**University of Jordan**
**King Abdullah II School of Information Technology**
**Computer Science Department**
**Discrete Mathematics Midterm Exam (2006-2007)**

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|---|---|---|
| اسم الطالب: | الرقم الجامعي: | رقم الشعبة: |
| رقم التسلسل في ورقة الحضور: | استاذ المادة: | الوقت: |

Note: your answers should be filled in the following Table in capital letters

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Answer | | | | | | | | | | | | | | | |

**Q1.** Given **$f(x) = x^2 + 1$ " $Z^+ \rightarrow Z$"** and **$g(x) = x - 1$ " $Z^+ \rightarrow Z$" answer the following:**

**A.** f o g (x) =

**$f(g(x)) = f(x-1) = (x-1)^2 + 1 = x^2 - 2x + 2$** **(1 mark)**

**B.** Determine whether function f (x) is **one-to-one** or not? And why? **(2 marks)**

**It is one to one because there is no two integers have the same f(x) value.**

**C.** Determine whether function f (x) is **onto** or not? And why? **(2 marks)**

**Not onto there is no integer such that f(x) = -2 .**

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**Q2: Show that $P \leftrightarrow Q$ and $(P \wedge Q) \vee (\neg P \wedge \neg Q)$ are logically equivalent. (Using Rules)**
**(5 marks) 1 mark on each step**

1. **$P \leftrightarrow Q = p \rightarrow Q \wedge Q \rightarrow P$** **….. 1 mark**
2. **$(\neg P \vee Q) \wedge (\neg Q \vee P)$** **….. 1 mark**
3. **$[(\neg P \vee Q) \wedge \neg Q] \vee [(\neg P \vee Q) \wedge P)]$** **….. 1 mark**
4. **$[(\neg P \wedge \neg Q) \vee (Q \wedge \neg Q)] \vee [(\neg P \wedge P) \vee (Q \wedge P)]$** **….. 1 mark**
5. **$[(\neg P \wedge \neg Q) \vee F] \vee [F \vee (Q \wedge P)]$** **….. 0.5 mark**
6. **$(\neg P \wedge \neg Q) \vee (Q \wedge P)$** **….. 0.5 mark**

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**Q3. Translate the following English statements. Assuming the domain is: all people**

T(x) : x is a CS teacher
S(x) : x is a student
C(x,y): x has taken a course with y
N(x): x is nice

**A.** All **CS** teachers are perfect and nice. **(2 marks)**

$\forall x ( t(x) \rightarrow (n(x) \wedge p(x))$

**B.** some student in IT has taken a course with every teacher in KASIT. **(2 marks)**

$\exists x ( s(x) \wedge \forall y [ t(y) \rightarrow c(x,y)] )$

**Q4: multiple choices ( 15 marks)**

**1)** $|\Phi \times \{a, b\}|$ is equivalent to

**A.** 0
**B.** **1**
**C.** {a,b}
**D.** $\Phi$

**2)** $p \rightarrow \neg q$ is equivalent to

**A.** $\neg p \rightarrow q$
**B.** $p \leftrightarrow \neg q$
**C.** $\neg(q \wedge p)$
**D.** None of the above

**3)** let U= $\{x \mid 1 \leq x \leq 12 and x \in Z\}$. Which of these sets are specified by "010111100000" bit string?

**A.** {1,3,5,7,9}
**B.** {2,4,5,6,7}
**C.** {2,4,6,8,10}
**D.** {1,3,8,9,10}

**4)** Which of the following is a true statement?

**A.** { $\Phi$ } has no elements
**B.** the cardinality of set X, is the umber of subsets of X
**C.** $\Phi$ is a singleton
**D.** The power set of set X, is the set of all subsets of X.

**5) The precedence order of logical connectives, listed in the order of being carried out first to last is correct for which of the following?**

**A.** $\neg \wedge \vee \leftrightarrow$
**B.** $\leftrightarrow \neg \wedge \vee$
**C.** $\wedge \neg \vee \rightarrow$
**D.** None of the above

**6)** Which of the following statement is true:

**A.** $\Phi \in \{\Phi\}$ **B.** $\{\Phi\} \in \{\Phi\}$ **C.** $\{\{\Phi\}\} \subset \{\{\Phi\}, \{\Phi\}\}$ **D.** None

**7)** Which of the following sets is a power set?

**A.** $\Phi$ **B.** $\{\Phi, \{a\}\}$ **C.** $\Phi, \{a\}, \{\Phi, a\}\}$ **D.** None

**8)**. Let A and B be sets, $A \subseteq B$ if and only if:

**A.** $B \subseteq A$

**B.** $\overline{B} \subseteq \overline{A}$

**C.** $A \subseteq \overline{B}$

**D.** $\overline{A} \subseteq B$

**9)** Let A be subset of a universal set U, then:

**A.** $A \oplus U = A$

**B.** $A \oplus U = U$

**C.** $A \oplus U = \overline{A}$

**D.** $A \oplus U = \phi$

**10)** What do you say a bout the sets A and B if we know that A-B=B-A?

**A.** $A = \overline{B}$

**B.** $A \subseteq \overline{B}$

**C.** $\overline{A} \subseteq B$

**D.** $A = B$

**11)** Let $X = \lfloor -5.8 \rfloor + \lceil 4.8 \rceil$, then X given by following value?

**A.** 1

**B.** 0

**C.** -1

**D.** None of them

**12)** if A and B are sets such that A= { 1, 2, 3 ,4, 4}, B= {2, 3, 3 ,0}what is the cardinality of A $\cup$ B?

**A.** 9

**B.** 5

**C.** 6

**D.** None of the above

**13)** Let P(x) denote the sentence: x + y = 4. Which of the following is true in the domain of all integers?

**A.** $\forall x \forall y \ p(x, y)$

**B.** $\exists x \forall y \ p(x, y)$

**C.** $\exists y \forall x \ p(x, y)$

**D.** $\forall y \exists x \ p(x, y)$

**14) T**he negation of $\exists x(p(x) \wedge Q(y))$ **is:**

**A.** $\forall x(\neg p(x) \wedge \neg Q(y))$

**B.** $\forall x(\neg p(x) \vee Q(y))$

**C.** $\forall x(p(x) \rightarrow \neg Q(y))$
**D.** None of the above

**15)** Two sets A and B are said to be disjoint if:
**A.** $A = B$
**B.** $A \subseteq B$ and $B \subseteq A$
**C.** $A \cap B = \Phi$
**D.** $A \cup B = \Phi$