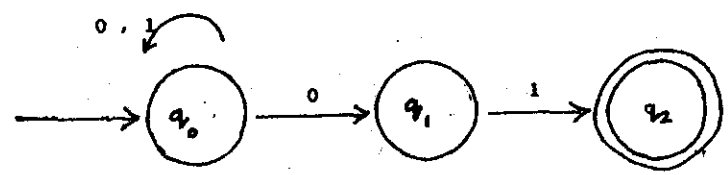
B.Tech. Degree V Semester Examination December 2002

CS 504 AUTOMATA LANGUAGES AND COMPUTATION

(1999 Admissions onwards)

Time: 3 Hours Maximum Marks: 100

I. (a) Construct the DFA equivalent to the following NFA on {0, 1}. (10)



(b) Show that if L is accepted by an NFA with ε-transitions, then L is accepted by an NFA without ε-transitions. (10)

OR

II. (a) Explain the term Deterministic Finite Automaton. Establish the equivalence between deterministic and Non deterministic finite automata. (10)

(b) Give deterministic finite automata accepting the following languages over {0, 1}:

(i) The set of all strings not ending in 00.

(ii) The set of all strings without three consecutive zeros. (10)

III. (a) Define the term 'regular set'. Prove that the class of regular sets is closed under substitutions. (10)

(b) Show that $\{0^i 1^j / \gcd(i, j) = 1\}$ is not regular. (10)

OR

(Turn over)

IV. (a) State and prove Myhill-Nerode theorem. (10)

(b) Give a decision procedure to determine if the set accepted by a DFA is

(i) The set of all strings of a given alphbabet.

(ii) Cofinite (a set whose complement is finite). (10)

V. (a) Explain the term context free grammar. Give a context free grammar generating the set of palindromes (strings that read the same forward and backward) over alphabet $\{0,1\}$. (10)

(b) Find a CFG with no useless symbols equivalent to

$$S \rightarrow AB / CA$$
$$B \rightarrow BC / AB$$
$$A \rightarrow a$$
$$C \rightarrow aB / b$$ (10)

OR

VI. (a) Explain 'language accepted by final state' and 'language accepted by empty stack' in the case of a PDA. (5)

(b) Show that if L is the language accepted by a empty stack for some PDA, M then L is a context free language. (15)

VII. (a) Explain the basic Turing machine model.
Explain how to design a Turing machine to implement proper subtraction on positive integers defined by

$$m \dot{-} n = \begin{cases} m-n & for \quad m \geq n \\ 0 & otherwise \end{cases}$$ (10)

(b) Explain how a Turing machine can be designed to check whether an integer is prime or not. (10)

OR

Contd.....3.

VIII. (a) Explain the following techniques of Turing Machine construction, with examples:

(i) Shifting over

(ii) Subroutines (10)

(b) Show that if L is accepted by a Non-deterministic Turing machine M_1, then L is accepted by some deterministic Turing machine M_2. (10)

IX. (a) Show that if L and $\bar{L}$ are a pair of compalementary languages then exactly one of the following holds:

(i) Both L and $\bar{L}$ are recursive.

(ii) Neither L or $\bar{L}$ is recursively enumerable.

(iii) One of L and $\bar{L}$ is recursively enumerable, but not recursive; the other is not recursively enumerable. (10)

(b) Show that it is undecidable whether a TM halts on all inputs. (10)

OR

X. (a) Explain with a suitable example the term 'regular grammar'. Show that a language is regular if and only if it has a left linear grammar. (10)

(b) Show that if L is a CSL, then L is accepted by some Linear Bounded Automaton (LBA). (10)

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