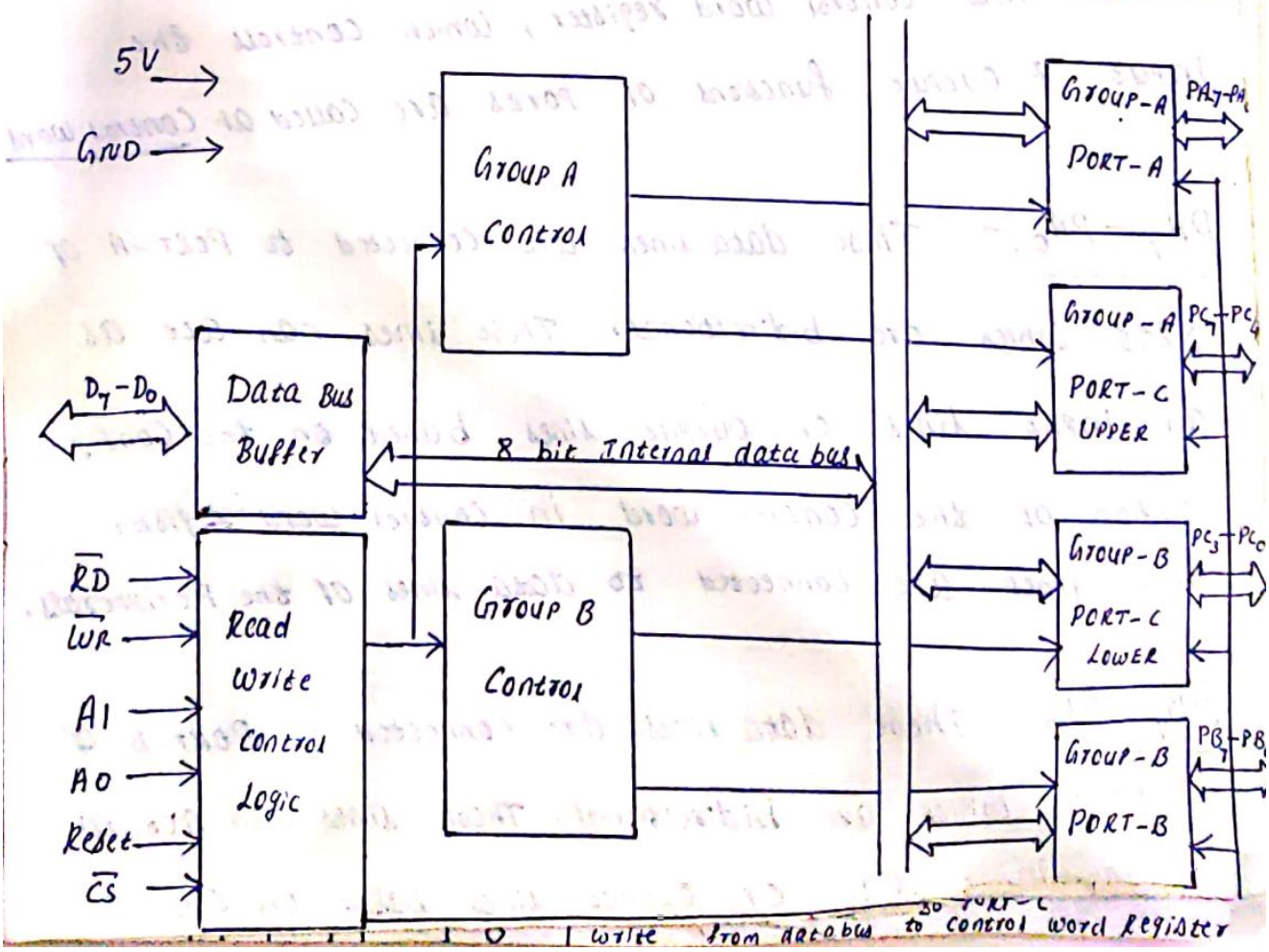
8255 Programmable Peripheral Interface (PPI)

The communication between the fast microprocessor & slow I/o devices always takes place using buffers. The buffers serve only one function. Some buffers are used as only input buffer & some are used only as output buffer. The function cannot be changed for different applications. To overcome this problem, there is a device called programmable peripheral interface (PPI). These PPI device provides multiple I/o ports that can be programmed so that any port can act as an input port or any port can act as an output port.

The below figure shows internal block diagram of 8255 PPI



8255 PPI has 40 pins, which operates with +5V power supply. 8255 has 24 Input/Output pins, which are grouped into three 8 bit ports as PORT A, PORT B & PORT C. PORT A & PORT B can be used as an 8 bit input port (Reads data from external device & gives it to processor) or an 8 bit output port (Reads data from the processor & display it on external device). PORT C can be used as two 4 bit ports PORT-C UPPER & PORT-C LOWER. PC_U & PC_L can be used as an input port or an output port. Port C can also be used as an 8 bit input port or output port.

Along with 3 ports, 8255 also has an control word register, which can hold 8 bit data. The 8bit data written into control word register, which controls the input & output functions of ports are called as Control word.

$PA_7 - PA_0$:- These data lines are connected to PORT-A of 8255, which are bidirectional. These lines can act as an input lines or output lines based on the configuration of the control word in control word register. These lines are connected to data lines of the peripherals.

$PB_7 - PB_0$:- These data lines are connected to PORT-B of 8255, which are bidirectional. These lines can act as an input lines or output lines based on the

Configuration of the control word in the control word register. These lines are connected to the datalines of the peripherals.

$PC_7 - PC_0$:- These data lines are connected to PORT-C of 8255, which are also bidirectional. These lines can act as an input lines or output lines based on the configuration of the control word in the control word register. These lines are connected to the datalines of the peripherals. These lines can also be used as 4 bit I/O ports PORT C UPPER & PORT-C LOWER to carry 4 bit information.

$D_7 - D_0$:- These are data pins, which are bidirectional & are connected to data bus of 8086 processor. These lines are used to carry data from MP to output port or from Input port to MP and control word from MP to control word register of 8255 PPI:

$A_1 - A_0$:- These two pins are used to address PORT A, PORT B, PORT C & control word register

A_1	A_0	$\overline{RD}$	$\overline{WR}$	Operation
0	0	0	1	Read from PORT-A to data bus
0	1	0	1	Read from PORT-B to data bus
1	0	0	1	Read from PORT-C to data bus
1	1	0	1	Illegal cannot read data from control Register
0	0	1	0	Write from databus to PORT-A
0	1	1	0	Write from databus to PORT-B
1	0	1	0	Write from databus to PORT-C
1	1	1	0	Write from databus to control word register

$\overline{RD}$:- (read Signal) :- This is an input pin, whenever Mp wants to read the data from the I/p port of 8255, it sends low signal on this pin.

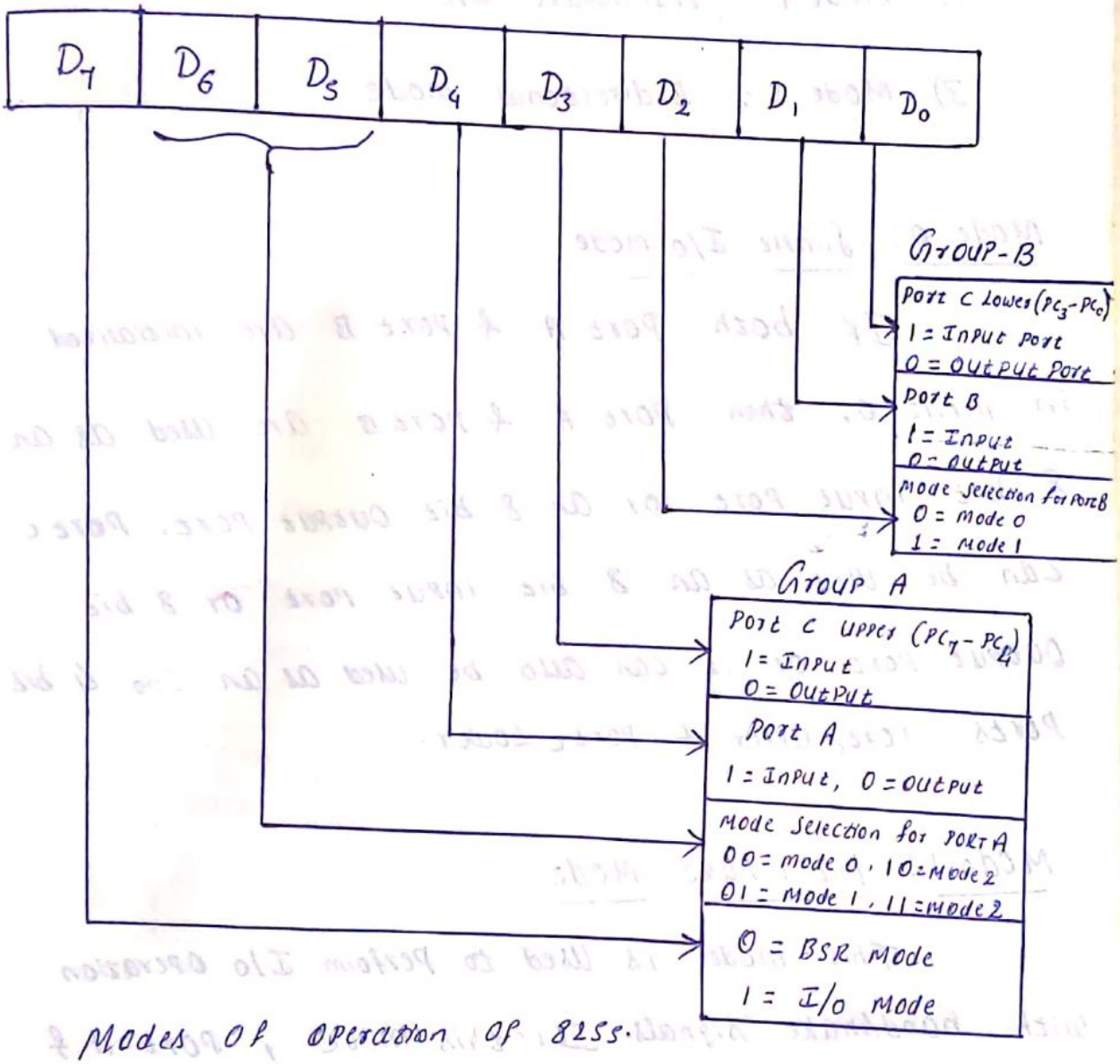
$\overline{WR}$: (write Signal) :- This is also an input pin, whenever Mp wants to write the data to output port or control word to control word register, then it sends low signal on this pin.

$\overline{CS}$:- Chip Select :- This is an input pin, which is connected to address decoder to select the Chip 8255

RESET :- This is an input pin activated by 8086 Mp when reset the system. When reset, the control word register is cleared + all ports are configured automatically for simple input mode.

Control word format of 8255

The control word format of 8255 is shown below



Modes of Operation of 8255.

The two basic modes of operation of 8255 are

1) I/O mode
2) BSR mode (Bit Set/Reset mode)

I/O Mode

In this mode, 8255 ports Port A, Port B & Port C work as a Programmable Input Port or as an

Output port. The I/O ports in 8255 can be configured to operate in three different modes

1) Mode 0 : Simple I/O mode

2) Mode 1 : Handshake I/O mode

3) Mode 2 : Bidirectional mode

Mode 0: Simple I/O mode

If both port A & port B are initialized in Mode 0, then port A & port B are used as an 8 bit input port or an 8 bit output port. Port C can be used as an 8 bit input port or 8 bit output port or it can also be used as an two 4 bit ports : $port_C$ upper & $port_C$ Lower.

Mode 1: Handshake Mode

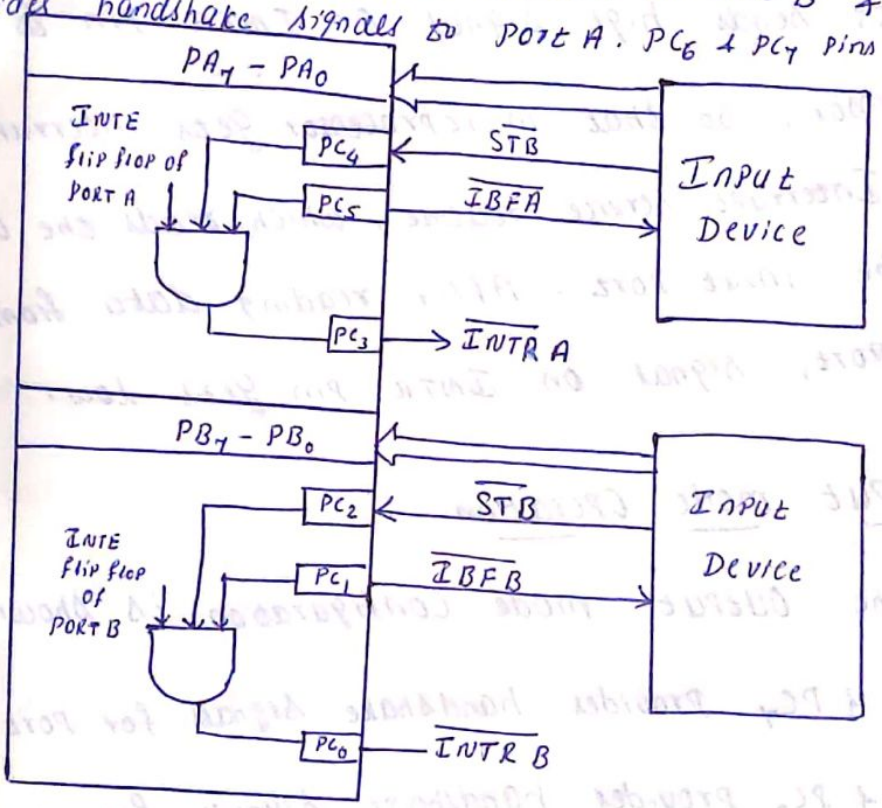
This mode is used to perform I/O operation with handshake signals. In this mode, port A & port B can be used as an input port or as an output port. port C pins are used to carry handshake signals for port A & port B. ~~$PC_0 - PC_2$ provides handshake signals to port B & $PC_3 - PC_5$ provides handshake signals to port A. PC_7 & PC_6 pins can be used as~~

In this mode, I/O operations are performed in two modes

1) Input mode operation
2) Output mode operation

Input mode Operation

The input mode configuration is shown below



$PC_0 - PC_2$ provides handshake signals to port B & $PC_3 - PC_5$ provides handshake signals to port A. PC_6 & PC_7 pins can be used as independent data lines.

The various handshake signals used to input the data are

$\overline{STB}$:- The input device issues strobe signal to 8255, which is active low. This informs to 8255 that the input device is sending the data. If $\overline{STB} = 0$, indicates that input device started sending data. If $\overline{STB} = 1$, indicates data transfer is complete & data is available on input port

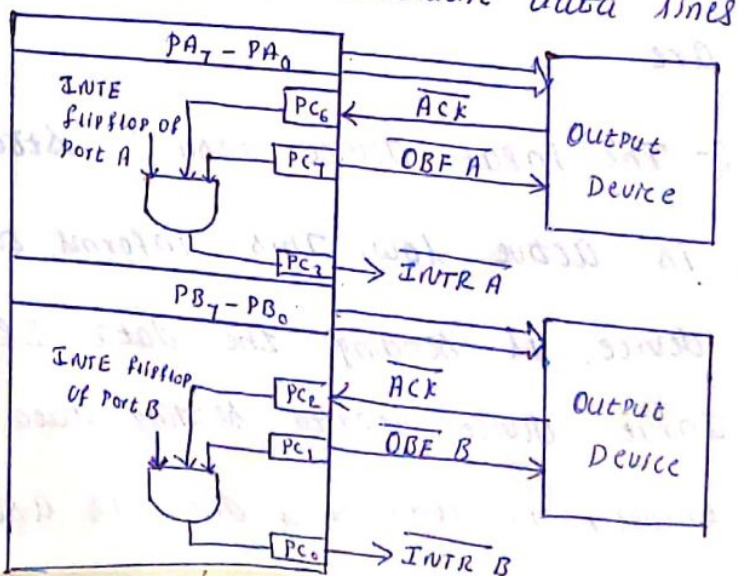
IBF: Input Buffer full, when data byte is available on input port, 8255 sends IBF signal to input device. If IBF=1, indicates data is in input port, so that input device will not send next data, so that Input port data is not erased. If IBF=0, indicates that the input device can send next data.

INTR:- As soon as the data is latched into input port, 8255 sends high signal on INTR pin to the microprocessor, so that microprocessor gets interrupted, executes Interrupt service routine, which reads the data byte from the input port. After reading data from the input port, signal on INTR pin gets low.

Output mode Operation

The output mode configuration is shown below.

PC_3, PC_6 & PC_7 provides handshake signals for port A & PC_2, PC_1 & PC_0 provides handshake signals for port B. PC_4 & PC_5 pins are used as an independent data lines.



$\overline{OBF}$: Output Buffer full: $\overline{OBF}$ = 0, indicates that the microprocessor has placed the data to be printed on the output port & output device can print. $\overline{OBF}$ = 1, indicates that the output port is empty, so that output device will not print. Thus junk data is not printed.

$\overline{ACK}$: When output device receives the data from the output port, it sends $\overline{ACK}$ to 8255. So that 8255 makes $\overline{OBF}$ = 1

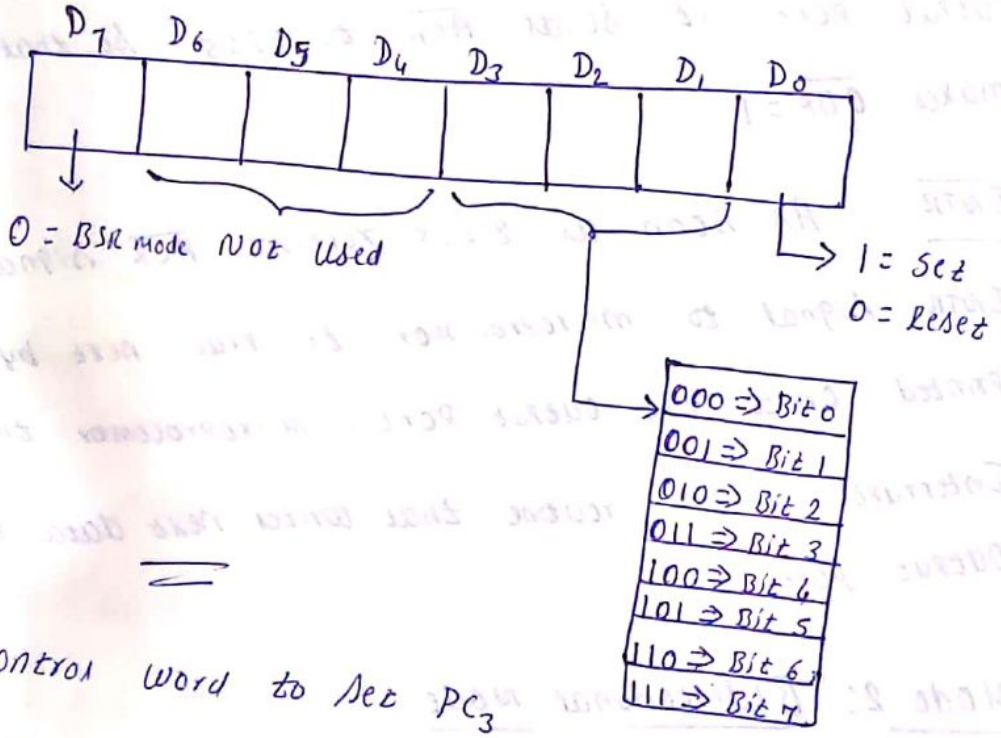
$\overline{INTR}$: As soon as 8255 receives $\overline{ACK}$ signal, it sends INTR signal to microprocessor to place next byte to be printed on to the output port. Microprocessor then executes Interrupt service routine that writes next data to the output port.

Mode 2: Bidirectional mode

In this mode, all the functionalities remains same as mode 1 operations thus combining Input & Output modes. This means data can input or output on the same data lines. If port A is initialized in mode 2, then PC_3 - PC_7 are used to provide handshake signals for port A. If port B is initialized in mode 2, then PC_0, PC_1, PC_2 are used to provide handshake signals for port B.

BSR Mode

In this mode, any of the 8 bits of Port C can be set or reset dependending upon the application. D_0 is used to set/reset of port C bit. D_1, D_2 & D_3 bits selects port C bit, which is to be set or reset. D_7 bit indicates BSR mode. The control word of BSR mode is shown below



Eg: ① Control word to set PC_3

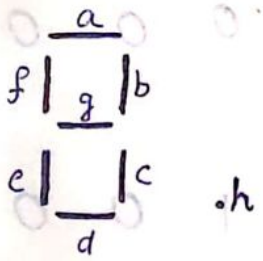
0 000 011 1

② Control word to reset PC_5

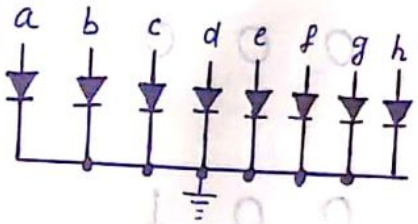
0 000 101 0

Seven Segment Display Interface

The below figure shows 7-segment LED (Light Emitting Diode) display that are commonly used in digital instruments.



The below figure shows Schematic of Common Cathode LED display

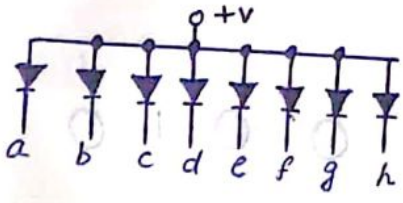


FOR Common cathod

0 → OFF

1 → ON

The below figure shows Schematic of Common Anode LED display



FOR Common Anode

0 → ON

1 → OFF

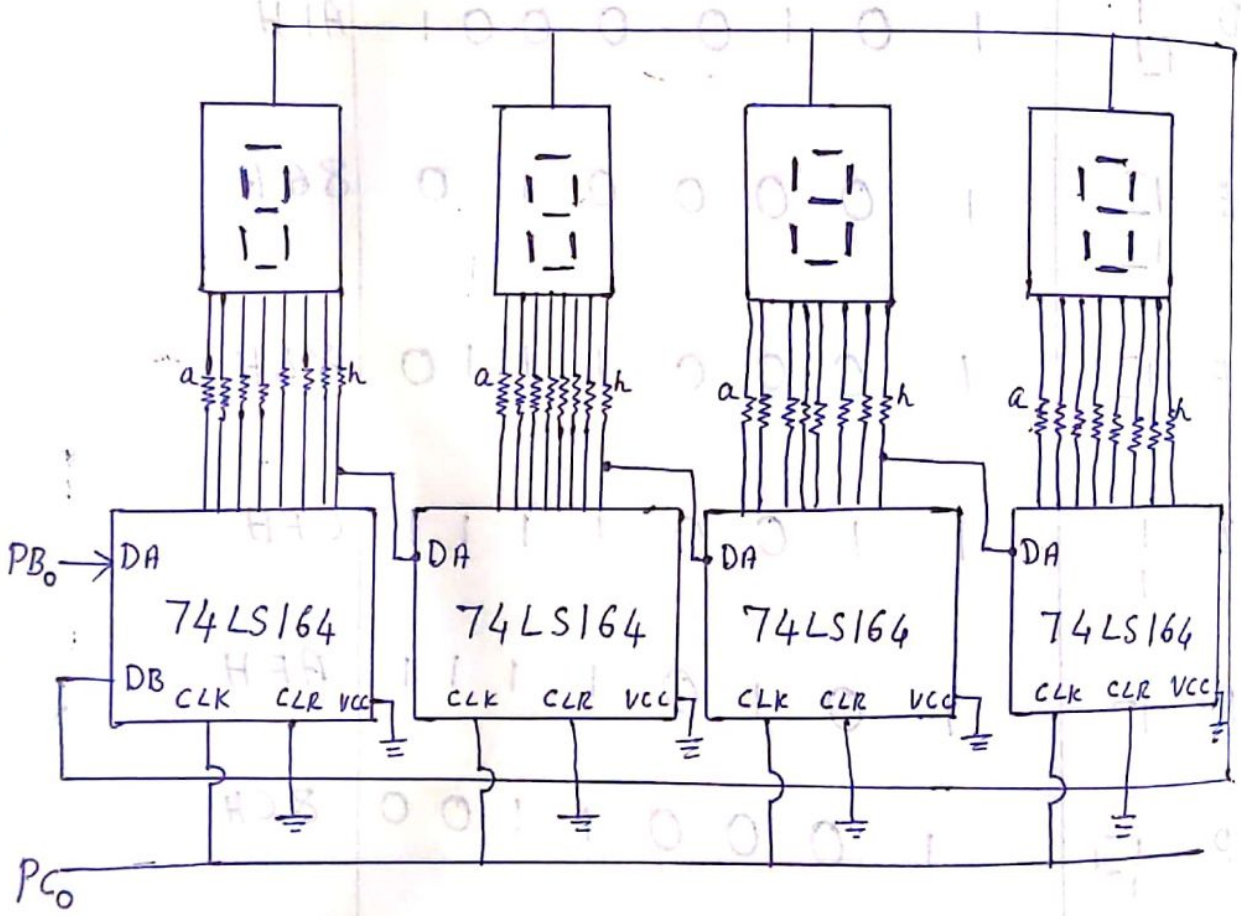
The below table shows 7-segment display code to display 0 to 9 & A, B, C, D, E, F, I, R, P, H, L

Digit/Alphabet	h	g	f	e	d	c	b	a	7-Segment Code
0	1	1	0	0	0	0	0	0	C0H
1	1	1	1	1	1	0	0	1	F9H
2	1	0	1	0	0	1	0	0	A4H
3	1	0	1	1	0	0	0	0	B0H
4	1	0	0	1	1	0	0	1	99H
5	1	0	0	1	0	0	1	0	92H
6	1	0	0	0	0	0	1	0	82H
7	1	1	1	1	1	0	0	0	F8H
8	1	0	0	0	0	0	0	0	80H

Q	1 0 0 1 1 0 0 0	98H
A	1 0 0 0 1 0 0 0	88H
B	1 0 0 0 0 0 1 1	83H
C	1 1 0 0 0 1 1 0	C6H
D	1 0 1 0 0 0 0 1	A1H
E	1 0 0 0 0 1 1 0	86H
F	1 0 0 0 1 1 1 0	8EH
I	1 1 0 0 1 1 1 1	CFH
R	1 0 1 0 1 1 1 1	AFH
P	1 0 0 0 1 1 0 0	8CH
H	1 0 0 0 1 0 0 1	89H
L	1 1 0 0 1 1 1 0	C7H

To display only numbers & hexadecimal letters, a simple 7-segment display can be used, however to display numbers & entire alphabet, 18-segment display can be used.

The 7-segment display interface circuit is as shown below



As shown in figure, there are 4 seven segment display. 74LS164 is a serial-in-parallel-out shift register. Here both port B & port C are in output mode. Port B_0 is used to output each bit of 7-segment code to display & port C_0 is used to apply clock pulse

$\overset{1}{\underset{0}{\lrcorner}}$. After applying clock pulse to PC_0, PB_0 bit is output to shift register & value of each register is shifted to next register.

Here both PortB & port C_L are in output mode,

∴ the control word for 7-segment display interface is as follows

D7	D6	D5	D4	D3	D2	D1	D0	
1	0	0	0	0	0	0	0	= 80H
I/O	mode 0		PA	PC_U	mode 0	PB	PC_L	