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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E **Semester: IV**
Branch: Computer Science and Engineering **Duration: 3 hrs.**
Course Code: 19CS4PCTFC **Max Marks: 100**
Course: Theoretical Foundations of Computations **Date: 21.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Design DFA for accepting strings ($\sum = \{0,1\}$) **10**

i. Whose Length is divisible by 3
ii. Which have the pattern 001
iii. Which ends with the pattern 011
iv. Whose value is divisible by 2
v. Which have minimum three 1's in it.

b) Design NFA for accepting strings over $\sum = \{0,1\}$ which has a 1 in the second last position. Convert the resulting NFA to DFA by subset construction method. **7**

c) Design epsilon NFA for accepting signed integer. **3**

UNIT - II

2 a) Design regular expressions for accepting the below languages over $\sum = \{a,b\}$. **12**

i. Strings start with ab or ba
ii. Strings having even number of a's
iii. Strings having alternate a's and b's
iv. Strings of odd length
v. Strings end with abb
vi. Strings having baa

b) Show that regular languages are closed under **8**

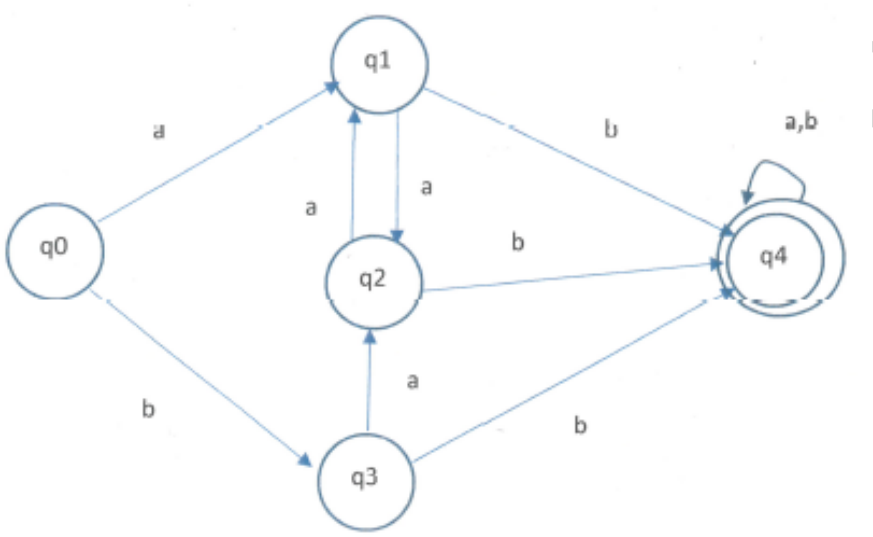
i. Union
ii. Complementation
iii. Intersection.

OR

3 a) Convert the below DFA to regular expression using Kleene's theorem: **10**

	0	1
→q0	q1	q0
*q1	q1	q1

b) Minimize the below DFA. Here, Σ={a,b} **10**



UNIT - III

4 a) Design Context Free Grammar (CFG) for below languages. **10**

i. L={$a^n b^n c^m$|n,m>=0}
ii. L={w|w is string of a's and b's and w is palindrome}
iii. L={$a^n b^m$|n<>m,m,n>=0}
iv. L={$a^n b^m c^m d^n$|m,n>=1}
v. L={w| w is string of a's and b's and |w|mod3=0}

b) Derive the string **00011** using below grammar with Leftmost and Rightmost derivation. **5**

S → A1B
A → 0A | **ε**
B → 0B | 1B | **ε**

c) Eliminate epsilon productions in the grammar. Given below **5**

S→ABCa|bD
A→BC|b
B→b|€
C→c|€
D→d

OR

5 a) Eliminate the useless symbols and productions in the below grammar. **10**

S→aA|bB
A→aA|a
B→bB
D→ab|Ea
E→aC|d

b) Convert the below grammar to CNF. **5**

S→0A|1B
A→0AA|1S|1
B→1A|0

c) Show that the below grammar is ambiguous. **5**

S→aB|bA
A→aS|bAA|a
B→bS|aBB|b

UNIT - IV

6 a) Design a Push Down Automata (PDA) for accepting the language $L=\{WCW^R|W$ is string of a's and b's$\}$ **6**

b) Convert the below grammar to PDA. **6**

S→aABC
A→aB|a
B→bA|b
C→a

c) Design PDA for accepting $L=\{a^nb^{2n}|n>=1\}$. Also check whether the string **"aabbbb"** is accepted or not using ID. **8**

UNIT - V

7 a) Design Turing machine for accepting $L=\{0^n1^n|n>=1\}$. Also show whether the string "00111" is accepted or not. **9**

b) Design Turing machine to accept the strings that end with 011 ($\sum = \{0,1\}$). **6**

c) Describe the Multi tape Turing machine with a neat diagram. **5**

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