

B.Tech II Year II Semester (R13) Supplementary Examinations December/January 2015/2016  
**FORMAL LANGUAGES & AUTOMATA THEORY**  
 (Computer Science and Engineering)

Time: 3 hours

Max. Marks: 70

**PART – A**  
 (Compulsory Question)

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- 1 Answer the following: (10 X 02 = 20 Marks)
- Give the mathematical definition of the grammar.
  - What is context sensitive grammar.
  - Describe the language generated by the regular expression  $(b + ab)^*(\epsilon + a)$ .
  - State the Arden's theorem.
  - Identify the type of the grammar:  $S \rightarrow aSa \mid bSb \mid c$ .
  - Show that the following CFG is ambiguous.  
 $S \rightarrow SS \mid a$
  - Write the definition of push down automata (PDA).
  - Give any two examples of languages that are accepted by PDA.
  - Define multi- tape turing machine.
  - What is unrestricted grammar? Give an example.

**PART – B**  
 (Answer all five units, 5 X 10 = 50 Marks)

**UNIT – I**

- 2 (a) Construct the Grammar for palindrome of binary numbers  
 (b) Construct the Grammar for the language  $a^n b^n, n > 0$

OR

- 3 Design a minimal DFA over the alphabet  $\Sigma = \{0, 1, 2\}$  to accept the language  $L = \{w \mid w \equiv 0 \pmod{4}\}$ .

**UNIT – II**

- 4 State the pumping lemma for regular expressions.
- (i) Show that  $L = \{a^{i^2} \mid i \geq 1\}$  is not regular by using pumping Lemma.
  - (ii) Show that  $L = \{a^i b^j \mid i, j \geq 1, i \neq j\}$  is not regular by using pumping lemma.

OR

- 5 Prove that the family of regular languages is closed under the following operations:
- Union.
  - Intersection.
  - Complementation.
  - Reversal.
  - Concatenation.

**UNIT – III**

- 6 Define the following terms: (i) Useless symbol. (ii) Null – production. (iii) Unit production. Remove Null – productions in the following grammar.

$$\begin{aligned} S &\rightarrow ABaC \\ A &\rightarrow BC \\ B &\rightarrow b \mid \epsilon \\ C &\rightarrow D \mid \epsilon \\ D &\rightarrow \epsilon \end{aligned}$$

OR

- 7 Define Chomsky Normal Form, Convert the following grammar into CNF:  
 $S \rightarrow bA \mid aB; A \rightarrow bAA \mid aS \mid a; B \rightarrow aBB \mid bS \mid a$ .

**UNIT – IV**

- 8 (a) Construct a PDA to accept the language  $L = \{WCW^R \mid W \in (a, b)^+\}$  by the empty stack.  
 (b) Construct a PDA to accept the language  $L = \{a^n b^{2n}, n \geq 1\}$  by the final state.

OR

- 9 Prove that “L is accepted by a PDA  $M_1$  by empty store, if and only if L is accepted by a PDA  $M_2$  by final state”.

**UNIT – V**

- 10 Prove that the problem that a string w is accepted by a DFA M is decidable.

OR

- 11 Construct linear bounded automata for the following context-sensitive language  $L = \{a^n b^n c^n \mid n \geq 0\}$ .

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