

CS/B.Tech/Even/CSE/4th Sem/CS-402/2014

2014

Formal Language and Automata Theory

Time Alloted : 3 Hours

Full Marks : 70

*The figure in the margin indicate full marks.
Candidates are required to give their answers in their
own words as far as practicable*

GROUP - A

(Multiple Choice Questions)

1. Choose the correct alternatives of the following 10x1=10

i) Consider the grammar $S \rightarrow aSAb / \epsilon$

$A \rightarrow bA / \epsilon$

The grammar generates the strings of the form $a^i b^j$ for some $i, j \geq 0$. What is the conditions of the values of i and j ?

- | | |
|----------------|----------------|
| a) $i = j$ | b) $j \leq 2i$ |
| c) $j \geq 2i$ | d) $i \leq j$ |

ii) Let N be an NFA with n states and let M be the minimized DFA with m states recognizing the same language. Which of the following is NECESSARILY true?

- | | |
|-----------------------------|---------------|
| a) $m \leq 2^n$ | b) $n \leq m$ |
| c) M has one accept state | d) $m = 2^n$ |

iii) Compatible pairs are obtained from

- | | |
|------------------|---------------------|
| a) Merger Graph | b) Compatible Graph |
| c) Testing Table | d) Testing Graph |

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iv) The string 1101 does not belong to the set represented by

- a) $110^*(0+1)$ b) $1(0+1)^*101$
 c) $(10)^*(01)^*(00+11)^*$ d) $(00+(11)^*01)^*$

vi) Regular sets are closed under

- a) Union b) Concatenation
 b) Kleene Closure d) All of the above

vi) The intersection of CFL & RE is always

- a) CFL b) RE
 c) CSL d) CFL OR CSL

vii) Which of the following common in both CNF & GNF?

- a) $(NT) \rightarrow (Single\ T)$ (String of NT)
 b) $(NT) \rightarrow (Single\ of\ exactly\ two\ NT)$
 c) $(NT) \rightarrow (String\ of\ NT)$
 d) $(NT) \rightarrow (Single\ T)$

viii) Consider the languages:

$$L_1 = \{ww^R \mid w \in \{0,1\}^*\}$$

$$L_2 = \{w\#w^R \mid w \in \{0,1\}^*\}, \text{ where } \# \text{ is a special symbol}$$

$$L_3 = \{ww \mid w \in \{0,1\}^*\}$$

Which one of the following is true?

- a) L_1 is a deterministic CFL
 b) L_2 is a deterministic CFL
 c) L_3 is a CFL, but not a deterministic CFL
 d) L_3 is a deterministic CFL

ix) Difference between Turing Machine & Two way FA is in

- a) Input Tape b) Read write head
 c) Finite Control d) All of the these

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x) Which of the following statements is false?

- a) The halting problem of Turing machine is undecidable.
 b) Determining whether a context free grammar is ambiguous is undecidable.
 c) Given two arbitrary context free grammars G_1 and G_2 . It is undecidable whether $L(G_1) = L(G_2)$.
 d) Given two regular grammars G_1 and G_2 . It is undecidable whether $L(G_1) = L(G_2)$.

GROUP - B**(Short Answer Type Questions)**

Answer any three of the following

3x5=15

2. What do you mean by Right Invariant? Let R be an equivalence relation in $\{0\}^*$ with the following equivalence classes:

$$[]_R = \{0\}^0$$

$$[0]_R = \{0\}^1$$

$$[00]_R = \{0\}^2 \cup \{0\}^3 \cup \{0\}^4 \dots$$

Show that R is right invariant.

1+4

3. Construct grammar of the following.

- a) Construct the grammar for the language $a^1 b^m c^n$, where $1+m=n$
 b) all even integers up to 998.

4. Define NFA. Construct equivalent DFA from the given NFA.

Present State	Next State	
	0	1
$\rightarrow q_0$	q_0, q_1	q_2
q_1	q_2	q_1
q_2	q_1	q_2

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5. Design a two input two output sequence detector which generates an output '1' every time the sequence 1001 is detected. And for all other cases output '0' is generated. Overlapping sequences are also counted. [Denote State Graph, State Table and perform State assignment] 2+1+2

6. Consider the machine show in the following table:

Present State	Next State	
	X=0	X=1
A	A,1	C,1
B	E,0	B,1
C	D,0	A,0
D	C,0	B,0
E	B,1	A,0

Is this machine information lossless of finite order? If yes, find the order μ

GROUP - C

(Long Answer Type Questions)

Answer any three of the followings

3x15=45

7. Find equivalent partitions and minimize the following Finite State Machine.

PS	NS, z	
	x=0	x=1
A	B,0	H,1
B	C,0	G,1
C	B,0	F,1
D	F,1	C,1
E	B,1	C,1
F	B,1	B,1
G	C,1	B,1
H	D,1	A,1

Minimize the following incompletely specified machine.

PS	NS, Z		
	1	I ₁	I ₂
A	A,1	D, _	C, _
B	A, _	D, _	E, _
C	E,0	A,1	_, _
D	E, _	A,1	_, _
E	E,0	_, _	C, _

5+(5+2+3)

8. Convert the following Mealy machine to equivalent Moore machine.

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Present State	I/P=0		I/P=1	
	Next State	O/P	Next State	O/P
q0	q1	1	q2	1
q1	q3	0	q0	1
q2	q4	0	q3	1
q3	q1	0	q4	0
q4	q2	1	q4	0

Using Pumping lemma prove that $L = \{a^i \mid i \geq 1\}$ is not regular

Construct Finite Automata equivalent to the Regular Expression

$$L = ab(aa+bb)(a+b)^* b$$

9. Find a reduced grammar equivalent to the grammar

$$S \rightarrow aAa,$$

$$A \rightarrow bBB,$$

$$B \rightarrow ab,$$

$$C \rightarrow aB$$

Convert the following grammar into GNF.

$$S \rightarrow AA/a$$

$$A \rightarrow SS/b$$

Prove that Context Free Languages are not closed under intersection.

(5+6+4)

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Define PDA by giving a block diagram. What is the difference between DPDA and NPDA? Design a Non Deterministic Pushdown Automata for accepting the string $L = \{(Set\ of\ all\ palindromes\ over\ a,b)\}$ by Empty stack.

Construct an equivalent PDA for the following Context Free Grammar.

$$S \rightarrow aA$$

$$A \rightarrow aABC/bB/a$$

$$C \rightarrow c$$

Show an ID for the string aabbbc for the PDA generated.

$$3+2+7+3$$

11. Design a Turing Machine which performs addition of two integers.

Write short note on Multi Tape and Multi Head Turing Machine.

Prove that the problem "A string w halts on a Turing Machine M"

is undecidable

$$5+(2+2)+6$$