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BRAC University

Department of Computer Science and Engineering (CSE)

CSE230: Discrete Mathematics

SET - B Semester: **Spring 2024** Time: **20 minutes**
Examination: **Quiz 2** Full marks: **20**

Name: ____________________ ID: ____________________ Section: _____

*(There are 4 questions total. You must answer all. Answer **Q3** and **Q4** after the line. Feel free to use the back of the question paper, if needed.)*

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Q1. Suppose that the domain of the propositional function $P(x)$ consists of the integers −2, −1, 0, 1, and 2. Write out each of these propositions using disjunctions, conjunctions, and negations:

(a) $\exists x \neg P(x)$	$\sim P(-2) \vee \sim P(-1) \vee \sim P(0) \vee \sim P(1) \vee \sim P(2)$
(b) $\neg \forall x P(x)$	$\sim (P(-2) \wedge P(-1) \wedge P(0) \wedge P(1) \wedge P(2))$

[1+1=2 marks]

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Q2. Let $Q(x)$ be the statement "$x + 1 > 2x$." If the domain consists of **all integers**, what are the truth values of the following statements? (Just circle the correct value)

$\sim Q(x) =$ "$x+1 \leq 2x$"

(a) $Q(0)$: T / F **(b)** $\exists x Q(x)$: T / F **(c)** $\forall x \neg Q(x)$: T / F

"$0+1 > 0$" = "$1 > 0$" = T

$\sim Q(0) =$ "$0+1 \leq 0$" = "$1 \leq 0$" = F

[1+1+1=3 marks]

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Q3. Translate each of these statements into logical expressions using predicates, quantifiers, and logical connectives:
(Describe/Define your propositional functions and write down the needed expression)
(a) Everything is in the correct place and in excellent condition.
(b) Nothing is in the correct place and is in excellent condition.

[2.5+2.5=5 marks]

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Q4. Show that $(p \vee q) \wedge (\neg p \vee r) \rightarrow (q \vee r) \equiv (p \rightarrow q) \wedge (q \rightarrow r) \rightarrow (p \rightarrow r) \equiv$ **T**.
(Simply show that both compound propositions are Tautology. You may use any method preferred.)

[5+5=10 marks]

End

Q3. Let, $P(x)$:= "x is in the correct place."
$C(x)$:= "x is in the excellent condition."
where Domain of x is all things.

Then, statement (a) $\Rightarrow$ $\forall x\,(P(x) \wedge C(x)) \Rightarrow \forall x\, P(x) \wedge \forall x\, C(x)$

and, statement (b) $\Rightarrow$ $\forall x \sim (P(x) \wedge C(x)) \Rightarrow \sim\exists x\,(P(x) \wedge C(x))$

$\cancel{\sim\exists x P(x) \wedge \sim\exists x C(x)}$