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 "For $n \geq 2$, n is either a prime or a product of two or more primes." 05

(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
$L=\{x\epsilon \{a,b\}^* \mid n_a(x) = n_b(x)\}$ (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 --------

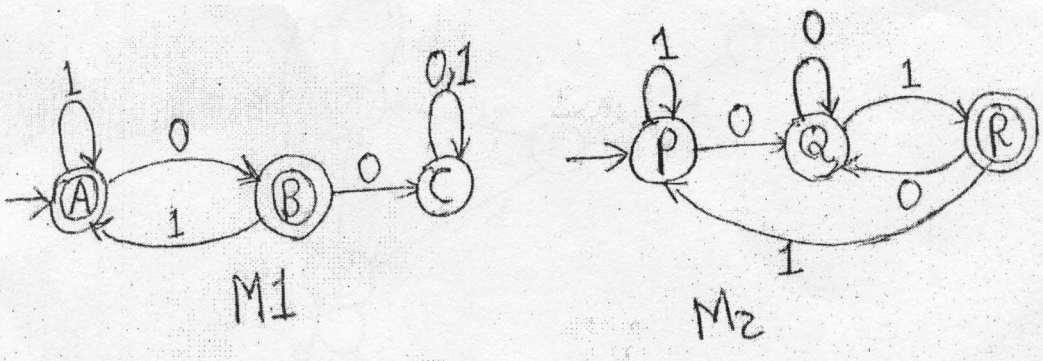

Figure -1

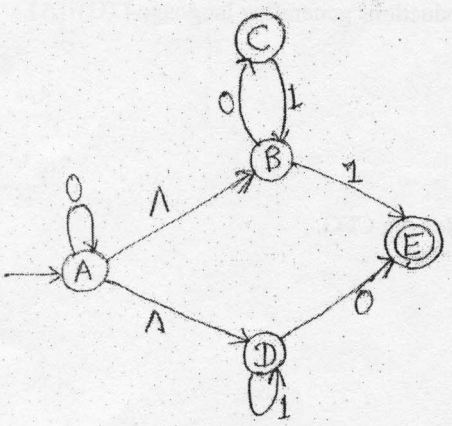

Figure – 2

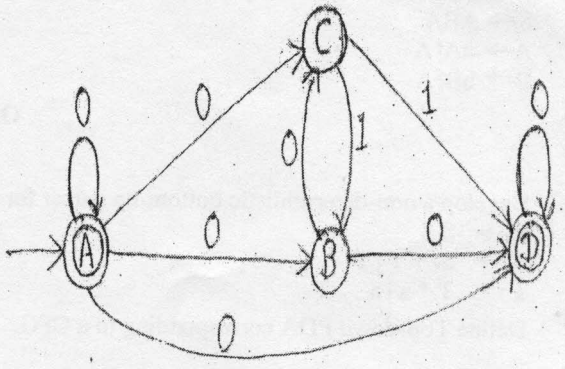

Figure – 3

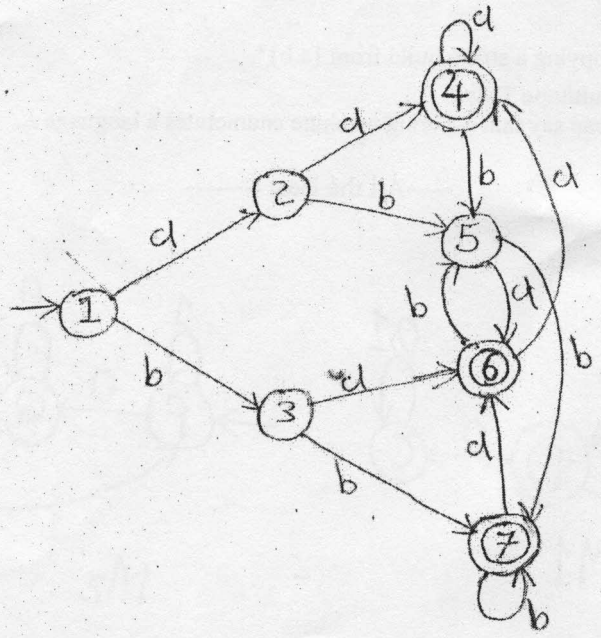

Figure - 4

KADI SARVA VISHWAVIDYALAYA

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

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

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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 ⋃ 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 $M=(Q,\Sigma, q_0, A, \delta)$ accepting a language $L \subseteq \Sigma^*$, there is an FA $M_1 = (Q_1,\Sigma, q_1, A_1, \delta_1)$ 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 --------

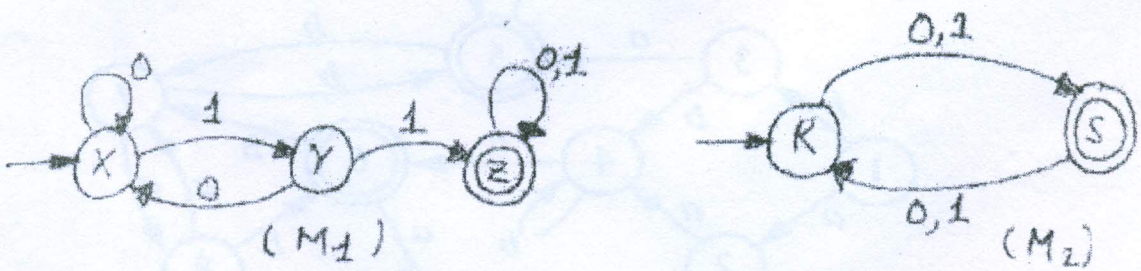

Figure – (1)

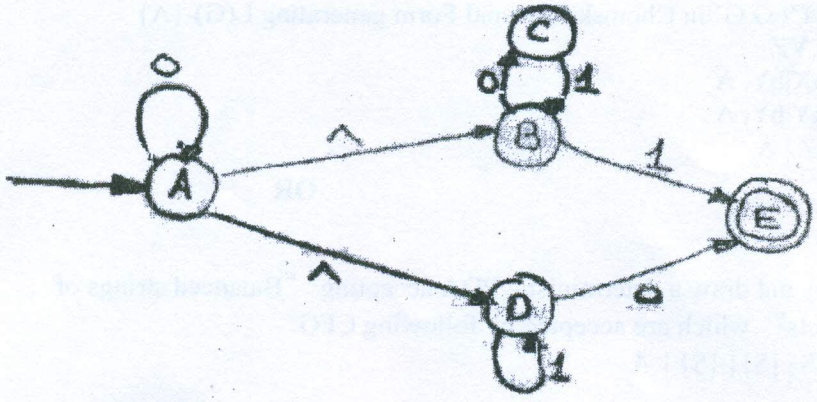

Figure – (2)

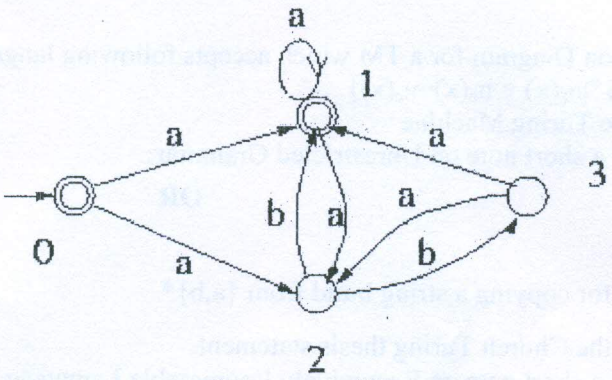

Figure – (3)

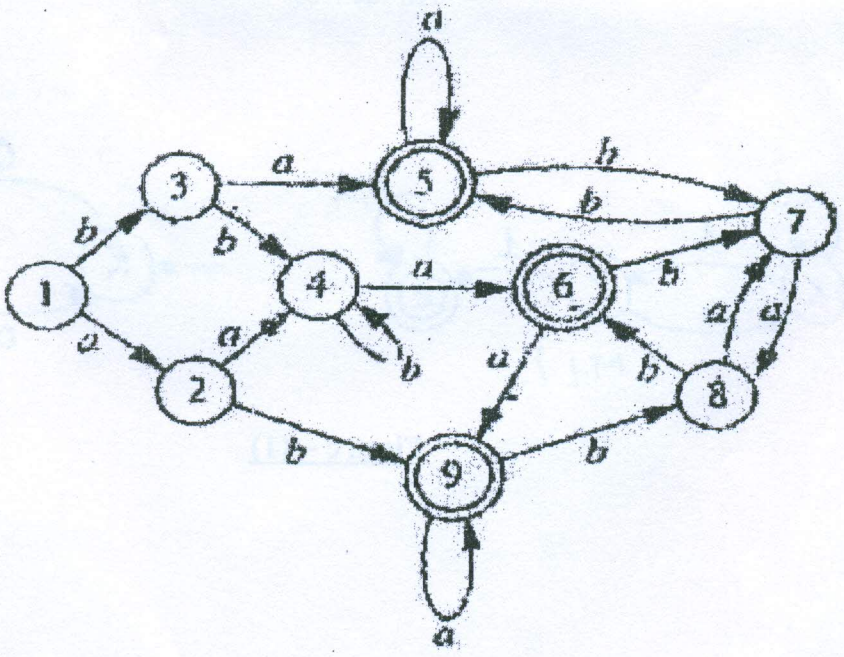

Figure – (4)