AUTUMN END SEMESTER EXAMINATION-2015

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

THEORY OF COMPUTATION (CS-504)

(Back-2012 & Previous Admitted Batches)

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 following questions: [2 × 10

(a) Design a DFA for the given language
$L = \{w \in \{a,b\}^* | \text{ second symbol of } w \text{ is } a \text{ and fourth symbol is } b\}$

(b) Check that the given regular expressions $(0+1)^*(1+\lambda)(0+1)^*$ and $(1+01+0)^*$ are equivalent or not. Justify.

(c) Find the S-grammar for the language $L = \{a^n b^n | n \geq 1\}$.

(d) Prove that the given CFG is ambiguous or not.
$S \rightarrow a|abSb|aAb, A \rightarrow bS|aAAb$

(e) Write the CFG for the language
$L = \{\text{alternate sequence of } a \text{ and } b\}$

(f) Give the formal definition of Turing Machine.

(g) A regular grammar is always linear, but not all linear grammars are regular. True or False, justify.

(h) Distinguish between DFA and NFA with examples.

(i) Write a regular expression for the language $L = \{a^i b^j \mid (i+j)\ is\ even\}$.

(j) Draw the Chomsky Hierarchy and explain in brief.

2. (a) Design a DFA for the given language [4

$L = \{w | n_a(w) \geq 1, n_b(w) = 2, w \in (a,b)^*\}$

(b) Find the regular expression for the given DFA [4 $M = \{Q, \Sigma, \delta, A, \{E\}\}$ where $Q = \{A, B, C, D\}$ and $\Sigma = \{a, b\}$.

δ =	a	b
A	B	C
B	D	C
C	B	D
D	D	D

3. (a) For the given $r = baba(a+b)^*(a+b)b$ [4

(i) Design NFA

(ii) Design corresponding DFA from (i)

(b) Show that L^2 is regular where $L = \{awa \mid w \in \{a,b\}^*\}$. [4

4. (a) Write Context Free Grammar (CFG) for the following: [2+2

(i) $L=\{a^n b^m \mid n \leq 2m \text{ and } n, m \geq 0\}$

(ii) $L=\{a^n b^m \mid n \neq m \text{ and } n, m \geq 0\}$

(b) (i) Construct NFA which will accept all strings that contain 0 in second position and 1 in fourth positions from the end of the string. [4

(ii) Design the corresponding DFA from the above designed NFA.

5. (a) State Pumping Lemma for context free languages. State the pumping lemma for context free grammar. Is the language $L=\{0^n1^n2^n|n>=1\}$ context free ? [4

(b) Define GNF. Convert the given grammar into GNF form. [4

$S \rightarrow ABb|a$
$A \rightarrow aaA|B$
$B \rightarrow bAb$

6. Consider the following given grammar G=({S, A, B, C}, {a, b}, P, S) where P is given as follows: [2+2+3+1

$S \rightarrow aA|aBB, A \rightarrow aaA|\lambda, B \rightarrow bB|bbC, C \rightarrow B.$

(i) Eliminate λ-production.

(ii) Eliminate all Unit-production.

(iii) Convert the resulting grammar to CNF.

(iv) What language does this grammar generate?

7. (a) Construct a PDA for the language $L=\{a^mb^nc^o|$ where m=o or n=o$\}$. [4

(b) Construct a nPDA for given CFG, where the rules are given below: [4

S→ aAB|aAA, A→ aBB|a, B→ b|BB|A.

8. (a) Design a Turing Machine(TM) M for $L = \{a^nb^nc^n|n \geq 1\}$. [6

(b) Try to write instantaneous descriptions (IDs) for feed the input string w={aabbcc} to the above designed TM(M). [2

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