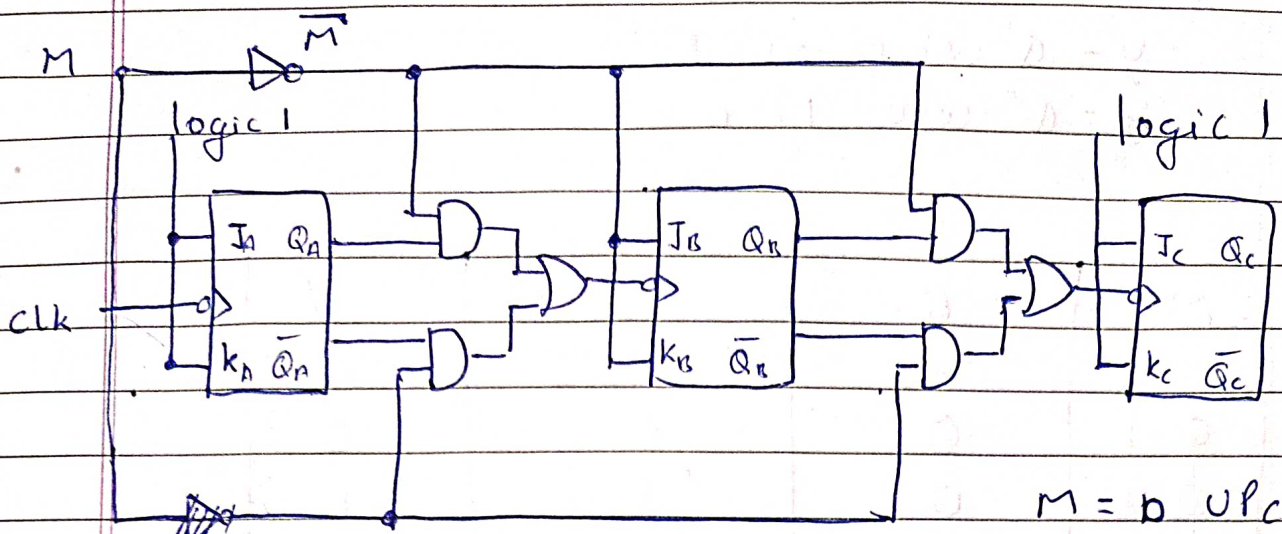


Q. 3 bit asynchronous up-down counter.



M = 0 UP counter  
M = 1 Down counter

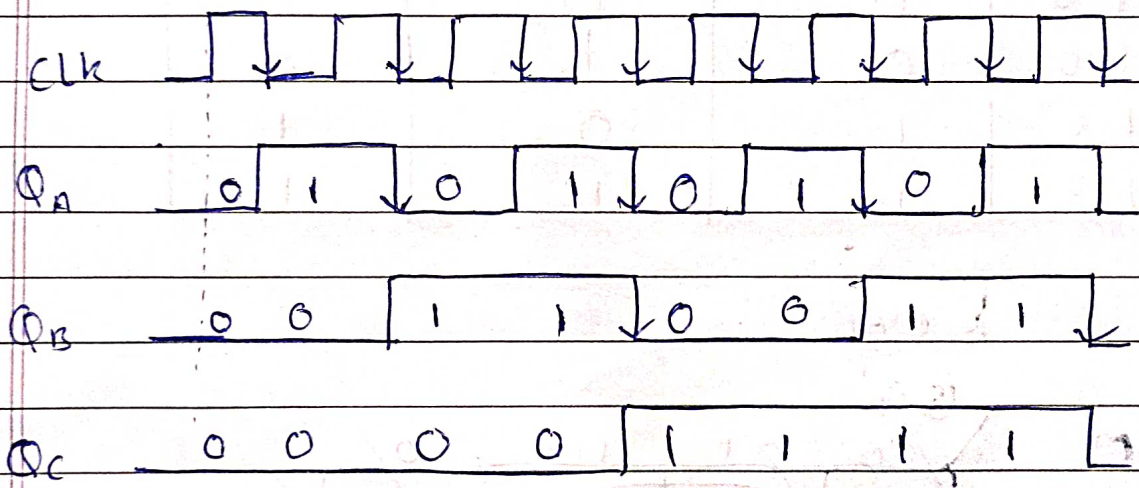
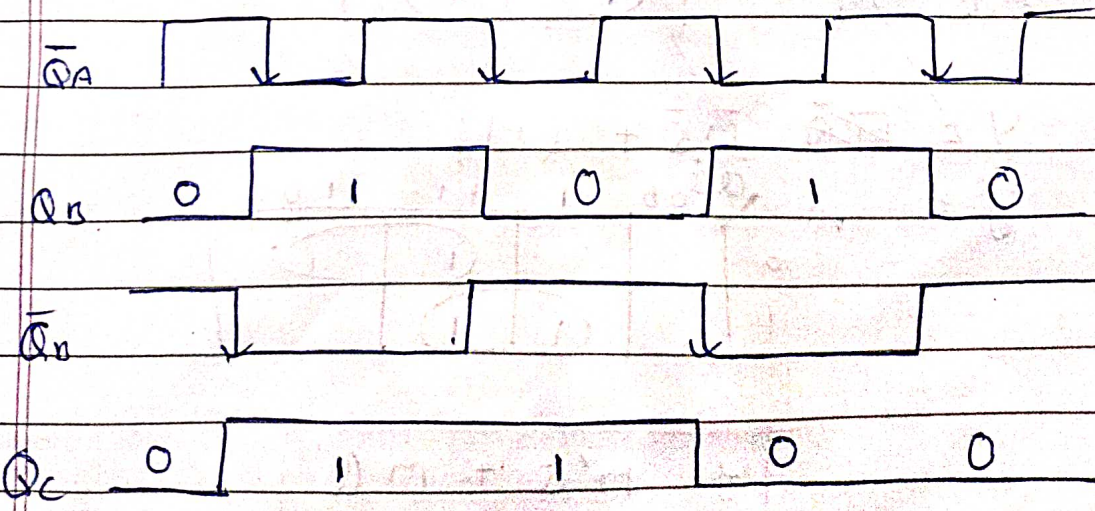
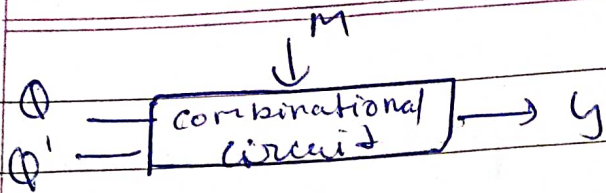


fig. a - up counter. M = 1





$$y = Q' \text{ when } M = 1$$

$$y = Q \text{ when } M = 0$$

M	Q	Q'	y
0	1	0	0
0	1	0	1
0	1	1	0
0	1	1	1
1	0	0	0
1	0	1	0
1	0	1	1
1	0	1	1

k map.  $y = M'Q + M\bar{Q}$