LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **NOVEMBER 2018**

MT 5407 – FORMAL LANGUAGES AND AUTOMATA

Date: 23-10-2018 Dept. No. Max. : 100 Marks
Time: 01:00-04:00

PART – A

ANSWER ALL THE QUESTIONS (10×2=20)

1. Construct deterministic finite automata to check whether given number is divisible by two.
2. Define non – deterministic finite automata.
3. What is a regular set?
4. Define ambiguous grammar and give an example.
5. Write a grammar to accept $L=\left\{a^n / n\geq 1\right\}$.
6. Define generation tree.
7. Eliminate the ε - production from the following set of production rules $A\to 0B1/1B1, B\to 0B/1B/\varepsilon$.
8. Define context free languages.
9. If $G=\left(\{S,A\},\{a,b,c\},S\to aAb, \mathrm{A}\to aAb, A\to c, S\right)$, find $L(G)$.
10. Define star closure.

PART – B

ANSWER ANY FIVE QUESTIONS (5×8=40)

11. Construct a DFA to accept the set of all strings over $\{0,1\}$ ending with 00.
12. Construct a NFA to accept set of all strings over $\{0,1\}$ ends with 111 or 000.
13. Write a brief note on Chomsky hierarchy.
14. For the string aabbaaa find the left most and right most derivation using the production rule, $S\to Aas/a/SS, A\to SbA/ba$.
15. Find a CNF grammar equivalent to a grammar whose production rules are $S\to aAbB, A\to aA/a, B\to bB/b$.
16. Let $G=(N,T,P,S)$, $N=\{S,B\}$, $T=\{a,b,c\}$. P consists of the following productions: $S\to aSBc, S\to abc, cB\to Bc, bB\to bb,$ Then show that $L(G)=\left(a^n b^n c^n / n\geq 1\right)$ is a CSL.
17. Prove that union of two regular set is regular.
18. Prove that the families of PSL, CSL, CFL and RL are closed under union.

PART – C

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

19. (a) Construct a DFA with minimum states for the following NFA

	a	b
$\rightarrow q_0$	$\{q_1\}$	ϕ
q_1	$\{q_1\}$	$\{q_2\}$
q_2	ϕ	$\{q_2\}$

(b) Construct a grammar to generate the set of all palindromes over $\{a,b\}$. **(16+4)**

20. Let $M=\{(q_0,q_1,q_2,q_3,q_4),(\mathrm{a,b}),\delta,q_0,\{q_3\}\}$ is a finite automaton, where δ is given by

$\delta(q_0,a)=q_0$, $\delta(q_0,\mathrm{b})=q_1$, $\delta(q_1,a)=q_2$, $\delta(q_1,\mathrm{b})=q_1$, $\delta(q_2,a)=q_4$, $\delta(q_2,\mathrm{b})=q_3$, $\delta(q_3,a)=q_4$,

$\delta(q_3,\mathrm{b})=q_3$, $\delta(q_4,a)=q_4$, $\delta(q_4,\mathrm{b})=q_4$,

(a) Represent M by its state table and by its state diagram.

(b) Which of the following strings are accepted by M?

(i) abab (ii)aabbaa (iii) abbbab (iv) aabba. **(12+8)**

21. (a) Prove that $L(\mathrm{G})=\{a^i \,/\, i \text{ is prime}\}$ is not a context free language.

(b) Write the Greibach normal form to generate the context free grammar $L=\{w\,w^R \,/\, w\in(\mathrm{a,b})\}$ and the production rules P is given by $S\rightarrow aSa/bSb/aa/bb.$ **(8+12)**

22. (a) Consider the grammar $G=(\mathrm{N,T,P,S})$, where $N=\{S,(P_r),(VP),V,(NP),A,N,(Aux),\mathrm{P}\}$,

$T=\{They, are, flying, planes\}$,

$$P=\left\{\begin{array}{l} S\rightarrow(P_r)(VP), P_r\rightarrow They, VP\rightarrow(V)(NP), V\rightarrow are, NP\rightarrow(A)(N), A\rightarrow flying, \\ N\rightarrow planes, V\rightarrow(Aux)(P), Aux\rightarrow are, NP\rightarrow N, P\rightarrow flying \end{array}\right\}$$. Find two derivations and draw their corresponding generation trees.

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

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