

**Machine Structure 1 Resit Exam**

**Full Name:** .....

Duration: 90 minutes

**Group:** .....

*It's strictly prohibited to use the calculator.*

**Exercice 1: Numeral systems**

**Q1:** Convert the following numbers to the corresponding format: (0,5x6)

	Corresponding value in decimal	
$(15)_8 =$		
$(111.01011)_2 =$		
	Corresponding value in binary	
$(42,4)_{16} =$		
$(15,5)_8 =$		
$(35,25)_{10} =$		
	1' Complement	2' Complement
$(1\ 0001011)_{SVA} =$		

**Q2:** Determine the bases in which the following numbers are expressed: (0,5x3)

Base (x)	Base (10)	X
34	22	
1110101	117	
13	7	

**Q3:** Perform the following operations: (0,5x3)

	Result
$(1011.1101)_2 + (11.1)_2 =$	(.....) <sub>2</sub>
$(91B)_{16} + (6F2)_{16} =$	(.....) <sub>16</sub>
$(340)_5 - (32)_5 =$	(.....) <sub>5</sub>

**Q4:** Find the solution to the following riddles: (2pt)

- I am a number that looks the same in base 2 and base 10. Who am I?
- I am a palindrome in base 2 and an odd number in base 10. What is the smallest number can I be?
- I am a prime number in base 10. In base 6, I have only one digit. What number am I in base 10?

**Q5:** Code the following real numbers according to the IEEE standard 754-32: (2pt)

	Sign	Exponent	Mantissa
$(-6.25)_{10}$			
$(+12.125)_{10}$			

**Q6:** We have two numbers A and B represented in three positions as follows: (2pt)

$$A = (a_3 a_2 a_1)_5 ; B = (b_3 b_2 b_1)_7$$

1. What are the possible values for the coefficients  $a_i, b_i$ ?
2. Knowing that  $A + B = (138)_9$ ,  $A - B = (200)_6$ , Find the values of the coefficients  $a_i, b_i$ .

**Exercice 2: Boolean Algebra (8pt)**

A post office manager with three counters (A, B, C) wants to optimize the work of his employees based on the number of waiting people.

To achieve this, he wants to design a circuit that meets the following conditions:

- If the number of people is between 1 and 10, counter A is open.
- If the number of people is between 11 and 20, counters A and C are open.
- If the number of people is greater than 20, all counters are open.

Questions:

1. Determine the input variables and explain the meaning of each.
2. Establish the corresponding truth table.
3. Simplify the output functions using Karnaugh maps.
4. Provide the corresponding circuit with a minimum number of logic gates.

**Good Luck.**