

Hardwired Control Units :

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- 1) State Table Method
- 2) Delay & Element method (Flowchart method)
- 3) Sequence Counter method (Real-world method)



1) State table method

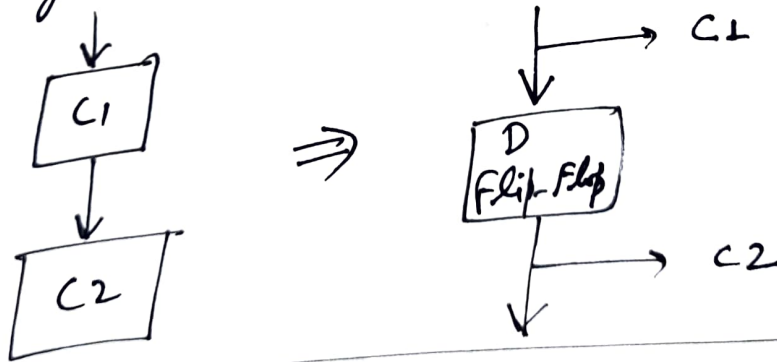
	inputs			
	I_1	I_2	I_n
S_1	$C_{1,1}$	$C_{1,2}$	$C_{1,n}$
S_2	$C_{2,1}$	$C_{2,2}$	$C_{2,n}$
\vdots				
S_m	$C_{m,1}$	$C_{m,2}$	$C_{m,n}$

- Decode the instructions
- Generate the control signals (micro operations)

- Behavior of CU is represented as a table called state table.
- Control signals are generated as output from Control Unit.
- Inputs are instructions.
- good for processor with less number of instructions.
- Redundancy is there in the circuit.

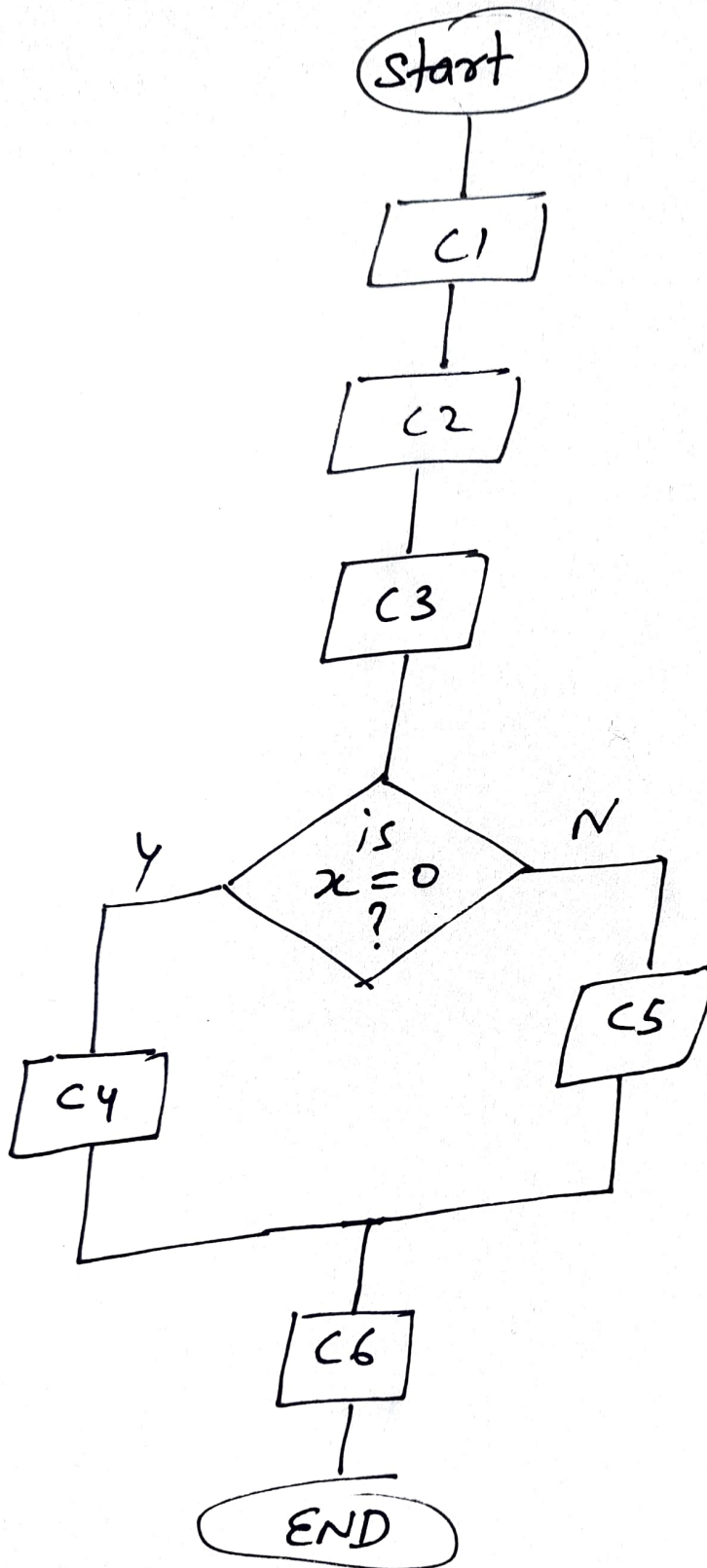
2) Delay Element Method:

- the behavior of CU is represented in the form of a flowchart.
- Each step in the flowchart represents a control signal to be produced.
- Control signals perform micro-operations, which require one T-state each.
- Hence between every two steps of the flowchart, there must be a delay element.
- The delay must be exactly of one T-state. This delay is achieved by D Flip Flops.
- The D Flip-Flops are inserted between every two consecutive control signals.



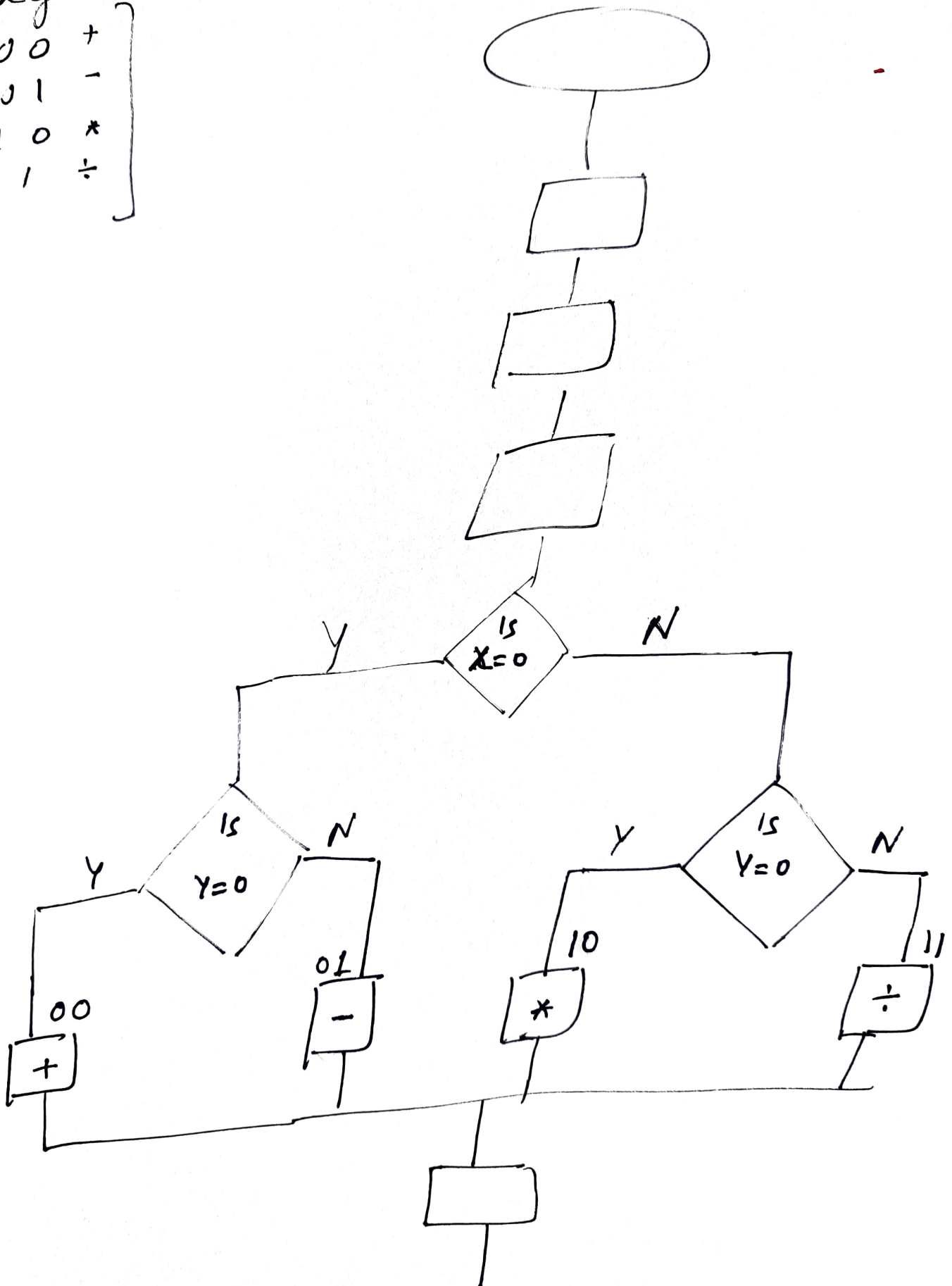
- of all D-Flip-Flops only one will be active at a time.
- In a multiple entry point to combine two or more paths, we use an OR gate.

Delay element method (Flow-chart)

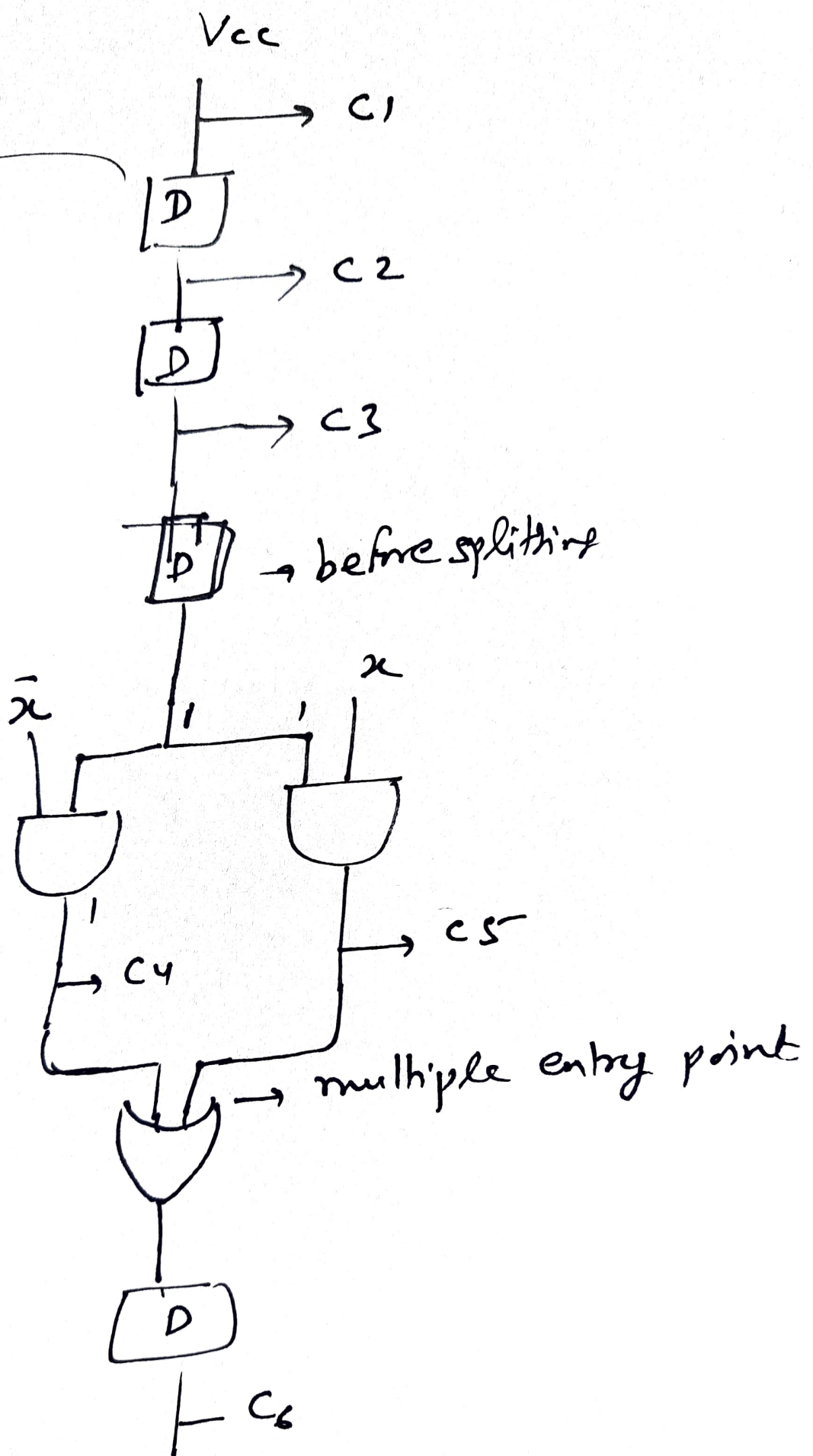


four instructions :-

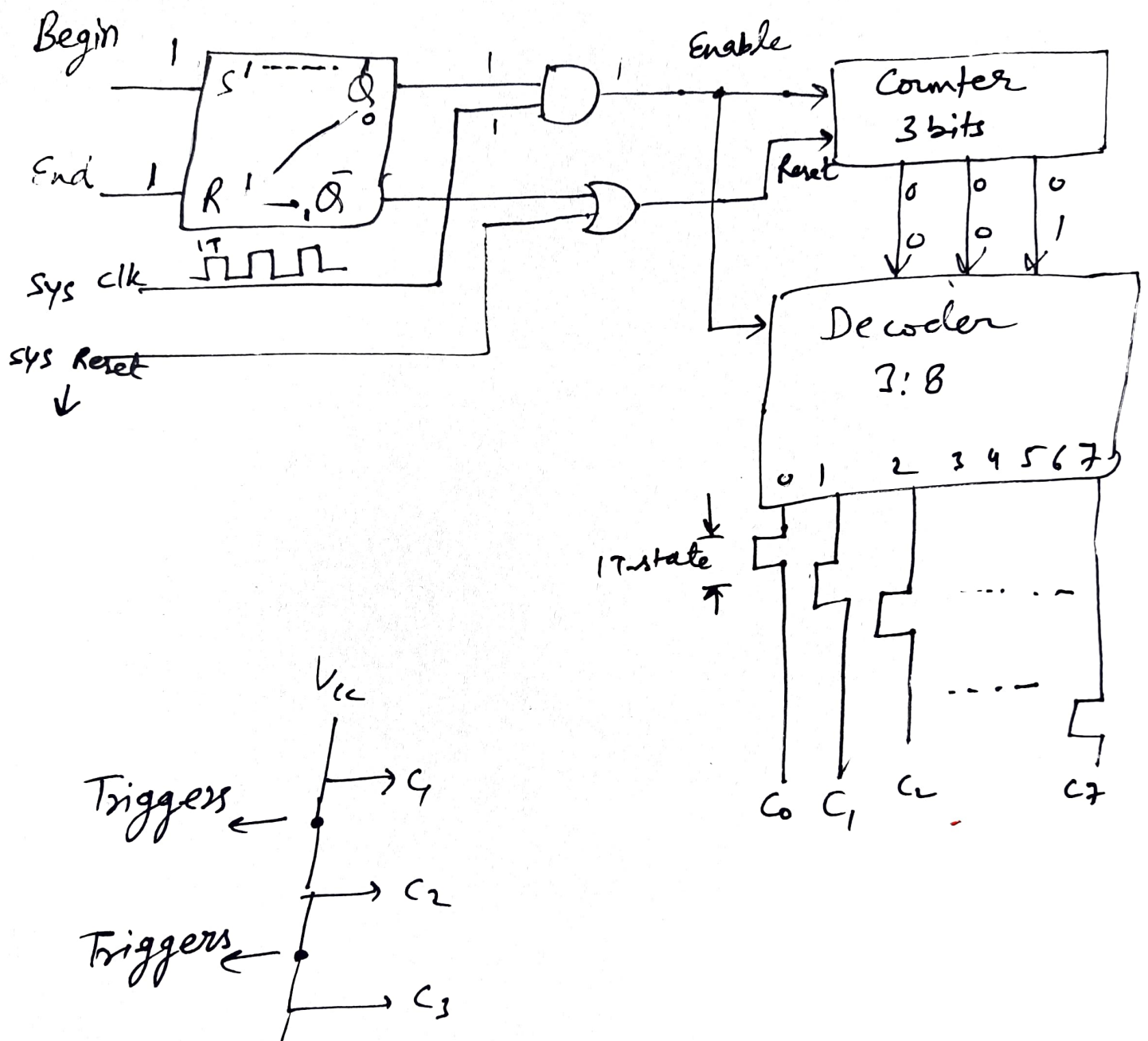
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00	+
01	-
10	*
11	÷



Delay



→ Each Delay elements produces the delay of one clock-cycle



- This is the most popular form of hardwired control unit.
- It follows the same logical approach of a flowchart, like the delay element method, but does not use all those unnecessary D Flip-Flops.
- We need a delay of 1 T-state (one clock cycle) b/w every two consecutive control signals.
- Adv : Avoids the use of too many D Flip-Flops

General drawback:

- 1) There are based on hardware, the circuit becomes more & more complex.
- 2) Such large circuits are difficult to make & debug.
- 3) As the processor gets upgraded, the entire control unit has to be redesigned.