U.S.N.										

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

Autonomous Institute Affiliated to VTU

October / November 2021 Supplementary Examinations

Programme: B.E. **Semester : IV**
Branch : Computer Science and Engineering **Duration: 3 hrs.**
Course Code: 19CS4PCTFC **Max Marks: 100**
Course Title: Theoretical Foundations of Computations **Date: 23.10.2021**

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

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as

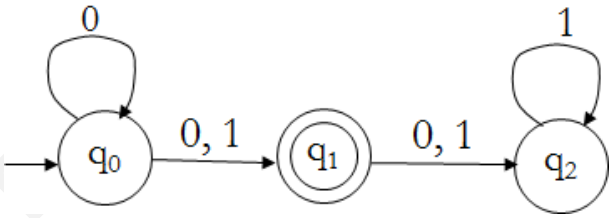
UNIT - 1

1 a) Design Deterministic Finite Automata (DFA) accepting the following strings over the alphabet set Σ ={a,b} **10**
i. Not more than three a's in the strings
ii. Set of all strings not containing the substring 'abb'
iii. Set of strings ending with ab or ba
iv. Set of all strings with at least one 'a' and exactly two b's

b) Given the following ε-NFA obtain its equivalent DFA using ε-closure. **5**

	ε	a	b	c
→p	{q, r}	ϕ	{q}	{r}
q	ϕ	{p}	{r}	{p, q}
*r	ϕ	ϕ	ϕ	ϕ

c) Convert the following NFA (Non-Deterministic Finite Automata) to DFA **5**



UNIT - 2

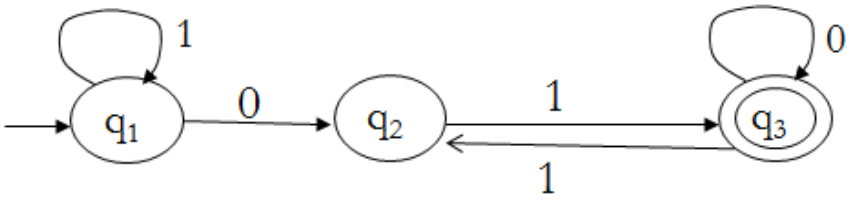
2 a) Design Regular Expressions (RE) for the following over the alphabet set Σ = {a, b} **8**
i. L = $\{a^n b^m$, (n+m) is even$\}$
ii. L = $\{a^n b^m$, n >= 4, m <= 3$\}$
iii. Strings of a's and b's whose lengths are multiples of 3
iv. Strings of a's and b's such that fourth symbol from right end is "a" and fifth symbol from right end is "b"

b) Show that the following languages are not regular using Pumping lemma **8**
i. L = $\{a^n b^n$, n >= 0$\}$ **ii.** L = $\{a^{n!}$, n >= 0$\}$

c) Show that the regular languages are closed under Intersection. **4**

OR

3 a) Convert the following DFA to a RE, using the Kleene's theorem **10**



b) Design minimized DFA using the concept of table filling algorithm for the DFA given below. **10**

	0	**1**
→ **q0**	q_1	q_4
q1	q_2	q_5
***q2**	q_3	q_7
q3	q_4	q_7
q4	q_5	q_8
***q5**	q_6	q_1
q6	q_7	q_1
q7	q_8	q_2
***q8**	q_0	q_4

UNIT - 3

4 a) Design Context Free Grammar (CFG) for the following languages **10**
i. L = $\{a^{n+1}b^n, n>=0\}$
ii. L = $\{a^nb^{2n}, n>=0\}$
iii. L = {w, |w| mod 3 > 0 , where w ∈ a* }
iv. L = $\{ww^R$, where w ∈ (a+b)*}

b) Derive the string **baabab** using below grammar with Leftmost and Rightmost derivation. **5**
S → CS | ε , C → aa | ab | ba | bb

c) Show that the below context free grammar is ambiguous. **5**
G = (V, T, P, S) , V = {S, C} , T = {i, t, e, a, b} , S = S
P = { S → iCtS | iCtSeS | a , C → b }

OR

5 a) Convert below grammar to Chomsky Normal Form (CNF). **8**
S → AbA
A → Aa | ε

b) Eliminate all Unit productions from the Grammar **6**
S → AB

A → a
B → C | b
C → D
D → E | bC
E → d | Ab

c) Eliminate Useless symbols in the grammar **6**
G = (V, T, P, S) , V={S, A, B, C, D} , T= {a, b, c, d}, S= S
P = { S →aA | a | Bb | cC
A → aB
B →a | Aa
C →cCD
D → ddd }

UNIT - 4

6 a) Design Deterministic Push Down Automata (PDA) for the language L = {W, W ∈ (a+b)* and $n_a(w) > n_b(w)$} by final state. Give the graphical representation of the PDA obtained. Show instantaneous description for the string **abaab** **10**

b) Show that the language L = {W , W ∈ (a+b)* , | W | is a perfect square } is not Context Free Language (CFL). **5**

c) Convert following Grammar to Push Down Automata (PDA) **5**
S → aABC
A → aB | a
B → bA | b
C → a

UNIT - 5

7 a) Design Turing Machine (TM) for the language L={wcw^r , w ∈ (0+1)*}. Give the formal definition of the obtained TM. **10**

b) Describe Multi stack and Multi tape Turing machine. **5**

c) With an example explain Post Correspondence Problem **5**

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