KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
DEPARTMENT OF ELECTRICAL ENGINEERING

EE 200 EXAMINATION

DIGITAL LOGIC DESIGN

EXAMINATION TYPE :	**Major Examination # 1**
DATE :	**Monday October 25, 2010**
Time :	**7:00 – 8:30 PM**

Student's name :	
I. D. # :	
Section :	

Q # 1	**/ 25**
Q # 2	**/ 25**
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Total	**/ 100**

Q.1)

a. Using signed 2's complement representation with 12-bits, perform the binary equivalent operation of (-88) + (-78). Then represent the answer in Decimal. [10 pts.]

b. Represent the decimal number 378.85 in BCD and 2421 codes. [10 pts.]

c. Determine the minimum number of bits needed to code KFUPM building numbers 1 to 60 so that each have a unique code. If the number of houses in the faculty housing area is 200 houses, what would be the minimum number of bits needed to code each house with a unique binary code? [5 pts]

a. $88 = 64 + 16 + 8 = 2^6 + 2^4 + 2^3 \rightarrow 1011000$

$+88 = 000001011000$

$-88 = 111110101000$

$78 = 64 + 8 + 4 + 2 = 2^6 + 2^3 + 2^2 + 2^1 \rightarrow 1001110$

$+78 = 000001001110$

$-78 = 111110110010$

$$\begin{array}{r} 111110101000 \\ +\ 111110110010 \\ \hline 1\,111101011010 \end{array}$$

Answer is negative $\equiv -000010100110$

$= 2^7 + 2^5 + 2^2 + 2^1 = 128 + 32 + 4 + 2 = -166$

b. 378.85 → BCD 0011 0111 1000 . 1000 0101

2421 ~~0110 1010 1011 . 1011 1000~~

0011 1101 1110 . 1110 1011

c. $32 < 60 < 64 \rightarrow 2^5 < 60 < 2^6$

∴ minimum no. of bits is 6 bits

$128 < 200 < 256 \rightarrow 2^7 < 200 < 2^8$

minimum no. of bits is 8 bits.

Q.2)

a. Express the complement of the following functions in products of maxterms algebraically. [8 pts.]

$F_1(A,B,C) = \Sigma(0,3,6,7)$ $\quad\quad$ $F_2(x,y,z) = \prod(1,2,6)$

b. Implement (simplify) the function F_1' (the complement of F_1) (in SOP form and) with the minimum number of logic gates. (Implement the simplified function) [8 pts.]

c. Prepare the truth table for the Boolean function G given by:

$$G(x,y,z) = xz + x'(y+z')$$

Express the function as a sum of minterms and product of maxterms. [9 pts.]

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a. $F_1' = \prod(0,3,6,7)$

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

$F_2' = \prod(0,3,4,5,7)$

$= (x+y+z)(x+y'+z')(x'+y+z)(x'+y+z')(x'+y'+z')$

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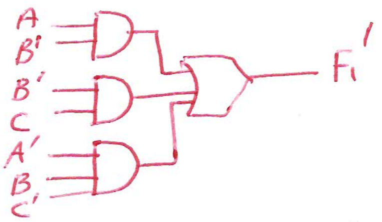
b. $F_1' = AB' + B'C + A'BC'$



			B	B
	0	1	0	1
A	1	1	0	0
		C	C	

---

c.

x	y	z	F
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

$F = \Sigma(0,2,3,5,7)$

$= \prod(1,4,6)$

Q.3)

a. Obtain the output waveform for the circuit shown in Figure 1. [8 pts.]

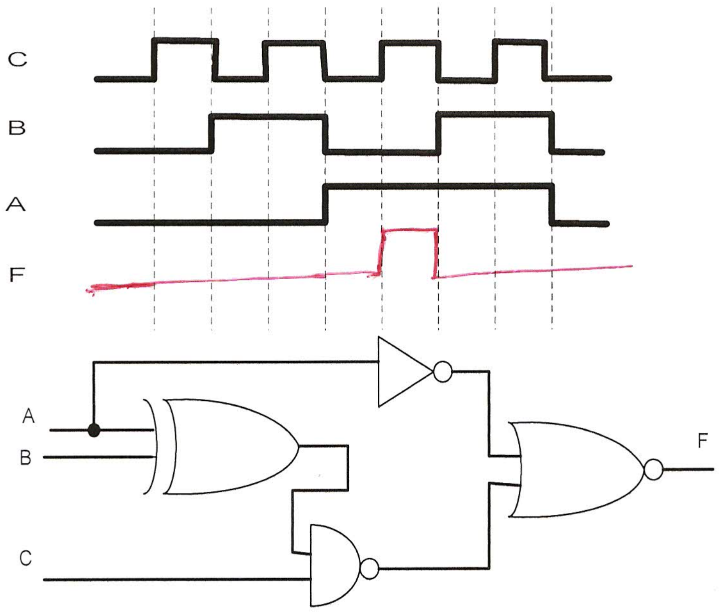


Figure 1

b. Minimize using theorems of Boolean Algebra the function $J(x,y,z) = \Sigma(0,1,4,5)$. [8 pts.]

c. Write the function J in part (b) as a product of max terms and minimize it algebraically. [9 pts.]

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a. $F = \{A' + [(A \oplus B)C]'\}'$

$= A\,[(A \oplus B)C] = A(A'B + AB')C = AA'BC + AB'C = 0 + AB'C$

$= AB'C$

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b. $J(x,y,z) = x'y'z' + x'y'z + xy'z' + xy'z$

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

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c. $J(x,y,z) = \Pi(2,3,6,7) = (x+y'+z)(x+y'+z')(x'+y'+z)(x'+y'+z')$

$= (x+y'+zz')(x'+y'+zz') = (x+y')(x'+y')$

$= (xx'+y') = (0+y') = y'$

Q.4)

Consider the two functions,

$$f = abc' + c'd + a'cd' + b'cd'$$

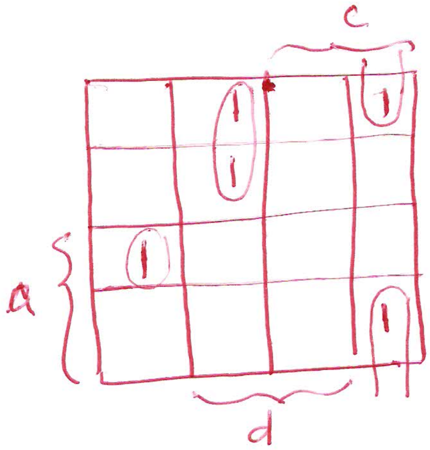
$$g = (a + b + c' + d')(b' + c' + d)(a' + c + d')$$

a. Prepare a truth table for the functions f and g, then complete the truth table for the function H = fg. [15 pts.]

b. Simplify the function H using K-maps, and write the final expression as a combination of the necessary prime implicants. [10 pts.]

a	b	c	d	f	g	H
0	0	0	0	0	1	0
0	0	0	1	1	1	1
0	0	1	0	1	1	1
0	0	1	1	0	0	0
0	1	0	0	0	1	0
0	1	0	1	1	1	1
0	1	1	0	1	0	0
0	1	1	1	0	1	0
1	0	0	0	0	1	0
1	0	0	1	1	0	0
1	0	1	0	1	1	1
1	0	1	1	0	1	0
1	1	0	0	1	1	1
1	1	0	1	1	0	0
1	1	1	0	0	0	0
1	1	1	1	0	1	0

$H = \sum(1, 2, 5, 10, 12)$



$H = a'c'd + b'cd' + abc'd'$

THE END.