

**Ankara University**  
**Computer Engineering Department**  
**COM3076 / COM376 Computer Architecture Midterm**

**Name-Surname:**

**Number:**

**Signature:**

**Duration:** 120mins.

**Note:** The questions will be answered by only using the techniques discussed in the classes.

**Good luck!**

**QUESTIONS**

**1. (10 points)** Answer the following questions considering modern computers.

**a. (5 points)** List the four main structural components of a computer.

1.	
2.	
3.	
4.	

**b. (5 points)** List the four major structural components of a processor.

1.	
2.	
3.	
4.	

**2. (25 points)** Answer the following questions considering performance optimization approaches used in modern computers.

**a. (10 points)** Briefly define the following approaches used to improve performance in terms of processing power:

<b>Pipelining</b>	
<b>Branch prediction</b>	
<b>Data flow analysis</b>	
<b>Speculative execution</b>	

**b. (10 points)** Compute the average CPI (cycles per instruction) and MIPS (million instructions per second) rate for a 800MHz processor for the following table of instruction statistics for a given program.

Instruction Type	CPI	Instruction Mix (%)
Arithmetic and logic	1	65
Load/store with cache hit	2	15
Branch	4	15
Memory reference with cache miss	8	5

<b>Average CPI</b>	
<b>MIPS</b>	

**c. (5 points)** Imagine that you have implemented an algorithm in a program which has 40% parallelizable code. Now consider the following two cases assuming that scheduling overhead is ignored:

- The program is executed on a single processor.
- The program is executed on a parallel system with 4 processors.

Compute the speed-up gained in the case where multiple processors are used.

**3. (5 points)** What are the two approaches for handling multiple interrupts?

1.	
2.	

**4. (5 points)** Define the two approaches used by different modules for gaining control over the bus (bus arbitration).

1.	
2.	

**5. (20 points)** Describe the following methods of accessing data stored in memory units. You also need to give an example for each method to get a full mark.

<b>Sequential access</b>	
<b>Direct access</b>	
<b>Random access</b>	
<b>Associative</b>	

**6. (25 points)** Answer the following questions considering memory hierarchies.

**a. (5 points)** Why does data tend to cluster in the memory system? What are the two main reasons that result in such clusters?

**b. (5 points)** How does the hit ratio affect the access time for the memory system?

**c. (5 points)** What is the difference between SRAM and DRAM?

**d. (5 points)** Assume that you have a memory system with two levels. Level 1 has an access time of  $0.01 \mu\text{s}$  and level 2 has an access time of  $0.1 \mu\text{s}$ . What will be the average access time if the 90% of the memory accesses are found in level 1?

**e. (5 points)** How many check bits are required for Single-Error-Correction and Double-Error-Detection (SEC-DED) when the data word size is 32bits when Hamming method is used for error checking?

**7. (10 points)** You are given a main memory of 64Mbytes with each byte addressable and asked to design a cache memory using direct mapping. The main memory is organized as blocks of 8bytes. The cache memory must have a size of 512Kbytes.

**a. (5 points)** How many lines do you need to use in the cache memory?

**b. (5 points)** What should be the size of the tag in bits?