FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
(SCHOOL OF INFORMATION AND COMMUNICATION TECHNOLOGY)
DEPARTMENT OF INFORMATION TECHNOLOGY
FIRST SEMESTER EXAMINATION (2010/2011 SESSION)

COURSE CODE: CIT 212 (DISCRETE MATHEMATICAL STRUCTURES)

INSTRUCTION: THIS IS AN EXAMINATION. ANSWER ALL QUESTIONS IN SECTION A AND TWO QUESTIONS FROM SECTION B. **DO NOT WRITE ON THIS QUESTION PAPER.** DO ALL ROUGH WORK IN YOUR ANSWER BOOKLET.

DATE: MAY 14, 2011. **TIME ALLOWED:** 2HR

SECTION A [4 Marks each: 20 marks]

1. The basic building blocks of logic are
(A) Sets
(B) Logic
(C) Propositions
(D) Relations

2. The inclusive disjunction of any proposition and its negation is
(A) Contradiction
(B) Tautology
(C) Exclusive
(D) Substitution instance

3. Two propositions that have identical truth values for every set of truth values of their components are said to be
(A) Logically equivalent
(B) Logically implied
(C) Equivalent
(D) Equal

4. If a relation R on a set A is reflexive, symmetric and transitive then R is called
(A) Logical equivalence
(B) Equivalence relation
(C) Exclusive relation
(D) Logical relation

5. Congruence modulo n is an example of

(A) Equivalence logic

(B) Equivalence relation

(C) Exclusive relation

(D) Logical relation

SECTION B [20 marks each]

1. (a) (i) List the six methods for producing new propositions from existing ones, explain any three, and draw their truth tables.

(ii) Consider the propositions:

p: Tunde dances

q: Fatima sings

r: Nkechi claps

Write in words, the following compound propositions and draw their corresponding truth tables:

- $(p \rightarrow (q \oplus r))$
- $(p \wedge r) \leftrightarrow q$
- $(\bar{p} \wedge q) \oplus (p \wedge r)$
- $(p \vee r) \leftrightarrow \bar{q}$

(b) Determine which of the following is a tautology, a contradiction or neither

(a) $(p \vee q) \leftrightarrow (q \vee p)$

(b) $[(p \vee q) \rightarrow r] \oplus (\bar{p} \vee \bar{q})]$

(c) $(p \rightarrow q) \wedge (\bar{p} \vee q)$

2. (a) The binary matrices M_R *and* M_S for two relations R and S respectively on the set $A = \{1, 2, 3, 4, 5\}$ are given below

$$M_R = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix} \text{ and } M_S = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & 0 \end{pmatrix}$$

(i) What are the elements of R and S?

(ii) Draw the directed graph of R and S

(b) State (without proof) the Principle of Mathematical Induction and use it to prove that the sum of the first n integers is n^2.

(c) Let $A = B = \mathbb{Z}^+$, and let aRb denote 'a has the same parity as b'. More precisely:

$$R = \{(a, b): a - b \text{ is an integer multiple of } 2\}$$

Draw the coordinate grid diagram of R.

3. (a) Define each of the following:

(i) A relation from a set A to a set B,

(ii) A relation on a set A,

(iii) Cartesian product of sets A and B,

(iv) Propositions,

(v) Truth tables,

(vi) Tautologies,

(vii) Contradictions,

(viii) Logical equivalence,

(ix) Logical implication,

(x) Properties of relations.

(b) For each of the following relations R on a set A, draw:

(a) its coordinate grid diagram,

(b) its directed graph, and

(c) its binary matrix.

(i) $A = P\{1, 2, 3\}$, the power set of $\{1, 2, 3\}$;

- aRb if and only if $a \subseteq b$
- aRb if and only if $a \subset b$

(ii) $A = \{1, 2, 3, 4, 5\}$;

$a \, R \, b$ if and only if $a < b$.

(iii) $A = \{1, 2, 3, 4, 5\}$;

$a \, R \, b$ if and only if $a/b \in \mathbb{Z}$

Best wishes.

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