PhD Course work (IT) Examination, 2013

Mathematical Methods for Computing (ICE 904/1)

Time: 3hr Full Marks: 70

Answer any FIVE questions

1. *a)* What do you mean by Relation? State how relational algebra helps in designing a database system?
   b) How can you differentiate *mapping* from *binary relation*? Explain surjective mapping with an example.
   c) Consider the function f: N → N U {0} (N is the set of natural numbers) defined by $f(n)=n-1$. Show that f is a bijection.

   (2 + 4) + 4 + 4

2. *a)* Define with example: semigroup, monoid and abelian group.
   b) Let S = {1, ω, ω^2}, where $\omega^3=1$. Then show that S is an abelian group with respect to multiplication.
   c) Show that a special class of non-uniform elementary cellular automata forms group.

   6 + 3 + 5

3. *a)* Define: Ring. Show that (Z,+,.) is a ring, but (N,+,.) is not.
   b) Write short note on homomorphism of rings.
   c) How can you differentiate ring and field?

   (2 + 5) + 4 + 3

4. *a)* What are the properties of finite field?
   b) What is primitive element?
   c) Find the elements of $GF(2^4)$. Consider $p(x)=x^4+x+1$ as a primitive polynomial.

   4 + 2 + 8

5. *a)* State Gödel's Incompleteness theorems.
   b) What do you understand by non-deterministic Turing machine?
   c) How can you relate an algorithm with Turing machine? What do mean by time and space complexity of an algorithm?

   6 + 3 + (2 + 3)

6. *a)* Define: Cellular Automata. What do you mean by self-reproduction property of cellular automata?
   b) Compare cellular automata and Turing machine.
   c) What do you mean by recursively enumerable language? Can cellular automata accept this language? Explain.

   (3 + 2) + 4 + (2 + 3)