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| Instructor | ***Prof. Papademas*** | Due Date |  |

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| Part | **1** | **2** | **3** | **4** | Total |
| *Maximum Points* | **25** points | **25** points | **25** points | **25** points | **100**G101010 pointsG |
| ***Your Score*** |  |  |  |  |  |

**Textbook Reading Assignment**

Thoroughly read Chapter(s) 4 in your Computer Architecture and Organization textbook.

**Part 1 Glossary Terms - Computer Hardware Specifications**

Define, in detail, each of these glossary terms from the realm of computer architecture and computer topics, in general. If applicable, use examples to support your definitions. Consult your notes

or course textbook(s) as references or the Internet by visiting Web sites such as:

[**http://www.bing.com**](http://www.bing.com) or [**http://www.webopedia.com**](http://www.webopedia.com/)

**(a) ALU ( Arithmetic Logic Unit )**

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| The ALU is the component of a CPU that handles arithmetic and comparison operations. Within an ALU is an accumulator, which is a register that holds data for processing in the ALU. Data is read from the memory buffer register into the accumulator, which is then read from by the ALU, where arithmetic or comparisons take place. Output from the ALU goes into the memory buffer register, which can then be read by an output’s address (e.g., a device to display the result of the arithmetic operation). |

**(b) Assemblers**

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| Assembly language is a symbolic representation of binary numbers (machine code). Assemblers convert this symbolic language into machine code by reading a source file (assembly program) and producing an object file (machine code). |

**(c) Buses**

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| A bus is a set of wires that act as a shared data path to connect subsystems in a larger system. In a CPU, a bus is used to share data between different components within a CPU (accumulator, ALU, memory buffer register, program counter, etc.), and in a computer, a bus is used to communicate between the CPU and other components within a computer (RAM/Main memory, I/O devices, memory storage, etc.).   A handshaking protocol as is used to coordinate operations on a bus, since a data path can only be in use by one component at a time. |

**(d) Clocks**

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| Clocks are electric pulses through a circuit that regulate how quickly instructions can be completed and synchronize components in a system. It is essentially an oscillation of high/low voltage measured by hertz (oscillations per second), e.g., 800 Megahertz (or 800,000,000 alternations per second frequency, with a 1.25 nanoseconds period).   Components within a system expect a certain number of “ticks” of the clock to complete instructions, this way, flow of control can be kept in sync within a system. Also, the minimum clock period must be greater than or equal to the maximum propagation delay of a circuit (i.e., the clock can’t be so fast so as to outpace the time it takes to run through an entire circuit, or else we’ll have race conditions / unreliable machine state).   Clocks can be “stepped” through or slowed down considerably when designing or troubleshooting circuitry. |

**(e) Control Unit**

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| The control unit is the “traffic manager” of the CPU, and uses a program counter register to find the next instruction for execution and a status register to track overflows, carries, borrows, etc., from computations. |

**Part 2 Exercises - Computer Hardware Specifications**

For each of the following, select the correct answer.

**(1)** Suppose the RAM for a certain computer has 256M words, where each word is 16 bits long. What is the capacity of this memory expressed in bytes?

(a) 2 30 (b) 2 29 **(c) 2 20** (d) 2 27 (e) 2 10

**(2)** A flip - flop circuit is also known as a(n) \_\_\_\_\_\_\_\_\_\_ .

**(a) Eccles - Jordan switch** (b) unlatching relay

(c) mercury switch (d) uni - polar switch

**(3)** Modern computer clock speeds are measured in \_\_\_\_\_\_\_\_\_\_ .

(a) gigabytes (b)millions of pulses per second

(c) millions of pulses per minute **(d) billions of pulses per second**

**(4)** Assemblers and compilers usually translate a source program into machine instructions contained in what type of file?

(a) include file (b) binary file

**(c) object module**  (d) hidden file

**(5)** A register is a(n) \_\_\_\_\_\_\_\_\_\_ .

(a) a part of the processor that performs an operation

(b) a part of the processor that keeps a log of operations

(c) the part of the operating system that oversees what programs are selected for execution

**(d) a part of the processor that holds a bit pattern**

**Part 3 Exercises - Computer Hardware Specifications**

Mix and Match

Match the definition on the left with the most appropriate definition on the right.

**(1)** **(F)** fetch, decode (a) assists in improving interoperability

**(2)** **(D)** computer architecture (b) the physical aspects of a computer system

**(3)** **(I)** PCI (c) the brain of the computer

**(4)** **(A)** RAM (d) the logical aspects of a computer system

**(5)** **(H)** bus (e) commands the CPU is designed to understand

**(6)** **(G)** clock speed (f) tasks performed by the control unit in the CPU

**(7)** **(C)** CPU (g) measured in cycles per second

**(8)** **(B)** computer organization (h) allows the flow of data and program instructions

**(9)** **(E)** instruction set (i) slots near the CPU to connect other devices

**(10)** **(J)** hardware standards (j) an important consideration when buying a computer

**Part 4 Exercises - Computer Hardware Specifications**

Write a complete answer for each of these.

**(1)** What are the main functions of the CPU?

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| The main functions of the CPU are to fetch and decode program instructions, and to process and delegate those instructions to different parts of the computer system as well as within the CPU itself. |

**(2)** How is the ALU related to the CPU ? What are its main functions?

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| The ALU executes arithmetic and comparison instructions delegated to it by the CPU. In-process values and addresses are kept within the accumulator, and read to/from the ALU via a memory buffer as operations are carried out. |

**(3)** Explain what the CPU should do when an interrupt occurs. Include in your answer the method the CPU uses to detect an interrupt, how it is handled, and what happens when the interrupt has been serviced.

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| CPU’s detect interrupts via user or system input, and when they are detected the CPU looks up the appropriate routine to handle the interrupt in an interrupt vector table, which is essentially a list of addresses of the appropriate routines to be executed when an interrupt is detected. After acknowledging the interrupt, it is then processed and once the routine for servicing the interrupt is completed, control is then passed back to the point where the interrupt occurred, and the program continues its execution (unless another interrupt is encountered). |

**(4)** 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?

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

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| 1. 8 bits are needed for the opcode. Because there are 150 different operations, we need a bit length that produces >= 150 possible combinations. Because 2^7 < 150 and 2^8 is >= 150, 8 bits are required for the opcodes in this instruction set architecture. 2. 16 bits are left over for instruction addresses. |