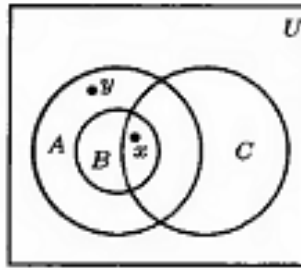# Assignment-1
Course: B.Tech 1st Year
Subject: Discrete Mathematical Structures (DMS)

1. Write the following sets in the set builder form: $\{x \mid P(x)\}$, where $P(x)$ is a property that describes the elements of the set:
   a) $A = \{1, 7, 5, 13, 9, 19, 13, 25, \ldots\}$
   b) $A = \{-2, -1, 0, 1, 2, \ldots\}$
   c) $A = \{2, 4, 7, 11, 16, 26, \ldots\}$
   d) $A = [-1,\ 5] \cap [-2,\ 3] \cup [1,\ 4]$

2. Use the Venn diagram, given below to identify each of the following as true or false:
   a) $A \subseteq B$, b) $B \subseteq A$, c) $C \subseteq B$, d) $x \in B$, e) $x \in A$, f) $y \in B$

3. For three given nonempty sets A, B, and C of which no two are disjoint, represent the following sets through appropriate Venn diagrams:
   a) $(A - B) \cap C$, b) $(A^c - B) \cap C$, c) $(A \cup B) \oplus (B \cap C)$, d) $A \oplus B \oplus C$,
   e) $A^c \cap B \cap C^c$, f) $(A \oplus B) - C$

4. Write down the power set of each of the following sets:
   a) $\{a, b, c\}$, b) $\{a, \{b, c\}\}$, c) $\{a\}$

5. Check the following identities for true or false and give proper justification (assume throughout that $\mathbb{R}$ is the universal set):
   a) $\mathbb{Z}^+ + \mathbb{Z}^- = \mathbb{Z}$, b) $(\mathbb{Z} - \mathbb{Z}^-) \cap \mathbb{N} = \{0\}$, c) $\mathbb{Q} \cup \mathbb{Z}^c \cup \mathbb{N} = (\mathbb{Z}^-)^c$

6. State the addition principle for three sets and verify it with the sets:
   $A = \{a, b, c, d, e, f, g, h\}$, $B = \{b, d, e, h, k, j, m, p\}$, $C = \{a, c, e, h, j, p\}$

7. Consider that $U = \{a,b,c,d,e,f,g,h\}$, $A = \{a,c,f,g\}$, $B = \{a,e\}$, $C = \{b,h\}$. compute the following:

      a) $A^c \cup B$, b) $A \cap B^c$, c) $A \oplus B$, d) $B \oplus C$

8. Prove the following set identities through the first principle as well as Venn diagram:

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

      b) $(A \cup B) \cap \left(A^c \cap B\right)^c = A$

      c) $A - B = A \cap B^c$

      d) $(A-B) - C = (A-C) - (B-C)$

      e) $(A-B) - C \subseteq A - C$

      f) $(B-A) \cup (C-A) \subseteq (B \cup C) - A$

      g) $(A \cup B) - (A \cap B) = (A-B) \cup (B-A)$

      h) $A \oplus B = A^c \oplus B^c$

      i) $A \cap (B \oplus C) = (A \cap B) \oplus (A \cap C)$

      j) $(A \oplus B) \oplus B = A$

9. Let, $A_i = \{1,2,3,\ldots,i\}$, $(\forall i = 1,2,3,\ldots)$. Find $\bigcup\limits_{i=1}^{n} A_i$ and $\bigcap\limits_{i=1}^{n} A_i$.

10. Let, $A_i = \{\ldots, -2, -1, 0, 1, \ldots, i\}$, $(\forall i = 1,2,3,\ldots)$. Find $\bigcup\limits_{i=1}^{n} A_i$ and $\bigcap\limits_{i=1}^{n} A_i$.

11. For: a) $A_i = \{i, i+1, i+2, \ldots\}$,   b) $A_i = \{0, i\}$, (for every positive integer i) find the sets representing: $\bigcup\limits_{i=1}^{\infty} A_i$ and $\bigcap\limits_{i=1}^{\infty} A_i$.

12. For the universal set $U = \{a,b,c,\ldots,o,p\}$, write the bit string representations for the sets: $A = \{a,b,c,d,e,f,g,h\}$, $B = \{b,d,e,h,k,j,m,p\}$, $C = \{a,c,e,h,j,p\}$. Then, compute the bit strings for the sets: $A \cup B$, $A \cap B$, $(A-B) - C$, $A \oplus B$, $B \oplus C$.

13. Write down a formula for the nth term of the following sequences:

      a) $1, -1, 1, -1, 1, \ldots$

      b) $0, 3, 0, 3, \ldots$

      c) $0, 3, 8, 15, 24, 35, \ldots$

      d) $2, 5, 8, 11, 14, 17, \ldots$

      e) $2, 5, 7, 12, 19, 31, \ldots$

      f) $2, 8, 14, 26, \ldots$

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