**Name:**

Note: Please post your homework to ICS232 D2L on or before the due date.

**Chapter 4 – MARIE: An Introduction to a Simple Computer**

**Essential Terms and Concepts**

4. Where are registers located and what are the different types?

They are located on the processor, “scratchpad”, index registers, stack pointer registers, flag registers, and general purpose registers (text page 335-336)

10. What is a bus cycle?

The time between two ticks of the bus clock (text page 340)

17. Explain the difference between memory-mapped I/O and instruction-based I/O.

Memory-mapped – the registers in the interface appear in the computer’s memory map, and there is no rea difference between accessing memory and accessing an I/O device. (text page 346)

Instruction-based – the COU has specialized instructions that perform the input and output. (text page 346)

20. Why is address alignment important?

The machine wouldn’t be able to read from memory or it wouldn’t be efficient for the machine to read from memory.

21. List and explain the two types of memory interleaving and the differences between them.

Low-Order Interleaving – the low-order bits if the address are used to select the bank.

High-Order interleaving – the high-order bits of the address are used.

The difference are the bits that are used to designate where the Module number vs the Offset in module.

33. How does interrupt driven I/O work?

The fetch-decode-execute cycle is interrupted when and I/O request is triggered. The system handles the interrupt then returns to the cycle after the interrupt latency time has passed.

38. What is a stack? Why is it important for programming?

A data structure that maintains a list of items that can be access from only one end, in this context its required to allow parameters.

**Exercises**

1. What are the main functions of the CPU?

Fetching program instructions, decoding each instruction that is fetched, and performing the indicated sequence of operations on the correct data.

2. How is the ALU related to the CPU? What are its main functions?

Carries out the logic operations required during the program executing, it lives on the CPU and is controlled by signals from the control unit.

5. How many bits are required to address a 4M × 16 bits main memory if

a) Main memory is byte-addressable?

23 bits

b) Main memory is word-addressable?

22 bits

13. A digital computer has a memory unit with 24 bits per word. The instruction set consists of 150 different operations. All instructions have an operation code part (opcode) and an address part (allowing for only one address). Each instruction is stored in one word of memory.

a) How many bits are needed for the opcode?

8 bits

b) How many bits are left for the address part of the instruction?

16 bits

c) What is the maximum allowable size for memory?

196,608 bytes

d) What is the largest unsigned binary number that can be accommodated in one word of memory?

16,777,215

21. Explain why, in MARIE, the MAR is only 12 bits wide while the AC is 16 bits wide.

Hint: Consider the difference between data and addresses

The job each component done is fundamentally different. The MAR holds memory addresses where the AC stores (temporarily) the results from operations, the larger bits allows for better precision.

27. Write the assembly language equivalent of the following MARIE machine language

instructions:

a) 0111000000000000 – Load 0

b) 1011001100110000 – Store 768

c) 0100111101001111 – Add 1951

29. Write the following code segment in MARIE's assembly language:

if (X > 1) {

Y = X + X;

X = 0;

}

Y = Y + 1;

Load 0

Subt 1

Skipcond 000

Jump continue

Load 0

Add 0

Load 0

Store 0

Load 1

Add 1

Store 1

33. Write the following code segment in MARIE assembly language:

X = 1;

while (X < 10) {

X = X + 1;

}

Load 0

Store 0

Add 1

Store 0

Load 0

Skipcond 000

Jump

Load 0

Add 1

Store 0

**Prepare for next class by continuing to read Chapter 4 – MARIE: An Introduction to a Simple Computer.**

**Start working on Your Group Project**

**Start working on Project 1**