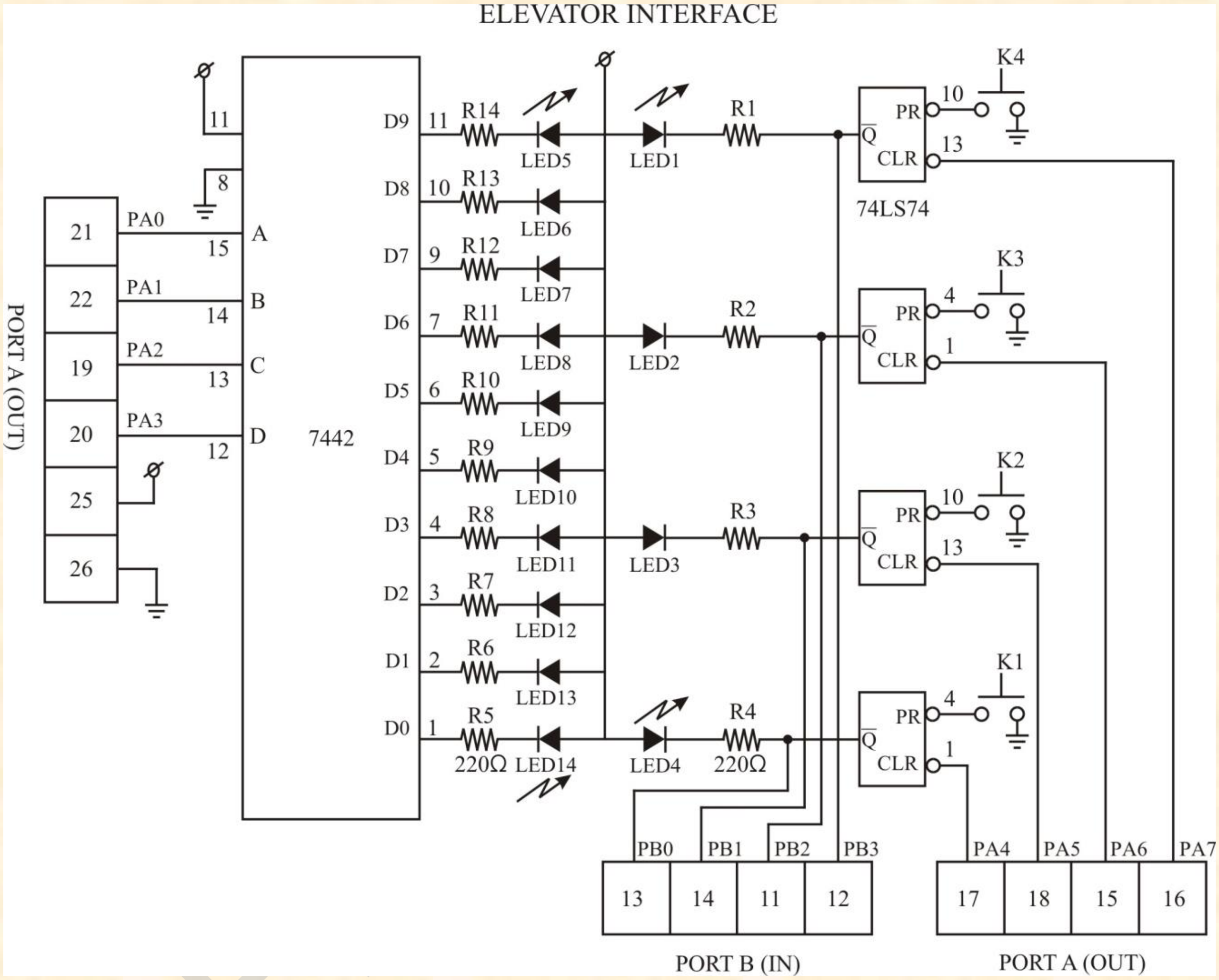
The pin details of DAC 0800 is given below and schematic diagram of the dual DAC interface is given below.

The port A and port B of 82C55A peripheral are used as output ports. The digital inputs to the DACs are porvided through these ports. The analog outputs of the DACs are connected to the inverting inputs of OP-amps 741 which acts as current to voltage converters. The outputs from the OP-amps are connected to points marked X out and Y out at which the waveforms are observed on a CRO. The power supplies of +12 and -12 are regulated for this interface.



Interfacing of DAC 0800

6. Elevator Interface.



The above figure gives hardware details required for the simulation of the elevator.
This interface has four keys, marked 0, 1, 2, and 3(In above fig K1, K2, K3, K4) representing the request buttons at the four floors. These keys are connected to preset (PR) of the D flip-flop. If this key is closed the output goes low and it goes high and thus the corresponding request LED will be ON.

The outputs of the four Flip-flops (74LS74) can be read through port B (PBO, PBI, PB2 and PB3) so that the floor at which request is required is known and the same will be serviced. Also, the status of these signals is reflected by a setoff 4 LED's which are called as request LEDs whose cathode are connected to outputs of four flip-flops; while anodes are connected to +5v as shown in figure. The Flip-Flop can be rest (LED's are cleared) through higher bits of port A (PA4, PA5, PA6, and PA7) so that after servicing the floor at which request was done the corresponding request LED is turned OFF, sending a low to the flip-flop through port A.

A column of 10 LED's, representing the elevator can be controlled through Port A (PA0, PA1, PA2 and PA3). These port lines are fed to the inputs of the BCD to decimal decoder IC7442 whose outputs are active-low used to control the on/off states of the LED's which simulate the motion of the elevator. These LEDS have their cathodes connected to the outputs of the decoder through the resistors and the anodes are commonly connected to the +5v supply as shown in the figure. As the output of BCD decoders are active low and logic low on output causes the corresponding LED goes ON. For Example, If 0010 is the input to the decoder then line 2 goes low and the third LED goes ON.

The motion of elevator can be simulated by turning on successive LED's one at a time. The delay between turning off one LED and turning on the next LED can simulate the "speed" of the elevator.

Viva Questions and Answers

1. What is a Microprocessor?

ANS: Microprocessor is a program-controlled device, which fetches the instructions from memory, decodes and executes the instructions. Most Micro Processor are single- chip devices.

2. What is the difference between 8086 and 8088?

ANS: The BIU in 8088 is 8-bit data bus & 16- bit in 8086.Instruction queue is 4 byte long in 8088and 6 byte in 8086.

3. what are the functional units in 8086?

ANS: 8086 has two independent functional units because of that the processor speed is more. The Bus interface unit and Exectuion unit are the two functional units.

4. What are the flags in 8086?

ANS: In 8086 Carry flag, Parity flag, Auxiliary carry flag, Zero flag, Overflow flag, Trace flag, Interrupt flag, Direction flag, and Sign flag.

5. What is the Maximum clock frequency in 8086?

ANS: 5 Mhz is the Maximum clock frequency in 8086.

6. What are the various segment registers in 8086?

ANS: Code, Data, Stack, Extra Segment registers in 8086.

7. Logic calculations are done in which type of registers?

ANS: Accumulator is the register in which Arithmetic and Logic calculations are done.

8. How 8086 is faster than 8085?

ANS: Because of pipelining concept. 8086 BIU fetches the next instruction when EU busy in executing the anoter instruction.

9. What does EU do?

ANS: Execution Unit receives program instruction codes and data from BIU, executes these instructions and store the result in general registers.

10. Which Segment is used to store interrupt and subroutine return address registers?

ANS: Stack Segment in segment register is used to store interrupt and subroutine return address registers.

11. What does microprocessor speed depend on?

ANS: The processing speed depends on DATA BUS WIDTH.

12. What is the size of data bus and address bus in 8086?

ANS: 8086 has 16-bit data bus and 20- bit address bus.

13. What is the maximun memory addressing capability of 8086?

ANS: The maximum memory capability of 8086 is 1MB.

14. What is flag?

ANS: Flag is a flip-flop used to store the information about the status of a processor and the status of the instruction executed most recently.

15. Which Flags can be set or reset by the programmer and also used to control the operation of the processor?

ANS: Trace Flag, Interrupt Flag, Direction Flag.

16. In how many modes 8086 can be opertaed and how?

ANS: 8086 can be opertaed in 2 modes. They are Minimum mode if MN/MX pin is active high and Maximum mode if MN/MX pin is ground.

17. What is the difference between min mode and max mode of 8086?

ANS: Minimum mode operation is the least expensive way to operate the 8086 microprocessor because all the control signals for the memory and I/O are generated by the micro processor. In Maximum mode some of the control signals must be externally generatred. This requires the addition of an external bus controller. It used only when the system contains external coprocessors such as 8087 arithmetic coprocessor.

18. Which bus controller used in maximum mode of 8086?

ANS: 8288 bus controller is used to provide the signals eliminated from the 8086 by the maximum mode operation.

19. What is stack?

ANS: Stack is a portion of RAM used for saving the content of Program Counter and general purpose registers.

20. Which Stack is used in 8086?

ANS: FIFO (First In First Out) stack is used in 8086.In this type of Stack the first stored information is retrieved first.

21. What is the position of the Stack Pointer after the PUSH instruction?

ANS: The address line is 02 less than the earlier value.

22. What is the position of the Stack Pointer after the POP instruction?

ANS: The address line is 02 greater than the earlier value.

23. What is interrupt?

ANS: Interrupt is a signal send by external device to the processor so as to request the processor to perform a particular work.

24. What are the various interrupts in 8086?

ANS: Maskable interrupts, Non-Maskable interrupts.

25. What is meant by Maskable interrupts?

ANS: An interrupt that can be turned off by the programmer is known as Maskable interrupt.

26. What is Non-Maskable interrupts?

ANS: An interrupt which can be never be turned off (ie.disabled) is known as Non-Maskable interrupt.

27. Which interrupts are generally used for critical events?

ANS: Non-Maskable interrupts are used in critical events. Such as Power failure, Emergency, Shut off etc.,

28. Give example for Non-Maskable interrupts?

ANS: Trap is known as Non-Maskable interrupts, which is used in emergency condition.

29. Give examples for Maskable interrupts?

ANS*:* RST 7.5, RST6.5, RST5.5 are Maskable interrupts. When RST5.5 interrupt is received the processor saves the contents of the PC register into stack and branches to 2Ch (hexadecimal) address.

When RST6.5 interrupt is received the processor saves the contents of the PC register into stack and branches to 34h (hexadecimal) address.

When RST7.5 interrupt is received the processor saves the contents of the PC register into stack and branches to 3Ch (hexadecimal) address.

30. What is SIM and RIM instructions?

ANS: SIM is Set Interrupt Mask. Used to mask the hardware interrupts. RIM is Read Interrupt Mask. Used to check whether the interrupt is Masked or not.

31. What is macro?

ANS: Macro is a set of instructions that perform a task and all the isntructions defined in it is inserted in the program at the point of usage.

32. What is the difference between Macro and Procedure?

ANS: A procedure is accessed via a CALL instruction and a macro will inserted in the program at the point of execution.

33. What is meant by LATCH?

ANS: Latch is a D- type flip-flop used as a temporary storage device controlled by a timing signal, which can store 0 or 1. The primary function of a Latch is data storage. It is used in output devices such as LED, to hold the data for display

34. What is a compiler?

ANS: Compiler is used to translate the high-level language program into machine code at a time. It doesn.t require special instruction to store in a memory, it stores automatically. The Execution time is less compared to Interpreter.

35. What is the disadvantage of microprocessor?

ANS: It has limitations on the size of data. Most Microprocessor does not support floating-point operations.

36. What is the 82C55A device?

ANS: The 8255A/82C55A interfaces peripheral I/O devices to the microcomputer system bus. It is programmable by the system software. It has a 3-state bi-directional 8-bit buffer which interfaces the 8255A/82C55A to the system data bus.

37. What kind of input/output interface dose a PPI implement?

ANS: It provides a parallel interface, which includes features such as single-bit, 4-bit, and byte-wide input and output ports; level-sensitive inputs; latched outputs; strobed inputs or outputs; and strobed bidirectional input/outputs.

38. How many I/O lines are available on the 82C55A?

ANS*: 82C55A has a total of 24 I/O lines.*

39. Describes the mode 0, mode 1, and mode 2 operations of the 82C55A?

ANS*:* MODE 0: Simple I/O mode. In this mode, any of the ports A, B, and C can be programmed as input or output. In this mode, all the bits are out or in.

MODE 1: Ports A and B can be used as input or output ports with handshaking capabilities. Handshaking signals are provided by the bits of port C.

MODE 2: Port A can be used as a bidirectional I/O port with handshaking capabilities whose signals are provided by port C. Port B can be used either in simple I/O mode or handshaking mode 1.

40. What is the mode and I/O configuration for ports A, B, and C of an 82C55A after its control register is loaded with 82H?

ANS: If control register is loaded with 82H, then the port B is configured as an input port, port A and port C are configured as output ports and in mode 0.