國立中山大學九十八學年度第二學期資工系數位系統期中考試

學號：　　姓名：

一、選擇與是非題（每題 3 分，15 分）

(　　) 1. 下列何者錯誤？①在 2's-complement 表示式中，可將減數(subtrahend)取 2's complement 後與被減數相加即可以加法取代減法，但 carry out of sign-bit position 必須捨棄　②gray code 中任意連續兩個數碼之間的 distance 必定等於 1 ③若將 parity bit 加在左邊，則 ASCII T=1010100 的 odd parity 為 11010100 ④sign-magnitude 表示式 1111011_2 代表 -58_{10}。

(　　) 2. 下列何者錯誤？①product of maxterms is canonical form ②$F(x, y, z) = y' + zy + x'yz'$ is standard form ③ $F(w, x, y, z) = wx + y(z+w)$ is standard form ④product of sums is standard form。

(　　) 3. 下列何者錯誤？① $x+yz = (x+y)(x+z)$ ② $x(x'+y) = xy$ ③$(x \oplus y)' = x'y + xy'$ ④$x \oplus y = y \oplus x$.

(　　) 4. 對於 Boolean algebra 而言，$x+(y \cdot z) = (x+y) \cdot (x+z)$成立而且・的 identity element 為 0。

(　　) 5. 對於 three-bit message x, y, z 而言，假如 parity bit $P = x \oplus y \oplus z$ 且 parity check $C = x \oplus y \oplus z \oplus P$，則 $C = 1$ 代表奇數個資料位元發生錯誤。

二、問答題（85 分）

1. (1) Find the two's complement of the following binary number: 10001111　(5%)
(2) Use De Morgan's law to derive the complement of the following Boolean function:　$F(x, y, z) = xy + y(x'+z)$,　$F' = ?$　(5%)

2. (1) Derive the sum-of-minterms and the product-of-maxterms canonical forms for Boolean function $F(w, x, y, z) = (w+x+y'+z)(w'+x'+z)(y+z)$.　(10%)
(2) Using the Karnaugh map to find the simplest sum-of-products and product-of-sums of this Boolean function.　(10%)
(3) Implement the function $F(w, x, y, z)$ with NAND-NAND logic, draw the logic diagram.　(10%)

3. Using the Karnaugh map to find all the simplest sum-of-products of Boolean function $F(v, w, x, y, z) = \sum m(0, 1, 3, 7, 8, 9, 11, 14, 15, 16, 17, 19, 24, 25, 27, 30)$.　(12%)

4. Derive the truth table, the simplified Boolean functions, and draw the logic diagram of the following circuits.
(1) Design the half adder (inputs: x, y and outputs: C, S) with XOR gate.　(6%)
(2) Design the full adder (inputs: x, y, z and outputs: C, S) with two half adders (with XOR gate) and an OR gate.　(8%)

5. Design the carry lookahead generator of a 4-bit carry lookahead adder with inputs $A = A_3A_2A_1A_0$ and $B = B_3B_2B_1B_0$, and outputs $S = S_3S_2S_1S_0$ and C_4.
(1) Let carry propagate $P_i = A_i \oplus B_i$ and carry generate $G_i = A_iB_i$, then sum $S_i = P_i \oplus C_i$ and carry $C_{i+1} = G_i + P_iC_i$, where $0 \le i \le 3$. Please derive the Boolean functions of C_1, C_2, and C_3 with input variables G_i, P_i and C_0.　(10%)
(2) Draw the logic diagram of carry lookahead generator to generate C_1, C_2, and C_3.　(8%)

6. Design a 4-bit two's complement adder-subtractor with inputs $A = A_3A_2A_1A_0$, $B = B_3B_2B_1B_0$, and M, and outputs $S = S_3S_2S_1S_0$, C_4, and V. If $M = 0$, the adder-subtractor performs $A+B$. Otherwise, it performs $A-B$ (i.e., $A+B'+1$).
(1) $V = 0$ denotes that no overflow occurs and $V = 1$ denotes that an overflow occurs. Design the circuit to generate V.　(5%)
(2) Draw the logic diagram of 4-bit two's complement adder-subtractor.　(6%)

wx \ yz	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10