AUTUMN END SEMESTER EXAMINATION-2017

5th Semester B.Tech & B.Tech Dual Degree

FLA

CS-3003

(Regular-2015 & Back of Previous Admitted Batches)

Time: 3 Hours Full Marks: 60

Answer any SIX questions including question No.1 which is compulsory.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. Answer all the Questions. [2×10]

(a) Show that the CFG $\mathbf{S \rightarrow aSaSbS \mid aSbSaS \mid bSaSaS \mid \lambda}$ generates the language $\{\mathbf{x \in \{a, b\}^* \mid n_a(x) = 2n_b(x)}\}$.

(b) Every subset of a regular language is regular(**True/False**). Justify your answer.

(c) State the pumping lemma for context free languages.

(d) Assume the height of a regular expression r, denoted by $h(r)$, is defined as follows:

$\mathbf{h(a) = 0}$ **where** $\mathbf{a \in \Sigma, h(rs) = h(r+s) = max(h(r), h(s)), h(r^*) = h(r) + 1}$

Using above fact, find out the height of regular expression $\mathbf{(a(a + a^*aa) + aaa)^*}$.

(e) Find a regular grammar that generates the following language $\mathbf{L = \{w \in (a, b)^*: |w| \text{ is even}\}}$.

(f) Convert the following grammar into Griebach Normal Form

$\mathbf{S \rightarrow aSb \mid bSa \mid a \mid b \mid ab}$

(g) What is an inherently ambiguous Context-free language? Give an example of inherently ambiguous language.

(h) Identify the language represented by the grammar $\mathbf{S \rightarrow XY}$, $\mathbf{X \rightarrow aX \mid a, Y \rightarrow aYb \mid \lambda}$. Assume that S is the start symbol of grammar.

(i) Design a DFA that accepts strings over **{a,b}** in which each **b** is immediately preceded and followed by **a**.

(j) Suppose $\mathbf{L = \{a^n b^n c^m \mid n \leq 100 \text{ and } m < n\}}$. The strings of **L** can be recognized by a Pushdown Automata but not by Finite Automata. (**True/False**). Justify your answer.

2. (a) Find context free grammars that generate the following languages [4]

a) $\mathbf{L = \{u2v \mid u, v \in (0+1)^* \text{ and } |u| = |v|\}}$

b) $\mathbf{L = \{a^n b^m \mid m \neq n\}}$

(b) Find a DFA equivalent to the following NFA [4]

δ	0	1	λ
A	{C}	φ	{B}
B	{A}	{C}	φ
C	φ	{C}	{B}

3. (a) Show that $\mathbf{L = \{v \mid v \in (a+b)^* \text{ and } n_a(v) \bmod 3 \neq n_b(v) \bmod 3\}}$ is regular. [4]

(b) Find a left linear equivalent for the following right linear grammar. [4]

$\mathbf{S \rightarrow bS \mid aA}$

$\mathbf{A \rightarrow aA \mid bB}$

$\mathbf{B \rightarrow aB \mid bB \mid \lambda}$

4. (a) Convert the grammar with productions [4]

$S \rightarrow abAB$

$B \rightarrow bAB \mid \lambda$

$B \rightarrow BAa \mid A \mid \lambda$

into Chomsky Normal Form.

(b) Show that $L = \{x^n y^m \mid n \neq m\}$ is not regular using pumping lemma for regular languages. [4]

5. (a) Consider the DFA $\{\{A, B, C, D, E, F, G, H, I\}, \{a, b\}, \delta, A, \{E, F, I\}\}$ [4]

δ	a	b
A	B	C
B	D	I
C	E	D
D	F	D
E	E	G
F	I	G
G	H	E
H	G	F
I	I	H

a) Find out the indistinguishable pair of states using mark procedure.

b) Minimize the DFA using reduce procedure.

(b) Show that regular languages are closed under intersection. [4]

6. (a) Design a Pushdown Automaton that accepts the language L. [4]

$L = \{a^n b^m \mid m \geq n\}$

(b) Consider the grammar [4]

$S \rightarrow SS$

$S \rightarrow aS \mid Sb \mid ab$

a) Show that the given grammar is ambiguous.

b) Find an equivalent unambiguous grammar.

7. (a) Find a simplified grammar equivalent to the grammar [4]

$S \rightarrow ABA \mid aSa \mid bSb$

$A \rightarrow aA \mid aAb \mid B$

$B \rightarrow bB \mid \lambda$

(b) Let $G=(V,T,S,P)$ be any context free grammar without any λ-productions or unit productions. Let m be the maximum number of symbols on the right of any production in P. Show that there is an equivalent grammar in Chomsky Normal Form with no more than $(m - 1)\,|P| + |T|$ production rules. [4]

8. (a) Design a Turing Machine for the language $L = \{a^m b^n \mid m < n\}$. [4]

(b) Design a Non-Deterministic Pushdown Automaton equivalent to the following grammar [4]

$S \rightarrow aABB \mid aAA$

$A \rightarrow aBB \mid b$

$B \rightarrow bBB \mid A$

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