Institution	**China Jiliang University**
Semester:	**WS 2013/14**
Course:	**Digital Design**
Homework No. 1:	**Number Systems, Boolean Algebra, Sequential Logic**

1 Number Systems, Boolean Algebra, Sequential Logic

1.1 Convert the following decimal numbers to binary (by division / multiplication):

673.23
10000
2013

1.2 Find the 1's and 2's complements of the following 8-digit binary numbers:

10101110
00000001
00000000

1.3 Perform the subtraction with the following unsigned binary numbers by taking the 2's complement of the subtrahend:

11010 - 10000
1010100 - 1010100

1.4 Describe the Venn-Diagrams for the Boolean functions "NOR" and "NAND"

1.5 How many ternary Boolean operations exist?

1.6 Use truth tables to show the validity of the following identities:

$$\overline{a \cdot b \cdot c} = \bar{a} + \bar{b} + \bar{c} \quad , \quad a + b \cdot c = (a + b) \cdot (a + c)$$

1.7 Simplify the following Boolean expressions using K-maps:

$$a\,b + \bar{a}\,\bar{b}\,\bar{c} + \bar{a}\,b\,\bar{c} \quad , \quad f(a,b,c,d) = \sum(2,3,10,11,12,13,14,15)$$

1.8 Draw a logic diagram using only two-input NAND gates to implement the following expression:

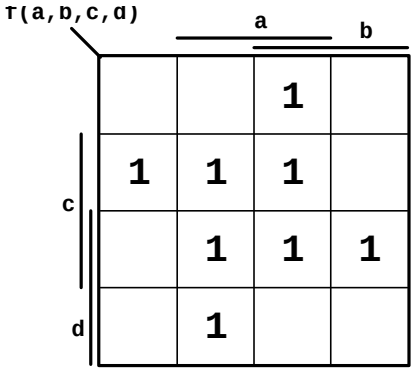
$$(a\,b + \bar{a}\,\bar{b})\,(c\,\bar{d} + \bar{c}\,d)$$

1.9 Use a K-map to simplify the following Boolean function f(a,b,c,d) under the indicated don't-care condition d(a,b,c,d) into sum of products form (SOP) and product of sums form (POS):

$$f(a,b,c,d) = \sum(0,1,2,3,7,8,10)$$
$$d(a,b,c,d) = \sum(5,6,11,15)$$

1.10 Simplify the following K-map forming implicants.

a) Indicate which are the essential prime implicants.



b) Determine the simplified Boolean function in SOP- and POS-form:

$$f(a,b,c,d)_{SOP} =$$
$$f(a,b,c,d)_{POS} =$$

c) Show how to implement this function using a

- 4- to 16-line decoder,
- 4-line to 1-line multiplexer,
- PAL device,
- PROM device.

1.11 Determine the signals Q_A and Q_B when clock is applied to the following circuit.