Department of Computer Science & Engineering,
Motilal Nehru National Institute of Technology, Allahabad.

B.Tech IV Semester CS
END Semester Examination 2017

Subject: Automata Theory
Duration: 3:00 HRS

Paper code: CS 1404
Max. Marks: 60

Note: Attempt all questions. Be specific in your answers. Make assumptions wherever necessary and quote it. Do all the questions serially.

1. Are the following statements true or false? Explain your answer in each case. (In each case, a fixed alphabet Σ is assumed.) [2X4]
   (a) If L is accepted by a deterministic PDA, then the compliment of L, L' must be a regular.
   (b) If L is accepted by deterministic PDA, then the compliment of L, L' must be a context free.
   (c) If L is a language over the alphabet Σ and $a \in \Sigma$, define $a\backslash L = \{w \mid aw \in L\}$. If L is regular, then so is $a\backslash L$
   (d) If L1 and L2 are non regular language, then L1 U L2 is also not regular.

2. a) Design deterministic finite automata for the set of strings over the alphabet {a, b} containing at least three occurrences of three consecutive b's, overlapping permitted (e.g., the string bbbbb should be accepted.)

   b) Let $\Sigma = \{0, 1\}$. Let L be the language that consists of strings having either 01 repeated one or more times or 010 repeated one or more times. Is L regular? Explain [2.5x3]

   c) Construct the equivalent finite automata from the following regular grammar.
   $S \rightarrow aS \mid bA \mid b$
   $A \rightarrow aA \mid bS \mid a$

3 a) Assume that a regular language L is provided to you as a DFA M $\{Q, \Sigma, \delta, q_0, F\}$. How would you check whether L is infinite?

   b) Design a Push down Automata for accepting the string for the laguage $L = \{WW^R \mid W \in (a,b)^*\}$ by the empty stack as well as final state. [2.5x3]

   c) show that L= Palindrome over {a, b} is not regular.

4. (a) Construct a Moore machine which determines the residue mod 3 for each binary string treated as binary integer. And the convert into the corresponding mealy machine. [2x3]

   (b) Design Finite State Machine or abstract model for binary adder

   (c) Prove that the language $L = \{a^{i^2} \mid i \geq 1\}$ is not context free language.

5. (a) Consider the language L= $\{a^m b^{2n} c^{3n} d^p : p > m \text{ and } m,n \geq 1\}$ [2.5x3]
Write a context free grammar to generate L and write shortest string in L.

(b) Design a PDA for Hypertext markup language (HTML) consisting of all the tags having immediate closing tags within the <BODY> </BODY> tag. For example:

```
<HTML>
  <HEAD>
   <TITLE>
    My first web page
     </TITLE>
        </HEAD>
          <BODY>
           <B> First web page </B>
            </BODY>
</HTML>
```

(c) Convert the following Context free Grammar into GNF

S → XY
X→ YS |b
Y → SX | a

6. (a) Prove that if L =N(P_N) for some empty stack pda $P_N = \{Q, \Sigma, \Gamma, \delta_N, q_0, Z_0, \emptyset\}$, the there is a final state pda P_F such that L =L(P_F). [2.5x3]

(b) Using the grammar
S → AB | BC
A → BA | a
B → CC | b
C → AB | a
Use the CYK algorithm to determine whether the given string "baaba" is in L(G) or not?

(c) Construct a push down automata that accept the following language.

L= $\{uawb: u \text{ and } w \in (a,b)^* \text{ and } |u| = |w|\}$

7. (a) Design A Turing Machine to perform 2"s compliment operation on binary string. [4x2]

(b) Consider the laguage L= $\{WW^R | W \in (a,b)^*\}$
(i) Design one tape turing machine to accept L
(ii) How much efficient is the two tape tuting machine as compare to one tape turing machine

8. Write Short Notes on following: [2x4]

(i)DeterminesticPDA Vs Nondeterminestic PDA ii) Universal Turing Machine

iii) Nondeterminestic Turing Machine iv) Post crospondance Problem (PCP)