Enrollment No: _______________________ Exam Seat No: _______________________

C.U.SHAH UNIVERSITY

Summer Examination-2017

Subject Name : Theory of Computation

Subject Code : 4TE06TOC1 **Branch: B.Tech (CE)**

Semester : 6 **Date : 21/04/2017** **Time : 02:30 To 05:30** **Marks : 70**

Instructions:

1. Use of Programmable calculator & any other electronic instrument is prohibited.
2. Instructions written on main answer book are strictly to be obeyed.
3. Draw neat diagrams and figures (if necessary) at right places.
4. Assume suitable data if needed.

Q-1 Attempt the following questions: (14)

a) Construct a truth table for the statement: $(p \rightarrow q) \wedge (p \rightarrow \neg q)$.

b) Give the definition of Context-Free Grammar.

c) Let n be the positive integer constant and L be the language with alphabet {a}. To recognize L the minimum number of states required in a DFA will be

(i) 2k + 1 (ii) k + 1 (iii) 2n + 1 (iv) n + 1

d) The number of eight-bit strings beginning with either 111 or 101 is:

(i) 64 (ii) 128 (iii) 265 (iv) None of the above

e) Pushdown machine represents

(i)Type -0 Grammar (ii) Type-1 Grammar

(iii) Type-2 Grammar (iv) Type-3 Grammar

f) 3-SAT and 2-SAT problems are

(i)NP-Complete and P (ii) Undecidable and NP-complete

(iii) Both NP-Complete (iv) Both in P

g) For the language $\{a^p \text{ I } P \text{ is a prime}\}$, the statement which hold true is

(i)It is not regular but context free (ii) It is regular but not context free

(iii) It is neither regular nor context free, but accepted by a TM

(iv) It is not accepted by TM

h) Which of the following regular expression identities are true?

(i) (r+s)* = r*s* (ii) (r+s)* = r*+s* (iii) (r+s)* = (r*s*)* (iv) r*s* = r*+s*

i) Regular expressions are closed under

(i) Union (ii) Intersection (iii) Kleen star (iv) All of the mentioned

j) What do you mean by time and space complexity of an algorithm?

k) Which of the following is not a regular expression?

(i) [(a+b)*(aa+bb)]* (ii) [(0+1)(0b+a1)*(a+b)]* (iii) (01+11+10)* (iv) (1+2+0)*(1+2)*

l) List out the applications of Theory of Computation.

m) Describe as simply as possible the language corresponding to given regular expression: 0*1(0*10*1)*0*

n) Find a regular expression over the subset of {0, 1}*, the language of all the strings containing no more than one occurrence of the string 00.

Attempt any four questions from Q-2 to Q-8

Q-2 **Attempt all questions**

(a) Prove that for any $n \geq 0$, **(05)**

$$\sum_{i=1}^{n} i^2 = n(n+1)(2n+1) / 6$$

(b) For each of the given languages, draw an FA recognizing the language. **(04)**

i) $1^* (011^+)^*$

ii) $1^*(01)^*0^*$

(c) An NFA has the following transition table: **(05)**

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

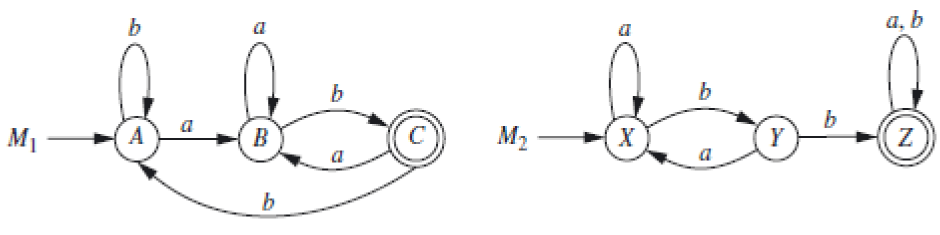
1) Draw a transition diagram.

2) Calculate δ^* (1, ababa)

3) Find Λ ({2, 3})

Q-3 **Attempt all questions**

(a) Let M1 and M2 be the FAs pictured in the figures given below, recognizing languages L1 and L2 respectively. **(06)**



(a) (b)

Draw FAs recognizing the following languages:

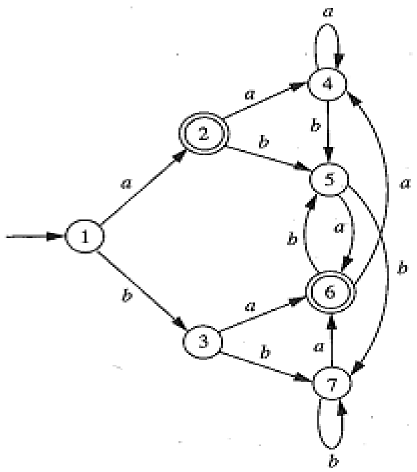
i) L1 U L2

ii) L1 – L2

iii) L1 ∩ L2

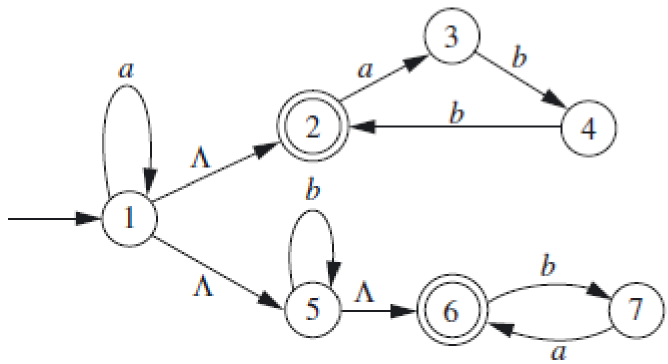
(b) For the given regular expression $(0 + 1) (01)^* (011)^*$ over {0, 1}, draw an NFA - Λ recognizing the corresponding language using Kleene's theorem. **(04)**

(c) For given FA, find a minimum-state FA recognizing the same language: **(04)**



Q-4 **Attempt all questions**

(a) For given NFA- Λ , draw an FA accepting the same language. **(06)**



(b) Prove that L= $\{0^n1^n \mid n > 0\}$ is non regular. **(03)**

(c) For the given CFG G, find a CFG G’ in Chomsky normal form generating L(G) – {^}. **(05)**

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

Q-5 **Attempt all questions**

(a) Find context-free grammars generating each of these languages: **(04)**

1) $\{a^ib^jc^k \mid i = j + k\}$
2) $\{a^ib^j \mid i < 2j\}$

(b) Design and draw a PDA to accept strings with more a’s than b’s. Trace it for the string “abbaaa”. **(07)**

(c) Discuss the properties of an Equivalence Relation. **(03)**

Q-6 **Attempt all questions**

(a) What is turing machine? Draw a TM accepting language L={SS | S ε{a, b}*} **(07)**

(b) Explain ambiguity in the CFG with the example of the “Dangling Else”. Also write down the unambiguous grammar for the “Dangling Else”. **(07)**

Q-7 **Attempt all questions**

(a) Explain Unbounded Minimalization and μ–Recursive Functions. **(05)**

(b) Write a short note on Church-Turing Thesis. **(05)**

(c) State and prove Arden’s Theorem. **(04)**

Q-8 **Attempt all questions**

(a) Explain universal Turing machine in detail. **(04)**

(b) Explain Halting problem in brief. **(03)**

(c) State and prove Cook’s Theorem. **(07)**