U.S.N.										

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

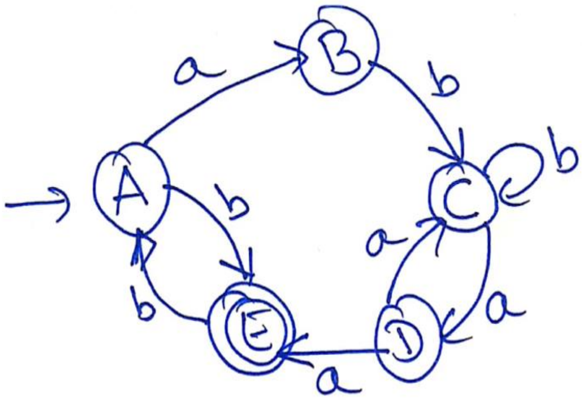
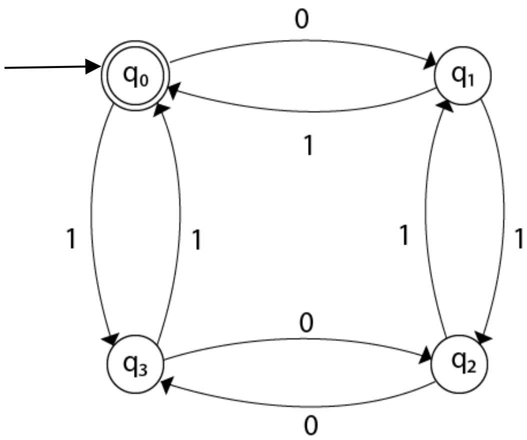
Autonomous Institute Affiliated to VTU

September / October 2023 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Information Science and Engineering **Duration: 3 hrs.**
Course Code: 22IS4PCTFC **Max Marks: 100**
Course: Theoretical Foundations of Computation

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

		UNIT - I	*CO*	*PO*	Marks
1	a)	For the NFA shown below, using the subset construction draw the equivalent DFA. Find a minimum state DFA accepting the same language. 	CO2	PO2	**10**
	b)	Design DFA for the languages over ={a,b} (i) L= $\{ab^5wb^2: w \in \{a,b\}^*\}$ (ii) L= {w: String beginning and ending with the same character}	CO3	PO3	**06**
	c)	Define extended transition function(δ*) for NFA. Find δ*(q0,0101) for the following NFA. 	CO1	PO1	**04**

OR

2 a) Consider the following ε-NFA.
(a) Compute the ε-closure of each state.
(b) Convert the automaton to a DFA.

δ	**ε**	**a**	**b**	**c**
→p	Φ	{p}	{q}	{r}
q	{p}	{q}	{r}	Φ
***r**	{q}	{r}	Φ	{p}

CO2 | PO2 | **08**

b) Minimize the given DFA using table filling algorithm.

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

CO1 | PO1 | **08**

c) Design an NFA with no more than five states for the set $\{abab^n : n > 0\} \cup \{aba^n : n \geq 0\}$.

CO3 | PO3 | **04**

UNIT - II

3 a) Consider regular expressions
i. (a+b)*ab(a+b)*
ii. a*(a+b)b*
Construct ε-NFA for these regular expression

CO1 | PO1 | **06**

b) Derive Regular expressions for the following languages.
i) Strings of a's and b's with length not more than four
ii) Strings of 0's and 1's with odd number of 1's.

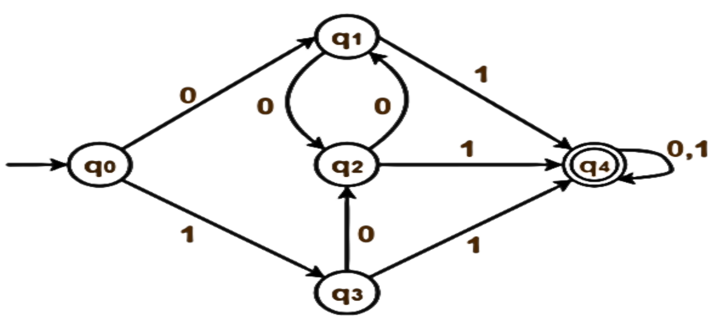
CO2 | PO2 | **06**

c) Using Pumping Lemma show that the following languages are not regular.
(i) $\{0^n : n \text{ is a perfect square}\}$
(ii) $\{0^n1^m : m \geq n\}$.

CO2 | PO2 | **08**

OR

4 a) Convert the following automata to Regular Expression using state elimination method



CO2 | PO2 | **08**

b) Describe the language represented by the following regular expressions –
i) (a+b)* (aa+ab+ba)
ii) a(a+b)* b+b (a+b)*a

CO2 | PO2 | **06**

		c)	State and prove pumping lemma for regular languages.	CO1	PO2	**06**
			UNIT - III			
	5	a)	Transform the grammar with the following productions to Chomsky Normal Form. S->ABaC| Eda | dE A->BC | Ed B->B | Ɛ |Ea C->D | Ɛ D-> d E-> aE | dFE F->a	CO2	PO2	**08**
		b)	Define ambiguity in grammar, RMD and LMD. Prove that the following grammar is ambiguous. S→S(E)|E E→(S)E|0|1|ϵ	CO2	PO2	**07**
		c)	Construct CFG for the following languages L1 ={ $a^n b^m c^k$| n+2m= k for n>=0,m>=0} L2 ={ $a^m b^n$aba | n =m, m >=0, n>=0 }	CO3	PO3	**05**
			UNIT - IV			
	6	a)	Consider the PDA defined by M = ({q0 ,q1,q2}, {a, b}, {A,z}, δ, q0 , z, {q2}), with transitions δ(q0 , a,z) = (q0 , Az) δ(q0 ,a, A) = (q0 , AA) δ(q0 , b, A) = (q1, Ɛ) δ(q1 , b, A) = (q1, Ɛ) δ(q1 , Ɛ , z) = (q2, Ɛ) a) Find a context-free grammar for the above PDA b) Derive the string **(aaabbb)** from the constructed CFG	CO3	PO3	**10**
		b)	Define Non-deterministic PDA. Design a PDA to accept the language L={$a^i b^j c^k$: i+j = k, i≥0, j≥0}. Show the instantaneous description for the input String **abbccc**.	CO3	PO3	**10**
			UNIT - V			
	7	a)	Define Turing Machine. Design Turing Machine to accept L={ ww^R | w ε {a, b}*}. Using Instantaneous Descriptions show that the string **abaaba** is accepted by the Turing Machine.	CO2	PO2	**10**
		b)	Let x and y are two positive integers represented using unary notation. Design a Turing Machine that computes the function f(x,y), where x,y ϵ 1+ f(x, y) = x - y if x > y f(x, y) = y - x if y>x f(x, y)=0 if x = y Use Instantaneous Descriptions to show operation on x=11111 and y=11.	CO3	PO3	**10**

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