# Code : 051611

## B.Tech 6th Semester Examination, 2017

## Formal Languages and Automata Theory

*Time : 3 hours* *Full Marks : 70*

***Instructions :***

*(i) There are **Nine** Questions in this Paper.*

*(ii) Attempt **Five** questions in all.*

*(iii) **Question No. 1 is Compulsory.***

*(iv) The marks are indicated in the right-hand margin.*

1. Choose the correct alternatives for ***any seven*** of the following: 7×2 = 14

(i) The output of the Moore Machine depends

(a) only on present state

(b) only on current input symbol

(c) both on present state and current input symbol

(d) none of the above

(ii) The logic of Pumping lemma is a good example of

(a) the pigeon-hole principle

(b) divide and conquer technique

(c) recursion

(d) iteration

(iii) Recursively enumerable languages are not closed under

(a) union

(b) intersection

(c) complementation

(d) concatenation

(iv) The language L={a"b"a" where n=1,2,3.....} is a

(a) regular language

(b) context-free language

(c) non-context-free

(d) none of the above

(v) A language L is denoted by a regular expression:

$$L=(x)^*(x|\ yx^*)$$

(a) x

(b) xyxyx

(c) xyx

(d) none of the above

(vi) Context free languages are not closed under

(a) union





(b) intersection

(c) concatenation

(vii) Recursive languages are

(a) a proper superset of CFLs.

(b) Always recognizable

(c) Also called type 0 languages

(d) Recognizable by Turing Machines

(viii) Choose the incorrect statements

(a) Every subset of a countable set is countable

(b) The class of DPDA is not countable

(c) the class of TMs is countable

(d) The class of LBA is countable

(ix) Which of the following statements is true?

(a) The language $\{a^n|\ n \text{ is prime}\}$ is regular language

(b) The union of 2 recursive languages is Recursive.

(c) Recursive enumerable languages are closed under complementation.

(d) Recursive languages are not closed under complementation

(x) In case of TM, by reading input x, TM

(a) may go to halt-final state

(b) may go to halt-non final state

(c) may go to infinite loop

(d) All of the above

2. (a) Obtain the regular expression for the following sets: 4×3=12

(i) Set of strings over $\sum = \{a,b,c\}$ with exactly one *c*.

(ii) Set of strings over $\sum = \{0,1\}$ containing all possible strings of length four.

(iii) Language over $\sum = \{0,1\}$ containing all possible combinations of 0's and 1's but not having two consecutive 0's.

(iv) Language over $\sum = \{0,1\}$ consisting of all string with at least two consecutive 0's.

(b) Describe in simple English the language represented by the regular expression $r = (1+10)^*$. 2

3. (a) Construct NFA equivalent to the following Regular expression: 4

$10|(0|11)0^*1$





(b) Construct a NFA with $\in$ moves for the regular expression $r = (a^* + b^*)$. 5

(c) Construct NFA for the Set of all strings over $\sum = \{0,1\}$ with alternate 0's and 1's. 5

4. (a) Construct a DFA for the regular expression r = (a|b )* aa (ab|ba ). 7

(b) Find out the regular expression for the following FA: 7

| Current States | I/P Symbol | |
|---|---|---|
| | a | b |
| p | p,q | --- |
| q | r | q,p |
| r | q | ---- |

Here, *r* is the final state.

5. (a) Prove the following two properties: 3×2=6

(i) Regular sets are closed over the union operation

(ii) Regular sets are closed over the intersection operation

(b) Show with the help of pumping lemma that following languages are not regular: 4×2=8

(i) $L=\{0^{i^2} \mid i \text{ is an integer, } i>=1\}$

(ii) $L = \{a^n b^n \mid n > 0\}$

6. (a) Give the CFG for each of the languages defined by the following regular expressions: 3×3 = 9

   i. $ab^*$

   ii. $a^*b^*$

   iii. $(baa+abb)^*$

   (b) Construct a CFG for the following language set:

   $L = \{a^{2n} b^n \mid n>=1\}$

7. (a) For the grammar G, which is defined as:

   $S \rightarrow aB|bA$

   $A \rightarrow a|aS|bAA$

   $B \rightarrow b|bS|aBB$

   Where *S* is the starting symbol, show the leftmost derivation, rightmost derivation and parse tree for the string *'bbaaba'*. 9

   (b) Determine a CFG without unit production equivalent to the CFG given below. 5

   $S \rightarrow Abb$

   $A \rightarrow Bb$

   $B \rightarrow Sa$





8. a) Find the CNF (Chomsky Normal Form) for the following CFG: 5

   $S \rightarrow aSa|bSb|a|b|aa|bb$

   (b) Eliminate null productions from the following CFG: 4

   $A \rightarrow aBb|bBa$

   $B \rightarrow aB|bB|\in$

   (c) Convert the following grammar to GNF: 5

   $S \rightarrow ABA|AB|BA|AA|A|B$

   $A \rightarrow aA|a$

   $B \rightarrow bB|b$

9. (a) Design a PDA that accepts all palindrome strings over $\sum = \{a,b\}$. 5

   (b) Design a PDA that accepts the language $L = \{a^{2n} | n > 0\}$. 5

   (c) Show that $L = \{a^p \mid p \text{ is prime}\}$ is not a context-free language. 4

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