Computer Engineering Department
COM376 / BLM376 Computer Architecture Midterm

Name-Surname:
Number:
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:

Pipelining	
Branch prediction	
Data flow analysis	
Speculative execution	

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

Average CPI	
MIPS	

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:
  i. The program is executed on a single processor.
  ii. 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.

Sequential access	
Direct access	
Random access	
Associative	

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 μs and level 2 has an access time of 0.1 μs. 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?