Machine Structure 1 Examination

Duration: 90 minutes

It's strictly prohibited to use the calculator.
For exercise 3, question 4, answer directly on the provided exam document.

Exercise 1

In this exercise, numbers will be represented in 8 bits.

1. Code the decimal numbers in binary: **32** and **122**. (1pt)

2. Code the integers **(+122)** and **(-32)** in 1's complement and in 2's complement. (2pt)

3. Calculate, in binary, the addition of the two decimal numbers **122** and **(- 32)**. (1pt)

4. Can the result of adding the two numbers **(-122)** and **(-32)** be represented in sign and absolute value using 8 bits? If so, why? If not, what are the limitations ? (1pt)

Exercise 2

The coding of a real number in floating point is done according to the IEEE 754 -32 standard:

$$(-1)^S \times (1,M_n) \times 2^E$$

- S: the sign bit.

- E: the exponent represented in 8-bit (coded with excess 127).

- M_n: the mantissa normalized to 23 bits.

1. What are the smallest and largest decimal values for the exponent ? (1pt)

2. Code the following real numbers according to the IEEE standard 754-32: **(-17,75)** and **(+21,05)** (2pt)

3. Convert to decimal the binary number (1 10000100 10010100000000000000000) representing a sequence of bits coded according to the IEEE 754-32 standard. (2pt)

Exercise 3

1. Simplify algebraically the following equation E = (a+c+d) (b+c+d) and give its circuit with

minimum of gates. (2pt)

2. Express $a \oplus b$ in the **second canonical** form. (1pt)

3. When does $(a \oplus b \oplus c) + (a \oplus c) = 0$? (1pt)

4. Provide the simplified function while clearly showing the grouping in the Karnaugh table:(2pt)

Student ID	Full Name	Group

ab \ cd	00	10	11	01
00	0	0	0	0
10	1	1	1	1
11	0	1	1	0
01	0	1	1	0

F_1 (a,b,c,d) = ……....

ab \ cd	00	10	11	01
00	1	0	1	1
10	0	0	0	0
11	0	0	0	0
01	1	1	0	1

F_2 (a,b,c,d) =……

ab \ cd	00	10	11	01
00	0	0	1	0
10	0	1	1	0
11	0	1	1	0
01	0	1	0	1

F_3 (a,b,c,d) =……

ab \ cd	00	10	11	01
00	1	1	1	0
10	1	0	1	0
11	1	0	1	0
01	1	0	1	1

F_4 (a,b,c,d) =……..

Exercice 4 (4pts)

Create a logic circuit to check whether a four-digit (a,b,c and d) binary number is prime .

Good Luck