



COMSATS University, Islamabad

Department of Computer Science
Terminal Examination, FALL 2024

Class: BCS, BSE, BAI, BDS, BCT
Semester: 1st
Subject: CSC102 – Discrete Structures
Instructions:

Date: 13-January-2025
Time Allowed: 180 Minutes
Marks: 50

- I. Answer all Questions.
- II. Return Question Paper along with the Answer Sheet.
- III. Understanding Question Paper is part of the Exam.

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

Q. 1:

- a) Rewrite the statement form without using the symbols $\rightarrow$ or $\leftrightarrow$ using laws. [2]
 $(p \leftrightarrow r) \rightarrow (q \leftrightarrow r)$
- b) For each of these collections of premises, what relevant conclusion or conclusions can be drawn? Explain the rules of inference used to obtain each conclusion from the premises. [1.5]
"If I eat spicy foods, then I have strange dreams."
"I have strange dreams if there is thunder while I sleep."
"I did not have strange dreams."
- c) 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 school. Use quantifiers to express the statement given below. [1.5]
"Some student has not asked any faculty member a question."

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

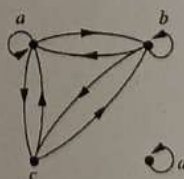
Q. 2:

- a) Prove that the following statement is true for all integers n, using the definitions of even integer and odd integer: If $7n - 5$ is odd, then n is even. [3]
- b) Prove by contradiction that $\sqrt{2}$ is irrational. [3]
- c) Show that $10^{2n-1} + 1$ is divisible by 11 for all natural numbers using the principle of mathematical induction. [3]

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

Q. 3:

- a) Show that if A, B, and C are sets, then $(A \cap B \cap C)' = A' \cup B' \cup C'$ using a membership table. [2]
- b) Determine whether the relation with the directed graph shown below is a reflexive, symmetric or anti-symmetric relation. [3]



$A \cap B \quad (A \cap B \cap C) \quad [3]$
 $A \quad B \quad C \quad A' \quad B' \quad C' \quad A' \cup B' \cup C'$

Q. 4:

- a) Determine whether the function $f(x) = (x^2 + 1)/(x^2 + 2)$ is a bijection from $\mathbb{R}$ to $\mathbb{R}$. [3]
- b) Find $f \circ g$ and $g \circ f$, where $f(x) = x^2 - 2$ and $g(x) = 3x + 4$, are functions from $\mathbb{R}$ to $\mathbb{R}$. [2]
- c) If the total sum of the first n natural numbers exceeds 200 but is less than 300, find the value(s) of n. [2]

sum of
n natural nos.

$$300 \geq 1 + 2 + 3 + \dots + n \geq 200$$
$$1, 2, 3, \dots, n$$
$$S_n = \frac{n}{2} (1 + n) \quad S_n = \frac{n(n+1)}{2}$$

$$\frac{26 \cdot 25 \cdot 24 \cdot 23 \cdot \dots}{A-2 \quad 0-9} \quad 2$$

CLO-4 Solve real-world problems using recurrence relation and counting formalisms.

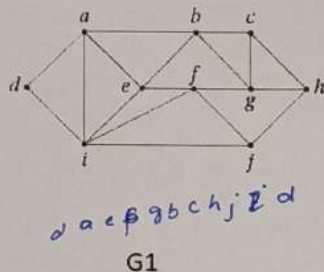
Q. 5:

- a) A password must be 8 characters long, where the first 4 are letters (A-Z) and the last 4 are digits (0-9). How many passwords can be created if no letter can repeat, and at least one digit must be odd? [4]
- b) Suppose that a department contains 10 men and 15 women. How many ways are there to form a committee with six members if it must have the same number of men and women? [4]

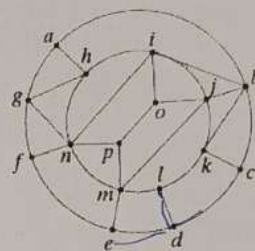
CLO-5 Solve real-world problems in computer science using appropriate forms of graphs and trees.

Q. 6:

- a) Determine whether the graphs G1 & G2 have a Euler cycle (Circuit) and Hamiltonian Cycle. If the graphs have a Euler & Hamiltonian cycle, **exhibit one**, otherwise explain the reasons for not having one. [5]

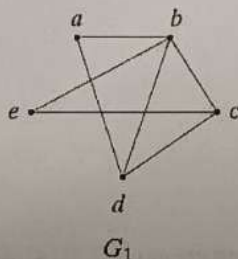


G1

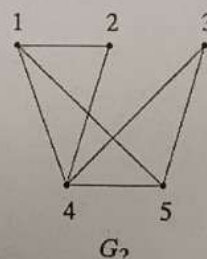


G2

- b) Determine whether the graph G1 and G2 are isomorphic or not? [8]

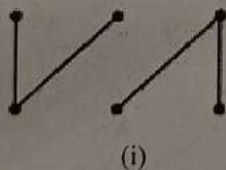


G1

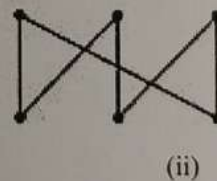


G2

- c) Find if the following graphs are tree or not? [3]



(i)



(ii)



(iii)

Best of Luck