

Name: \_\_\_\_\_ Student #: \_\_\_\_\_ Signature: \_\_\_\_\_

All programming questions relate to the NIOS II processor

1. (4 marks) Using a conditional branch instruction, write the assembly code to repeat a block of code 5 times. The code needs to initially store a value in register r6 and then loop through decrementing that value and repeating the loop until the value in r6 is zero (include comments):

ori r6, r0, 5                      # r6 = 5 = loop counter

start: addi r6, r6, -1              # decrement counter

bne r6, r0, start                  # repeat while counter not zero

2. (4 marks) All of the available registers are being used by the main program, when a subroutine, **mysub**. The subroutine, **mysub**, changes the value stored in register r7. Write the assembly instructions required to ensure that r7 is restored to its original value after returning from **mysub**. Use comments to name the two operations used to “save” r7 before calling **mysub** and to restore r7 after returning from **mysub**.

addi sp, sp, -4                    # push r7

stw r7, 0(sp)

call    mysub

ldw r7, 0(sp)                    # pop r7

addi sp, sp, 4

3. (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.

Name: \_\_\_\_\_ Student #: \_\_\_\_\_ Signature: \_\_\_\_\_

4. (2 marks) Explain the difference between interrupts and polling.

Polling requires that an input be continually checked for a change in state and when that  
change in state is detected the software must perform the appropriate action.  
When an input that is associated with an enabled interrupt changes state, the hardware  
automatically redirects the software to execute instructions (interrupt service routine) stored at  
a specific area of memory.