



# 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.

Part	Question 01 [10 Marks]					Question 02 [07 marks]			Question 03 [08 Marks]		
	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*:

$$\begin{aligned} p &\rightarrow q \\ q \\ \therefore p \end{aligned}$$

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:

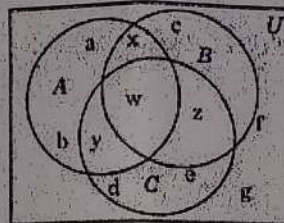
- i. If I go swimming, then I will stay in the sun too long.
- ii. If I stay in the sun too long, then I will get sunburned.

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*