5 pages. 10 problems. 100 points. No calculators. Show all work.

Problem 1 (5 points each).

(a) Convert 74_{10} to base-8.

(b) Convert $A5_{16}$ to base-10.

Problem 2 (5 points each). *Suppose you work in a school and all equipment that belongs to the school is assigned an item number. Suppose you get a new computer monitor, which is assigned item number 38673.*

(a) Compute a basic checksum for the item number.

(b) You're told to write the serial number including the checksum (as the last digit) on the back of the monitor. What do you write?

(c) Why would the school want to use checksums instead of just writing down the item number?

Problem 3 (5 points each).

(a) Write out the multiplication table mod 7.

(b) Which numbers don't *have square roots?*

(c) In mod 7 arithmetic, what is 3 divided by 4?

(d) Use the quadratic formula to find all solutions to $x^2 + 6x + 1 = 0$ mod 7. Simplify your solution down to specific numbers.

Problem 4 (5 points). *Write the following message in a 2-letter shift cipher:*
Hello World

Problem 5 (5 points). *Write out the truth table for "(A or B) and C".*

Problem 6 (5 points total). *Find the prime factors of the following numbers:*

(a) 23

(b) 333

Problem 7 (5 points each). *Let A be the phrase "if it is cold outside, then it is snowing".*

(a) What are the two pieces of A? Call them B and C.

(b) Write A as a Boolean expression involving B and C.

(c) Negate the Boolean expression from (b) and simplify.

(d) Write out "not A" in words, based on your answer in part c.

ASCII Chart

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

Problem 8 (10 points). *Decode from ASCII:* ▢▮▢▢▮▮▮▮▢▮▮▢▮▢▮▮ .

Problem 9 (5 points). *How many prime numbers are there?*

Problem 10 (5 points). *Answer in 20 words or less: what was your favorite Engineering Open House exhibit, and why?*