National University of Computer and Emerging Sciences
Lahore Campus

Discrete Structures (CS1005)

Date: 04-01-2025

Course Instructors

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Final Exam

Total Time: 3 Hours

Total Marks: 75

Total Questions: 5

Roll No _____ _____ Student Signature

Attempt all questions. Attach question paper to the answer sheet.

CLO #1: Express statements in terms of predicates, quantifiers and logical connectives.

Q. No 1: [15=5+10]

a. Show that $(p \to q) \land (q \to r) \to (p \to r)$ is a tautology.

b. Translate each of these statements into logical expressions using predicates, quantifiers, and logical connectives.

1) All tools are in the correct place and are in excellent condition.
2) Nothing is in the correct place and is in excellent condition.
3) The negation of a contradiction is a tautology.
4) There is no one in this class who knows French and Russian.
5) At least one of your friends is perfect.

CLO #3: Apply fundamental concepts of number theory, such as divisibility, greatest common divisors, modular arithmetic, prime numbers, and congruences.

Q. No 2: [15=5+10]

a. Use the extended Euclidean algorithm to express $\gcd(252, 356)$ as a linear combination of 252 and 356.

b. Use the construction in the proof of the Chinese remainder theorem to find all solutions to the system of congruences $x \equiv 1 \pmod{2}, x \equiv 2 \pmod 3, x \equiv 3 \pmod 5,$ and $x \equiv 4 \pmod{11}$.

CLO #4: Apply mathematical induction to prove properties of sequences.

Q. No 3: [15=5+5+5]

a. Prove that $2^n > n^2$, if n is an integer greater than 4.

b. Let m be an integer with $m > 1$. **i.** Show that the relation $R = \{(a, b) \mid a \equiv b \pmod{m}\}$ is an equivalence relation on the set of integers.

c. Find the transitive closure of $\{(1, 1), (1,4), (2,1), (2,3), (3,1), (3, 2), (3,4), (4, 2)\}$ on $\{1, 2, 3, 4\}$.

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CLO #4: Apply mathematical techniques to solve recursive relation.

Q. No 4:   [15=5+10]

a. Solve these recurrence relations together with the given initial conditions.

Home

$$a_n = -6a_{n-1} - 9a_{n-2} \text{ for } n \geq 2, \ a_0 = 3, \ a_1 = -3$$

b. How many different messages can be transmitted in n microseconds using three different signals if one signal requires 1 microsecond for transmittal, the other two signals require 2 microseconds each for transmittal, and a signal in a message is followed immediately by the next signal?[Use appropriate technique to find general solution of linear homogeneous recurrence relation).

CLO #6: Apply graph theory concepts to compute network related metrics and develop solutions for computing applications related to the program.

Q No 5:   [15=5+10]

a. Determine whether the given pair of graphs is isomorphic or not. Justify your answer.
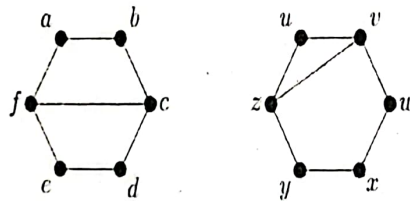
b. Define the following terminologies with one example for each term, **i.** Bipartite Graph **ii.** Wheel **iii.** Complete Graph **iv.** Degree sequence **v.** Directed Graph

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