24/6/22

GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
FORMAL LANGUAGE AND AUTOMATA THEORY
CS403

TIME ALLOTTED: 3 HOURS **FULL MARKS: 70**

The figures 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 Type Questions)

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

			Marks	CO No
1.	(i)	Choose the correct option. a) FSM can accept strings of Regular Language but not Context Free Language b) FSM can accept strings of Context Free Language but not Regular Language c) FSM can accept strings of Both Regular Language and Context Free Language d) Both PDA and FSM can accept strings of Context Sensitive Language	1	CO1
	(ii)	The Regular Expression representing the set of all strings over $\Sigma=\{0,1\}$ starting with 0 and ending with 01 is a) 0*(0+1)*01 b) 0(0+1)*01 c) 001(0+1)* d) (0+1)*001	1	CO2
	(iii)	Which of the following is **NOT** equivalent to (P*Q*)* ? a) (P+Q)* b) (P*+Q*)* c) (P+Q*)* d) (P*Q)*	1	CO3
	(iv)	The set of all strings over the alphabet S = {a, b} (including ε) is denoted by a) (a + b)* b) $(a + b)^+$ c) $a+b^+$ d) a*b*	1	CO3
	(v)	A Push down automaton is different from a finite automaton because of a) a read head b) a memory in the form of stack c) a set of states d) all of these	1	CO3

(vi) Consider L = { $a^n b^n$ | n>=1 } , L is — 1 CO2
a) CFL but not Regular
b) CSL but not CFL
c) Regular
d) Any Type

(vii) Type 0 is accepted by — 1 CO3
a) Linear bounded Automata
b) Push down automata
c) Finite state automata
d) Turing machine

(viii) Which is NOT a part of the mechanical diagram of 'Turing Machine"? — 1 CO3
a) Input tape
b) read-write head
c) Finite Control
d) Stack

(ix) Maximum no of states of a DFA converted from a NFA with n states is — 1 CO3
a) n
b) n^2
c) 2^n
d) None of these

(x) The class of regular language is NOT closed under — 1 CO4
a) Concatenation
b) Union
c) Kleene closure
d) Subset

(xi) The string 1101 does not belong to the set represented by — 1 CO3
a) 110*(0+1)
b) 1(0+1)*101
c) (10)*(01)*(00+11)*
d) (00+(11)*01)*

(xii) The following transitions represent — 1 CO4
δ (q0, a, Z0) = (q0, aZ0)
δ (q0, a, a) = (q0, aa)
δ (q0, b, a) = (q1, ε)
δ (q1, b, a) = (q1, ϵ)
δ (q1, ϵ, Z0) = (q1, ε)
a) acceptance of L = {$a^n b^n$, n≥1} without empty stack
b) acceptance of L = {$a^n b^n$, n≥0} with empty stack
c) acceptance of L = {$a^n b^n$, n≥1} with empty stack
d) acceptance of L = {$a^n b^n$, n≥0} without empty stack

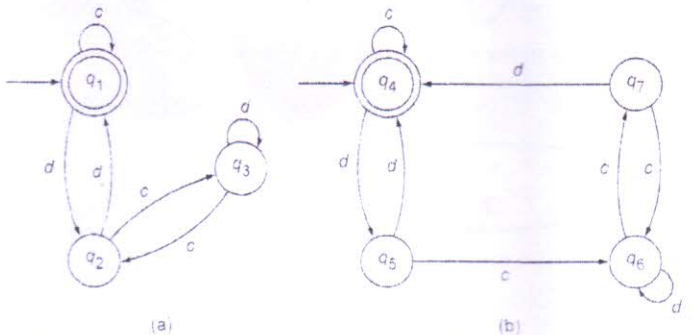
GROUP – B
(Short Answer Type Questions)
Answer any ***three*** from the following: **3×5=15**

			Marks	CO No
2.	(a)	Construct a CFG for palindrome of binary numbers.	3	CO4
	(b)	Construct a context-free grammar for the language L = ($a^n b^{2n}$ | n>=1 } over $\sum$ = {a, b}.	2	CO4

3.	(a)	Differentiate between Mealy machine and Moore machine.	2	CO3
	(b)	Design a Finite Automata (FA) that accepts set of all strings over $\Sigma = \{0, 1\}$ such that every string ends with 100 but starts with 1.	3	CO3
4.	(a)	Construct a Finite Automata equivalent to the Regular Expression L = ab(a+b)(ab)*b	3	CO3
	(b)	Design a DFA that accepts set of all strings over $\sum = \{0, 1\}$ such that number of 1s and the number of 0s in an acceptable string are divisible by 2.	2	CO3
5.	(a)	Using Pumping Lemma prove that $L = \{a^n b^n \mid n >= 1\}$ is not regular.	5	CO3
6.	(a)	What do you mean by unit production?	1	CO5
	(b)	Remove unit productions from the following grammar. $S \rightarrow AB, A \rightarrow a, B \rightarrow C, C \rightarrow D, D \rightarrow b$.	4	CO5

GROUP – C
(Long Answer Type Questions)
Answer any ***three*** from the following: **3×15=45**

			Marks	CO No.
7.	(a)	Illustrate PDA with a schematic diagram.	2	CO1
	(b)	Design a PDA for the language $L = \{WW^R \mid W \in (a, b)^*\}$ and trace its moves for an input string *aabbaa*.	9	CO1
	(c)	Discuss on the Chomsky classification of grammar.	4	CO1
8.	(a)	Describe a Turing Machine with schematic diagram?	2	CO1
	(b)	Design a Turing Machine for the language $L = \{a^n b^n \mid n > 0\}$ and draw the state transition diagram for the same and trace its moves while scanning *aabb*.	10	CO2
	(c)	Illustrate the Halting Problem of Turing Machine?	3	CO2
9.	(a)	Examine whether the following FSMs are equivalent.	3	CO1



	(b)	Considering the following machine, draw the corresponding Merger Graph and the Compatibility Graph. Also develop the minimal machine which covers the given machine.	12	CO1

PS	NS, z			
	I_1	I_2	I_3	I_4
→A	-	-	E,1	-
B	C,0	A,1	B,0	-
C	C,0	D,1	-	A,0
D	-	E,1	B, -	-
E	B,0	-	C, -	B,0

10. (a) Transform the grammar with following productions into Chomsky Normal Form. 7 CO3

$S \rightarrow ASB$
$A \rightarrow aAS \mid a \mid \varepsilon$
$B \rightarrow SbS \mid bb$

(b) Consider the following grammar for an arithmetic expression and prove that it is an ambiguous grammar over $\Sigma = \{+, *, 1, 2\}$ and $NT = \{E, F\}$. Can you suggest a strategy to make it an equivalent unambiguous grammar? 5 CO3

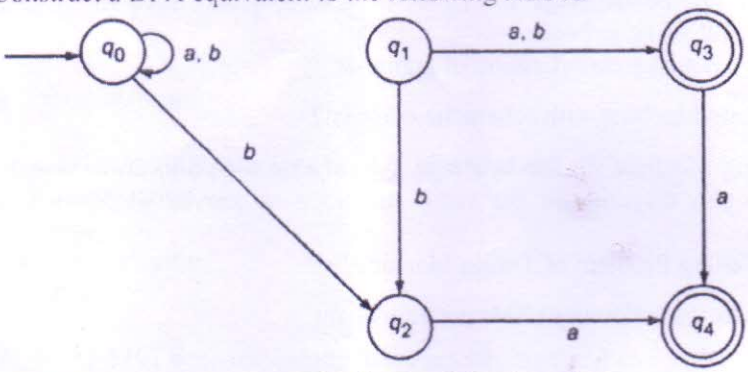
$E \rightarrow E + E \mid E * E \mid F$
$F \rightarrow 1 \mid 2$

(c) Construct a derivation tree for the string aabbabba for the CFG given by, 3 CO3

$S \rightarrow aB \mid bA$
$A \rightarrow a \mid aS \mid bAA$
$B \rightarrow b \mid bS \mid aBB$

11. (a) Write a regular expression for integer numbers over $\Sigma = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$ such that the acceptable number is divisible by both 5 and 2. 1 CO5

(b) Construct a DFA equivalent to the following NDFA. 7 CO4



(c) Generate the regular expression for the following FSM. 7 CO5