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- (b) Prove that language recognized by final state PDA is also recognized empty stack PDA and vice-versa. (CO4)
- (c) Construct a grammar for the language which has equal no. of a's and b's. Then convert it into PDA. (CO4)
5. (a) Write short notes on the following : (CO5)
- (i) Halting problem of TM
 - (ii) Universal TM
 - (iii) Church's thesis
- (b) Design a Turing machine which will accept the following language : (CO5)
- $$L = \{a^n b^m a^{n+m} : n > 0, m > 0\}$$
- (c) Design a TM to reverse a string over alphabet $\{a, b\}$. (CO5)

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Roll No. 2194026

TCS-402

B. TECH. (CSE)
(FOURTH SEMESTER)
END SEMESTER
EXAMINATION, June, 2023
FINITE AUTOMATA AND FORMAL
LANGUAGES

Time : Three Hours

Maximum Marks : 100

- Note :** (i) All questions are compulsory.
(ii) Answer any *two* sub-questions among (a), (b) and (c) in each main question.
(iii) Total marks in each main question are **twenty**.
(iv) Each sub-question carries 10 marks.
1. (a) Using induction show that if for some state q and some string n , $\delta^*(q, n) = q$, then for every $n > 0$, $\delta^*(q, n^n) = q$. (CO1)
- (b) (i) Design a DFA in which every 00 is followed immediately by a 1, for

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example, the strings 101, 0010, 0010011001 are in the language, but 0001 and 00100) are not in the language.

- (ii) Design a DFA for the language, containing strings in which leftmost symbol differ from rightmost symbol over alphabet $\{0, 1\}$. (CO1)
- (c) Convert the following NFA to a DFA and informally describe the language it accepts : (CO1)

P/S	N/S	
	0	1
$\rightarrow p$	$\{p, q\}$	$\{p\}$
q	$\{r\}$	$\{r\}$
r	$\{s\}$	—
s^*	$\{s\}$	$\{s\}$

2. (a) Write a short notes on the following : (CO2)
- (i) CHOMSKY classification of the language
- (ii) Kleene's theorem
- (iii) Myhill-Nerode theorem

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- (b) State Pumping Lemma for regular sets. Show that the set $L = \{0^n \mid n \text{ is a prime}\}$ is not regular. (CO2)
- (c) Design a Moore and Mealy machine for a binary input sequence such that if it has a substring 110 the machine outputs A, if it has a substring 101 machine output B, otherwise outputs C. (CO2)
3. (a) Construct a grammar in GNF which is equivalent to the grammar : (CO3)
- $$S \rightarrow AA \mid a, A \rightarrow SS \mid b$$
- (b) Find CFG for the following language : (CO3)
- (i) $L = \{a^i b^j c^k : i = j \text{ or } i = k\}$
- (ii) $L = \{a^i b^j c^k : i = j - 1 \text{ or } i \leq k\}$
- (c) Find the language generated by following grammar. Give leftmost and rightmost derivation of strings "aabbabba" : (CO3)
- $$S \rightarrow aB \mid bA$$
- $$A \rightarrow a \mid aS \mid bAA$$
- $$B \rightarrow b \mid bS \mid aBB$$
4. (a) Construct PDA for the language : (CO4)
- $$L = \{ww^R : w \in \{0, 1\}^*\}$$

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