LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTHSEMESTER – APRIL 2018

MT 5407- FORMAL LANGUAGES AND AUTOMATA

Date: 10-05-2018 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

PART-A

Answer ALL the questions: **(10 x 2=20)**

1. Write any two differences between DFA and NFA.
2. Draw a DFA accepting the set of all strings over {0, 1} with three consecutive zero's.
3. Define a context free grammar.
4. Show that the grammar $G=\left(\{S\},\{a\},S\to SS,S\to a,S\right)$ is ambiguous.
5. Define a derivation tree.
6. Define a star closure.
7. Define an e- free homomorphism.
8. Write a grammar for the language $L=\left\{a^n b^n / n \geq 1\right\}$.
9. Define unit production.
10. Define Greibach normal form.

PART-B

Answer any FIVE questions: **(5 x 8=40)**

11. Construct a DFA to accept set of strings over (0,1) where the string is considered as a binary integer divisible by 3.
12. Eliminate the $\in$ - production for the following set of production rules

    $S\to AB, A\to aAA/\in, B\to bBB/\in$.
13. Let $G=\{N,T,P,S\}$ $N=\{S,B\}$ and $T=\{a,b,c\}$. *P* consists of the following productions:

    (i) $S \to aSB$ (iii) $bB \to bbc$

    (ii) $S \to abc$ (iv) $cB \to Bc$

    Show that $L(G)=\left\{a^n b^n c^n / n \geq 1\right\}$ is a *CSL*.
14. Prove that union of two regular set is regular.
15. Let $G=\{N,T,P,S\}$, where $N=\{S,A\}$ $T=\{a,b\}$ and *P* consists of the rules

    1. $S \to aAb$ 2. $S \to abSb$ 3. $S \to a$ 4. $A \to bS$ 5. $A \to aAAb$

    Find the leftmost and rightmost derivations for the string *abab* .

16. Prove that the families of *PSL*, *CSL*, *CFL* and *RL* are closed under union.

17. State and prove the pumping lemma.

18. Prove that $L(G)=\{a^n b^n c^n / n \geq 1\}$ is not a Context Free Language (CFL).

PART - C

Answer any TWO questions: **(2 x 20=40)**

19. (i) Consider the grammar $G=\{N,T,P,S\}$ where

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

$$P=\begin{Bmatrix} S\to(P_r)(VP), P_r\to They, VP\to(V)(NP), V\to are, NP\to(A)(N), \\ A\to flying, N\to planes, V\to(Aux)(P), Aux\to are, NP\to N, P\to flying \end{Bmatrix},$$ and

S is the start symbol, generate the language consisting of the single sentence,

$\{They\ are\ flying\ planes\}$.

(ii) Show that id+id*id can be generated by two distinct leftmost and right most derivation in the grammar $E\to E+E/E*E/E/id$. **(12+8)**

20. Construct a deterministic finite automaton (FA) equivalent to a given NFA where,

$M=(\{q_0,q_1,q_2,q_3\},\{0,1\},\delta,q_0,\{q_3\})$, δ is given in the following table:

δ	a	b
q_0	$\{q_0,q_1\}$	$\{q_0\}$
q_1	ϕ	$\{q_2\}$
q_2	ϕ	ϕ

21. (i) 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. $bA\to ba$ 9. $aA\to aa$

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

(ii) Prove that the family of CFL is closed under substitution. **(12+8)**

22. (i) Write a brief note on Chomsky Hierarchy.

(ii) Write a grammar CNF equivalent to a grammar whose production rules are $S\to aAbB, A\to aA/a, B\to bB/b$. **(10+10)**

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