Code : 105503

B.Tech 5th Semester Exam., 2020
(New Course)

FORMAL LANGUAGES AND AUTOMATA THEORY

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct answer of the following (any *seven*) : 2×7=14

(a) Definition of a language L with alphabet $\{a\}$ is given as

$L = \{a^{nk} | k > 0$, and n is a positive integer constant$\}$

What is the minimum number of states needed in a DFA to recognize L?

(i) $k+1$

(ii) $n+1$

(iii) 2^{n+1}

(iv) 2^{k+1}

(b) Which of the following versions of Unix came up with YACC first?

(i) V3

(ii) V5

(iii) CB UNIX

(iv) UNIX-RT

(c) A pushdown automata can be represented as PDA = ε-NFA + [stack].

(i) True

(ii) False

(d) A language accepted by deterministic pushdown automata is closed under which of the following?

(i) Complement

(ii) Union

(iii) Both *(i)* and *(ii)*

(iv) None of the above

(e) A _____ is context free grammar with atmost one non-terminal in the right handside of the production.

(i) linear grammar

(ii) linear bounded grammar

(iii) regular grammar

(iv) None of the above

(f) The lexical analysis for a modern language such as Java needs the power of which one of the following machine models in a necessary and sufficient sense?

(i) Finite state automata

(ii) Deterministic pushdown automata

(iii) Non-deterministic pushdown automata

(iv) Turing machine

(g) Let $L = \{w \backslash in\ (0+1)^* | w$ has even number of 1s$\}$, i.e.. L is the set of all bit strings with even number of 1s. Which one of the regular expression below represents L?

(i) $(0^* 10^* 1)^*$

(ii) $0^* (10^* 10^*)^*$

(iii) $0^* (10^* 1^*)^* 0^*$

(iv) $0^* 1(10^* 1)^* 10^*$

(h) What is the minimum number of states in deterministic finite automata (DFA) for string starting with ba^2 and ending with a over alphabet $\{a, b\}$?

(i) Ten

(ii) Nine

(iii) Eight

(iv) Six

(i) The decision problem is the function from string to ____.

(i) char

(ii) int

(iii) boolean

(iv) None of the above

(j) A language L may not be accepted by a turing machine if

(i) it is recursively enumerable

(ii) it is recursive

(iii) L can be enumerated by some turing machine

(iv) None of the above

2. (a) Write the context-free grammar to create palindrome over (a, b).

(b) Construct a DFA which accepts the set of all binary strings that interpreted as binary representation of an unsigned decimal integer, is divisible by 5. 7+7=14

3. (a) Design a turing machine to compute the sum of two positive integers m and n.

(b) Design ANPDA for accepting the string L = {set of all palindrome over (a, b)} by the empty stack and by final state. 7+7=14

4. *(a)* Construct finite automaton corresponding to the regular expression :

$$(a+b)^* \; c \; d^* \; e$$

(b) Explain the multi-tape version of turing machine and its significance. 7+7=14

5. *(a)* Show given grammar over alphabet $\{a, b\}$ verify whether it is ambiguous or unambiguous :

$$S \rightarrow a \,/\, abSb \,/\, aAb$$
$$A \rightarrow bS \,/\, aAAb$$

(b) Show that L = palindrome over $\{a, b\}$ is not regular. 7+7=14

6. *(a)* Prove that if L is generated by a CFG, then L is accepted by a non-deterministic PDA by empty stack.

(b) Design a pushdown automaton for the following context-free grammar : 7+7=14

$$S \rightarrow aB \mid bA$$
$$A \rightarrow aS \mid bAA \mid a$$
$$B \rightarrow bS \mid aBB \mid b$$

7. *(a)* Design a turing machine that accepts all palindromes over $\sum = \{a, b\}$.

(b) Explain Myhill-Nerode theorem for minimization of automata with suitable example. 7+7=14

8. *(a)* Prove that if L is the language generated by an unrestricted grammar $G = (N, T, P, S)$, then L is recognized by a turing machine.

(b) Design a pushdown automata for accepting the string for the language $L = \{WW^R \mid W \in (a, b)^*\}$ by the empty stack as well as final state. 7+7=14

9. Write short notes on the following : 3½×4=14

(a) Minimization of automata

(b) Type 2 grammar (context free)

(c) NP-hard problem

(d) Pumping lemma for CFL

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