Reg. No.:

Name :

VIT

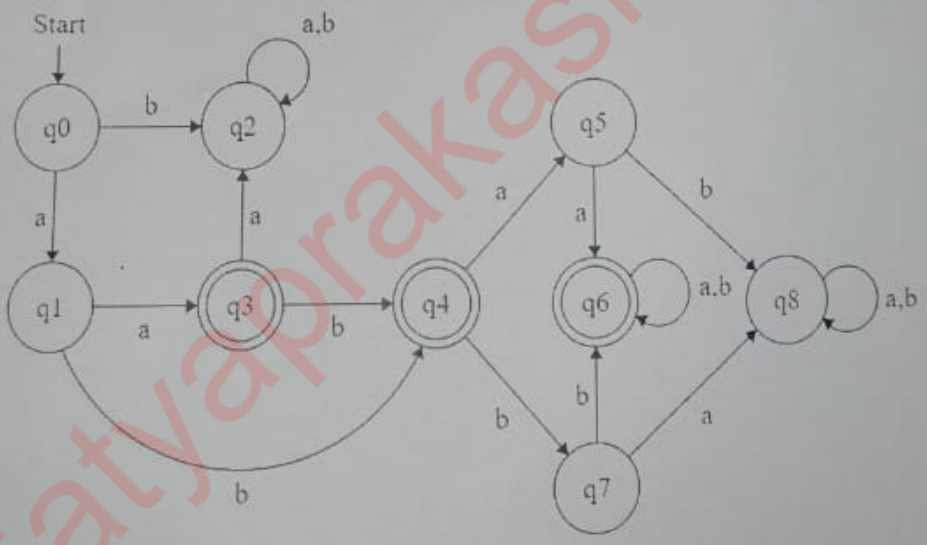
Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act 1956)

Continuous Assessment Test I – September 2023

Programme	: **B.Tech CSE**	**Semester**	: FALL 2023-24
Course	: Theory of Computation	**Code**	: BCSE304L
		Slot	: F1+TF1
Faculty	: Dr. S. Suseela Dr. K. Sathyarajasekaran	**Class Nbr**	: CH2023240101110 CH2023240101108
Time	: 90 Minutes	**Max. Marks**	: 50

Answer ALL the questions

Q. No.	Questions	Marks
1.	a) Construct the DFA for the language over $\sum = \{0,1,2\}$ for all strings in which the number of ones is divisible by 5. [5M] b) Construct the NFA for the language, $L = \{a^{3i} b^{2j} c^{2+k} \mid i, j, k \geq 0\}$ [5M]	10
2.	Justify the given machine is DFA and construct a minimized DFA for the same. 	10
3.	$L = \{a^{2+i} b^{2j} c^{2k+1} \mid i \geq 0, j > 0, k \geq 0\}$ a) Convert the given language L into a regular expression. [2M] b) Convert the generated regular expression into a NFA with Null moves. [3M] c) Convert the generated Null NFA into a NFA without Null moves. [5M]	10

4.	Construct the finite automaton for the language L, where L = $\{L_1 \mid L_2\}$ L_1 = {w | w $\sum$ {0,1}* contains strings where string starts with 00 and ends with 11} L_2 = {w | w is a multiple of '4' when interpreted as a binary integer}	10
5.	In a school library, the librarian instructs the books to be arranged in the following order. a) Either magazines or newspapers should be arranged first b) Three types of language books in any order but not in mixed fashion. c) The last two books should be encyclopaedia or dictionary. Design minimized automata to check whether the books arranged follow the pattern or not.	10

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Reg. No.:

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Continuous Assessment Test I – September 2023

Programme	:	B.Tech (CSE) and its Specialization	Semester	:	Fall Semester
Course Title	:	Theory of Computation	Code	:	BCSE304L
			Class Nbr(s)	:	CH2023240100678 CH2023240100680 CH2023240100679
Faculty (s)	:	Dr.T.Benil Dr. Jannath Nisha Dr. R. Rathna	Slot	:	G1+TG1
Time	:	9.00 AM to 10.30 AM	Max. Marks	:	50 marks

Answer all the Questions

1. i) Prove that the sum of the first n positive integers is given by the formula using inductive proof .(7 marks)

$$1 + 2 + 3 + \ldots + n = \frac{n(n+1)}{2} \text{ for } n \geq 1$$ 10

ii) Consider a binary tree data structure where each node can have zero, one, or two children. Justify what type of induction and explain? (3 marks)

2. i) Imagine you are developing a social media platform, and you need to implement a username validation system. Usernames on your platform must adhere to certain rules:

a) Usernames can consist of letters (both uppercase and lowercase), digits, and underscores.

b) Usernames must start with a letter.

c) Usernames can be at most 20 characters long.

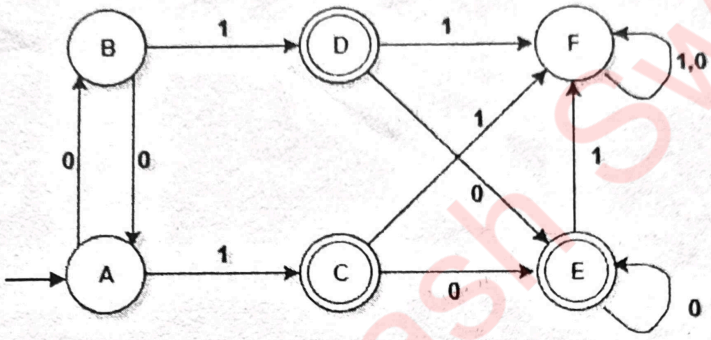
Design an NFA that recognizes valid usernames according to the specified rules. Provide a detailed explanation of the states, transitions, and acceptance criteria in your NFA. Additionally, explain how the NFA processes a username input and determines whether it's valid or not. The NFA should accept valid usernames and reject invalid ones. (10 marks) 15

ii) Convert the obtained NFA into DFA (5 marks)

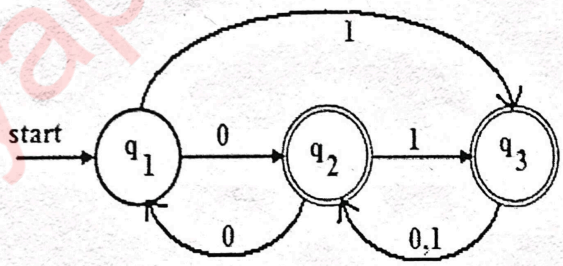
3.

i) Design an ε – NFA (Nondeterministic finite automaton) to recognize the language L, containing only binary strings of non-zero length whose bits sum to a multiple of 3. (5 marks)

ii) Explain the Myhill-Nerode theorem and demonstrate how to minimize a given DFA and detail the process of identifying equivalent states and creating a minimized DFA.(10 marks) 15



4 Find the Regular expression for the set of all strings denoted by $R_{12}^{(2)}$ from the DFA given below. 10



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Vellore Institute of Technology
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Continuous Assessment Test I – September 2022

Programme	:	B.Tech. CSE and Specialization	Semester	:	FS 2022-23
Course	:	Theory of Computation	Code	:	BCSE304L
			Slot	:	B1+TB1
Faculty	:	Dr.Prakash, Dr.Sureshkumar, Dr.Sivakumar P, Dr. Ashoka Rajan, Dr. Smrithy G S, Dr. Maria Anu V	Class Nbr	:	CH2022231001519, CH2022231001517, CH2022231001518, CH2022231001521, CH2022231001516, CH2022231001520
Time	:	**90 Minutes**	Max. Marks	:	**50**

Answer ALL the questions

Q.No.	Sub. Sec.	Questions	Marks
1.	a	Consider two languages $L_1 = \{w \mid w \in \{a,b\}^*$ contains strings whose length is exactly 2$\}$ and $L_2 = \{w \mid w \in \{c,d\}^*$ contains strings whose length is at most 2$\}$. Compute the following. i. $L_3 = L_2 - L_1$ ii. $L_4 = L_1 . L_3$ iii. $L_5 = L_1^R - L_3^R$ iv. $L_6 = L_2^R \cap L_3^R$ v. $L_7 = (L_1)^*$ **NOTE: L^R represents reverse of the language L**	2*5
2.	a	Consider a machine which can only handle ternary (base 3) number system with input alphabet $\{0, 1, 2\}^+$. [0_3 represents decimal 0_{10}, 1_3 represents decimal 1_{10}, 2_3 represents decimal 2_{10}, 10_3 represents decimal 3_{10}, 11_3 represents decimal 4_{10}, 12_3 represents decimal 5_{10} and so on.] Construct a Deterministic Finite Automata (DFA) so that the machine should accept all ternary numbers which should be divisible by 3. For instance, ternary number "12" is invalid but "10" is valid.	5
	b	Let 'M' be the deterministic finite automaton that accepts the language, L= {w ϵ {0,1}* | w is the set of strings where second or third last input symbol should be 1}. Design a minimal DFA for the given language.	5
3.	a	Construct a Non-Deterministic Finite Automata (NFA) for the language L defined over $\{\$, \&, \#\}^*$ subject to the following constraints. 1. Before a '$' symbol at least one '&' symbol must be present at the front end of the queue. 2. After the '$' symbol at most three '#' symbols can be placed.	5

3. However, the queue's rear end must end with '$' symbols such that the number of occurrences of '$' symbol must be multiples of three.

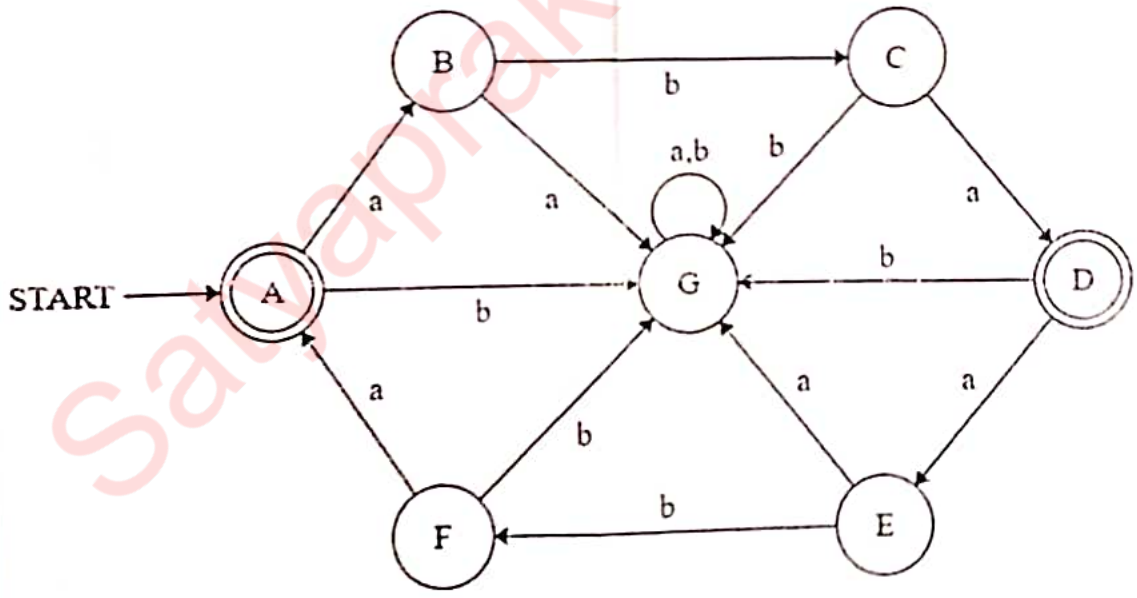
b Construct a Non Deterministic Finite Automata (NFA) for the given language, 5

L = { w ∈ {0,1}* | w is the set of strings with number of 0's divisible by 4 or number of 1's divisible by 5}.

4. Consider the following ε-NFA transition table. Compute the ε-closure of each state and find its equivalent deterministic finite automata (DFA). 10

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

5. Consider the DFA in the following figure where A is the initial state. A and D are final states. Identify the equivalent states and distinguishable states. Construct the minimum state DFA. 10



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Reg. Number:

VIT
Vellore Institute of Technology
CHENNAI

Continuous Assessment Test (CAT) – I FEB 2024

Programme	:	BTech Computer science and Engineering	Semester	:	WIN 23-24
Course Code & Course Title	:	BCSE304L THEORY OF COMPUTATION	Class Number	:	CH2023240501827 CH2023240501829 CH2023240501831 CH2023240501832
Faculty	:	Dr. SATHYARAJASEKARAN K Dr. UMITTY SRINIVASA RAO Dr. B V A N S S PRABHAKAR RAO Dr. SARAVANAN P	Slot	:	C2+TC2
Duration	:	90 MINUTES	Max. Mark		50

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.
- Use statistical tables supplied from the exam cell as necessary
- Use graph sheets supplied from the exam cell as necessary
- Only non-programmable calculator without storage is permitted

Answer all questions

<table>
<tr><th>Q. No</th><th>Sub Sec.</th><th>Description</th><th>Marks</th></tr>
<tr><td>1.</td><td></td><td>Construct a non-deterministic finite automaton without null moves for the following language,
a) L= {w | w ∑ {0,1}*, which accepts string 1001 or 0110 substring}. (5 marks)
b) L= {w | w ∑ {0,1}*, which rejects string 10001}. (5 marks)</td><td>10</td></tr>
<tr><td>2.</td><td></td><td>Construct the minimized DFA for the following finite automata.
<table>
<tr><th>State</th><th>0</th><th>1</th><th>2</th></tr>
<tr><td>→A</td><td>A</td><td>B</td><td>B</td></tr>
<tr><td>B</td><td>C</td><td>C</td><td>D</td></tr>
<tr><td>C</td><td>A</td><td>B</td><td>E</td></tr>
<tr><td>D*</td><td>D</td><td>E</td><td>E</td></tr>
<tr><td>E*</td><td>C</td><td>D</td><td>B</td></tr>
<tr><td>F</td><td>F</td><td>D</td><td>E</td></tr>
</table></td><td>10</td></tr>
<tr><td>3.</td><td></td><td>Construct an equivalent finite automaton for the expression given below.
a. (ab*) (ba*) | (a | b) (5 marks)
b. (a | b)* (a^+ b^+) (5 marks)</td><td>10</td></tr>
<tr><td>4.</td><td></td><td>Construct a non-deterministic finite automaton without null moves for the ε-non-deterministic automaton given in Figure 1.</td><td>10</td></tr>
</table>

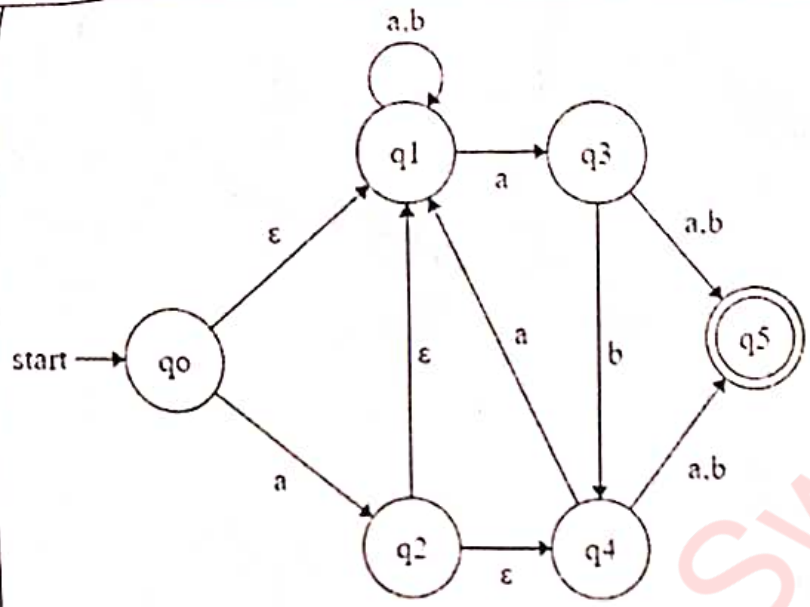


Figure 1.

5. Construct an equivalent deterministic finite automaton for the non-deterministic automaton given in Figure 2. 10

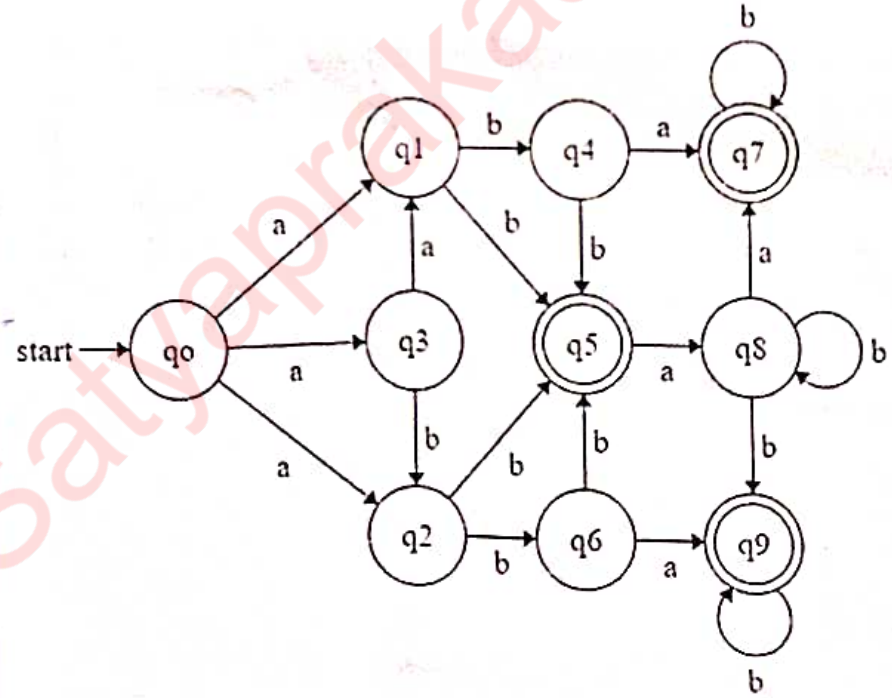


Figure 2.

**********All the best **********

Reg. Number: 22BLC1193

VIT
Vellore Institute of Technology
CHENNAI

Continuous Assessment Test (CAT) - 1 - FEB 2024

Programme	:	B. Tech	Semester	:	WINTER 2023-2024
Course Code & Course Title	:	BCSE304L & Theory of Computation	Class Number	:	CH2023240502[illegible]47 CH2023240502[illegible]48 CH2023240502[illegible]45
Faculty	:	Dr. P. Saravanan Dr. Padma J Dr. Senthil Prakash P N	Slot	:	D2+TD2
Duration	:	90 Mins	Max. Mark	:	50

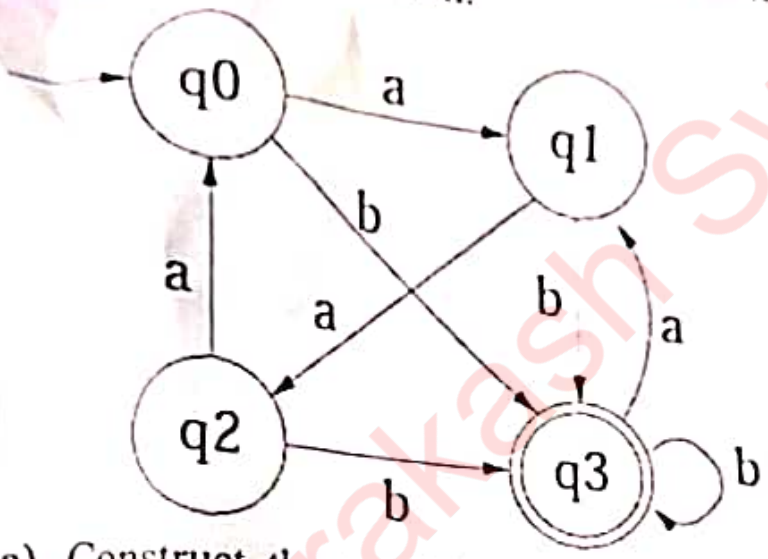
General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.
- Only non-programmable calculator without storage is permitted

Answer all questions

Q. No	Sub Sec	Description	Marks
1.	a)	Prove that $1+2+ \ldots+n=(n(n+1))/2$ for all $n \geq 0$ using inductive proof. **[5 marks]**	10
	b)	Design a DFA for accepting set of all binary strings where the second last symbol will never be a 0. **[5 marks]**	
2.		Consider a software engineer designing a Flight Reservation System for an airline. The system needs to recognize valid flight reservation codes based on the following rules: • A valid reservation code starts with the letter 'F' followed by a series of digits. • The second character can be any digit from 0 to 9. • The third character can be either 'A' or 'B'. • The remaining characters can be any combination of letters (both uppercase and lowercase) and digits. To model the validation process, the engineer decides to use a Non-deterministic Finite Automaton (NFA). Help him by, a) Design the NFA as per the requirement with state names as q0, q1, and so on. Where q0 is the initial state. Also, construct the NFA Transition Table. **[7 Marks]** b) Convert the NFA into an equivalent Deterministic Finite Automaton (DFA) for the Flight Reservation System. Clearly define the states, provide the transition table, identify the initial state, and indicate the set of accepting states in the DFA. **[8 Marks]**	15
3.		Consider an Auto Teller Machine processing, which has different states of the system before delivering the cash.	15

The ATM machine designer has identified Q ={q0, q1, ...q3} and [illegible] with input {a,b}. As per the transitions, he constructed the following DFA. In the implementation phase, each state logic has been converted into a piece of code. He needs to reduce the number of lines in the program. He decided to reduce the number of states in the DFA to reduce the number of lines. Help him in this regard to reduce the number of states by following the appropriate algorithm.



a) Construct the transition table for the given DFA. [4 Marks]

b) Apply the minimization algorithm, describe each step in the minimization, and construct the minimized DFA. [11 Marks]

4. Consider the following regular expression which generates a language L with the alphabet = {0,1}.

$$0 + (0+11)0^*1$$

Convert the above regular expression into its equivalent epsilon-NFA.

********** All the best **********

VIT
Vellore Institute of Technology
CHENNAI

Reg. Number: 22BCE5074

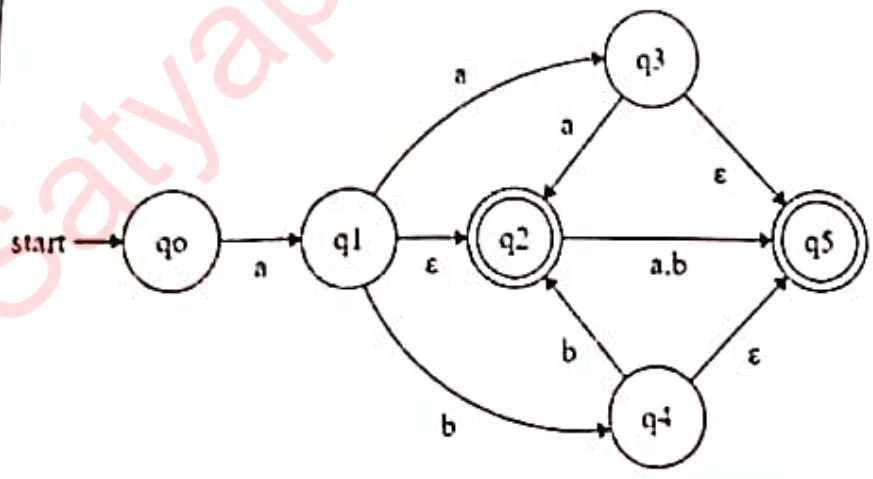
Continuous Assessment Test (CAT) – 1 FEB 2024

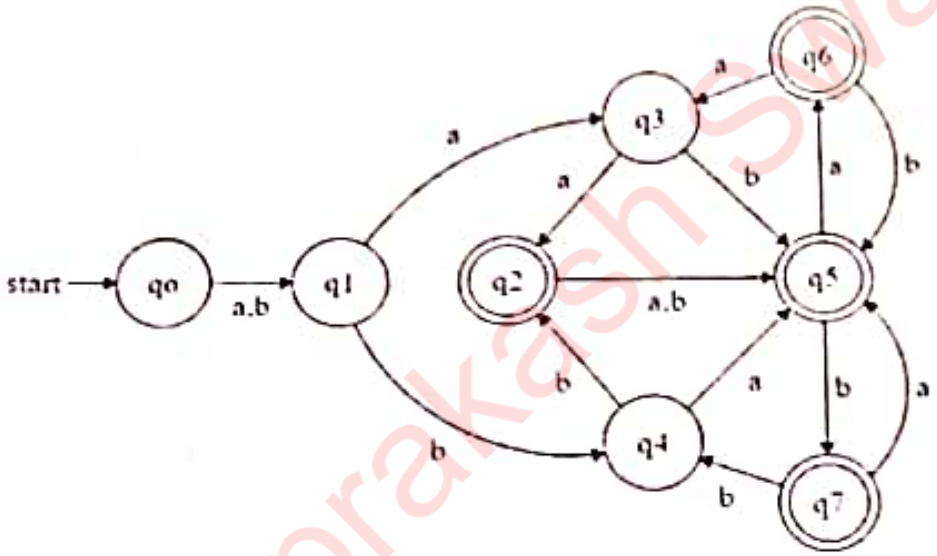
Programme	:	BTech Computer Science and Engineering	Semester	:	WIN 23-24
Course Code & Course Title	:	BCSE304L THEORY OF COMPUTATION	Class Number	:	CH2023240501826 CH2023240501828 CH2023240501830 CH2023240503350
Faculty	:	Dr. SATHYARAJASEKARAN K Dr. UMITTY SRINIVASA RAO Dr. B V A N S S PRABHAKAR RAO Dr. KAVITHA J C	Slot	:	C1+TC1
Duration	:	90 MINUTES	Max. Mark		50

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.
- Use statistical tables supplied from the exam cell as necessary
- Use graph sheets supplied from the exam cell as necessary
- Only non-programmable calculator without storage is permitted

Answer all questions

Q. No	Sub Sec.	Description	Marks
1.		Construct the finite automaton for the following languages, a) L1 = {w | w ∑ {0,1}*, contains strings that are multiples of 5, where the numbers are in binary form}. (5 Marks) b) L2 = {w | w ∑ {0,1}*, contains the strings that starts with two consecutive 0's and end with three consecutive 1's}. (5 Marks)	10
2.		Convert the given ε -NFA into NFA without ε moves. 	10
3.		Construct the deterministic finite automaton for the following languages, a) L1 = {w | w ∑ {a,b}*, where w does not accept the substring aabb}. (5 Marks)	10

		b) L2 = {w | w $\sum$ {a,b}*, where w accepts strings which end with baa}. (5 Marks)	
8		For the following expression construct a DFA through ε -NFA, ((ab)*|(ba)*) (aba)+	10
9		Construct a minimized deterministic finite automaton for the automation given below. 	10

**********All the best **********

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CHENNAI

Reg. Number:	22BAI1226

Continuous Assessment Test(CAT) – I - FEB 2024

Programme	:	B.Tech. (CSE Specialization in BAI, BRS and BPS)	Semester	:	Winter 23-24
Course Code & Course Title	:	BCSE304L & Theory of Computation	Class Number	:	CH2023240503052 CH2023240503056 CH2023240503054 CH2023240503175
Faculty	:	Dr.A.MENAKA PUSHPA, Dr.S. DEEPA NIVETHIKA, Dr. R. RENUKA DEVI, Prof. B. NATARAJAN	Slot	:	F1+TF1
Duration	:	90 Minutes	Max. Mark		50

General Instructions:

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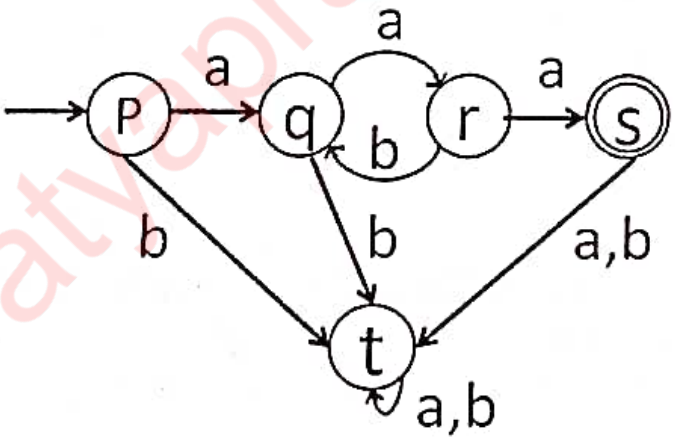
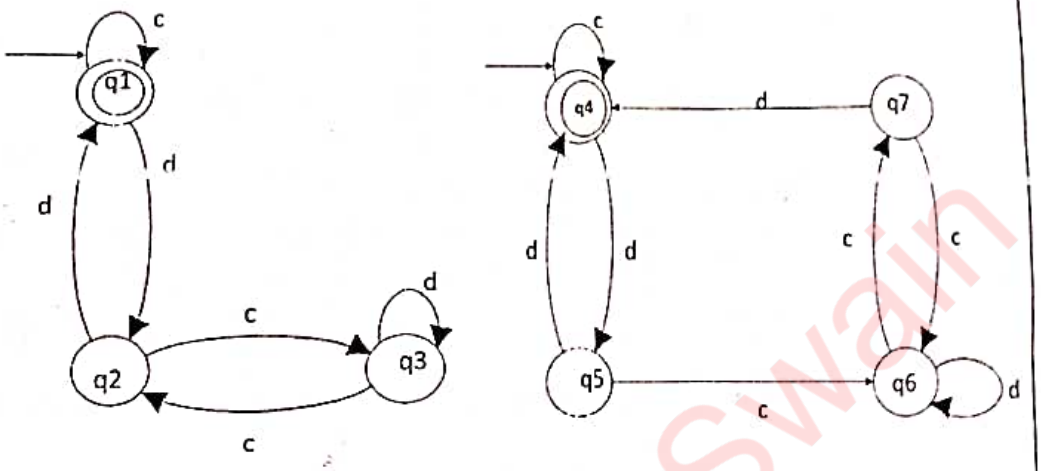
- Only non-programmable calculator without storage is permitted

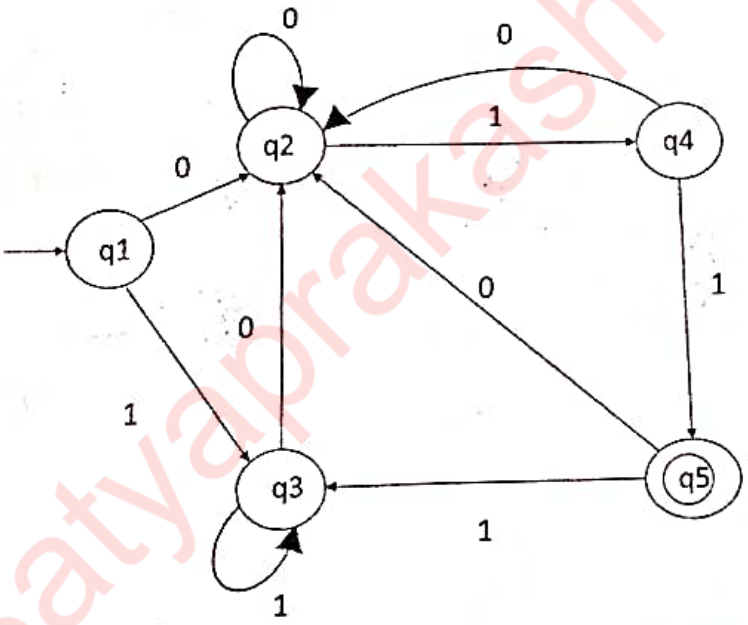
Answer all questions

Q. No	Sub Sec.	Description	Marks
1	(a)	Anitha and Rishi are creating a music album. The strings used in the music language are formed in such a way that the words start and end with the same letter on the inputs {a,b,c}. Create an FA with a 5-tuple structure.	5
	(b)	Appraise about the statement for all $n \geq 0$, $\sum i^2$ using inductive proof, where i ranges from 1 to n	5
2.	(a)	List out the valid strings for the language accepted by the automata 	4
	(b)	The house of Mr.X has a unique door security system. Mr. X and his family create a password by the following rules: i It consists of the symbols {0,1} ii The third number from the right end should be 1. Give the proper FSA structure for this password format and convert it to the corresponding DFA.	6
3.	(a)	Design an NFA for the following finite languages over the alphabet {a,b}. (i) L={ε} (ii) L= {aa, ab} (iii) L= {aba, abb, aaa}	6

	(b)	(i) Design an ε-NFA for the language which consists of strings with all a's followed by all b's. (ii) Design an ε-NFA for the language b^+	4
4.	(a)	Check whether the following two finite automata are equivalent or not.	4



	(b)	Construct the Minimization of the following DFA.	6



5		Consider the following Finite Automata and compute the equivalent regular expression using $\mathbf{R}_{ij}^{k}$ Method.	10

States/Input	0	1
→q_1	{q_2}	{q_3}
q_2	{q_1}	{q_3}
* q_3	{q_2}	{q_1}

**********All the best **********

Reg. Number:	22BCE1251

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CHENNAI

Continuous Assessment Test (CAT) – I - FEB 2024

Programme	:	B.Tech. (CSE Specialization in BAI, BRS and BPS)	Semester	:	Winter 23-24
Course Code & Course Title	:	BCSE304L & Theory of Computation	Class Number	:	CH2023240503053 CH2023240503057 CH2023240503055 CH2023240503349
Faculty	:	Dr.A.MENAKA PUSHPA, Dr.S. DEEPA NIVETHIKA, Dr. R. RENUKA DEVI, Prof. B. NATARAJAN	Slot	:	F2+TF2
Duration	:	90 Minutes	Max. Mark		50

General Instructions:

- Write only your registration number on the question paper in the box provided and do not write other information.
- Only non-programmable calculator without storage is permitted

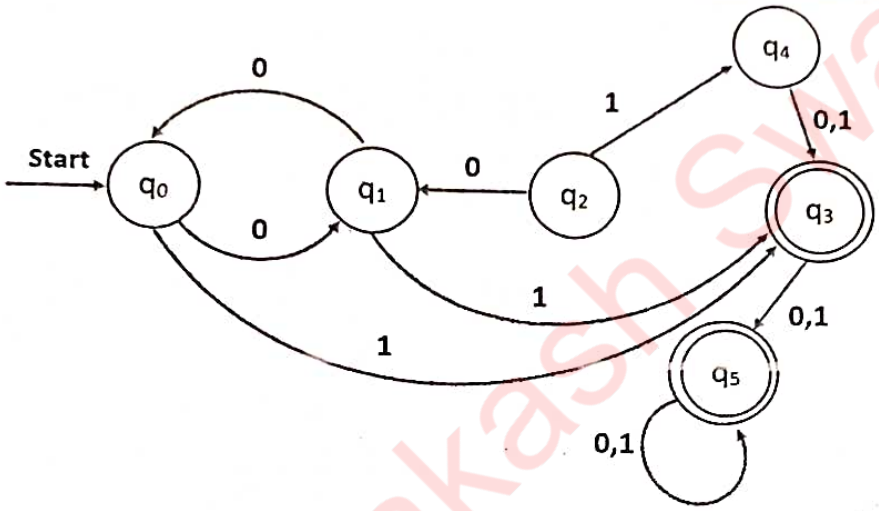
Answer all questions

Q. No	Sub Sec.	Description	Marks
1	(a)	Form a regular expression and design an automata for language $L = \{L: \|W\| Mod\ 5 \neq 0\}$ over the inputs {x,y}	5
	(b)	Ram has been assigned the task of designing a finite automata model to check the length of strings divisible by 3 with the input symbol being 0. Assist him by exploring the first ten valid strings accepted by the automaton.	5
2		Consider the following transition table of ε-NFA shown below with (Q, Σ, δ, q0, F).	10

δ	ε	A	b	C
→p	{q,r}	Φ	{q}	{r}
q	Φ	{p}	{r}	{p,q}
*r	Φ	Φ	Φ	Φ

Use the design and transition table to convert this ε-NFA transition table into a DFA.

3	(a)	Draw the deterministic finite automata model for a vacuum cleaner with a formal definition using 5 tuples. Validate the finite model with the accepted and rejected (error) sequence of actions.	5
	(b)	Design a finite automata model to recognize the regular expression $(01+1)^*11$	5
4		Minimize the states in the DFA M = (Q, Σ, δ, q_0, F) given in the following diagram.	10



	(a)	Construct the Regular Expression for the Language (L) over the $\sum = \{0,1\}$, such that all the strings do not contain the substring 01. RE	3
5	(b)	Design the Regular Expression for the Language (L) accepting all the strings which are starting with 1 and ending with 0, over the input symbols $\sum = \{0,1\}$. RE	2
	4(c)	Construct the Ɛ-NFA for the Regular Expression (0 + 1) * (00 + 11)* (0 + 1)* ε-NFA	5

**********All the best **********