CS 240 Gates [78 points] **Your ID Number:**

About how many total hours did you spend actively working on this assignment? _____

Q1 [6 points] *Time spent on Q1:* _____

Truth Tables

A	B	C		P	Q
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

Unsimplified Boolean Expressions

P =

Q =

Q2 [6 points] *Time spent on Q2:* _____

Q3 [4 points] *Time spent on Q3:* _____

a [1] **Counterexample or explanation:**

- ☐ Equivalent
- ☐ Not equivalent

b [1] **Counterexample or explanation:**

- ☐ Equivalent
- ☐ Not equivalent

c [1] [Independent] **Counterexample or explanation:**

- ☐ Equivalent
- ☐ Not equivalent

d [1] [Independent] **Counterexample or explanation:**

- ☐ Equivalent
- ☐ Not equivalent

Q4 [5 points] *Time spent on Q4:* _____

a [2] bexp_4 =

b [3] circuit diagram:

Q5 [5 points] *Time spent on Q5:* _____

a [2] bexp_5 =

b [3] circuit diagram:

Q6 [12 points] *Time spent on Q6:* _____

Q6a [6 points] *Time spent on Q6a:* _____

Truth table

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

Derivation (you are given more rows than you need; box, underline, or color all redexes)

Simplification steps	Law(s) used to simplify redex in previous line
ABC + ABC' + A'C + A'B'C + AB'C	

Q6b [Independent] [6 points] *Time spent on Q6b:* _____

Truth table

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

Derivation (you are given more rows than you need; box, underline, or color all redexes)

Simplification steps	Law(s) used to simplify redex in previous line
A'B' + A'BC' + (A + C')'	

Q7 [10 points] *Time spent on Q7:* _____

Truth table for parts a [1] and c [1]

A	B	AB	A'B'	AB + A'B'	$bexp_{7b}$	AB + $bexp_{7b}$
0	0					
0	1					
1	0					
1	1					

Below, show steps in deriving the answer expressions

b [1] $bexp_{7b}$ =

d [2] $bexp_{7d}$ =

e [2] [independent]
$bexp_{7e}$ =

f [3] [Independent]
$bexp_{7f}$ =

Q8 [12 points] *Time spent on Q8:* _____

Q8a [6] Express XOR in terms of 2-input NAND gates. Show both the final circuit *and* your derivation/explanation *Time spent on Q8a:* _____

Q8b [Independent] [6] Express XOR in terms of 2-input NOR gates.
Show both the final circuit *and* your derivation/explanation *Time spent on Q8b:* _____

Q9 Decoding a T-Shirt [8 points] *Time spent on Q9:* _____

1a [2 points] Message in base of flag:

Hex pairs: `43 53 33 34 32 20 43 6f 6d 70 75 74 65 72 20 53 65 63 75 72 69 74 79`
ASCII:

Decoded message from base of flag:

1b [6 points] Message in binary bits of the flag. Write down the bits and show your decoding details.

Q10 Decoding a Unicode Message [12 points] *Time spent on Q10:* _____

2a [10 points] Show how to decode the Unicode message in the hex bytes `49 E2 99 A5 CF 80 21` to Unicode code points. Write the **message bits** corresponding to the hex bytes**,** distinguish **header** bits from **content** bits, and indicate **the number of bytes in each code point.** Show the **code points** determined by the content bits.

2b [2 points]. What would the message look like in a Unicode enabled application?