Figure 1

HW1-Set Theory (ECE 313/ECE317, Fall 2023):

Problem 1:

Let the three sets A, B and C as shown in Figure 1 (Venn diagram). Shade the area representing each of the following sets.

1) $A \cup B \cup C$

2) $A \cap B \cap C$

3) $A \cap (B \cup C)$

4) $C \cup (A \cap B)$

5) $C - B$

6) $B - C$

7) $A - (B \cap C)$

8) $(A \cup B) - C$

9) $C \cap (A \cap B)^c$

10) $B \cup (C - B) \cup [A - (C \cup B)]$

Problem 2:

Let the subsets $A = \{11, 80, 10, 19, 14\}$, $B = \{10, 14, 20\}$ and $C = \{20, 10, 11, 5\}$ of the universal set $S = \{11, 80, 5, 10, 19, 3, 14, 20\}$.

1) Compute the following sets:

1) $A \cup B \cup C$

2) $A \cap B \cap C$

3) $(A \cap B \cap C)^c$

4) $(A \cup B \cup C)^c$

5) $A - (C \cap B)$

6) $C - (A \cup B)$

2) Verify the following two Morgan's laws (compute the two sets and check the equality between them):

- $(A \cup B \cup C)^c = A^c \cap B^c \cap C^c$

- $[(A \cap B) \cup C]^c = (A^c \cup B^c) \cap C^c$

Problem 3:
In a sample of 200 persons, 140 like tea, 95 like coffee, and 11 like neither. Using the set theory, find the following

1) How many people like tea or coffee?

2) How many people like both?

3) How many people like coffee only?

4) How many people like tea only?

5) How many people don't like tea?

6) How many people don't like coffee?

7) How many people don't like both coffee and tea?

8) How many people don't like coffee and don't like tea?

Problem 4:
A) Write in different ways the following sets:

1) $A \cup (B \cap C)$

2) $A - B$

3) $(A - B) \cap (A - C)$

4) $A - (B \cup C)$

5) $[A \cap (B^c \cap C^c)]^c$

6) $[(A \cap B) \cup (B \cap C)^c]^c$

7) $(A \cap B) \cup (A - B)$

8) $A \cup B \cup C$

9) $A \cup (B^c \cup C^c)^c$

B) Using the answer of 9), find $A \cup (B^c \cup C^c)^c$ in each of the following cases:

a) $B \cap C = \emptyset$.

b) $A \subset B$