



الامتحان مكون من أربع صفحات، الإجابة في نفس ورقة الأسئلة.
حاول في كل الأسئلة، النهاية العظمى ٤٠ درجة.
الإجابة النهائية يجب أن تكون مكتوبة في المكان المخصص لها وخطوات الحل في الصفحة المقابلة.

Question # 1: (2 Points)

Find the 9's and the 10's complement of the decimal number: 3427097

The 9's complement: **6572902**

The 10's complement: **6572903**

Question # 2: (4 Points)

(a) Prove that: $x + x'y = x + y$ (Hint: Use DeMorgan's theorem)

(b) Reduce the following Boolean expressions to three literals

$$F = (x'y' + z)' + z + xy + wz$$

$$F = x + x'y$$

(a) $F' = x'(x + y') = x'y'$

$$F = x + y$$

(b) $F = x + y + z$

Question # 3: (4 Points)

Simplify the Boolean function:

$$F = wyz' + y'z + wx'z + wxyz$$

Using Karnaugh maps to:

(a) sum-of-products

(b) product-of-sums

(a) $F = y'z + wy$

(b) $F = (y + z)(w + y')$

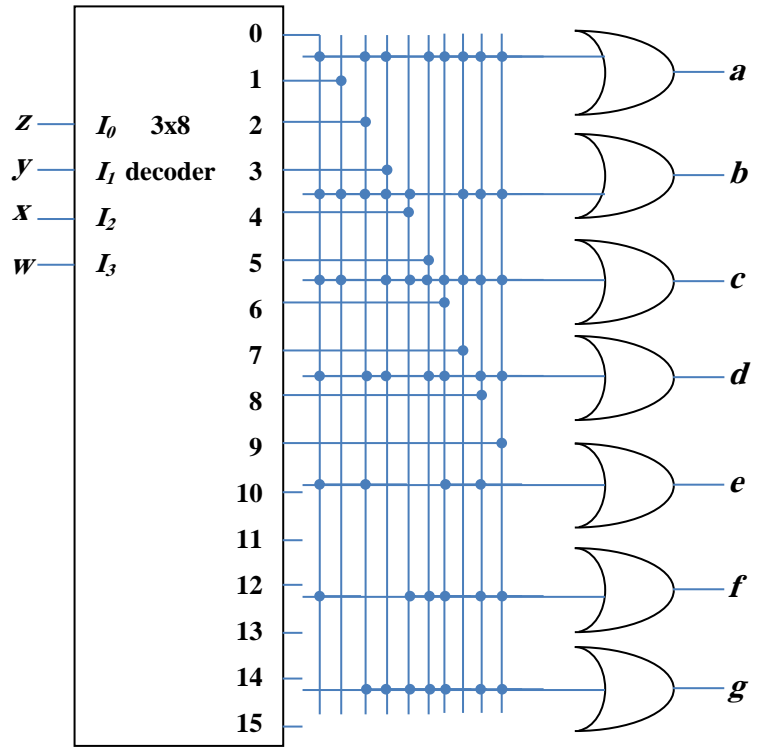
	yz	00	01	11	10
wx	00		1		
	01		1		
	11		1	1	1
	10		1	1	1

	yz	00	01	11	10
wx	00	0		0	0
	01	0		0	0
	11	0			
	10	0			

Question # 4: (6 Points)

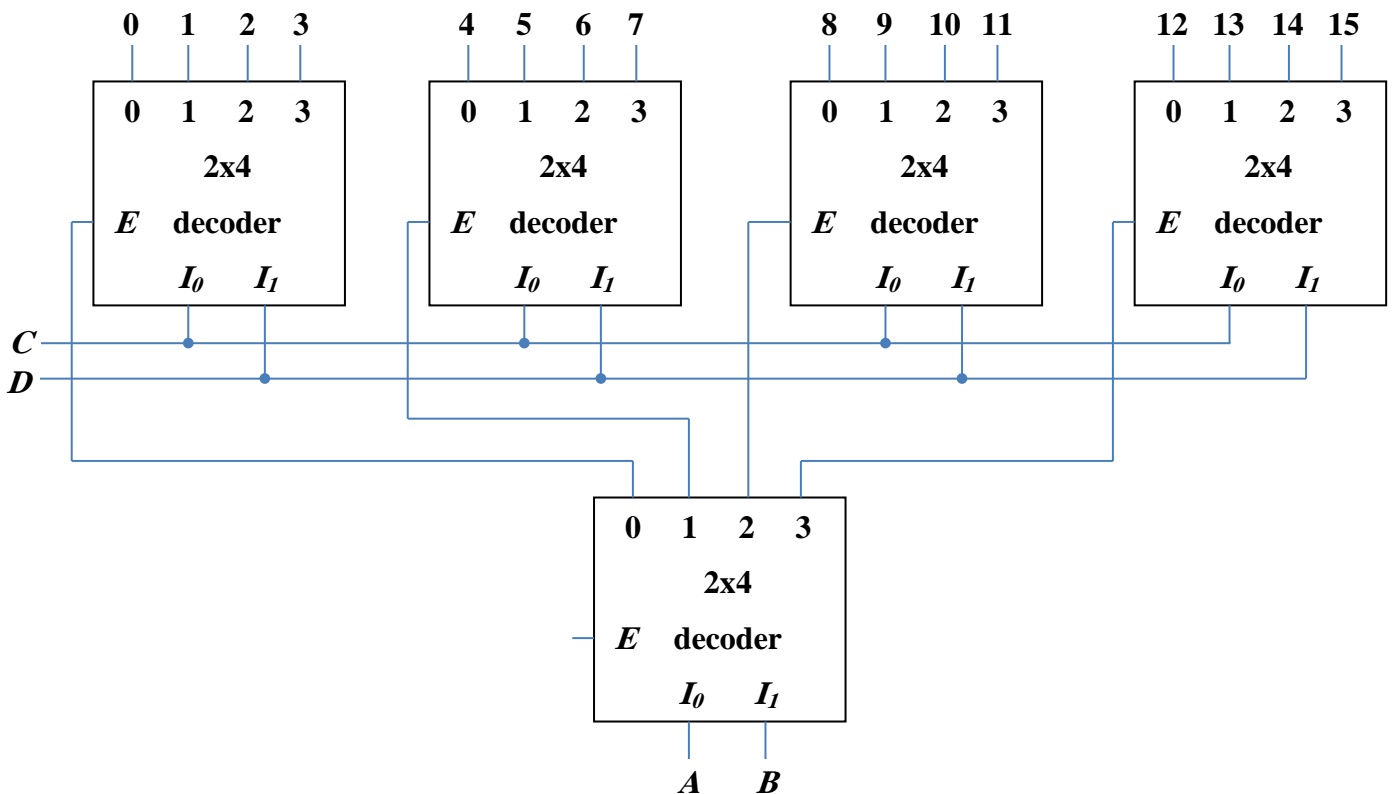
Design a *BCD-to-seven-segment decoder* using a single 4x16 decoder and seven OR gates. Write the truth table and draw the logic diagram.

Decimal	Input				Outputs						
	w	x	y	z	a	b	c	d	e	f	g
0	0	0	0	0	1	1	1	1	1	1	0
1	0	0	0	1	0	1	1	0	0	0	0
2	0	0	1	0	1	1	0	1	1	0	1
3	0	0	1	1	1	1	1	1	0	0	1
4	0	1	0	0	0	1	1	0	0	1	1
5	0	1	0	1	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	1	1	1	1
7	0	1	1	1	1	1	1	0	0	0	0
8	1	0	0	0	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	0	1	1



Question # 5: (4 Points)

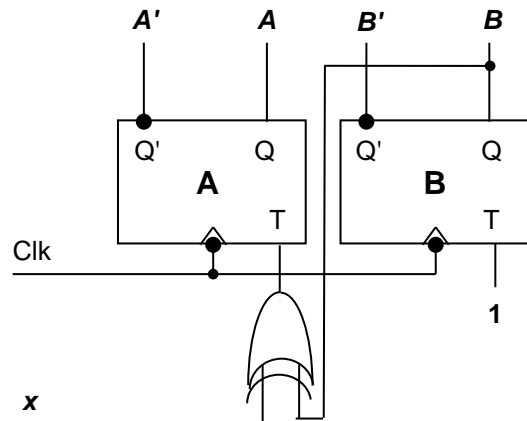
Construct a 4-to-16-line decoder with five 2-to-4-line decoders with enable.



Question # 6: (6 Points)

Design a sequential circuit with two *T* flip-flops *A* and *B*, and one input *x*. When *x* = 0, the circuit counts up (00, 01, 10, 11) and repeats. When *x* = 1, the circuit counts down (11, 10, 01, 00) and repeats.

Present State		Input	Next State		Flip-Flop Inputs	
<i>A</i>	<i>B</i>	<i>x</i>	<i>A</i>	<i>B</i>	<i>TA</i>	<i>TB</i>
0	0	0	0	1	0	1
0	0	1	1	1	1	1
0	1	0	1	0	1	1
0	1	1	0	0	0	1
1	0	0	1	1	0	1
1	0	1	0	1	1	1
1	1	0	0	0	1	1
1	1	1	1	0	0	1



$$TA = B'x + Bx'$$

$$TB = 1$$

Question # 7: (2 Points)

The content of a four-bit register is initially 1011. The register is shifted six times to the right with the serial input being 111010. What is the content of the register after each shift?

The register contents are:

1011, 0101, 1010, 0101, 1010, 1101, 1110

Question # 8: (2 Points)

- (a) How many 32K x 8 RAM chips are needed to provide a memory capacity of 256K bytes?
- (b) How many lines of the address must be used to access 256K bytes?

(a) Number of chips = 8 chips

(b) Number of address lines = 18 lines

Question # 9: (10 Points)

- a) Derive the *PLA* programming table for the combinational circuit that squares a three-bit binary number using the minimum number of product terms. (6 Points)
- b) Draw a schematic diagram for the *PLA*, and mark the fuse map. (4 Points)

Truth Table

Dec.	Inputs			Outputs						
	x	y	z	A	B	C	D	E	F	
0	0	0	0	0	0	0	0	0	0	
1	0	0	1	0	0	0	0	0	1	
2	0	1	0	0	0	0	1	0	0	
3	0	1	1	0	0	1	0	0	1	
4	1	0	0	0	1	0	0	0	0	
5	1	0	1	0	1	1	0	0	1	
6	1	1	0	1	0	0	1	0	0	
7	1	1	1	1	1	0	0	0	1	

PLA Programming Table

Product Term	Inputs			Outputs			
	x	y	z	(T) A	(T) B	(C) C	(T) D
1: xy	1	1	-	1	-	1	-
2: $xy'z'$	1	0	0	-	1	1	-
3: xz	1	-	1	-	1	-	-
4: yz'	-	1	0	-	-	1	1
5: $x'y'$	0	0	-	-	-	1	-

$E = 0, F = z$

