Nathaniel Daniel
12/10/2020

CPE 301 Final Exam

1. $<=$ is a non-blocking assignment while $=$ is a blocking assignment. Non blocking assignments are executed at the same time. Here:

   A. $= 1'b1$
   A $= 1'b0$
   B $= A$

   B will take on a value of $1'b0$ while here:

   A $= 1'b1$
   A $<= 1'b0$
   B $<= A$

   B will take on a value of $1b1$.

2. $*((volatile\ char\ *)\ 0X25)\ \&=\ 0b11101111;$

3. Error checking based on parity, counts the number of 1's or 0's in a serial transmission and checks to see if that number is even or odd based on the parity bits and current serial specification.

4.

   $T_W = \frac{1}{1200}$ s

   $T_{W/4} = \frac{1}{4800}$ s

   $T_{clk} = \frac{1}{16,000,000} = 0.0000000625$ s

   $\frac{T_{W/4}}{T_{clk}} = \frac{16,000,000}{4,800} = \frac{160000}{48} = \frac{20,000}{6} = \frac{10000}{3}$

   $65,536 - (\frac{10,000}{3} \cdot 3) = \boxed{55,536\ ticks\ high}$

   $65,536 - (\frac{10,000}{3}) = \frac{186,608}{3} = \boxed{62,226.3\ ticks\ low}$

   $\boxed{1X\ prescalar}$

5. The I^2C protocol includes an address field in its data packets. While the data is transmitted to all devices, only the

device with the correct address processes the message.
This way, one master can send data to many peripherals
using only 2 wires.

6.

Lowpass Filter:
Removes noisy, unrelated signals from the incoming
signal.

Sample and Hold:
Holds the current input constant so sampling
may be done without the signal changing.

ADC:
Convert the analog input signal into a digital
output.

Storage:
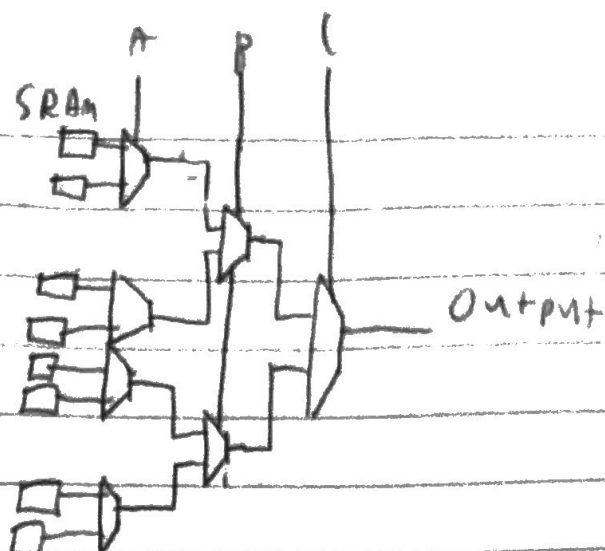Store the converted, digital value from the ADC.

DAC:
Convert the incoming digital signal into an analog
signal.

Reconstruction Filter:
Smooth the output analog signal to remove the
sharp "jumps" in the DAC output.

7.

A LUT works by using multiplexers and SRAM to implement a look up table that simulates a combinatorial circuit. Data is loaded into the SRAM above, providing the values for the Output. The data is looked up by using the A, B, and C lines which select data from the appropriate memory cell and output it.

8.
$$0 \times 33 DA$$
$$0b 0011 / 0011 / 1101 / 1010$$

D	C	B	A	F		D	C	B	A	F
0	0	0	0	0		1	1	0	0	1
0	0	0	1	1		1	1	0	1	1
0	0	1	0	0		1	1	1	0	0
0	0	1	1	1		1	1	1	1	0
0	1	0	0	1						
0	1	0	1	0						
0	1	1	0	1						
0	1	1	1	1						
1	0	0	0	1						
1	0	0	1	1						
1	0	1	0	0						
1	0	1	1	0						

$$F = D'C'B'A + D'C'BA + D'CB'A' + D'CBA' + D'CBA$$
$$+ DC'B'A' + DC'B'A + DCB'A' + DCB'A$$
$$F = DB' + A'CD' + ABC + AC'D'$$

CD\AB K-map:

CD\AB	00	01	11	10
00	0	0	1	1
01	1	0	0	1
11	1	0	0	1
10	1	1	1	0

9. mask: 0x40aa

$$F = A'BC + BD'$$

D	C	B	A	F	mask:
0	0	0	0	0	0/0100/0000/1100/1100
0	0	0	1	0	0x04 0x00 0xD9 0x09
0	0	1	0	1	
0	0	1	1	1	0x4099
0	1	0	0	0	
0	1	0	1	0	
0	1	1	0	1	
0	1	1	1	1	
1	0	0	0	0	
1	0	0	1	0	
1	0	1	0	0	
1	0	1	1	0	
1	1	0	0	0	
1	1	0	1	0	
1	1	1	0	1	
1	1	1	1	0	

10. Single-ended connections send signals with a reference to ground, while differential connections send signals over 2 wires, that reference each other. This makes differential signalling more robust and resistant to outside interference, but it requires more wires to send the same amount of data. While single-ended connections are more vulnerable to noise, they require less wires to implement and can be created with as few as 1 wire, while differential signalling requires at least 2 wires.

11. ISRs interrupt the currently executing code to execute a pre-specified subroutine when an event occurs. Polling manually checks whether an event occured in a loop. As a result, ISRs are a more efficient way to deal with events, as they do not block the CPU. However, writing correct ISRs is much more difficult than writing a similar correct polling implementation.

12. One failure might be the fan motor jamming. Another might be the water spilling on the internal circuitry. Jamming the motor could lead to circuit damage or a fire, and spilling water on the internal circuits might cause electrocution. Installers should be sure to house the system in waterproof casing, and consumers must be sure that the fan can spin unimpeded.