Universidad Carlos III de Madrid
Digital Electronics. 2nd partial exam. April, 2012
Groups 65,69,79,95.

Name: _____
Group: _____

Surname:

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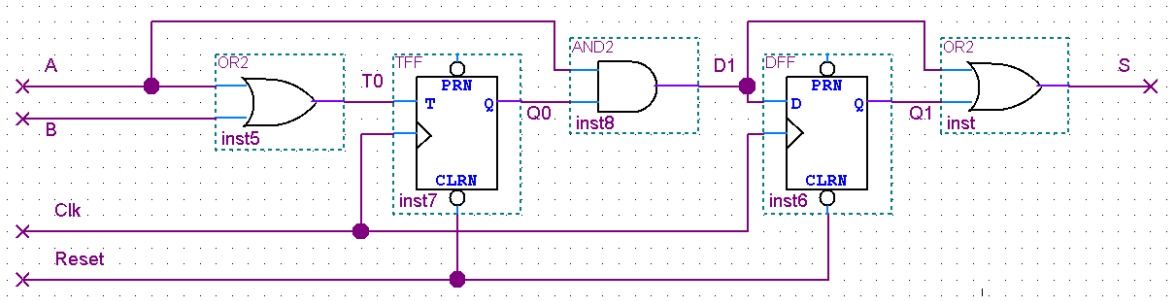
Question 1 (3 pt.)

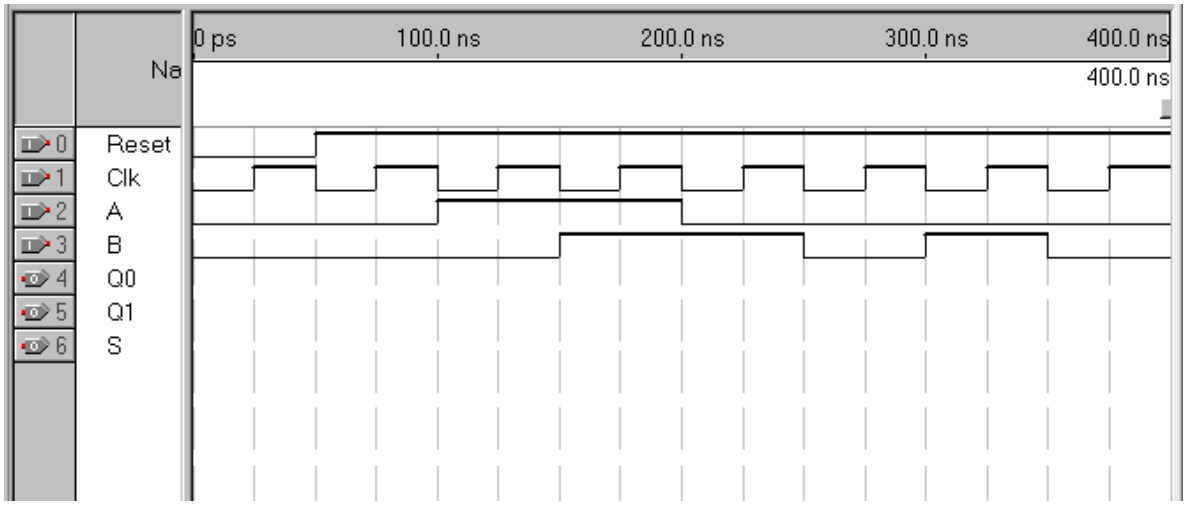
Given the following circuit:



a) Find the Boolean expressions for the State and Output Functions. Consider that A and B are the synchronous inputs, and S is the output of the circuit.

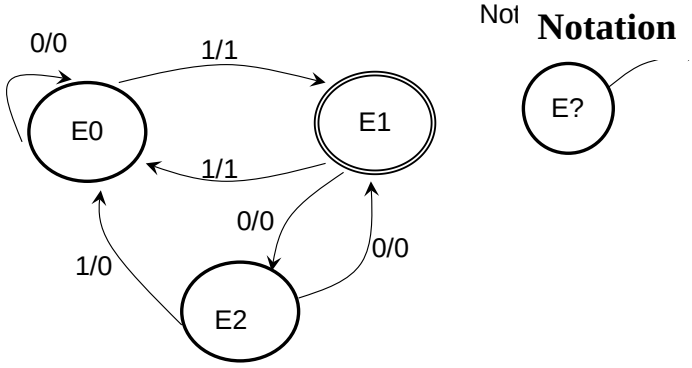
b) Is it Moore's, or is it Mealy's? Justify your answer.

c) Complete the following chronogram, using intermediate variables if necessary.



Question 2 (4 pt.)

Given the following STG, implement the corresponding synchronous sequential circuit, using D flip-flops.



a) Which are the inputs and outputs of the FSM?

b) Encode the states. Justify your decision on the number of flip-flops.

c) Write the transitions table

d) Find simplified expressions for the state and output functions

e) Draw the circuit with logic gates and D flip-flops.

Question 3 (3 pt.)

Design a sequential circuit for a remote opener of a garage door. In order to open the door, the remote should send a sequence of several encodings that has to be repeated cyclically. The remote has two switches S1 and S0 that can be used to select this sequence. Depending on S1 and S2, the sequence to send is:

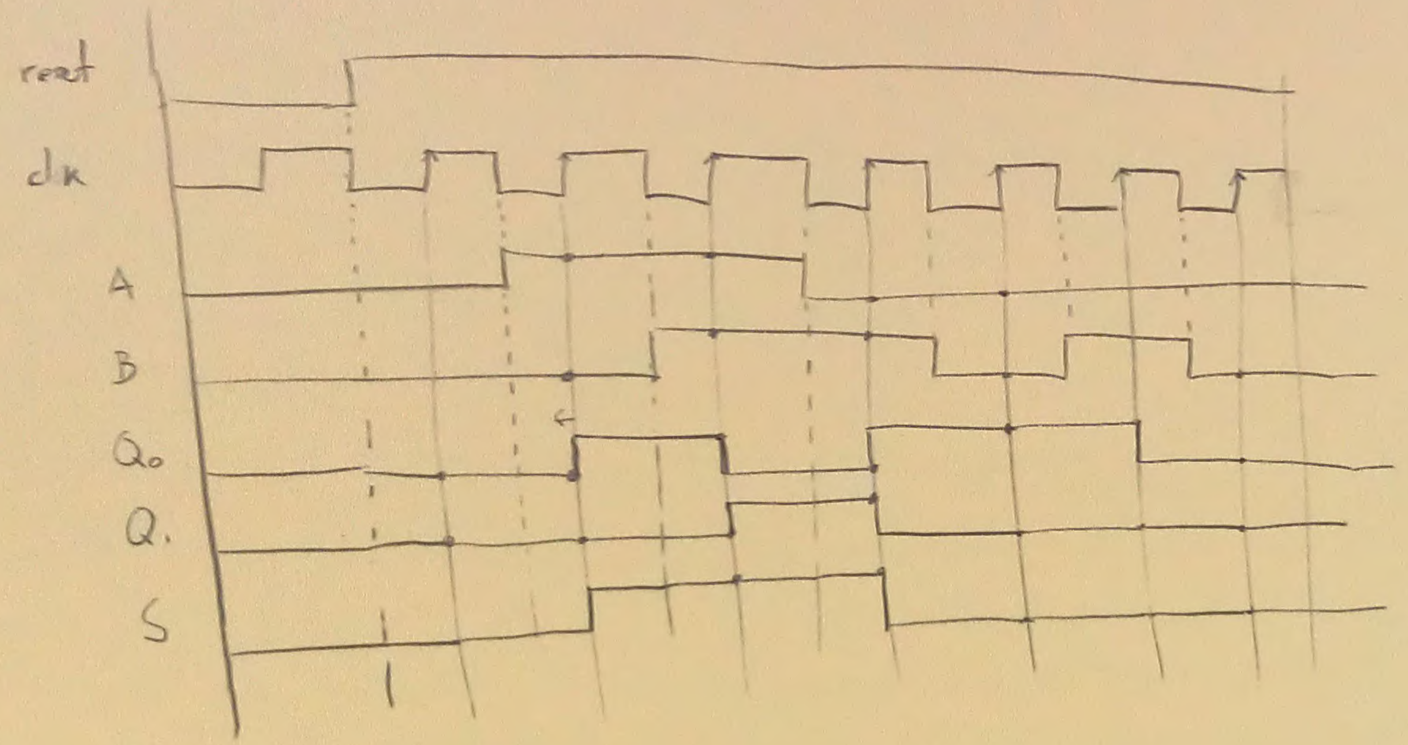
S1	S0	Sequence:
0	0	Binary counter: 00, 01, 10, 11, 00, 01, 10, …
0	1	Gray's code counter: 00, 01, 11, 10, 00, 01, 11, …
1	0	Ring counter: 01, 10, 01, 10, 01, …
1	1	Always zero: 00, 00, 00, 00, …

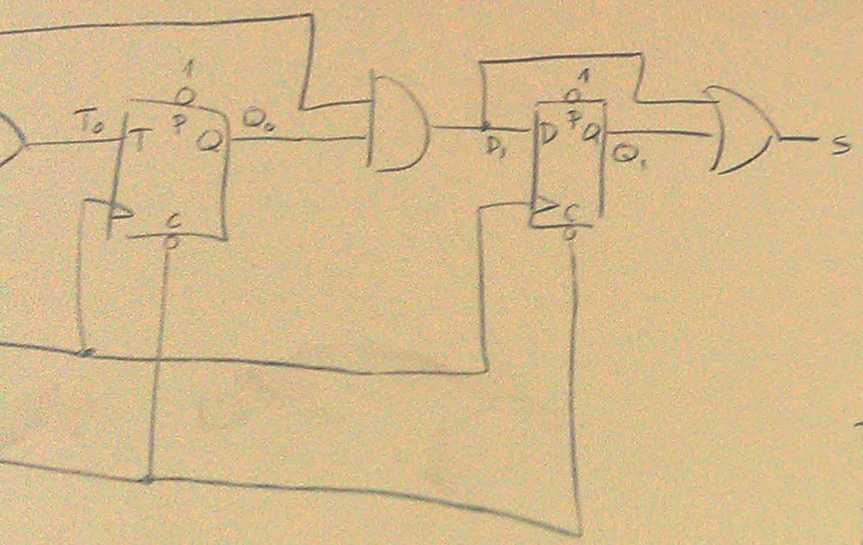
Draw the State Transition Graph of a **Moore's model** finite state machine for the functionality described before.

The different states, inputs and outputs of the system must be clearly indicated in the graph. **Consider the solution with the least possible number of states.**

function

$Q_1 + Q_0 A$





a) state functions

$T_0 = A + B$

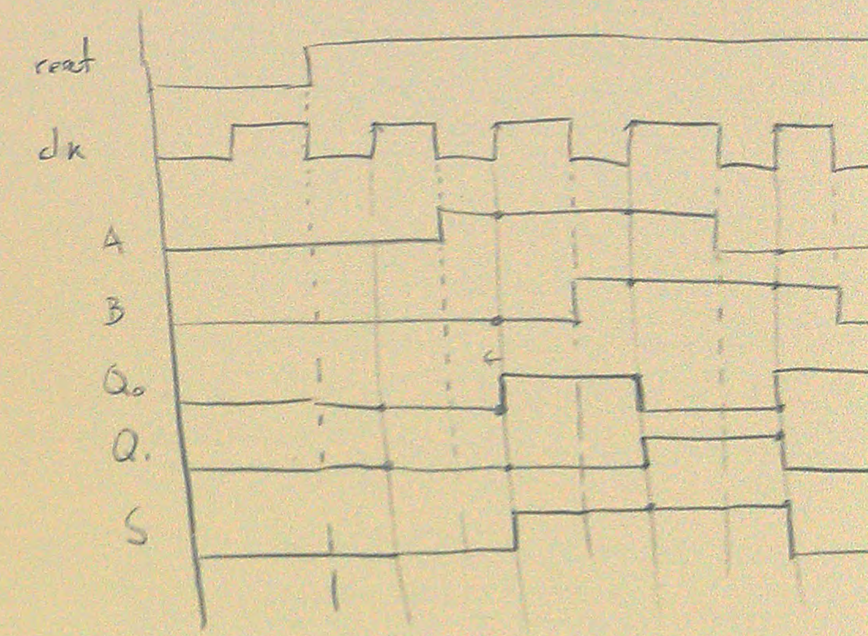
$D_1 = Q_0 A$

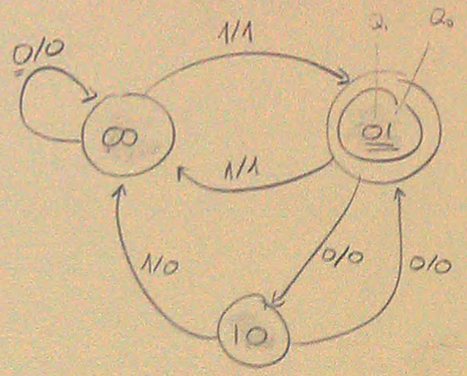
output function

$S = Q_1 + Q_0 A$

b) Mealy's

$T_0 = A+B$	0	1	1	1	0	1	0
$D_1 = Q_0 A$	0	0	1	0	0	0	0





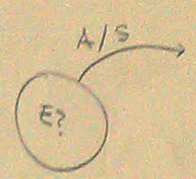
b)

	Q_1	Q_0
E_0	0	0
E_1	0	1
E_2	1	0

c)

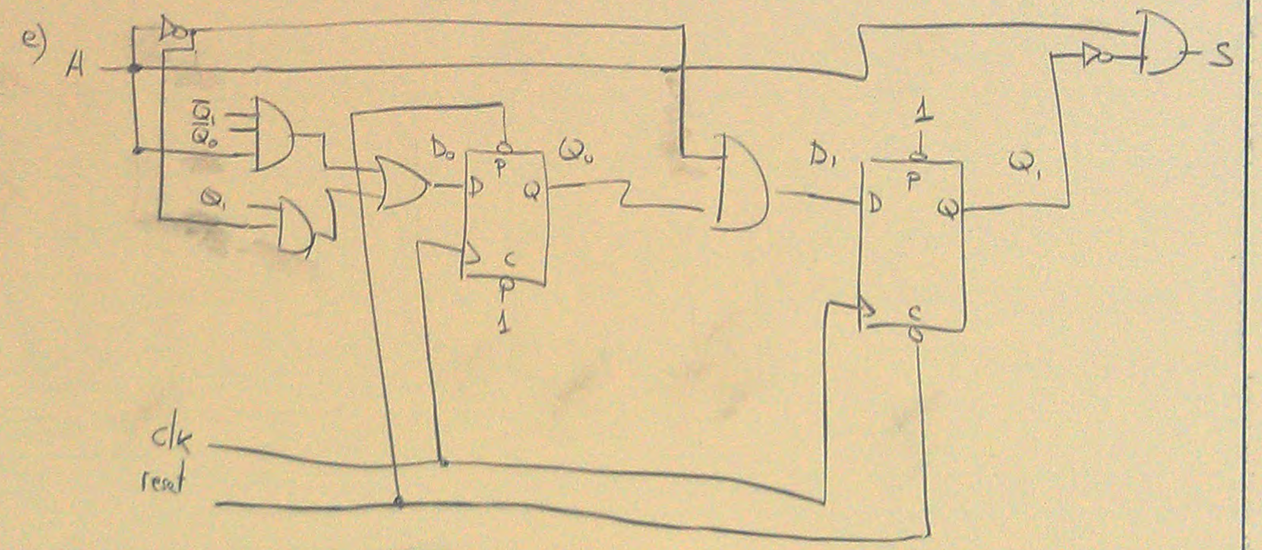
Q_1	Q_0	A	$D_1 = Q_1^+$
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	x
1	1	1	x

d)



A = Input
S = Output

e)



c)

Q_1	Q_0	A	D_1 = Q_1^+	D_0 = Q_0^+	S
0	0	0	0	0	0
0	0	1	0	1	1
0	1	0	1	0	0
0	1	1	0	0	1
1	0	0	0	1	0
1	0	1	0	0	0
1	1	0	X	X	X
1	1	1	X	X	X

d) $D_1 = Q_0\bar{A}$

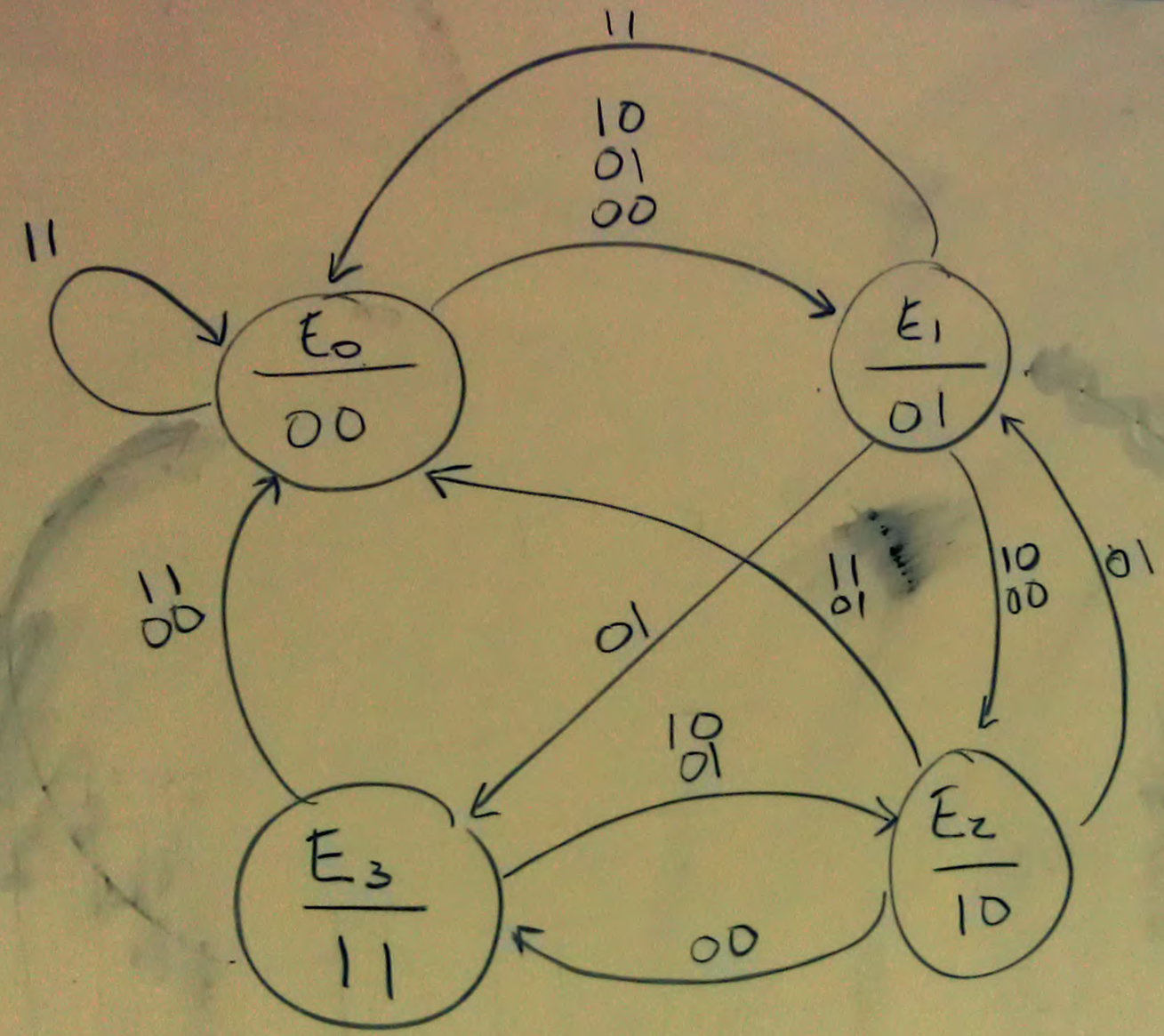
Q_1/Q_0A	00	01	11	10
0	0	0	0	1
1	0	0	X	X

$S = \bar{Q}_1 A$

Q_1/Q_0A	00	01	11	10
0	0	1	1	0
1	0	0	X	X

$D_0 = \bar{Q}_1\bar{Q}_0A + Q_1\bar{A}$

Q_1/Q_0A	00	01	11	10
0	0	1	0	0
1	1	0	X	X


11
10
01
00
11
E_0
00
E_1
01
11
00
01
11
01
10
00
01
10
01
E_3
11
E_2
10
00