# 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 $((p \lor q) \land (r \lor \neg q)) \rightarrow (p \lor r)$ 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]

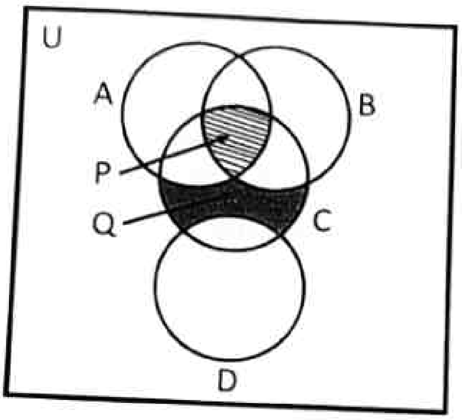


**Figure 1: Venn Diagram for Question 4(a)**

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** $\cup$ **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)** $f: R \rightarrow R, f(x) = x^3 - x$