



**UTM**  
UNIVERSITI TEKNOLOGI MALAYSIA

SUBJECT: SECR1013 DIGITAL LOGIC

SESSION/SEM: 1/1

**LAB 3: SYNCHRONOUS DIGITAL COUNTER**

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DATE: 27/1/2021

REMARKS:

MARKS:

**Lab #3: Identifying the Properties of a Synchronous Counter**  
**D. Preliminary Works**

1)

Table 1

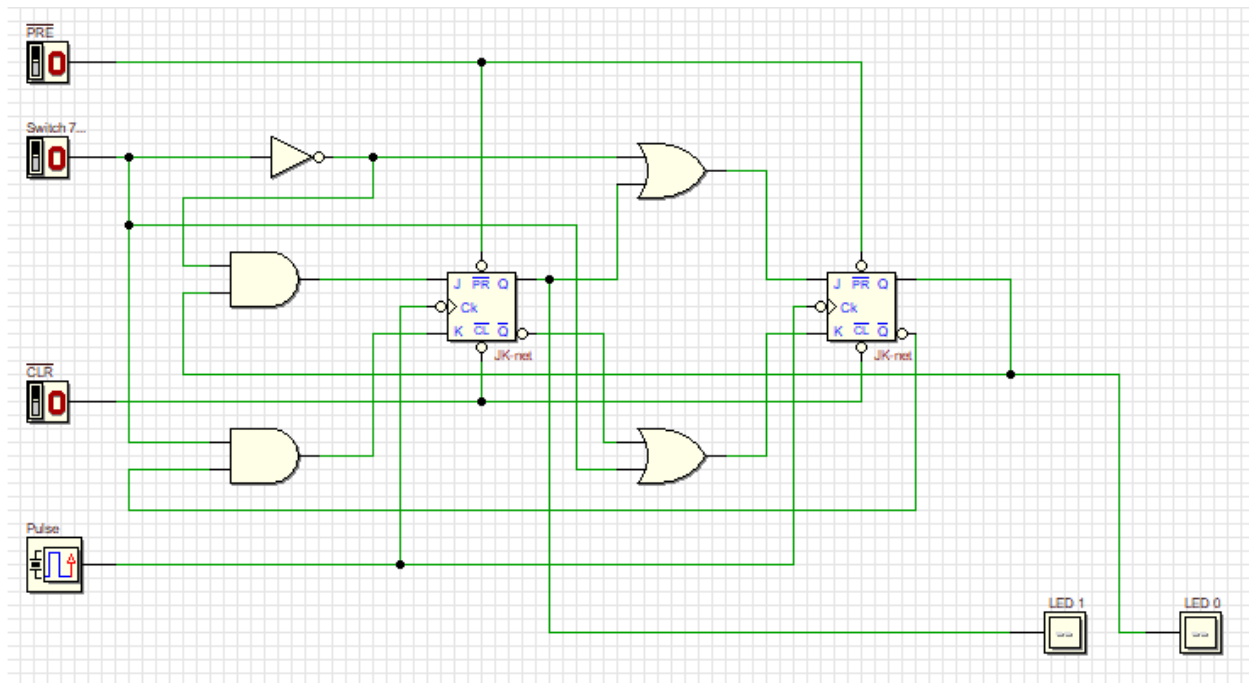
Desired Result	PRE'	CLR'	J	K	CLK	Q
Set initial value Q = 1			X	X	--	
Output Q stays the same	1	1	0	0	↓	1
Output Q become 0, no change in asynchronous input	1	0	X	X	↓	0
Output Q is not the previous Q	1	1	1	1	↓	1
RESET Q	1	1	0	1	↓	0
SET Q	1	1	1	0	↓	1

2)

- a) The J-K flip-flop has a toggle state of operation when both J and K inputs are HIGH while S-R flip flop don't have.
- b) The J-K flip flop in 7476 is a negative-edge triggered flip flop.

## E. Lab Activities

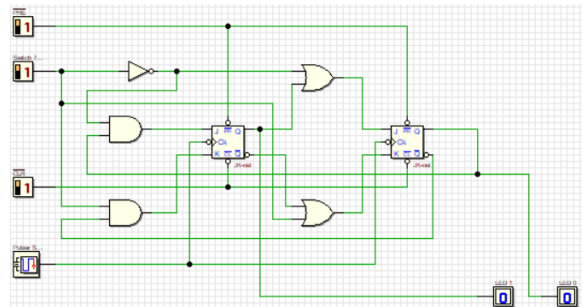
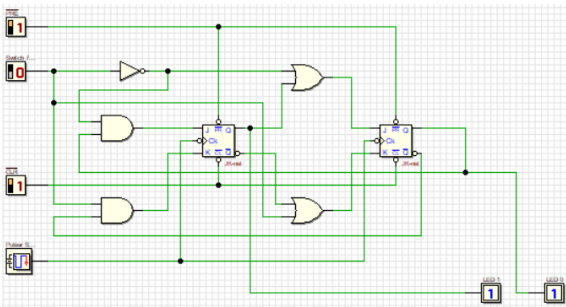
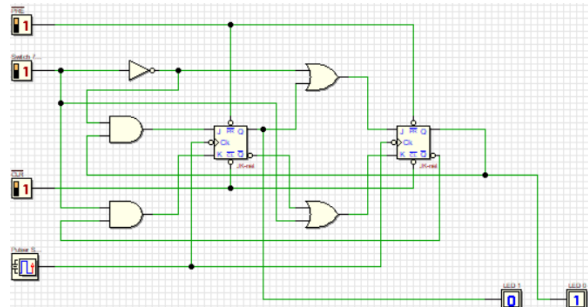
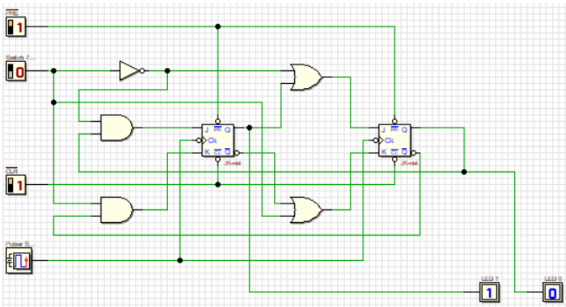
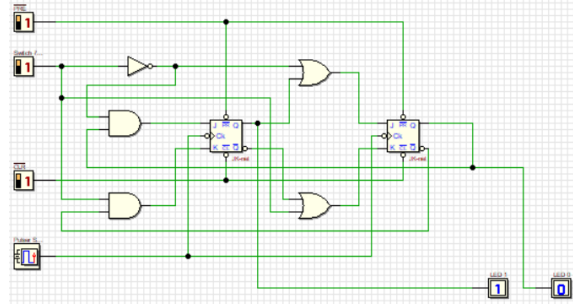
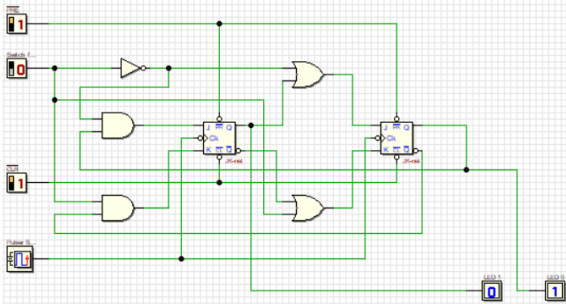
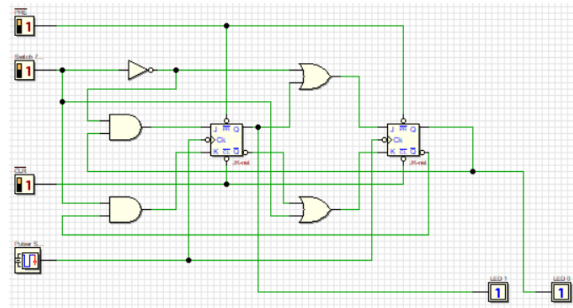
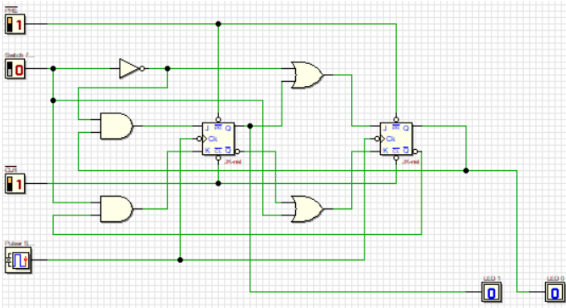
2)



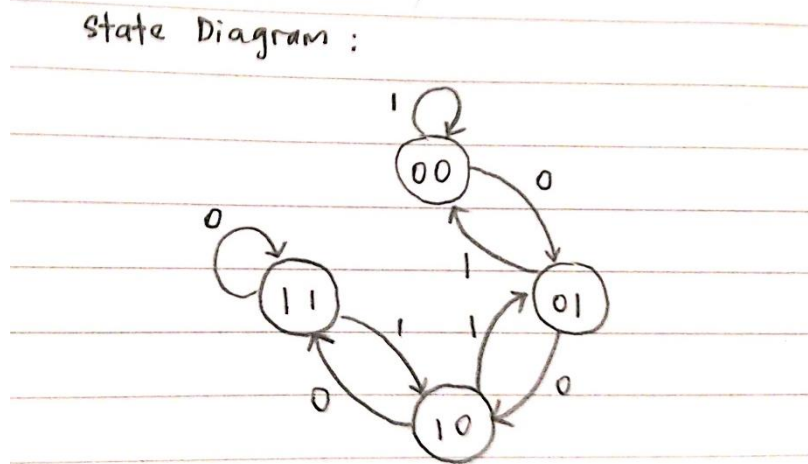
3)

Table 2

Switch 7	Present State		Next State	
X	Q1 LED 1	Q0 LED 0	Q1 LED 1	Q0 LED 0
0	0	0	0	1
0	0	1	1	0
0	1	0	1	1
0	1	1	1	1
1	0	0	0	0
1	0	1	0	0
1	1	0	0	1
1	1	1	1	0



4)



5)

- The main indicator is counting sequence. The bits are changed synchronously with the same clock.
- There are 4 states available for the counter which includes 00, 01, 10 and 11.
- The function of Switch 7 (X) in the circuit is to determine the count sequence whether up or down.
- The function of Switch 0 and Switch 1 is act as asynchronous input. To allow the normal operation of the flip flop, both asynchronous inputs must be deactivated.
- The counter is saturated because the counter repeats the maximum count if count up or repeat the minimum count if count down.

6)(a)

Table 3

Input X	Present State		Next State		D FF Transition	
	Q1	Q0	Q1+	Q0+	D1	D0
0	0	0	0	1	0	1
0	0	1	1	0	1	0
0	1	0	1	1	1	1
0	1	1	1	1	1	1
1	0	0	0	0	0	0
1	0	1	0	0	0	0
1	1	0	0	1	0	1
1	1	1	1	0	1	0

(b)

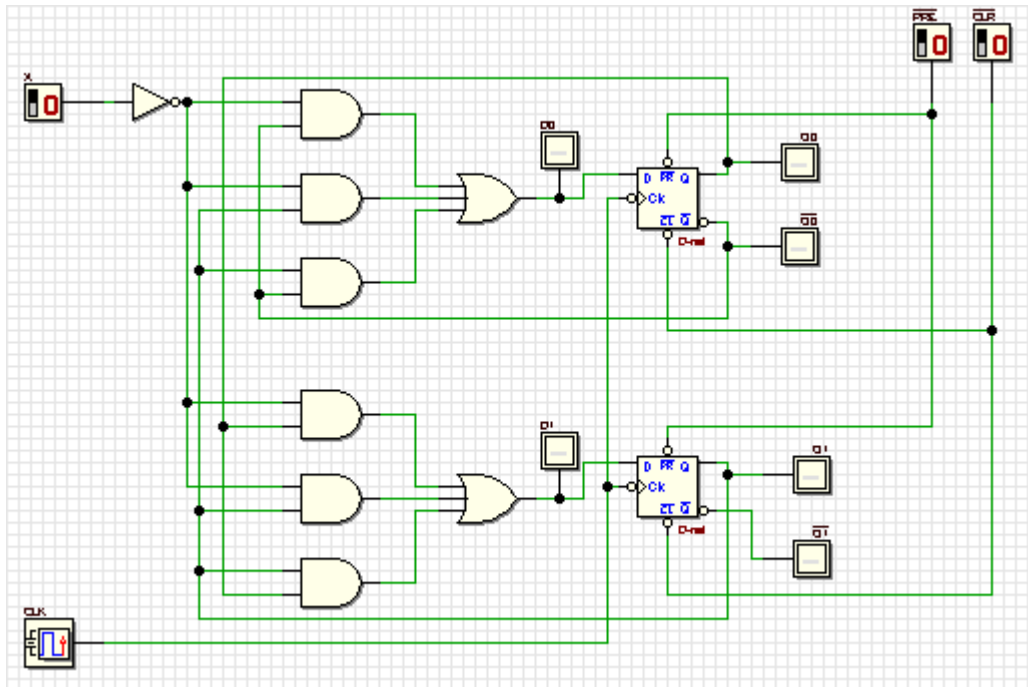
X \ Q <sub>1</sub> Q <sub>0</sub>				
	00	01	11	10
0	0	1	1	1
1	0	0	1	0

$$D_1 = \bar{X}Q_0 + \bar{X}Q_1 + Q_1Q_0$$

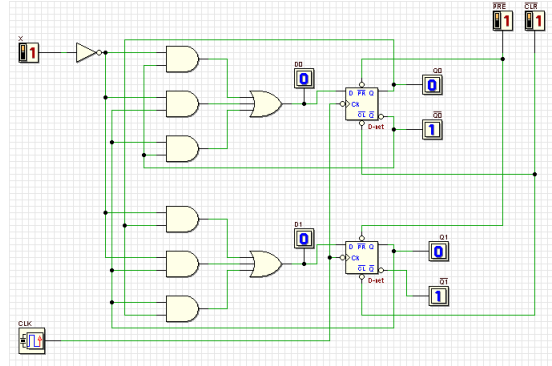
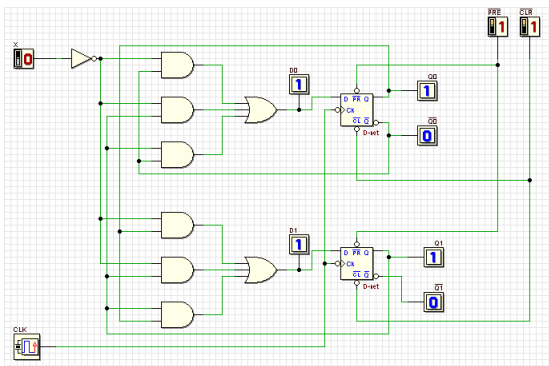
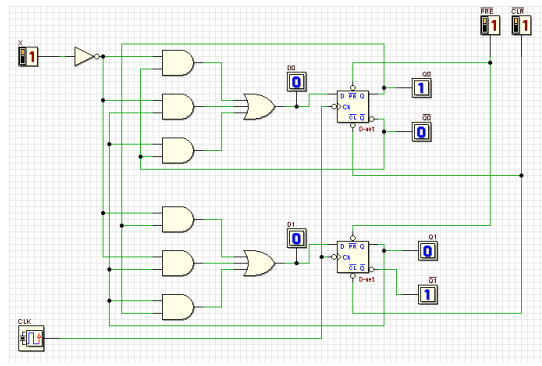
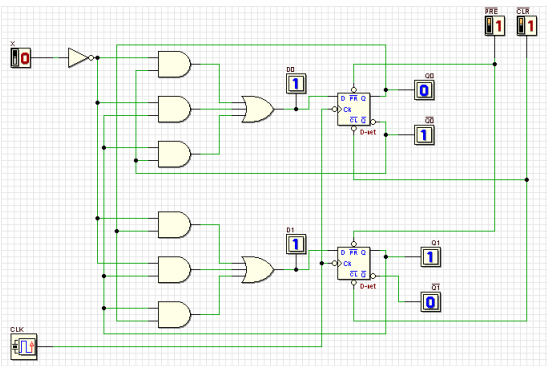
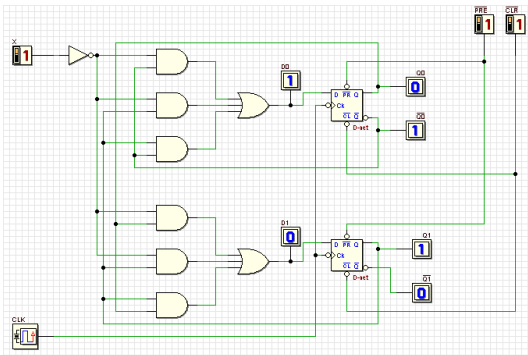
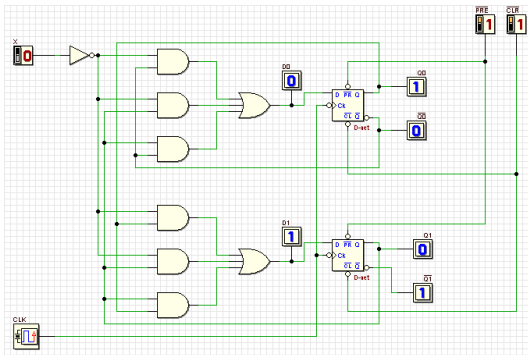
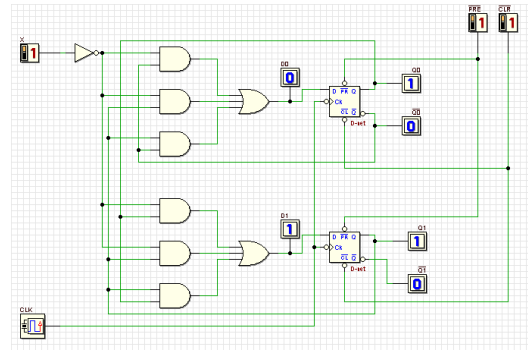
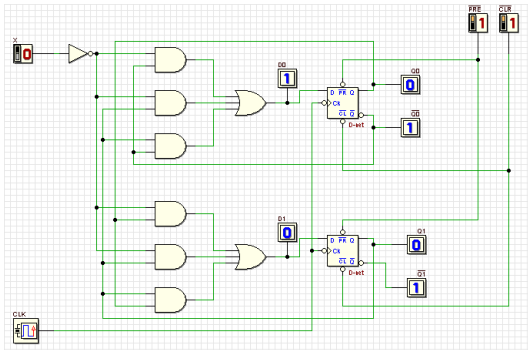
X \ Q <sub>1</sub> Q <sub>0</sub>				
	00	01	11	10
0	1	0	1	1
1	0	0	0	1

$$D_0 = \bar{X}\bar{Q}_0 + \bar{X}Q_1 + Q_1\bar{Q}_0$$

(c)



(d)





7)(a)

Table 4

Input X	Present State		Next State		T FF Transition	
	Q1	Q0	Q1+	Q0+	T1	T0
0	0	0	0	1	0	1
0	0	1	1	0	1	1
0	1	0	1	1	0	1
0	1	1	1	1	0	0
1	0	0	0	0	0	0
1	0	1	0	0	0	1
1	1	0	0	1	1	1
1	1	1	1	0	0	1

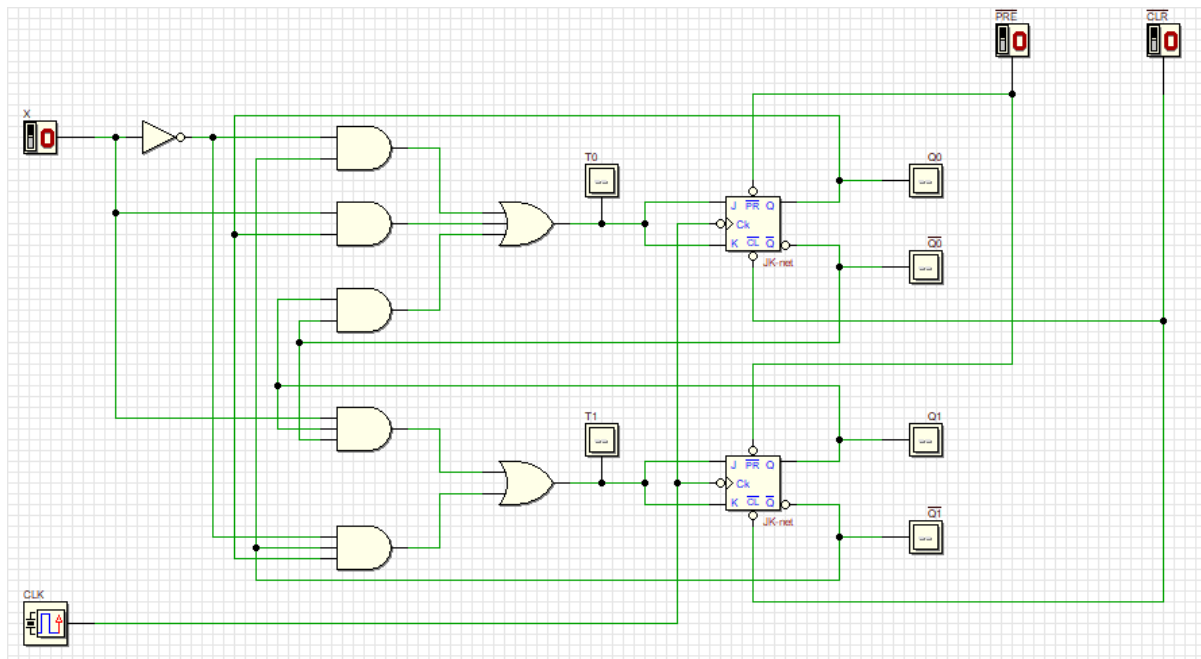
(b)

X	$Q_1 Q_0$					X	$Q_1 Q_0$				
	00	01	11	10			00	01	11	10	
0	0	1	0	0		0	1	1	0	1	$Q_1 \bar{Q}_0$
1	0	0	0	1	$X Q_1 \bar{Q}_0$	1	0	1	1	1	$X Q_0$

$T1 = \bar{X} \bar{Q}_1 Q_0 + X Q_1 \bar{Q}_0$

$T0 = \bar{X} \bar{Q}_1 + X Q_0 + Q_1 \bar{Q}_0$

(c)



(d)

