



# United International University

## Department of Computer Science and Engineering

CSE 2213/CSI 219: Discrete Mathematics  
Mid-term Examination : Fall 2021  
Total Marks: 30      Time: 1 hour 45 minutes

Answer all the 5 questions. Numbers to the right of the questions denote their marks.

1. (a) Find the inverse, converse and contrapositive of the following sentence: [0.5×3=1.5]  
“People feel stressed when they have a lot on their plate.”  
(b) Prepare the truth table for the following compound proposition: [2.5]  
$$(\neg p \leftrightarrow \neg q) \leftrightarrow (q \leftrightarrow r)$$
  
(c) Using propositional laws, prove that  $(p \rightarrow q) \rightarrow r$  and  $(\neg r \rightarrow p) \wedge (q \rightarrow r)$  are logically equivalent. [2]
2. (a) Consider the following predicates:  
 $T(x) : x$  is a teacher of CSE.  
 $L(x) : x$  is a Lecturer.  
 $D(x) : x$  teaches Discrete Mathematics.  
 $S(x, y) : x$  is the substitute teacher of  $y$ .  
Represent the following statements using the above predicates, quantifiers and logical connectives. The domain of all variables consists of all people of the world. [1×3=3]
  - i. Some teachers of CSE are Lecturers.
  - ii. All teachers of CSE teach Discrete Mathematics.
  - iii. The substitute of some Discrete Mathematics teachers of CSE are some lecturers.  
(b) State and explain the truth values of each of the following expression, where the domain of all variables is all real numbers. [1×3=3]
  - i.  $\forall x \exists y (x^2 = y)$
  - ii.  $\exists x \forall y (xy = 0)$
  - iii.  $\forall x \forall y \exists z (z = \frac{x+y}{2})$
3. (a) Suppose  $A \subset B$ . Determine whether the following statements are true or false (with reasoning): [1.5×2=3]
  - i.  $B' \subset A'$
  - ii.  $B - A = \emptyset$  
(b) Suppose you have two sets  $A = \{1, 2\}$  and  $B = \{a, b\}$ .
  - i. Determine  $A \times B$ . [1]
  - ii. Find the power set  $P(A \times B)$ . [1]
  - iii. Show that  $|P(A \times B)| = 2^{|A||B|}$ . [1]
4. (a) Find  $f \circ g$  and  $g \circ f$ , where  $f(x) = \frac{1}{x} - \frac{2}{x+1}$  and  $g(x) = \frac{x-1}{x+2}$  are functions from  $R$  to  $R$ . [2]  
(b) Determine if the following functions are invertible with necessary explanation: [2×2=4]
  - i.  $f : Z^+ \rightarrow R, f(x) = \frac{x-1}{x+1}$
  - ii.  $f : R - \{1\} \rightarrow R, f(x) = \frac{1}{x-1}$
5. (a) Prove the following statement using a direct proof: [3]  
“If  $n$  is a multiple of 3, then  $2n + 3$  is a multiple of 3.”  
(b) Prove the following statement using a proof by contradiction: [3]  
“The product of a non-zero rational number and an irrational number is irrational.”