United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Mid: Spring - 2023

Course: CSE 2213 Name: Discrete Mathematics

Marks: 30, Time: 1 hour 45 minutes

Figures in the right-hand margin indicate full marks.

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules

There are 2 pages in this question paper

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1. a) Consider the following propositions, **[3]**

a: Argentina wins the match
b: Brazil goes to semi-final
e: Emi Martinez plays well
f: France wins the match
m: Mbappe plays well

Now using the logical operators formulate the following compound propositions:

i) If Brazil goes to semi-final, then neither Argentina nor France will win the match.

ii) For Argentina to win the match, Emi Martinez must play well

iii) Both Mbappe and Emi Martinez play well, but either only Argentina or France will win the match.

b) Determine whether **((p v q) ∧ (r v ¬q)) → (p v r)** is a tautology or not by using different logical equivalence laws. **[3]**

2. a) Express the following statements using the given predicates and quantifiers: **[3]**

Domain : All People

Given Predicates:

$A(x) \equiv x \text{ is Roman}$

$B(x) \equiv x \text{ loves ice cream}$

$C(x) \equiv x \text{ is rich}$

$D(x) \equiv x \text{ has a lot of friends}$

i) Romans are rich.

ii) Some ice cream lovers do not have a lot of friends.

iii) People that are rich hate ice cream.

b) Explain with reasoning whether the following propositions are true or false. The domain of all the variables is the set of real numbers. **[1.5*2]**

i) $\forall x \exists y \exists z\ (z = x * y)$

ii) $\forall x \forall y \exists z\ (z = (x + y)/2)$

3. **a)** Prove the following proposition using **contradiction** principle: **[3]**
There are no integers a, b, and c for which 2a + 4b + 6c = 1

b) Prove the following proposition using **contrapositive** principle: **[3]**
Let p, q be integers. If p(q+1) is odd, then at least one of p OR q is odd.

4. **a)** **[3]**

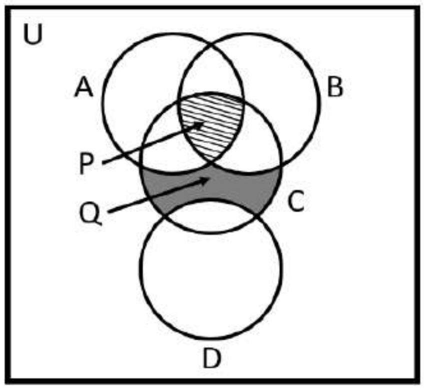

Figure 1: Venn Diagram for Question 4(a)

Consider the Venn diagram in Figure 1, where the four circles represent the sets A, B, C and D respectively. The striped portion at the top represents the set P and the highlighted portion at the bottom represents the set Q as shown in the diagram. Here, A = {1, 2, 3, 4, 5}, B = {3, 5, 6, 7}, C = {4, 5, 7, 10, 11} and D ={11,12,15}.

Determine the elements of the set **P** ∪ **Q**. (You must use the values given in the set definitions above.)

b) Given that A={10, 20, 30, 50}, B={30, 40}, C={50, 60}. Determine: **[3]**
i) ((A - B) - C)
ii) P(B∩C)
iii) | P(((A - B) - C)) |

5. **a)** Find out $f \circ g(0)$ and $g \circ f(0)$ where $f: R \rightarrow R, f(x) = x^3 + x$ and $g: R \rightarrow R, g(x) = \frac{3}{x^2+1}$ **[2]**

b) Find out with proper reasoning if the following functions are one-to-one, onto or neither. **[2*2]**
i) $f: R \rightarrow R^+, f(x) = x^2 + 1$
ii) $f: R \rightarrow R, f(x) = x^3 - x$