Diploma in Information Technology

Mid-Session Examination 1
Spring Session 2008

WUCT121
Discrete Mathematics

This exam represents 10% of the total subject marks

Reading Time: 5 minutes
Time allowed: 75 minutes

DIRECTIONS TO CANDIDATES
Refer to Page 2
DIRECTIONS TO CANDIDATES

1. Total number of questions: 9.
2. All questions are to be attempted.
3. All answers must be written in the Examination Answer Booklet supplied.
4. Questions are not of equal value.
5. All working must be clearly shown.
6. Non-programmable calculators may be used.
7. No other examination aids are permitted.
8. Electronic dictionaries are not allowed.
9. Non-English speaking Background students may use an approved English to Foreign language translation dictionary
10. The examination paper must not be removed from the examination room and must be submitted with the examination answer booklet.
11. During the 5 minutes reading time, you may make notes on the examination paper only. Answer Booklets must remain closed.
Question 1

Explain the following Laws for the set $\mathbb{N}$:

(a) The Distributive Law.  
(b) The Law of Trichotomy.

Question 2

Break each of the following sentences into simple statements, giving each statement a label. Then write each sentence in symbolic form:

(a) If either the front light or the radio is on, then I am at home.  
(b) I shall go home if it rains, but if does not rain, I will stay.

Question 3

Construct a truth table to determine whether the following compound statement is a tautology, a contradiction or a contingent statement.

$$(P \Rightarrow Q) \land ((R \land Q) \lor \neg (R \land P))$$

Question 4

Use the “quick method” to determine if the following statement is a contradiction:

$$(P \Rightarrow Q) \land (P \land \neg Q)$$

Question 5

Use the Laws of Substitution of Equivalence to show the following statement is a tautology:

$$((P \Rightarrow Q) \land P) \Rightarrow Q$$
**Question 6**

Write the following statements in the notation of predicate logic:

(a) Not all real numbers are natural numbers. \[2\]

(b) Each real number is less than or equal to some integer. \[3\]

**Question 7**

Write the following statements in English, and state whether they are true or false, giving reasons for your answers.

(a) \(\forall x \in \mathbb{R}, \exists y \in \mathbb{R}, xy = 1\); \[3\]

(b) \(\exists x \in \mathbb{N}, \forall y \in \mathbb{N}, xy = y\). \[3\]

**Question 8**

Consider the statement:

\[P: \text{There is a Mathematics book which has a diagram on every page.}\]

(a) Write this statement in predicate logic notation. \[2\]

(b) Find the negation, \(\sim P\), of the statement in (a). \[2\]

(c) Write the negation in English. \[2\]

**Question 9**

(a) State the Well-Ordering Property for \(\mathbb{N}\). \[2\]

(b) State whether the following sets are well-ordered, and give reasons for your answers.

(i) \(O = \{1, 3, 5, \ldots\}\), the set of odd natural numbers. \[2\]

(ii) \(P = [1, 2) = \{x \in \mathbb{R}: 1 \leq x < 2\}\). \[2\]

**END OF EXAM**