NARULA INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT

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PAPER TYPE: REGULAR/SUPPLE(R18)
YEAR: 2021

FORMAL LANGUAGE & AUTOMATA THEORY
IT403

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)

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

SL. NO.	Question	CO No.	Marks
(i)	A grammar in CNF may contain production rules like a) A→ B b) A → BC c) A →aB d)A → aBCD.	4	1
(ii)	A shift register is a) Mealy machine b) Turing machine c) Moore machine d) all of these.	1,5	1
(iii)	Which of the below accepts context sensitive language? a) linear bounded automata b) finite automata c) push down automata d) all of these.	4,5	1
(iv)	a*(a + b)* is equivalent to a) a* + b* b) (ab)* c) a*b* d) none of these.	1,4	1
(v)	Which one is not a prerequisite of GNF conversion of a grammar? a)Elimination of ε-production b) Elimination of unit production c) Elimination of left recursion d) None of these	1,3,4	1
(vi)	Pumping Lemma for CFL is used to show that a) a given language is Regular b) a given language is Context Free c) a given language is Context Sensitive d) a given language is not Context Free.	4	1
(vii)	The intersection of CFL & regular language a) need not be regular b) need not be CF c) is always regular d) none of these.	4,1	1
(viii)	The value of L(φ*) is a) ∑ b) {ε} c) { } d) none of these.	4,5	1
(ix)	The regular expression representing the set of all strings over {x, y} ending with xx and beginning with y is a) xx (x + y)*y b) yy (x+y)*x c) y(x+y)*xx d) y(xy)*xx.	2,4	1

(x)	If S is the number of states in NFA, then the equivalent DFA can have maximum of a) S states b) S – 1 states c) 2S states d) 2S – 1 states.		2,3	1
(xi)	Which production rule from the following is/are in CNF? a) A→ B b) A → BC c) A →aB d) A → aBCD e) None of these		2,3,4	1
(xii)	The logic of pumping lemma is a good example of a) the pigeon-hole principle b)Divide and conquer technique c) recursion d) iteration.		2,3,5	1

GROUP – B*
(Short Answer Type Questions)

Answer any ***three*** from the following: **3×5=15**

SL. NO.			CO No.	Marks
2.		State different categories of formal grammars according to Chomsky hierarchy of languages with examples. Define each along with the corresponding automata to accept the generated languages.	2,4	5
3.	(a)	Define CNF.	2,3,4	2
	(b)	Consider the grammar with following production rules. Obtain an equivalent grammar in CNF. $S \rightarrow ASB \mid \varepsilon$ $A \rightarrow aAS \mid a$ $B \rightarrow SbS \mid A \mid bb$	4,5	3
4.	(a)	Consider the regular expression defined over the alphabet $\sum = \{0, 1\}$ as $01(01)^*$ Find the language generated by it.	4,5	2
	(b)	Find the regular expression for the languages of all the strings of odd length over the alphabet $\sum = \{a, b\}$.	3,4,5	3
5.	(a)	State pumping lemma for regular language.	2,4	2
	(b)	Show that the following language is not regular: $L = \{0^n 1^n \mid n \geq 1\}$	2,5	3
6.		Let G be the grammar with the following production rules: $S \rightarrow aB \mid ba$ $A \rightarrow a \mid aS \mid bAA$ $B \rightarrow b \mid bS \mid aBB$ For the string *aaabbabbba* find leftmost derivation, rightmost derivation and parse tree.	3,4	5

GROUP – C*
(Long Answer Type Questions)

Answer any ***three*** from the following: **3×15=45**

SL. NO.			CO No.	Marks
7.	(a)	Minimize the following finite automata by the Myhill–Nerode theorem. Where final state is C and initial state is A	4	10

Present state	Next State	
	X=0	X=1
A	B	F
B	G	C
C	A	C
D	C	G
E	H	F
F	C	G
G	G	E
H	G	C

	(b)	State and Proof Ardent Theorem	2	5
8.	(a)	Design the sequence detector and output transition table for the sequence 1101, when detected it will produce o/p as 1 and 0 rest of the time. Draw the Digital circuit diagram.	3	10
	(b)	Let G be the grammar **S→ ASA|BSB|a|b**. A→ a B→ b For the string **aaabbbaaa**, find, i> the leftmost derivation. ii> the rightmost derivation	4	5
9.	(a)	Find the input string applied to state A of the following machine where the final state is B and the output string is **1110000010.**	4	8

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

	(b)	Develop a merger graph for the following incompletely specifi ed machine. From there, find the compatible pairs.	3	7

Present state	Next State,Z			
	I1	I2	I3	I4
A	D,1	C,-	-,-	D,1
B	-,-	D,-	A,0	-,-
C	E,1	-,-	B,0	C,1
D	-,-	D,1	E,0	C,1
E	-,-	A,0	-,-	-,-

10.	(a)	Explain basic structure of PDA.	2	5
	(b)	Design a PDA M to accept the Language L=$\{0^n1^n\}$	3	6
	(c)	Design the FA from the regular Expression **(a+b)*(ba+ab)*c**	3	4
11.	(a)	Check the Definiteness of the following m/c, if definite, find out its order	3	4

PS	NS,Z	
	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

	(b)	Design Modulo 2^4 binary counter with its T flip flop Implementation	4	8
	(c)	Define FSM. What are the limitations of FSM	1	3