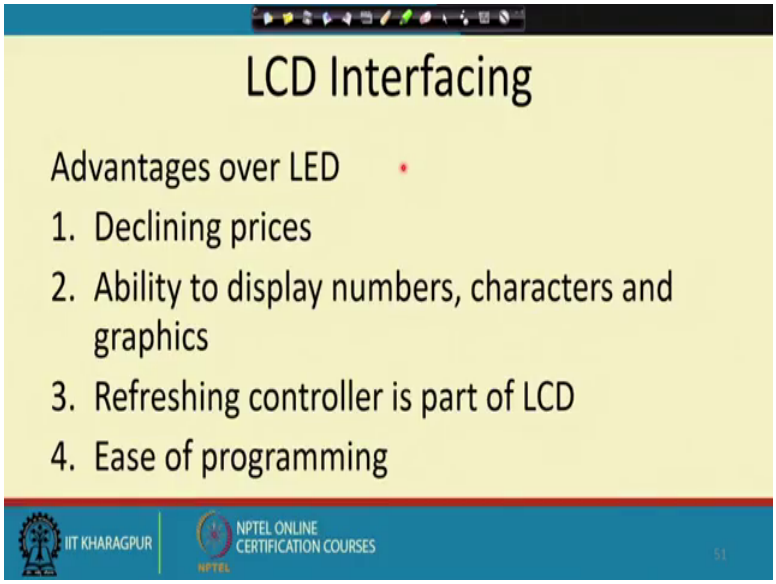
Microprocessors and Microcontrollers
Prof. Santanu Chattopadhyay
Department of E & EC Engineering
Indian Institute of Technology, Kharagpur

Lecture-58
Interfacing (Contd.)

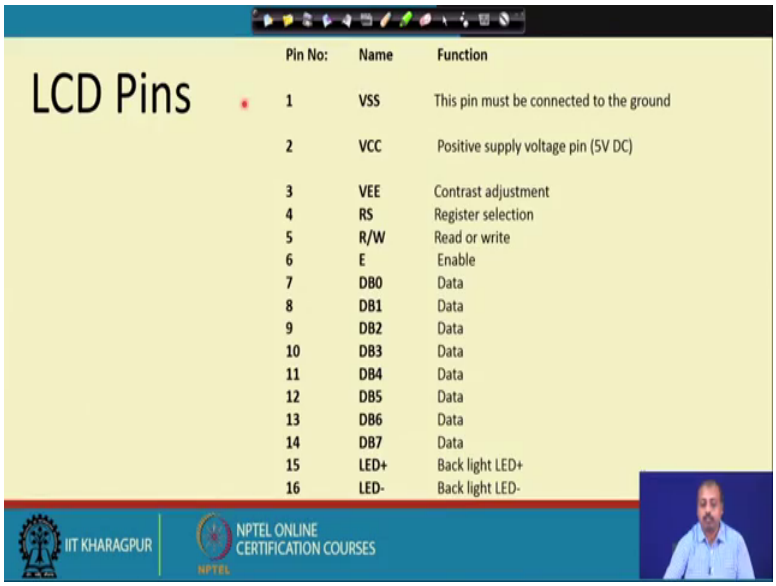
So, as far as connecting one LCD is concerned.

(Refer Slide Time: 00:22)



So, there are some pin structures for the LCDs and those pin structure more or less standard one like.

(Refer Slide Time: 00:27)



These are the common, commonly available pins on some LCD panel ok. So, pin number 1 to 16. So, that is pin number one is the VSS that is connected to the ground line, when pin 2 is VCC positive supply voltage which is the 5 volt, then pin number 3 is for contrast adjustment. So, you can put some voltage value there accordingly the contrast of the display will be selected then the pin number 4 is for the register selection.

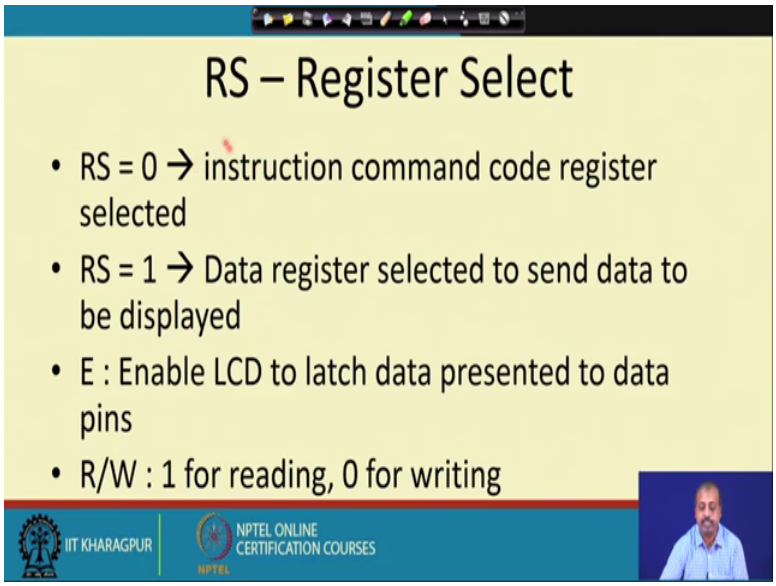
So, as I said there are different types of registers inside the LED, inside the LCD panel. So, it is basically if you have got if you have there is control register and there is data register in the control register we put commands for the display and in the data register we put the display the characters or the graphics or whatever it is whatever pattern we want to display. So, they are put on to the, this data register, then there is a read write pin.

So, which is read or right so, the whether we are trying to write something on to the panel or we are trying to read something for the panel like sometimes we need to know the status of the panel. So, what it is doing and all that? So, then we can have this status input to the read by activating the read line and if you are trying to put something on to the panel. So, you can activate the right line and that way you can put that right control to the LCD, then there is a enable pin.

So, this enable pin. So, naturally for the operation of the LCD this enable pin should be activated then we have got this data lines DB 0 to DB 7 they are for this connecting the giving the data control to the panel and then there is some LEDs LCD display they have

got this back light facility. So, you can put this back light by this differential input this LED plus and LED minus. So, you can control this back light part, some LCDs may not have this back light, some LCDs may have this back light out of them this register select so this is very important.

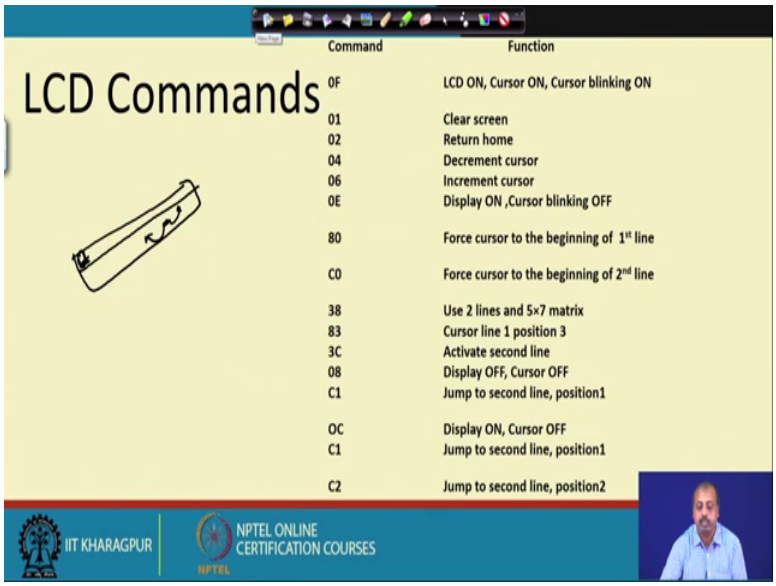
(Refer Slide Time: 02:38)



So, this pin so if RS equal to 0 the register select is equal to 0 then the instruction command code register gets selected. So, whatever you are righting. So, that will go to the command port, that will go as command to the LCD panel it will be stored in the command code register and if RS equal to 1 then the data that you are showing that you have sending. So, it will put on to the data register for display then the enable.

So, enable LCD to latch data presented to data pin. So, this enable is naturally this similar to all other enables. So, enable it. So, it will be it will be the value that you are putting on to the data base we will be put into the data register and for display and there is a read write pin. So, it is one for reading and 0 for writing. So, if you are trying to write something on to the command code register or data register if you put a 0 here and if you are trying to read the status of the LCDs. So, give a one on the read write pin ok.

(Refer Slide Time: 03:51)



So, there is a standard set up commands that are understood by all the LCD display. So, these are all standardized like the command 0 f the function is to turn on LCD turn on curser and the cursor blinks ok.

So, these 3 things are turned on by giving a command. So, on the command port command register. So, if you right 0 f then this will happen, LCD will turn on curser will be on the it will show the position where the characteristic will be input and the blinking will turn on, then if sometimes you want to clear the screen. So, that for that you send a command 0 1 to the LCD display. So, this command goes to command port, command port register and the display gets cleared then return home return home for the LCD panels. So, you can have a home position define.

So, may be if is a LCD panel like this normally there will be 2 lines on the LCD panel. So, this may be the home position. So, cursor was somewhere here say now if you say return home by 0 2. So, the cursor will come to this point and depending upon the setting. So, it will start blinking or something like that. So, then increment sorry (Refer Time: 05:07) decrement cursor. So, decrement cursor will take cursor back by one position. So, if cursor were here it will come back to the previous position so that is the decrement cursor.

So, similarly increment cursor will take the cursor to the next position. So, you can, so if you are putting some pattern. So, you can use this increment cursor decrement cursor

commands for putting the cursor at a proper place and then you put the data to be displayed. So, the data that pattern that you want to display will become visible, then we have got this 0 e for display on and cursor blinking off, sometimes we do not want the cursor. So, it should remain as a steady output so the cursor cannot blink.

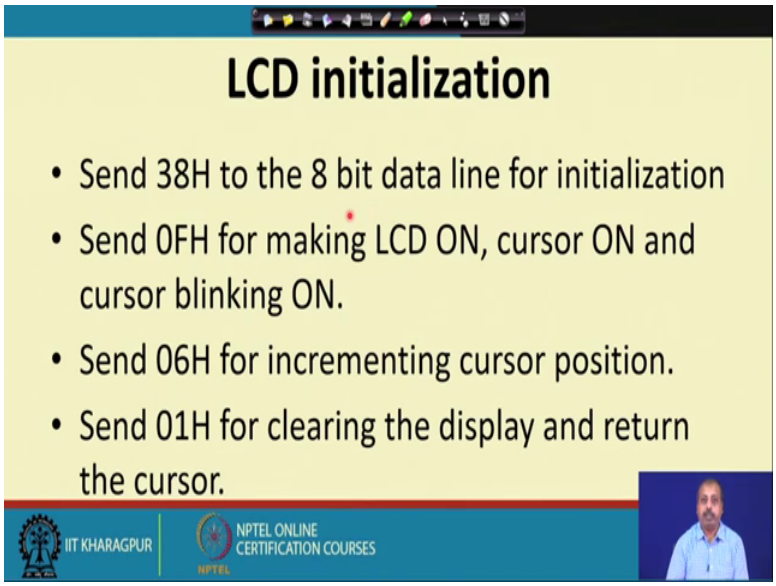
So, that way it is display is turned on and cursor blinking is turned off then 8 0 it will force cursor to the beginning of first line. So, it is a 2 line display that I was telling that most of the LCD they are having 2 line displays. So, if you give the command 8 0 it will take the cursor to the beginning of first line, similarly if you put the command c 0 it will put the cursor to the beginning of second line then 3 8. So, 3 8 it will stand for use 2 lines and 5 cross 7 matrix ok. So, 5 plus 7 matrix means how many dots will be there per character the 5 plus 7 matrix so.

So, many dots there are so based on these dots. So, you can select some pattern to be displayed, then we can have say 83. So, it is cursor line 1 position thre3e. So, this is an example. So, you are there are number of positions. So, that way you can you can put at it you can you can put the cursor at the particular position. So, 83 80 will take it to the first position and 83 will take it to the third position like that, then 3C 3C will activate the second line, second line will become active and 08, if you put 08 then display will be off and cursor will also be off C 1.

So, it jumps to the second line position 1. So, C 0 is the second line position 0 C 1 is the second line position 1 then 0 c. So, display on cursor off c one jump to second line position 1 C 2 jump to second line position 2. So, this way so 8 will identify first line c identify the second line and then for a position within the line. So, you can go to the second part will be specified that like c 1, takes it to position 1 c 0 takes it to position 0 c 2 takes it to position 2 all in the second line. So, this way you can you can control the cursor and then put a character to be displayed.

So, that it will be displayed at current cursor position.

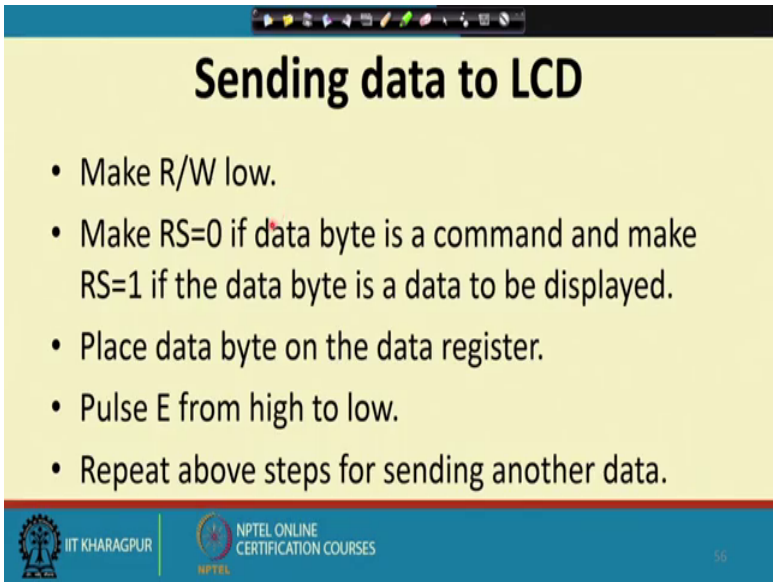
(Refer Slide Time: 08:05)



So, how to operate the first thing is that we should do for a LCD operation is to initialize the LCD. So, we sent the command 38 x to the to the 8 b data line for initialization. So, for LCD is connected to the data base of the processor so, sending 38 x to the 8 b data line. So, it will initialize the LCD then we turn we want to turn the LCD on the cursor on and also the cursor blinking on. So, for that the command lowered is 0 f x as we have seen, 0 f x will be put on to the command port.

So, it will be displaying the LCD will be on the cursor will be on and the cursor will also blink, then we want to go to the next position of the cursor. So, we can send 0 6 x for implementing it and then we send 0 1 x clearing the display and return the cursor. So, that way whatever if something is there on the display will go off by putting 0 1 x by. So, that way we can do it.

(Refer Slide Time: 09:10)

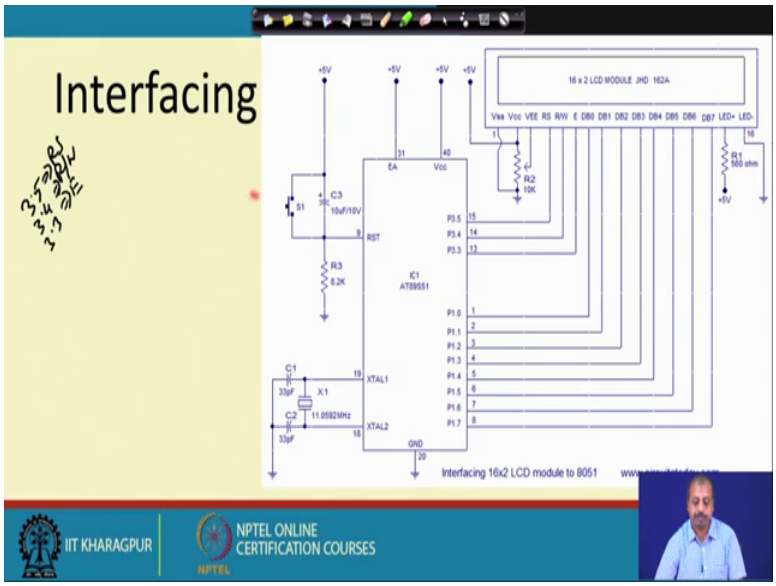


After that we should may this read write low and make RS equal to 0 if data bite is same then the command then RS is equal to 1 if data byte is data byte is, if you are sending the data byte. So, if you are sending a command bite then RS is equal to 0 if you are sending a data byte then it the data byte will be displayed.

So, this read write is equal to low. So, after that so the data is retained. So, read write is low means this write is activated. So, the data byte will be retained either to the command port or to the common register or to the data register, after that we place the data bite on the data register and pulse give a pulse on the e line the enable line from high to low. So, this e line makes a transition from high to low as a result this, the display will be enabled and the pattern that I have sent will be displayed, then we are repeating this process for sending another data.

So, this process should go on for sending different characters to be displayed. So, once the cursor position and send the next data byte to be displayed so that way it it will continue. So, after sending data byte then you can you can right it and give a right control to the LED to the LCD display and it will be outputted corresponding register.

(Refer Slide Time: 10:39)

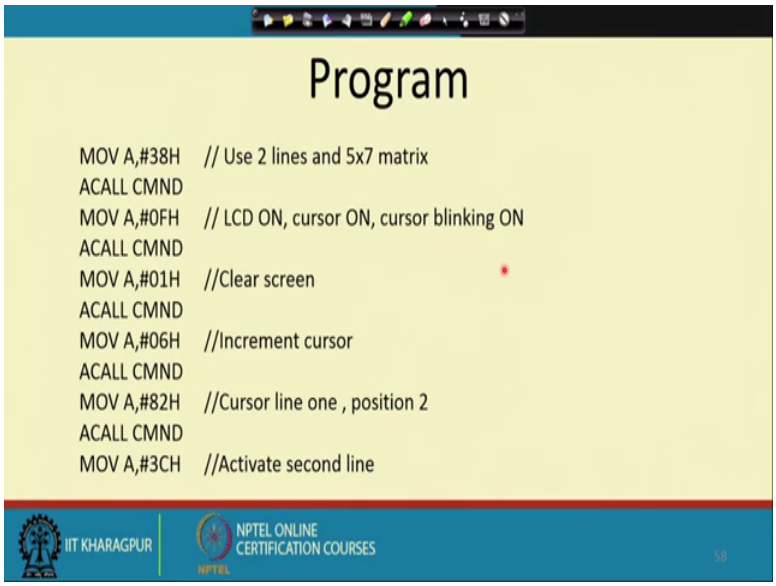


So, this is the interfacing diagram we have got this particular diagram for this display 162 JHD 162A. So, 16 by 2 LCD modules so, each line has got 16 cursor positions and there are 2 such LCD lines.

So, it is a 2 line display and if you look into the connection pattern then you see that we have connected this port 1 to the data lines of the LCD, DB 0 to DB 7 they are connected to port 1.0 to 1.07 then this line register select then this read write and enable. So, they are controlled by pin 13, 14 and 15 and rest of the pins are connected to VCC, VSS and then this 5 volt power supply connected here.

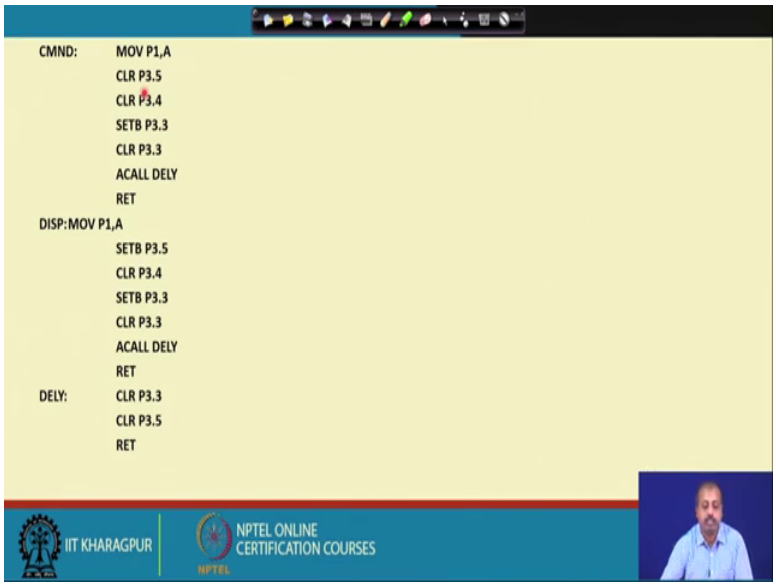
So, this way we are, so then we is for contrast adjustment they port here if you change this port position then this v, v change as a result the contrast of this display will change, some of the displays may have this then this LED plus and LED minus, LED plus and LED minus has been given 5 volt and this minus has been given 0 volt as a result this back light will be turn on ok. So, we can do this thing then on the 8051 sides. So, there is nothing new here. So, the port 3 bits 3 4 and 5 controlling this 3 bits and this port 1 controlling the data base line for the LCD then the program for doing.

(Refer Slide Time: 12:13)



It is MOV a comma as 38 bits. So, that will be using 2 lines. So, so we use 2 lines and 5 cross 7 matrix structures, then a call command. So, this will call the routine for putting this output onto the command ports. So, we will see how this is done.

(Refer Slide Time: 12:38)

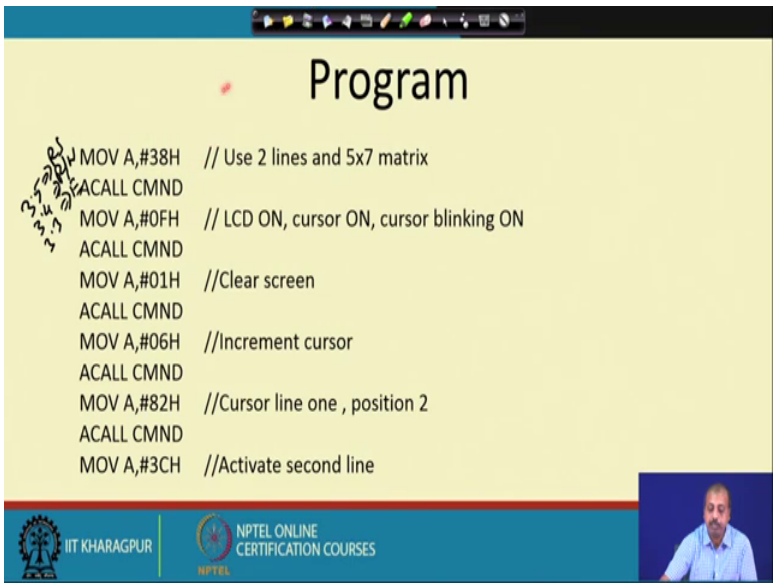


So, this is that command. So, this is doing a register we have got 38 x. So, that is moved to p 1 then clear p 3.5 clear p 3.4. So, so we just need to see what are these for 3.5, 3.4 etcetera. So, this 3.5 is 3.5 is r s. So, our 3, 3.5, 3.5 is the RS register, RS bit then 3.4 is the read write, 3.4 is the read write and 3.3 is the enable ok. So, these 3 are the setting

now we can look into that command port. So, the command code you see first we have done clear p 3.5 this register select this register select bit is cleared and then this we are writing onto the command port since this bit is cleared. So, you are writing on to the command port, then this clear 3.4. So, this will be clearing this read write line. So, we are trying to write some value and say bit p 3.3 and clear p 3.3. So, we are giving it a pulse of high to low on the e line.

So, as a result the value will be put on to the register and we put a small delay routine for the value to get latched and then it is returned, this delay routine is very simple. So, it is just clearing the 2. So, we need a small amount of delay for latching the value to some useful thing clearing p 3.3 and 3 point for that metal you can any other statements here which does not have effect on the operation of the LCD panel ok. So, we can do that. So, if we go back to the program.

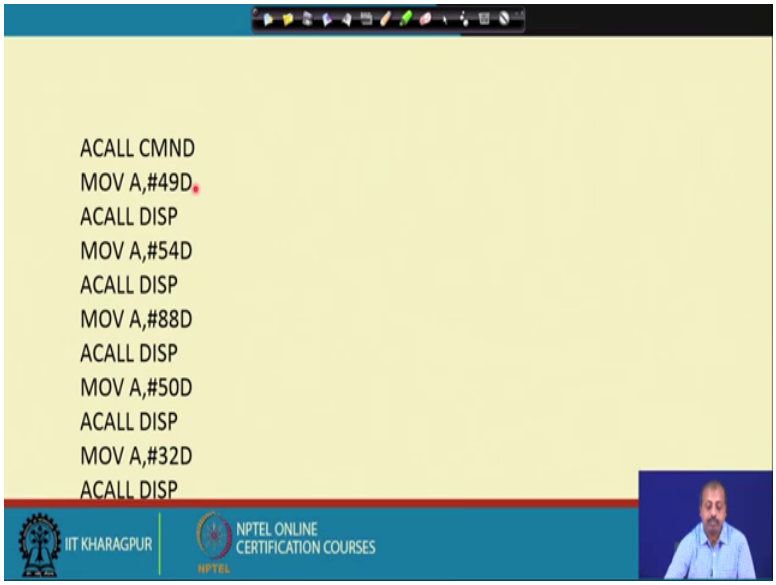
(Refer Slide Time: 14:48)



So, what we are doing is that, we are simply we are simply putting the 38 x on to the command port command code register then 0 f x, 0 f x it will turn on the LCD cursor will be set on and blinking will be turned on, then the again the command port it will be written then we are putting 0 on x on to the command port. So, screen is cleared, then we implement the cursor. So, that it comes to a valid position and then a cursor line 1 position to move the cursor line 1 position to by doing this and then we activate the

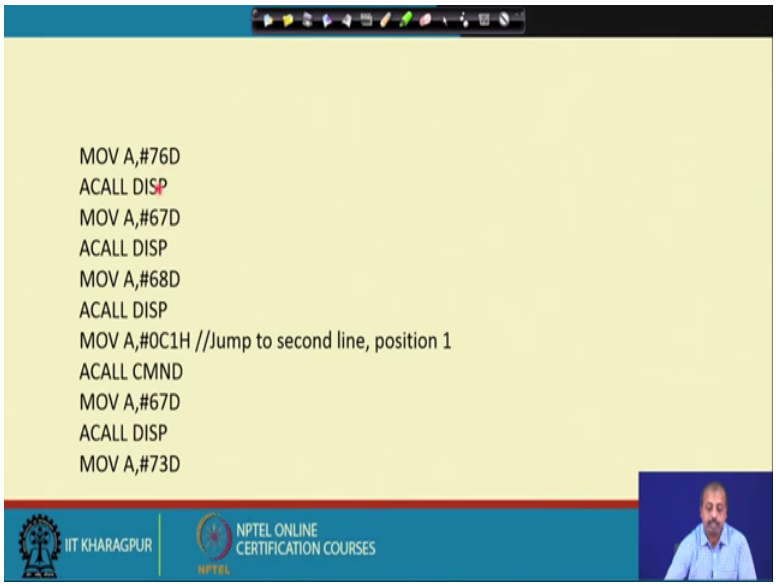
second line. So, 3C x this will also activate the second line then this 49 D so this is some value that we want to display.

(Refer Slide Time: 15:30)



So, a call display so display routine it will put this character 49D. So, 49D is basically so this decimal 49. So, this will be put onto the whatever be the corresponding character. So, that will be put on to the display, then we are then after that for putting the character 54 decimal on to the a register calling the display routine so, this 49, 54, 88 so these are various as key code for different characters that we want to display for some pattern. So, this 32 is the space. So, that way it is just outputting some pattern on to the display, then this 170 that way we are 76, 67, 68.

(Refer Slide Time: 16:18)



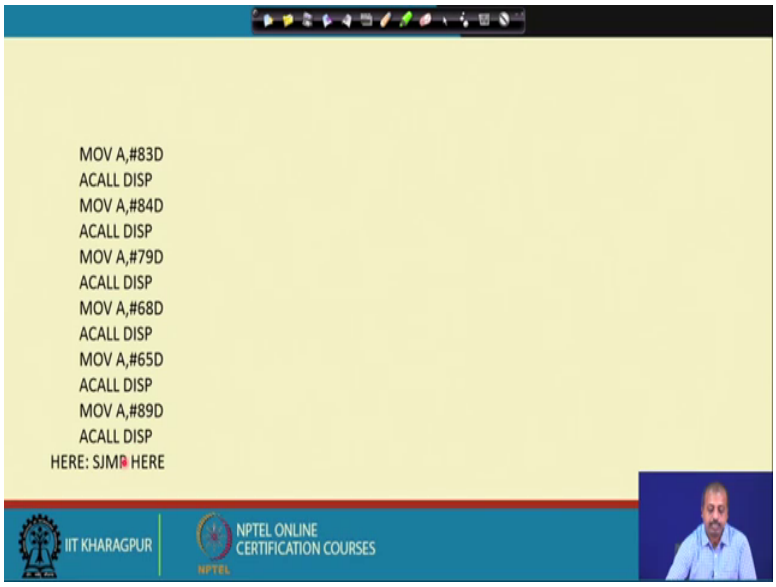
So, they are outputting corresponding pattern on to the display, then we jump to the second line. So, this aims the display of the first line then we come to the second line, in the second line for going to second line we have to output something to the command port. So, 0 0 s that c one x that should be outputted on to the command port so that is done here command register then this 67D. So, this is the first character that we want to display. So, that is put here, and calls the display routine. So, it will be displayed then 73 decimal.

So, that is the next character that we want to display. So, that will be shown here and that will be displayed that will be put into the display register and that will be shown there, shown there.

(Refer Slide Time: 17:07)

So, this way all the character that we want to display on the second line so, they are put on one after the other and this correspond the display routine is called so, that it will be putting that value on to the display register and at the end.

(Refer Slide Time: 17:20)

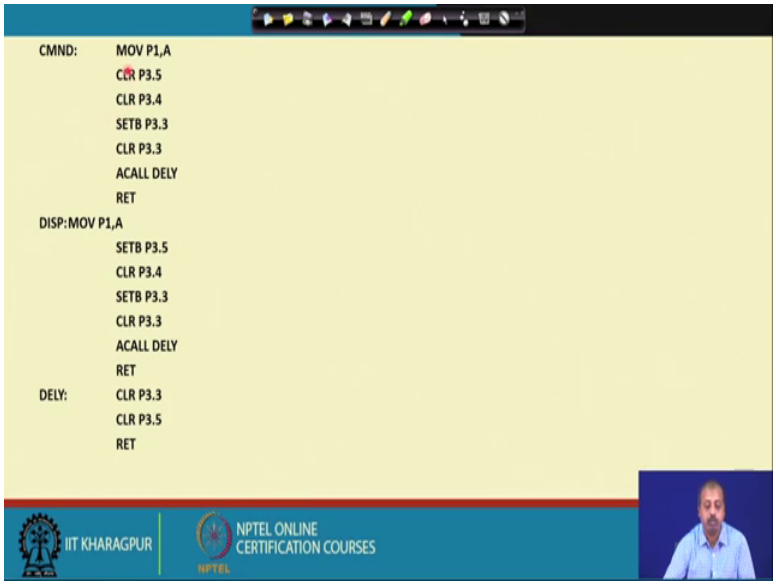


So, we are just after all the character that we want to display has been shown. So, we are putting the program on to the infinite loop here. So, unlike LED programs where you need to again start displaying the first character because by this time the content is lost, but here it does not happen because there are dedicated register to hold the values. So,

once you ate putting different characters that different positions and then calling for the display routine. So, that display part remains there. So, it is not vanished and the refreshing circuitry is built in with the LCD panel. So, the refreshing circuitry will ensure that the periodic intervals that it will put the corresponding characters that we have put at different cells and refreshed them and if you want to clear a cell then for that purpose so we have to write a new character on that cell or if you want to clear the display all together.

So, we can do that by the clear display type of command ok. So, this program is jump is infinite loop here because nothing more serious needs to be done. So, this was the program for this command, command port part.

(Refer Slide Time: 18:30)



So, command port register is loaded with this value, this statement. So, command code will be register will be getting the values then we have got the display routine. So, this a called display. So, here also the same thing first we have to move this a value to p 1. So, we do say p 3, p 3.5. So, p 3.5 was that read write line. So, we are putting.

So, 3.5 line is set. So, that I am this is that sorry this is that RS bit register, RS bit line. So, RS bit line is set to one thinking that whatever we are writing go to the data register, then clear 3 pa p 3.4 said b p 3.3. So, these are fine clear p 3.4 will be putting that read write line to write making it is easy 0 and there is a pulse on p line 3.3. So, that will give a pulse from high to low as a result the selection will be enabled then this a called delay.

So, this will put a delay here. So, after setting all these things the value that is there available on the p 1 register p 1 port through the data base it will go to the the data register of the display, then a called delay.

So, it will put a delay and then we are returning going to the program from point which was called. So, in this way you can interface a number of LCD, a number of interfacing devices to the system starting with simple system simple keyboard, simple a single LED s to multiple LEDs to 7 segment displays then we can we have seen the connection of 8 to 55 as a programmable device by which again you can connect number of, number of other interfacing devices then we have seen this other interfacing devices like this ADC analog to digital converter.

So, that you can connect some you can get some analog signals converted into digital value and stored inside the microprocessor controller or microprocessor, the digital to analog converter where you convert this digital value to corresponding analog value and when you are going to connect some actuator to some to some micro controller micro processor you can you can put the digital value there it will be converted there to the corresponding analog signal and then it is outputted to the actuator. So, that the environment the actuator gets the control and it behaves properly and finally, we have the another display this LCD panel display and these are also quite common in many of the displays that we have. So, of course, there are more advance version of LCD panel colour LCDs and all that.

So, only thing that is going to differ is basically some more selection lines and some more commands ok. So, if you are looking in a particular display. So, what you need to see is that what are this extra commands and what is the sequence in which they are to be activated, otherwise the interface remains same, interface remains same with any microcontroller or microprocessor you are going to connect it so, only the sequence of this command that you are sending and data that you are putting so that will be varying. So, this way you can connect a number of devices to the microprocessor and micro controllers.