Student name: ______________________

Remarks:

- Exam time: 5:00PM – 6:20PM
- Please write your name at the top-right corner of each page of your exam papers.
- One page of cheat sheet is allowed (back and forth).
- You are allowed to leave early. But, please drop your exam papers. You don't need to drop your cheat sheet.
- GOOD LUCK!

Problem #	1	2	3	4	5
Total points	12	12	10	10	16
Student scores					

Problem 1. Consider binary variables A, B, and C.
(1) Consider F(A, B, C) = A' B + C. What is the value of F when A = 1, B = 1, and C = 0?
(2) What is the dual expression of (A' + B) (A + C')?
(3) Is the following equation true?

(A + B) (B' + C) (C + A) = (A + B) (B' + C)

Solution:

(1) F = 0
(2) A'B + AC'
(3) Yes, it is true.

Problem 2. Perform the following operations involving 7-bit 2's complement numbers and indicate whether arithmetic overflow occurs in each of the operation.

```
  0 1 0 1 1 1 1
– 1 0 0 1 0 1 1
```

```
  1 1 1 0 1 0 0
+ 0 1 0 1 1 0 0
```

Solution:

```
  0 1 0 1 1 1 1
– 1 0 0 1 0 1 1

  0 1 0 1 1 1 1
+ 0 1 1 0 1 0 1
  1 1 0 0 1 0 0
```

Overflow occurs.

```
  1 1 1 0 1 0 0
+ 0 1 0 1 1 0 0
  0 1 0 0 0 0 0
```

Overflow does not occur.

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Problem 3. The Karnaugh map for the function F (A, B, C, D) is given below. Please find the simplest POS expression of the output F.

AC \ BD	00	01	11	10
00	1	0	0	1
01	0	0	0	0
11	1	1	1	1
10	1	0	1	1

Solution:

AC \ BD	00	01	11	10
00	1	0	0	1
01	0	0	0	0
11	1	1	1	1
10	1	0	1	1

F = (A + C')(A + D')(B + C + D')

Problem 4. The Karnaugh map for the incompletely specified function F (A, B, C, D) is given below. Please find the simplest SOP expression of the output F.

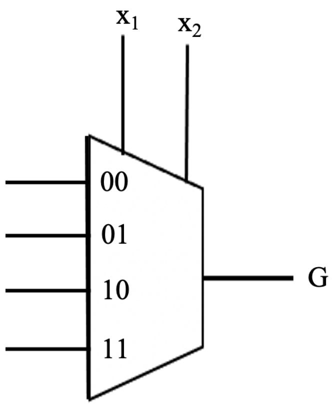
AB \ CD	00	01	11	10
00	X	0	0	1
01	X	0	0	1
11	1	0	1	1
10	1	0	0	X

Solution:

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

F = D' + ABC

Problem 5. Complete a combinational circuit design using the given Multiplexer and logic gates if needed that fulfills the function G (x_1, x_2, x_3) = $M_0\,M_2\,M_5\,M_7$. Complete the truth table. Show all your work.



x_1	x_2	x_3	G
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Solution:

When $x_1 = 0$ and $x_2 = 0$, we have

x_3	G
0	0
1	1

Thus, G = x_3.

When $x_1 = 1$ and $x_2 = 0$, we have

x_3	G
0	1
1	0

Thus, G = x_3'.

When $x_1 = 0$ and $x_2 = 1$, we have

x_3	G
0	0
1	1

Thus, G = x_3.

When $x_1 = 1$ and $x_2 = 1$, we have

x_3	G
0	1
1	0

Thus, G = x_3'.

x_1	x_2	x_3	G
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0