Al Imam Mohammad Ibn Saud Islamic University
College of Computer and Information Sciences

Computer Science Department

Course Title:	Digital Logic
Course Code:	CS 106
Course Instructor:	Dr. Sultan S. Alqahtani
Exam:	First Midterm
Semester:	Summer semester
Date:	10/07/2019 - 07/11/1440
Duration:	60 minutes
Marks:	30

Privileges: ☐ Open Book ☐ Open Notes
☑ Calculator Permitted ☐ Laptop Permitted

Student name:	MODEL ANSWERS
Student ID:	
Section No.:	

Instructions:

1. Answer all questions; there are **three** questions in 5 pages.
2. Write your answers directly on the question sheets. Use the ends of the question pages for rough work or if you need extra space for your answer.
3. If information appears to be missing from a question, make a reasonable assumption, state your assumption, and proceed.
4. **No** questions will be answered by the invigilator(s) during the exam period.

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Question	Student Marks	Question Marks
1		10
2		10
3		10
Total		**30**

Question1:

(25) Minutes [ ] / 10 Marks

1. Convert the hexadecimal number 64CD to binary, and then convert it from binary to octal.

$(64CD)_{16} = (0110\ 0100\ 1100\ 1101)_2 = 110\ 010\ 011\ 001\ 101 = (62315)_8$

2. Represent the decimal number 6,248 in BCD, and from BCD to Excess-3.

$6248_{10} \Rightarrow$ BCD: 0110 0010 0100 1000

Excess-3: 1001 0101 0111 1011

3. Find the 9's and the 10's complement of the following decimal numbers:

00000000	25,000,000
9's complement: 99999999	9's complement: 74 999 999
10's complement: 100000000	10's complement: 75 000 000

4. Perform subtraction on the given unsigned binary numbers using the 2's complement of the subtrahend. Where the result should be negative, find its 2's complement and affix a minus sign

a) 10011 - 10010

10010

1's → 01101

2's → 01110

10011

00001 ⇒ check 19 − 18 = 1

5. Convert decimal+49 and+29 to binary, using the signed-2's-complement representation and enough digits to accommodate the numbers. Then perform the binary equivalent of (+29)+(-49), (-29)+(+49), and (-29)+(-49). Convert the answers back to decimal and verify that they are correct.

+49 = 110001 → 0_110001 (sign bit)

+29 = 011101 → 0_011101

−49 = 0_110001 (2's)

1_001110 (2's)

1_001111

−29 = 0_011101 (2's)

1_100010 (2's)

1_100011

① (+29)+(−49) = 0_011101 + 1_001111

= 1_101100

indicates negative

⇒ magnitude: 101100 (2's) → 010011 (2's) → 010100 = −20

Check (+29)−49 = −20

② (−29)+(+49) = 1_100011 + 0_110001

= 0_010100 = +20

indicates positive

Check ⇒ −29 + 49 = +20

③ (−29)+(−49) = (1)1_100011 + (1)1_001111 (sign bit; must increase to accommodate overflow)

= 10_110010 ⇒ Check:

magnitude: 01_001110 = 78 (−29)+(−49) = −78

Question2:

(20) Minutes [ ] / 10 Marks

1. Simplify the following Boolean expressions to a minimum number of literals:
   a) XY + XY'
   b) (A + B)' (A' + B')

(a) $XY + X\bar{Y}$

$= X(Y + \bar{Y})$

$= X$

(b) $\overline{(A+B)}\,(\bar{A}+\bar{B}) = \bar{A}\bar{B}\,(\bar{A}+\bar{B})$

$= \bar{A}\bar{B}\bar{A} + \bar{A}\bar{B}\bar{B}$

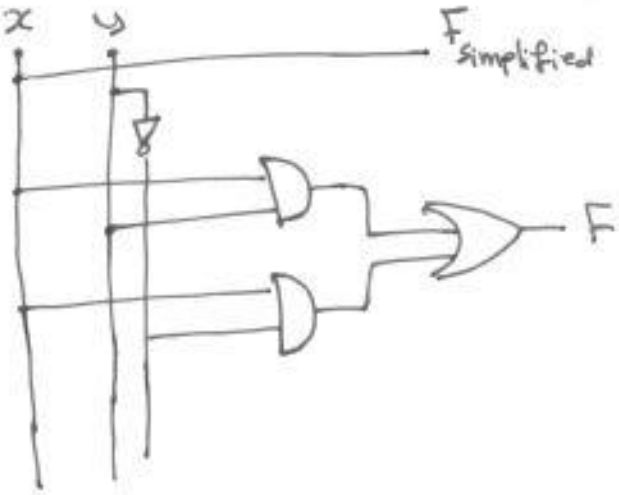
$= \bar{A}\bar{B} + \bar{A}\bar{B}$

$= \bar{A}(\bar{B}+\bar{B})$

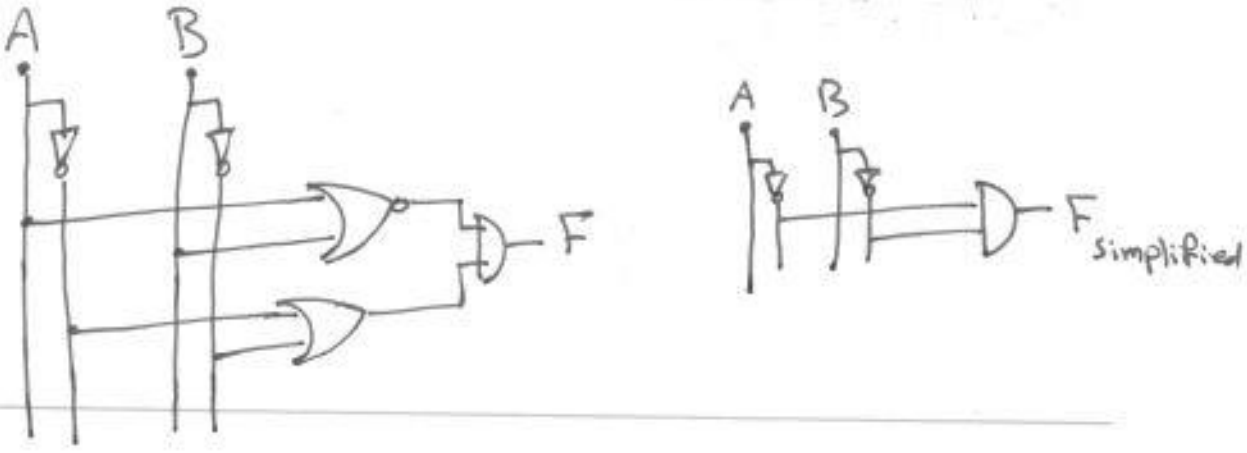
$= \bar{A}\bar{B}$

Draw logic diagrams of the circuits that implement the original and simplified expressions in a and b.

(a)



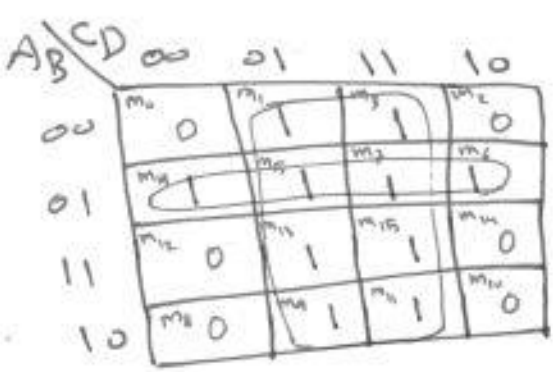
(b)



2. Express the following function as a sum of minterms and as a product of maxterms:
$F(A,B,C,D) = B'D + A'B + BD$

A	B	C	D	F	
0	0	0	0	0	$\leftarrow m_0$
0	0	0	1	1	$\leftarrow m_1$
0	0	1	0	0	$\leftarrow m_2$
0	0	1	1	1	$\leftarrow m_3$
0	1	0	0	1	$\leftarrow m_4$
0	1	0	1	1	$\leftarrow m_5$
0	1	1	0	1	$\leftarrow m_6$
0	1	1	1	1	$\leftarrow m_7$
1	0	0	0	0	$\leftarrow m_8$
1	0	0	1	1	$\leftarrow m_9$
1	0	1	0	0	$\leftarrow m_{10}$
1	0	1	1	1	$\leftarrow m_{11}$
1	1	0	0	0	$\leftarrow m_{12}$
1	1	0	1	1	$\leftarrow m_{13}$
1	1	1	0	0	$\leftarrow m_{14}$
1	1	1	1	1	$\leftarrow m_{15}$

OR



$F(A,B,C,D) = \sum(1,3,4,5,6,7,9,11,13,15)$

$F(A,B,C,D) = \prod(0,2,8,10,12,14)$

3. Express the complement of the following functions in sum of minterms form:

a) $F(A, B, C, D) = \Sigma(2, 4, 7, 10, 12, 14)$

$F'(A,B,C,D) = \sum(0,1,3,5,6,8,9,11,13,15)$

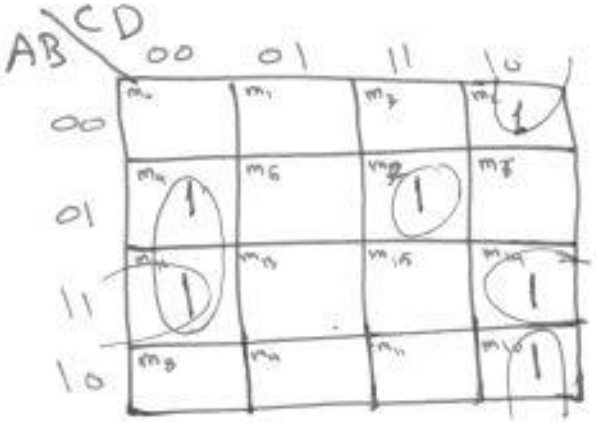
b) $F(x, y, z) = \Pi(3, 5, 7)$

$F'(x,y,z) = \sum(3,5,7)$

Question3:

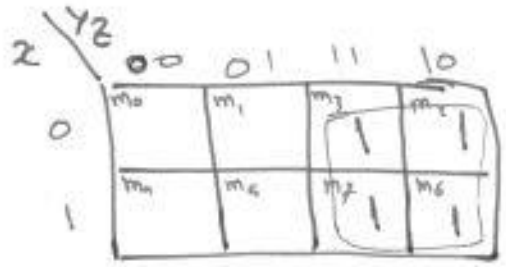
(15) Minutes [ ] / 10 Marks

1. Simplify the following Boolean functions using Karnaugh Maps:
   c) F(A, B, C, D) =Σ(2, 4, 7, 10, 12, 14)



$$F = B\bar{C}\bar{D} + AB\bar{D} + \bar{B}C\bar{D} + \bar{A}BCD$$

d) F(x,y,z) =Σ(2,3,6,7)



$$F = y$$