Quiz 6, COE 233, Term 252 B

Student Name: _____ **ID#:** _____

In all the questions requesting a value write your answer in HEX or Decimal (but not in binary).

Q1) Consider the code below with text segment starting at **0x00400000**

```
.text
      li $v0 5
      syscall
      bltz  $v0, L
      add   $v0, $v0, $v0
      j     cont
L:    sub   $v0, $v0, $v0
cont:
```

a) What does the code do?

Input an integer, then
If the input is positive, it doubles it
If the input is negative, it is converted to 0

OR

Read x;
If (x>= 0) x=2x else x=0

b) What is machine code for the *bltz* instruction? (given that the op code for *bltz* instruction is 1 and $v0 is $2).

You need to find the offset first. (2 in this example)

Binary : 000001 00010 00000 0000 0000 0000 0010

In HEX : 0x04400002

c) What is machine code for j instruction ? (given that the op code for j instruction is 2)

You need to find the jump to address (**0x00400018 in this example)**
Then write the address in binary, then cut the required 26 bits needed in the machine code:
0000 0000 0100 0000 0000 0000 0001 1000

Th instruction in Binary : 000010 0000 0100 0000 0000 0000 0001 10

In HEX **: 0x08100006**

OR

You can convert shift the address 2 bis to the right: 0x00400018 >> 2 = 0x00100006
Then correctly concatenate that with the opcode to get the same result:

In HEX **: 0x08100006**

Q2) Consider the code below with text segment starting at 0x00400000

```
.text
        jal   init
        add   $t0   $0   $v0
        ## REST of the code
        ##
        ##
```

a) Given that the machine code for the instruction `jal init` is `0x0C100300`, determine the address of the label `init`.

The machine code in binary: `0000 1100 0001 0000 0000 0011 0000 0000`

Extract the 26-bit the first 26 bits: `00 0001 0000 0000 0011 0000 0000`

Concatenate the 26 bits with `00` to the right and the last 4 bits of the current PC (`0000` in this example)

So, The New 32 bits address: `0000 00 0001 0000 0000 0011 0000 0000 00`

`init` **Address in HEX:** `0x00400C00`

b) What is value stored in $31 as a result of executing the *jal* instruction?

0x00400004 (The address of next instruction)

c) According to the MIPS calling convention, which specific register must be saved on the stack before a subroutine calls another function (nested call)?

$ra ($31)

d) If you need to save a total of four 32-bit registers onto the stack, how must the stack pointer ($sp) be adjusted? Write the single MIPS assembly instruction required to allocate this space.

addi $sp, $sp, -16

e) Suppose the value of register **$k1** was previously saved on the stack using the address `sp+4`. Write the MIPS instruction required to retrieve that value and load it into register **$a1**.

lw $a1 4($sp)