

March 25, 2006

COMPUTER ENGINEERING DEPARTMENT

COE 202

FUNDAMENTALS OF COMPUTER ENGINEERING

Major Exam I

Second Semester (052)

Time: 7:30-9:30 PM

Student Name : _____

Student ID. : _____

Question	Max Points	Score
Q1	25	
Q2	18	
Q3	12	
Q4	20	
Q5	25	
Total	100	

Dr. Aiman El-Maleh

[25 Points]

(Q1) Indicate whether the following is true or false, and if it is false **correct** it:

(1) (True, False) The hexadecimal number $(421)_{16}$ is equal to the octal number $(841)_8$.

(2) (True, False) The binary number $(1110.0111)_2$ is equal to $(14.875)_{10}$, $(E.7)_{16}$ and $(16.7)_8$.

(3) (True, False) The 16's complement of the hexadecimal number $(B120)_{16}$ is $(4EE0)_{16}$ while the 15's complement is $(4ED0)_{16}$.

(4) (True, False) Assuming 6-bit representation of numbers, the binary number 111010 is equal to +58 in sign-magnitude representation, -5 in 1's complement representation, and -4 in 2's complement representation.

(5) (True, False) The decimal number 2048 can be represented as an unsigned number in 11 bits.

(6) (True, False) Assuming 5-bit 1's complement representation of numbers, then $11011 + 01001$ is equal to 00101 .

(7) (True, False) Assuming 6-bit 2's complement representation, the range of numbers that can be represented is -63 to $+63$.

(8) (True, False) Assuming 8-bit 2's complement representation of numbers, then $E6 + 9A$ produces overflow i.e. it produces incorrect result.

(9) (True, False) The result of the following addition operation $(AA)_{16} + (13)_{16}$ is $(123)_{16}$.

(10) (True, False) The result of the following unsigned multiplication operation $(A15)_{16} * (8)_{16}$ is $(50A8)_{16}$.

[18 Points]

(Q2) Prove the identity of each of the following Boolean functions using algebraic manipulation. Start with the left-hand side expression and derive from it the right-hand side expression. *Clearly indicate the postulates and theorems used.*

(i) $(a + b)(a' + c)(b + c) = a'b + ac$

$$(ii) \{ [b + (a + c) + a(c+d)][d + b^2] \} = b(a + c) + d(b + c)$$

[12 Points]

(Q3) Given the function $F(A, B, C) = A + B \bar{C}$

- (i) Determine the minterms of the function F and express it as an algebraic sum of minterms.
- (ii) Determine the maxterms of the function F and express it as an algebraic product of maxterms.

(Q4) Consider the function $F(A, B, C) = \prod M(3, 5)$.

- (i) Simplify the function into a minimal sum-of-products expression.
- (ii) Simplify the function into a minimal product-of-sums expression.
- (iii) Implement the function using only **2-input NAND** gates and **Inverters**, with minimal number of gates. Draw the circuit diagram for your implementation.
- (iv) Implement the function using only **2-input NOR** gates and **Inverters**, with minimal number of gates. Draw the circuit diagram for your implementation.

[25 Points]

(Q5) Simplify the following Boolean functions **F** together with the don't care conditions **d**, into minimal sum-of-products expressions. Identify all the prime implicants and the essential prime implicants.

(i) $F(A, B, C, D) = \sum m(0, 6, 7, 9, 11, 13, 15)$, $d(A, B, C, D) = \sum m(2, 5, 8, 10)$

		CD			
		00	01	11	10
AB	00	1	0	0	X
	01	0	X	1	1
	11	0	1	1	0
	10	X	1	1	X

(ii) $F(A, B, C, D, E) = \sum m(0, 1, 2, 3, 4, 6, 10, 11, 14, 17, 18, 21, 22, 25, 26, 27, 29, 30)$

A=0

		DE			
		00	01	11	10
BC	00	1	1	1	1
	01	1	0	0	1
	11	0	0	0	1
	10	0	0	1	1

A=1

		DE			
		00	01	11	10
BC	00	0	1	0	1
	01	0	1	0	1
	11	0	1	0	1
	10	0	1	1	1