Krishna Kanta Handiqui State Open University
MCA / M Sc IT 3rd Sem. Examination, 2015
Formal Languages and Automata

Time : 3 Hrs. Full Marks : 80

1. Answer any five from the following questions : 5×2 = 10
   (a) What is positive closure ? If $\Sigma = \{0, 1\}$, then find Σ^3.
   (b) Find the regular expression for the set of all strings over $\Sigma = \{a, b\}$ ending with bb and starting with a. What is a null string?
   (c) State Turing's thesis.
   (d) Define Recurssive and Recurssively eneumerable language.
   (e) What is Chomsky Normal form.
   (f) Find the langauge generated by the grammar a={{s}, {a, b}, s, p} where the productions are given as - $s \rightarrow aSa \mid bSb \mid c$.

2. Answer any three from the following questions : 4×3 = 12
   (a) Design a DFA to accept the language L = {w | w is of even length string and begins with 01}
   (b) Define ambiguous grammar. Consider a grammar with $s \rightarrow sbs \mid a$ which is ambiguous. Show in particular that the string 'abababa' has two parse tree.
   (c) Sketch the DFA given M($\{q_1, q_2\}$, {0, 1}, δ, q_1, $\{q_2\}$) and δ is given by $\delta(q_1, 0) = q_1$, $\delta(q_2, 0) = q_1$, $\delta(q_1, 1) = q_2$ and $\delta(q_2, 1) = q_2$ Determine a language L(M) that the DFA recognizes.
   (d) What are the three possible outcomes of executing a Turing Machine over a given input? Define Universal Turing Machine.

3. Answer any three from the following questions : 6×3 = 16
   (a) Define Non-deterministic Finite Automata. What are the basic differences between NFA and DFA?
   (b) Define parse tree. Construct a parse tree for the grammar

a = {{s, A}, {a,b}, P, S} where P is given as $S \rightarrow aAS$, $S \rightarrow a$, $A \rightarrow SbA$, $A \rightarrow ab$.

   (c) What problems cannot be solved by Turing Machine? Design a Turing Machine that can concatenate two strings.
   (d) What is the significance of halting problem? Differentiate NP and P class.

4. Answer any four from the following questions : 10×4 = 40
   (a) Explain the Chomsky Classification of grammar with suitable examples.
   (b) Give the formal definition of Pushdown automata. What is the meaning of following two transition function :
      (i) $\delta(q, 1, x) = \{p, y\}$
      (ii) $\delta(q, 1, x) = \{p, \in\}$
      What type of language is accepted by a PDA and a DFA? Which data structure is used in a PDA?
   (c) Define regular expression over an alphabet Σ along with operators of regular expression.
   (d) Define parsing. Show with an example the Bottom-up parsing technique.
   (e) Write short notes on -
      (i) Post's correspondence problem.
      (ii) μ -recurssive functions.