LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **MATHEMATICS**

FIFTH SEMESTER – NOVEMBER 2017

MT 5407 - FORMAL LANGUAGES AND AUTOMATA

Date: 11-13-2017 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

SECTION-A

ANSWER ALL QUESTIONS **(10 X 2 = 20)**

1. Write any two differences between deterministic finite automata and non – deterministic finite automata.
2. Construct a deterministic finite automaton to check whether given number is divisible by two.
3. Define the equivalence of finite automata and non – deterministic finite automata.
4. Define a phrase structure grammar.
5. If $G = (\{S\}, \{a, b, c\}, P, S)$ where P consists of $S \to aSa / bSb / c$, find $L(G)$.
6. Define a parse tree (or a derivation tree).
7. Eliminate the $\in$ – productions from the following set of production rules $A \to 0B1/1B1,\ B \to 0B/1B/\in$.
8. Define Ambiguity.
9. State uvwxy theorem.
10. Define Star closure.

SECTION – B

ANSWER ANY FIVE QUESTIONS **(5 X 8 = 40)**

11. Construct a finite automaton M accepting {ab, ba}.
12. Construct a non – deterministic finite automaton to accept set of all strings over {0, 1} ending with 01.
13. Prove that union of two regular sets is also regular.
14. Let G be the grammar with the production rules $S \to aB / bA,\ A \to a / aS / bAA,\ B \to b / bs / aBB,$ for the string aaabbabbba, find a rightmost derivation and parse tree.
15. Write a brief note on Chomsky hierarchy.
16. Find a CNF grammar equivalent to a grammar whose production rules are $S \to aAbB,\ A \to aA / a,$ $B \to bB / b$.
17. Prove that $L(G) = \{a^i / i \text{ is prime}\}$ is not a Context Free Language (CFL).
18. Let G be a grammar with the production rules $S \to aSBc / abc,\ cB \to Bc,\ bB \to bb$, then show that $L(G) = \{a^n b^n c^n / n \geq 1\}$ is a context sensitive language (CSL).

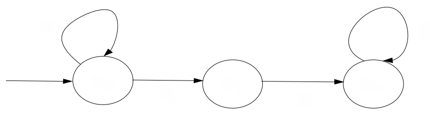
SECTION – C

ANSWER ANY TWO QUESTIONS **(2 X 20 = 40)**

19. a) Construct a finite automata accepting all strings over {0, 1} having even number of 0's and even number of 1's.

    b) Construct an NFA to accept set of all strings $L = \{a^n b^m / m, n \geq 1\}$. **(10+10)**

20. Construct a deterministic finite automaton (FA) equivalent to an NFA with the transition diagram (state diagram) given below :



21. a) Let $L = \{a^n b^n / n \geq 1\}$, consider the grammars G_1 and G_2 defined as follows: $G_1 = (\{S\}, \{a, b\}, \{S \to aSb/ab\}, S)$ and $G_2 = (\{S, A\}, \{a, b\}, \{S \to aASb/aSb/ab, A \to \in\}, S)$ then $L = L(G_1) = L(G_2)$. Check whether the grammars G_1 and G_2 have two left most derivations?

    b) Write a CNF grammar for the language $L = \{a^n b^n / n \geq 1\}$. **(12 + 8)**

22. a) Write the Greibach normal form to generate the context free grammar $L = \{w w^R / w \in (a, b)\}$ and the production rules P is given by P $= \{S \to aSa / bSb/ aa/ bb\}$.

    b) Consider the grammar $G = (N, T, P, S)$, where $N = \{S, (P_r), (VP), V, A, N, (Aux), P\}$, $T = \{They, are, flying, planes\}$, $P = \{S \to (P_r)(VP), P_r \to They, VP \to (V)(NP), V \to are, NP \to (A)(N), A \to flying, N \to planes, V \to (Aux)(P), (Aux) \to are, NP \to N, P \to flying\}$. Find two derivations and draw their corresponding generation trees.

(12 + 8)

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