Code: 9A05407

1

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

FORMAL LANGUAGES & AUTOMATA THEORY

(Computer Science and Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Describe the following languages over the input set A = {a, b}

(i) L_1 = {a, ab, abb, aba} (ii) $L_2 = \{a^n b^n \mid n >= 1\}$ (iii) $L_3 = \{a^n b^n \mid n > 0\}$

(b) What is the Kleen closure? Let $\sum$ = {a,b} obtain:

$\Sigma^* = \Sigma_0 \cup \Sigma_1 \cup \Sigma_2 \cup \Sigma_3$ - - - - - - - - .

2 Find the Minimal DFA's for the language $L = \{a^n b^m, n \geq 2, m \geq 1\}$.

3 (a) Write a regular expression to denote a language L which accepts all the strings which begin or end with either 00 or 11.

(b) Construct a R.E. for the language which accept all strings with at least two c's over the set Σ = {c, b}

(c) Construct a R.E for the language over the set Σ = {a, b} in which the total number of a's are divisible by 3.

4 (a) Construct the CFG for set of all strings over {a, b} consisting of equal number of a's and b's

(b) Give CFG for $L = \{a^n b^m | n >= 1, m \geq 1\}$.

5 (a) In a CFG, a variable A is live if A ==>* x. Give a recursive definition and corresponding algorithm to find live variables in a given CFG.

(b) Convert the following CFG into CNF.

S → ABC / BaB A → Aa / BaC / a

B → bBb / a C → aC / bC / c

6 (a) Define a PDA. Design a PDA for $L = \{xcx^r / x \in \{a, b\}^*\}$. Process the string abbacabba. Note: x^r stands for reverse of the string x.

(b) What do you mean by an instantaneous description of a PDA? Explain with example.

7 (a) How can we compute a function using TM? Design a TM for computing f (x,y) = x + y, where x and y are any two positive integers.

(b) Discuss about Chuch's hypothesis.

8 (a) What is PCP? Find the solution to the following instance of PCP.

w = (1, 10111, 10) and x = (111,10, 0)

(b) Discuss in detail about LBA model with one example.

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2

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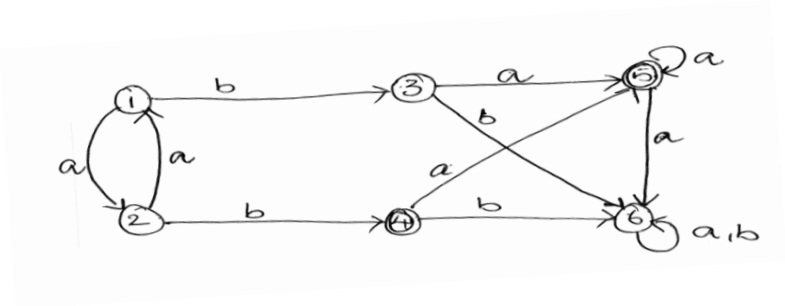
1 Design a finite automation that reads strings made up of letters in the word CHARIOT and recognize those strings that contain the word 'CAT' as a substring.

2 Using the algorithm minDFSM. Minimize the FSM in the figure below.



3 (a) What is the closure property of regular sets?
(b) What is the relationship between finite automata and regular expression?
(c) Give the R.E for the language such that every string will have at least one 'a' followed by at least one 'b'.

4 (a) Write the procedure for the conversion of right linear grammar to left-linear grammar.
(b) Explain the properties of deviation trees.

5 (a) State and prove pumping lemma for Context Free Languages.
(b) Using pumping lemma, prove that $L = \{ a^i b^i c^i \ / \ i >= 1 \}$ is not a CFL.

6 When do you say that a language L is recognized or accepted by a PDA? Design PDA for $L = \{a^i b^j c^k / j >= i + k$ and $i, j, k > 0\}$. Process the string aaabbbbbbccc using instantaneous description.

7 (a) Write about the process of combining different TMs with example.
(b) Design a TM for L = {x Є {a, b}*/x contains even no. of a's and odd no. of b's}. Show the moves of the TM for the input string abaabba.

8 (a) Define LR (0) grammar. Specify a grammar and show that it is LR (0).
(b) Discuss the P and NP computational complexity of problems with suitable examples.

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3

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1 Draw a DFA that recognizes the language of all strings of 0's and 1's for length ≥ 1 that, if they were interpreted as binary representations of integers, would represent integers evenly divisible by 3. Leading 0's are permissible.

2 Prove the theorem "if L is accepted by an NFA with ε - transitions then L is accepted by an NFA without ε - transitions".

3 (a) Discuss the applications of a regular expression.
(b) Explain and prove 'if L_1 and L_2 are two languages then $L_1 \cup L_2$ is regular.

4 (a) Explain in detail about right and left linear grammars with example.
(b) Explain the equivalence and differences between regular grammar and finite automata.

5 (a) Show that if L is a CFL and F is finite set, L-F is a CFL.
(b) Decide whether $L = \{ a^n b^m a^m b^n / m, n >= 0\}$ is a CFL or not? Justify your answer.

6 (a) Construct PDA for accepting the language $L = \{xcx^r / x \in \{a, b\}^*\}$ by empty stack.
(b) Compare and contrast the regular languages and context free languages.

7 (a) Discuss in detail about any three modifications that can be done to the basic model of a Turing Machine.
(b) Design a TM for recognizing L = { x Є {a, b, c }* / x contains a or b in the third position from right end.}

8 (a) Define P and NP problems with examples.
(b) What is PCP? Explain why PCP with two lists x = (01, 1, 1) and y = (0101, 10, 11) has no solution?

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4

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1 Design an NFA to accept strings with 1's and 0's such that string contains two consecutive 1's or two consecutive 0's.

2 Prove the theorem 'Let L be a set accepted by non-deterministic finite automata, then there exists a DFA that accepts L".

3 (a) Explain and prove "The complement of regular language is regular"

(b) Explain and prove "if L_1 and L_2 are two regular languages then $L_1 \cap L_2$ is regular.

4 (a) Let L be the language $(0^n 1^n 2^n | n \varepsilon N\}$ is L context free? i.e. there is a grammar that generates L. Explain.

(b) Prove the theorem "Let G = (v_n, Σ_1, P, S) be a CFG. Then $s \Rightarrow \propto$ if and only if there is a derivation tree for G with yield $\propto$"

5 (a) Show that context free languages are not closed under complement.

(b) Convert the CFG with following productions into GNF.

A →BC B → CA / b C →AB/a

6 (a) Prove that the PDA accepting a language L by final state is no more powerful than PDA accepting L by empty stack.

(b) Construct a PDA for L = { $a^{2n} b^n$ / n >= 1}. Show the moves of the PDA for aaaabb.

7 (a) Design a TM for recognizing L = { wcw / w Є {a, b}* }. Show the moves of the TM for the string abbcabb.

(b) Give a brief note on counter machines.

8 (a) Explain in detail about PCP and MPCP.

(b) b) Write about Universal Turing Machine.

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