

**BCSE IIIrd Year - 2017**  
**1st Semester Supplementary**  
**FORMAL LANGUAGE & AUTOMATA THEORY**

Time: Three hours

Answer any *five* questions

Full Marks: 100

1. Construct Deterministic Finite Automatas to accept the following languages with necessary justifications :
  - (a) All binary strings that represent an unsigned number divisible by 5.
  - (b) All binary strings whose 3rd symbol from the right hand end is 1.

10+10
2. (a) Let  $L_1, L_2$  be languages that are acceptable by DFAs. Prove that the language  $L_1 \cup L_2$  is also acceptable by a DFA.  
 (b) Prove that every finite language is acceptable by a DFA.
 

10+10
3. (a) State and prove the **Pumping Lemma** for regular languages.  
 Why it is useful?  
 (b) Find out if the language  $\{a^i b^j : i \neq j\}$  is acceptable by a DFA.
 

12+8
4. (a) Let  $L$  be a language accepted by a DFA. Prove that its reverse  $L^R$  is accepted by a NDFA.  
 Explain how non-determinism is introduced in this construction.  
 (b) Let  $L = \{\text{All strings of } a, b \text{ where at least one pair of } a\text{'s is separated by a substring of even length}\}$ . Show that  $L$  can be accepted by a NDFA. Hence explain why *non-determinism* is useful.
 

10+10
5. (a) Explain the concept of  $\epsilon$ -closure of a set of states of a NDFA.  
 (b) Prove that for each non-deterministic finite automata, there exists an *equivalent* deterministic automata.
 

3+17
6. (a) Develop regular expressions for all strings of  $\{a, b\}$  that contain an *even* number of  $a$ 's and *even* number of  $b$ 's.  
 (b) Prove that the language accepted by a DFA can always be described by a regular expression.
 

8+12
7. (a) Explain when is a Push Down Automata called *deterministic*.  
 Construct a DPDA to accept the language  $\{a^m b^n : 0 \leq m < n\}$  with necessary justifications.  
 What is the mode of acceptance of this DPDA?  
 (b) Construct a PDA to accept the language  $\{ww^R : w \in \{a, b\}^+\}$  with necessary justifications.  
 Explain all sources of *non-determinism* present in the transitions of this PDA.  
 What is the mode of acceptance of this PDA?
 

10+10