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※請在答案卷內作答

考生請注意：

- 本試卷共有 20 題試題。 每題 5 分。
- 你的答案必須如下圖所示由上而下依序寫在答案卷的做答區。
- 只要填寫考題所要求的答案，**請勿附加計算過程**。

從此處開始寫起
1. (a), (b).
2. (c), (d).
3. 15
4. (1) 1 ,(2) 0
5. Z = B+AC'
、、、

注意：背面有試題

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Question 1 [5pt]. Convert 63.2_7 to a number with base 16.

Question 2 [5pt]. Which of the following equations are valid? (**Multiple choices**)

(a) A'B'C+B'CD' + EF' = (B' + E)(B' + F')(C+ E)(C+ F')(A' + D' + E)(A' + D' + F')

(b) WXY' + (W' ≡ X) + (Y ⊕ W) = (X +Y) ⊕ W

(c) [(A' + B')' + (A'B'C)' + C'D]' = A'B'C

(d) H'I' + JK = (H' + I')(K' + J)(H' + K)(I' + K)

Question 3 [5pt]. Which of the following statements is always true? (**Multiple choices**)

(a) If AD' + BD' = CD', then AE + BE = CE.

(b) If A ≡ B is always **true**, then A(X' +Y +Z') = B(X' +Y +Z') is always valid.

(c) If A ⊕ B is always **true**, and AX = BY is always valid, then XY must be **false**.

(d) If A + C = B + C, then AZ = BZ.

Question 4 [5pt]. A combinational circuit has three binary inputs (A,B,C) and two binary outputs (X,Y). XY_2 represents a binary number whose value equals the number of 1's at the input. For example, if ABC=011,then XY=10. Choose the correct minterms to form the m-notation of X, where the order of literals for m-notation is ABC. (**Multiple choices**)

$(a)\ m_0$　$(b)\ m_1$　$(c)\ m_2$　$(d)\ m_3$　$(e)\ m_4$　$(f)\ m_5$　$(g)\ m_6$　$(h)\ m_7$

注：背面有試題

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Question 5 [5pt]. The Karnaugh map below shows the function F with four inputs (A, B, C, D), where A is the most significant bit and D is the least significant bit.

CD \ AB	00	01	11	10
00	X	1	X	0
01	0	X	0	X
11	X	1	X	1
10	0	X	1	X

Which of the following statements is true? (**Multiple choices**)

(a) If minterm $m_{13} = 1$, then $F = 0$.

(b) If $F = 0$, then maxterms $M_4 = M_7 = M_{11} = M_{14} = 1$.

(c) If minterms $m_1 = m_2 = m_8 = m_{13} = 0$, then $F = 1$.

(d) $A'C'D'$, $BC'D'$, $A'B$, CD, BC, AC are prime implicants of F.

(e) F has more than six prime implicants.

(f) F has no essential prime implicant.

Question 6 [5pt]. Given $F(A, B, C, D) = \Pi M(0, 1, 2, 8, 14) \cdot \Pi D(3, 5, 7, 9, 10, 15)$. Which of the following statements is true? (**Multiple choices**)

(a) The minimum sum of product (SoP) for F is unique.

(b) The minimum sum of product (SoP) for F is $A'B + BC' + CD$.

(c) The minimum product of sum (PoS) for F is $(B + D) \cdot (A' + C' + D) \cdot (A + B)$.

(d) The minimum sum of product (SoP) for F is $A'B + BC' + AD$.

(e) The minimum product of sum (PoS) for F is $(B + D) \cdot (A' + C' + D) \cdot (B + C)$.

(f) Boolean expressions respectively shown in (b) and (c) are equivalent.

(g) Boolean expressions respectively shown in (b) and (e) are equivalent.

(h) F has more than three minimum product of sum (PoS) solutions.

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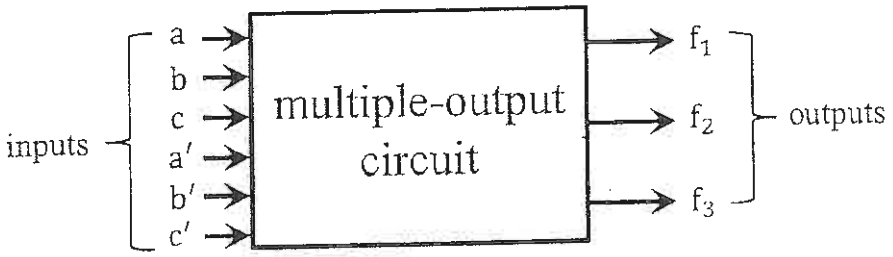
※請在答案卷內作答

Question 7 [5pt]. Choose the circuits which can realize the multiple-output circuit shown in the following figure. (**Multiple choices**)



The Karnaugh map for each output function is given below.

f_1

bc \ a	0	1
00	1	1
01	1	0
11	0	0
10	1	0

f_2

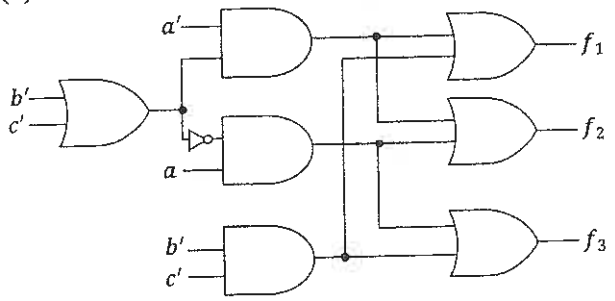
bc \ a	0	1
00	1	0
01	1	0
11	0	1
10	1	0

f_3

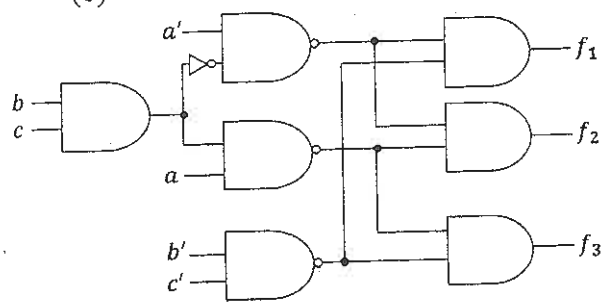
bc \ a	0	1
00	1	1
01	0	0
11	0	1
10	0	0

參考用

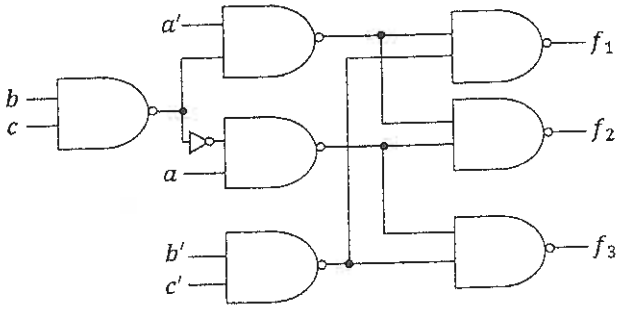
(a)



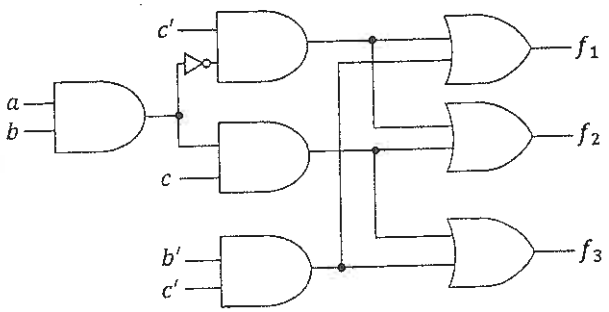
(b)



(c)



(d)



注意：背面有試題

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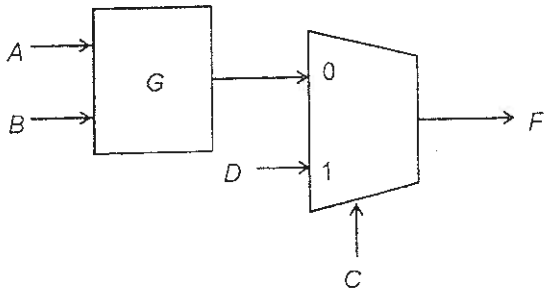
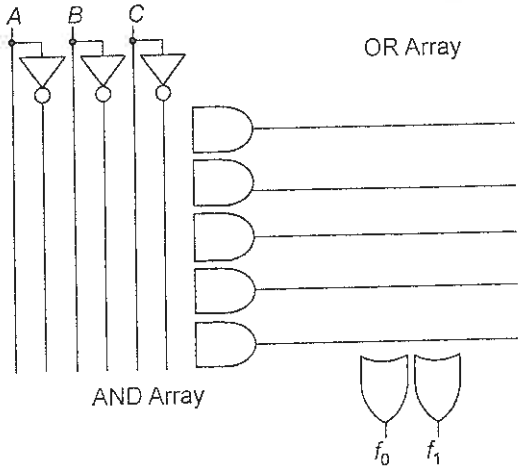
Question 8 [5pt]. Suppose a Boolean function F is implemented by the following circuit with a multiplexor and some unknown function G. In addition, F is partially known shown in the following Karnaugh map. What is the possible function of F in terms of minimum sum of products?



CD \ AB	00	01	11	10
00	?	?	1	?
01	1	?	?	0
11	?	?	?	?
10	?	?	?	?

Question 9 [5pt]. What is the corresponding function of G in Question 8?

Question 10 [5pt]. Implement $f_1(A, B, C)=\Sigma m(3, 7)$ and $f_2(A, B, C) =\Sigma m(1, 2, 5)$ using a PLA. Please complete the design with the minimum form.



注意：背面有試題

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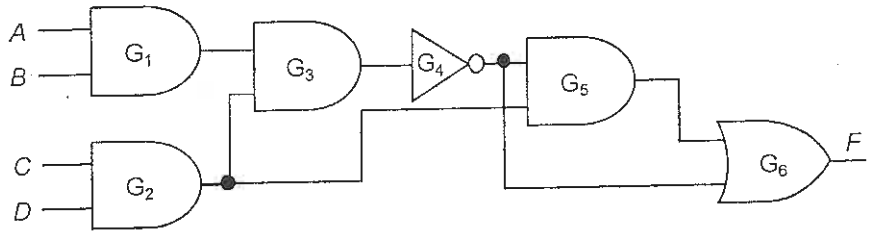
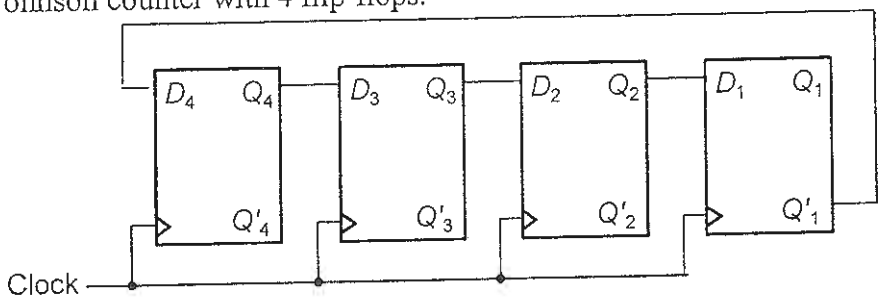
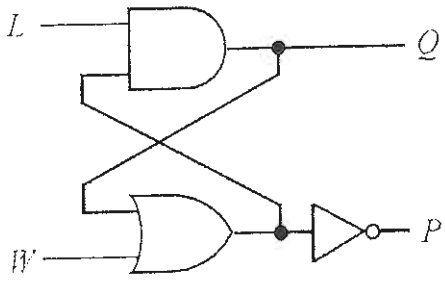
Question 11 [5pt]. Dr. Hunt is debugging a faulty circuit as shown below. According to the specification, with applying the input vector $(A, B, C, D) = (0, 0, 1, 1)$, the output value at F should be 0. However, the actual simulation result is 1. Hunt knows errors come from using wrong gate types. Assume only the following gate types could be misused: AND↔NAND, OR↔NOR, Inverter↔Buffer (one buffer equals two cascaded inverters), and only one error exists in this circuit. Please indicate all possible erroneous gates. (Please write down the gate instance names.)



Question 12 [5pt]. How many states does a Johnson counter with N flip-flops have? The figure below shows a Johnson counter with 4 flip-flops.



Question 13 [5pt]. A latch design is given below. To guarantee Q will always equal P', what values cannot be placed on L and W?



注意：背面有試題

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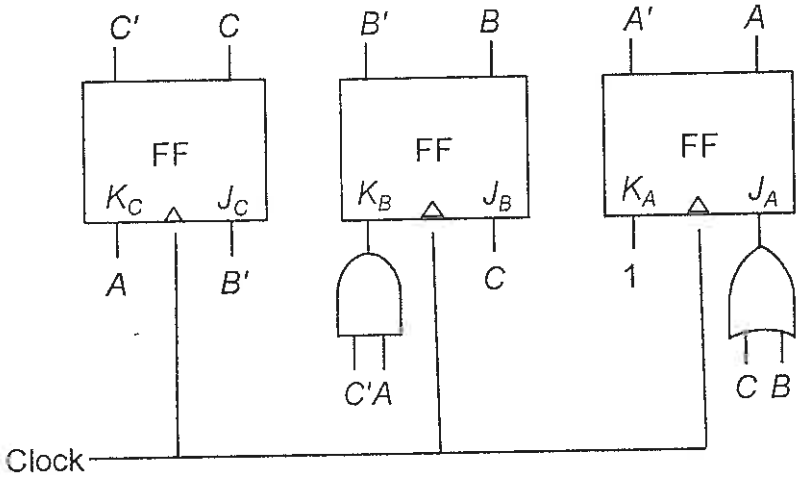
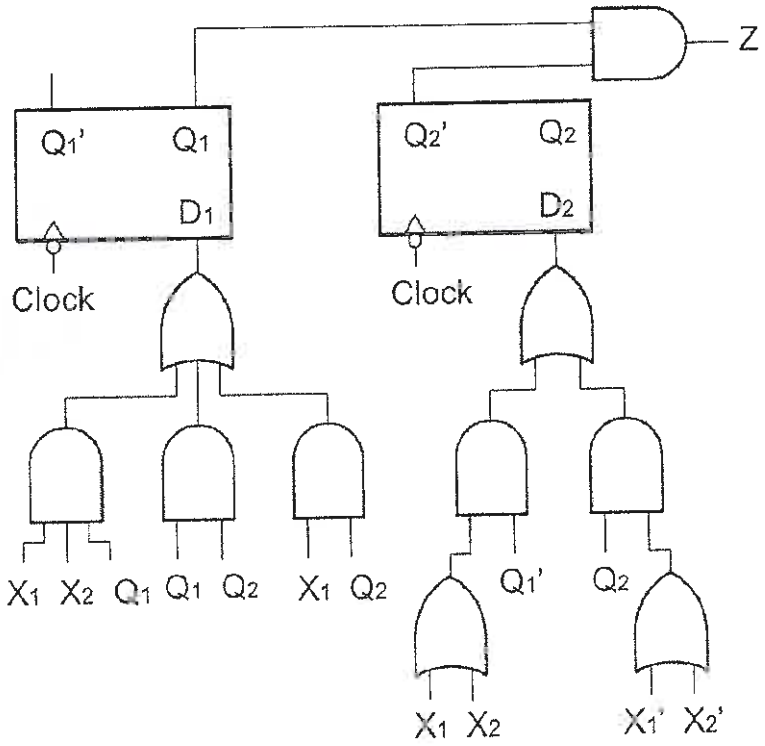
Question 14 [5pt]. Professor Pond received the following circuit diagram of a secret counter implemented by J-K flip-flops. Given that the initial state of CBA is 000, please derive the entire counting sequence of this counter. (000 -> ??? -> … -> 000)



Question 15 [5pt]. For a Moore machine as illustrated in the figure below, if Q_1Q_2=11, please identify the values of X_1X_2 to make Z = 1 in the next state.



注意：背面有試題

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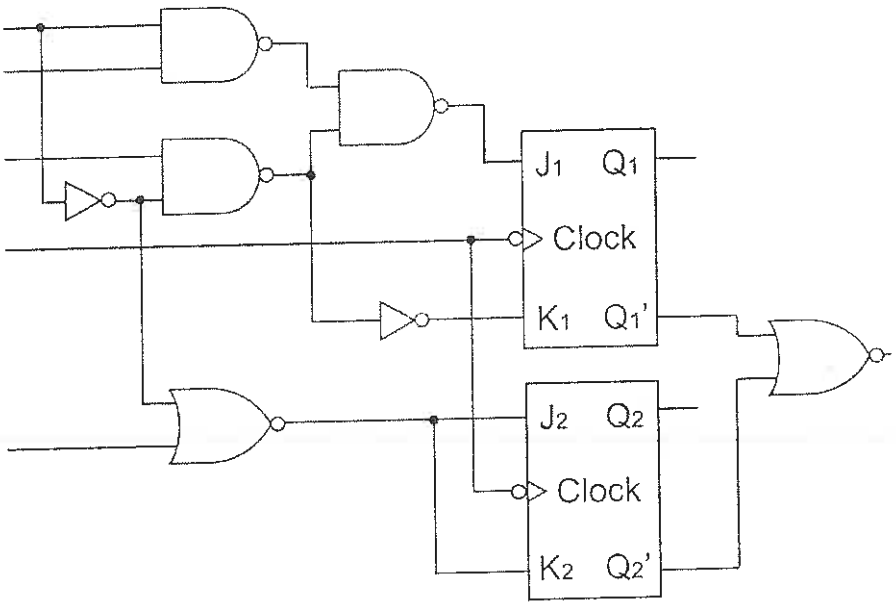
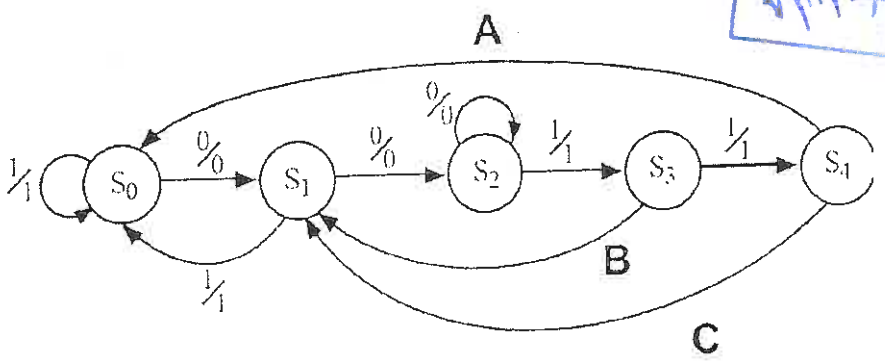
Question 16 [5pt]. The figure below shows a Moore machine. The state variables Q_1 and Q_2 can specify four states. Please identify the state (Q_1Q_2) that will loop to itself (a state that is not connected to other states).



Question 17 [5pt]. The state graph of a Mealy sequential circuit is shown in the figure below. The circuit transmits its input, except that it should prevent the sequence 00100 from occurring. Z should be the same as X, except that if the input sequence 00110 occurs, Z should be 1 rather than 0 when the last 0 is received. So the sequence X=00110 is replaced with Z=00111. Please specify the correct input and output for the three missing transitions (A, B, and C).



注意：背面有試題

Question 18 [5pt]. A Mealy machine has one input X and two outputs (Z_1 and Z_2). The circuit produces an output of Z_1=1 whenever the sequence 011 is completed, and an output of Z_2=1 whenever the sequence 0111 is completed. The figure below shows the state table. Which state (S_0 to S_3) specifies the state when the machine receives the sequence 011?

State	Next State $X=0$	Next State $X=1$	Z_1Z_2 $X=0$	Z_1Z_2 $X=1$
S_0	S_1	S_0	00	00
S_1	S_1	S_2	00	00
S_2	S_1	S_3	00	10
S_3	S_1	S_0	00	01

Question 19 [5pt]. A Mealy machine has one input and one output that will produce an output of 1 for every second 0 it receives and for every second 1 it receives.

For example:

$X(\text{input}) = 0\ 1\ 1\ 0\ 1\ 1\ 1\ 0\ 0\ 0\ 0\ 1\ 0\ 1\ 1\ 0\ 0\ 1\ 0\ 1\ 1\ 0\ 1\ 0$

$Z(\text{output}) = 0\ 0\ 1\ 1\ 0\ 1\ 0\ 0\ 1\ 0\ 1\ 1\ 0\ 0\ 1\ 1\ 0\ 0\ 1\ 1\ 0\ 0\ 1\ 1$

The circuit is implemented using two J-K flip-flops. Which of the following logic expressions can meet the specification of the Mealy machine defined above?

(a) J_a=X' , K_a=1 , J_b=X , K_b=1

(b) J_a=0 , K_a=1 , J_b=1 , K_b=X

(c) J_a=X , K_a=X , J_b=0 , K_b=1

(d) J_a=1 , K_a=X' , J_b=X' , K_b=X

(e) J_a=X', K_a=X', J_b=1 , K_b=1

(f) J_a=X' , K_a=0 , J_b=X' , K_b=1

注意：背面有試題

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※請在答案卷內作答

Question 20 [5pt].

Which of the following choices contain tables that are equivalent?

(a)

	$XY=00$	01	11	10	Z
a	a	c	e	d	0
b	d	e	e	a	0
c	e	a	f	b	1
d	b	c	c	b	0
e	c	d	f	a	1
f	f	b	a	d	1

	$XY=00$	01	11	10	Z
a	b	i	c	g	0
b	b	c	f	g	0
c	h	d	d	f	1
d	h	c	e	g	1
e	b	c	i	g	0
f	f	i	i	k	0
g	j	k	g	h	0
h	e	f	c	g	0
i	i	i	i	d	0
j	b	f	c	g	0
k	a	c	e	g	1

(b)

	$X=0$	1	
S_0	S_3	S_1	0
S_1	S_0	S_1	0
S_2	S_0	S_2	1
S_3	S_0	S_3	1

	$X=0$	1	
A	E	A	1
B	F	B	1
C	E	D	0
D	E	C	0
E	B	D	0
F	B	C	0

(c)

Present State	$X=0$	1	$X=0$	1
a	h	c	1	0
b	c	d	0	1
c	h	b	0	0
d	f	h	0	0
e	c	f	0	1
f	f	g	0	0
g	g	c	1	0
h	a	c	1	0

Present State	$X=0$	$X=1$	$X=0$	$X=1$
a	e	g	0	1
b	d	f	0	1
c	e	c	1	0
d	b	f	0	1
e	g	f	0	1
f	b	d	1	0
g	e	c	1	0

注意：背面有試題