

TUT-III

21.08.2012

Objectives

- K-map
- Latch circuit
- Clocked flip-flops
- Asynchronous inputs

K-Map

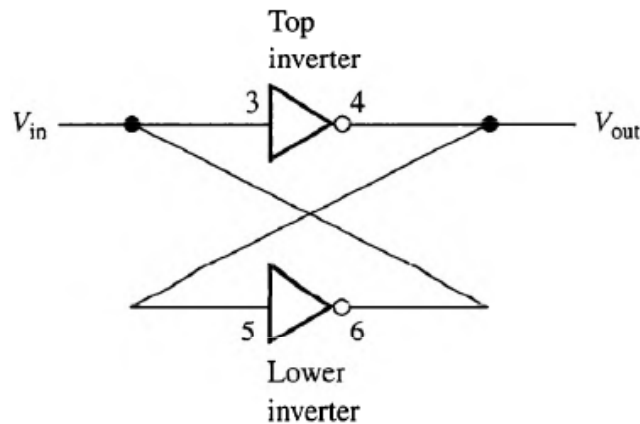
- Determine minimum expression for following K-map. Inputs to the circuit are 4 binary bits ABCD with A as MSB

		CD		
AB				
	1	1	1	
			1	
			1	
	1	1	1	

- Prepare truth table for given K-map

Latches

- Prepare truth table for following digital circuit



Input (Pin 3)	Output (Pin 4)	Pin 5	Pin 6
momentarily at GND			
momentarily at +5V			

- State limitation of the circuit if any. How to overcome it? Draw the diagram by realizing Not gate using NAND gates.
- Modify the circuit such that a control signal provided to the latch such that : the output will change as soon as there is a change in the input ONLY IF CONTROL INPUT IS ACTIVE
- Prepare the truth table for the ckt.

Gated Latch

Inputs			Output		Observed O/p	
E	Set	Clear	Q	Q'	Q	Q'
0	1	1				
0	0	1				
0	1	0				
0	0	0				
1	1	1				
1	0	1				
1	1	0				
1	0	0				

Use K-Map to Find Characteristic equation of FF

R	S	Previous		New	
		Q_p	$Q_p(\text{bar})$	Q	$Q(\text{bar})$
0	0	1	0	1	0
0	1	1	0	1	0
1	0	1	0	0	1
1	1	0	1	INVALID	
0	0	0	1	0	1
0	1	0	1	1	0
1	0	0	1	0	1
1	1	0	1	INVALID	

$Q_p \backslash RS$	00	01	11	10
0	0	1	x	0
1	1	1	x	0

We place don't cares for
 $R=1, S=1$

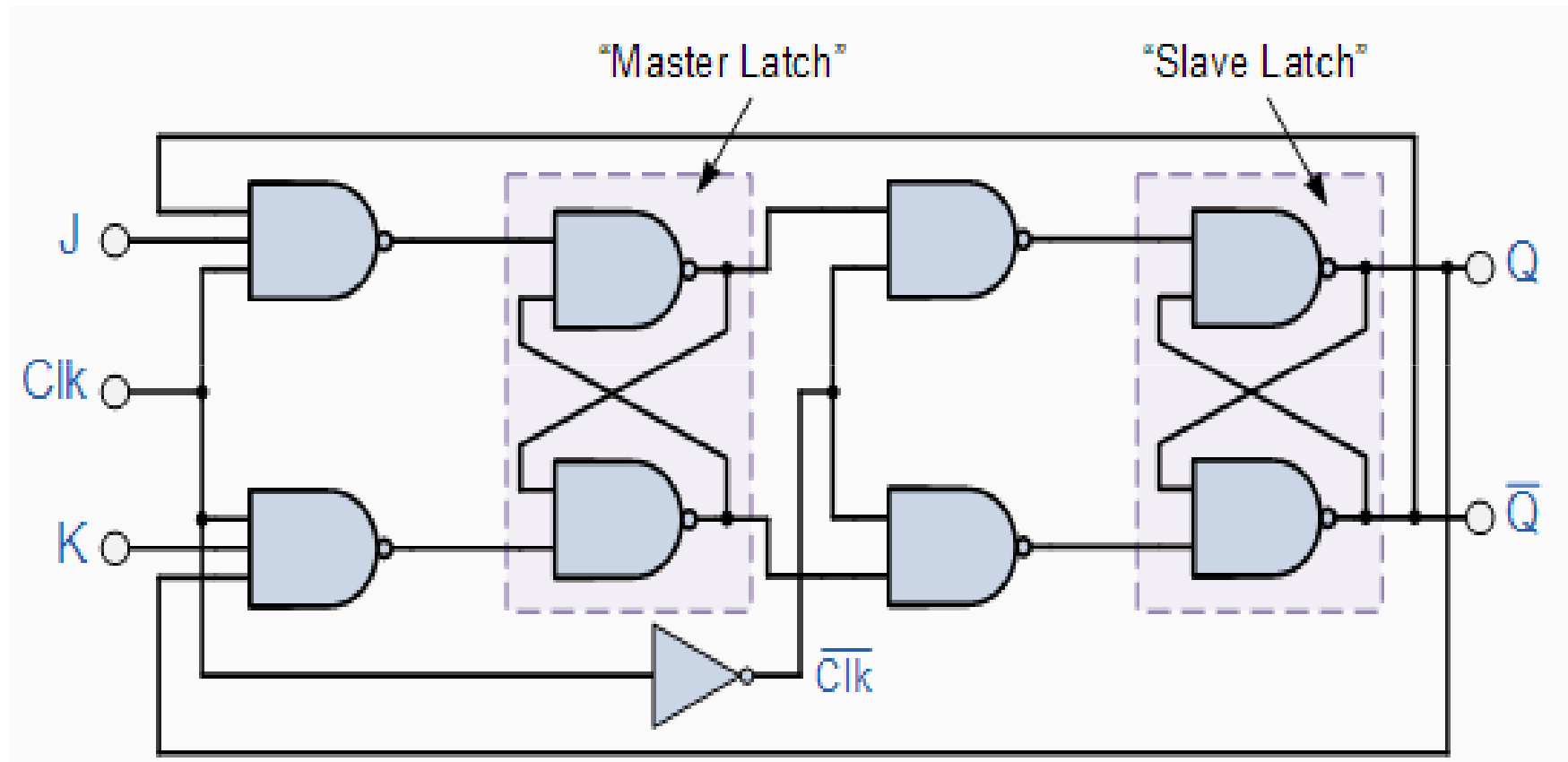
The Equation we get is
 $Q = R' Q_p + S \text{ \& } R.S=0$

Try Yourself: Similarly find chara. equation for J-K FF using K-Map

Master-Slave J-K FF

- Uses two SR flip-flops connected together in series, one for the "Master" circuit, which triggers on the leading edge of the clock pulse and the other, the "Slave" circuit, which triggers on the falling edge of the clock pulse. This results in the two sections, the master section and the slave section being enabled during opposite half-cycles of the clock signal.

Master-Slave J-K FF

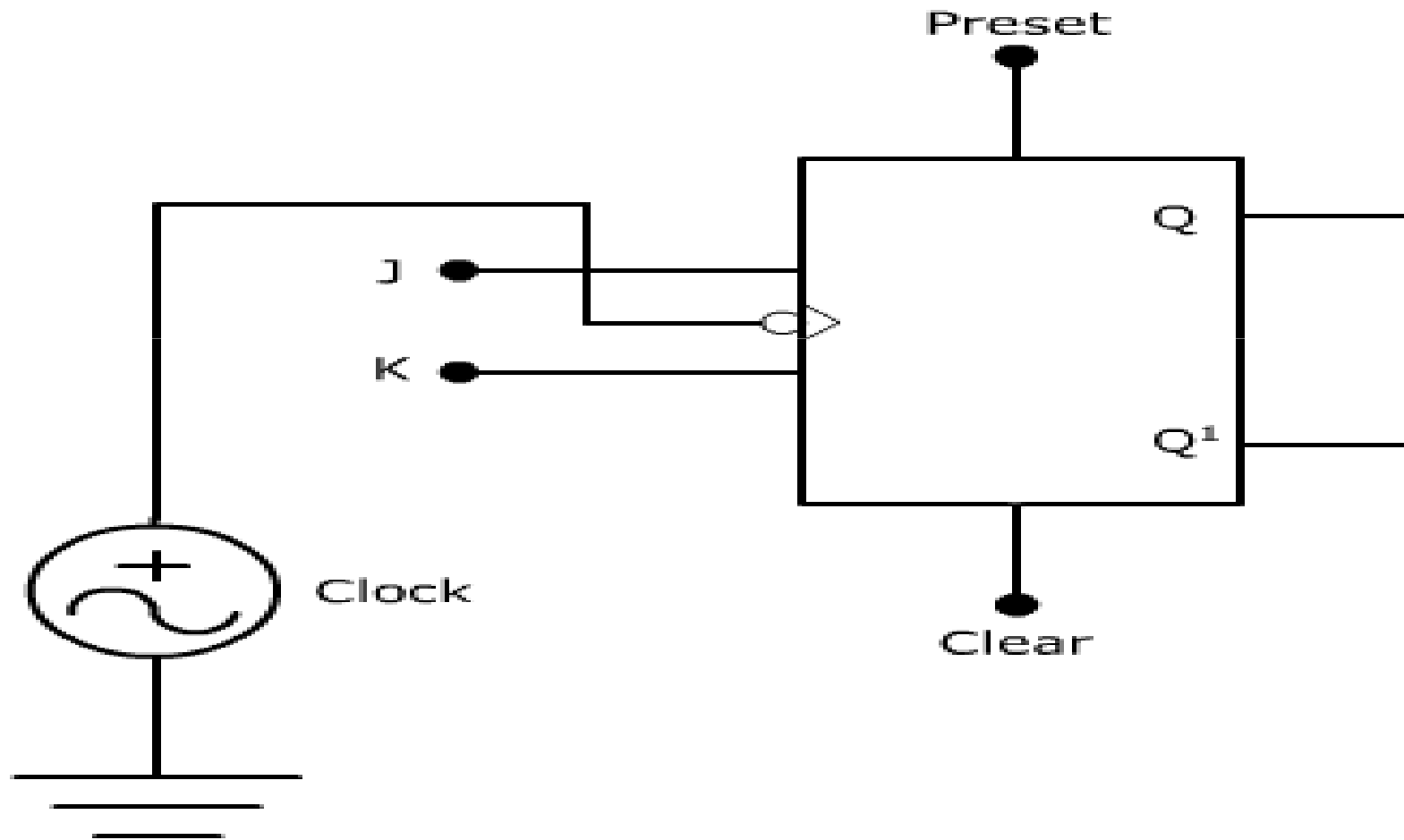


- **Master-Slave JK Flip-flop** is a "Synchronous" device as it only passes data with the timing of the clock signal.

Asynchronous inputs

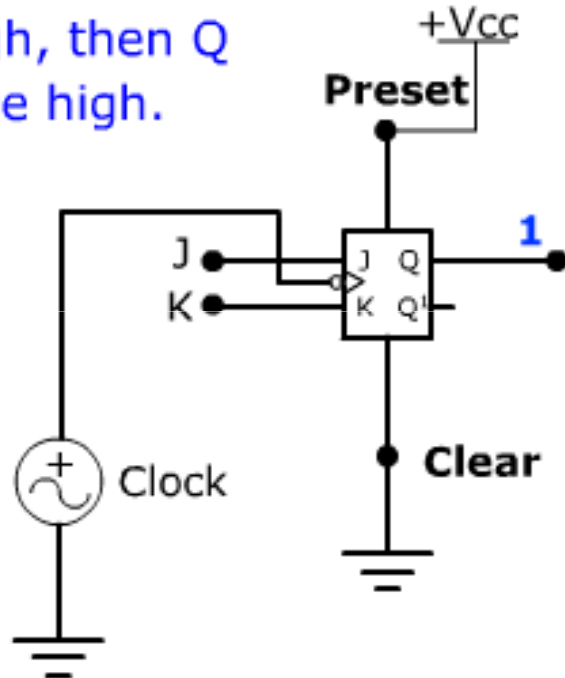
- Asynchronous/ direct : Don't wait for the clock to come but can affect the output independent of the clock.
- These inputs can be of two types:
- **Active LOW**: This means when the input is LOW, it would affect the output otherwise if input is HIGH then it causes no change.
- **Active HIGH**: This means when input is HIGH then it can change the output otherwise if input is LOW, it doesn't cause any change in the output.

Synchronous & Asynchronous inputs



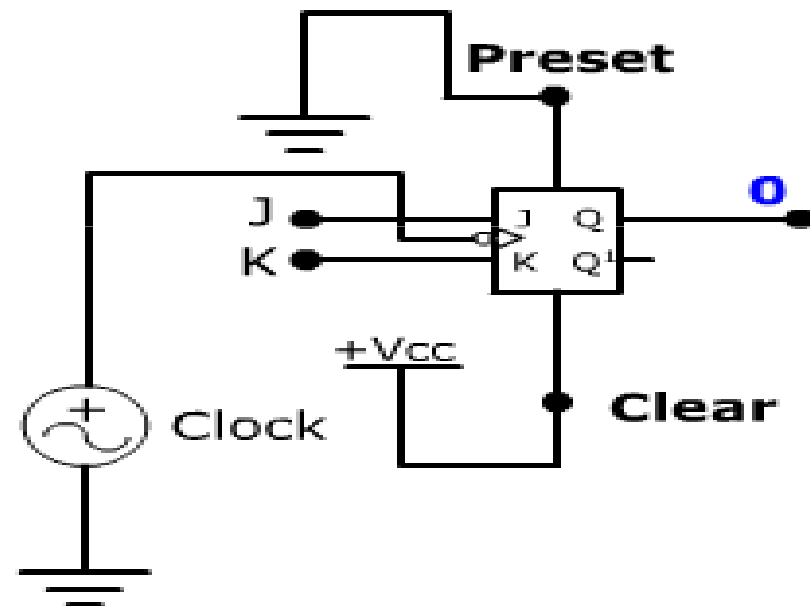
Asynchronous Inputs of FF

If the "Preset" is held high, then Q will be high.



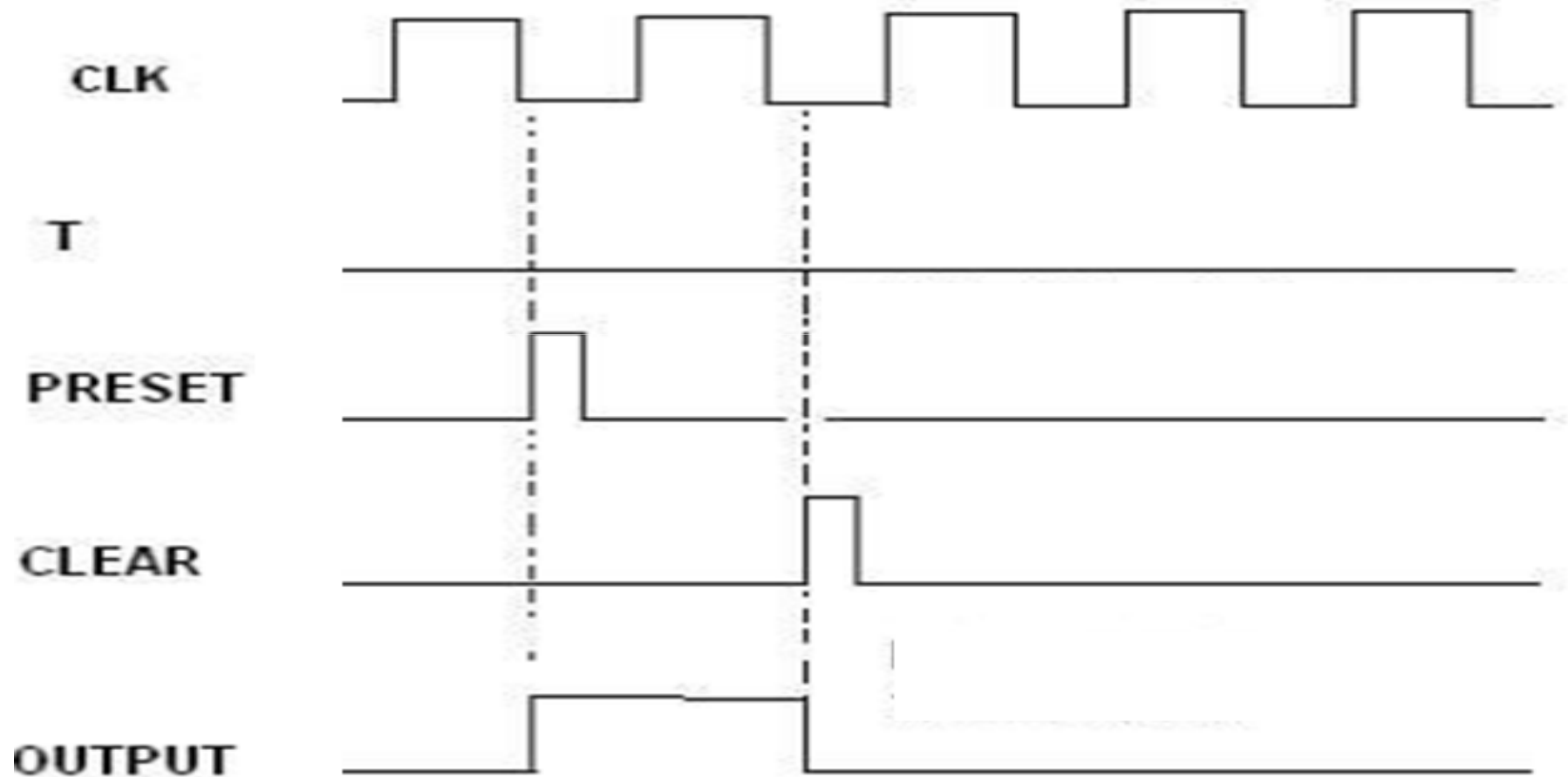
Preset = 1
Q = 1

If the "Clear" is held high, then Q will be low.



Clear = 1
Q = 0

Asynchronous inputs



Asynchronous inputs

- Asynchronous inputs have priority over synchronous inputs.
- If they are not used, they should be tied “Low”.
- If both of them are “High”, ambiguous.
- If both of them are “Low”, no effect of preset and clear. FF will respond to J,K & CLK

