

國立中山大學一百學年度第一學期資工系數位系統期中考試

學號：

姓名：

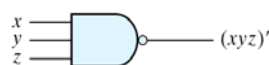
一、選擇與是非題 (每題 3 分, 15 分)

- () 1. 下列何者錯誤? ① product of maxterms is canonical form ② $F(x, y, z) = y' + zy + x'y'z'$ is standard form ③ $F(w, x, y, z) = wx + y(z+w)$ is standard form ④ combinational circuits 中沒有 feedback path。
- () 2. 下列那一個 two-level form 是 degenerate form (亦即可轉換成 a single operation)? ① NOR-OR ② NAND-NAND ③ OR-NAND ④ NAND-OR。
- () 3. 關於 XOR 以及 XNOR, 何者錯誤? ① $(x \oplus y)' = x \odot y$ ② $x \oplus y' = (y \oplus x)'$ ③ $x \oplus 1 = x'$ ④ $x \oplus x' = 0$ 。
- () 4. 一般而言, Product of sums 應該轉換成 NAND Implementation, 而 Sum of products 則應該轉換成 NOR Implementation 以獲得較簡單的電路。
- () 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 P 為 odd parity bit 且 $C = 0$ 代表沒有發生錯誤或是 x, y, z, P 中有偶數個位元發生錯誤。

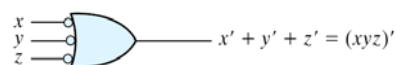
二、問答題 (85 分)

1. (1) Find the signed-magnitude and two's complement representations of the decimal number: -98 (4%)
 (2) Use De Morgan's law to derive the complement of the following Boolean function: $F(x, y, z) = x + y(x' + xz)$, $F' = ?$ (4%)
2. (1) Derive the sum-of-minterms and the product-of-maxterms canonical forms for Boolean function $F(w, x, y, z) = (x+z')(x'+y+z)(w'+x+y'+z')$. (8%)
 (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 and NOR-NOR logics, draw the logic diagrams. (8%)
3. Using the Karnaugh map to find all the simplest sum-of-products of Boolean function $F(v, w, x, y, z) = \sum m(0, 1, 2, 3, 8, 9, 10, 11, 13, 15, 16, 17, 18, 19, 24, 26, 29, 31)$. (8%)
4. Design a code converter that can convert the BCD code $ABCD$ to excess-3 code $wxyz$.
 (1) Derive the truth table (3%)
 (2) Derive the simplified Boolean functions (8%)
 (3) Draw the logic diagram (3%)
5. List the truth table, derive the simplified Boolean functions, and draw the logic diagrams of the following circuits with XOR function.
 (1) The half adder (inputs: x, y and outputs: C, S) with XOR gate. (4%)
 (2) The full adder (inputs: x, y, z and outputs: C, S) with two half adders and an OR gate. (6%)
6. Design a 4-bit 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) Draw the block diagram of 4-bit ripple-carry adder. (3%)
 (2) Let carry propagate $P_i = A_i \oplus B_i$ and carry generate $G_i = A_i B_i$, then sum $S_i = P_i \oplus C_i$ and carry $C_{i+1} = G_i + P_i C_i$, where $0 \leq i \leq 3$. Derive the Boolean functions of C_1, C_2, C_3 , and C_4 . Draw the carry lookahead generator. (12%)
 (3) Draw the 4-bit carry lookahead adder with carry lookahead generator. (4%)

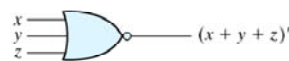
	yz	00	01	11	10
wx	00	0	1	3	2
01	01	4	5	7	6
11	11	12	13	15	14
10	10	8	9	11	10



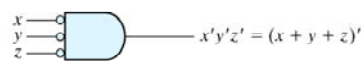
(a) AND-invert



(b) Invert-OR



(a) OR-invert



(b) Invert-AND