



# COMSATS UNIVERSITY ISLAMABAD (CUI)

## DEPARTMENT OF COMPUTER SCIENCE MIDTERM EXAMINATION SPRING - 2026 BS (CS) - II SEMESTER BS (SE) - II SEMESTER BS (DS/AI/CYS) - II SEMESTER

Course: CSC102-Discrete Structure  
Maximum Marks: 25

Dated: April 16, 2026  
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]		
	1.1	1.2	1.3	1.4	1.5	2.1	2.2	3.1	3.2	3.3
Part										
Marks	01	03	01	02	03	04	03	02	03	03
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. Given that proposition  $p$  is false, proposition  $q$  is true, and proposition  $r$  is false, determine whether each proposition is true or false (Write T for true and F for False in the specified cell)

i.  $(p \vee \sim r) \wedge \sim((q \vee r) \leftrightarrow \sim(r \vee p))$

ii.  $(q \vee \sim r) \oplus ((p \wedge r))$

1.2. Let  $s$  = "The router can send packets to the edge system".

$a$  = "The router supports the new address space".

$r$  = "The latest software release is installed."

Determine the "truth value" of above propositions so that the following system specifications must be consistent (i.e., all given statements form must be true simultaneously).

*"The router can send packets to the edge system only if it supports the new address space. For the router to support the new address space it is necessary that the latest software release be installed. The router can send packets to the edge system if the latest software release is installed. The router does not support the new address space."*

1.3. Let  $Q(x, y)$  be the statement " $x$  has sent an e-mail message to  $y$ " where the domain for both  $x$  and  $y$  consist of all students in your class. Express the following quantification in English.

$$\forall x \exists y Q(x, y)$$

1.4. Let  $S(x)$  be the predicate " $x$  is a student,"  $F(x)$  the predicate " $x$  is a faculty member," and  $A(x, y)$  the predicate " $x$  has asked  $y$  a question," where the domain consists of all people associated with your University. Use quantifiers to express the following statement.

*There is a faculty member who has never been asked a question by a student.*

1.5. Write the statement  $p \rightarrow (\sim q \wedge r)$  using only the connectives  $\sim$  and  $\wedge$ .

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

Q.# 2.

Marks: 07]

2.1. Use a truth table to determine whether the following argument is valid or invalid.

If I got an Eid bonus, I'll buy a stereo.

If I sell my motorcycle, I'll buy a stereo.

∴ If I get an Eid bonus or I sell my motorcycle, then I'll buy a stereo.

2.2. Prove that if  $n = ab$ , where  $a$  and  $b$  are positive integers, then  $a \leq \sqrt{n}$  or  $b \leq \sqrt{n}$ .

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

Q. # 3.

[Marks:08].

3.1 An AI-based recruitment system is used by a company to shortlist candidates based on test scores. Let the universal set  $U = \{x: x \text{ is an integer less than } 22\}$  represent all candidate test scores.

Set  $A = \{x: x \text{ is a prime number less than } 20\}$  represents candidates selected by the AI for a special talent pool based on unique scoring patterns. Set  $B = \{x: a < x < b\}$  represents candidates whose scores fall within a specific range defined by the recruiter. Find two different pairs of values of  $a$  and  $b$  such that no candidate is selected in both sets  $A$  and  $B$ , i.e.,  $A \cap B = \emptyset$ .

3.2 Let  $A = \{a, b, c\}$  and the following relations be defined on  $A$ :

$$R_1 = \{(a, b), (b, c), (c, a)\}$$

$$R_2 = \{(a, a), (b, a), (b, c), (c, c)\}$$

$$R_3 = \{(a, b), (b, b), (b, c), (c, a)\}$$

- Add the minimum number of ordered pairs to  $R_1$  to make it *reflexive*.
- Add the minimum number of ordered pairs to  $R_2$  to make it *symmetric*.
- Add the minimum number of ordered pairs to  $R_3$  to make it *transitive*.

3.3 A group of 68 elderly men failed a medical test due to defects in at least one of the following organs: heart, lungs, and kidneys. 30 men have heart disease, 30 men have lung disease, 33 men have kidney disease, 7 men have both heart and lung diseases, 10 men have both lung and kidney diseases, 11 men have both heart and kidney diseases.

a) Draw a Venn diagram to represent the information given.

b) Find the number of elderly men who:

(i) suffer from all three diseases

(ii) suffer from only lung disease.

*End*