AUTUMN END SEMESTER EXAMINATION-2018

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

FORMAL LANGUAGES AND AUTOMATA THEORY

CS3003

[For 2017(L.E.), 2016 & 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 the following questions. [2 × 10]

   (a) Differentiate between DFA and NFA.

   (b) Design an NFA that accepts a binary string iff it starts with 1 and ends with 0.

   (c) Construct a CFG without λ production equivalent to the CFG: S-> a|Ab|aBa A-> b|λ B-> b|A

   (d) Find the language of the CFG:

   S-> 0S1 | 0A | 0 | 1B |1 A->0A | 0 B-> 1B |1

   (e) Design an NFA equivalent to the regular expression r = 01^*+10

   (f) State Pumping Lemma for context free languages.

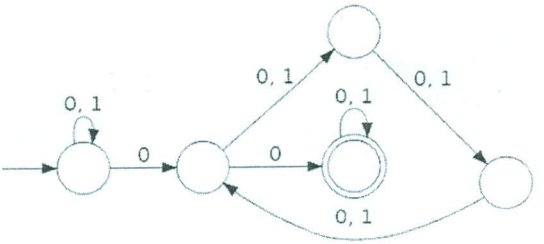
   (g) Differentiate between Recursive languages and Recursive Enumerable languages.

   (h) Define Deterministic PDA. Is the family of DPDA equivalent to the family of NPDA?

(i) Give example of two context-free languages whose intersection is not a CFL.

(j) Differentiate between Turing Machine & Pushdown Automaton.

2. (a) Consider the following non-deterministic finite automaton (NFA) over the alphabet $\Sigma = \{0, 1\}$. [4]



Find a regular expression equivalent to the NFA.

(b) Design a DFA for the language, $L = \{ w \in (0+1)^* :$ w contains an equal number of ocurrences of 01 and 10 $\}$. For example, the string 01010 is in the language whereas 11010 is not in the language. [4]

3. (a) Show that the language [4]

$\mathbf{L = \{v \mid v \in (a+b)^* \text{ and } n_a(v) \bmod 3 \neq n_b(v) \bmod 2\}}$ is regular.

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

4. (a) State pumping lemma for regular languages. Prove that the language of palindromes over {a, b} is not regular using pumping lemma. [4]

(b) Design a Pushdown Automaton (PDA) equivalent to the context- free grammar. [4]

S-> XaaX

X-> ax | bx

5. (a) Find a CFG that generates all binary strings which are not palindromes. [4]

(b) (i) Convert the grammar with following productions into CNF. [4]

S -> aSa | bSb | ab

(ii) Convert the grammar with following productions into GNF.

S -> ABAb | ab

B -> ABA | a

A -> a | b

6. (a) Simplify the following Grammar by removing λ-productions, unit productions and useless productions. [4]

S-> aAA

B-> bBB | D

B-> ab | λ

C->aB

(b) Let G be the grammar [4]

S-> 0B | 1A

A-> 0 | 0S | 1AA

B ->1 | 1S | 0BB

For the string 00110101, find

(i) a leftmost derivation. (ii) a rightmost derivation. (iii) a derivation tree. (iv) Check whether the grammar is ambiguous or not.

7. (a) Design a Turing Machine for the language $L = \{ww^R \mid w \in (0+1)^*\}$ [4]

(b) Design a Turing machine that accepts the language. $L=\{x \in \{a,b\}^* \mid x \text{ is a palindrome}\}$. [4]

8. Writes short-notes on. [4×2]

(a) Closure properties of Context free languages

(b) Chomsky hierarchy of languages

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