MCA (Revised)

Term-End Examination

June, 2007

MCS-013 Ⓢ : DISCRETE MATHEMATICS

Time : 2 hours *Maximum Marks : 50*

Note : *Question number 1 is* ***compulsory****. Attempt any* ***three*** *questions from the rest.*

1. (a) In the following statement, identify the simple propositions p, q, r etc. that are combined to make it.

   'If Sun rises in the West or 15 is a prime, 1997 is a leap year.'

   Write the statement in symbols and give the truth value. Write the negation in words. *3*

   (b) Differentiate between tautology, absurdity i.e. contradiction and contingency, with suitable example. *3*

   (c) Draw the logic circuit for the boolean expression $(x_1 \wedge (x_2' \vee x_3)) \vee (x_2' \wedge x_3')$ *3*

(d) Let $A = \{1, 2, 3, 4, 5\}$. Let R be a relation on A such that xRy if $x \leq y$. Write R and make relation matrix. Check for symmetry, reflexivity and transitivity. *3*

(e) Under the IPv4 protocol, the 32-bit Class A IP address of a computer in a network has the following specifications :

(i) Leftmost bit is 0.

(ii) The next 7 bits is the net-id and this cannot be 1111111.

(iii) The next 24 bits form the host-id and host-ids consisting of all 1's and all 0's are not allowed.

What is the maximum number of Class A addresses possible under the IPv4 protocol ? *3*

(f) Write all partitions of 7. Also find P_7^3 and P_7^2. *3*

(g) There are 20 students in a class and 5 different grades are available. In how many ways can these grades be awarded ? *2*

2. (a) Check if $(p \wedge q') \vee (p' \wedge q) \leftrightarrow p \oplus q$ is a tautology using a truth table. *4*

(b) Let $f : \mathbf{R} \rightarrow \mathbf{R}$ be defined by $f(x) = 2x + 1$. Check that f is a bijective function. Find f^{-1}. *6*

3. (a) Prove by induction that $2^n > n^2$, $\forall\, n \geq 5$. 4

(b) Anita collects stamps. In a box she has 4 stamps of England, 3 stamps of France and 3 stamps of Germany. In how many ways can she take out 7 stamps from the box if

(i) the order is not important.

(ii) the order is important. 6

4. (a) Make a table of values for the function $(x_1 \wedge x_2) \vee (x_2' \wedge x_3)'$. Find a boolean expression in CNF or DNF, whichever is simpler. 6

(b) Two players A and B roll a dice with player A rolling the dice first. What is the probability that A gets at least 2 more than the number B gets ? 2

(c) Define pigeonhole principle with example. 2

5. (a) Give direct proof to prove $\frac{p}{q} = \sqrt{2}$ is not a rational number. 5

(b) Among the candidates who applied for the job of interpreter, 15 knew French, 12 knew German, 8 knew Mandarin, 7 knew both French and German, 5 knew both French and Mandarin, 6 knew both German and Mandarin and 3 knew all the three languages.

(i) How many candidates applied for the job ?

(ii) How many candidates knew at least two languages ? 5