Candidate Seat no……

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

Sixth Semester of B. Tech (CE) Examination

May 2015

CE306 Theory of Computation (TOC)

Date: 09.05.2015, Saturday **Time: 10.00 a.m. To 01.00 p.m.** **Maximum Marks: 70**

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Rough work is to be done in the last page of main supplementary, please don't write anything on the question paper.
5. Indicate clearly, the option(s) you attempt along with its respective question number.
6. Figures to the right indicate marks.

SECTION – I

Q - 1 Choose the appropriate option: **07**

1. $2^A \cap 2^B = 2^{A \cap B}$
   A. True
   B. False
   C. Not Always
   D. can't say
2. The basic limitation of Finite State Machine is that
   A. It can't remember arbitrary large amount of information
   B. It sometimes recognizes grammars that are not regular
   C. It sometimes fails to recognize grammars that are regular
   D. All of the above comments are true
3. Regular expression are
   A. Type 0 language
   B. Type 1 language
   C. Type 2 language
   D. Type 3 language.
4. Given an arbitrary non-deterministic finite automata (NFA) with N states, the maximum number of states in an equivalent minimized DFA is at least
   A. N^2
   B. 2^N
   C. 2N
   D. N!
5. Which of the following pairs have DIFFERENT expressive power?
   A. DFA & NFA
   B. DPDA & NPDA
   C. DETERMINISTIC SINGLE TAPE TURING MACHINE AND NON DETERMINISTIC SINGLE TAPE TURING MACHINE
   D. ALL OF THE ABOVE

6. Pumping Lemma is used to decide whether Language L is
   A. Not a regular
   B. Regular
   C. Proved or not
   D. None

7. The smallest finite automaton which accepts the language
   L ={ x | length of x is divisible by 3} has
   A. 5 states
   B. 4 states
   C. 3 states
   D. 2 states

Q – 2.a Define the followings: **[04]**

1. Strong Principle of Mathematical Induction
2. Distinguishable Strings with Respect to L

Q – 2.b Answer the following questions (Any Two). **[10]**

(i) Define: DFA. Draw Deterministic Finite Automata for the following language:

$$0+10^{*}+01^{*}0$$

(ii) The Fibonacci function is defined using the definition as:
$f_0=0$;
$f_1=1$;
for $n>=2$, $f_n = f_{n-1}+f_{n-2,}$
Suppose C is a positive real number satisfying $C > 8/13$.
Prove that for every $n>=0$, $f_n < C(13/8)^n$.

(iii) State Kleen's Theorem. Also, Draw NFA-^ for $(00+1)^{*}(10)^{*}$ applying Kleen's theorem.

Q - 3 Answer any two questions. **[14]**

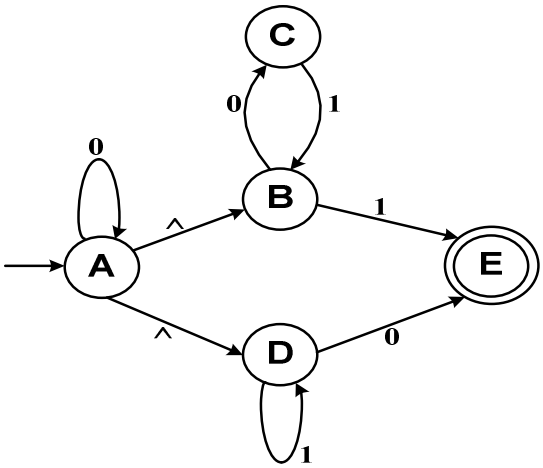
a. Define: Nondeterministic Finite Automata. An NFA **-** ^ with states 1-7 has the following transition table.

q	δ (q, a)	δ (q, b)	δ (q, ∧)
1	∅	∅	{2}
2	{3}	∅	{5}
3	∅	{4}	∅
4	{4}	∅	{1}
5	∅	{6, 7}	∅
6	{5}	∅	∅
7	∅	∅	{1}

Find:

a. ∧({3,4})
b. δ^{*}(1, ababa)

b. Convert the following NFA-∧ to DFA.



c. Suppose L_1 and L_2 are subsets of $\{0, 1\}^*$.
L_1= {x | 00 is not a substring of x}
L_2={x | x ends with 01}
Find L_1- L_2.

SECTION – II

Q - 4 Do as directed:

a. Consider the Finite Automata M given below & state True or False for the following statements : **03**

a. M accepts a Null String
b. M accepts all strings over {a, b}
c. M is a deterministic FA
d. M is an NFA
e. Some string over {a, b} may not be accepted by M
f. M does not accept a null string

b. State whether the following grammars are ambiguous or not. Justify your answer. **04**

1. S → aSbS | bSaS | ^
2. S → a | Sa | bSS | SSb | SbS

Q – 5.a Convert the following Context Free Grammar to Chomsky Normal Form: **[04]**

S→AACD
A→ aAb | ^
C→aC | a
D→ aDa | bDb | ^

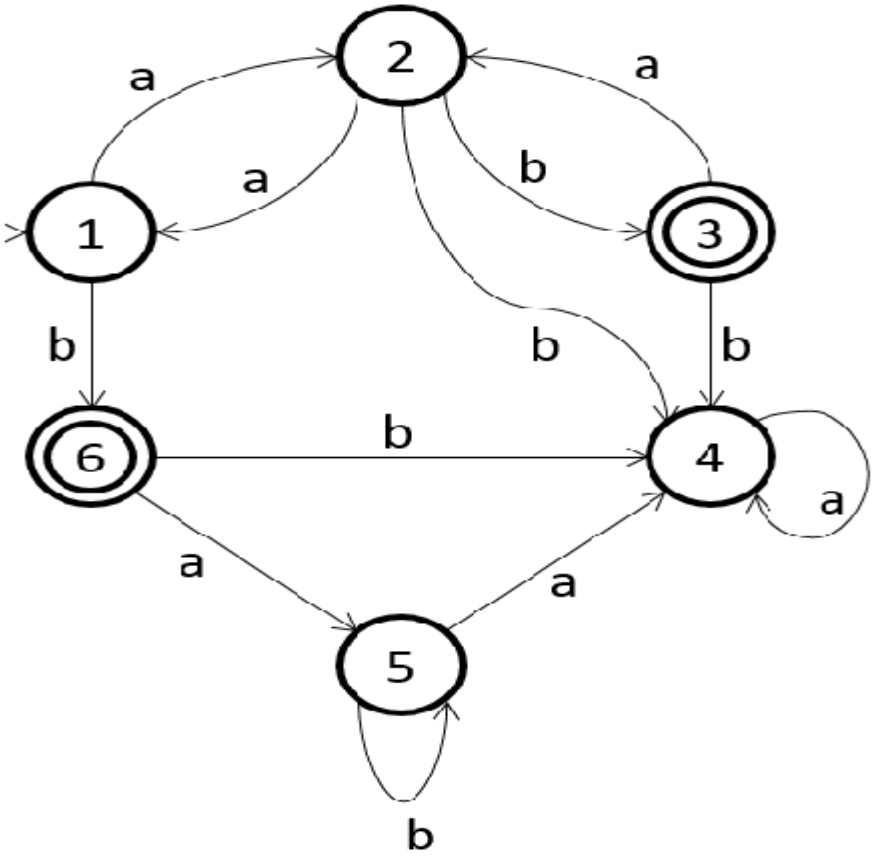
Q – 5.b Answer the following questions (Any Two). **[10]**

(i) Using unary representation design a TM for f(x)=x mod 3

(ii) Show using pumping lemma that the given language is not a CFL.

$L=\{a^i b^i c^i | i>=1\}$

(iii) Minimization of following Deterministic Finite Automata having starting state 1 and final states are state 3 & 6.



Q – 6 Answer any two questions. **[14]**

a. Define: CFG. In each of the following case, find a CFG generating the given language

1. The set of odd-length strings in $\{a, b\}^*$ with middle symbol a
2. The set of even-length strings in $\{a, b\}^*$ with two middle symbols equal
3. The set of odd-length strings in $\{a, b\}^*$ whose first, middle and last symbols are same.

b. Construct PDA for accepting the language:

$L = \{ xcy \mid x,y \in \{a, b\}^* \text{ and } |x| = |y| \}$

c. Define: Turing Machine. Mention I/P device, O/P device and Storage device in Turing Machine. Also throw light on how it is most powerful machine as compare to DFA, NFA and PDA.