NAME: Kundrapu N R Sai Akash

ROLL NO: 20EC10043

DIGITAL LABORATORY EXPERIMENT 2

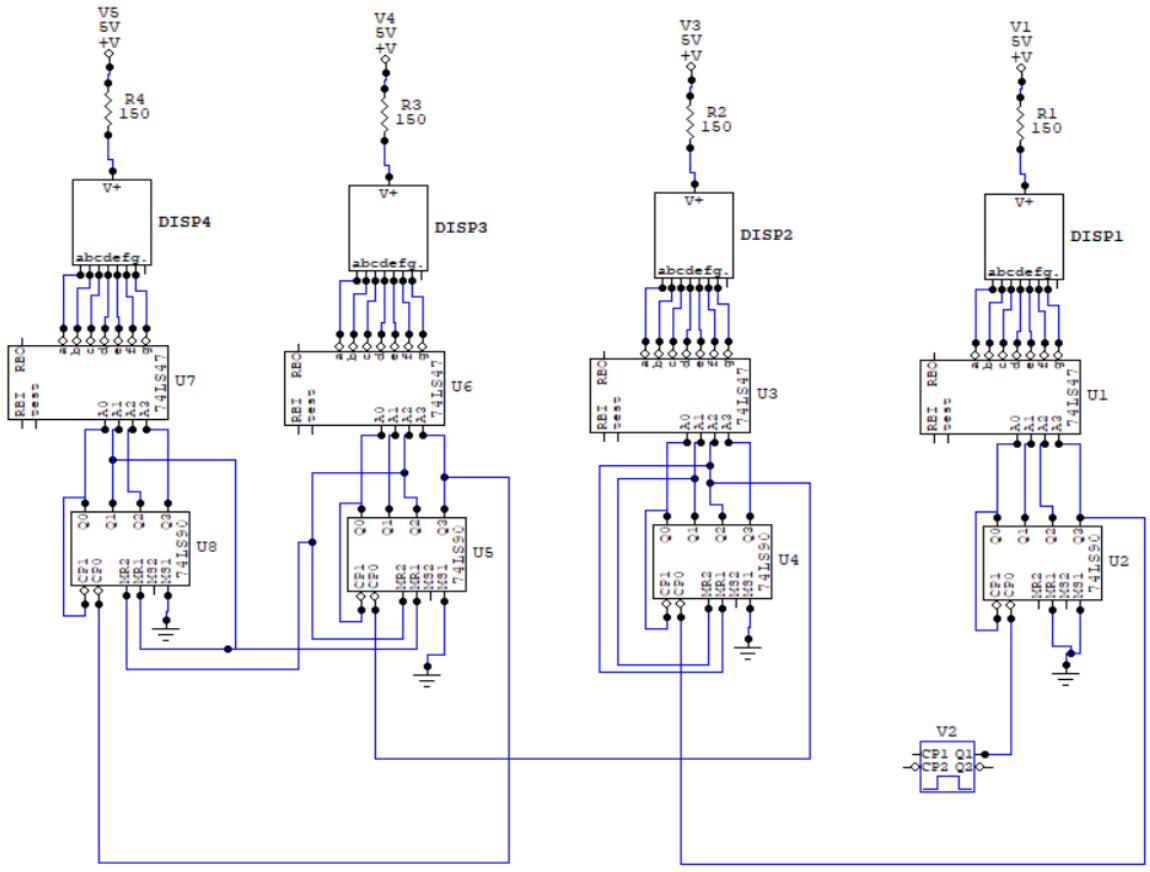
AIM:

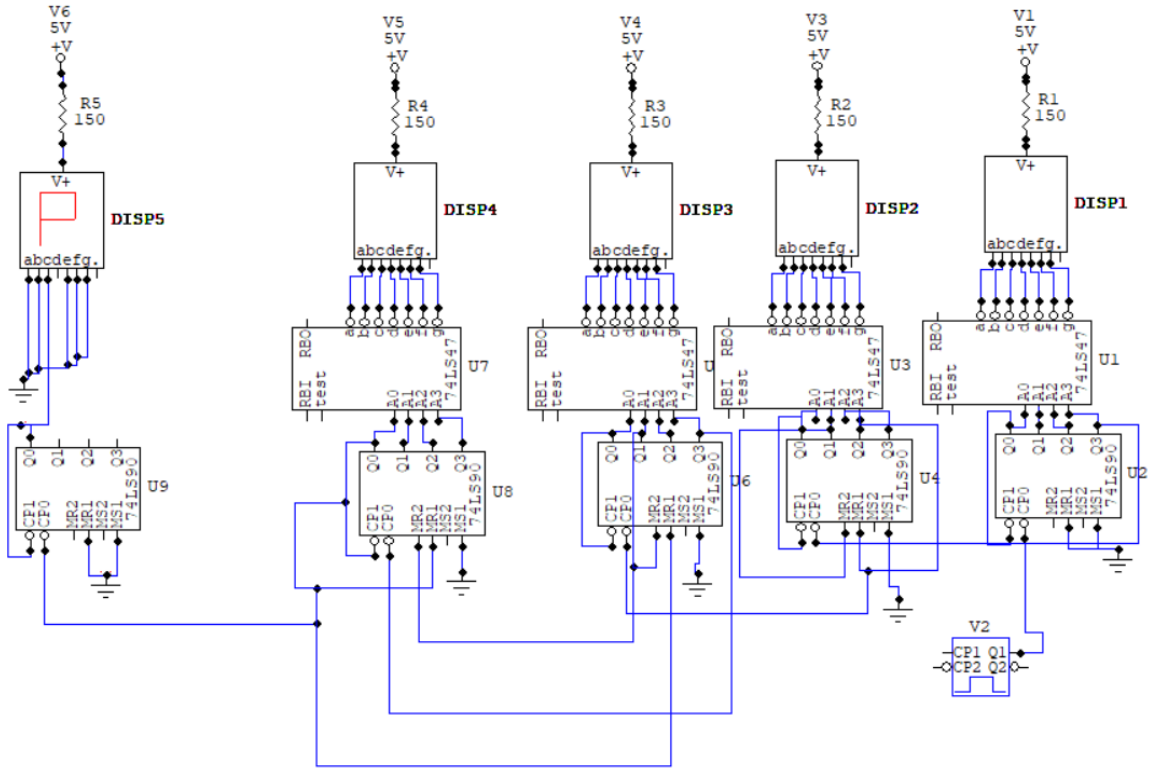
To implement a digital clock showing hours and minutes information using four 7-segment displays and counters.

There are two parts to it,

1. *A twenty- four hours clock.*
2. *A twelve hours clock with AM / PM*

CIRCUIT DIAGRAM





The first image is for 24hours clock which starts at 00 00 and ends at 23 59 before going back to 00 00. It requires 4 displays.

The second image is for 12hours clock which starts at 00 00 and ends at 11 59 before going back to 00 00. It required 4+1 displays, where the additional display is used to show AM/PM in form of A or P.

BREIF THEORY AND EXPLAINATION

We need to go through each device one by one and see how they work in conjunction. Every display unit consists of a digital power supply with 5V potential, connected in series to a 150ohm Resistor which is connected to the 7-segment display. We have 8 terminals on the other side namely a, b, c, d, e, f, g, . We have no use with '.' terminal as it used to show the decimal point, which has no use in a digital clock. We connect the remain 7 pins to the subsequent pins of IC 7447. We can leave RBO, RBI, LT open which means they are in HIGH and connect the pins of A0, A1, A2, A3 to the pins of Q0, Q1, Q2, Q3 of IC 7490 respectively.

IC 7447 is an IC unit used to drive the 7-segment display directly through pins A0, A1, A2 and A3. Each of which represent the binary code combinations. IC 7490 is a modulo-10 counter also called as decade counter, it displays from 0 to 9 in an order at a certain speed which can be set by CP0 pin.

And lastly, we use a digital pulser to send signal to the CP0 pin of the first display unit. We need to connect MR1 and MS1 of 1st display unit to ground, so that we have it go back to 0 at the end and not to 9. Then we connect the CP0 pin of second display unit of the minutes display to the Q3 pin of the first one, as we need it to go to the next number after a complete cycle is completed in the 1st one. With this our minutes part is almost done, we connect MS1 to ground to ensure zero when the display is not in use, and we connect MR1 to Q2 and MR2 to Q1 so that the number in 2nd display will stop before 6, this will sure that display will only go it 59 and wont exceed this number.

When we come to the hours part, we need to connect the CP0 pin of the third display (UNITS PLACE IN HOURS) to the Q2 pin of the 2nd display, so that the number will increase here after 2nd display crossed 5 every time. We connect the CP0 of the 4th display unit (TENS PLACE IN HOURS DISPLAY) to the Q3 pin of the third display. This will ensure that a number will increase at the tens place display in the hours part after every cycle in 3rd display. Connections till here are same for both the parts of the experiment. We connect all the Q0 pins to CP1, this will ensure the numbers are repeating from 0 to 9 to 0 and doesn't stop at 9.

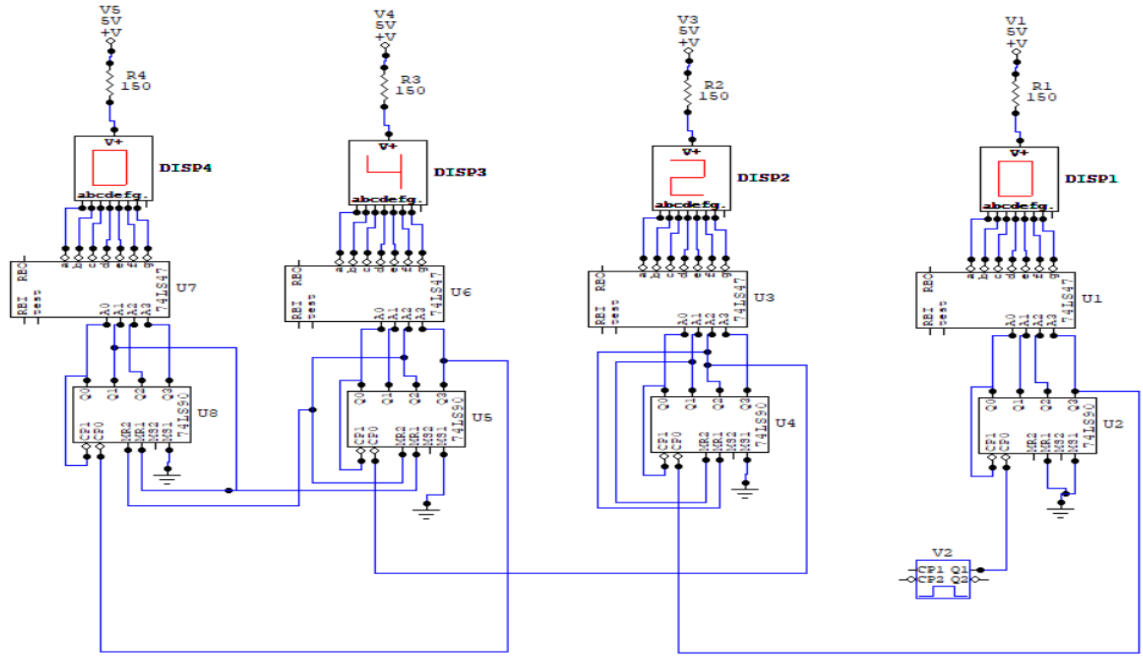
For the 24hours clock, we need to go till 23 59 only, so we attach the pins of MR1 and MR2 in such a way that we can achieve this, first of all, we will connect MR1 pins and MR2 pins of both the hours display to achieve a reset at the same time. We need to set MR1 pin of 4th display to Q1 which will stop it at 2, and set MR2 pin of 3rd display to Q2 which will stop it before 4. In this way we can achieve a perfect clock which goes from 00 00 to 23 59. We need to attach MS1 of all the units to ground so it will reset to 0 when not in use, basically we need to ensure that one of the MR pins or MS pins are at low, if they are not at low, they will reset to 9. After grounding the pins in this way, we see that the clock will go back to 00 00 after reaching 23 59, so the cycle is complete.

For the 12hours clock, the difference will come in the connections of MR1 and MR2 of 3rd and 4th display units to Q0 of 4th display and Q1 of 3rd display respectively, this will ensure a complete cycle from 00 00 to 11 59 and back to 00 00. Other addition is the 5th display which is used to show A/P, this can be achieved by, connecting the a, b, e, f, g pins to ground so it will show P all the time, and we need to send digital signal to c pin so that it will change to A for every 12hours. For that to happen, we connect the c pin to Q0 pin of the IC 7490 and connect CP1 to Q0 to repeat the process from A to P to A ....so on. We connect CP0 pin to Q0 of 4th display so that it will change alphabet for every 12hours.

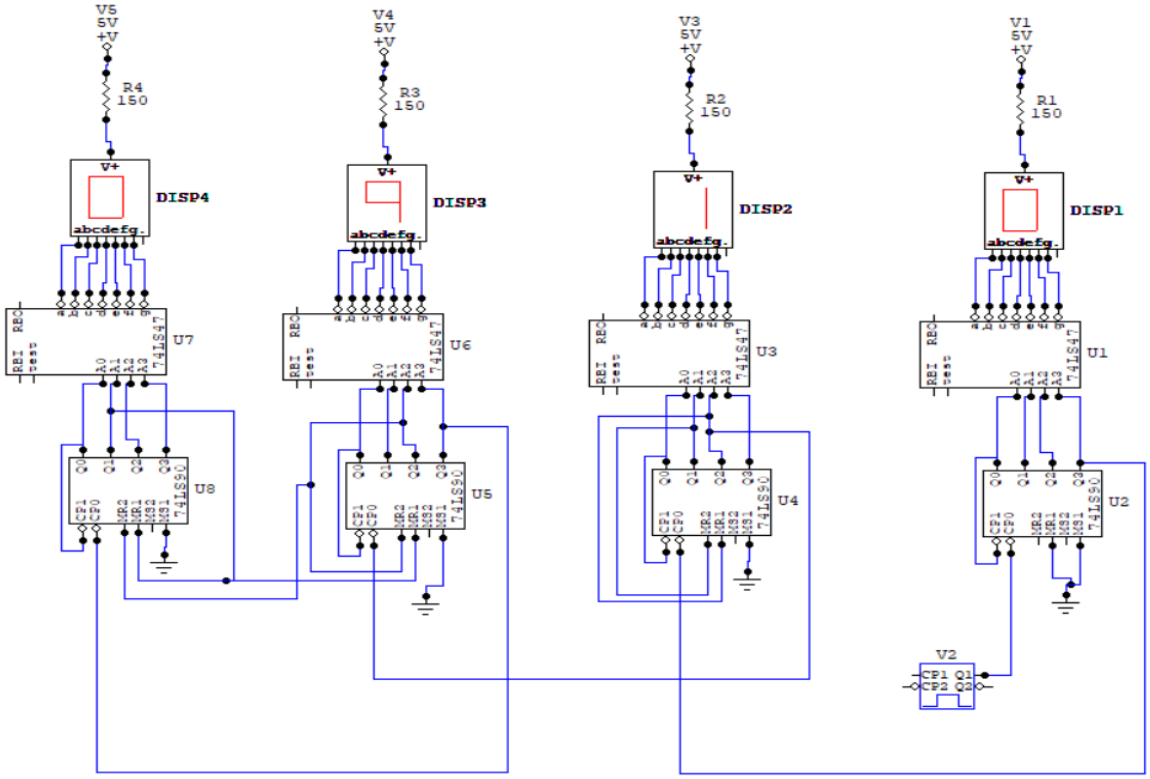
I couldn't get any simulated/ measured data in form of a graph or table, as this is a simple clock, only display keeps changing ang nothing more happens. So, instead I have added snapshots of the simulation for every 5 seconds interval at simulation speed '29', and I will also attach the .ckt files from where the observations can be checked upon.

SNAPSHOTS OF THE SIMULATION:

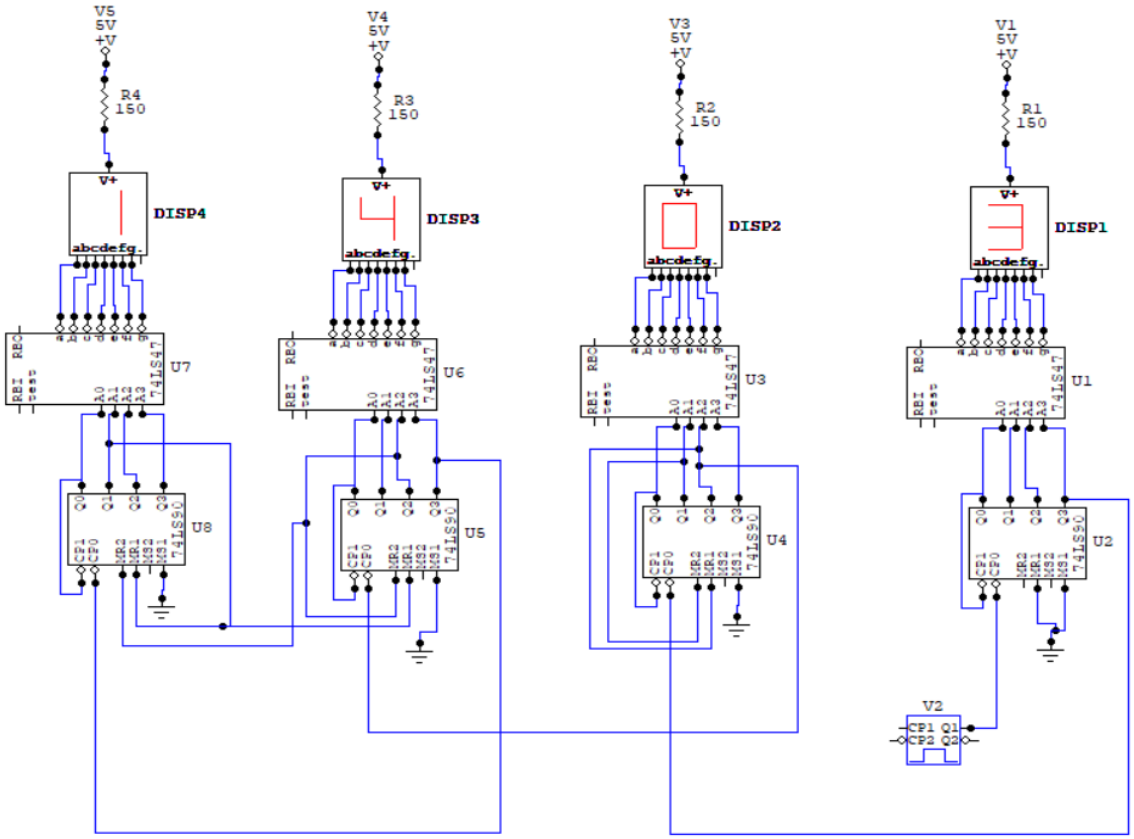
24 HOURS CLOCK.



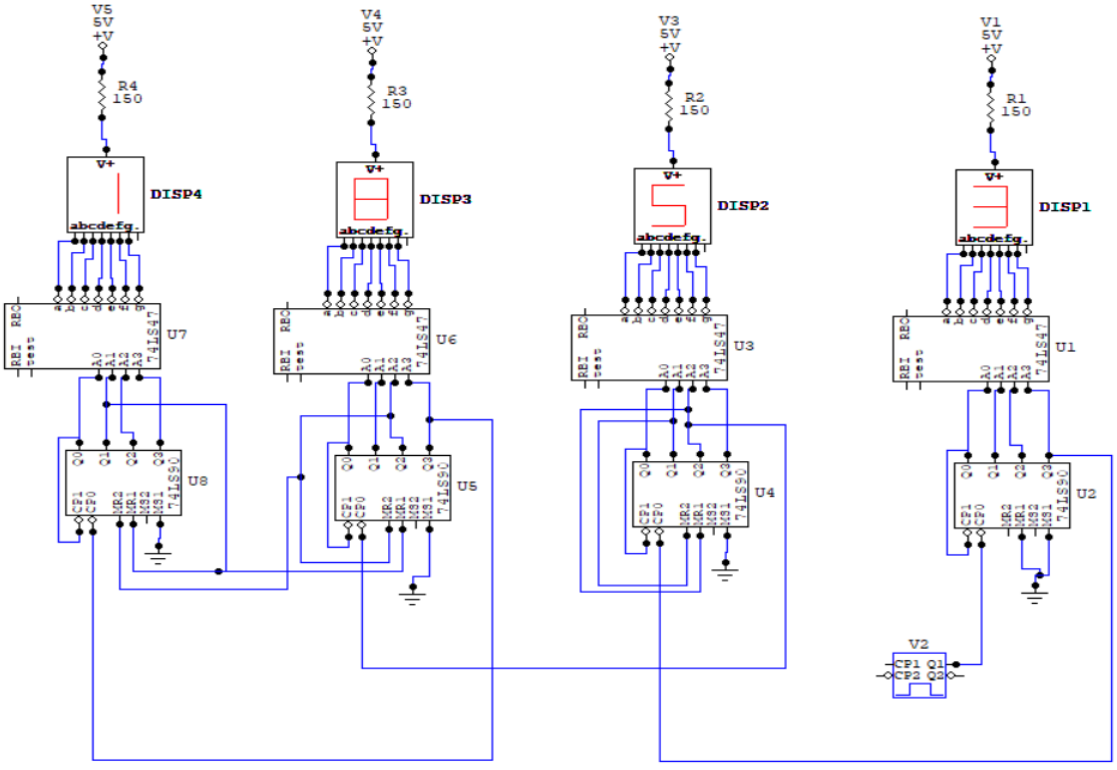
After 5seconds.



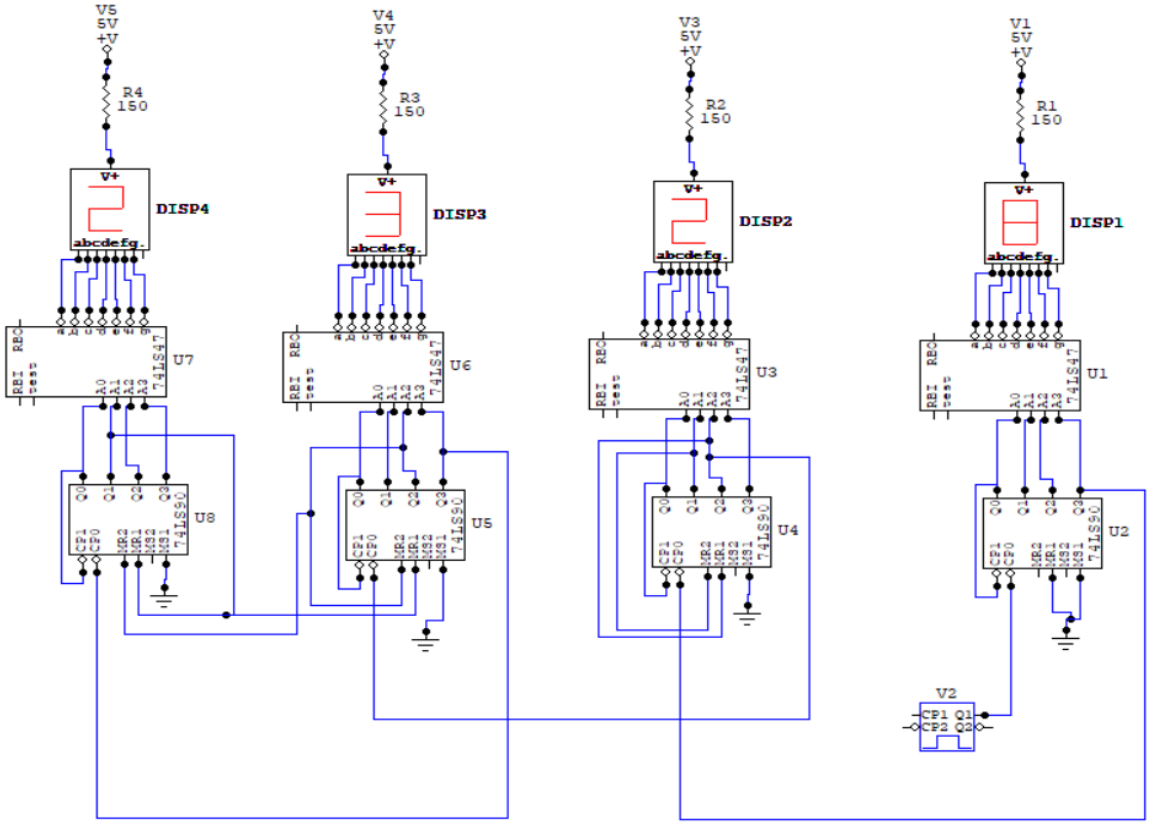
After 10seconds.



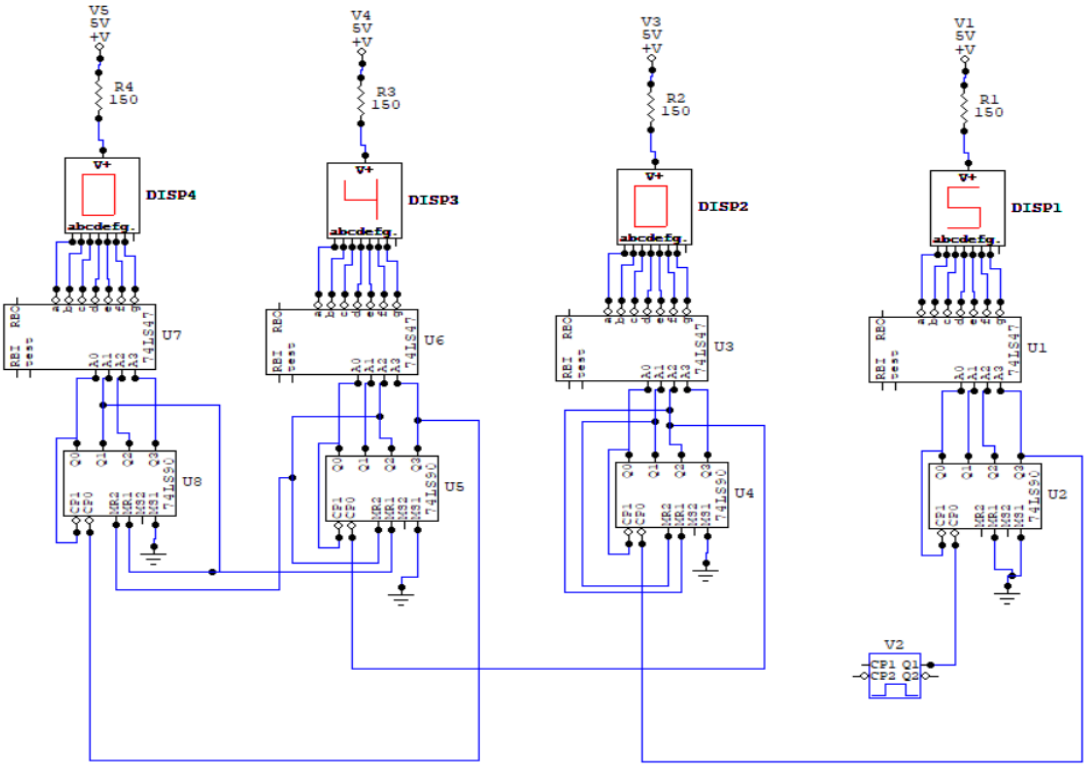
After 15seconds.



After 20seconds.

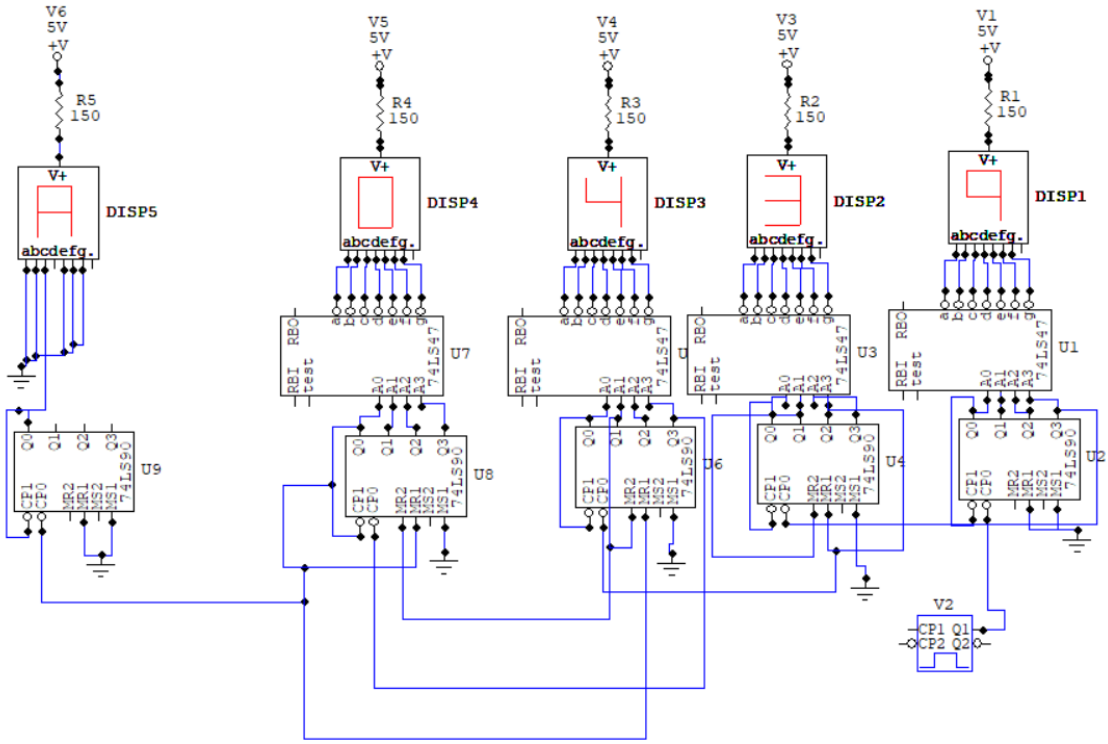


After 25seconds.

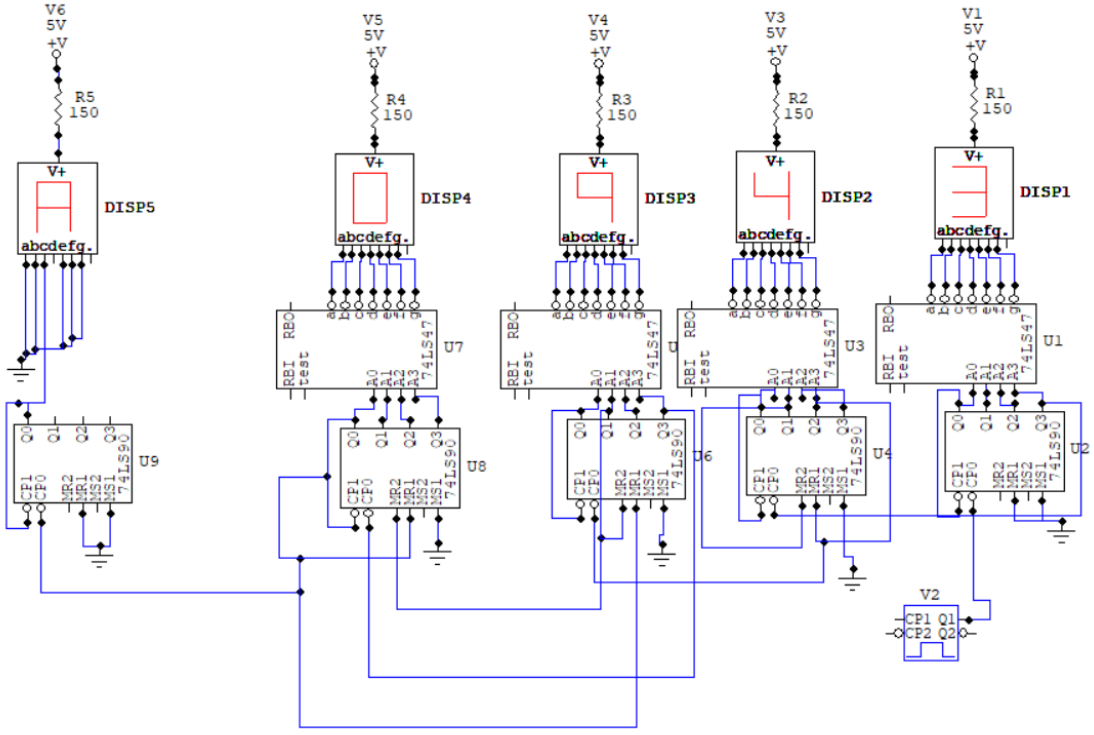


After 30seconds.

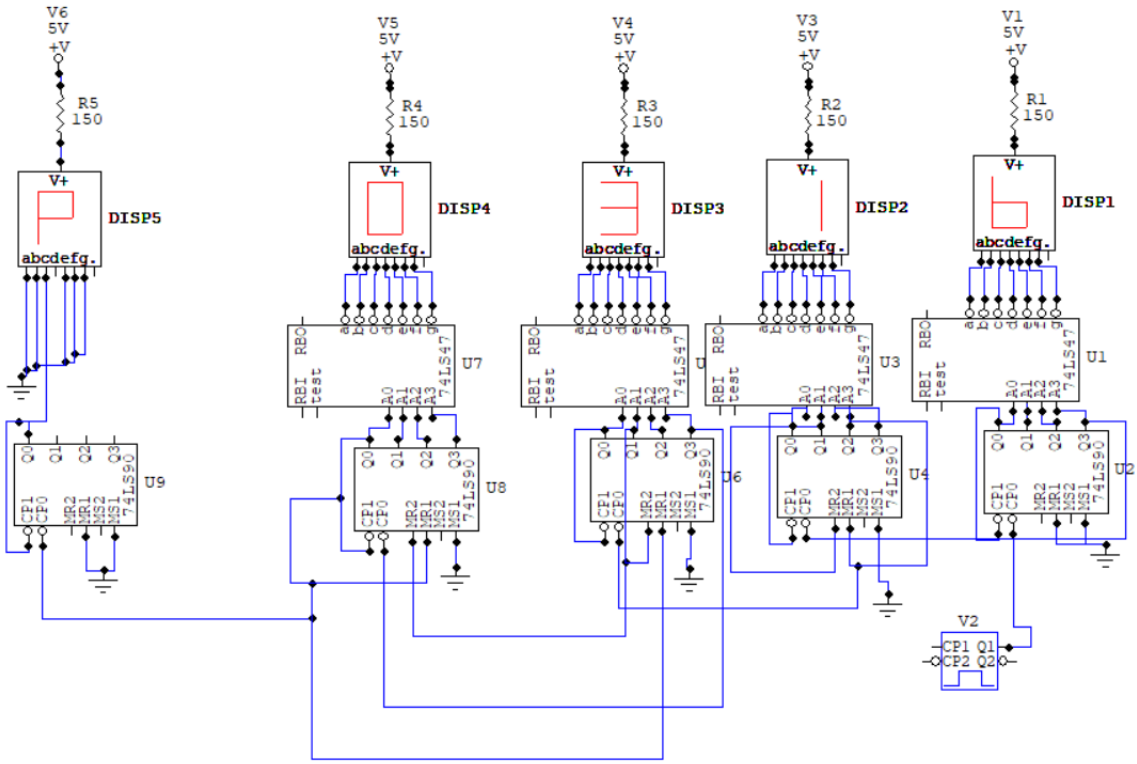
12 HOURS CLOCK.



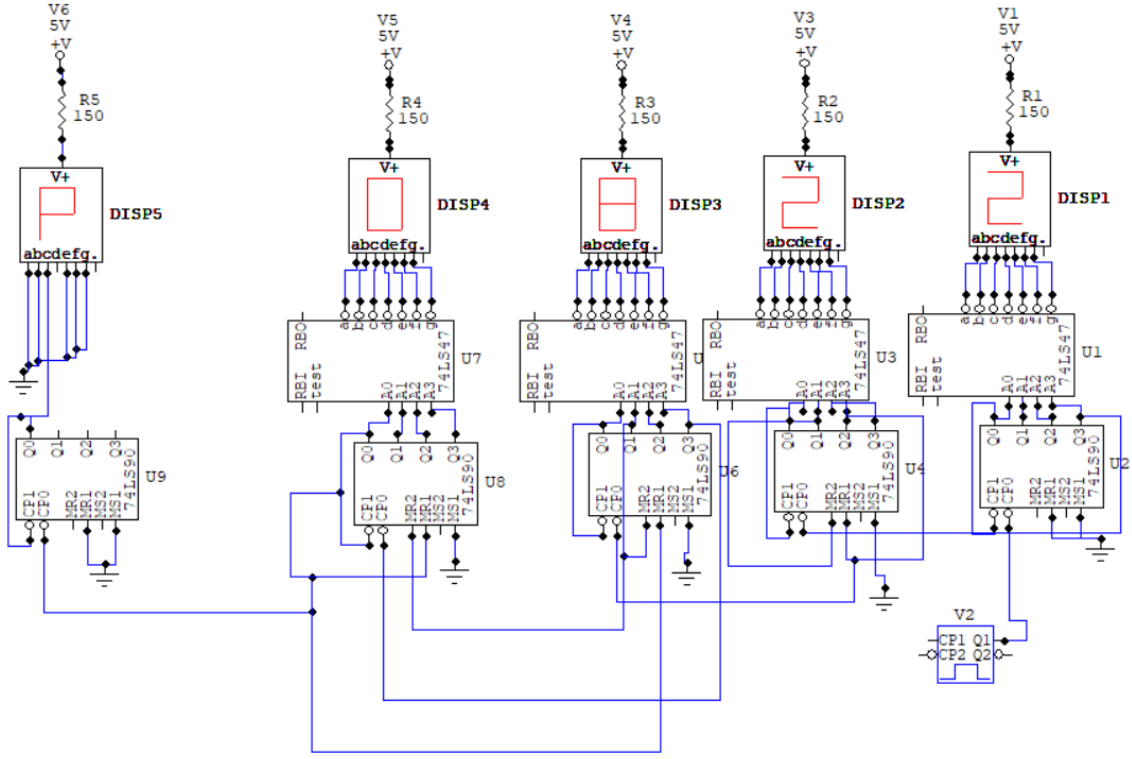
After 5seconds.



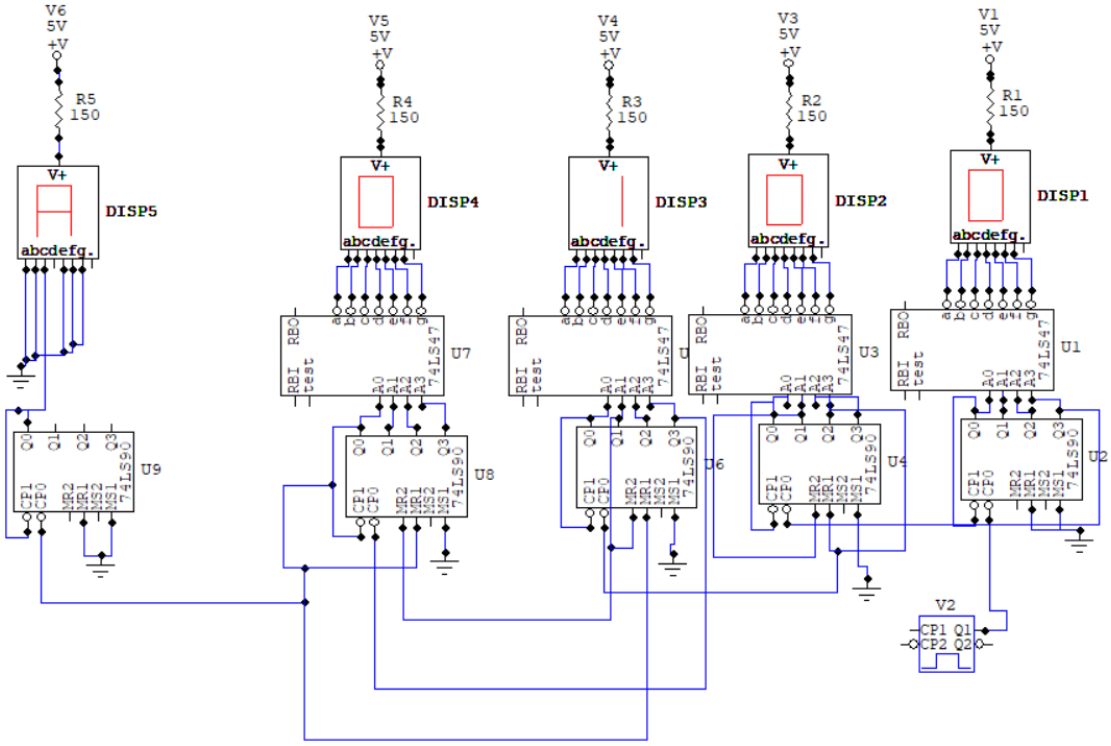
After 10seconds.



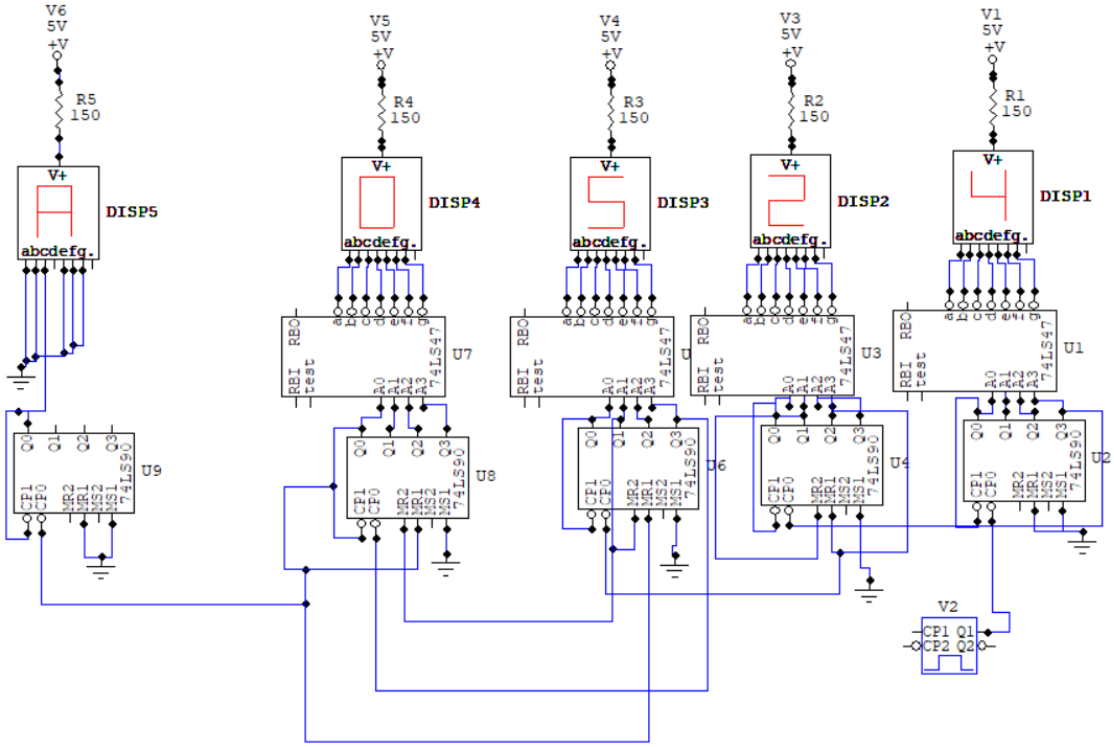
After 15seconds.



After 20seconds.



After 25seconds.



After 30seconds.

As we can see, when I took the readings at different intervals of 5seconds gap each, we can see a fairly similar timings in both 24hr and 12hr clocks, like there is a few minutes gap, but due to a high simulation speed, it is difficult to control the start and stop as I had to do it manually each time, but neglecting the reading errors, the clocks are working as they were supposed to be. This brings the report for lab experiment 2 to an end.