0201

National University of Computer and Emerging Sciences

Lahore Campus

Discrete Structures (CS1005)

Date: September 23rd 2024

Course Instructors

Dr. Saeeda Zia

Dr. Tahir Ejaz

Dr. Imran Nadeem

Mr. Amjad Ali

Ms. Hina Dilawer

Ms. Laila Yawar

Sessional-I Exam
Total Time: 1 Hour
Total Marks: 30
Total Questions: 03

Roll ... Section Student Signature

Attempt all questions. Attach question paper with answer sheet.

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

Q. No 1:

i) Write the following English sentences in symbolic form. [5]

a) Jack did not eat chocolate, but he did eat broccoli.
b) You can see the movie only if you are over 18 years old or you have the permission of a parent.
c) I will take tomorrow's flight or I will go out with my friends to the beach.
d) For the Nadir Software to have the smallest net profit it is necessary and sufficient that the Acme Computer to have the largest annual revenue.
e) Whenever I have to catch a connecting flight neither I am late nor I am sick.

$q \to p$ $\neg p \to \neg q$

ii) Write following statement in the form of if p then q. Also, write converse, inverse and contrapositive.

$\neg q \to \neg p$ "This door will not open unless a security code is entered." [5]

CLO #2: Apply formal logic proofs, logical reasoning to practical problems related to offered program.

Q. No 2: [5]

i) Use rules of interference and quantifiers to determine if the following argument is valid, "If I graduate this semester, then I will have passed the physics course.", "If I do not study physics for 10 hours a week, then I will not pass physics.", and "If I study physics for 10 hours a week, then I cannot play volleyball."

Therefore, "If I play volleyball, I will not graduate this semester."

$p \to q$
$\neg r \to \neg q$
$r \to \neg t$
$t \to \neg p$

ii) Let $n \in \mathbb{Z}$. Use an indirect proof to show that if $n^3 + 5$ is odd, then n is even. [5]

Proof
$\neg t \to \neg q$

(n is odd, n^3+5 is even.)
Contrapositive.

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Q. No 3:

i) Use Laws of equivalence to prove the compound proposition [5]

$$(p \rightarrow q) \wedge (\sim q \wedge (r \vee \sim q)) \equiv \sim (p \vee q)$$

ii) Answer the following questions. [5]

a) Find truth value of $\forall x \forall y((x^2 = y^2) \rightarrow (x = y))$, where the domain for all variables consists of all integers. Give a counter example if it is false.

b) Use quantifiers and predicates with more than one variable to express these statements.

$\exists x\, P_x \rightarrow Q(x)$ 1) There is a student in this class who can speak Hindi.

$\forall x\, P_x \rightarrow Q(x)$ 2) Every student in this class plays some sport.

$\forall x\, P(x) \rightarrow Q(x)$ 3) All students in this class have learned at least one programming language.

c) Translate the nested quantification $\forall x \forall y \exists z(x + y = z)$ into an English statement that expresses a mathematical fact. The domain consists of all real numbers.