King Fahd University of Petroleum and Minerals
College of Computer Science and Engineering
Computer Engineering Department

COE 202: Digital Logic Design (3-0-3)
Term 111 (FALL 2011)
Major Exam 1
Thursday October 13, 2011

Time: 90 minutes, Total Pages: 6

Name:_____ ID:_____ Section: _____

Notes:

- Do not open the exam book until instructed
- **Calculators are not allowed** (*basic, advanced, cell phones, etc*.)
- Answer all questions
- All steps must be shown
- Any assumptions made must be clearly stated

Question	Maximum Points	Your Points
1	**22**	
2	**14**	
3	**14**	
4	**11**	
5	**14**	
Total	**75**	

Question 1. **(22 points)**

Convert the following numbers from the given base to the other uncrossed bases listed in the table (if needed, express fractions up to 3 digits only). Show your solution steps below the table.

Decimal	Binary	Octal	Hexadecimal	BCD (8421)
37.3	100101.010	45.2		
	1010101.011	125.3	55.6	
189.25	10111101.010	275.2	BD.4	
14	1110			00010100

Question 2. **(14 points)**

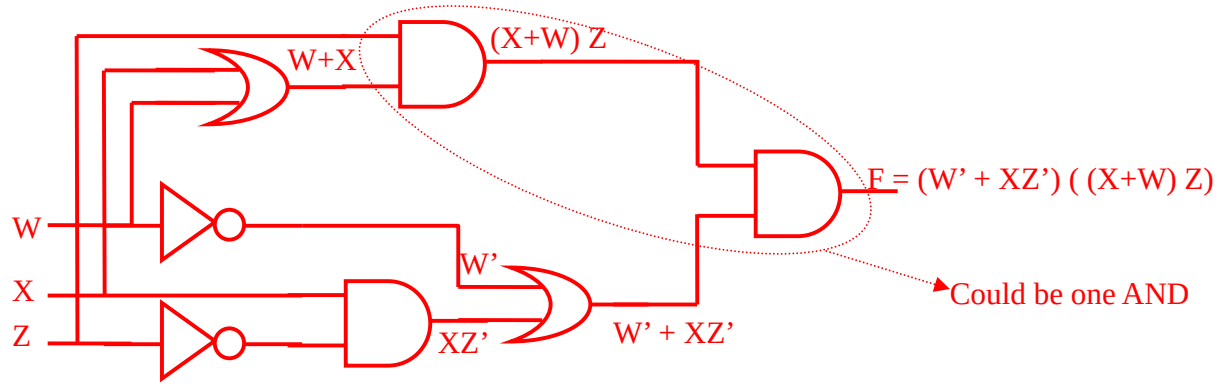
Perform the following arithmetic operations in the specified number system.

Octal Addition	Hexadecimal Subtraction	Binary Subtraction	Binary Multiplication
1 1 1 1775 +1734	9 19 FA3B - 27E9	11010011 - 10000101	1101 × 1100
3731	D252	01001110	0000 0000 1101 1101 10011100

Question 3. **(14 points)**

a. Draw the logic implementation of the function below (*use F as is*, ***do not simplify***):

$$F = \left(\overline{W} + X\ \overline{Z}\right)\left((X + W)\ Z\right)$$



b. Obtain the complement of the following function (***Don't Simplify***):

$$G(A,B,C,D) = A\left[B(\overline{C+D}) + \overline{B}C\overline{D}\right] + D$$

$$= \overline{A\left[B\ \overline{(C+D)} + \overline{B}C\overline{D}\right]} \bullet \overline{D}$$

$$= \left\{\overline{A} + \left[\overline{B\ \overline{(C+D)} + \overline{B}C\overline{D}}\right]\right\} \bullet \overline{D}$$

$$= \left\{\overline{A} + \left[\overline{B\ \overline{(C+D)}} \bullet \overline{\overline{B}C\overline{D}}\right]\right\} \bullet \overline{D}$$

$$= \left\{\overline{A} + \left[\overline{B} + \overline{(C+D)} \bullet (B + \overline{C} + D)\right]\right\} \bullet \overline{D}$$

$$= \left\{\overline{A} + \left[(\overline{B} + C + D) \bullet (B + \overline{C} + D)\right]\right\} \bullet \overline{D}$$

= {A' + [(B'+C+D)·(B+C'+D)]} · D'

c. *Using Algebraic manipulation*, simplify the following function to **three** literals:

$$H(A,B,C,D) = (B + C)\overline{(\overline{A} + D)} \quad + \quad \overline{D}\,(\overline{A}\,C + A\,\overline{B})$$

= (B+C)(AD') + A'CD' + AB'D'

= ABD' + ACD' + A'CD' + AB'D'

= AD' ~~(B+B')~~ + ~~(A+A')~~ CD'

= AD' + CD' = D' (A+C)

Question 4. **(11 points)**

I. Given the SOP Boolean function $F(x, y, z) = x + \bar{y}\,\bar{z}$

a. Express the function as a POS

F(x, y, z) = (x + y') (x + z')

b. Express the function as a sum of minterms

F = x(y + y')(z+z') + y'z'(x + x')
= xyz + xyz' + xy'z + xy'z' + x'y'z'
= Σm(0, 4, 5, 6, 7)

II. Given the function $F(A, B, C) = \sum m(0,2,3,4,6,7)$

a. Express F as a product of Maxterms → **Π**M(1, 5)
b. Give the ***algebraic*** product of Maxterms expression for F. → F=(A+ B +C')(A' +B+C')
c. Express $\bar{F}$ as a sum of minterms and product of Maxterms

F' = Σm(1,5) = **Π**M(0, 2, 3, 4, 6, 7)

Question 5. **(14 points)**

Fill in the Spaces: (Show all work needed to obtain your answer)

a. Given that $F(A,B) = A + \overline{A}B + \overline{A}\,\overline{B}$, then the function F is 1 at ___4___ (how many) rows in its truth table. 2

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

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

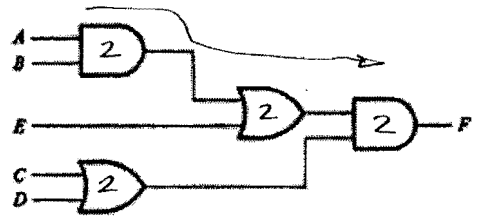
$= \underbrace{A+\overline{A}}_{1} + B = 1$

b. $F(A,B,C) = ABC + \overline{A}\,\overline{B}C + \overline{A}B\overline{C} = \Pi\, M(0,3,4,5,6)$ 2

$m_{111} + m_{001} + m_{010}$

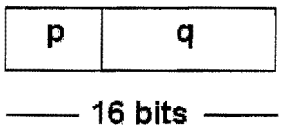
$= \Sigma(1,2,7)$

c. The logic circuit shown below is an example of ___3___ (how many) - level logic. If all gates have the same propagation delay of 2 ns, then the circuit takes ___6___ ns to produce the correct output. 2



d. Before sending the data 1011001 over a communication link using **even** parity, the transmitter appends a parity check bit equal to ___0___ (0/1) to it. 2

e. A 16-bit international character code consists of p bits to represent the language and q bits to represent the character. If no language requires more than 350 characters, then it is possible to support up to _____ (how many) languages.



350 chars → need 9 bits $(512 > 350 > 256)$ 3

$16 - 9 = 7$ bits for language → $2^7 = 128$ languages

f. For functions of the logic variables V, W, X, Y, Z, the maxterm M_3 is given in the algebraic form as $V + W + X + \overline{Y} + \overline{Z}$ 1

00011

g. The function $Y + \overline{X}\,\overline{Z} + X\,\overline{Y}$ can be simplified to the single maxterm: $X + Y + \overline{Z}$. 2

$Y + \overline{Y}X + \overline{X}\,\overline{Z}$

$= (Y+\overline{Y})(Y+X) + \overline{X}\,\overline{Z}$

$= Y + X + \overline{X}\,\overline{Z}$

$= Y + \underbrace{(X+\overline{X})}_{1}\cdot(X+\overline{Z})$

$= Y + X + \overline{Z} = X + Y + \overline{Z}$