Mid
Exam 01 – 2006/2007
University of Jordan
King Abdullah II School of Information Technology
Computer Science Department
Discrete Mathematics Midterm Exam (2006-2007)

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

Q1. **Given** f (x) = x^2 + 1 " Z_+ → Z" **and** g (x) = x - 1 " Z_+ → 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 .

Q2: Show that P ↔ Q and (P ∧ Q) ∨ (¬P ∧¬Q) are logically equivalent. (Using Rules)
(5 marks) 1 mark on each step

1. **P ↔ Q = p→ Q ∧ Q→P ….. 1 mark**
2. **(¬ P ∨ Q) ∧ (¬ Q ∨ P) ….. 1 mark**
3. **[(¬ P ∨ Q) ∧ ¬ Q]∨ [(¬ P ∨ Q) ∧ P)] ….. 1 mark**
4. **[(¬ P ∧ ¬ Q) ∨ (Q ∧ ¬ Q)] ∨ [(¬ P ∧ P) ∨ (Q ∧ P)] ….. 1 mark**
5. **[(¬ P ∧ ¬ Q) ∨ F] ∨ [F ∨ (Q ∧ P)] ….. 0.5 mark**
6. **(¬ P ∧ ¬ Q) ∨ (Q ∧ P) ….. 0.5 mark**

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)**
∀ x (t(x) → (n(x) ∧ p(x))

B. some student in IT has taken a course with every teacher in KASIT. **(2 marks)**
∃ x (s(x) ∧ ∀ y [t(y) → c(x,y)])

Q4: multiple choices (15 marks)

1) $\Phi \times \{a,b\}$ is equivalent to
A. 0
B. 1
C. {a,b}
D. Φ

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 | $1 \le x \le 12$ and $x \in \mathbb{Z}$}. 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. { Φ } has no elements
B. the cardinality of set X, is the umber of subsets of X
C. Φ 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. Φ **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. $B \subseteq A$
C. $A \subseteq B$
D. $A \subseteq B$

9) Let A be subset of a universal set U, then:
A. $A \oplus U = A$
B. $A \oplus U = U$
C. $A \oplus U = A$
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. $A = B$
B. $A \subseteq B$
C. $A \subseteq B$
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 ∪ 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) The 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 ⊆ B and B ⊆ A
C. A∩ B = Φ
D. A ∪ B = Φ