AUTUMN END SEMESTER EXAMINATION-2015

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

FLA (CS-3003)

(Regular-2013 Admitted Batch)

Full Marks: 60 **Time: 3 Hours**

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) Let $L = \{ab, aa, baa\}$ and $W = \{abaabaaabaa, aaaabaaaa, baaaaabaaaab, baaaaabaa\}$. Then find the string(s) of W that is / are not in L*. Justify your answer.

b) Every language accepted by NPDA is also accepted by DPDA. Write True or False, and Justify your answer.

c) Find a regular expression for the language of all strings of length two or more over $\{a, b\}$ in which all a's precede the b's.

d) Every finite subset of a non-Regular language is regular. Write True or False, and Justify your answer.

e) What is the minimum number of states in any DFA that accepts the language $L = \{w \mid w \in \{0,1\}^* \text{ and number of } 0\text{'s and } 1\text{'s in } w \text{ are divisible by } 3 \text{ and } 5 \text{ respectively}\}$. Justify your answer.

f) Show that a CFG $G = \{V, T, P, S\}$ having at most k symbols in RHS of any production has at most $(k-1)|P| + |T|$ number of productions in its corresponding CNF representation.

g) The complement of a Context Free Language is Context Free. Write True or False, and Justify your answer.

h) Design a TM for the language $L = \{a^m b^n : n \geq 1, m \geq 1\}$.

i) Show that the language L(G) of the grammar

$G = (\{A, B, C\}, \{a, b, d\}, C, \{A \rightarrow aA \mid bC,\ C \rightarrow aC \mid bA, B \rightarrow d\})$ is empty.

j) Find an NPDA equivalent to the CFG $A \rightarrow aBC \mid bD \mid a$.

2. a) Design a DFA that accepts strings over {b} of length $2i + 5k$ for any non-negative values of i and k. [4

b) Design a regular grammar for the language $L = \{(aab^*ab)^*\}$. [4

3. a) Convert the following DFA into a regular expression. [4

δ	A	B
$\rightarrow q_0$	q_1	q_0
$^*q_1$	q_2	q_1
$^*q_2$	q_1	q_2
q_3	q_1	q_2

b) Find minimized DFA for the language [4

$L = \{a^n : n \bmod 3 = 0\} \cup \{a^n : n \bmod 5 = 1\}$

4. a) Find a CFG that generates the language [4

$L = \{a^n b^m : n \neq m - 1\}$

b) Consider the following grammar G: [4

$S \rightarrow AS \mid \lambda$

$A \rightarrow aAb \mid aA \mid ab$

Show that the grammar G is ambiguous.

Find an unambiguous grammar equivalent to G.

5. a) Transform the following grammar into Chomsky Normal Form. [4

$S \rightarrow abAB$

$A \rightarrow bAB \mid \lambda$

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

b) Show that the following CFG and NPDA are equivalent. [4

$S \rightarrow aAb$ $A \rightarrow aAb \mid \lambda$	$\delta(q_0, a, Z) = (q_0, AZ)$ $\delta(q_0, a, A) = (q_0, AA)$ $\delta(q_0, b, A) = (q_1, \lambda)$ $\delta(q_1, b, A) = (q_1, \lambda)$ $\delta(q_1, \lambda, Z) = (q_f, \lambda)$

6. a) Show that the family of context free languages is not closed under intersection. [4

b) What do you mean by Chomsky Hierarchy? Explain. [4

7. a) Construct a PDA that accepts the following language [4

$L = \{a^n b^{2n} : n \geq 1\}$

b) State pumping lemma for context free languages. Show that the family of context-free languages is closed under union. [4

8. a) Design a Turing Machine M for the language [4

$L = \{ a^m b^m c^n : m \geq 1, \quad n \geq 1\}$

b) Give a sequence of instantaneous descriptions leading to acceptance of the string $aabbcc$ by the Turing Machine M. [4

XXXXX