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Question Paper Code : 57255

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Computer Science and Engineering

CS 6503 – THEORY OF COMPUTATION

(Regulations 2013)

Time : Three Hours   Maximum : 100 Marks

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Draw a non-deterministic automata to accept strings containing the substring 0101.

2. State the pumping Lemma for regular languages.

3. What do you mean by null production and unit production ? Give an example.

4. Construct a CFG for set of strings that contain equal number of a's and b's over $\Sigma = \{a,b\}$.

5. Does a pushdown Automata has memory ? Justify.

6. Define a pushdown automaton.

7. What are the differences between a finite automata and a Turing machine ?

8. What is a Turing machine ?

9. When is a recursively enumerable language said to be recursive ?

10. Identify whether Tower of Hanoi' problem is tractable or intractable. Justify your answer.

PART – B (5 × 16 = 80 Marks)

11. (a) (i) Construct a NFA that accepts all strings that end in 01. Give its transition table and the extended transition function for the input string 00101. Also construct a DFA for the above NFA using subset construction method. **(10)**

    (ii) Prove the following by principle of Induction. $\Sigma_{x=1}^{n} x^2 = \dfrac{n(n+1)(2n+1)}{6}$. **(6)**

OR

(b) (i) What is a Regular Expression ? Write a regular expression for set of strings that consists of alternating 0's and 1's. **(8)**

    (ii) Write and explain the algorithm for minimization of a DFA. Using the above algorithm minimize the following DFA. **(8)**
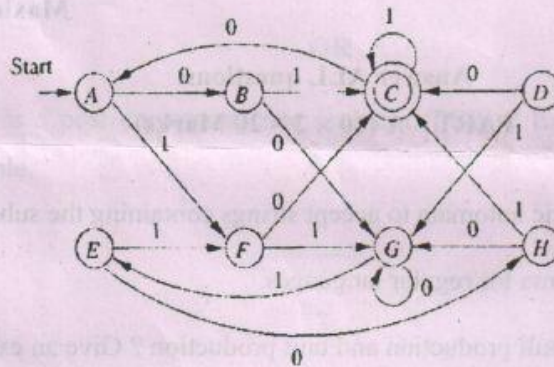
12. (a) (i) Construct a reduced grammar equivalent to the grammar $G = (N, T, S, P)$ where

$N = \{S, A, C, D, E\}$

$T = \{a, b\}$

$P = \{S \rightarrow aAa, \ A \rightarrow Sb, \ A \rightarrow bCC, \ A \rightarrow DaA, \ C \rightarrow abb, \ C \rightarrow DD,$
$E \rightarrow aC, \ D \rightarrow aDA\}$ **(6)**

    (ii) When is a grammar said to be ambiguous ? Explain with the help of an example. **(5)**

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(iii) Show the derivation steps and construct derivation tree for the string 'ababbb' (5)

by using leftmost derivation with the grammar

$S \rightarrow AB \mid \varepsilon$

$A \rightarrow aB$

$B \rightarrow Sb$

OR

(b) (i) What is the purpose of normalization ? Construct the CNF and GNF for the following grammar and explain the steps. (10)

$S \rightarrow aAa \mid bBb \mid \varepsilon$

$A \rightarrow C \mid a$

$B \rightarrow C \mid b$

$C \rightarrow CDE \mid \varepsilon$

$D \rightarrow A \mid B \mid ab$

(ii) Construct a CFG for the regular expression $(011 + 1)(01)$. (6)

13. (a) (i) Construct a pushdown automaton to accept the following language L on $\Sigma = \{a, b\}$ by empty stack. $L = \{ww^R \mid w \in \Sigma^+\}$ (10)

(ii) What is an Instantaneous description of a PDA ? How will you represent it ? Also give the three important principles of ID and their transactions. (6)

OR

(b) (i) Explain acceptance by final state and acceptance by empty stack of a pushdown automata. (8)

(ii) State pumping Lemma for CFL. Use pumping lemma to show that the language $L = \{a^i b^j c^k / 1 < j < k\}$ is not a CFL. (8)

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14. (a) (i) Construct a Turing machine to accept palindromes in an alphabet set
$\Sigma = \{a, b\}$. Trace the strings "abab" and "baab". (8)

(ii) Explain the variations of Turing machines. (8)

OR

(b) (i) Explain Halting problem. Is it solvable or unsolvable problem ? Discuss. (8)

(ii) Describe Chomsky hierarchy of languages with example. What are the
devices that accept these languages ? (8)

15. (a) What is a Universal Turing machine ? Bring out its significance. Also construct
a Turing machine to add two numbers and encode it. (16)

OR ·

(b) What is a post correspondence problem (PCP) ? Explain with the help of an
example. (16)

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