Candidate Seat no…….

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

Sixth Semester of B. Tech (CE) Examination

May 2018

CE306/CE306.01 Theory of Computation (TOC)

Date: 05.05.2018, Saturday **Time: 10.00 a.m. To 01.00 p.m.** **Maximum Marks: 70**

Instructions:

1. The symbols used carry their usual meanings.
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 Do as directed:

a. The string 0100 belong to the set represented by **[01]**

a. $110^*(0+1)$ b. $1(0+1)^*101$

c. $(10)^*(01)^*(00+11)^*$ d. $(00+(11)^*0)^*$

b. Prove by contradiction that for any set A, B and C if AΠB=Φ and C is a subset of B then AΠC= Φ. **[02]**

c. Give regular expressions for the language: $\{a^n \mid n \text{ is divisible by 2 or 3 or 5}\}$ **[02]**

d. Design a DFA (Deterministic Finite Automata) equivalent to the following regular expression. **[03]**

$10 + (0 + 11)\, 0^*\, 1$

e. Write down major differences between Moore Machine & Mealy Machine with examples. **[03]**

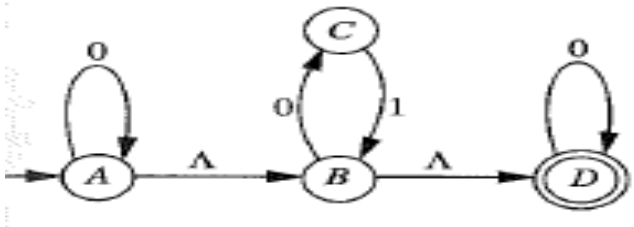
Q – 2 Answer the following questions (Any Three). **[12]**

a. State and prove Kleene's theorem – part I.

b. Using principle of mathematical induction, prove that for every n>=1,

$$7 + 13 + 19 + \ldots\ldots\ldots + (6n + 1) = n(3n + 4)$$

c. Convert the following NFA-∧ to NFA.



d. Suppose L_1 and L_2 are subsets of $\{0, 1\}^*$ can be defined as follows.

$L_1 = \{x \mid 00 \text{ is not a substring of } x\}$ & $L_2 = \{x \mid x \text{ ends with } 01\}$. Find $L_1 - L_2$.

e. Define the following terms with examples:

1. *Properties of Equivalence Relation*
2. *Distinguishable strings with respect to L*

Q - 3 Answer the following questions (Any Three). **[12]**

a. What are advantages of minimizing Finite Automata? Construct a minimal state automaton equivalent to a following given automaton, whose transition table is given below. State q4 is an accepting state.

States	Input	
	a	b
q0	q1	q3
q1	q2	q4
q2	q1	q4
q3	q2	q4
q4*	q4	q4

b. Write down recursive definitions for the following.

1. Set S of all integer(positive and negative) divisible by 7
2. Palindrome language over {a, b}

c. A transition table is given for NFA-^ with seven states.

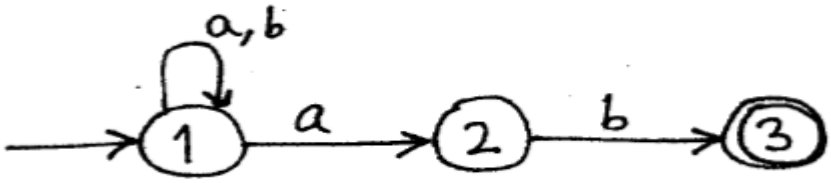
q	$\delta(q, a)$	$\delta(q, b)$	$\delta(q, \Lambda)$
1	{5}	∅	{4}
2	{1}	∅	∅
3	∅	{2}	∅
4	∅	{7}	{3}
5	∅	∅	{1}
6	∅	{5}	{4}
7	{6}	∅	∅

Calculate $\delta^*(1, ba)$.

d. Write down definition of *"Deterministic Finite Automata"*. Consider the Finite Automata M given below & state T/F for the following statements with reasons:

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. Using the subset construction, draw an FA accepting the same language as the following NFA. Label the final picture so as to make it clear how it was obtained from the subset construction.



SECTION – II

Q - 4 Do as directed:

a. Differentiate Decidable Problems and Undecidable Problems. **[01]**

b. "Non-Determinism adds power to a PDA". Justify the correctness or falsehood of the statement. **[02]**

c. State and Prove De Morgan's laws. **[02]**

d. State true or false with justification: TM is more powerful than FA & PDA. **[03]**

e. Remove useless symbol from the given CFG: **[03]**

S →AB|a A →BC|b B →aB|C C →aC|B

Q – 5 Answer the following questions (Any Three). [12]

a. Write down pumping lemma for "*regular languages*". Also prove that $\{a^{n!}: n>=0\}$ is not regular.

b. Construct PDA for accepting the language: L = { XcY | X,Y ∈ {a, b}* and |X| = |Y| }

c. Design a Turing Machine accepting language of even length palindrome over {0, 1}.

d. When a grammar is said to be an ambiguous grammar? Show that the grammar S→aB|ab, A→aAB|a, B→ABb|b is ambiguous.

e. Define: "*Context Free Grammar*". What languages are generated by Context Free Grammar whose production rules are given below:

1. S → aSb , S → ab
2. S → aSa , S →bSb , S →aa , S →bb

Q – 6 Answer the following questions (Any Three). **[12]**

a. What are the input device, output device and storage device in Turing Machine? Using unary representation design a Turing Machine for:

$$f(x) = x \bmod 3$$

b. Show using pumping lemma that the given language is not a CFL.

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

c. Write down CFG for the given languages below:

(1) L= The set of odd-length strings in $\{a, b\}^*$ with middle symbol a

(2) $L=\{a^i b^j c^k \mid j=i+k\}$

d. Convert the following Context Free Grammar to CNF(Chomsky Normal Form):

S→AACD

A→aAb|^

C→aC|a

D→aDa|bDb|^

e. Design deterministic pushdown automata accepting "Balanced Strings of Brackets" which are accepted by the following CFG.

S → SS | [S] |{S} | ^