CS 240 Circuits Assignment [83 points] **ID Number:**

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

Q1 Decoding a T-Shirt [10 points] *Time spent on Q1:* _____

1a [3 points] Message in base of flag

1b [7 points] Message in binary bits of the flag. Write down the bits and show your decoding details

Q2 Decoding a Unicode Message [12 points] *Time spent on Q2:* _____

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?

Q3 Universal Muxification of Gates [14 points] *Time spent on Q3:* _____

3a NOT A (one 2:1 mux) [1]

3b. A AND B (one 2:1 mux) [1.5]

3c. A OR B (one 2:1 mux) [1.5]

3d A NAND B (two 2:1 muxes) [2]

3e A NOR B (two 2:1 muxes) [2]

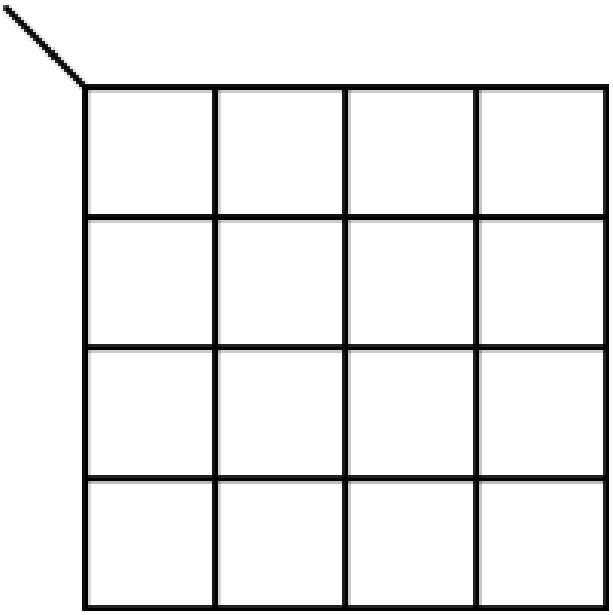
3f A XOR B (two 2:1 muxes) [3]

3g A XOR B (one 2:4 decoder and one 2:1 mux) [3]

4.. Switching Network [8 points] *Time spent on Q4:* _____

Q5 Karnaugh Maps [10 points] *Time spent on Q5:* _____

5a. Karnaugh Map [8 points]



5b. Minimal sum of products expression [2 points]

Q6 vALUe [29 points] *Time spent on Q6:* _____ Draw circuits on next page, text answers here.

6a(i-iv) Condition Flags [5 points]
(draw circuits on next page)

6b Result of the ALU when *Invert A = 1, Negate B = 1,* and *Operation ID = 10*. [4 points]

6c(i) [3 points] Three examples of A, B, where sign bit of A-B gives the **correct result** for A<B.

A	B	A - B	sign(A-B)	Is A < B?

6c(ii) [1 point] For what range of values for (A - B) (**before** modular arithmetic) does the approach work correctly?

6c(iii) [2 points] Two examples of A, B, where sign bit of A-B gives the **incorrect result** for A<B.

A	B	A - B	sign(A-B)	Is A < B?

6c(iv) [2 points] For what range(s) of values for (A - B) (**before** modular arithmetic) does the approach work **incorrectly**?

6c(v) [4 points] Draw your circuit for the Less-Than Flag on the next page and indicate the values of *Invert*, *Negate B*, and *Operation* for the operator A < B.

6c(vi) [2 points] Explain why your Less-Than Flag design is correct.

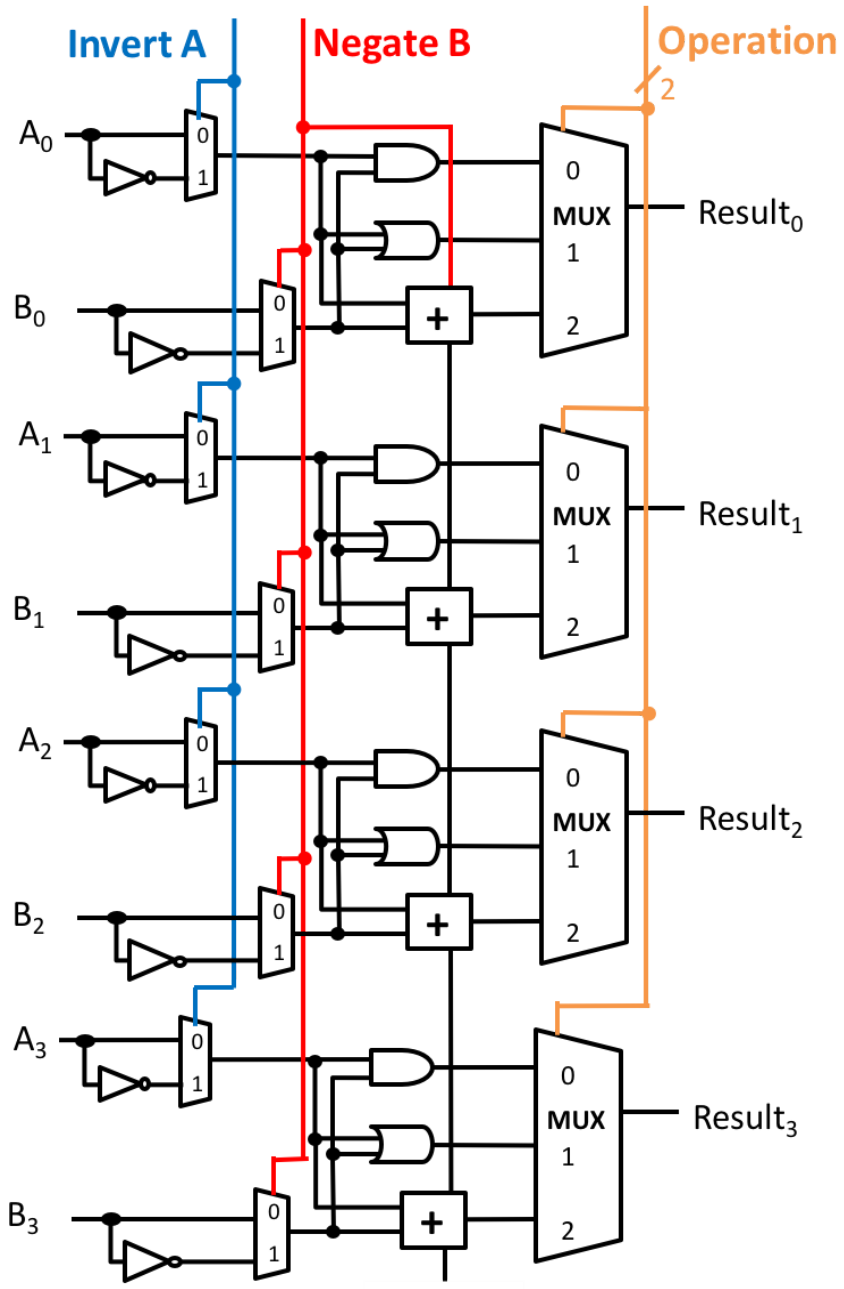
6d [3 points] Show your Equals Flag design on the next page and indicate the values of *Invert*, *Negate B*, and *Operation* for the operator A == B.

6e. [3 points] Argue that signed overflow can't affect the Equals Flag.

(i) If A = B:

(ii) If A ≠ B:

6a(i-iv) Condition Flags, **6c(v)** Less-Than Flag, **6d** Equals Flag. **Label outputs clearly.**



Q7 Base64 Encoding [Optional for Fun] *Time spent on Q7:* _____

Show how to encode the hex bytes `49 E2 99 A5 CF 80 21` as Base64 digits:

Base64 representation of the message: