FCO's Midterm Exam – Subjects 1 to 4

7th November 2016

LAST NAME: _____ FIRST NAME: _____

DNI: _____ Signature:

Normative:

- You have two hours to solve the exam.
- You must write your name using UPPERCASE.
- You must sign all the sheets of paper.
- You must write your answers in the assigned space.
- You are not allowed to use *calculators nor smart-phones*.
- You must remain silent during the exam.
- You must leave the classroom only when the teachers tell you
- You must have an identification card (DNI, carnet UPV, resident card, etc.)

1. **(1.0 points)** Given the positive integer number represented in BCD **A = 01000001 , 01110101$_{BCD}$**.

   You have to:

   a) (0.25 points) Write the corresponding value of number A in decimal format.

Integer part: **0100 0001 $_{BCD}$ = 41$_{10}$**
Fractional part: **0111 0101 $_{BCD}$ = 75 $_{10}$**

Answer: **41,75$_{10}$**

   b) (0.75 points) Write the corresponding represenattion of number A in hexadecimal format

41,75$_{10}$**= 101001 , 11 $_2$= 00101001 , 1100$_2$= 0010 1001 , 1100$_2$**
41,75 = 0x29,C

Answer: **0x29,C**

2. **(2 points)** It is desired to design part of the control system of a vehicle. The circuit is responsible of activating two binary signals: **C** and **A**. Both signals are high level activated. Signal N is used to turn on a Video Camera while signal **A** is used to activate an audible signal. The circuit under design has 4 high level activated input signals: **M, R. Vmin, and Vmax**. Signal **M** is active when the engine is turned on. Signal R is active when the vehicle is put in reverse. Signal **Vmin** is active when the speed of the vehicle is **lower than** a predefined minimal speed. Signal Vmax is active when the vehicle's speed is higher to the maximum speed allowed.

The circuit under design has to activate Signals A and C when the following criteria are met:

- The signal **C** must be active when i) the vehicle's engine is turned on, ii) the car is put in reverse and iii) the speed of the vehicle ***is lower than*** the minimal speed.
- The audible signal **A** must be active when the vehicle's engine is turned on and the speed of the vehicle is ***higher than*** the maximum speed.

You have to fulfill the truth table

Shown to the right:

Se desea diseñar una parte del circuito de control de un vehículo. El circuito será responsable de la activación de dos señales binarias, **C** y **A** cuya activación (a nivel alto) pondrá en funcionamiento una Cámara de vídeo y una Alarma sonora respectivamente. Para el diseño de dicho circuito se dispone de 4 señales de entrada binarias (activas a nivel alto) **M, R, Vmin y Vmax** respectivamente. **M** se activará cuando el vehículo esté con el motor encendido. **R** se activará cuando el vehículo tenga puesta la marcha atrás. **Vmin** se activará cuando la velocidad del vehículo sea inferior a una determinada velocidad mínima. **Vmax** se activará cuando la velocidad del vehículo sea superior a una determinada velocidad máxima.

El circuito a diseñar deberá generar como salida las señales C y A cuando se cumplan los siguientes criterios:

- La cámara se activará cuando el vehículo esté con el motor encendido, la marcha atrás esté conectada y la velocidad sea inferior a la velocidad mínima.
- La alarma se activará cuando el vehículo esté con el motor encendido y la velocidad sea superior a la velocidad máxima.

M	R	Vmin	Vmax	C	A
0	0	0	0	**0**	**0**
0	0	0	1	**0**	**0**
0	0	1	0	**0**	**0**
0	0	1	1	**X**	**X**
0	1	0	0	**0**	**0**
0	1	0	1	**0**	**0**
0	1	1	0	**0**	**0**
0	1	1	1	**X**	**X**
1	0	0	0	**0**	**0**
1	0	0	1	**0**	**0**
1	0	1	0	**0**	**0**
1	0	1	1	**X**	**X**
1	1	0	0	**0**	**0**
1	1	0	1	**0**	**1**
1	1	1	0	**1**	**0**
1	1	1	1	**X**	**X**

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3. (1.0 points) Given the following truth table you have to obtain the minimal expression as indicated:

D	C	B	A	S
0	0	0	0	X
0	0	0	1	0
0	0	1	0	1
0	0	1	1	X
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	x

a) (0,5 points) Using Karnaughs map you have to write the minimal equation of the signal **S**. You must minimize the equation using minterms (ones simplification).

DC/BA	00	01	11	10
00	X			1
01		1	1	
11	X	1	X	
10	1			1

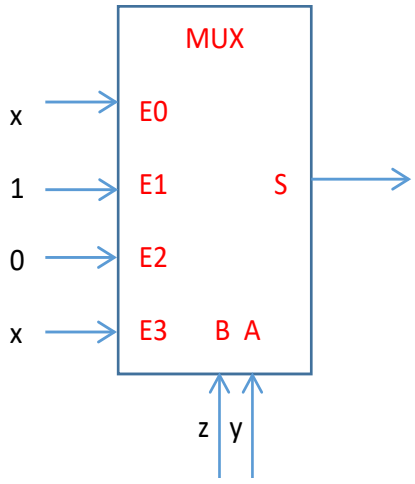
$$S = C \cdot A + \bar{C} \cdot \bar{A}$$

b) (0,5 points) Using Karnaughs map you have to write the minimal equation of the signal **S**. You must minimize the equation using maxterms (zeroes simplification):

DC/BA	00	01	11	10
00	X	0	0	
01	0			0
11	X		X	0
10		0	0	

$$S = (\bar{C} + A) \cdot (C + \bar{A})$$

4. (1,0 points) You have to write the truth table of the combinatorial circuit shown below**.** The circuit was designed using a MULTIPLEXOR (MUX). The selection inputs of the MUX are signals B and A. A corresponds to the LSB and B corresponds to the MSB. In order to write the truth table Signal Z is the MSB and signal x corresponds to the LSB.



z	y	x	S
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

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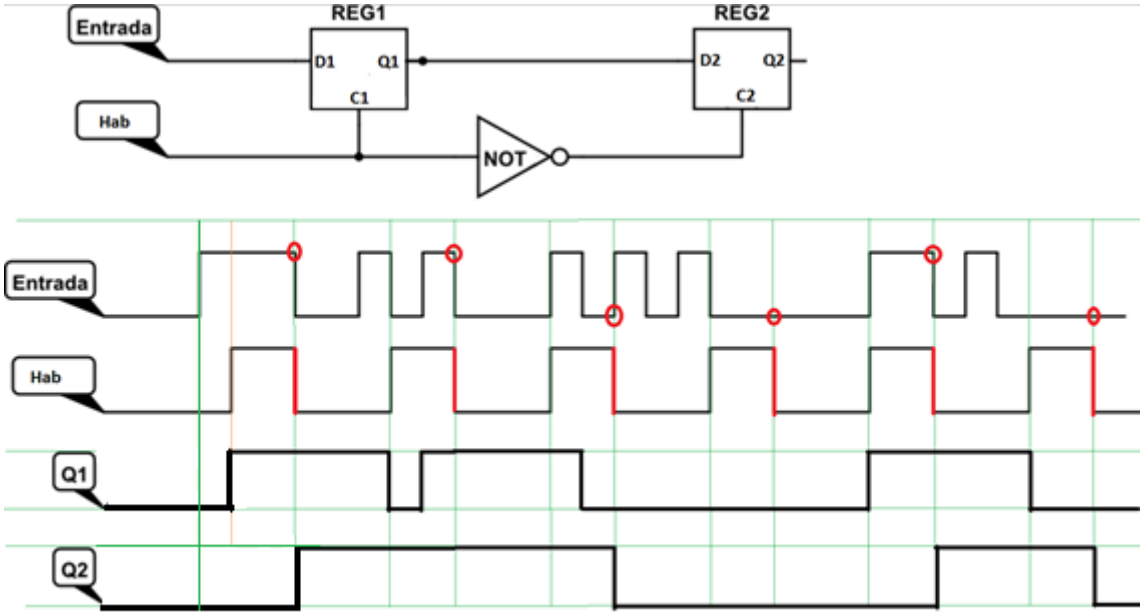
5. (1.0 points) You have to design a 3 to 8 binary decoder with low level activated enable input (**/G**). High level activated **selection inputs C, B**, and **A**. Selection Input C is the MSB while selection input A is the LSB. The 8 outputs (/S7, /S6, … , /S0) of the decoder are low level activated.

You dispose of three 2 to 4 decoders. Each one of the decoders has four low level activated outputs (/S3, /S2, /S1 and /S0), and a low level activated enable input (/G). The selection inputs B and A are high level activated, where B corresponds to the MSB.

For the design you must take in consideration that:

- Only one of the three decoders has an input **damaged** it must be clearly marked in the implementation.
- You have to label all the inputs and outputs. **The labelling must be made inside the interfaces**.

6. **(1,5 points) Given the following circuit.**
   a) **(1.0 points) You must complete the chronogram shown below the chronogram**



   b) **(0,5 points)** Complete the following phrase:

The circuit is an implementation of the D Flip-Flop triggered by _____falling_____ edge.

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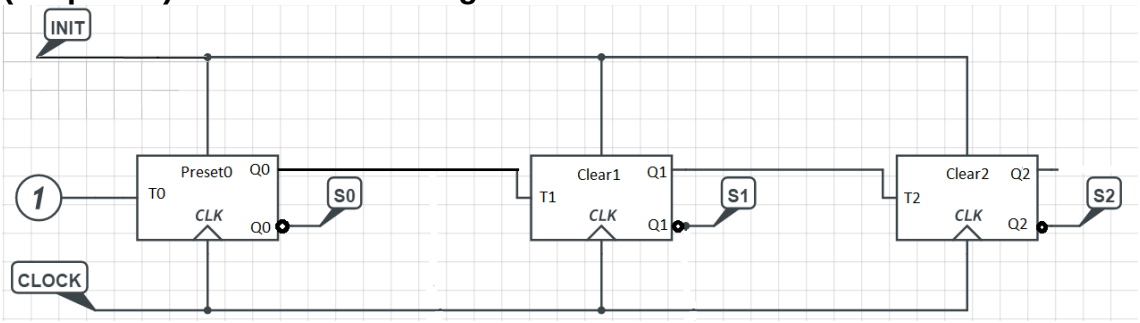
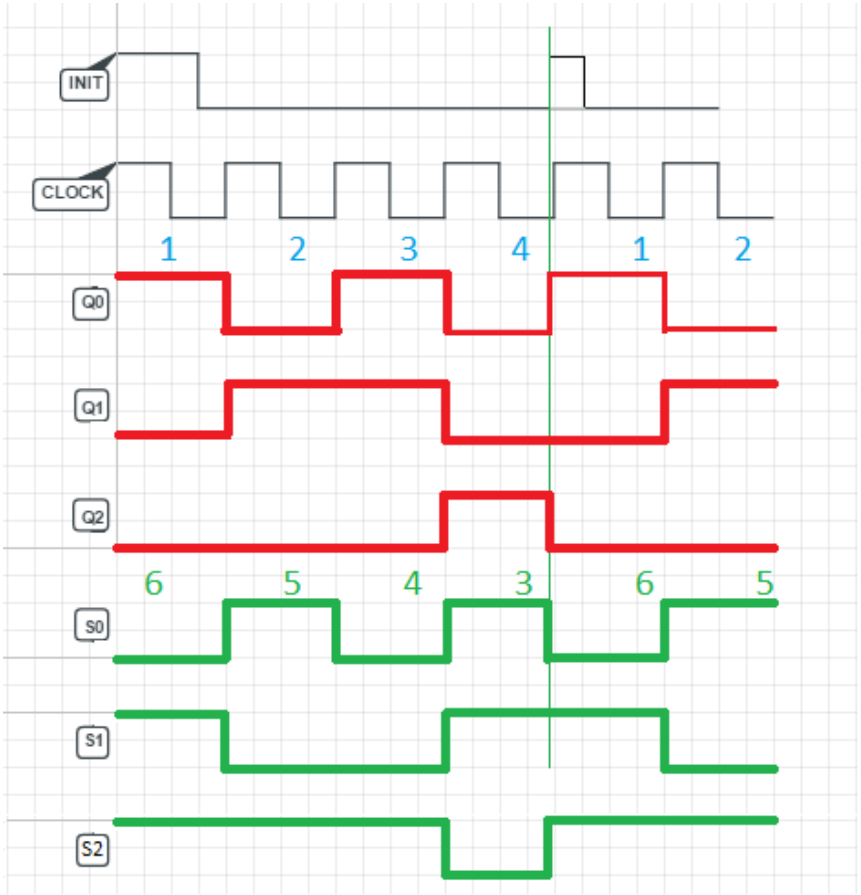
7. (2.5 points) Given the following circuit.



(1.5 Points) You have to complete the chronogram shown below



Based on the chronogram:

a) **(0.5 puntos)** Write the count obtained in the chronogram for the bits S2S1S0 where **S2 corresponds to the MSB and S0 corresponds to the LSB**:

Answer: 6,5,4,3,6,5

b) **(0.25 puntos)** Given that the output of the circuit is the set of bits S2 S1 S0, where **S2 corresponds to the MSB and S0 corresponds to the LSB**. The circuit is an up-counter or a down-counter?

Answer: __down-counter___

c) **(0.25 puntos)** When the INIT signal is active, what are the binary values of signals S2, S1 and S0?

Answer: S2= __1__ S1= _1__ y S0= _0__

What is the corresponding decimal value of the set of bits S2S1S0? (Remember that signal S2 corresponds to the MSB and S0 corresponds to the LSB)

Answer: ___6_____