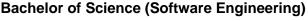


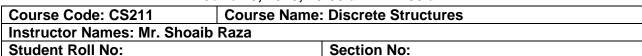
## National University of Computer & Emerging Sciences, Karachi

# Spring-2020 - Department of Computer Science





June 10, 2020, 10:00 am - 11:00 am



#### **Instructions:**

- Read each question completely before answering it. There are 3 questions and 2 pages.
- In case of any ambiguity, you may make assumption. But your assumption should not contradict any statement
  in the question paper.
- Answer all the questions in given sequence of the question paper. Step by step solution is required.
- Write your NU ID on the top of every page of answer script. Answer script should be of A4 size.
- Scan your answer script properly. If I can't read the text then I can't grade it.

Total Time: 60 minutes Maximum Marks: 26

#### Question # 1 (Propositional Logic and Rules of Inference)

[5x2=10 points]

(i) Consider the following propositions:

p: Zafar is a Doctor. q: Zafar is an advisor to prime minister.

*r*: Zafar is healthy man. s: Zafar do not eat junk food.

Express these statements using the propositions p, q, r and s together with logical connectives (including negations).

- (a) "If Zafar is a doctor, then he is an advisor to prime minister."
- (b) "If Zafar is healthy man then he does not eat junk food."
- (c) "If Zafar is an advisor to prime minister then he is healthy man."
- (ii) Write in English, the contrapositive of (a), inverse of (b) & converse of (c) using the statements given in part (i).
- (iii) Using the premises(statements) from part(i), apply rules of inference to obtain conclusion(s) from these premises.
- (iv) Determine whether the following two propositions are logically equivalent:  $a \to (\neg b \to c)$  and  $\neg a \lor \neg (c \to b)$ .
- (v) Prove the following logical equivalence using the laws of logic:  $\neg$  ( $X \leftrightarrow Y$ ) and  $X \leftrightarrow \neg Y$

#### **Question # 2 (Predicate and Quantifiers)**

[3x2=6 points]

(i) Assume that the universe for p is all the kids and the universe for q is the set of all cartoon movies. Write the English statement using the following predicates and any needed quantifiers:

B(p, q): p saw q,

A(q): q won an award,

C(q): q is a comedy.

- a) Some kids have seen every comedy.
- b) Bilal has never seen a movie that won an award.
- (ii) Let F(a, b) means "a + 2b = ab", where a and b are integers. Determine the truth value of the statement.
- a)  $\forall a \exists b F (a, b)$ .
- b) ¬ ∀a ∃b ¬F (a, b).

- (iii) Suppose the variable a represents students and b represents courses, and:
- R(b): b is an aeronautics course, Q(a): a is a freshman, P(b): a is a full-time student, S(a, b): a is taking b. Write the statement in good English without using variables in your answers.
- a) ∀a ∃b S (a, b).
- b)  $\forall a \exists b [(P(a) \land Q(a)) \rightarrow (R(b) \land S(a, b))].$

### **Question # 3 (Set theory and Functions)**

[5x2=10 points]

- (i) Using Set identities, prove or disprove the following set operations:  $P (Q \cap R) = (P Q) \cap (P R)$ .
- (ii) Using Venn diagram, determine how many like both cold drinks and hot drinks. If in a group of 1000 people, 370 like cold drinks and 720 like hot drinks and each person likes at least one of the two drinks.
- (iii) Find three subsets of {a, b, c, d, e, f, g, h} such that the intersection of two (any two combinations) has size (cardinality) 3 and the intersection of all three has size 2.
- (iv) Suppose  $g: A \to B$  and  $f: B \to C$  where  $A = \{1, 2, 3, 4\}$ ,  $B = \{a, b, c\}$ ,  $C = \{2, 7, 10\}$ , and f and g are defined by  $f = \{(a, 10), (b, 7), (c, 2)\}$  and  $g = \{(1, b), (2, a), (3, a), (4, b)\}$ . Is Function f and g invertible? If yes find  $f^{-1}$  and  $g^{-1}$  or if not why?
- (v) How many functions are there from a set with five elements to a set with three elements?

