ECE3221 – Quiz # 3 **May 24, 2017** **Adam Wilson**

Name: ___SOLUTIONS____ Student #: _____ Signature: _____

Calculators not allowed. All programming questions relate to the NIOS II processor.

1. (1 mark) What binary instruction is generated by the assembler for the following instruction:

   add r2, r4, r8

   0b 00100 01000 00010 11000 1 00000 111010 / 0x2205883A

2. (1 mark) Use an assembler directive to tell the assembler to begin placing binary values at memory address 0x00001200.

   .ORG 0x00001200

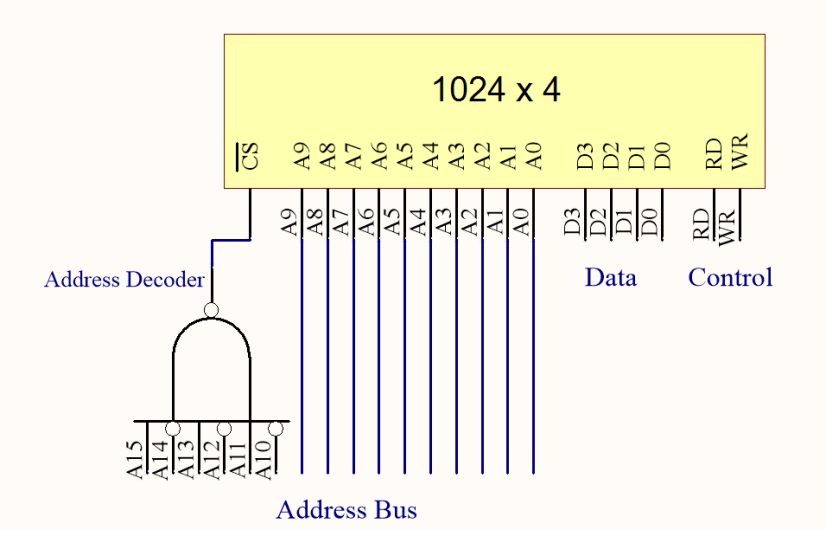
3. (2 marks) Explain why switch debouncing is necessary when interfacing real switches to digital circuits:

   A real switch tends to produce a less-than-ideal voltage signal as it is pressed and released. This results in multiple edges when a single edge is expected.

4. (3 marks) List the 3 pieces of information that must be provided to the CPU of a computer when giving an instruction in machine language or assembly language:

   Operation to be performed, **source** of operands, **destination** of result

5. (5 marks) Draw and label a block diagram of a single port **1024x4** read write memory chip. Ensure that the memory chip includes **an active low chip select line, all address lines, all data lines, a read line, and a write line**. The memory is to be interfaced to a system with a **16-bit address space (use a NAND gate to perform the address decoding)** and this block of memory is to span the address range **0xA800 to 0xABFF**.



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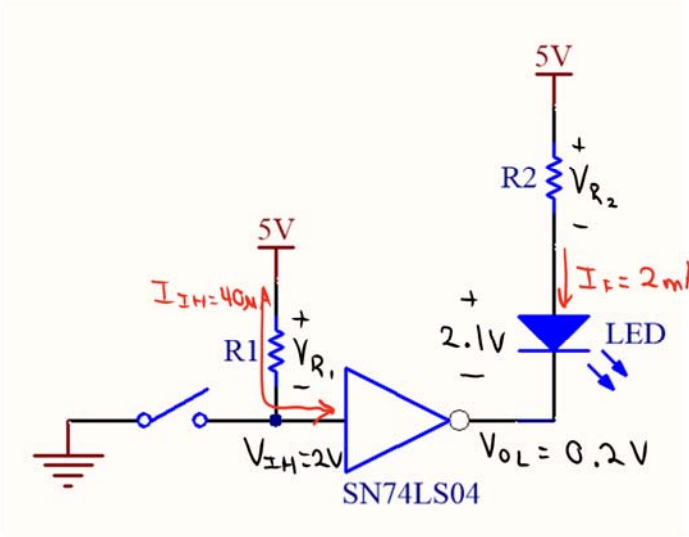
6. (4 marks) Use as many inverters as required from a SN74LS04 hex inverter such that when: a switch connected to an input of one of the inverters is opened, an LED connected to an output of one of the inverters turns on. A SN74LS04 hex inverter is an integrated circuit which contains 6 logic inverters (part of specification sheet is attached). The LED has a forward voltage drop of 2.1V and requires 2mA of forward current to be sufficiently bright in the on state. Power supply is 5V. **Bonus mark: Label appropriate resistance values of all resistors used.**



LED must be pulled low to meet I_F requirement (I_{OL}=16mA, ~~I_{OH}=0.4mA~~)

$V_{R_1 max} = 5V - 2V = 3V$

$R_{1max} = \frac{V_{R_1 max}}{I_{IH}} = \frac{3V}{40mA} = 75k\Omega$

$\therefore R_1 \leq 75\,k\Omega$

$V_{R_2} = 5V - 2.1V - 0.2V$

$V_{R_2} = 2.7V$

$R_2 = \frac{V_{R_2}}{I_F} = \frac{2.7V}{0.002A}$

$R_2 = 1.35\,k\Omega$