



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

There are **5 (Five)** questions. Answer **all 5 (Five)** questions. All questions are of values indicated on the right-hand margin.

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- Q1. a.** Use equivalence laws to prove the following propositions are equivalent or not: [2.5]  
$$(p \rightarrow q) \vee (r \rightarrow s) \equiv (p \wedge r) \rightarrow (q \vee s)$$
- Q1. b.** Consider at the following statement: [1.5+1+1]  
“If everything goes right, Rony or Jahid will become a member of the committee.”
- Determine whether an inclusive or, or an exclusive or, is intended in the above sentence. Justify your answer.
  - Let  $p$  be “Everything goes right”,  $q$  be “Rony will become an executive member”, and  $r$  be “Jahid will become an executive member”. Represent the abovementioned statement using these propositions and appropriate logical connectives.
  - Write down the contrapositive of statement provided in Q1. (b).
- Q2. a.** Let  $T(x)$ :  $x$  is a top scorer;  $M(x)$ :  $x$  gets Man of the Match prize;  $W(x)$ :  $x$  works hard; [3x1=3]  
 $C(x)$ :  $x$  is complacent;  $H(x)$ :  $x$  is haughty;  $R(x)$ :  $x$  remains content with whatever he performs;  
Translate the following statements using quantifiers.
- Every top scorer gets Man of the Match prize.
  - Not all hardworking player becomes top scorer.
  - Any complacent and haughty player remains content with whatever he performs.
- Q2. b.** Determine the truth values of the following propositions. Here, the domain of each variable [3x1=3]  
consists of all real numbers ( $\mathbb{R}$ ).
- $\neg \forall x (x^5 > 0)$
  - $\neg \exists x ((-x^2 + 2) = (x^2 + 1))$
  - $\forall x \exists y (x^2 + y^2 < 0)$
- Q3. a.** Show that, for any two sets  $A$  and  $B$ ,  $|P(A \times B)| = 2^{|A|+|B|}$  [2]
- Q3. b.** Given that  $A$  and  $B$  are two mutually exclusive/disjoint sets such that, [2+2]  
 $A - B = \{1, 2\}$   
 $A \cup B = \{1, 2, x, y\}$ ,  
Universal Set =  $\{1, 2, x, y, a\}$
- Represent the set operations mentioned above in a Venn Diagram.
  - Find  $P(B \times (A \cup B)')$
- Q4. a.** Determine whether the functions are one-to-one or not from  $\mathbb{R}$  to  $\mathbb{R}$ . Here,  $\mathbb{R}$  = set of real [1.5x2=3]  
numbers
- $p(x) = |1 - 3x|$
  - $f(x) = (3x - 5)^3$



- Q4. b.** Given  $f(x) = \frac{4x}{5-x}$ , Determine the following
- $f^{-1}(x)$
  - $f \circ f^{-1}$

[1.5x2=3]

- Q5. a.** Using proof by contrapositive technique, provide a proof for the following claim. [3]

*For any two integers  $p$  and  $q$ ,  $p + q \geq 15$  implies that  $p \geq 8$  or  $q \geq 8$*

*Suppose  $p, q \in \mathbb{Z}$  (set of integers)*

- Q5. b.** Using proof by contradiction technique, provide a proof for the following claim. [3]

*If  $x^2 - 2x + 9$  is even, then  $x$  is odd.*

*Suppose  $x \in \mathbb{Z}$  (set of integers)*