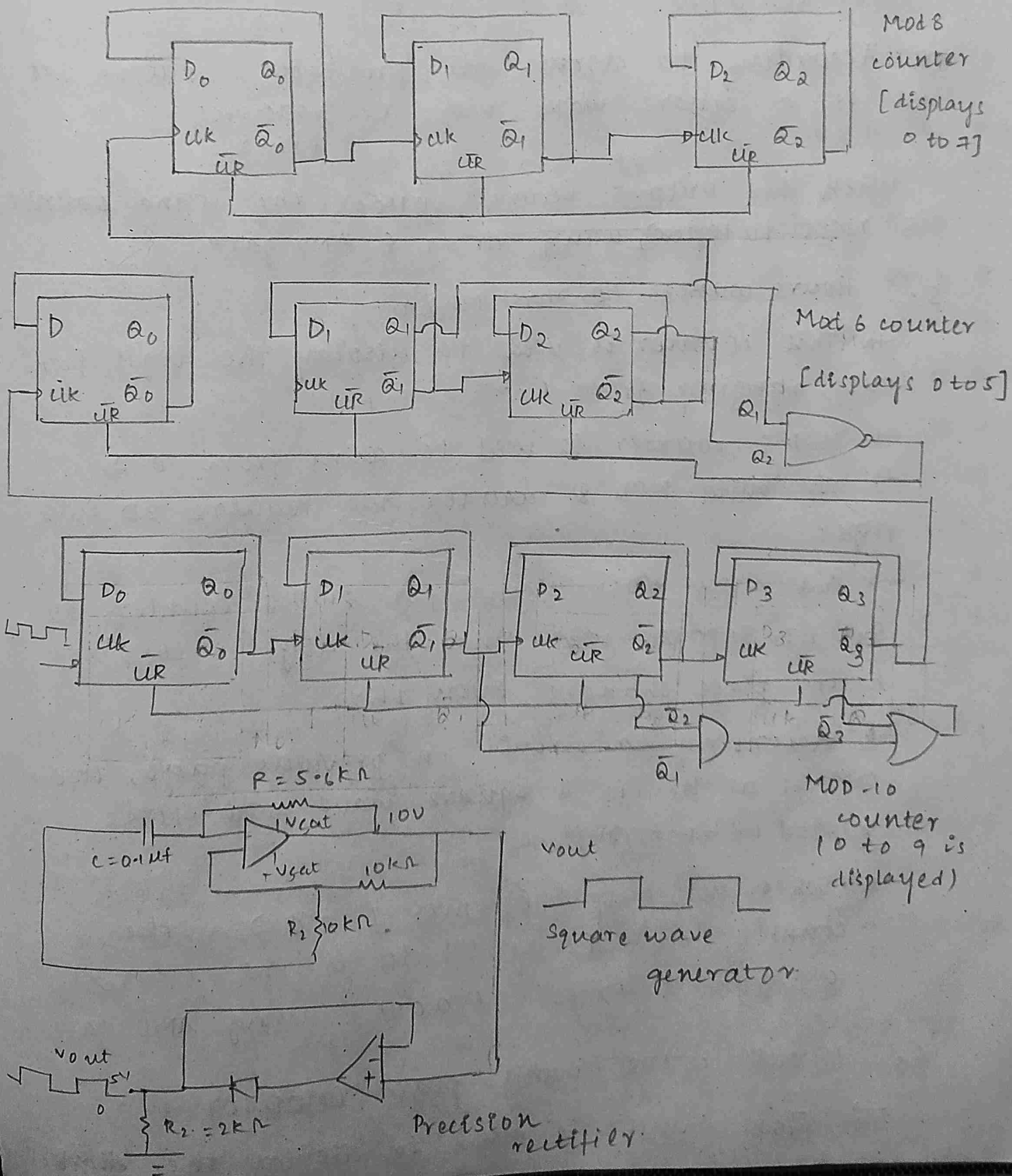
LAB SESSION-4

Aim of the experiment : To make a digital clock using asynchronous counter which shows until 7 hours 59 minutes from digital 0.

Components :- D flip flops, 7 segment displays, connecting wires, bread board, DC power supply, square wave generator, decoders, 4 input NAND gate, 4 input OR gate, resistors.

Circuit diagram :-



It can also be done using only AND gates.

Theory:

1. To build a digital clock showing minutes & hours, we require 4 type of counters, made using D-flip flops

2. Seconds counter (MOD 60) - This counter is required to count seconds, ranging from 0-59 which serves as input clock signal for minutes (unit place) counter

→ To build MOD 60 counter, we require 6 D flipflops and AND gate to count from 0-59 & again reset to 0 sec.

→ According to circuit on previous output at Q_2 is a square wave with T = 3600 secs (1hr)

When the output becomes $(111100)_2$, the using counter is reset to $1000000)_2$ using clr = 1 & AND gate.

5. Hours counter (0-7hrs) MOD-8

→ This counter is used to display the digit for hours, ranging from 0-7.

→ MOD 8 counter is used to count from 0-7

→ To build MOD 8 counter, we requere 3D flip flops.

→ The input clock signal for MOD 8 counter is Q_2 t (T = 3600 sec = 1hr) since the digit after hours place changes every 1hr

→ According to circuit on previous page, the output at Q_5 is a square wave with time period (T = 60sec)

→ when the output becomes $(112'0)_2$, the counter immeaditely set to 0, i.e clear = 1 & output becomes $(000)_2$ using AND gate.

6. Minutes counter (unit's place) (MOD 10)

→ This counter is used to display the digit

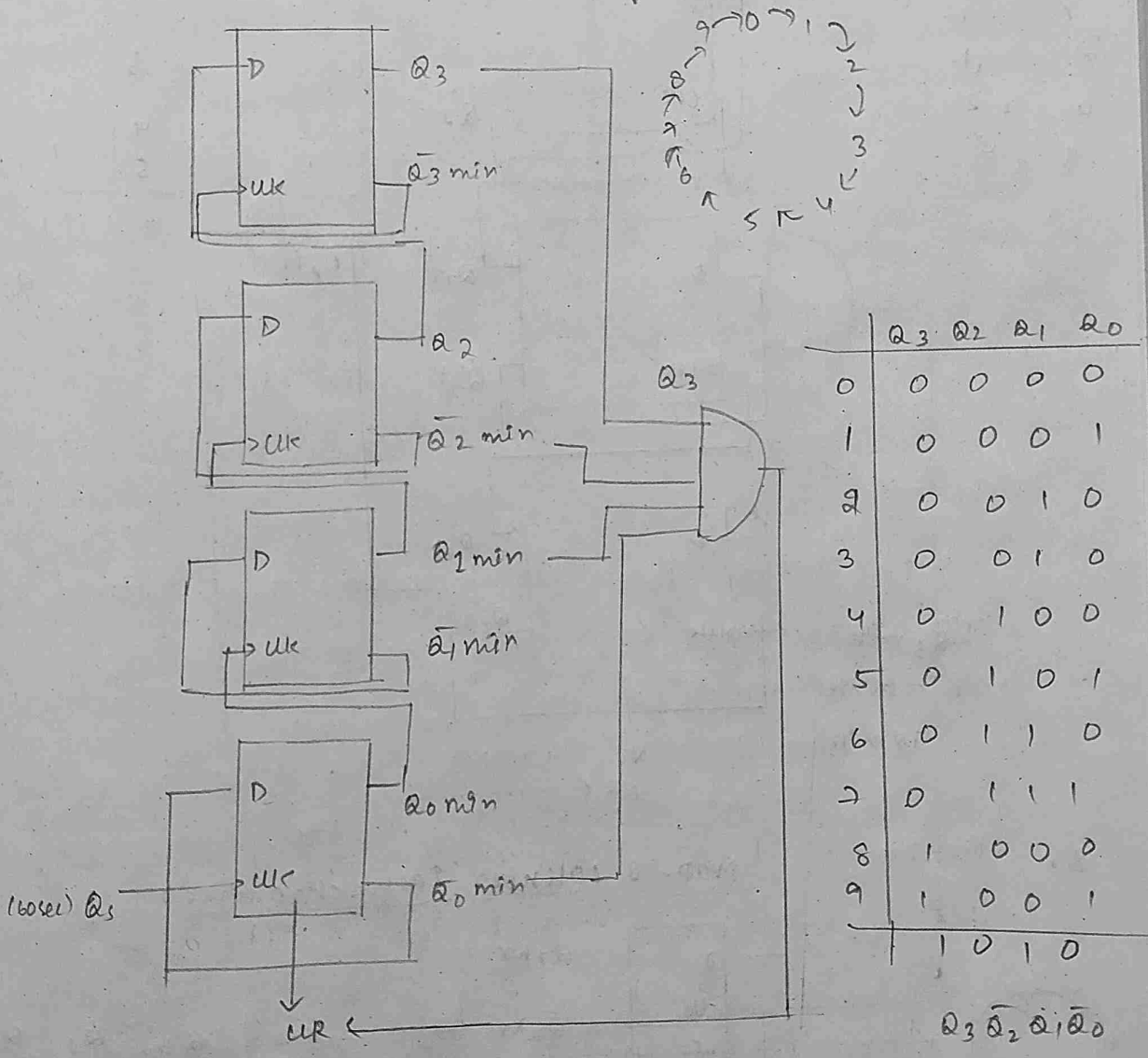
at units place for minutes ranging from 0-9 min

→ MOD 10 counter is used to count from 0-9 min

→ To build MOD 10 counter, we require 4 D flip flops & AND gate

→ The input clock signal for MOD 10 counter is Q_5 (T = 60sec), since the digit changes after every 60sec.

MOD 10 counter (asynchronous)



→ According to the circuit on previous page, output at Q_5 min as a square wave with T = 600sec when the output becomes 1010, the counter automatically reset to 0000 using clr=1 by AND gate

7. Minutes counter (Tens place) (MOD 6)

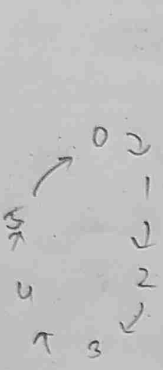
→ This counter is used to display the digit at tens place for minutes, ranging from 0-5

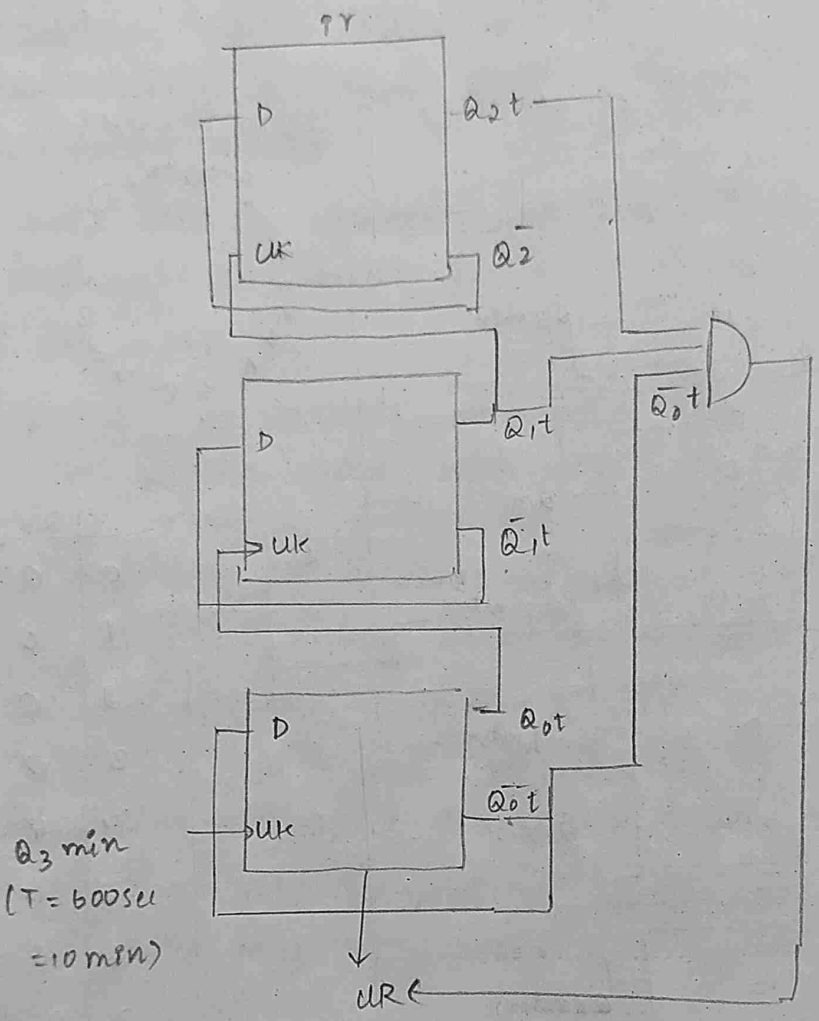
→ To build MOD 6 counter, we require 3 D

flip flops & AND gate

→ The input clock signal for MOD 6 counter is Q_3 min (T = 600sec) since the digit at tens place change after every 10 min (600 sec)

MOD-6 counter (asynchronous)

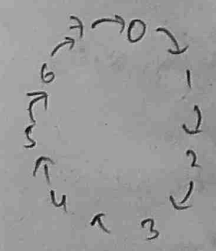


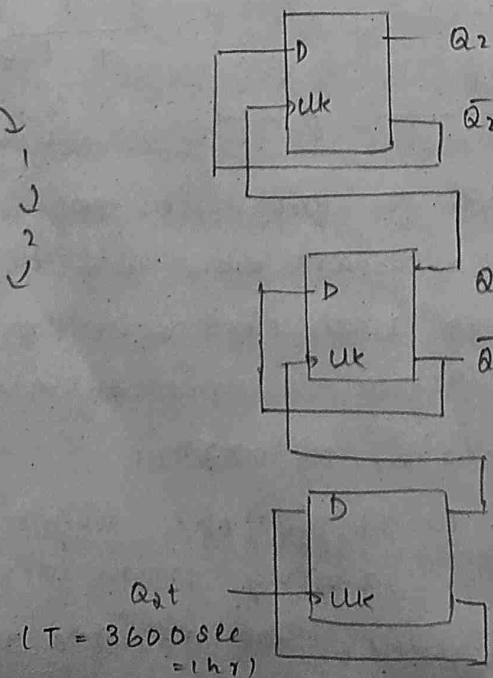


	Q_2	Q_1	Q_0
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
	1	1	0

$Q_2 Q_1 \bar{Q}_0$

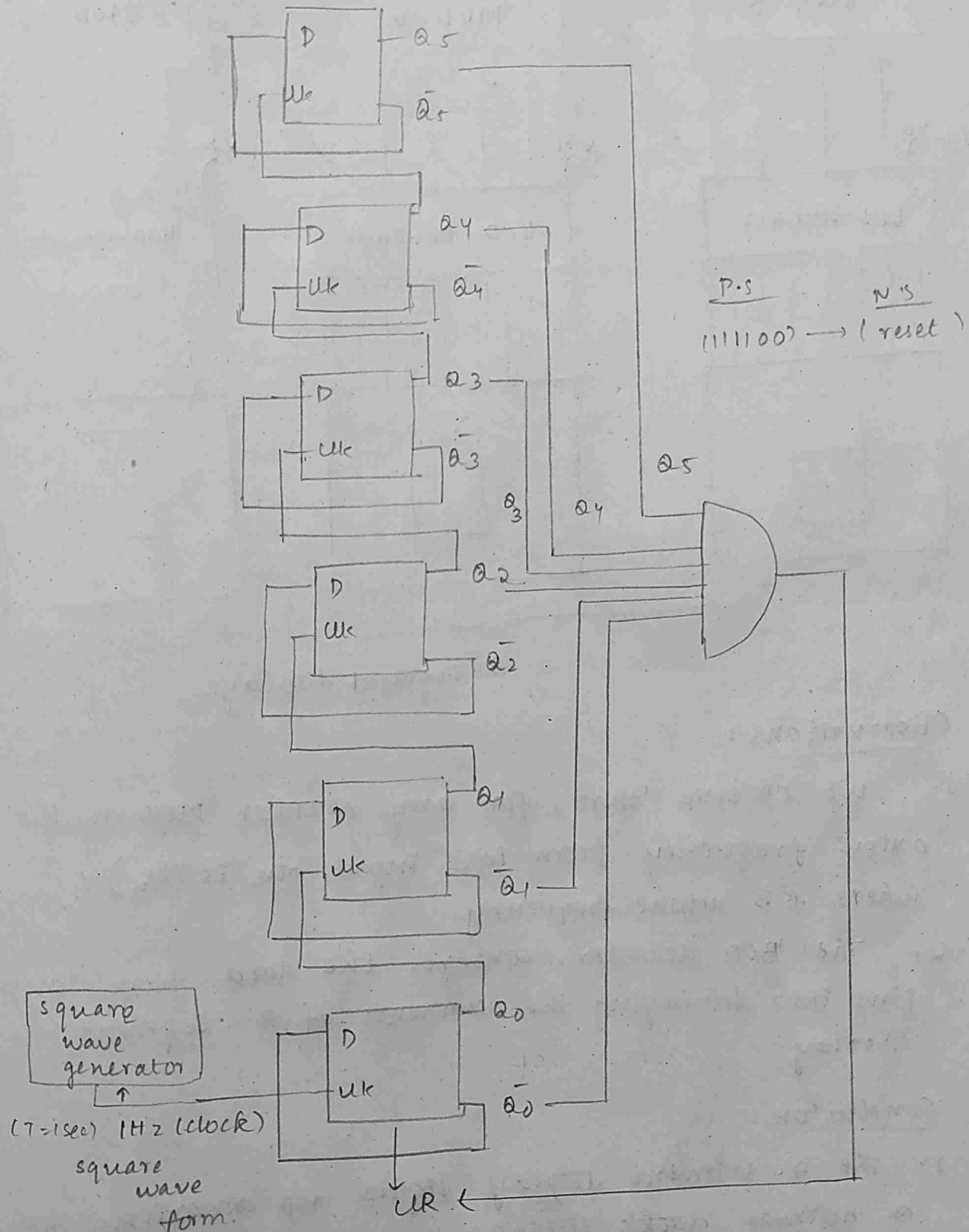
8. MOD-8 counter (asynchronous)





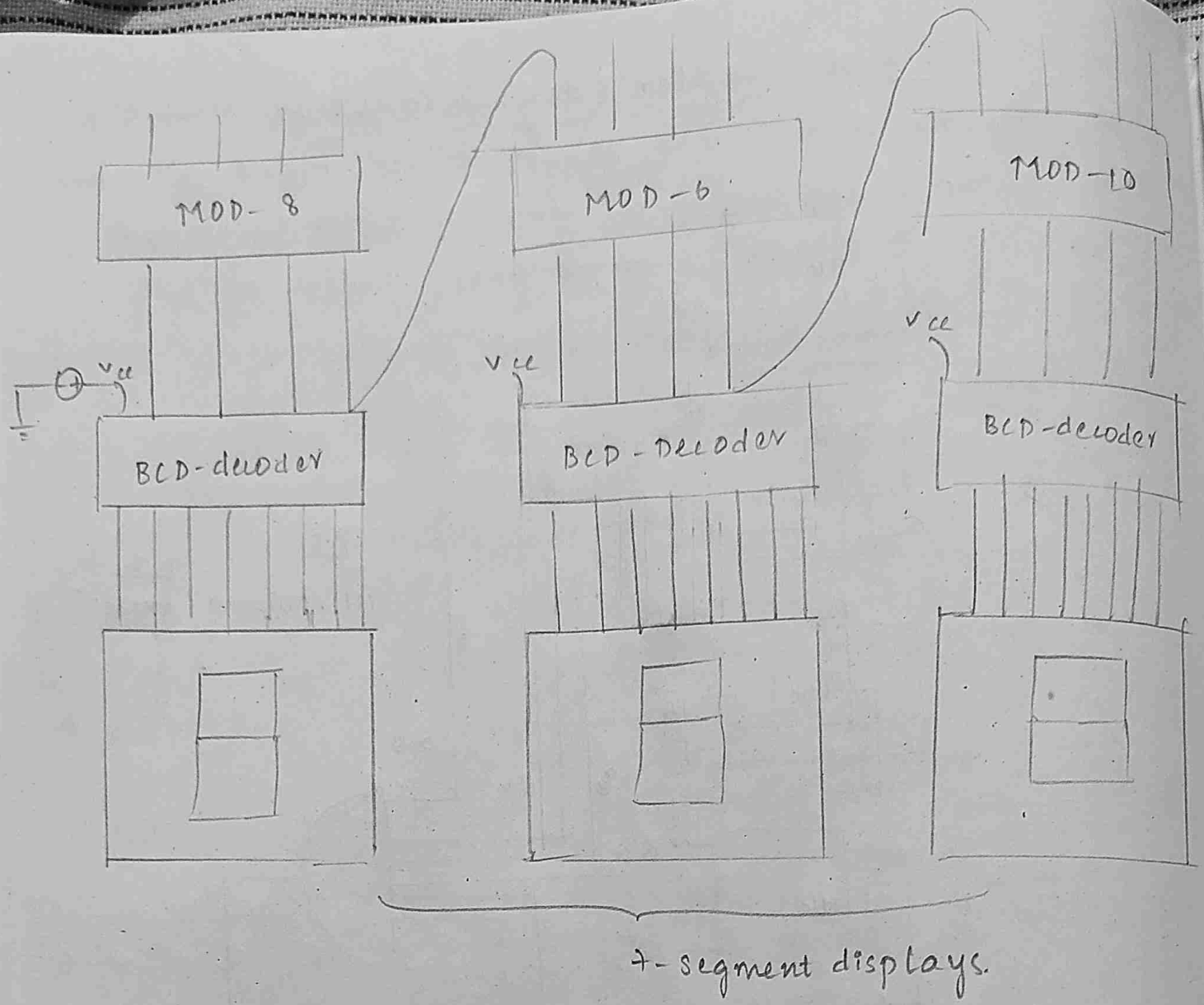
	Q_2	Q_1	Q_0
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

9. MOD-60 counter (asynchronous)



10. To display digits

We connect the pins of each counter to BCD 7 segment decoder which is connected to a 7-digit segement LCD display.



7-segment displays.

Observations:

1. We observe that, for any counter MOD-n, the output frequency from last input pin is (f/n), where f is actual frequency
2. The BCD decoder, converts the data from input pins into displaying the segments of 7-segment display.

Conclusion:

1. The 7-segment display lights up according to a normal clock's timings
2. Counters work as frequency dividers.

Few snaps of readings