Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2021

Subject Code:3151605 Date:09/09/2021

Subject Name:Formal Language and Automata Theory

Time:10:30 AM TO 01:00 PM Total Marks: 70

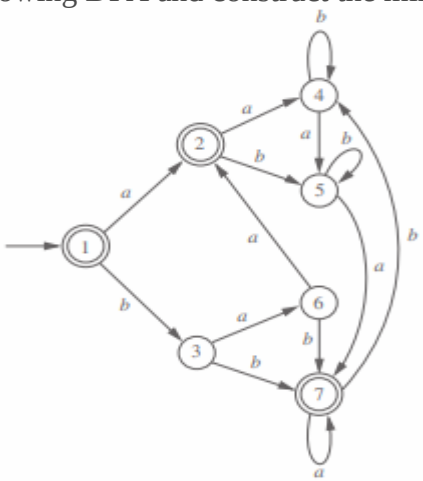
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	What do you mean by formal languages? Describe.	**03**
	(b)	State whether the following statement(s) is/are True or False. Justify your answer. i. L = { i ! | i>=0} is a regular language. ii. L = {$a^i b^j c^j$ | i=j } is a Context Free Language.	**04**
	(c)	Define DFA and construct DFA for the following languages: Σ = *{a,b}* L1 = {Last two symbols of the string are same} L2 = {Every *a* is followed by at least two *b*s}	**07**
Q.2	**(a)**	What is regular expression? Write regular expression for the language which contains at least one occurrence of every symbol. Σ = *{a,b,c}*	**03**
	(b)	Define Extended transition function for NFA and find δ^*(1,abb) for the following transition table of NFA-^.	**04**

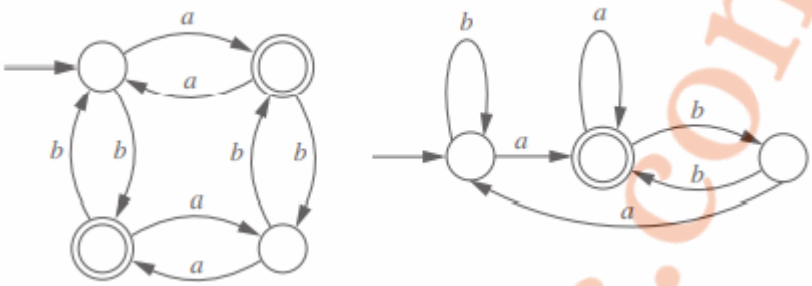
q	δ(q, a)	δ(q, b)	δ(q,Λ)
1	Ø	Ø	{2}
2	{3}	Ø	{5}
3	Ø	{4}	Ø
4	{4}	Ø	{1}
5	Ø	{6, 7}	Ø
6	{5}	Ø	Ø
7	Ø	Ø	{1}

(c) Minimize the following DFA and construct the minimized DFA. **07**



OR

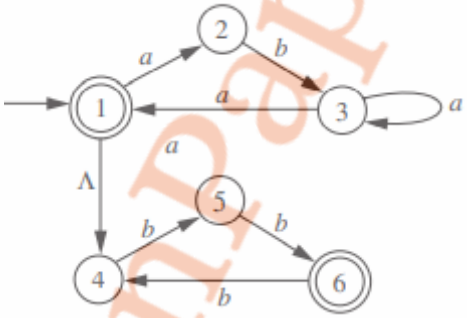
(c) Consider the DFAs for languages L1 and L2 respectively and construct DFA for L1 U L2 and L1 ∩ L2. **07**



Q.3 **(a)** Context free languages are not closed under intersection operation. Explain this statement with example. **03**

(b) What is pumping lemma. Prove the following language is not regular using pumping lemma. **04**
L = {ww | w ∈ {a,b}*}

(c) Convert the following NFA-^ into NFA and DFA. **07**



OR

Q.3 **(a)** What are reachable symbols? Explain with example. **03**

(b) Convert the following grammar into Chomsky Normal Form. **04**
G(V,Σ,S,P) = {{E,T}, {id}, {E}, {E->E+T|T, T->id|^}}

(c) Prove: "*For every alphabet , every regular language over can be accepted by a finite automaton.*" **07**

Q.4 **(a)** State whether the following sentence(s) is/are True or False. Justify your answer. **03**

i. DFA is more powerful than NFA.
ii. NPDA is more powerful than DPDA.

Note: Here, the term powerful is with respect to language acceptance.

(b) Define Context Free Grammar and write CFG for the following languages:Σ = {a,b} **04**

i. L = {$a^i b^j c^j$ | i,j>=0}
ii. L = {strings in which first, last and middle symbols are same}

(c) Define Push Down Automata and construct it for L = {$a^i b^j c^j d^i$ | i,j>=0} **07**

OR

Q.4 **(a)** Define ambiguous grammar and write unambiguous grammar of the following grammar. **03**
E->E+E | E.E | E* | (E) | id

(b) Explain Post correspondence problem with example. **04**

(c) What are the limitations of PDA as compared to Turing Machine? Construct PDA for L = {ww^r | w ∈{a,b}*} **07**

Q.5	**(a)**	Define the followings: • Primitive recursive functions • Partial functions	**03**
	(b)	Write a note on Chomsky Hierarchy.	**04**
	(c)	Define Turing Machine and construct the same for language of odd length palindrome strings.	**07**

OR

Q.5	**(a)**	Define recursive and recursively enumerable languages.	**03**
	(b)	Construct turing machine for L = $\{a^n b^n c^n \mid n>= 0\}$	**04**
	(c)	Define unrestricted grammar and Write unrestricted grammar for the following languages. L1 = $\{a^n b^n c^n \mid n>= 0\}$ L2 = $\{ww^r w \mid w \in \{a,b\}^*\}$	**07**

************************ BEST OF LUCK ************************