國立中山大學 101 學年度第一學期資工系數位系統期中考試

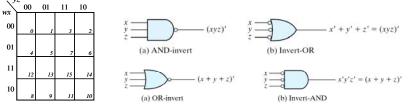
學號: 姓名:

一、選擇與是非題(每題3分,15分)

- () 1. 關於 Karnaugh maps 而言,下列何者錯誤? ① a pictorial form of a truth table ② each square represents one maxterm ③ any two adjacent squares in the map differ by only one variable ④ applicable if the number of variables < 7。
- () 2. 下列何者錯誤? ① x+yz = (x+y)(x+z) ② (x⊕y)' = x'y + xy' ③ x⊕1 = x' ④ x⊙x' = 0。
- () 3. 下列那一個 two-level form 是 nondegenerate form? ①AND-NOR ②AND-NAND ③NAND-OR
 ④ NOR-NAND。
- () 4. A prime implicant is a product term obtained by combining the maximum possible number of adjacent squares and not contained in any other prime implicant.
- () 5. XOR 是 odd function 而且可以產生偶同位的 parity bit。

二、問答題(85分)

- **1.** $F(w, x, y, z) = \sum (0, 2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$. Draw the Karnaugh map and find all the simplest sum-of-products and product-of-sums of this Boolean function. (10%)
- **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)(y'+z). (6%)
 - (2) Implement the function F(w, x, y, z) with the simplest NAND-NAND and NOR-NOR logics, draw the logic diagrams. (10%)
- **3.** Draw the Karnaugh map of Boolean function $F(v, w, x, y, z) = \sum (0, 1, 3, 6, 7, 8, 9, 11, 14, 15, 16, 17, 19, 22, 24, 25, 27, 30)$ and find all the simplest sum-of-products of this Boolean function. (10%)
- **4.** Design a nine's complement converter that can convert the BCD code $x_3x_2x_1x_0$ to its decimal nine's complement $y_3y_2y_1y_0$.
 - (1) List the truth table (4%)
 - (2) Draw the Karnaugh map and derive the simplified Boolean functions (8%)
 - (3) Draw the logic diagram (3%)
- **5.** 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) List the truth table, Karnaugh map and then draw the logic diagrams of the full adder (inputs: x, y, z and outputs: C, S) with two half adders and an OR gate. (4%)
 - (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 $0 \le i \le 3$. Derive the Boolean functions of C_1 , C_2 , C_3 , and C_4 with input variables G_i , P_i and C_0 . Draw the logic diagram of carry lookahead generator to generate C_1 , C_2 , C_3 , and C_4 . (10%)
- 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. (4%)
 (2) Draw the locic diagram of 4 bit two's complement. Table 1
 - (2) Draw the logic diagram of 4-bit two's complement adder-subtractor. (6%)
- 7. Design one digit of decimal adder.
 - (1) Complete the truth table shown in Table 1. (4%)
 - (2) Derive the Boolean function of C and draw its logic
 - diagram. (6%)



Binary Sum					BCD Sum					Decima
к	Z8	Z4	Z2	Z1	c	\$ ₈	S4	\$ ₂	S ₁	
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	1	1
0	0	0	1	0	0	0	0	1	0	2
0	0	0	1	1	0	0	0	1	1	3
0	0	1	0	0	0	0	1	0	0	4
0	0	1	0	1	0	0	1	0	1	5
0	0	1	1	0	0	0	1	1	0	6
0	0	1	1	1	0	0	1	1	1	7
0	1	0	0	0	0	1	0	0	0	8
0	1	0	0	1	0	1	0	0	1	9
0	1	0	1	0						10
0	i	0	1	1						11
0	1	1	0	0						12
0	1	1	0	1						13
0	1	1	1	0						14
0	1	1	1	1						15
1	0	0	0	0						16
1	0	0	0	1						17
1	0	0	1	0						18
1	0	0	1	1						19