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

Autonomous Institute Affiliated to VTU

October 2023 Semester End Main 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

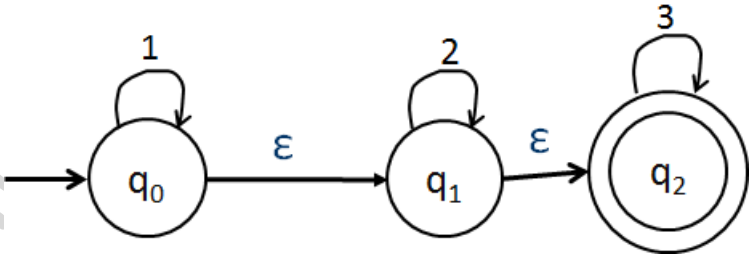
Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Design Deterministic Finite Automata (DFA) for the following **10**
i. Set of all strings not containing the substring 'abb' over the alphabet set Σ ={a,b}
ii. To accept strings of a's and b's such that L={w / w ∈ (a+b)* such that $N_a(w)$ mod 5 == 0 and $N_b(w)$ mod 3 ==0}

b) Obtain Non-deterministic Finite Automata (NFA) for the following **5**
i. L = {a^3 ∪ a^{2n} , n>=1}
ii. To accept strings of a's and b's ending with ab or ba

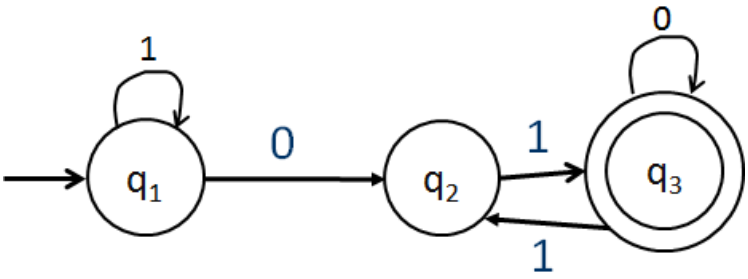
c) Converting ε-NFA to DFA **5**



UNIT - II

2 a) Design Regular Expressions (RE) for the following **10**
i. To accept strings of a's and b's ending with "b" and has no substring "aa"
ii. To accept a language consisting of strings of a's and b's with alternate a's and b's
iii. Strings of a's and b's such that fourth symbol from right end is "a" and fifth symbol from right end is "b"
iv. L={a^nb^m , (n+m) is even}
v. L={a^nb^m , n>=1, m >= 1, nm >= 3}

b) Convert the following Finite Automate to regular expression using Kleene's theorem **10**



OR

3 a) Design minimized DFA using the concept of table filling algorithm for the DFA given below. **10**
Note: Show the minimization steps completely and clearly.

	0	**1**
→ **A**	B	E
B	C	F
***C**	D	H
D	E	H
E	F	I
***F**	G	B
G	H	B
H	I	C
***I**	A	E

b) Show that the following language L = { ww , w ∈ (a+b)*} is not regular using Pumping lemma. **5**

c) Show that regular languages are closed under Complement operation. **5**

UNIT - III

4 a) Design Context Free Grammar (CFG) to accept **10**
i. Strings of the form { $a^{n-3}b^n$ | n >= 3 }
ii. Strings which are palindromes over {a, b}
iii. Strings of the pattern {$a^nb^nc^md^m$ | n >= 0, m > 0 }
iv. L = { $a^nb^mc^k$, (n+2m) == k , $n \geq 0$, $m \geq 0$ }
v. L = { a^ib^j , $i \neq j$, $i \geq 0$, $j \geq 0$ }

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

$S \rightarrow A1B$
$A \rightarrow 0A \mid \varepsilon$
$B \rightarrow 0B \mid 1B \mid \varepsilon$

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

$S \rightarrow iCtS \mid iCtSeS \mid a$
$C \rightarrow b$

OR

5 a) Convert below grammar to Chomsky Normal Form (CNF). **12**

$S \rightarrow aXbX$, $X \rightarrow aY \mid bY \mid \varepsilon$, $Y \rightarrow X \mid c$

b) Eliminate Useless symbols from the following grammar **8**

$S \rightarrow aB / bX$
$A \rightarrow Bad / bSX / a$
$B \rightarrow aSB / bBX$
$X \rightarrow SBD / aBx / ad$

UNIT - IV

6 a) Design Deterministic Push Down Automata (PDA) for the following languages **12**

i. $L=\{W, W \in (a+b)^* \text{ and } n_a(w) < n_b(w)\}$ by final state method.
ii. $L=\{a^{2n}b^n, n>=1\}$ by empty stack method
Give the graphical representation of the designed PDA.

b) Convert following Grammar to PDA. Show the instantaneous description for the string "aabba" **8**

$S \rightarrow aABC$
$A \rightarrow aB \mid a$
$B \rightarrow bA \mid b$
$C \rightarrow a$

UNIT - V

7 a) Design Turing Machine (TM) for the following **12**

i. $L= \{0^n1^n2^n, n>=1\}$ **ii.** $L=\{wcw^r, w \in (0+1)^*\}$
Give the graphical representation of the designed TM.

b) Describe "Post Correspondence Problem". Find whether the lists **8**
M = (abb, aa, aaa) and
N = (bba, aaa, aa) have a Post Correspondence Solution.

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