University of Information Technology & Sciences (UITS)
Faculty of Science and Engineering
Department of Computer Science and Engineering
Program: B.Sc. in CSE
Term Final Examination, Spring - 2025
Course Title: Discrete Mathematics
Course Code: CSE 0541123

Marks: 50   Time: 3 *(three)* hours

(Answer all questions)

1. a) Let Q(x) be the statement "3x + 1 > 2x." If the domain consists of all integers, find the truth values of the following statements and explain with an example.   [05]
   a) Q(−1)   **b)** ∃xQ(x)   **c)** ∀xQ(x)
   d) ∃x ¬ Q(x)   **e)** ∀x ¬ Q(x)

   b) Translate these statements into English, where R(x) is "x is a leopard" and H(x) is "x jumps" and the domain consists of all animals.   [05]
   a) ∀x(R(x) → H(x))   **b)** ∀x(R(x) ∧ H(x))
   c) ∃x(R(x) → H(x))   **d)** ∃x(R(x) ∧ H(x))
   e) ∃x(H(x) → R(x))

   $L(x) = R(x)$
   $J(x) = H(x)$

2. a) Prove that if n is a composite integer then it has a divisor not great than $\sqrt{n}$.   [05]

   b) For the sum $1 + 3 + 5 + \ldots + (2n − 1)$, formulate a hypothesis and prove it by induction.   [05]

3. a) Let A = {1, 2, 4, 5, 6, 7, 8} and B = {1, 2, 3, 7, 9}. Find -   [05]
   a) A ∪ B.   **b)** A ∩ B.   **c)** A − B.   **d)** B − A.   **e)** (A − B) ∪ (B − A)

   b) Define function. Explain with example each of the following functions from N to N that is -   [05]
   a) one-to-one but not onto.
   b) onto but not one-to-one.
   c) both onto and one-to-one.
   d) neither one-to-one nor onto.

4. a) Contradict the hypothesis that there are exactly k primes.   [05]

   b) Prove that any integer $n \geq 1$ can be represented using 0's and 1's in decimal number system.   [05]

5. a) Consider the following congruences –   [05]
   x ≡ 3 (mod 5)   x ≡ 1 (mod 7)   x ≡ 1(mod 3)
   Calculate the value of x using Chinese Remainder Theorem.

   b) Using shift cipher with k=5 that is f(p)=(p+5) mod 26 produce the secret message for "SEE YOU AFTER THE CLASS IN THE PARK".   [05]