Student ID: _____

ICS 151
Quiz 5

Name : _____ , _____
(Last Name) (First Name)

Student ID : _____

Signature : _____

Instructions:

1. Please verify that your paper contains **4 pages** including this cover.
2. Write down your Student-Id on the top of each page of this quiz.
3. This exam is **closed book**. No notes or other materials are permitted.
4. Total credits of this quiz are **50 points.**
5. To receive credit you must show your work clearly.
6. **No re-grades will be entertained if you use a pencil.**
7. Calculators are **NOT** allowed.

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Q1: Function Minimization [30 points]

Consider function F with the following equation:

F (a,b,c,d) = a'b'c'd' + a'bc'd' + a'bc'd + abcd + abcd' + ab'cd' + ab'c'd'

Assuming that abcd = 0011 never happens in the input (so you can regard it as don't care situation):

a. **Fill the following K-map table (5 points)**

ab \ cd	00	01	11	10
00	1 m_0	0 m_1	X m_3	0 m_2
01	1 m_4	1 m_5	0 m_7	0 m_6
11	0 m_{12}	0 m_{13}	1 m_{15}	1 m_{14}
10	1 m_8	0 m_9	0 m_{11}	1 m_{10}

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b. Identify Prime Implicants and Essential Prime Implicants. (15 points)

Prime Implicants:

$m_4 + m_5 = a'bc'$

$m_0 + m_4 = a'c'd'$

$m_0 + m_8 = b'c'd'$

$m_8 + m_{10} = ab'd'$

$m_{10} + m_{14} = acd'$

$m_{14} + m_{15} = abc$

Essential Prime Implicants:

$m_4 + m_5 = a'bc'$

$m_{14} + m_{15} = abc$

c. Using the K-map table in 1(a), write the minimized equation for function F. (10 points)

Minimized equation = Essential Prime Implicants + non-Essential Prime Implicants

$$= \left[(m_4 + m_5) + (m_{14} + m_{15})\right] + \left[(m_4 + m_0) + (m_8 + m_{10})\right]$$

$$= a'bc' + abc + a'c'd' + ab'd'$$

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Q2: Size-Delay trade off [20 points]

Show the trade-off in delay vs. size for the circuit representing function F.

F(a,b,c,d,e,f) = abcd + cdef + abe

You can use the following gate library showing costs for different gates:

Gate	Cost
2-input AND	4
3-input AND	6
2-input OR	4
3-input OR	6