Name:_____

Homework #2 Computer Organization
Due: Feb. 5, 2016 (Friday) by 4 PM

1. Assuming each ASCII character is store as a byte (8-bits) **<u>with the most-significant bit being used for even-parity</u>**, what would the string "Disk" be as a sequence of hexadecimal values. (For example, "cab" would be: 63_{16} $E1_{16}$ $E2_{16}$)

2. The following Hamming codeword contains 8-bits of data (D_7 to D_0), and four (P_8, P_4, P_2, and P_1) even-parity bits to allow for one-bit error detection and correction. Determine if an error has occurred and correct it if possible.

12	11	10	9	8	7	6	5	4	3	2	1
D_7	D_6	D_5	D_4	P_8	D_3	D_2	D_1	P_4	D_0	P_2	P_1
0	1	1	0	1	1	0	0	1	0	1	1
4+8	1+2+8	2+8	1+8	8	1+2+4	2+4	1+4	4	1+2	2	1

3. Determine the Hamming codeword if the 8-bits of data (D_7 to D_0) are $0101\ 1011_2$, i.e., what are the values of the four even-parity bits (P_8, P_4, P_2, and P_1) to allow for one-bit error detection and correction.

12	11	10	9	8	7	6	5	4	3	2	1
D_7	D_6	D_5	D_4	P_8	D_3	D_2	D_1	P_4	D_0	P_2	P_1
4+8	1+2+8	2+8	1+8	8	1+2+4	2+4	1+4	4	1+2	2	1

4. Let D = 1010110010110101_2 (16-bit data) with $G = x^4 + x^1 + 1$ is 10011_2 (degree 4 polynomial)

a) Determine the CRC remainder:

```
                    1
1 0 0 1 1 )1 0 1 0 1 1 0 0 1 0 1 1 0 1 0 1 0 0 0 0
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append 4 0's since G has 5 bits, so the remainder will have 4 bits

b) Determine the codeword sent which is the data appended with the remainder.

c) Divide the codeword by the generator $G = x^4 + x^1 + 1$ (10011_2) to check for an error. Remainder should be zero if no errors.

d) Introduce some random error into the codeword and check for an error by dividing by the generator $G = x^4 + x^1 + 1$ (10011_2)

Name:_____

5.

A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

Identity Name	AND Form	OR Form
Identity Law	$1x = x$	$0+x = x$
Null (or Dominance) Law	$0x = 0$	$1+x = 1$
Idempotent Law	$xx = x$	$x+x = x$
Inverse Law	$x\bar{x} = 0$	$x+\bar{x} = 1$
Commutative Law	$xy = yx$	$x+y = y+x$
Associative Law	$(xy)z = x(yz)$	$(x+y)+z = x+(y+z)$
Distributive Law	$x+yz = (x+y)(x+z)$	$x(y+z) = xy+xz$
Absorption Law	$x(x+y) = x$	$x+xy = x$
DeMorgan's Law	$(\overline{xy}) = \bar{x}+\bar{y}$	$(\overline{x+y}) = \bar{x}\bar{y}$
Double Complement Law	$\bar{\bar{x}} = x$	

For the Boolean function F represented in the truth table:

a) write the sum-of-products (SOP) Boolean expression (i.e., where the 1's are in the F column, F = $\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + ...$)

b) draw the unsimplified circuit for this SOP expression, **and** determine the number of gate delays and circuit complexity (# gates + # inputs into those gates)

c) using the identities of Boolean algebra (or a K-map) , simplify this function F as much as you can

d) draw the simplified circuit for your answer in part (c), **and** determine the number of gate delays and circuit complexity (# gates + # inputs into those gates) of this circuit