

**CSN-106: Discrete Structures**  
**(Autumn semester 2022-23)**

Name :

Tutorial

Date :

Enrollment No.:

Programme:

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1. **Question:** If A, B, and C are sets, then prove the following statements:

- if  $A \subseteq B$ , then  $A - C \subseteq B - C$
- if  $B \subseteq C$ , then  $A \times B \subseteq A \times C$
- $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$
- $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$

2. **Question:** Compute the following operations on defined function:

- If  $f(x) = x^2 + 2x$ ,  $g(x) = 2x - 3$  compute  $(f-g)(x)$ ,  $(f+g)(x)$ ,  $(fg)(x)$ .
- If  $f(x) = 2x^3 + 4x^2 + 2x + 1$ ,  $g(x) = x + 1$  compute  $(f-g)(x)$ ,  $(f+g)(x)$ ,  $(fg)(x)$ .

3. **Question:** Prove the following:

- $f(x) = \frac{1}{x}$  is one-to-one.
- $f(x) = x^n - x$  is one-to-one or not?
- $f(x) = 3x + 11$  is onto function.
- $f(x) = 3x^2 - 4x + 5$  is onto or not?

4. **Question:** Compute the Big-Oh of the following functions:

- $f(n) = 0.01n \log(n) + n(\log(n))^2$
- $f(n) = 100n \log(n^3) + n^2 + n \log(n^2)$
- $f(n) = 24n \log(n^2) + 78n \log(n^3)$
- $f(n) = 0.3n + 1.2n^{1.3} + n \log(n^2)$

5. **Question:** Prove that for any natural number  $n \geq 2$ ,

$$\frac{1}{2^2} + \frac{1}{3^2} + \cdots + \frac{1}{n^2} < 1.$$

Prove the above using mathematical induction.