Computer Engineering 111
Test 1
September 21, 2009

Name _____

Nine problems, 100 points.

Closed books, closed notes, no calculators. You would be wise to read all problems before beginning, note point values and difficulty of problems, and budget your time accordingly. The order you should do the problems might be different than the order in which they appear.

Please do not open the test until I tell you to.

"This test sounds like fun!"

Good luck! Have fun! ☺

1. (15 points, 6 for part a and 9 for part b) Assume that the most significant bit below is the sign bit. Perform the following subtractions:

   a) using regular binary arithmetic (with borrows if necessary)

01010110	01010110	01010110
-01001111	-01101011	-01100111

b) the same numbers using 8-bit two's complement arithmetic

2. (7 points) a) Fill in the truth table below so that F = 1 if the input is expressing a valid BCD code, and F = 0, otherwise:

	ABCD	F
0.	0000	
1.	0001	
2.	0010	
3.	0011	
4.	0100	
5.	0101	
6.	0110	
7.	0111	
8.	1000	
9.	1001	
10.	1010	
11.	1011	
12.	1100	
13.	1101	
14.	1110	
15.	1111	

b) Write the expression for F in decimal notation:

F = • m( )

c) Write YOUR CHOICE of the answers below (1 point extra credit for getting both)

c.1) The canonical SOP expression for F is

F =

_____

c.2) The minimal SOP expression for F is:

F = _____

Hint: You might be able to tell it just from the truth table.

3. (11 total points)

a) (2 points) convert to hex and binary:

74036 (octal) = (binary) = (hex)

b) (2 points) convert to decimal:

10101101011 (binary) = (decimal)

c) (5 points) convert to binary, octal and hex:

8283.9375 (decimal) = (binary)

8283.9375 (decimal) = (octal)

8283.9375 (decimal) = (hex)

d) (2 points) convert to octal and hex

1101001010101.10010010001 (binary) = (octal) = (hex)

4. (4 points) Write down the number "9" in the following codes:

"Natural" BCD: _____

XS3: _____

5. (12 points points: 4 each for (a) and (d), 2 each for (b) and (c).) Replicate these operations, showing all steps, in binary:

a) 67.5 / 5 = 13.5.

b) 12 X 7 = 84.

c) 39 + 17 = 56.

d) (For this one, assume 8-bit 2's complement representation, i.e., subtract by adding): 93 – 37 = 56.

6. (14 points)

a) **(3 Points)** Find the 2s complement of the following 8-bit binary words.

10011001 01101010

b) **(4 Points)** Convert the following decimal value to its hexadecimal equivalent.

76

d) **(2 Points)** Convert these binary numbers to their octal equivalents.

1101 0101

f) **(5 Points)** Convert the following decimal value to its binary equivalent. Show your work.

0.8125

7. (19 points)

Assume an 8th bit, b7, serving as an odd-parity bit is added to the 7-bit ASCII Code (the table is given on the last page of this exam). Give the coded representation for the strings below as binary numbers.

a) (5 points) MST107

b) (4 points) Rolla

c) (2 points) express the answer from part a) in hex instead of binary

d) (2 points) express the answer from part b) in hex instead of binary

e) (3 points) Consider the following binary code. Circle the code(s) that correspond to an identified error.

11001101 11101001 11101110 11100101 11110010

f) (3 points) Now assume that the error is solely in the parity bit. (Usually that assumption is not justified, but for this problem it is.) Given this information, reconstruct the message given by the code in part e).

8. (12 points: 6 each) Simplify these Boolean expressions to minimal Sum-of-Product form:

(You must show all your work for full credit.)

a)

$$F = [\, AB'C' + AB + BC \,] \cdot (A + C')$$

b) $$F = \overline{[\, AB + AC' + AB'C' \,]}$$

9. (6 points)
Show that you can implement any circuit with only NAND gates. To do this, just redraw the AND, OR, and INVERTER (i.e., NOT) gates, in NAND logic.

This page is an extra sheet of scratch paper. Please don't use it for showing solutions, but refer to it on the problem page if you have work here that you are required to show on the problem, or that you otherwise believe needs to be considered in grading. You are permitted to tear off this sheet if there's nothing on here that you think needs to be considered.

Table 2.10 The 7-bit American Standard Code for Information Interchange (ASCII)

				$b_6b_5b_4$							
b_3	b_2	b_1	b_0	000	001	010	011	100	101	110	111
0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	STX	DC2	"	2	B	R	b	r
0	0	1	1	ETX	DC3	#	3	C	S	c	s
0	1	0	0	EOT	DC4	$	4	D	T	d	t
0	1	0	1	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	ACK	SYN	&	6	F	V	f	v
0	1	1	1	BEL	ETB	'	7	G	W	g	w
1	0	0	0	BS	CAN	(	8	H	X	h	x
1	0	0	1	HT	EM	)	9	I	Y	i	y
1	0	1	0	LF	SUB	*	:	J	Z	j	z
1	0	1	1	VT	ESC	+	;	K	[	k	{
1	1	0	0	FF	FS	,	<	L	\	l	|
1	1	0	1	CR	GS	-	=	M	]	m	}
1	1	1	0	SO	RS	.	>	N	^	n	~
1	1	1	1	SI	US	/	?	O	—	o	DEL

Control Characters

NUL	Null	DC1	Device Control 1
SOH	Start of Heading	DC2	Device Control 2
STX	Start of Text	DC3	Device Control 3
ETX	End of Text	DC4	Device Control 4
EOT	End of Transmission	NAK	Negative Acknowledge
ENQ	Enquiry	SYN	Synchronous Idle
ACK	Acknowledge	ETB	End of Transmission Block
BEL	Bell	CAN	Cancel
BS	Backspace	EM	End of Medium
HT	Horizontal Tab	SUB	Substitute
LF	Line Feed	ESC	Escape
VT	Vertical Tab	FS	File Separator
FF	Form Feed	GS	Group Separator
CR	Carriage Return	RS	Record Separator
SO	Shift Out	US	Unit Separator
SI	Shift In	SP	Space
DLE	Data Link Escape	DEL	Delete