# Practice Exam in Computer Organization, 2DT901

*Instruction set: LEGv8 in all tasks*
*Total score: 50 credits*

*Grade F: 0–19, Grade E: 20–25, Grade D: 26–32,*
*Grade C: 33–38, Grade B: 39–44: Grade A: 45-50*

1. Convert the following numbers to hexadecimal form.
   a. $10010111_2$
   b. $11101_2$
   c. $133_{10}$                                                     3p

2. Calculate the subtraction 1101 – 1001 by using the two-complementary method.                                               2p

3. Below is a simple LEGv8 Assembly program. What number is stored in register X1 after the program has finished? Give the answer as a **hexadecimal number**!

   MOVZ X1, #10
   MOVZ X2, #20
   ADD X1, X1, X2
   LSL X1, X1, #3                                               2p

4. Translate the following bit patterns into LEGv8 Assembly instruction.
   a. 11010010100000000000010000100001
   b. 11010010100000000000001011000010
   c. 11001011000000100000000000100001                          3p

5. Explain the fundamental differences between the von Neumann and Harvard architectures.                                        3p

6. Explain why data is often presented in hexadecimal and not binary form!                                                       2p

7. Three fundamental components of a microprocessor are ALU, Registers and Buses (Data bus, Address bus, Control Bus). Explain the purpose of these three components.                   3p

8.  A logic function is defined by the following truth table:

| A | B | C | Y |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

    a.  Use a Karnaugh map to find the simplest Boolean expression for the function. (2p)

    b.  Draw a logic diagram that implements the function. (2p)

9.  The code below shows a simple LEGv8 program.

```
MOVZ        X1, #5
MOVZ        X2, #10
loop:
        ADDI        X1, X1, #5
        SUBIS       X2, X2, #2
        B.GE        loop
```

    a.  Which number is stored in X1 after the program finishes? Give your answer in decimal form. 2p

    b.  How many times does the loop repeat? Explain your answer! 2p

    c.  Why is the instruction SUBIS and not SUBI used? 1p

10. In the following program, four numbers are inserted into registers.

```
        MOVZ        X0, #17
        MOVZ        X1, #23
        MOVZ        X2, #15
        MOVZ        X3, #18
```

    a.  Write a subroutine that takes the four registers X0, X1, X2, X3 and return their average number, with return value in register X0. 3p

    b.  Call the subroutine from the main program. 2p

    c.  How is the Link Register (LR) used when subroutines are called? 2p

11. When subroutines are called within subroutines, the Link Register must be saved on the stack before subroutine calls. Explain why!

2p

12. What is virtual memory, and how does it help in managing limited physical memory in a computer system?

3p

13. A very large hexadecimal number can not be inserted into a register using the MOVZ instruction. For example, the instruction MOVZ X1, 0x3f4c01 fails when the program is translated to machine code.

Write a LEGv8 program that solves this problem!  2p

14. When adding an immediate value to a register, the instruction ADDI can be used, in the form ADDI Xn, Xn, #IMMEDIATE, for example ADDI X1, X1, #12. What number is the largest possible immediate number possible in this instruction? You have to **motivate your answer**!

2p

15. Find the error in the following LEGv8 program:
```
MOVZ      X1, #11
MOVZ      X2, #2
SUB       X1, X1, #4
SUB       X1, X1, X2
```
3p

16. Write a LEGv8 program that calculates the sum $1^2+3^2+5^2+…99^2$

4p