Embedded Real-Time Systems (AME 3623)
Homework 2 Solutions

February 15, 2007

Question 1

1. (5pts) Given the binary number: 1101000. What is the decimal equivalent? Show your work.

   $64 + 32 + 8 = 104$

2. (5pts) Given the binary number: 101110. What is the decimal equivalent? Show your work.

   $32 + 8 + 4 + 2 = 46$

3. (5pts) Given the decimal number: 57. What is the binary equivalent? Show your work (all of the steps of the algorithm that we discussed in class).

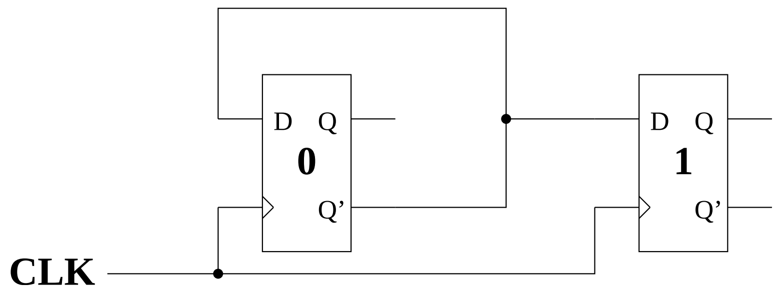
value	**binary**	i	2^i
57	000000		
		5	32
25	100000		
		4	16
9	110000		
		3	8
1	111000		
		0	1
0	111001		

4. (5pts) Given the decimal number: 119. What is the binary equivalent? Show your work.

value	**binary**	i	2^i
119	0000000		
		6	64
55	1000000		
		5	32
23	1100000		
		4	16
7	1110000		
		2	4
3	1110100		
		1	2
1	1110110		
		0	1
0	1110111		

Question 2

Consider the following circuit:



1. (10pts) Show the truth table that enumerates all possible states (the Qs) and shows the next state.

Q1	Q0	D1	D0
0	0	1	1
0	1	0	0
1	0	1	1
1	1	0	0

2. (10pts) Assuming that the initial state is $Q_1 = 0$ and $Q_0 = 1$, what is the sequence of states that the circuit moves through over the next four clock "ticks" (four high-to-low transitions)?

   $Q_1\, Q_0 = 01, 00, 11, 00, 11$

Question 3

Imagine a circuit with two flip flops (we will call their states Q_1 and Q_0). The circuit also has a control signal (C): when $C = 1$, the circuit will increment its state on the high-to-low clock transition (so the circuit is a counter); when $C = 0$, the circuit will not change state on the high-to-low clock transition.

1. (10pts) Give the truth table that expresses the behavior of this circuit.

C	Q_1	Q_0	D_1	D_0
0	0	0	0	0
0	0	1	0	1
0	1	0	1	0
0	1	1	1	1
1	0	0	0	1
1	0	1	1	0
1	1	0	1	1
1	1	1	0	0

2. (10pts) Show the minterm form of D_1

   $D_1 = \overline{C}Q_1\overline{Q_0} + \overline{C}Q_1Q_0 + C\overline{Q_1}Q_0 + CQ_1\overline{Q_0}$

3. (10pts) Show the reduced algebraic expression.

   $D_1 = \overline{C}Q_1 + C(Q_1 \oplus Q_0)$

4. (10pts) Show the minterm form of D_0

   $D_0 = \overline{C}\,\overline{Q_1}Q_0 + \overline{C}Q_1Q_0 + C\overline{Q_1}\,\overline{Q_0} + CQ_1\overline{Q_0}$

5. (10pts) Show the reduced algebraic expression.

   $D_0 = \overline{C}Q_0 + C\overline{Q_0}$

   OR

   $D_0 = C \oplus Q_0$

6. (10pts) Show the reduced circuit (include both the flip flops)