*NAME: Kundrapu N R Sai Akash*

*ROLL NO: 20EC10043*

# *DIGITAL LABORATORY EXPERIMENT 7*

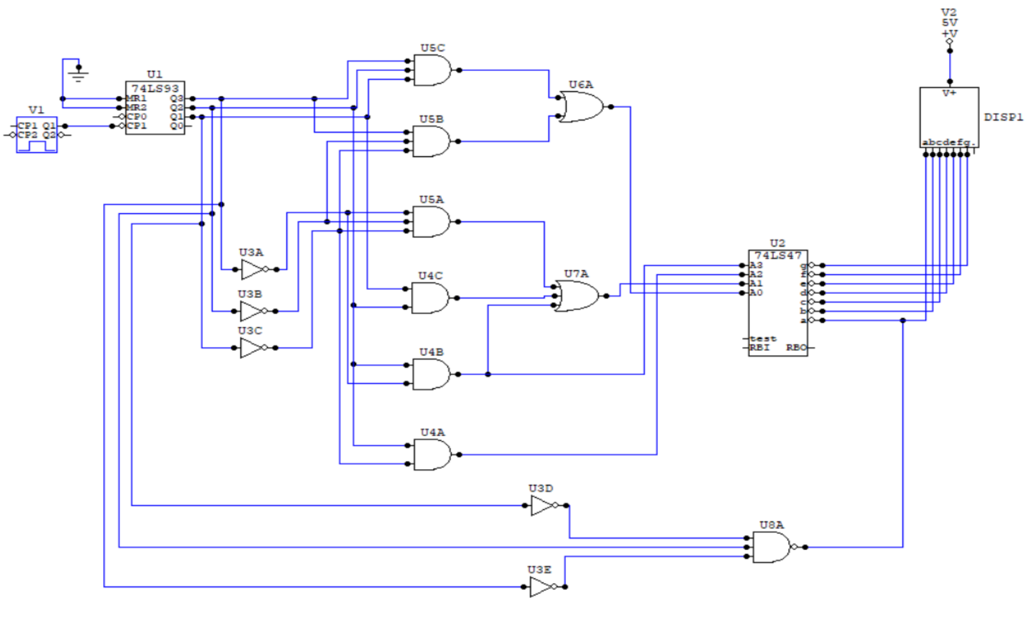
## AIM:

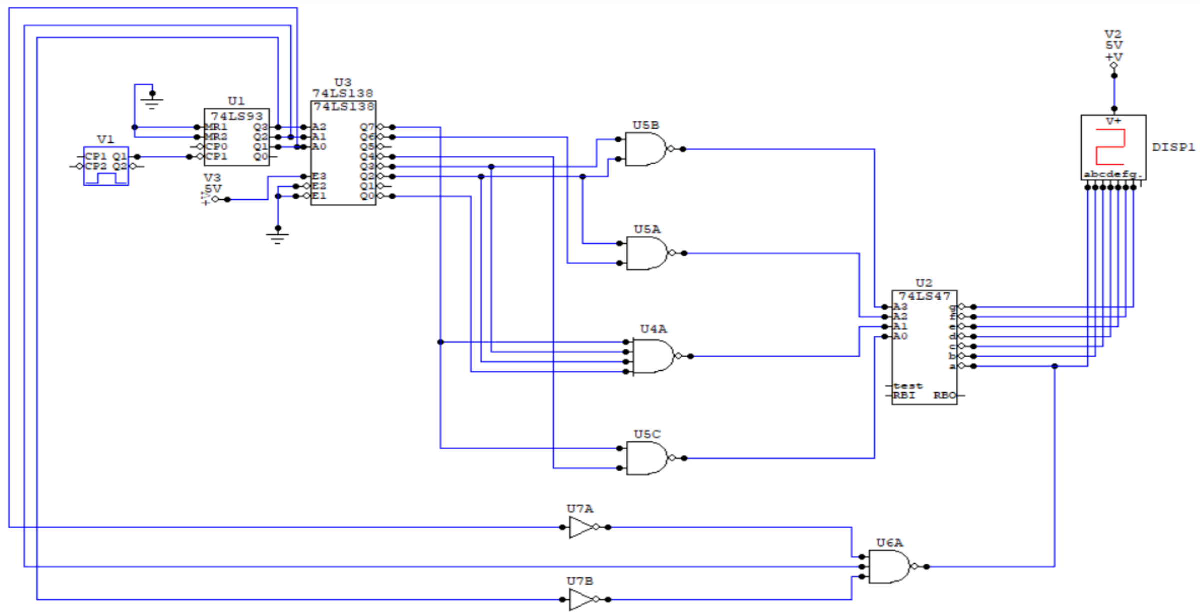
*Displaying Roll No. in a CA 7-segment display using a modulo-8 counter. The roll number has 9-digits, we omit a 0 at the thousands' place 20EC1_043, which is now an 8-digit number, we will use and try to display.*

## CIRCUIT DIAGRAM

*For this experiment, we need a modulo-8 counter, a digital pulser, a few logic gates and a BCD to 7-segment decoder and a 7-segment CA display.*

*For part1 of the experiment we use logic gates to achieve a logical combination to connect between our modulo-8counter and decoder, whereas in part2, we use a 3-8 decoder, to make our task easier by reducing the no. of logic gates.*






## BREIF THEORY AND EXPLAINATION

*First and foremost, we need to know what sort of components we are using in this experiment, and then how to get a logical connection between them to achieve our final result.*

*We have a digital pulser, which is used to produce a pulsating signal which enables our modulo-8 counter to work as it does.*

*The use of modulo-8 pulser is to produce a signal which gives the values of 000 to 111 in a 3-bit binary code. We have a total of 8states in it from 0-7, we use those states and get the desired output. We connect the Q1 pin of pulser to CP1 pin of the counter for this purpose. Master resets are set to LOW to get our desired results.*

*We then have a BCD to 7-segment display decoder, which takes a 4-bit value and decodes it to the display, which is used to display the numbers / alphabets on the screen.*

*The display we use gives 0-9 for BCD values, from 10-16 it gives some other symbols, which we use to produce the alphabets in our roll number*

*1110 – produces E without the top line*

*1010 – produces C in small size*

*We use these two for this experiment, as we are asked to have E with the top line as well, we need to use another combinational circuit to achieve that as well.*

*Let's look at the truth table for our 4-bit inputs of BCD Decoder.*

| *Q3* | *Q2* | *Q1* | *A3* | *A2* | *A1* | *A0* | *Roll No.* |
|---|---|---|---|---|---|---|---|
| *0* | *0* | *0* | *0* | *0* | *1* | *0* | ***2*** |
| *0* | *0* | *1* | *0* | *0* | *0* | *0* | ***0*** |
| *0* | *1* | *0* | *1* | *1* | *1* | *0* | ***E*** |
| *0* | *1* | *1* | *1* | *0* | *1* | *0* | ***C*** |
| *1* | *0* | *0* | *0* | *0* | *0* | *1* | ***1*** |
| *1* | *0* | *1* | *0* | *0* | *0* | *0* | ***0*** |
| *1* | *1* | *0* | *0* | *1* | *0* | *0* | ***4*** |
| *1* | *1* | *1* | *0* | *0* | *1* | *1* | ***3*** |

*From the truth table, we can draw K-Map for each pin from A0-3 and find its logical Boolean expression. We get*

*A0 = Q3.Q2'.Q1' + Q3.Q2.Q1*

*A1 = Q1'.Q2'.Q3' + Q1.Q2 + Q2.Q3'*

*A2 = Q1'.Q2*

*A3 = Q2.Q3'*

*We can only change A1 by replacing the last term with A3, which are the same.*

*Now, for part1 of the experiment, we connect the pins using logic gates. For part2 of the experiment, we use a 3-8 decoder which is a min-term generator and proceed with it by using NAND gate to combine different min-terms and give it to BCD Decoder.*

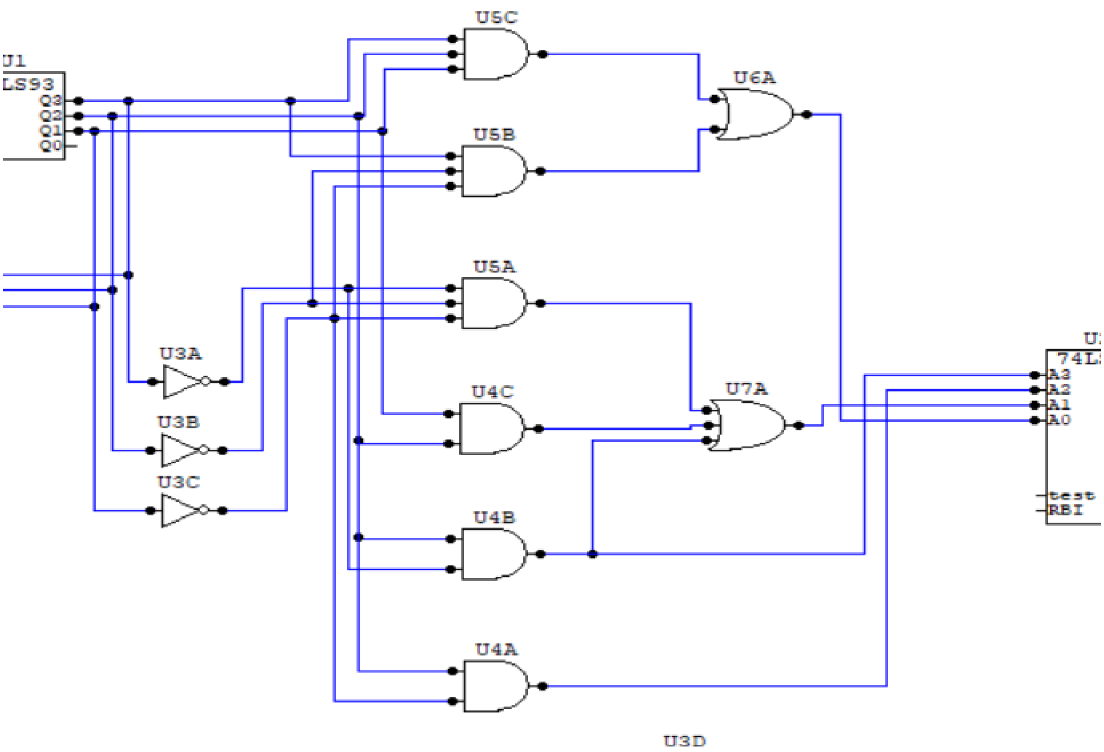
*Now, with the correct combination of the logic gates, we are almost done with the experiment, now, we need to find a way to make the E look complete by making the a-segment glow, when we have to display E. For that, we need to check when we are getting E. So, by looking at the roll number, it is at 3rd place, which is 010 code for Q3, Q2, Q1. So, we need a Q3', Q2, Q1' to get a HIGH when the counter is at the number. As we need to have a LOW for the segment glow in a CA display, we connect these components to a NAND gate, to get the output as,*

*Y = (Q1'.Q2.Q3')' ;This is connected to a-pin of display.*

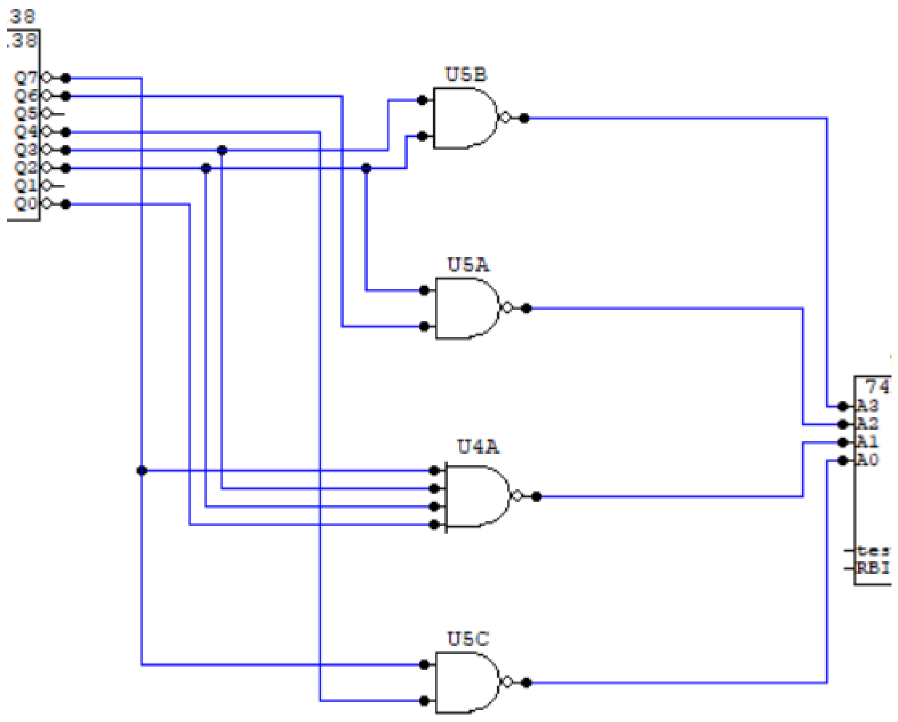
## SNAPSHOTS FROM THE EXPERIMENT

*Since this experiment cannot be shown with a few images due to the fact being that, we are using a counter, so we get a pulsing display of all digits in the roll number one after another. So, instead of images, I will be adding the .ckt files for the experiments from which, this can be checked.*

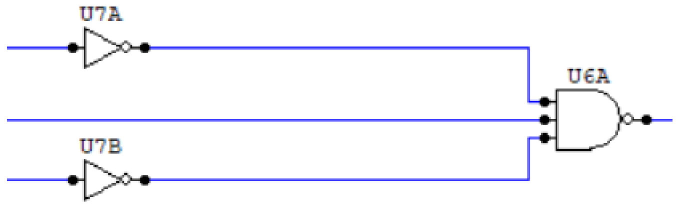
*We can still we the logical combination of the circuits from the snapshots below,*



*In this snapshot, as we see, in the Boolean expressions I got for my roll number, I need all the values of Q1,Q2,Q3 as well as the complimentary values of the those pins, so I used 3NOT gates to get them. None of the expressions can be minimized further to reduce the cost of the circuit, as all the expressions are unique to one another except for A1, where we can reduce a AND gate by using A3 in place the AND gate used otherwise.*




*The outputs of 3-8 decoder are from Q0-7, in the form of compliments of the min-terms. So, instead of using OR gates, we need to use NAND gates to get the combination of multiple outputs.*




*In this circuit, we have Q1 and Q3 as inputs to NOT gates and Q2 to as the other input to the NAND gate, the output is connected to the a-pin of the display to show the alphabet E with the top line along with it.*

## OBSERVATION AND CONCLUSION

*I haven't attached any snapshots to show the observations for this experiment, and checking can be done from the .ckt files from the submission. One observation, which can be made from seeing the roll number play out is we get some other random numbers in between at lower speed, most probably due to some static hazards we have in the circuit, however the main goal of this experiment is to have low-cost connections, any connections made for the sake of making a hazard free circuit is not very necessary. So, in order to have the correct order to be shown, we need to increase the simulation speed of the experiment, which will solve the problem for us. This takes us to the end of this experiment.*