

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY,
LONERE – RAIGAD -402 103
Semester Winter Examination – December - 2019

Branch: B.Tech Computer Science
Subject:- Theory of Computation (BTCOC502)
Date:- 11/12/2019

Sem.:- V
Marks: 60
Time:- 3 Hr.

Instructions to the Students

1. Each question carries 12 marks.
2. Attempt **any five** questions of the following.
3. Illustrate your answers with neat sketches, diagram etc., wherever necessary.
4. If some part or parameter is noticed to be missing, you may appropriately assume it and should mention it clearly

Q.1. a) What is FA(Finite Automaton)? Explain with example. Elaborate on 'Automaton and complexity'. (06)

Q1. b) Convert following regular expression to their equivalent FA. (06)

- i) ba^*b
- ii) $(a+b)c$
- iii) $a(bc)$

Q.2. a) Let G be the grammar :

- i. $S \rightarrow 0B \mid 1A$
- ii. $A \rightarrow 0 \mid 0S \mid 1AA$
- iii. $B \rightarrow 1 \mid 1S \mid 0BB$

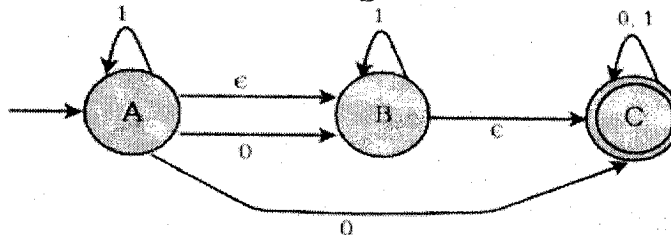
For the string 00110101 and 11001010 find:

- 1) Left most derivation
- 2) Right most derivation

(06)

Q.2. b) Explain Pumping Lemma and its applications. (06)

Q.3. a) Construct DFA for following NFA



(06)

Q.3. b) Discuss the Chomsky Hierarchy of languages by taking suitable example of each classification. (06)

Q.4 a) Convert the given Grammar into Chomsky Normal Form (CNF)

$$S \rightarrow ASB$$

$$A \rightarrow aAS \mid a \mid \varepsilon$$

$$B \rightarrow SbS \mid A \mid bb$$

(06)

Q.4. b) Explain:

1) Recursively Enumerable Language

2) Greibach Normal Form

(06)

Q.5. a) Explain Turing Machine in details along with halting problem. Also state its applications. (06)

Q.5. b) Construct a PDA for language $L = \{wcw^R \mid w = \{0, 1\}^*\}$ where w^R is the reverse of w . (06)

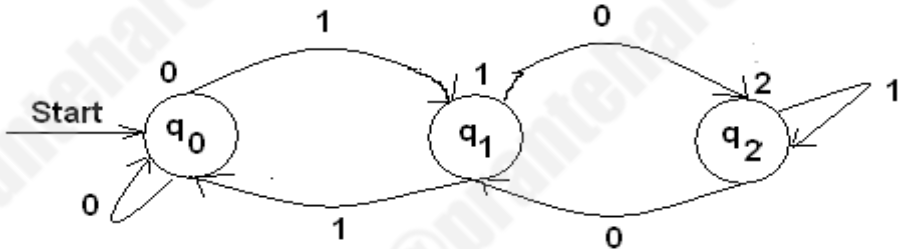
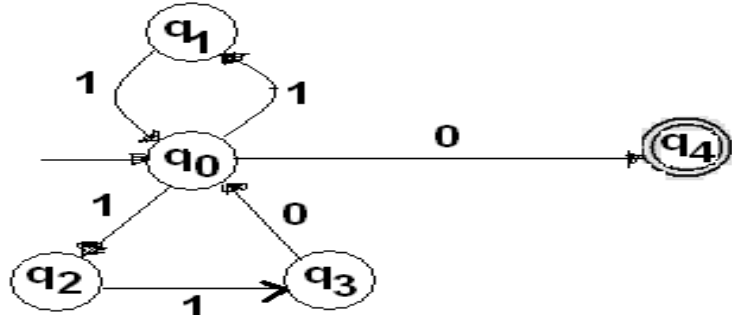
Q.6. a) Explain Random access Turing Machines and Non deterministic Turing Machines. (06)

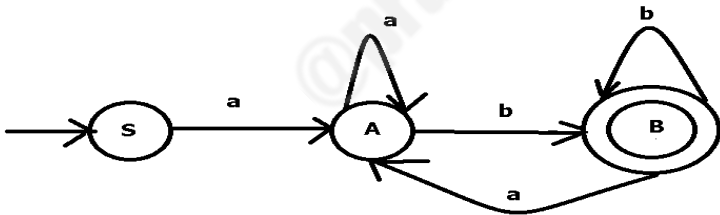
Q.6. b) Define Mealy machine and Moore machine and Convert following Mealy machine into Moore machine.

State	Input	
	a	b
Q_0	$Q_{2,1}$	$Q_{3,0}$
Q_1	$Q_{0,0}$	$Q_{1,1}$
Q_2	$Q_{1,1}$	$Q_{2,0}$
Q_3	$Q_{2,0}$	$Q_{0,1}$

(06)

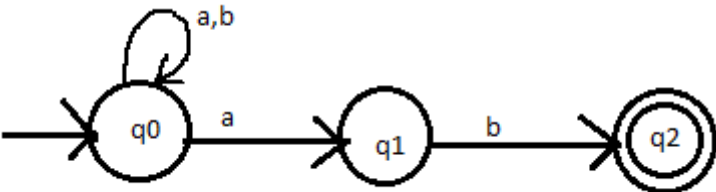
Paper End

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE Supplementary Examination – Summer 2022 Course: B. Tech. Branch : CSE Semester :5th Subject Code & Name: BTCOC502: Theory of Computations Max Marks: 60 Date: Duration: 3 Hr.			
Instructions to the Students: 1. All the questions are compulsory. 2. The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in () in front of the question. 3. Use of non-programmable scientific calculators is allowed. 4. Assume suitable data wherever necessary and mention it clearly.			
		(Level/CO)	Marks
Q. 1	Solve Any Two of the following.		2*6= 12M
A)	Find DFA that accepts only the language of all strings with b as the second letter over the alphabet $\Sigma=\{a,b\}$.		6M
B)	Construct a Mealy machine of the following Moore machine 		6M
C)	Construct the DFA for the following NFA 		6M
Q.2	Solve Any Two of the following.		2*6= 12M
A)	Explain Chomsky classification of grammars		6M
B)	Consider the grammar given as $G = (\{S,A\}, \{a,b\}, P, S)$ Where production P consists of ,		6M

	$S \rightarrow aAS \mid a$ $A \rightarrow SbA \mid SS \mid ba$ Find a) Leftmost derivation b) Rightmost derivation c) Parse tree for the string " aabbaa ".		
C)	Find a reduced grammar G to the grammar given below $S \rightarrow AB \mid CA$ $A \rightarrow a$ $B \rightarrow BC \mid AB$ $C \rightarrow aB \mid b$		6M
Q. 3	Solve Any One of the following.		2*6= 12M
A)	Convert the following CFG to CNF: $S \rightarrow aSa \mid bSb \mid a \mid b \mid aa \mid bb$		6M
B)	Obtain RLG from the given Finite Automata 		6M
C)	For the grammar given find L(G) $S \rightarrow a \mid Sa \mid b \mid bS$.		6M
Q.4	Solve Any Two of the following.		2*6= 12M
A)	Construct a PDA accepting $L = \{ a^n b^m a^n \mid m, n \geq 1 \}$ by a null stack. Is it deterministic?		6M
B)	Construct a PDA equivalent to the following context free grammar $S \rightarrow aAA$ $A \rightarrow aS \mid bS \mid a$		6M

C)	<p>Let $M = (\{ q_0, q_1 \}, \{ 0, 1 \}, \{ X, Z_0 \}, \delta, q_0, Z_0, \Phi)$ where δ is given by</p> $\delta(q_0, 0, Z_0) = \{ (q_0, X Z_0) \}$ $\delta(q_0, 0, X) = \{ (q_0, X X) \}$ $\delta(q_0, 1, X) = \{ (q_1, \varepsilon) \}$ $\delta(q_1, 1, X) = \{ (q_1, \varepsilon) \}$ $\delta(q_1, \varepsilon, X) = \{ (q_1, \varepsilon) \}$ $\delta(q_1, \varepsilon, Z_0) = \{ (q_1, \varepsilon) \}$ <p>Construct a CFG</p>		6M
Q. 5	Solve Any One of the following.		2*6= 12M
A)	Obtain a Turing machine to accept the language $L = \{ 0^n 1^n 2^n \mid n \geq 1 \}$.		6M
B)	Design a TM to find one's complement of the binary number.		6M
C)	<p>Explain the following</p> <ol style="list-style-type: none"> 1) Turing Machine with stay-option 2) Multiple Tapes Turing Machine 		6M
	*** End ***		

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DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE Supplementary Summer Examination – 2023 Course: B. Tech. Branch :Computer Engineering Semester :V Subject Code & Name: Theory Of Computation (BTCOC502) Max Marks: 60 Date:09/08/2023 Duration: 3 Hr.			
Instructions to the Students: 1. All the questions are compulsory. 2. The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in () in front of the question. 3. Use of non-programmable scientific calculators is allowed. 4. Assume suitable data wherever necessary and mention it clearly.			
		(Level/CO)	Marks
Q. 1	Solve Any Two of the following.		12
A)	Construct a Deterministic Finite Automaton for the set of string over {a, b} such that length of the string $ w =2$.	Design	6
B)	State and explain applications of Regular Expressions.	Understand	6
C)	Design an NFA with $\Sigma = \{0, 1\}$ accepts all string ending with 01.	Design	6
Q.2	Solve Any Two of the following.		12
A)	Distinguish between Moore machine and Mealy machine .	Analyze	6
B)	Write a regular expression over alphabet $\Sigma = \{0, 1\}$ for following . (i) begins with 1, ends with 1 (ii) ends with 00 (iii) contains at least three consecutive 1s	Create	6
C)	Convert the following Non Deterministic Automaton into Deterministic Finite Automaton . 	Apply	6
Q. 3	Solve Any Two of the following.		12
A)	Write the steps for grammar reduction. Eliminate Unit Productions from the following grammar. $S \rightarrow Aa B c$ $B \rightarrow A bb$ $A \rightarrow a bc B$	Apply	6

B)	Explain Chomsky classification of grammar.	Remember	6
C)	When does context free grammar is said to be in Chomsky Normal Form(CNF)? Write steps to convert context free grammar into CNF.	Understand	6
Q.4	Solve Any Two of the following.		12
A)	Write the productions rule of Context free grammar for following regular expressions. (i) 0^* (ii) $(a+b)^*$ (iii) $(ab)^*$	Design	6
B)	What are the different components of Pushdown Automaton? Explain with neat diagram.	Remember	6
C)	Distinguish between Deterministic and Non Deterministic PDA.	Analyze	6
Q. 5	Solve Any Two of the following.		12
A)	Design Turing machine that accepts the language of all strings over alphabet $\Sigma = \{a, b\}$ whose second letter is b.	Design	6
B)	Explain the following (i)Multihead Turing machine (ii)Universal Turing machine (iii) Non Deterministic Turing machine	Understand	6
C)	What is Church Turing Thesis ? Explain.	Remember	6
	*** End ***		

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Instructions to the Students:

1. All the questions are compulsory.
2. The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in () in front of the question.
3. Use of non-programmable scientific calculators is allowed.
4. Assume suitable data wherever necessary and mention it clearly.

		(Level/CO)	Marks																				
Q. 1 Solve Any Two of the following.			12																				
A) Explain in brief FSM Properties and Limitations? Write Applications of FSM?	Understand /	CO-1	6																				
B) Construct Mealy Machine for the given Moore Machine?	Apply/	CO-2	6																				
<table border="1"><thead><tr><th>Present state</th><th colspan="2">Next State</th><th>Output</th></tr><tr><td></td><th>a=0</th><th>a=1</th><td></td></tr></thead><tbody><tr><td>→q1</td><td>q1</td><td>q2</td><td>0</td></tr><tr><td>q2</td><td>q1</td><td>q3</td><td>0</td></tr><tr><td>q3</td><td>q1</td><td>q3</td><td>1</td></tr></tbody></table>				Present state	Next State		Output		a=0	a=1		→q1	q1	q2	0	q2	q1	q3	0	q3	q1	q3	1
Present state	Next State		Output																				
	a=0	a=1																					
→q1	q1	q2	0																				
q2	q1	q3	0																				
q3	q1	q3	1																				
C) Design a FSM to check whether a given decimal number is divisible by 5?	Understand/	CO-1	6																				
Q.2 Solve Any Two of the following.			12																				
A) Explain in brief Chomsky hierarchy with suitable examples?	Understand /	CO-2	6																				
B) Eliminate NULL production from the grammar G given below: a. $S \rightarrow a / Xb / aYa$ b. $X \rightarrow Y / \wedge$ c. $Y \rightarrow b / X$	Apply /	CO-3	6																				
Write the productions after elimination.																							
C) Check whether the given grammar is ambiguous or not- a. $S \rightarrow a / abSb / aAb$ b. $A \rightarrow bS / aAAb$	Analyse /	CO-3	6																				

Q. 3 Solve Any Two of the following. 12

A) Consider a left linear grammar as given below – Apply / CO-3 6

a. $S \rightarrow Sa|Abc$

b. $A \rightarrow Sa|Ab|a$

Convert left linear grammar to right linear grammar.

B) Convert the given to context free grammar to CNF forms Apply / CO-3 6

a. $S \rightarrow ASB$

b. $A \rightarrow aAS|a|\epsilon$

c. $B \rightarrow SbS|A|bb$

C) Derive a derivation tree for the string aabbabba for the given context free grammar (CFG) – Analyse / 6
CO-3

a. $S \rightarrow aB|bA$

b. $A \rightarrow a|aS|bAA$

c. $B \rightarrow b|bS|aBB$

Q.4 Solve Any Two of the following. 12

A) Define a PDA & list three important properties of a PDA Machine? Understand / 6
CO-2

B) Construct a PDA to check well formedness of parenthesis? Create / CO-3 6

C) Convert the following grammar to a PDA that accepts the same language. Apply / CO-3 6

a. $S \rightarrow 0S1|A$

b. $A \rightarrow 1A0|S|\epsilon$

Q. 5 Solve Any Two of the following. 12

A) Design a TM for an equal number of a's and b's must follow a. Create / CO-3 6

B) Design a TM which recognizes palindromes over $= \{a, b\}$ Create / CO-3 6

C) Explain 'Halting Problem of turning machine' with neat diagrams? Understand / 6
CO-4

*** End ***

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Regular & Supplementary Winter 23

Course: B. Tech. Branch : Computer Science & Design

Semester : V

Subject Code & Name: BTCSD501 - Theory of Computation

Max Marks: 60

Date: 01/01/2024

Duration: 3 Hr.

Instructions to the Students:

1. All the questions are compulsory.
2. The level of question expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in () in front of the question.
3. Use of non-programmable scientific calculators is allowed.
4. Assume suitable data wherever necessary and mention it clearly.

(Level/CO) Marks

Q.1 Solve Any Two of the following.

12

A) Explain the following with a suitable example

- (i) Deterministic Finite Automata (DFA)
- (ii) Non - deterministic Finite Automata (NFA)

Understanding

6

B) Construct a Deterministic Finite Automata (DFA) equivalent to NFA $M = (\{p, q, r, s\}, \{0, 1\}, \delta, p, \{q, s\})$ where δ is defined by following table

Apply

6

States \ Σ	0	1
p	q, s	q
q	r	q, r
r	s	p
s	-	p

C) Construct a Mealy machine equivalent to the Moore machine defined in the table below.

Apply

present State	State		o/p
	a=0	a=1	
$\rightarrow q_0$	q_2	q_1	0
q_1	q_1	q_2	1
q_2	q_2	q_3	1
q_3	q_3	q_0	1

Q.2 Solve Any Two of the following.

12

A) Write and explain applications of regular expression.

Understanding

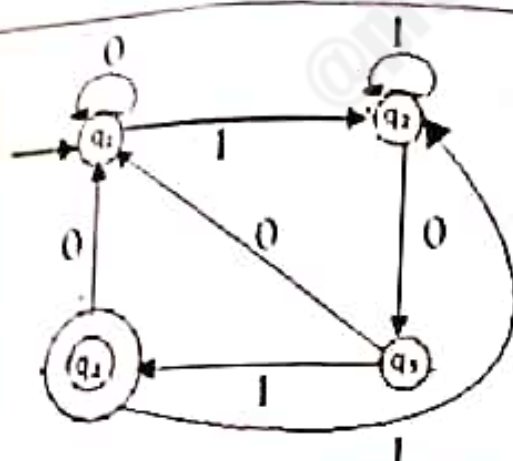
6

B) Write regular expression for the following finite automata using Arden's theorem.

Apply

6

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3	(C) Prove that $L = \{a^l b^{2l} l \geq 1\}$ is not regular using pumping lemma.	Analyze	6
	Q.3 Solve Any Two of the following.		12
3	A) Consider the following productions: $S \rightarrow aD bC$ $C \rightarrow aS bCC a$ $D \rightarrow bS aDD b$ For the string $a a a b b a b b b a$, find a) Leftmost derivation b) Rightmost derivation c) Parse tree or Derivation tree	Apply	6
2	(B) Convert the following grammar into CNF: $E \rightarrow E+T T$ $T \rightarrow T * F F$ $F \rightarrow (E) a$	Apply	6
2	C) Eliminate null productions from the following grammar: $S \rightarrow A a b a a B$ $A \rightarrow \epsilon$ $B \rightarrow b b A \epsilon$	Apply	6
	Q.4 Solve Any Two of the following.		12
6	A) Design Pushdown Automata for the language L $L = \{a^n b^m b^n m, n \geq 1 \text{ by empty stack}\}$	Analyze	6
6	B) Define PDA using tuples. Construct a PDA that accepts the language generated by the grammar $S \rightarrow aSbh abh$	Apply	6
1	C) Explain in detail the Linear Bounded Automata	Understand	6
	Q.5 Solve Any Two of the following.		
	A) Design Turing Machine to accept the language $L = \{w c w^t w \in \{a, b\}^*\}$	Apply	6

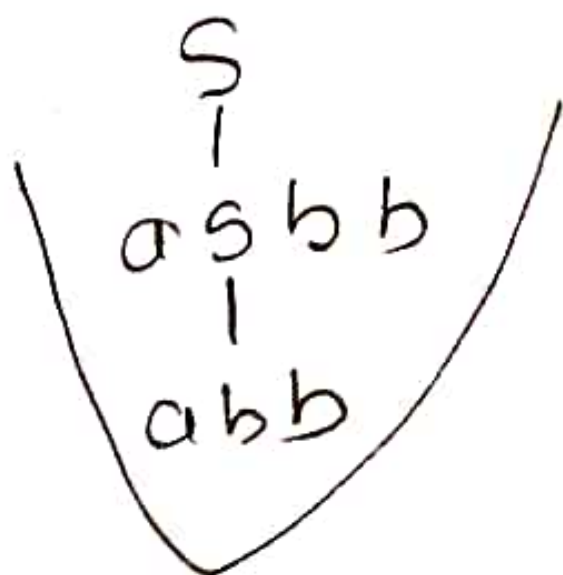
$a a b b b a$

a
 b

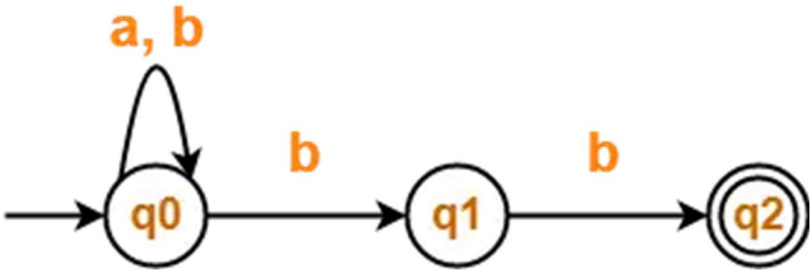
$a^2 a$

BT	Explain Church-Turing Thesis	Understand	6
CT	Explain in brief Universal Turing Machine.	Understand	6
ET		Understanding	
	*** End ***		

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DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE Regular/Supplementary Winter Examination – 2023 Course: B. Tech. Branch : Computer and Allied Semester :V Subject Code & Name: Theory Of Computation (BTCOC502) Max Marks: 60 Date:03/01/2024 Duration: 3 Hrs.			
Instructions to the Students: 1. All the questions are compulsory. 2. The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in () in front of the question. 3. Use of non-programmable scientific calculators is allowed. 4. Assume suitable data wherever necessary and mention it clearly.			
		(Level/CO)	Marks
Q. 1	Solve Any Two of the following.		12
A)	Find the string set for following regular expressions. (i) 00^* (ii) a^*b^* (iii) $(0+1)^*$	Create	6
B)	What are the elements of Deterministic Finite Automaton? How it is represented?	Remember	6
C)	Design Non Deterministic Finite Automaton that accepts set of all strings over $\{0,1\}$ that start with 0 or 1 and end with 01 or 10.	Design	6
Q.2	Solve Any Two of the following.		12
A)	Distinguish between Mealy machine and Moore machine.	Remember	6
B)	Apply subset construction algorithm to convert following Non Deterministic Finite Automaton to Deterministic Finite Automaton 	Apply	6
C)	Consider the following production rules. $S \rightarrow aAB$ $A \rightarrow bBb$ $B \rightarrow A \epsilon$ Obtain leftmost and rightmost derivation for string “abbbb”	Apply	6

Q. 3	Solve Any Two of the following.		12
A)	Show that the given grammar is ambiguous grammar. $E \rightarrow E+E$ $E \rightarrow E * E$ $E \rightarrow a$	Apply	6
B)	Explain Chomsky classification of grammar.	Remember	6
C)	Find Context Free Grammar without ϵ- productions equivalent to the following grammar . $S \rightarrow ABaC$ $A \rightarrow BC$ $B \rightarrow b \mid \epsilon$ $C \rightarrow D \mid \epsilon$ $D \rightarrow d$	Apply	6
Q.4	Solve Any Two of the following.		12
A)	Reduce the following grammar to Chomsky Normal Form(CNF). $S \rightarrow aAD$ $A \rightarrow aB \mid bAB$ $B \rightarrow b$ $D \rightarrow d$	Apply	6
B)	Design Push down Automata (PDA) to accept language $L=(a,b)^*$ where $n_a = n_b$.	Design	6
C)	Distinguish between Deterministic and Non Deterministic PDA.	Remember	6
Q. 5	Solve Any Two of the following.		12
A)	What are the different components of Turing machine?	Remember	6
B)	What is halt state of Turing machine? Explain Church Turing thesis.	Understand	6
C)	Design Turing machine that erases all non-blank symbols from its tape .	Design	6
	*** End ***		

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE Supplementary Examination Summer 2024 Course: B. Tech. Semester :V Branch : Computer Engineering/ Computer Science And Engineering Subject Code & Name: Theory of Computation (BTCOC502) Max Marks: 60 Date: 03/07/2024 Duration: 3 Hrs.			
Instructions to the Students: 1. All the questions are compulsory. 2. The level of question/expected answer as per OBE or the Course Outcome (CO) on which the question is based is mentioned in () in front of the question. 3. Use of non-programmable scientific calculators is allowed. 4. Assume suitable data wherever necessary and mention it clearly.			
		(Level/CO)	Marks
Q. 1	Solve Any Two of the following.		
A)	Design Non deterministic Finite Automaton to accept all strings over alphabet {a, b} ending with abab.	Design	6
B)	Distinguish between Moore machine and Mealy machine.	Analyze	6
C)	Construct Deterministic Finite Automaton for regular expression (a+b)*aba	Design	6
Q.2	Solve Any Two of the following.		
A)	State some applications of regular expressions.	Remember	6
B)	Distinguish between regular language and context free language.	Understand	6
C)	Design context free grammar for following language $(ab)^n$ where $n \geq 1$ and $a^n b^n$ where $n \geq 0$.	Design	6
Q. 3	Solve Any Two of the following.		
A)	State some applications of Context Free Grammar.	Understand	6
B)	Explain the following. (i) Type 0 grammar (ii) Type 1 grammar (iii) Type 2 grammar (iv) Type 3 grammar	Remember	6
C)	Find the reduced grammar equivalent to the following grammar where productions are : $S \rightarrow AC \mid SB$ 	Apply	6

	$A \rightarrow bASC \mid a$ $B \rightarrow aSB \mid bbc$ $C \rightarrow BC \mid ad$		
Q.4	Solve Any Two of the following.		
A)	What is Push Down Automaton (PDA)? Explain different components of PDA.	Remember	6
B)	Design PDA to accept language $L = (ab)^*$ where $n_a = n_b$.	Design	6
C)	Construct PDA for following grammar. $S \rightarrow aAA$ $A \rightarrow aS \mid bS \mid a$	Apply	6
Q. 5	Solve Any Two of the following.		
A)	Explain how Turing machine is represented using transition diagram and transition table.	Understand	6
B)	Explain concept infinite loop in Turing machine with the help of an example.	Analyze	6
C)	Design Turing machine that recognizes the language L of all strings over $\{a, b\}$ with number of a's equal to number of b's.	Design	6
	*** End ***		