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Internal Assessment Test 1 – Sept. 2017

Sub:	Automata Theory and Computability				Sub Code:	15CS54	Branch:	ISE
Date:	20/9/17	Duration:	90 min's	Max Marks: 50	Sem/Sec:	5/ISE(A)		OBE

<u>Answer any FIVE FULL Questions</u>

		MARKS	CO	RBT
1 (a)	Design DFSM for the language L={w Є {a,b}* : w doesn't have **bbab** as substring}	[05]	CO1	L3
(b)	Design DFSM for the language L={w Є {0,1}* : w corresponds to the binary encoding, without leading 0's of natural numbers that are evenly divisible by 4}	[05]	CO1	L3
2 (a)	Design a nondeterministic FSM for the language L={w Є {0,1}*: w contains both **101** and **010** as substrings}	[06]	CO1	L3
(b)	Define the following terms with example. (i) Alphabet (ii) String (iii) Language (iv) Kleene Closure	[04]	CO1	L1
3 (a)	Convert the following NFA to DFA given in **Table1**.	[06]	CO2	L3

	a	b
→A	{A,B}	{C}
B	{A}	{B}
*C	{B,C}	{A,B}

Table 1

	a	b	Є
→A	{A,B}	{C}	Ø
B	{A}	{B}	{A,C}
*C	{B,C}	{A,B}	{B}

Table 2

		MARKS	CO	RBT
(b)	Write the difference between DFSM and NDFSM	[04]	CO2	L1

		MARKS	CO	RBT
4 (a)	Convert the Є-NFA to DFA given in **Table2**	[06]	CO2	L3
(b)	Write down the applications of Finite Automata.	[04]	CO1	L1
5 (a)	Design a Mealy Machine to find addition of two binary coded natural numbers which will give sum as output. If the input string is **1010** and **0101**, show the output string.	[06]	CO2	L3
(b)	Design a Moore machine which will give output as **'1'** on every occurrence of the substring **'ab'**, otherwise **'0'**. Consider the Σ	[04]	CO2	L3
6 (a)	Minimize the following DFA. Draw the minimized DFA.	[07]	CO2	L3

Input/ State	→A	B	C	*D	E	F	G	H
0	B	A	D	D	D	G	F	G
1	A	C	B	A	F	E	G	D

		MARKS	CO	RBT
(b)	Explain the term **'equivalence state'** and **'distinguishable state'**.	[03]	CO2	L2
7 (a)	Design a DFA for language L={wЄ{a,b}*: w contains odd no. of a's and odd no. of b's}	[05]	CO1	L3
(b)	Design a DFA for language L={wЄ{a,b}*: $N_a(w)$ mod 3=1 and $N_b(w)$ mod 2=0 }	[05]	CO1	L3

SCHEME & SOLUTION

Sub: Automata Theory & Computability (15CS54)

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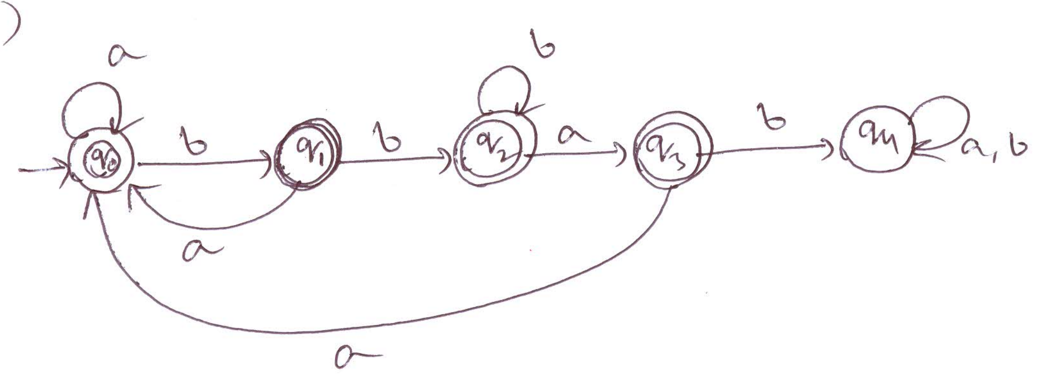
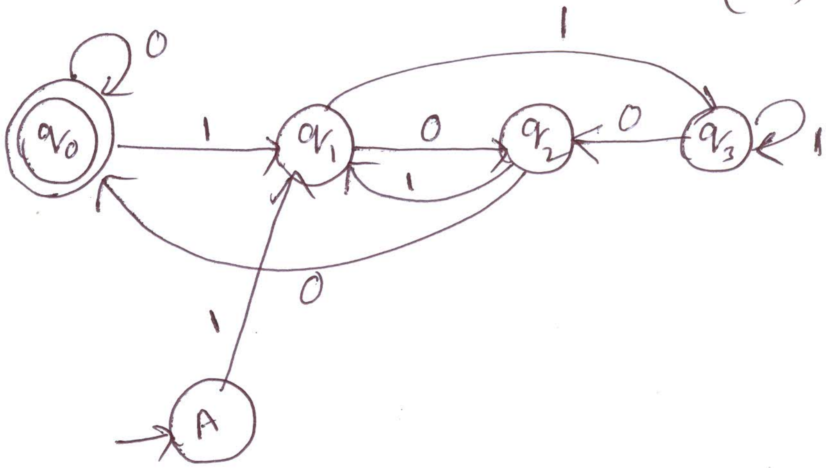
1. (a) (5M)

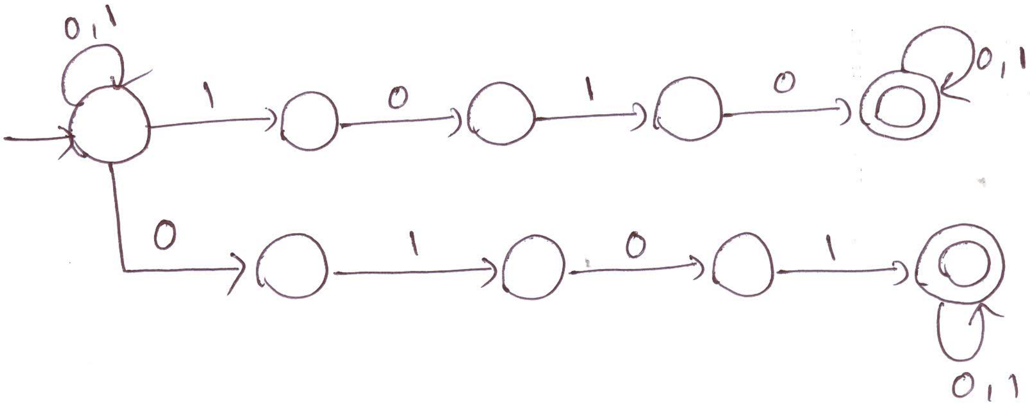


(b) (5M)

	0	1
→ A	∅	q_1
* q_0	q_0	q_1
q_1	q_2	q_3
q_2	q_0	q_1
q_3	q_2	q_3



2. (a) (6M)



(b) <u>Alphabet</u>: (4x1)M

It contains a finite set of input symbols. Denoted by Σ.

Ex $\Sigma = \{0, 1\}$ or $\Sigma = \{a, b\}$

String

A string is a combination of symbols from a perticular alphabet Σ.

Ex If $\Sigma = \{0,1\}$ then string is

$\{0, 1, 00, 01, 10, 11, 010, 110, \dots\}$

Language

A language is a collection of strings from a perticular alphabet which satisfies some conditions.

Ex $L = \{$ strings ending with 11 $\}$

$\{11, 011, 111, 01011, \dots\}$

Kleene Closure

It is a collection of strings of zero or more length.

If $\Sigma = \{a, b\}$

$$\Sigma^* = \bigcup_{i=0}^{\infty} \Sigma^i = \Sigma^0 \cup \Sigma^1 \cup \Sigma^2 \cup \Sigma^3 \cup \dots$$

$$= \{\epsilon, a, b, aa, ab, \dots\}$$

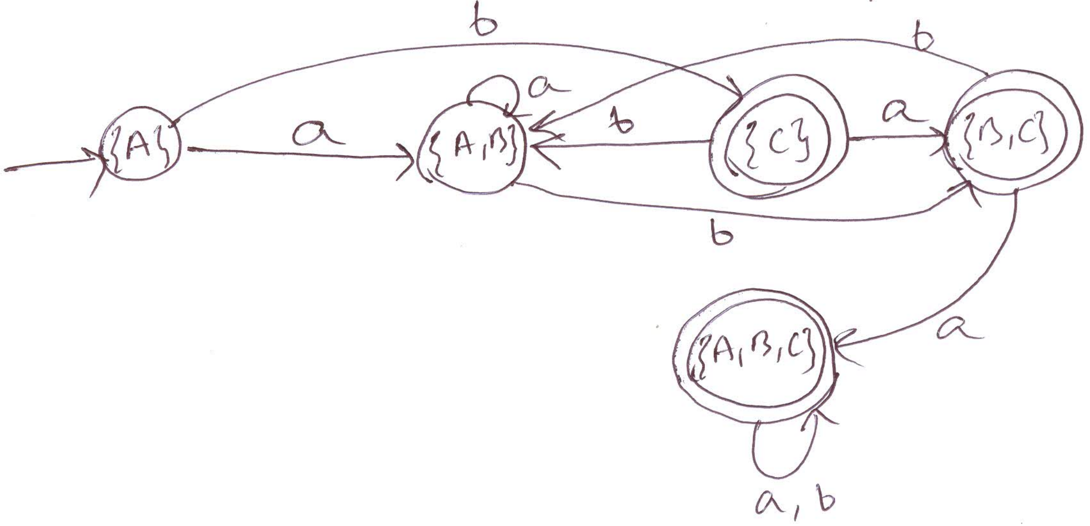
3. (a) NFA Table

	a	b
$\rightarrow A$	$\{A, B\}$	$\{C\}$
B	$\{A\}$	$\{B\}$
$*C$	$\{B, C\}$	$\{A, B\}$

DFA Table

(6M)

	a	b
$\rightarrow A$	$\{A, B\}$	$\{C\}$
$\{A, B\}$	$\{A, B\}$	$\{B, C\}$
$*\{C\}$	$\{B, C\}$	$\{A, B\}$
$*\{B, C\}$	$\{A, B, C\}$	$\{A, B\}$
$*\{A, B, C\}$	$\{A, B, C\}$	$\{A, B, C\}$



(4M)

(b) DFSM

→ It is defined by 5 tuples.

$M = (K, \Sigma, \delta, s, A)$

where K is the set of states

Σ is input alphabet

δ : transition function

$\delta : K \times \Sigma \rightarrow K$

s is start state.

A is finite set of final states.

NDFSM

→ It is defined by 5 tuples.

$N = (K, \Sigma, \delta, s, A)$

Here

$\delta : K \times \Sigma \rightarrow 2^K$

Other symbols are same.

→ In DFSM on a single i/p there will be only one transition from one state to another state.

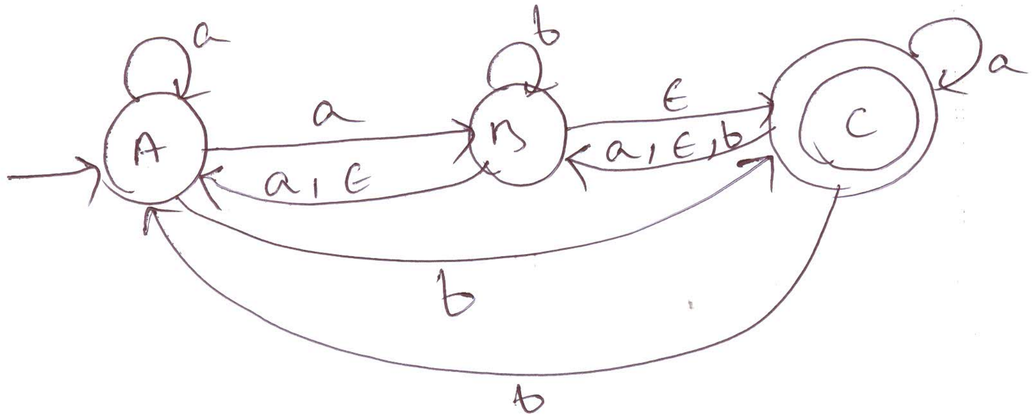
→ In NDFSM there will be zero, one or more than one transition from one state to another state.

(6M)

4. (a) ε-NFA Table

	a	b	ε
→ A	{A, B}	{C}	φ
B	{A}	{B}	{A, C}
* C	{B, C}	{A, B}	{B}

Transition diagram



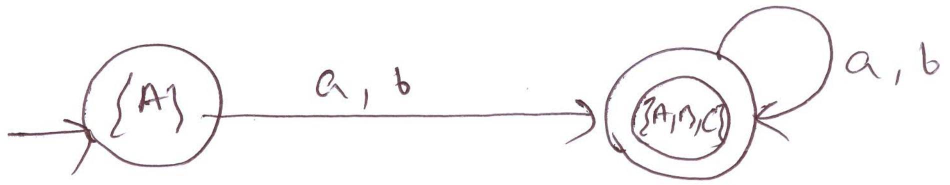
ECLOSE (A) = {A}

ECLOSE (B) = {A, B, C}

ECLOSE (C) = {A, B, C}

DFA Table

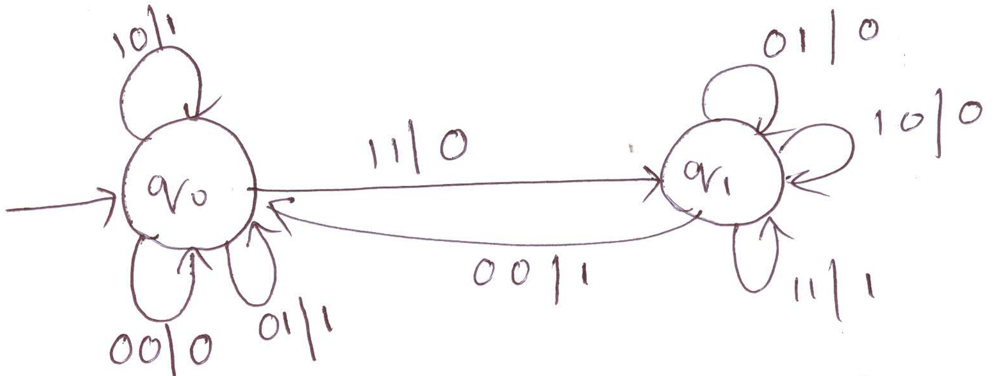
	a	b
$\rightarrow \{A\}$	$\{A,B,C\}$	$\{A,B,C\}$
$*\{A,B,C\}$	$\{A,B,C\}$	$\{A,B,C\}$



(b) **Applications of Finite Automata** (4M)

1. In lexical analysis phase of compiler design
2. In switching theory, design & analysis of digital circuits.
3. In network protocol modeling.

5.(a) (6M)



$$q_0 \xrightarrow[1]{01} q_0 \xrightarrow[1]{10} q_0 \xrightarrow[1]{01} q_0 \xrightarrow[1]{10} q_0$$

1 0 1 0
0 1 0 1

So O/P string is 1 1 1 1

Fig: Mealy Machine

5.(b) (4m) ⑥

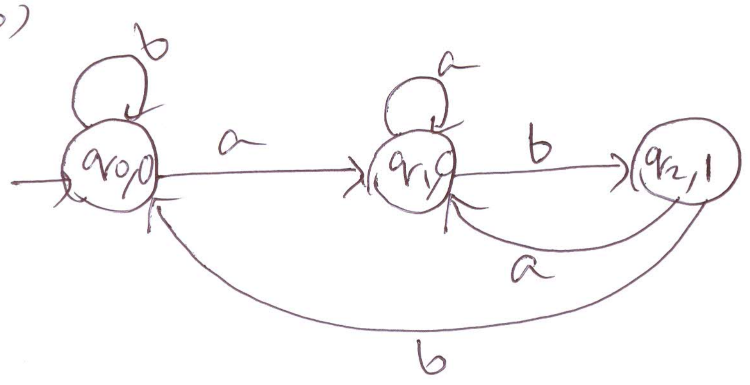


Fig: Moore Machine

6.(a) Partition 0: (7m)

(A, B, C, E, F, G, H) — Gr 1

(D) — Gr 2

Partition 1:

(A, B, F, G, H) — Gr 1

(C, E) — Gr 2

(D) — Gr 3

Partition 2:

(A, B, F, G) (H) (C, E) (D)

Partition 3:

(A, G) — Gr 1

(B, F) — Gr 2

(H) — Gr 3

(C, E) — Gr 4

(D) — Gr 5

	0	1
→ 1	2	1
2	1	4
3	1	5
4	5	2
* 5	5	1

Minimized DFA Table

6.(b) Equivalence state (1.5x2=3M)

Two states P & q are said to be equivalent if for all input string both P&q are going to final states or both are going to non-final states.

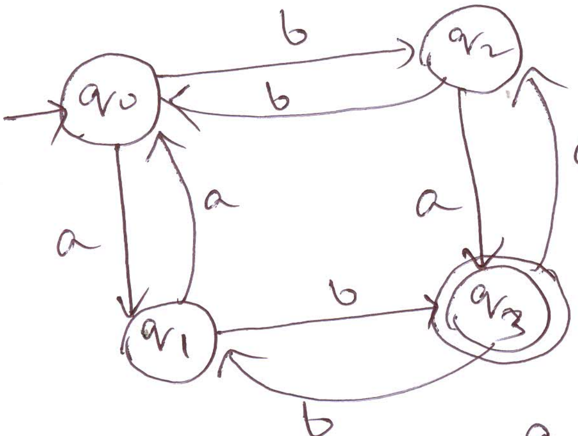
ie $\delta(P, w) \in A$ and $\delta(q, w) \in A$

Distinguishable state

Two states P & q are said to be distinguishable if for any one input string "a", state P is going to final state & q is going to non final state, or vice versa.

ie $\delta(P, a) \in A$ but $\delta(q, a) \notin A$.

7.(a) (5M)



(b)