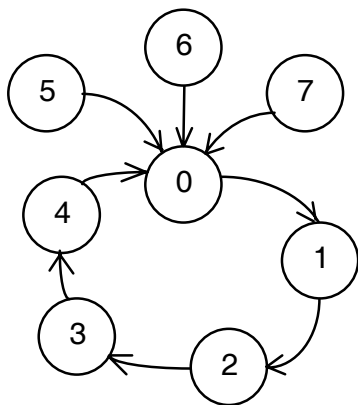


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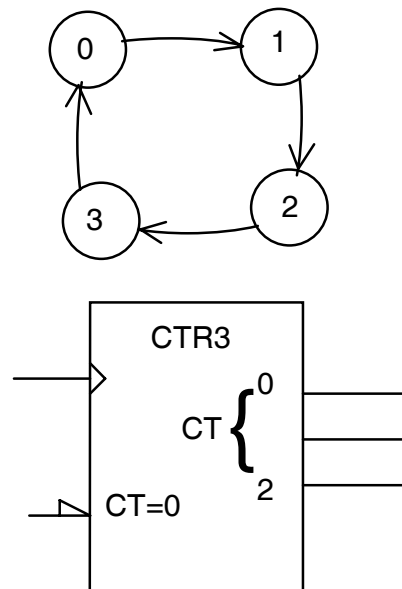
Answer Sheet 12

1. It can be seen that a down-counter is an up-counter but with the outputs taken from the \bar{Q} outputs instead of the Q outputs.

2. Synchronous CLEAR:

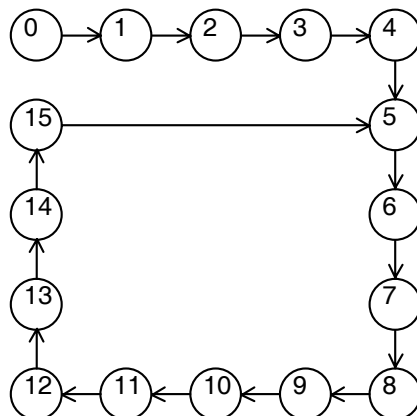


Asynchronous CLEAR:



3.

a)



b) The number of states in one complete cycle is 11. TC and OUT go high once per cycle and, hence, the output frequency is $16/11$ kHz.

c) For $N < 15$, $f_{\text{out}} = \frac{16}{16-N}$ kHz

d) For $N = 15$, $f_{\text{out}} = 0$ and OUT always equals 1.