Nirma University

Institute of Technology

Semester End Examination (IR/RPR), May - 2023

B. Tech. in Computer Science and Engineering, Semester-VI

2CS601 Theory of Computation

| Roll/ Exam No.		Supervisor's initial with date	

Time: 3 Hours _____ Max. Marks: 100

Instructions:
1. Attempt all questions.
2. Figures to the right indicate full marks.
3. Draw neat sketches wherever necessary.
4. Make suitable assumptions wherever necessary and specify them.
5. Section wise separate answer book should be used.

SECTION-I

Q-1 **Answer the following questions:** **[16]**

(A) Minimize the following Finite Automata using the Table filling (08)
CLO3, BL4 (Myhill Nerode) Method.
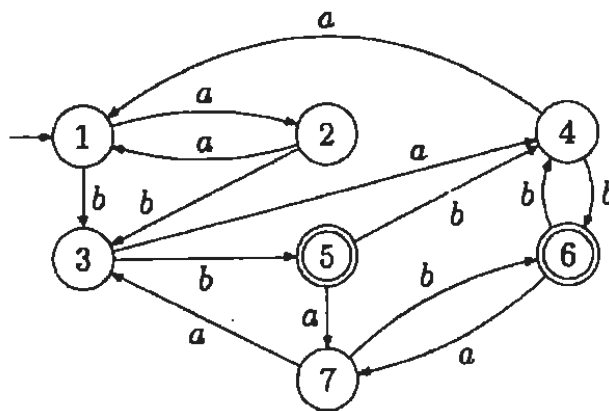
(B) Construct NFA for the language accepted by regular expression (08)
CLO3, BL4 **b(a+ba+abb)(ba(a+b)*)**. Also, convert the resultant NFA to DFA.

Q-2 **Answer the following questions:** **[14]**

(A) Design a Turing Machine that accept L={w | $n_a(w) = n_b(w) = n_c(w)$}, Here (08)
CLO3, BL6 $w \in \{a,b,c\}^*$

OR

(A) Design a Turing machine to delete the occurrence of the special (08)
CLO3, BL6 character '$' from the string of binary input. If the input is
1101$01, then the machine should delete the '$' and give 110101
as output. (Consider the read/write head at first character)

(B) Construct DFA that recognizes the language accepted by the (06)
CLO1, BL6 regular expression **(101+11) (00)***

OR

(B) Construct DFA that recognizes the language L={ n | (n mod 5) > 2} (06)
CLO1, BL6 of binary numbers over the input alphabet {0,1}

Q-3 **Answer the following questions:** **[20]**
(A) Check whether string **"aabbba"** belongs to the given CFG or not (08)
CLO4, BL5 (using CYK algo)

S→ AB
A→AA|AB|a
B→CC
C→b

(B) Show that the following grammar is ambiguous (06)
CLO4, BL3 P→ a | P+P | P-P | P*P | P/P
[Note: Here, +, -, *, and / are operators of given grammar]

(C) Show that language L={ a^n b a^m b a^{n+m} | n, m > 1 } is not regular (06)
CLO4, BL3 using Pumping Lemma

SECTION-II

Q-4 **Answer the following questions:** **[22]**
(A) Convert the following Context Free Grammar (CFG) into Greibach (08)
CLO3, BL3 Normal Form (GNF)

S→CA|BB
B→b|SB
C→b
A→a

(B) Design PDA for the following CFG and trace the string 001101110 (08)
CLO3, BL6
S→0B|1A
A→0S|1AA|0
B→1S|0BB|1

(C) Design a Turing Machine that accepts even length palindromes (06)
CLO3, BL6 over the input alphabet {a,b}

Q-5 **Answer the following questions:** **[20]**
(A) Design a DFA for the language that accepts binary numbers not (08)
CLO1, BL6 divisible by 3 or 5.

(B)
CLO1, BL2
Simplify the following grammar by removing useless, null, and unit (08) productions. Also, identify language generated by resultant grammar and write regular expression.

S→aA | bBB,

A→aaA | ∈
B→bB | bbC,
C→B,
D→B | a

[Note: Here, ∈ represents null production]

OR

(B)
CLO1, BL6
Design Context Free Grammar (CFG) for the given languages L. (08)
L= {WᵃXᵇYᶜZᵈ | a>b or b>c or c>d}

(C)
CLO2, BL1
Prove with an example, if S1 and S2 are finite sets with $|S_1|$=X and (04) $|S_2|$=Y, then $|S_1 \cup S_2| \leq X+Y$.

Q-6
CLO2, BL2
Show that $10^{(2n-1)} + 1$ is divisible by 11 for all the natural numbers **[08]** using Mathematical Induction.

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