KADI SARVA VISHWAVIDYALAYA

B.E. Semester VI Examination April-2019

SUBJECT NAME & CODE: THEORY OF COMPUTATION CE-IT 604

DATE & TIME: 19/04/2019 10.30 AM to 1.30 PM **TOTAL MARKS: 70**

Instructions:

1 Answer each section in separate answer sheet.
2 All questions are **Compulsory**.
3 Indicate **clearly**, the options you attempt along with its respective question number.
4 Use the last page of main supplementary for **rough work**.

SECTION-I Marks

Q.1 (A) Let M1, M2 be the FAs pictured in following figure1, recognizing languages L1 and L2 respectively. Draw FA recognizing the following language. [5]

1. L2 - L1 2. L1 U L2

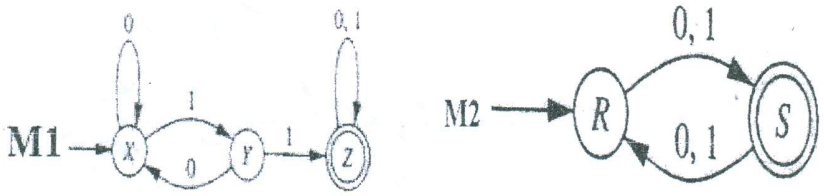


Figure 1

(B) In each case, a relation on the set {1, 2 ,3} is given. Of the three properties Reflexivity, Symmetry and Transitivity, determine which one the relation has. [5]

a. R= {(1,3),(3,1),(2,2)} b. R= {(1,1),(2,2),(3,3),(1,2)}
c. R= ø

(C) Consider the two regular expressions [5]

R= 0* + 1* and S= 01* + 10* +1*0 + (0*1)*

Find Minimum Length string for all below questions.

1. Find a string corresponding to R but not to S.
2. Find a string corresponding to S but not to R.
3. Find a string corresponding to both R and S.
4. Find a string in {0,1}* corresponding to neither R nor S.

OR

(C) Define the Terms: [5]

1. DFA 2. NFA- Λ 3. Pumping lemma for Regular Language
4. Function 5. Extended transition function δ* for an NFA.

Q.2 (A) Convert following NFA(Figure 2) to FA using subset construction. [5]

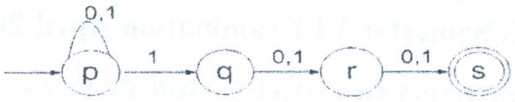


Figure 2

(B) Draw F.A corresponds to regular expression (11 + 10)* . [5]

OR

(A) Suppose r is real number other than 1. Prove using principle of mathematical induction that for any n>=0, [5]

$\sum r^i = (1- r^{n+1})/(1-r)$

(B) Draw NFA - Λ using KLEEN's theorem for aa(ba)* + b*aba* [5]

Q.3 (A) For the following FA (Figure 3) find a minimum state FA recognizing the same language. [5]

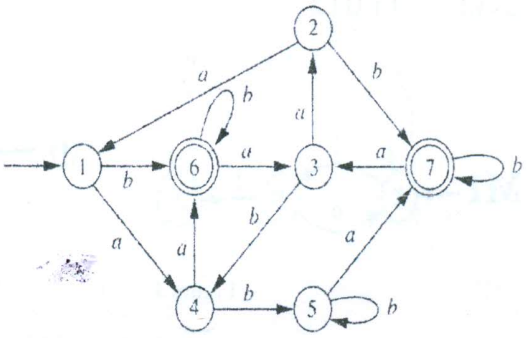


Figure 3

(B) For a given regular expression draw NFA and convert it into FA [5]

(0)*(01)*(0)*.

OR

(A) Take L = { $0^i 1^j 0^k$ | k > i+j } show that L is non-regular using pumping lemma theorem. [5]

(B) Explain for any NFA M= (Q, Σ , q_0 ,A , δ) accepting a language L⊆ Σ*,there is an FA M_1=(Q_1, Σ , q_1 , A_1 , δ_1) that also accept L. [5]

SECTION-II

Q-4 (A) Prove that given CFG is ambiguous or not. [5]
$S \rightarrow a \mid Sa \mid bSS \mid SSb \mid SbS$

(B) In each case, say what language is generated by the context free grammar with the indicated productions. [5]

1. S-> aSb / bSa / Λ
2. S-> aSa / bSb / aAb / bAa
   A->aAa / bAb / a / b / Λ

(C) Convert following CFG to Chomsky normal form. [5]
S –> AACD
A –> aAb / Λ
C –> aC / a
D –> aDa / bDb / Λ

OR

(C) Convert given CFG to Chomsky normal form (CNF) [5]
S→ AaA / CA / BaB
A→ aaBa / CDA / aa / DC
B →bB / bAB / bb / aS
C→ Ca / bC / D
D→ bD / Λ

Q-5 (A) Prove using Pumping lemma that following language is not CFL. [5]
$L = \{ a^i b^j c^k / i < j < k \}$

(B) Draw the **Deterministic** PDA accepting all balanced strings involving two types of brackets {} & []. [5]

OR

(A) Explain "Dangling Else" in terms of ambiguity in context free language. [5]

(B) Draw the PDA for language of Odd palindrome over $\{a,b\}^*$. [5]

Q-6 (A) Give differences among FA,PDA and TM [5]

(B) Draw a Turing Machine (TM) for accepting a language $\{a,b\}^*\{aba\}\{a,b\}^*$ [5]

OR

(A) Define TM. Explain Universal Turing Machine. [5]

(B) Draw the Turing machine (TM) for accepting an even length palindrome with tracing of any even input string. [5]

----------***** Best Luck *****----------

KADI SARVA VISHWAVIDHYALAYA

B.E. SEMESTER VI EXAMINATION(April -2018)

SUBJECT CODE : CE/IT 604 **SUBJECT NAME : THEORY OF COMPUTATION**
DATE :27th April, 2018 **TIME : 10:30 AM to 01:30 PM** **TOTAL MARKS : 70**

Instructions :

1. Answer each section in separate answer sheet
2. Use of scientific calculator is permitted
3. All questions are compulsory
4. Indicate **clearly**, the options you attempted along with its respective question number
5. Use the last page of main supplementary for rough work.

SECTION – 1

Q - 1 (All Compulsory)

(A) For any $n>=4$, $n!>2^n$ using PMI. 05

(B) Explain Equivalence relation with suitable example. 05

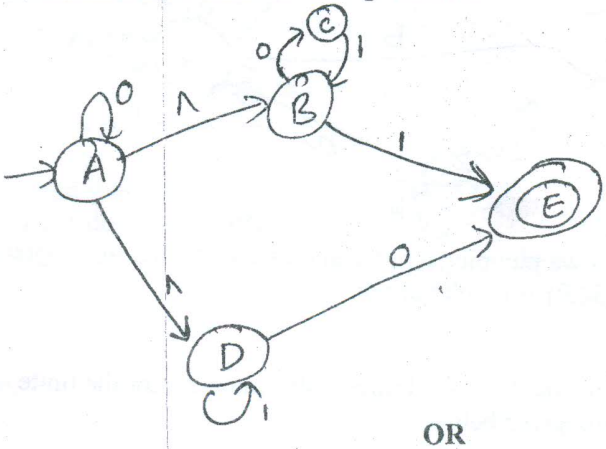
(C) Prove that P(n) is true for every $n>=2$, where, n is either prime or product of two or more primes. 05

OR

(C) Can every regular language not containing Λ be accepted by an NFA having only one accepting state? Justify your answer. 05

Q - 2 (A) Prove that any NFA $M=(Q,\sum, qo,A,\delta)$ accepting a language $L\subseteq\sum^*$, There a DFA $M_1=(Q_1,\sum, q_1,A_1,\delta_1)$ that also accepts L. 05

(B) Construct a DFA from NFA- Λ given below: 05



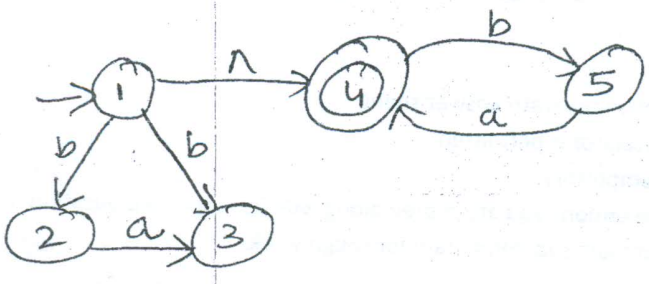
OR

Q - 2 (A) Give the Proof of Kleene's Theorem Part 1 and using it construct NFA- Λ 05

for the following

(00+10)*(00+1)

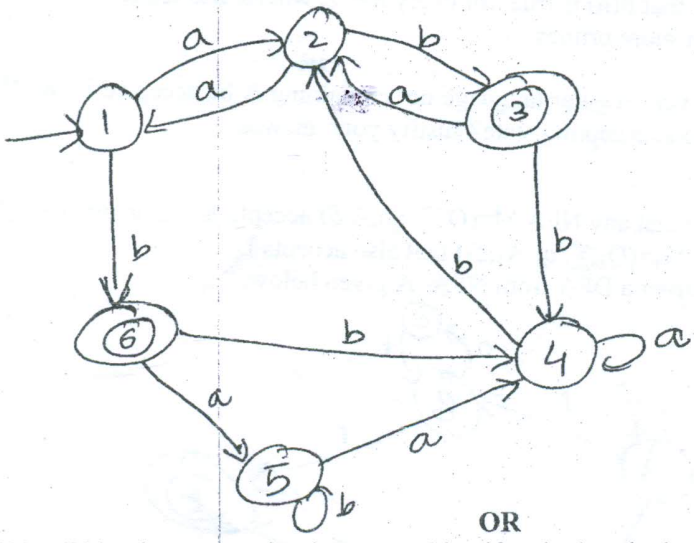
(B) Construct a DFA from the NFA- Λ given below: 05



Q - 3

(A) Write down RE and Draw a FA for the languages of all string in which every 0 is followed by 11". 05

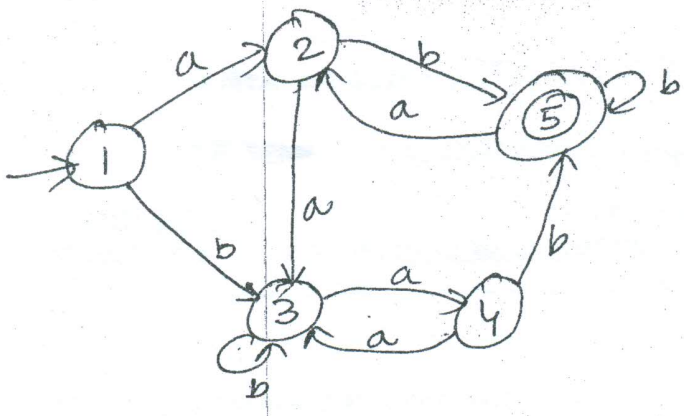
(B) Construct the Minimal Finite State Automata for the finite automata shown in the figure given below: 05



OR

Q - 3 (A) Write down pumping lemma and justify whether the language $L = \{0^i1^k | k=2i, i,k\geq 0\}$ is regular or not. 05

(B) Construct the Minimal Finite State Automata for the finite automata shown in figure given below 05



SECTION – 2

Q – 4 (All Compulsory)

(A) Explain dangling else problem with suitable example and solution. 05

(B) Convert the following grammar to Chomsky Normal Form(CNF) 05

S ->SS|(S)|Λ|PAC
A ->aAb|Λ
C ->aC|a
P->aa|bPb|Λ

(C) Define i)Nullable variable ii) Ambiguity 05

OR

(C) Prove that: if L1 and L2 are context free languages, then L1UL2, L1L2 and L* are also CFLs. 05

Q – 5 (A) Write down CFG and draw a PDA for the strings of odd length palindromes. 05

(B) Construct the PDA for the given language for the strings having number of a and b equal. Where, L⊆{a,b}* 05

OR

Q – 5 (A) Write down CFG and draw a PDA for the balanced strings of parenthesis. 05

(B) Check whether the below statement is true or false and justify your answer with the suitable example. 05
"For every NPDA there is an equivalent DPDA"

Q – 6 (A) Draw a turing machine to copy the string. 05

(B) Draw a turing machine for the strings of odd and even length palindrome. 05

OR

Q – 6 (A) Write short note on Universal turing machine and its significance. 05

(B) Write down a short note on recursively and non-recursively enumerable languages. 05

3/3

KADI SARVA VISHWAVIDYALAYA

B.E SEMESTER VI EXAMINATION (APRIL-2017)

SUBJECT CODE: CE/IT 604 SUBJECT NAME: Theory of Computation

DATE: 24·04·2017 TIME: 10 to 1 TOTAL MARKS: 70

Instructions:

1. Answer each section in separate Answer Sheet.
2. Use of scientific Calculator is permitted.
3. All questions are compulsory.
4. Indicate **clearly**, the options you attempted along with its respective question number.
5. Use the last page of main supplementary for rough work.

SECTION – I

Q.1 Answer the following questions.

(a) Find inverse of a function $f(x) = 2x + 3$ **[5]**

(b) Prove by induction: $n! \geq 2^{n-1}$ **[5]**

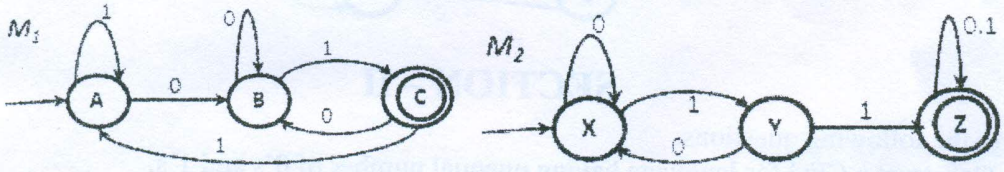
(c) Define following terms and give an example: **[5]**
(i) Equivalence relation (ii) one-one function

OR

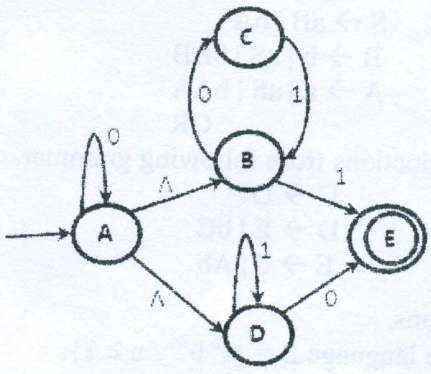
(c) Simplify the given expression for two sets A and B, $A \cup (B \cap (A - (B - A)))$ **[5]**

Q. 2 Answer the following questions.

(a) Let M_1 and M_2 be the FAs given below, recognizing languages L_1 and L_2 respectively. Draw FA recognizing the language $L_1 - L_2$. **[5]**



(b) Convert the given NFA-Λ to NFA. **[5]**



OR

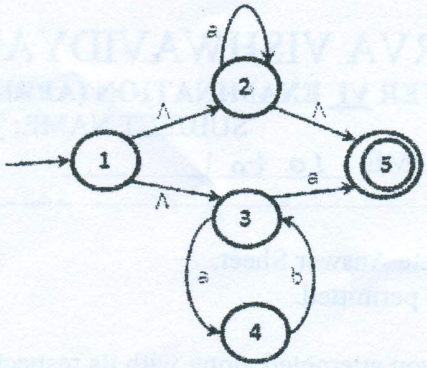
(a) Design a *FA* which checks whether the given binary number is even. **[5]**

(b) Prove Kleene's theorem Part - I. **[5]**

Q.3 Answer the following questions.

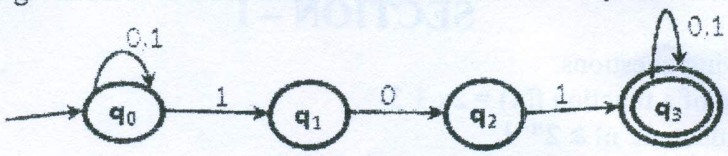
(a) Using pumping lemma show that the language $L = \{ 0^n / n \text{ is prime} \}$ is not regular. **[5]**

(b) For the given NFA-Λ, find a minimum-state FA accepting the same language. **[5]**

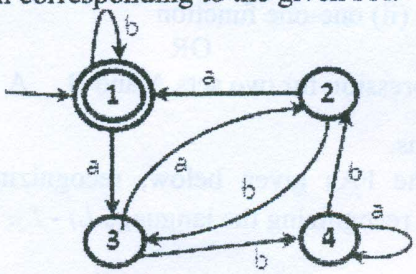


OR

(a) Convert the given NFA to DFA minimize it and find its complement. **[5]**



(b) Find a regular expression corresponding to the given FA. **[5]**



SECTION – II

Q.4 Answer the following questions.

(a) Construct a CFG for language having unequal number of 0's and 1's. **[5]**

(b) Explain the ambiguity of "dangling else" in the programming language. **[5]**

(c) Convert the given CFG to CNF. **[5]**

$V = \{ S, A, B\}$ $\quad S \rightarrow aB \mid bA$

$T = \{a, b\}$ $\quad B \rightarrow b \mid aS \mid bBB$

$A \rightarrow a \mid aS \mid bAA$

OR

(c) Eliminate the unit productions from following grammar. **[5]**

$S \rightarrow AB$ $\quad C \rightarrow D$

$A \rightarrow a$ $\quad D \rightarrow E \mid bC$

$B \rightarrow C \mid b$ $\quad E \rightarrow d \mid Ab$

Q.5 Answer the following questions.

(a) Construct PDA for the language $L = \{a^n b^{2n} / n \geq 1\}$. **[5]**

(b) Construct a Bottom-up PDA for Simple Algebraic Expression. **[5]**

OR

(a) Construct PDA for the language of Palindromes. **[5]**

(b) Construct a Top down PDA for strings with same number of a's and b's. **[5]**

Q.6 Answer the following questions.

(a) Turing machine accepting language of palindrome. **[5]**

(b) Explain Halting problem of TM using example. **[5]**

OR

(a) Construct a Turing Machine for $L = \{a^n b^n c^n / n \geq 1\}$. **[5]**

(b) Explain Recursive and Recursive Enumerable Languages. **[5]**

-------All the Best-------

KADI SARVA VISHWAVIDYALAYA

B.E SEMESTER VI EXAMINATION (APRIL-MAY / 2015)

SUBJECT CODE : **CE 604 / IT 604** SUBJECT NAME : **THEORY OF COMPUTATION**

DATE: **4th November,2015** TIME: **10:30 A.M. to 1:30 P.M.** TOTAL MARKS: **70**

Instructions:
1. Answer each section in separate Answer Sheet.
2. Use of scientific Calculator is permitted.
3. All questions are compulsory.
4. Indicate **clearly**, the options you attempted along with its respective question number.
5. Use the last page of main supplementary for rough work.

Section - 1

Q:1 (All Compulsory)

(A) 1. Suppose A and B are finite sets. A has n elements, and $f: A \rightarrow B$.
   i. If f is one-to-one, what can you say about the numbers of elements of B?
   ii. If f is onto, what can you say about the number of elements of B? 01

2. Define equivalence relation with its properties and give one example of it. 02

3. Prove that for every $n \geq 0$, 02

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

(B) Define the Strong Principal of Mathematical Induction and using it prove that 05
"For $n \geq 2$, n is either a prime or a product of two or more primes."

(C) Find Regular Expression corresponding to following subsets of {0,1}* 05
   i. The language of even length strings.
   ii. The language of all strings which ends with 01.

OR

(C) Let M1 and M2 be the two FAs given in figure - (1). Draw FA corresponding to L1 - L2 where L1 and L2 are the languages corresponding to M1 and M2 respectively. 05

Q:2

(A) Draw FA for following 05
- (0+1)*0
- (1+01)*

(B) Convert NFA-^ as shown in Figure - (2) to an equivalent NFA 05

OR

Q:2

(A) Give the proof for Kleen's theorem Part-1 05
"Any regular language can be accepted by a finite automaton"

(B) Draw an NFA-Λ for following 05
(00+1)*(10)*

Q:3

(A) Use the Pumping lemma to show that the following language is not regular : 05
"The set of strings over $\{a,b\}$ in the form $a^n b^n$, where $n>0$"

(B) Convert the NFA shown in figure – (3) into an equivalent DFA 05

OR

Q:3

(A) Minimize the finite automata shown in figure – (4) into equivalent machine accepting the same language. 05

(B) Define following : 05
i. Recursive and Nonrecursive definition of δ* for NFA
ii. Recursive and Nonrecursive definition of δ* for NFA-Λ

Section - 2

Q:4 (All Compulsory)

(A) i. Let L = {x ϵ {0,1}* | x ends with 10}. Find the three equivalence classes of strings for L. 02

ii. Define Regular Grammar and an ambiguous CFG 03

(B) Find CFG for the following languages. 05
1. $L = \{ a^i b^j \mid i < 2j \}$
2. $L = \{ a^i b^j c^k \mid j = i + k \}$

(C) Fill in the blanks 05
i. Both regular and nonregular grammars are included in _____Grammar.
ii. A context-free grammar (CFG) is 4-tuple G=(_ ,_ ,_ ,_)
iii. _____ is the method of deciding whether the string belongs to a grammar or not.
iv. A compound proposition is called a _____ if it is true in every case.
v. The regular expression corresponding to language {Λ} is ____

OR

(C) In each of the following cases, write down which language is generated by CFG 05
i. S-> aSa|bSb|Λ
ii. S->aS|bS|a

Q:5

(A) Give transition table for deterministic PDA recognizing the following language. 05
L={xϵ {a,b}* | $n_a(x) = n_b(x)$} (Explanation :Strings with equal number of a's and b's)

(B) Find a CFG G' with no Λ-productions and no unit productions generating language L(G)-{Λ} 05

S → ABA
A → aA| Λ
B → bB| Λ

OR

Q:5

(A) Develop a non-deterministic bottom-up parser for following CFG. 05

$S \rightarrow S_1\$$
$S_1 \rightarrow S_1 + T \mid T$
$T \rightarrow T * a \mid a$

(B) Define Top-down PDA corresponding to a CFG. 05

Q:6

(A) Draw Transition Diagram for a TM which reverses a string constructed from alphabet {a,b}. 05

(B) i. Define the languages accepted by Turing Machine 02
ii. What are Turing-acceptable and Turing-decidable languages? 03

OR

Q:6

(A) Design a TM for copying a string build from {a,b}* 05

(B) i. Explain Multitape TMs. 02
ii. When we can say that a Turing machine enumerates a language *L*. 03

-----All the Best --------

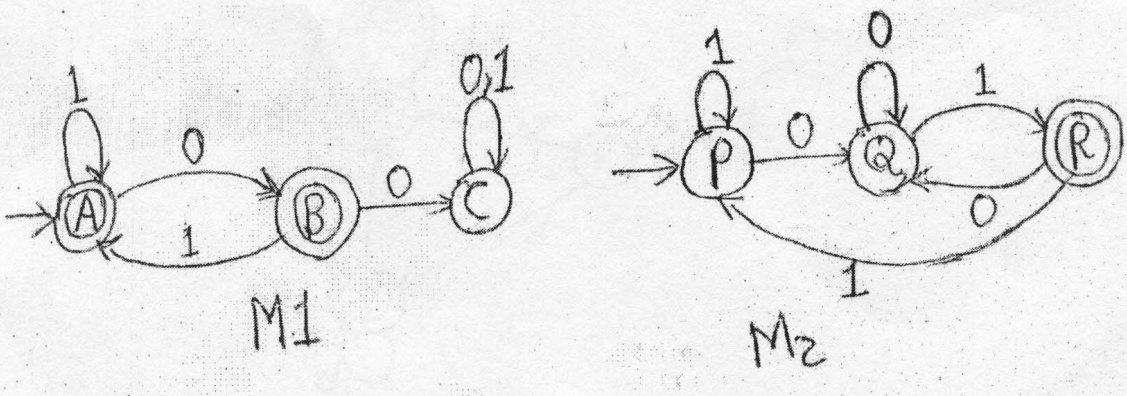


Figure -1

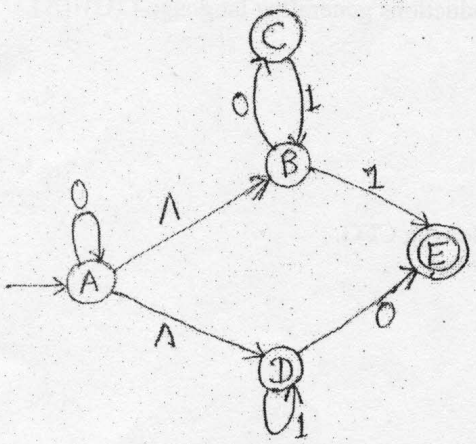


Figure – 2

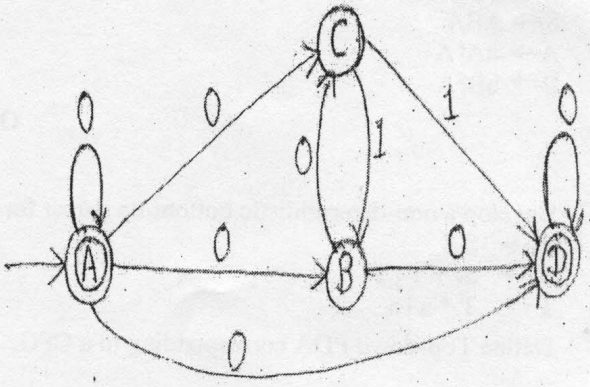


Figure – 3

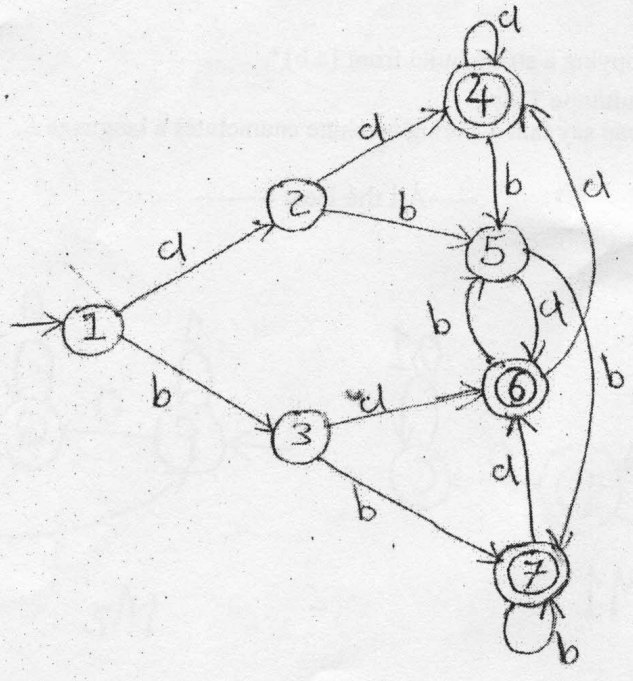


Figure - 4

KADI SARVA VISHWAVIDYALAYA

B.E SEMESTER VI EXAMINATION (APRIL-MAY / 2015)

SUBJECT CODE : **IT 604** SUBJECT NAME : **THEORY OF COMPUTATION**

DATE: **4th MAY, 2015** TIME: **10:30 A.M. to 1:30 P.M.** TOTAL MARKS: **70**

Instructions:
1. Answer each section in separate Answer Sheet.
2. Use of scientific Calculator is permitted.
3. All questions are compulsory.
4. Indicate **clearly**, the options you attempted along with its respective question number.
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Section - 1

Q:1 (All Compulsory)

(A)

1. List the elements of $2^{2^{\{0,1\}}}$ 01

2. Following relations are given on the set of all nonempty subsets of *N*. In each case, say whether the relation is reflexive, whether it is symmetric, and whether it is transitive. 02
   i. R is defined by $A\ R\ B$ if and only if $A \subseteq B$
   ii. R is defined by $A\ R\ B$ if and only if $A \cap B \neq \phi$

3. The numbers a_n, for $n >= 0$ are defined recursively as follows : 02
   $a_0 = -2$; $a_1 = -2$; for $n >= 2$, $a_n = 5a_{n-1} - 6a_{n-2}$
   Prove that for every $n >= 0$, $a_n = 2*3^n - 4*2^n$

(B) List and explain the categories and subcategories of Proof methods. 05

(C) Find Regular Expression corresponding to following subsets of {0,1}* 05
   i. The language of all strings containing both 11 and 010 as substrings
   ii. The language of all strings in which both the number of 0's and the number of 1's are even

OR

(C) Let M1 and M2 be the two FAs given in figure - (1). Draw FA corresponding to L1 $\cup$ L2 where L1 and L2 are the languages corresponding to M1 and M2 respectively. 05

Q:2

(A) Draw FA for following 05
- (0+1)*(1+00)(0+1)*
- 0+10*+01*0

(B) Convert NFA-^ as shown in Figure - (2) to an equivalent NFA 05

OR

Q:2

(A) Prove that "For any NFA $M=(Q,\sum, q_0, A, \delta)$ accepting a language $L \subseteq \sum^*$, there is an FA $M_1 = (Q_1,\sum, q_1, A_1, \delta_1)$ that also accepts L." 05

(B) Using Kleen's theorem Part-1 draw an NFA-Λ for (0+1)*(01)*(011)* 05

Q:3

(A) Use the Pumping lemma to show that the following language is not regular : 05
"The set of odd length strings over {0,1} with middle symbol 0"

(B) Convert the NFA shown in figure – (3) into an equivalent DFA 05

OR

Q:3

(A) Minimize the finite automata shown in figure – (4) into equivalent machine accepting the same language 05

(B) Define following : 05
i. Recursive and Nonrecursive definition of δ* for NFA
ii. Recursive and Nonrecursive definition of δ* for NFA-Λ

Section - 2

Q:4 (All Compulsory)

(A) i. Let L be the language $\{0^n1^n, n>=0\}$. Find the two distinct strings x and y that are indistinguishable w.r.t. L. 02
ii. Define a CFG (Context-Free Grammar) and languages generated from CFG 03

(B) Find CFG for the following languages. 05
1. $L = \{ a^i b^j a^k \mid j > i + k \}$
2. $L = \{ a^i b^j c^k \mid i = j \text{ or } j = k \}$

(C) State True or False 05
i. Every regular grammar is CFG
ii. A push-down automata (PDA) is 6-tuple
iii. Parsing is the method of deciding whether the string belongs to a grammar or not.
iv. If no two elements of domain have the same image in the range then it is called "onto" function.
v. Statement (a*+b*)* = a* + b* is correct.

OR

(C) Prove that the following CFG is Ambiguous. 05
S -> S + S | S * S | (S) | a
Write the unambiguous CFG for the above grammar.

Q:5

(A) Give transition table for deterministic PDA recognizing the following language. $\{ a^n b^{n+m} a^m \mid n,m >= 0)$ 05

(B) Find a CFG G' in Chomsky Normal Form generating L(G)-{Λ} 05

S → XYZ
X → aX|bY| Λ
Y → aY|bY| Λ
Z → aZ | Λ

OR

Q:5

(A) Design and draw a deterministic PDA accepting "Balanced strings of Brackets" which are accepted by following CFG. 05

S -> SS | [S] | {S} | Λ

(B) Give difference between Top-down parsing and Bottom-up parsing 05

Q:6

(A) Draw Transition Diagram for a TM which accepts following language 05

$L=\{x \in \{a,b,c\}^* | n_a(x) = n_b(x)=n_c(x)\}$

(B) i. Define Turing Machine 02

ii. Write a short note on Unrestricted Grammar. 03

OR

Q:6

(A) Design a TM for copying a string build from {a,b}* 05

(B) i. State the Church Turing thesis statement. 02

ii. Write a short note on Recursively Enumerable Language. 03

-----All the Best --------

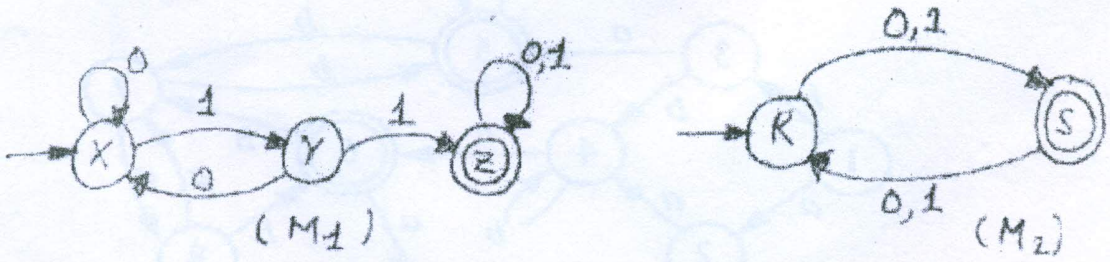

Figure – (1)

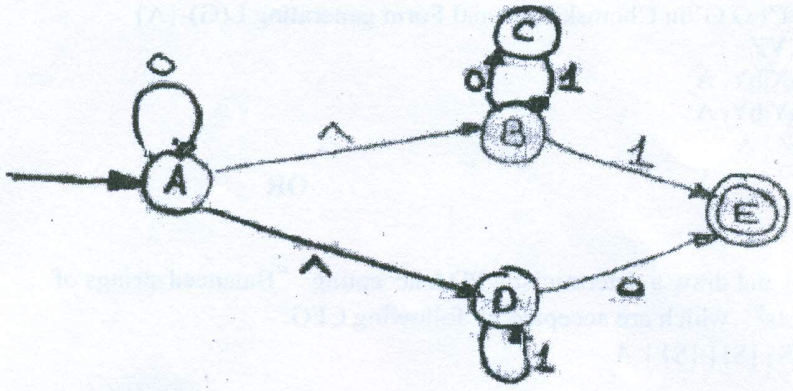

Figure – (2)

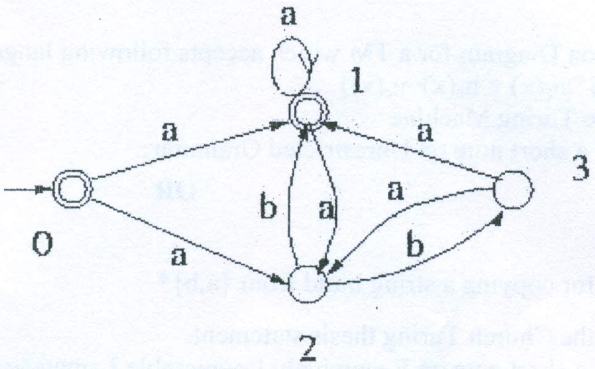

Figure – (3)

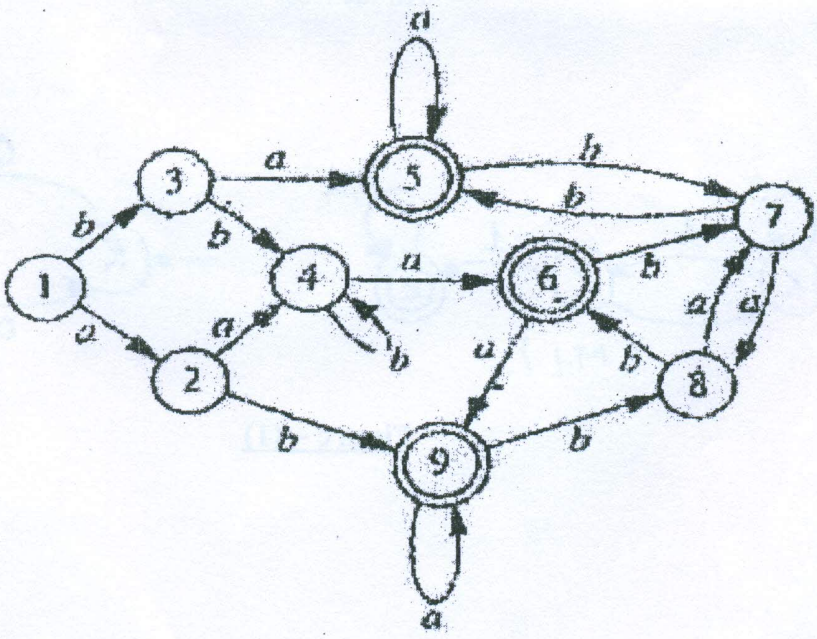

Figure – (4)