

COMP278 FINAL

NAME: _____

Complete this exam within 2.5 hours. Read each question carefully. Write legibly and check your work. Good luck! Happy Holidays!

- (1) **Truth tables.** Complete the following table (fill in the blanks).

X	Y	$X \oplus Y$	_____	_____
0	0	_____	1	0
0	1	_____	1	0
1	0	_____	0	1
1	1	_____	1	0

- (2) **Logic expressions.** Using only **ANDs**, **ORs**, and **NOTs**, write a *logic expression* equivalent to:

$X \oplus Y$ _____

$\overline{X \oplus Y}$ _____

- (3) **DeMorgan's Law.** Prove $\overline{X \oplus Y}$ is the inverse of $X \oplus Y$ with DeMorgan's law.

(4) **Base conversion.** Convert these numbers to the specified base. Notation: $(digits)_{base}$

$$(1011111011101111)_2 \quad (\text{_____})_{16}$$

$$(135276)_8 \quad (\text{_____})_2$$

$$(135276)_8 \quad (\text{_____})_{16}$$

$$(120)_{10} \quad (\text{_____})_2$$

(5) **Boolean algebra.** Prove $ABC + ABC\bar{C} + A\bar{B} = A$

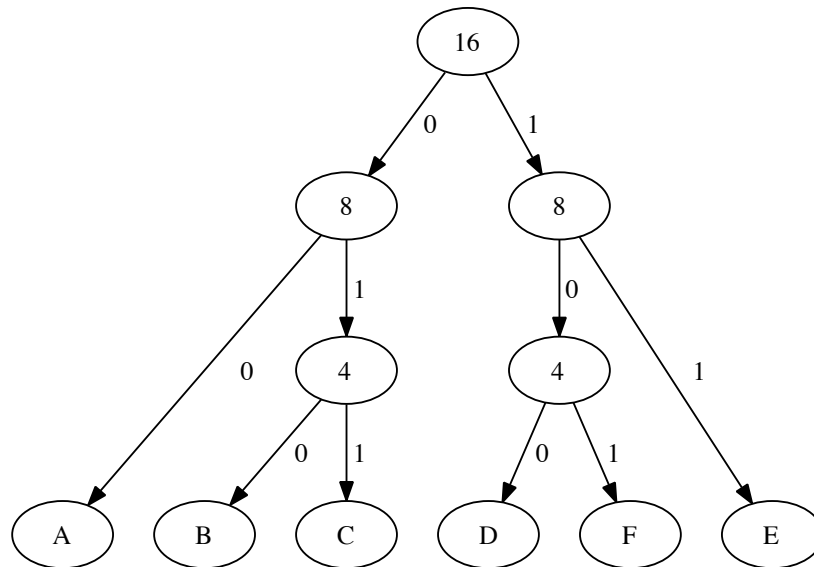
(6) **Binary arithmetic.** What is $(110110)_2 - (10011)_2$? _____
 Show how to perform subtraction using addition and 2's complement.

(7) **Huffman coding.** Convert hexadecimal ED FACED A CAFE BABE to binary.

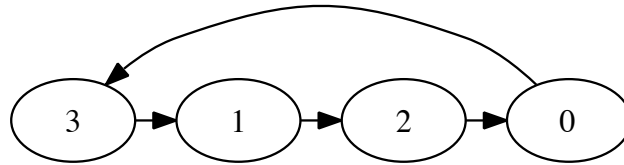
How many bits are in the number above? _____

Encode the message above using the Huffman tree below. (Ignore spaces)

How many bits are in the Huffman-encoded message? _____



(8) **Sequential logic.** Design the following counter.



- (a) Draw a truth table that relates the next state to the current state.
- (b) Draw this circuit using **ANDs**, **ORs**, **NOTs**, and two D-flip flops.

