Digital Systems Lab

CE2120

Lab 9

Hashem Qaryouti

20201502049

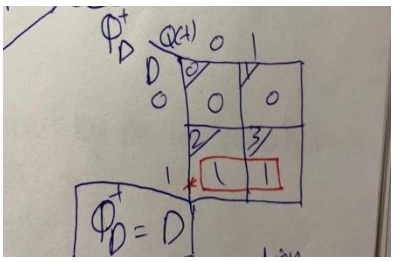
Question 1

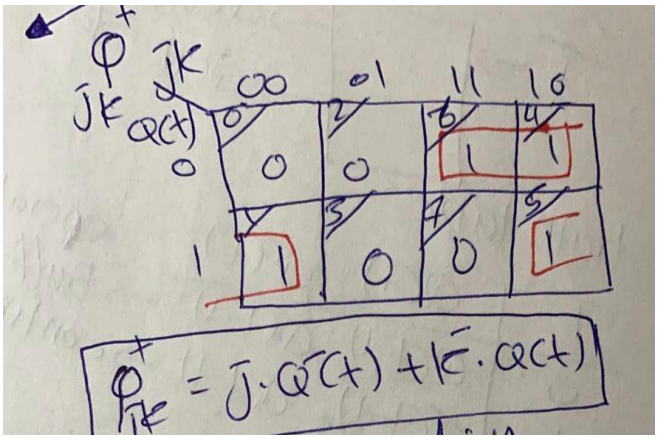
a.

J	K	Q(t)	Q(t+1)
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

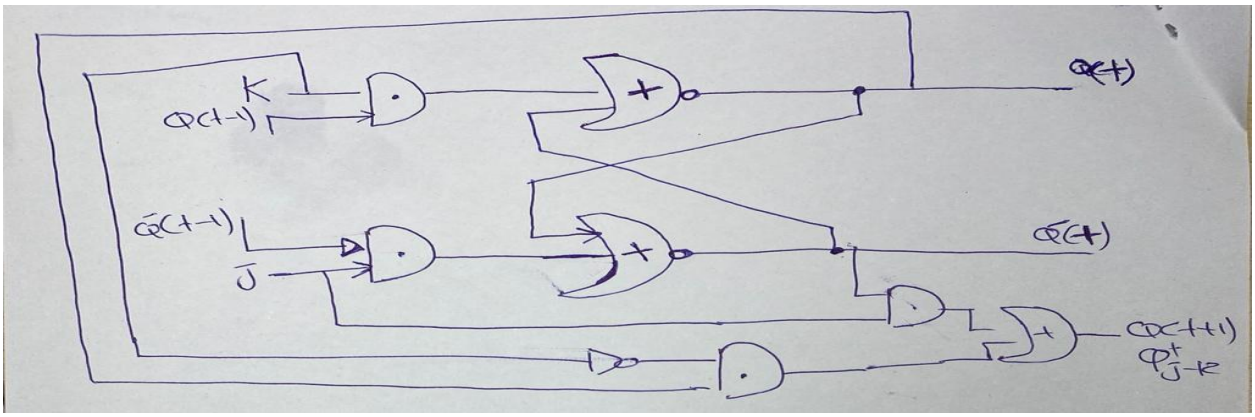
D	Q(t)	Q(t+1)
0	0	0
0	1	0
1	0	1
1	1	1

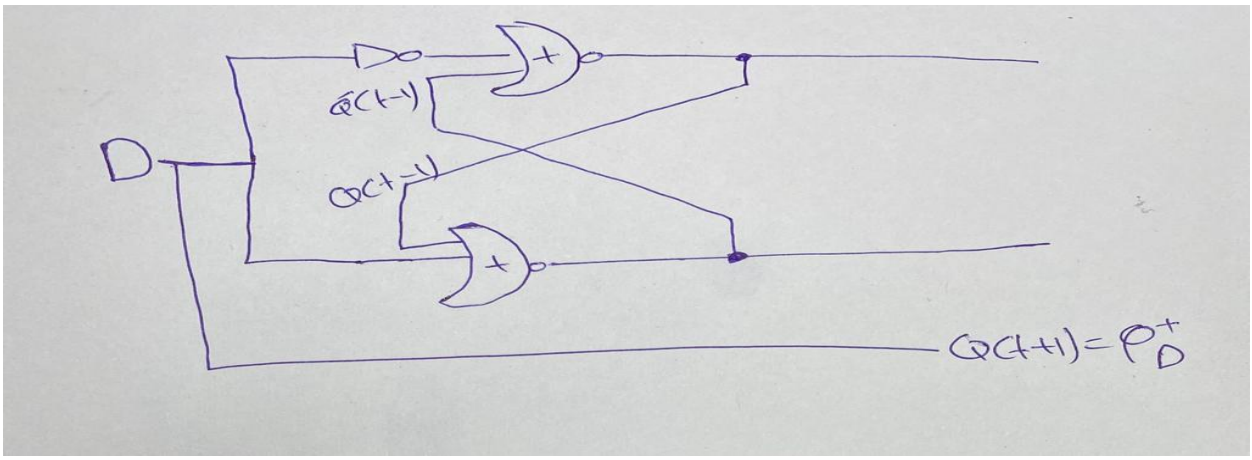
b.




Q^+
JK
Q(t)
00
01
11
10
0
1
$Q^+_{JK} = J \cdot \bar{Q}(t) + \bar{K} \cdot Q(t)$

c.


K
Q(t-1)
$\bar{Q}(t-1)$
J
Q(t)
$\bar{Q}(t)$
Q(t+1)
Q^+_{JK}


D
$\bar{Q}(t-1)$
Q(t-1)
$Q(t+1) = Q^+_D$

Question 2

a. step1: Build the next state table of the T f.f

T	Q(t)	Q(t+1)
0	0	0
0	1	1
1	0	1
1	1	0

Step2: Build the excitation table of the D f.f

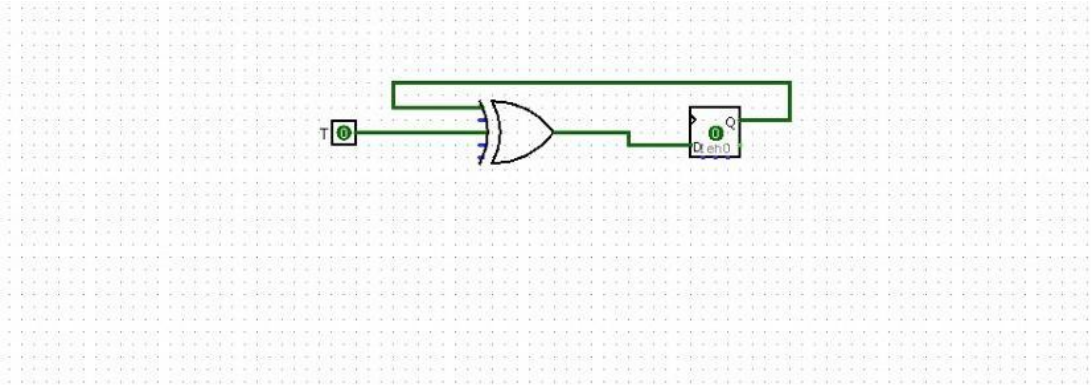
Q(t)	Q(t+1)	D
0	0	0
0	1	1
1	0	0
1	1	1

Step3: Add a column for each input of the building block f.f to the next state table of the f.f we want to build

T	Q(t)	Q(t+1)	D
0	0	0	0
0	1	1	1
1	0	1	1
1	1	0	0

D(T,Q(t))= T XOR Q(t)

b.



Question 3

a. step1: Build the next state table of the T f.f

J	K	Q(t)	Q(t+1)
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

Step2: Build the excitation table of the D f.f

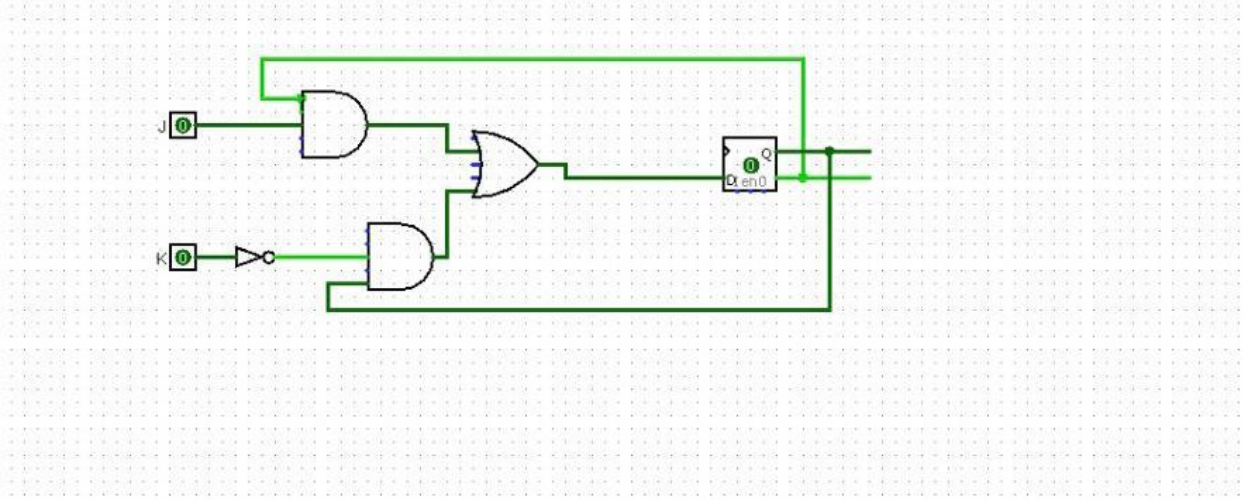
Q(t)	Q(t+1)	D
0	0	0
0	1	1
1	0	0
1	1	1

Step3: Add a column for each input of the building block f.f to the next state table of the f.f we want to build

J	K	Q(t)	Q(t+1)	D
0	0	0	0	0
0	0	1	1	1
0	1	0	0	0
0	1	1	0	0
1	0	0	1	1
1	0	1	1	1
1	1	0	1	1
1	1	1	0	0

$D(J,K,Q(t)) = K'.Q(t) + J.Q'(t)$

b.



Question 4

Step1: we need 3 J-K F.Fs

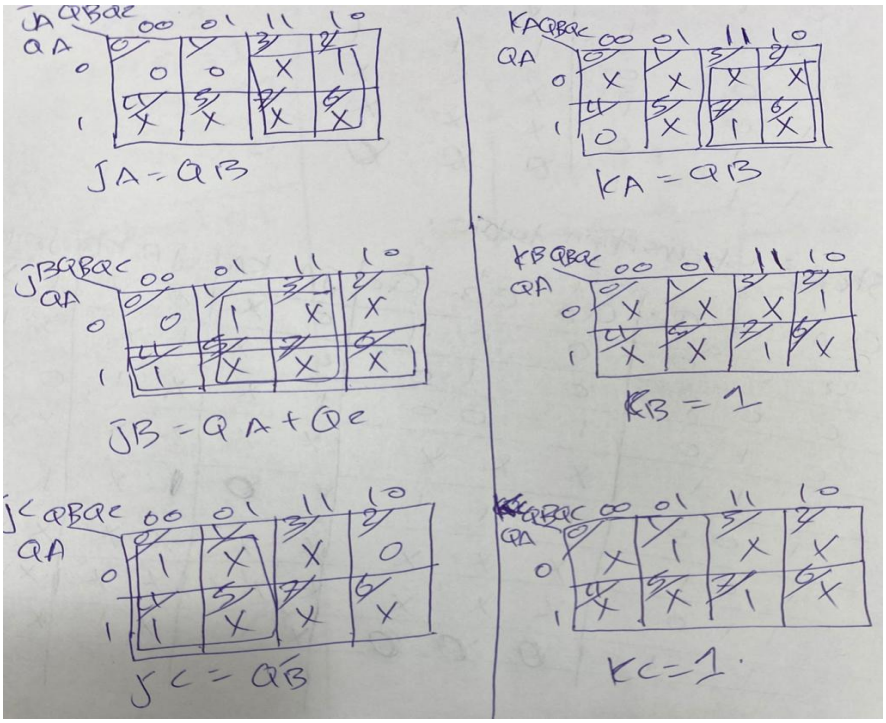
Step2 : Sate table

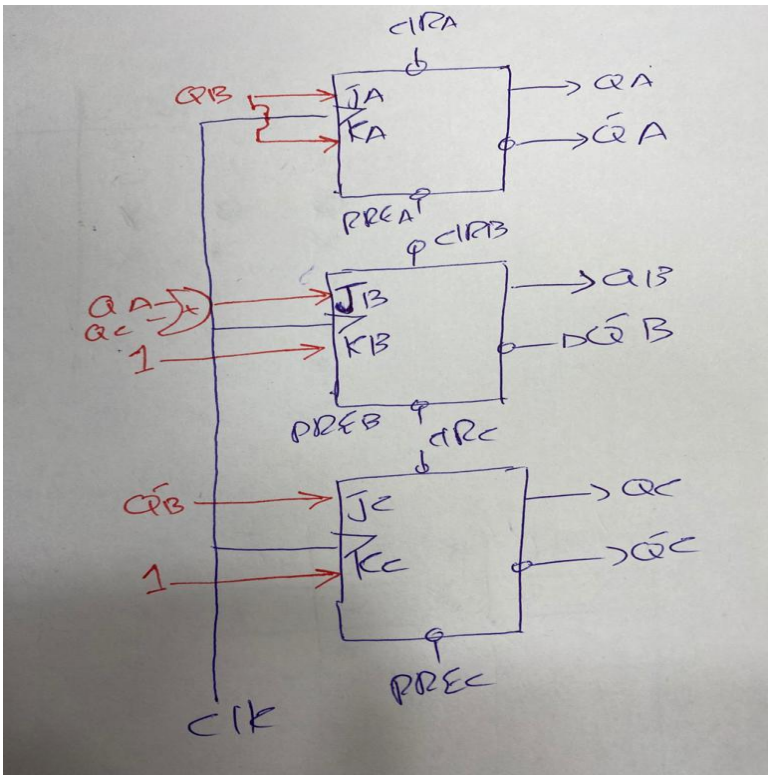
QA	QB	QC	QA^+	QB^+	QC^+
0	0	0	0	0	1
0	0	1	0	1	0
0	1	0	1	0	0
0	1	1	X	X	X
1	0	0	1	1	1
1	0	1	X	X	X
1	1	0	X	X	X
1	1	1	0	0	0

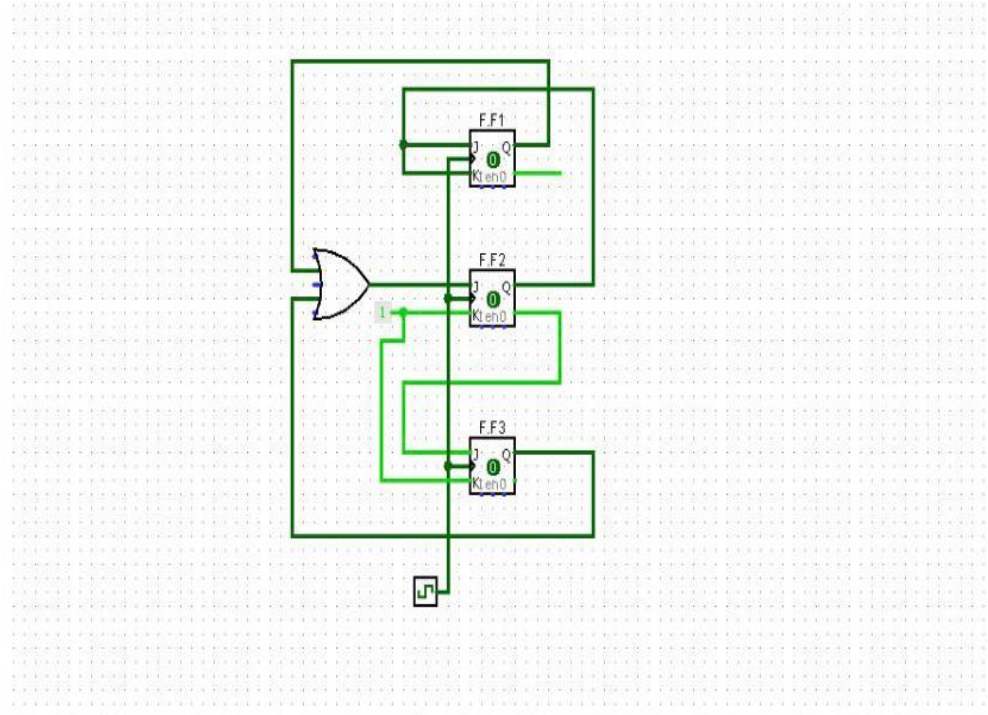
Step 3: Transition table

QA	QA	QA	QA^+	QB^+	QC^+	JA	KA	JB	KB	JC	KC
0	0	0	0	0	1	0	X	0	X	1	X
0	0	1	0	1	0	0	X	1	X	X	1
0	1	0	1	0	0	1	X	X	1	0	X
0	1	1	X	X	X	X	X	X	X	X	X
1	0	0	1	1	1	X	0	1	X	1	X
1	0	1	X	X	X	X	X	X	X	X	X
1	1	0	X	X	X	X	X	X	X	X	X
1	1	1	0	0	0	X	1	X	1	X	1

Step 4 : f.fs inputs equation




CLRA
QB
JA
KA
QA
Q̄A
PREA
CLRB
QA
Qc
1
JB
KB
QB
Q̄B
PREB
CLRc
Q̄B
1
Jc
Kc
Qc
Q̄c
PREc
CLK


FF1
J
Q
K
en
FF2
1
FF3

Unused States

QA QB QC = 0 1 1

To be in this state

CLR_A=PRE_B=PRE_C= 0

CLR_B=PRE_A= CLR_C = 1

To proceed, deactivate all clears and presets inputs

Rising edge : 0 1 1 →1 0 0

JA= KB = 1 → toggle operation

JB = KB = 1 → toggle operation

JC = KC = 0 → reset operation

QA QB QC = 1 0 1

Rising edge : 1 0 1 →1 1 0

JA= KB = 0 → Buffer operation

JB = KB = 1 → toggle operation

JC = KC = 1 → toggle operation

QA QB QC = 1 1 0

Rising edge : 1 1 0 →0 0 0

JA= KB = 1 → toggle operation

JB = KB = 1 → toggle operation

JC =0, KC = 1 →Reset operation
