LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – MATHEMATICS

FIFTH SEMESTER – APRIL 2017

MT 5407- FORMAL LANGUAGES AND AUTOMATA

Date: 03-05-2017   Dept. No.   Max. : 100 Marks
01:00-04:00

SECTION A

ANSWER ALL QUESTIONS. $(10 \times 2 = 20)$

1) Define finite automaton.
2) Write the procedure for constructing the state diagram.
3) What is meant by acceptability of a string by NFA?
4) Write any two properties of regular sets.
5) Define Context-free Languages.
6) Define the union of two languages.
7) What is meant by unambiguous?
8) Define leftmost derivation tree.
9) Define Star closure.
10) Define Greibach normal form.

SECTION B

ANSWER ANY FIVE QUESTIONS. $(5 \times 8 = 40)$

11. Let $M = \{(q_0, q_1, q_2, q_3, q_4), (a, b), \delta, q_0, \{q_0\}\}$ is a finite automaton, where δ is given by
   $\delta(q_0, a) = q_3, \delta(q_0, b) = q_1, \delta(q_1, a) = q_2, \ \delta(q_1, b) = q_4, \delta(q_2, a) = q_3,$
   $\delta(q_2, b) = q_3, \delta(q_3, a) = q_1, \delta(q_3, b) = q_2, \delta(q_4, a) = q_1, \delta(q_4, b) = q_2.$ Construct the state table and State diagram.

12. Construct a finite automaton M accepting $\{ab, ba\}$.

13. Construct an NFA accepting L given by $L = \{x \in \{a, b\}^* / |x| \geq 3$ and the third symbol of x from right is $a\}$.

14. Write short note on Chomskian hierarchy.

15. Briefly explain the uses and characteristics of the generation trees.

16. Let $L = \{a^n b^n, n \geq 1\}$. Then prove that the grammar $G = (N, T, P, S)$ where $N = \{S\}$, $T = \{a, b\}$ and $P = \{S \rightarrow aSb, S \rightarrow ab\}$ generates L.

17. Prove that the families of PSL, CSL, CFL and RL are closed under product.

18. Prove that $L = \{a^i / i$ is a prime $\}$ is not a CFL.

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SECTION - C

ANSWER ANY TWO QUESTIONS. $(2 \times 20 = 40)$

19. a) Construct a deterministic finite automaton FA equivalent to NFA

$M = (\{q_0, q_1, q_2, q_3\}, \{a, b\}, \delta, q_0, \{q_3\})$, δ is given below.

δ	a	b
q_0	$\{q_0, q_1\}$	q_0
q_1	q_2	q_1
q_2	q_3	q_3
q_3	-	q_2

b) Find $\hat{\delta}(q_0, 1001)$ for the NFA given by $M = \{(q_0, q_1, q_2, q_3), (0, 1), \delta, q_0, \{q_3\}\}$ and δ is

defined in the following table: **(10+10)**

δ	0	1
q_0	$\{q_0, q_1\}$	$\{q_0, q_2\}$
q_1	q_3	—
q_2	—	q_3
q_3	q_3	q_3

20. a) Find M such that $T(M) = \{b^m a b^n, m, n \geq 1\}$.

b) State and prove pumping lemma. **(8+12)**

21. a) Prove that G is Ambiguous for the grammar $G = (N, T, P, S)$ where

$N = \{S, (P_r), (VP), V, A, N, (Aux), P\}, T = \{They, are, flying, planes\}$,

$P = \{S \to (P_r)(VP), P_r \to They, VP \to (V)(NP), V \to are, NP \to (A)(N), A \to flying, N \to$

$planes, V \to (Aux)(P),$

$(Aux) \to are, NP \to N, P \to flying\}$.

b) Let $G = (N, T, P, S)$ where $N = \{S, A\}, T = \{a, b\}$. Construct a production rule to show that the

word **abab** has two different leftmost derivations and generation trees. **(10+10)**

22. a) Let $G = (\{S, Z, A, B\}, \{a, b\}, P, S)$ where P consists of the following productions:

     1. $S \to aSA$ 2. $S \to aZA$ 3. $Z \to bZB$ 4. $Z \to bB$ 5. $BA \to AB$ 6. $AB \to Ab$

7. $bB \to bb$ 8. $bA \to ba$ 3. $aA \to aa$.

Then prove that $L(G) = \{a^n b^m a^n b^m / n, m \geq 1\}$ is a CSL.

b) State and prove Chomsky Normal form theorem. **(12+8)**

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