ECE3221 – Quiz # 4 **June 3, 2019** **Adam Wilson**

Name: ___SOLUTIONS___ Student #: _____ Signature: _____

Time limit: 30 min. Calculators not allowed. All programming questions relate to the NIOS II processor.

1. (4 marks) Complete the table below with the signed 8-bit binary values indicated.

Signed Decimal Value	Sign and Magnitude (8-bit)	2's Complement (8-bit)
+31	$0001\ 1111_2$	$0001\ 1111_2$
-31	$1001\ 1111_2$	$1110\ 0001_2$
+65	$0100\ 0001_2$	$0100\ 0001_2$
-65	$1100\ 0001_2$	$1011\ 1111_2$

2. (1 mark) A technique used to improve the efficiency of input (or output) operations of computer system by allowing writes (or reads) to (or from) memory directly without continual CPU interaction is called:

Direct Memory Access or DMA

3. (1 mark) This unit serves as the interface between the processor and the computer buses of a computer. It initiates read and write operations by manipulating the address and control lines. What is this unit called?

Control Unit

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4. (2 marks) Show the assembly language instruction(s) required to convert an ASCII character that is stored in r8 to uppercase.

andi r8, r8, 0xDF

5. (3 marks) When a subroutine is called from the main program code using the **call** instruction, the processor branches to the area of memory where the subroutine is stored by updating the program counter with the address of the subroutine. Explain how the processor is redirected to continue to execute the instructions that follow the call instruction in the main program code following completion of the subroutine. Discuss the instruction(s) required and the registers involved:

The **ret** instruction is placed at the end of the subroutine. This instruction takes return address (ra) (or r31) and places it back into the program counter. When the call instruction was executed, the value in the program counter (which was the address of the instruction immediately following the call instruction) was placed in ra.

6. (4 marks) Describe what the stack is in a computer program and how it may be used. List 2 common operations that are used to access the stack and describe the purpose of these operations.

The stack is a special section of memor set aside to serve as temporary storage.

The stack is available for temporary register storage.

The stack pointer register (sp) contains the address of the last value sent to the stack.

The PUSH operation is used to store a value contained in a register on the stack.

The POP operation is used to retrieve the last value stored on the stack and place that value in a register.