COMSATS University, Islamabad

Department of Computer Science

Terminal Examination, FALL 2024

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

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

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

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 → or ↔ 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]**

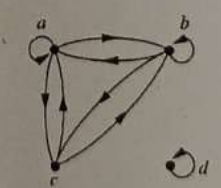
c) Show that *$10^{2n-1} + 1$ is divisible by 11* for all natural numbers using the principle of mathematical induction. **[3]**

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

Q. 3: **[2]**

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.

b) Determine whether the relation with the directed graph shown below is a reflexive, symmetric or anti-symmetric relation. **[3]**



Q. 4:

a) Determine whether the function $f(x) = (x^2 + 1)/(x^2 + 2)$ is a bijection from **R** to **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 **R** to **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]**

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

Q. 5: [4]

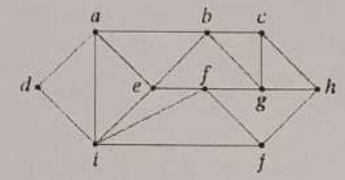
a) A password must be 8 characters long, where the first 4 are letters (A-Z) and the last 4 are digits (0-9). How many passwords can be created if no letter can repeat, and at least one digit must be odd?

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]

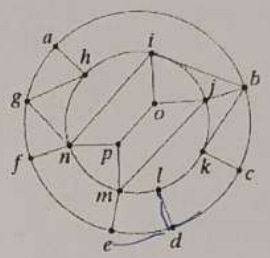
CLO-5 Solve real-world problems in computer science using appropriate forms of graphs and trees.

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]

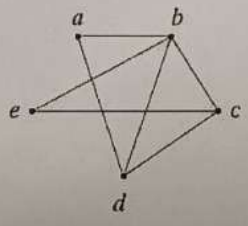


G1

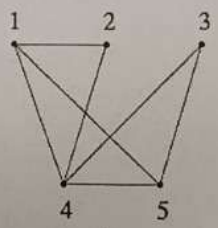


G2

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



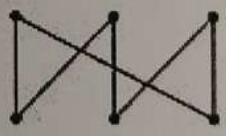
G_1



G_2

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

(i)



(ii)

(iii)

----------Best of Luck----------