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Question Paper Code : 27173

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

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)

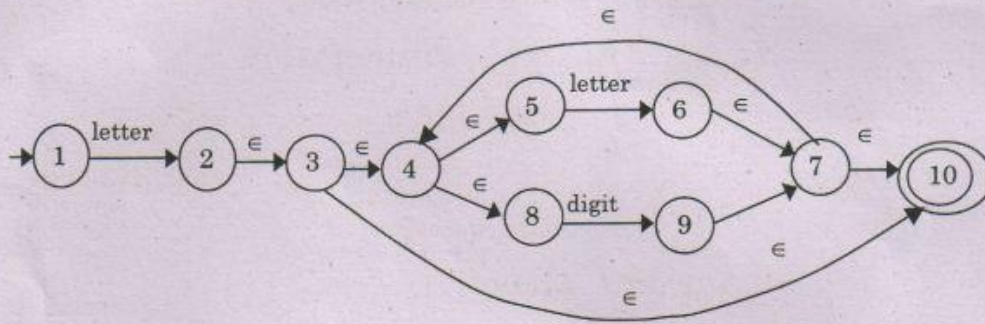
1. What is a finite automaton?
2. Write Regular Expression for the set of strings over $\{0,1\}$ that have atleast one.
3. Let G be the grammar with
$$S \rightarrow aB|bA,$$
$$A \rightarrow a|aS|bAA,$$
$$B \rightarrow b|bS|aBB.$$
for the string aaabbabbba find the left most derivation.
4. Construct the context-free grammar representing the set of palindromes over $(0+1)^*$.
5. What are the different ways of language acceptances by a PDA and define them?
6. Convert the following CFG to a PDA.
$$S \rightarrow aAA, A \rightarrow aS|bS|a.$$
7. Define a Turing machine.
8. What is a multitape turing machine?
9. State when a problem is said to be decidable and give an example of an undecidable problem.
10. What is a universal language L_U ?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Prove that "A language L is accepted by some DFA if and only if L is accepted by some NFA". (10)
- (ii) Construct Finite Automata equivalent to the regular expression $(ab+a)^*$. (6)

Or

- (b) (i) Consider the following ϵ -NFA for an identifier. Consider the ϵ -closure of each state and find its equivalent DFA. (10)



- (ii) State the pumping lemma for Regular languages. Show that the set $L = \{0^{i^2} \mid i \geq 1\}$ is not regular. (6)
12. (a) (i) Let $G = (V, T, P, S)$ be a Context free Grammar then prove that if the recursive inference procedure tells us that terminal string W is in the language of variable A , then there is a parse tree with root A and yield w . (10)
- (ii) Given the grammar $G = (V, \Sigma, R, E)$, where $V = \{E, D, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, +, -, *, /, (,)\}$, $\Sigma = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 0, +, -, *, /, (,)\}$, and R contains the following rules :
- $$E \rightarrow D \mid (E) \mid E + E \mid E - E \mid E * E \mid E / E$$
- $$D \rightarrow 0 \mid 1 \mid 2 \mid \dots \mid 9$$
- find a parse tree for the string $1 + 2 * 3$. (6)

Or

- (b) (i) Construct an equivalent grammar G in CNF for the grammar G_1 where $G_1 = (\{S, A, B\}, \{a, b\}, \{S \rightarrow ASB \mid \epsilon, A \rightarrow aAS \mid a, B \rightarrow SbS \mid A \mid bb\}, S)$. (10)
- (ii) What is an ambiguous grammar? Explain with an example. (6)

13. (a) (i) Design a PDA to accept $\{0^n 1^n \mid n > 1\}$. Draw the transition diagram for the PDA. Show by instantaneous description that the PDA accepts the string '0011'. (10)
- (ii) State the Pumping lemma for CFL and Show that the language $L = \{a^n b^n c^n \mid n \geq 1\}$ is not a CFL. (6)

Or

- (b) (i) Convert PDA to CFG. PDA is given by $P = (\{p, q\}, \{0, 1\}, \{X, Z\}, \delta, q, Z)$, δ is defined by $\delta(p, 1, Z) = \{(p, XZ)\}$, $\delta(p, \epsilon, Z) = \{(p, \epsilon)\}$, $\delta(p, 1, X) = \{(p, XX)\}$, $\delta(q, 1, X) = \{(q, \epsilon)\}$, $\delta(p, 0, X) = \{(q, X)\}$, $\delta(q, 0, Z) = \{(p, Z)\}$. (10)
- (ii) What are deterministic PDA's? Give example for Non-deterministic and deterministic PDA. (6)
14. (a) (i) Design a Turing-machine to accept the language $L = \{0^n 1^n \mid n \geq 1\}$. Draw the transition diagram. (Also specify the instantaneous description to trace the string 0011. (10)
- (ii) State and describe the Halting problem for Turing machine. (6)

Or

- (b) (i) Explain the programming techniques for Turing Machine construction. (10)
- (ii) Describe the Chomsky hierarchy of languages. (6)
15. (a) (i) Prove that "MPCP reduces to PCP". (10)
- (ii) Discuss about the tractable and intractable problems. (6)

Or

- (b) (i) State and explain RICE theorem. (10)
- (ii) Describe about Recursive and Recursively Enumerable languages with examples. (6)