



COMSATS UNIVERSITY ISLAMABAD (CUI)

DEPARTMENT OF COMPUTER SCIENCE

MIDTERM EXAMINATION FALL -2025

BS (CS)– -II SEMESTER

BS (SE)– -II SEMESTER

BS (DS/AI/CYS)– II SEMESTER

Course: CSC102-Discrete Structure Dated:

Maximum Marks: 25

Time Allowed: 90 Minutes

- All questions are self-explanatory and require no further explanations during exam time.
- Make sure that you have signed the attendance sheet before leaving the examination room.
- Return the question paper along with the answer sheet.
- Attempt all questions.

	Question 01 [10 Marks]					Question 02 [07 marks]			Question 03 [08 Marks]		
Part	1.1	1.2	1.3	1.4	1.5	2.1	2.2	3.1	3.2	3.3	3.4
Marks	01	02	01	04	02	04	03	02	02	02	02
Marks Obtained											

CLO – 1: Apply symbolic propositional and predicate logic to determine the most effective solutions of a given problem

Q.# 1. [Marks:10]

1.1. Find the negation of the following statement.

"If you pay your membership dues, then if you come to the club, you can enter free."

1.2. Write the following statement in English, using the predicates

$F(x)$: "x is a Freshman"

$M(y)$: "y is a math course"

$T(x, y)$: "x is taking y"

where x represents students and y represents courses:

$\neg \exists x [F(x) \wedge \forall y (M(y) \rightarrow T(x, y))]$.

1.3. Express the following specification using predicates and quantifiers

"Whenever at least one network link is operating, a 10-megabyte file can be transmitted".

1.4. A university is testing an AI-based attendance system for classrooms. The system works according to the following propositions:

i. **I**: "The AI system is working correctly."

ii. **S**: "The student is present in class."

iii. **C**: "The camera is turned on."

Check whether the following two statements are logically equivalent or not using Truth table

Statement 1:

"It is not true that either the camera is turned on, or the student is present and if the camera is not on then the AI does not work correctly."

Statement 2:

"The camera is not turned on, and either the AI system is working correctly, or the student is not present in class."

1.5. Let $P(x, y)$ denote "x is a factor of y" where $x \in \{1, 2, 3, \dots\}$ and $y \in \{2, 3, 4, \dots\}$. Let $Q(y)$ denote " $\forall x [P(x, y) \rightarrow ((x = y) \vee (x = 1))]$ ". When is $Q(y)$ true?

CLO-2: Apply formal logic proofs and reasoning to construct a sound argument

Q.# 2. [Marks:07].

2.1 Consider the following argument:

$$\begin{array}{l} p \rightarrow q \\ q \\ \therefore p \end{array}$$

We know that an implication is logically equivalent to its contrapositive, i.e.

$$p \rightarrow q \equiv \sim q \rightarrow \sim p$$

If we replace the *implication* in the above argument with its *contrapositive*, will the resulting argument be valid? Prove your answer with logical reasoning.

2.2 Consider the following premises:

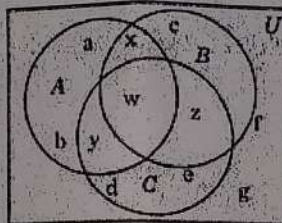
- i. If I go swimming, then I will stay in the sun too long.
- ii. If I stay in the sun too long, then I will get sunburned.

Using the appropriate *rules of inference*, derive the logical conclusion from the above premises. Show each step clearly with the rule(s) applied.

(CLO-3: Solve a computing problem using a specific set, function, or relation model.)

Q. # 3. [Marks:08].

Consider the following Venn Diagram



3.1 Determine the set $R = (A - B) \times (B \cap C)$.

3.2 Represent this relation (R) in **matrix form** M_R , where rows correspond to elements of $(A - B)$ and columns correspond to elements of $(B \cap C)$.

3.3 Draw the **directed graph** (digraph) of the relation $R = (A - B) \times (B \cap C)$.

3.4 Check whether the relation R is **anti-symmetric** or not.

End