CSE 230 Sec-2 and Sec-7
Practice sheet on **Chapter 1 and 2**

This practice sheet contains practice problems covering the following topics:

- Propositional Logic
- Predicate Logic
- Quantifiers
- Proofs
- Set & Functions
- Summations

Instructions:

- No soft copies allowed. **You have to submit hard copy of your work to me**. There will be a folder placed for submitting your work outside my room **UB50301.**

- **Deadline: Tuesday, October 30, 2018 at 5.00 PM**. So you can submit your work in Tuesday's Mid Term Exam. **Please make sure you hand it over to the invigilator before the exam starts.**

- **Late submission policy applicable for this submission.** For details on late policy check the course outline document provided to you in the very first class (also available on TSR).

Question Codes: (**B)** - Beginner, (**I)** - Intermediate, (**A)** - Advanced

Practice Problems:

1. Construct a truth table for each of the following compound propositions:
   a. $(p \leftrightarrow q) \oplus (\neg p \leftrightarrow q)$(B)
   b. $[(p \wedge q) \rightarrow (p \vee q)] \oplus (p \leftrightarrow r)$ (I)

2. Prove that the following statement is a tautology.

$$[\neg p \wedge (p \vee q)] \rightarrow q$$

   a. Prove using truth tables. (B)
   b. Prove without using truth tables (I)

3. Determine whether $(p \wedge q) \rightarrow (p \vee q)$ a tautology, contradiction or contingency is by developing a series of logical equivalences. (B)

4. Express the statements “Some student in this class has visited Sylhet” and “Every student in this class has visited either Sylhet or Cox’s Bazar” using predicates (B) and quantifiers (I). **[Similar to Example 24, Page - 42, Kenneth H. Rosen Book]**

5. Let $P(x)$, $Q(x)$, and $R(x)$ be the statements "x is a clear explanation," "x is satisfactory," and "x is an excuse," respectively. Suppose that the domain for x consists of all English text. Express each of these statements using quantifiers, logical connectives, and $P(x)$, $Q(x)$, and $R(x)$. (I)

a. All clear explanations are satisfactory.
b. Some excuses are unsatisfactory.
c. Some excuses are not clear explanations
d. Does (c) follow from (a) and (b)?

6. Show that the square of an even number is an even number using a direct proof. (B)

7. Prove that $\sqrt[3]{2}$ (cubic root of 2) is irrational. (A)

8. Consider the following sentences: i) All actors and journalists invited to the party are late, ii). There is at least a person who is on time and iii). There is at least an invited person who is neither a journalist nor an actor.

a. Formalize the sentences using quantifiers (I)
b. Prove that iii) is not a logical consequence of i) and ii). (A)

9. Out of 50 students who exercise regularly, 25 jog, 20 play basketball and 15 swim. 10 play basketball and jog, 5 play basketball and swim, 7 jog and swim and 2 people do all three. How many students do not do any of these activities? (B)

10. Let **P** be the set of all U. S. presidents, and let **G** be the set of all ordered pairs **(a, b)** in **P×P** such that **b** succeeded **a** in office. Is **G** the graph of a function? Explain your answer. (I)

11. You have three boxes of fruit. One contains just apples, one contains just oranges, and one contains a mixture of both. Each box is labeled -- one says "apples," one says "oranges," and one says "apples and oranges." However, it is known that none of the boxes are labeled correctly. How can you label the boxes correctly if you are only allowed to take and look at just one piece of fruit from just one of the boxes? (A)

12. A farmer is taking a fox, a chicken, and a bag of grain home. To get there, he must cross a river, but he's only allowed to take one item across the bridge with them at a time. If the fox is left alone with the chicken, the fox will eat the chicken. If the chicken is left alone with the grain, the chicken will eat the grain. How can the farmer cross the river without any of his possessions being eaten? (I)

13. If and only if you get 100% in final and do not cheat, then you will get a grade bump or A in the course. Write the statement in terms of p, q, r, s and find if it is a tautology or not. (I)

14. Write the following propositions as sensible English sentences: (I)
(a) ∃ x, scout(x) ^ cheats(x)
(b) ∀ x, punk(x) ⇒ cheats(x)
(c) ∀ x, scout(x) ⇒ ¬(punk(x) ∨ cheats(x))
(d) ∃ x, cheats(x) ^ ¬punk(x)

15. Find if these are *bijective* or not:

$$f_4(n) = \begin{cases} n-1, & \text{odd } n \\ n+1, & \text{even } n \end{cases}$$

$$f(n) = 2n + 1$$

16. Problem no. 18 page 162 of Rosen's book (summation problem).