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Fifth Semester B.E. Degree Examination, June/July 2011
Formal Languages and Automata Theory

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions selecting atleast TWO questions from each part.

PART - A

1.
 - a. Define symbols, alphabets, strings and languages, with examples. (04 Marks)
 - b. Construct a DFA to accept strings over {a, b}, such that every block of length five contains at least two a's. Use extended transition of function to trace a string $W = aabba$. (08 Marks)
 - c. Prove that if $D = (\theta_D, \Sigma, \delta_D, \{q_0\}, F_D)$ is the DFA constructed from NFA $N = (\theta_N, \Sigma, \delta_N, \{q_N\}, F_N)$ by subset construction then $L(D) = L(N)$. (08 Marks)

2.
 - a. Define ϵ - NFA. What are the steps involved in converting ϵ - NFA to DFA. Convert following ϵ - NFA to DFA. (08 Marks)

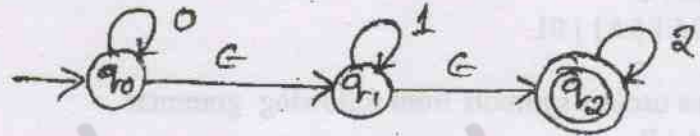


Fig. Q2(a)

- b. Write regular expression for
 - i) $L = \{a^n b^m \mid n \geq 4 \text{ and } m \leq 3\}$
 - ii) $L = \{a^{2n} b^{2m} \mid n \geq 0, m \geq 0\}$. (06 Marks)
- c. Convert the following DFA to regular expression using Kleene's theorem. (06 Marks)

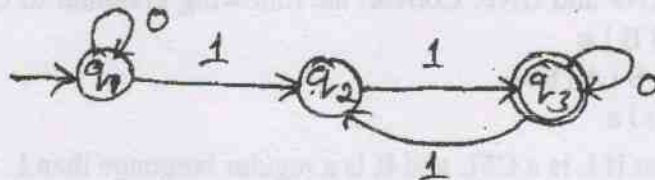


Fig. 2(b)(DFA)

3.
 - a. Construct NFA for the regular expression $(a^* + b^* + c^*)$. (04 Marks)
 - b. State and prove pumping lemma for regular languages. Show that $L = \{0^n \mid n \text{ is prime}\}$ is not regular. (10 Marks)
 - c. Minimize the following DFA using table filling algorithm. (06 Marks)

δ	0	1
$\rightarrow A$	B	E
B	C	F
* C	D	H
D	E	H
E	F	I
* F	G	B
G	H	B
H	I	C
* I	A	E

Table Q3 (C)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- 4 a. Define CFG. Write a CFG for
- $L = \{\text{Strings of } a\text{'s and } b\text{'s, with equal number of } a\text{'s and } b\text{'s}\}$
 - $L = \{a^n b^n c^i \mid n \geq 0, i \geq 1\} \cup \{a^n b^n c^m d^m \mid n, m \geq 0\}$. (06 Marks)
- b. Design a grammar for valid expressions over operator $-$ and $/$. The arguments of expressions are valid identifier over symbols $a, b, 0$ and 1 . Derive LMD and RMD for string $W = (a11 - b0) / (b00 - a01)$. Write parse tree for LMD. (10 Marks)
- c. Show that the following grammar is ambiguous
 $S \rightarrow SS \mid (S) \mid \epsilon$ over $W = ((())())$. (04 Marks)

PART - B

- 5 a. Write block diagram, of PDA with its tuples. What are the two ways of accepting languages in PDA? (04 Marks)
- b. Design a PDA for $L = \{a^i b^j c^k \mid j = i + k, i, k \geq 0\}$ write transition diagram and ID for string $W = abbcc$. (12 Marks)
- c. Convert following CFG to PDA.
 $S \rightarrow AS \mid \epsilon$
 $A \rightarrow OA1 \mid A1 \mid 01$. (04 Marks)
- 6 a. Remove useless symbols from following grammar
 $S \rightarrow aA \mid B$
 $A \rightarrow aB \mid B$
 $B \rightarrow aB \mid b \mid bC$
 $D \rightarrow Ea$
 $E \rightarrow a/aE \mid bc$. (06 Marks)
- b. Define CNF and GNF. Convert the following grammar to CNF
 $S \rightarrow ASB \mid \epsilon$
 $B \rightarrow SbS \mid A \mid bb$
 $A \rightarrow aAs \mid a$. (08 Marks)
- c. Prove that if L is a CFL and R is a regular language then $L \cap R$ is a CFL. (06 Marks)
- 7 a. Define Turing Machine and Instantaneous Descriptions (ID) for Turing machine. (04 Marks)
- b. Design a Turing machine to add 2 numbers consider input $= 0^m 1 0^n$ and output $= 0^{m+n}$. Write transition diagram and ID for string $W = 00/0000$. (12 Marks)
- c. Write a note on multitape and non-deterministic turing machines. (04 Marks)
- 8 a. Explain the relationship between the recursive, RE and non-RE languages. (06 Marks)
- b. If both a language L and its complement are RE, then prove that L is recursive. (06 Marks)
- c. Write a short note on :
 i) Post correspondence problem
 ii) Undecidability of ambiguity for CFG's. (08 Marks)
