Final Exam S1
Computer Architecture

Duration: 1 hr. 30 min.

Last name: .... First name: .... Group: ....

Write answers only on the worksheet.
Do not show any calculation unless you are explicitly asked.
Do not use a pencil or red ink.

Exercise 1 (2 points)

Convert the following numbers from the source form into the destination form. Do not write down the result in a fraction or a power form (e.g. write down 0.25 and not ¼ or 2 $^?$).

Number to Convert	Source Form	Destination Form	Result
110111011.01101	Binary	Decimal	
A34.68	Hexadecimal	Decimal	
528	Decimal	Base 5	
375.25	Base 8	Hexadecimal	

Exercise 2 (5 points)

Perform the following 8-bit binary operations (the two operands and the result are 8 bits wide). Then, convert the result into unsigned and signed decimal values. If an overflow occurs, write down 'ERROR' instead of the decimal value.

Operation	Binary Result	Decimal Value	
		Unsigned	**Signed**
10010111 - 10101101			
01010010 + 11001101			
00110110 - 10111100			
10010001 - 10000010			
01000111 + 01001100			

Exercise 3 (6 points)

For the whole exercise, the variables from *S1* to *S6* can be either 0 or 1. Complete the Karnaugh maps below (circles included) and give their most simplified expressions. **No points will be given to an expression if its Karnaugh map is wrong.**

1. Let us consider *N*, a 3-bit binary number (*C, B, A*). *A* is the least significant bit.
   - S1 = 1 when N = 1, 3, 4, 5
   - S2 = 1 when N = 0, 2, 4, 5, 6, 7

BA

	S1	00	01	11	10
C	0				
	1				

S1 =

BA

	S2	00	01	11	10
C	0				
	1				

S2 =

2. Let us consider *N*, a 4-bit binary number (*D, C, B, A*). *A* is the least significant bit.
   - S3 = 1 when N = 0, 1, 2, 3, 4, 5, 6, 7, 9, 11, 13, 15
   - S4 = 1 when N = 0, 1, 4, 6, 8, 9, 12, 14
   - S5 = 1 when N = 5, 7, 13, 15 and S5 is undefined when N = 0, 2, 8, 10
   - S6 = 1 when N = 2, 6 and S6 is undefined when N = 0, 1, 4, 5, 8, 9, 12, 13

BA

	S3	00	01	11	10
DC	00				
	01				
	11				
	10				

S3 =

BA

	S4	00	01	11	10
DC	00				
	01				
	11				
	10				

S4 =

BA

	S5	00	01	11	10
DC	00				
	01				
	11				
	10				

S5 =

BA

	S6	00	01	11	10
DC	00				
	01				
	11				
	10				

S6 =

Exercise 4 (7 points)

For the whole exercise, write down the result only (do not show any calculation).

Let us consider the two following expressions:

$S1 = (A + \overline{B} + C).(A + \overline{C}).(\overline{A} + \overline{B})$

$S2 = \overline{A}.\overline{(A + BC)}.(A.D + C) + \overline{A}.C$

1. Give the most simplified expressions of *S1* and *S2*. **The result must be given as a sum of products (without parentheses)**.

$S1 =$

$S2 =$

2. Write down the minterm canonical form of *S1*.

$S1 =$

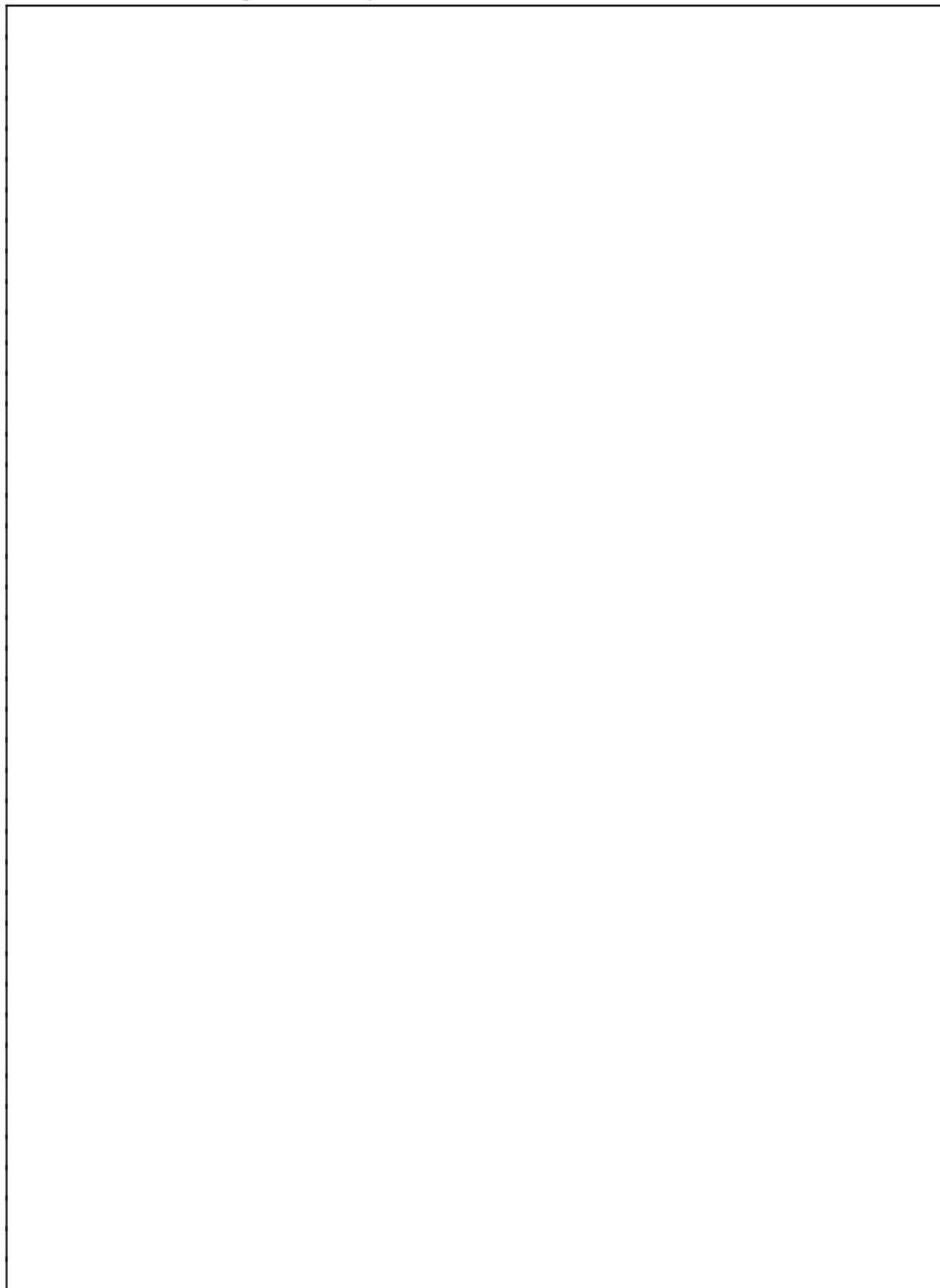3. Write down the maxterm canonical form of *S1*.

$S1 =$

4. If *A = 1*, give the most simplified expression of *S1*.

$S1 =$

5. Simplify the following expression by using the EXCLUSIVE-OR operator: $A + B.C.D + B.\overline{C}.\overline{D}$

6. Simplify the following expression by using the EXCLUSIVE-OR operator: $B.C + \overline{A}.B + A.\overline{B}.\overline{C}$

Feel free to use the blank space below if you need to: