Note: You can give the answers in English or Swedish.

1. Describe the basic components of a computer and the main functions of each of these components. Discuss also how these components work together to execute instructions.

    (2 p)

2. What is the function of each the following registers in the CPU? Explain why it is useful to have each of them, respectively.

    a) Instruction register (IR)

    b) Program counter (PC)

    c) Accumulator register (AR)

    (3 p)

3. a) Why is memory access the bottleneck of a computer?

    b) Describe two different methods to increase the bandwidth of the main memory.

    (3 p)

4. a) What is the basic idea of associative mapping for cache organization? What are the advantages and disadvantages of the associative mapping organization?

    b) Why is the fully associative cache organization seldom used in practical computers? Which cache organization is commonly used? Why?

    (3 p)

5. a) Explain how a hard disk works and discuss its main features.

    b) Give a short definition of seek time, rotational delay, read/write time, and data/transfer rate for a disk-based device.

    c) Explain why a hard disk has much better performance in all the measurements given above, when compared with a floppy diskette.

    (4 p)

6. a) What does it mean by interrupt-driven I/O? What are the advantages and disadvantages of this technique?

    b) Define the concept of multiple interrupts? What are the two main approaches used to handle multiple interrupts?

    (3 p)

Note: You can give the answers in English or Swedish.

7. a) What is an assembler?

    b) What are the main tasks performed by an assembler?

    (2 p)

8. a) Why is instruction pipeline widely used in a modern computer?

    b) In general, a larger number of pipeline stages gives a better performance. However, this has not led to the situation that we have a huge number of pipeline stages. Why?

    (3 p)

9. a) What are the main characteristics of a superscalar architecture? You should provide at least two of them.

    b) Why do we have a "commit" mechanism in a superscalar architecture? How does this mechanism work?

    (3 p)

10. a) Identify all the different types of data dependencies in the following code. Indicate the type of dependency you have identified for each one, and give the reasons for your answers.

```
L1: move r3,r4         Note: r3 <- r4
    load r8,(r3)       Note: r8 <- memory location pointed by r3
    add r4,r3,4        Note: r4 <- r3 + 4
    load r9,(r4)       Note: r9 <- memory location pointed by r4
    ble r8,r9,L1       Note: branch to L1 if r8 <= r9
```

    b) Which of the identified dependencies can be eliminated? How?

    (3 p)

11. What are the two main techniques for control unit implementation? Describe briefly how these two techniques work, respectively.

    (3 p)

Note: You can give the answers in English or Swedish.

12. Describe Flynn's classification of computers. Give briefly the definition of each alternative architecture class and an example of each class. Draw a block diagram to illustrate each architecture example you have given.

(3 p)

13. What is a symmetric multiprocessor system? What are its main characteristics?

(2 p)

14. What are the basic features of CICS and RISC computers, respectively? Discuss the differences between the RISC and CISC machines, and the arguments for each of these two different computers.

(3 p)