



EXAM I

110 MINUTES

WORK ALL PROBLEMS

OPEN BOOK

(25 pts)

1) Consider the following expression :

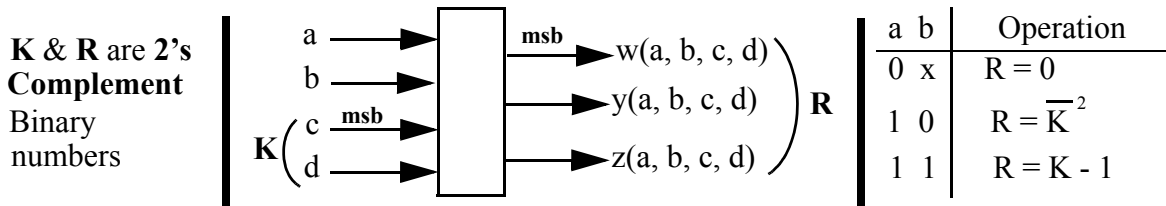
$$f(a, b, c, d) = (ac + \bar{a} + \bar{a}\bar{c} + d + \bar{d}\bar{b} + \bar{a}d + \bar{a}\bar{b}\bar{c}\bar{d})(\bar{a}\bar{b} + \bar{c}d + \bar{a}bcd + \bar{b}\bar{c})$$

(i) Simplify the expression to obtain the **minimal SOP** expression by using **Switching Algebra** as shown in class.

(ii) Then, draw the corresponding minimal 2-level **AND-OR** gate network, by assuming **single-rail** inputs as shown in class.

(30 pts)

2) Consider the following combinational circuit with **four** inputs and **three** outputs :



$$\begin{array}{r}
 (A\ 5)_{\text{Hex}} \leftarrow \text{Hex coded} \\
 + \quad 1110\ 1110 \\
 \hline
 ?
 \end{array}$$

Without using a calculator, perform the 8-bit **2's Complement Binary addition** as shown in class. Make observations on the overflow. Then, convert the result to a decimal number as shown in class.

Note again that **both** numbers above are 2's Complement Binary numbers and the first number is shown in *Hex-coding*.

(20 pts)

4) Consider the **Ppm** term project. The graph of the playing strategy of an imaginary machine player is as follows :

Play on the (rightmost) largest regular reward position (directly if equal)

Consider the following table that shows the random digit, position displays **before** and **after** the **machine** player plays, whether the random digit is played directly or added, the number of adjacencies, the points earned by the **machine** player and whether the machine player plays again :

| RD | Displays Before Play PD3 PD2 PD1 PD0 | Displays After Play PD3 PD2 PD1 PD0 | D/A | The Adjacency | Points Earned (Decimal) | Machine player plays again ? |
|----|---|--|-----|---------------|-------------------------|------------------------------|
| 5 | A 5 5 2 | | | | | |
| 4 | 8 4 4 C | | | | | |
| 7 | E 7 7 E | | | | | |
| 0 | F F F C | | | | | |
| 1 | 7 1 7 1 | | | | | |

You can complete the table on this sheet

Write your name on this sheet

Assume that the code is **8C**.

The meaning of **D/A** is Direct/Add which is whether the machine player plays the random digit **directly** on a position or by **adding** to a position. A **circle** is drawn on a position if it is played on. Note that the cases are **independent** of each other. That is, they do not necessarily follow each other with respect to time.

Work on the rows.