

2021

Time: 2 Hours

Full Mark: 70

(Answer all questions and the figures in the right hand margin indicates marks)

- 1.
- a) Design DFA over $\{1, 0\}$ that accept set of all strings that, when interpreted *in reverse* as a binary integer divisible by 5. For example are 0, 10011, 1001100, and 0101. [7]
- b) Construct a NFA that accept the following languages over $\{0,1\}^*$: The set of all strings such that containing either 101 or 110 as substring. [7]

OR

- c) Construct a NFA that accept all string that 4th symbol from RHS is a over alphabets $\{a, b\}$. Give its transition table and the extended transition function for the input string "abbabab". [8]
- d) Prove that "A language L is accepted by some DFA if and only if L is accepted by some NFA". [6]
- 2.
- a) Write down the regular expression over $\{a, b\}$ for [8]
- The set of all string that contain exactly three 1's.
 - Length of string at least 3
 - String should not contain two a's come together.
 - The set of all string such that number of 0's is odd.
- b) Prove that the following is not a regular languages. [6]
 $L = \{0^n | n \text{ is power of } 2\}$.

OR

- c) Construct a minimized DFA for the RE= $101 + 0^*1(0+11)$. [8]
- d) Show that the class of RLs is closed under the following operations: [6]
- Concatenation
 - Kleene Closure

- 3.
- a) Construct a PDA to accept the language $L = \{a^n b^{2n+1} | n \geq 1\}$ by empty stack. [7]
- b) Simplify the following grammar by eliminating null productions, unit productions, and useless symbols and then convert to Chomsky normal form. [7]
 $S \rightarrow ABC \mid BaB, A \rightarrow aA \mid BaC \mid aaa, B \rightarrow bBb \mid a \mid D, C \rightarrow CA \mid AC, D \rightarrow \epsilon$

OR

- c) Design a NPDA over alphabets $\{a, b\}$ that will accept the language $L = \{a^i b^j c^k \mid i=j \text{ or } k \leq j \leq 2k\}$. [7]
- d) Show that the class of RLs is closed under the following operations: [7]
- Kleene Closure
 - Concatenation

4.

a) Design a Turing Machine to compute $\max(n_1, n_2)$, where n_1 and n_2 are unary number. [7]

b) Design a TM over alphabets $\{a, b\}$ that will accept the language $L = \{wcw \mid w \in (a, b)^+\}$. [7]

OR

c) Design a TM over alphabets $\{a, b\}$ that will accept the language $L = \{a^n b^m c^n \mid n, m \geq 0\}$. [7]

d) Design a Turing machine which reverse the given string "abb". [7]

5.

a) How Queue Machine is equivalent to Turing Machine? Explain with example. [7]

b) If L_1 and L_2 are recursively enumerable languages, prove that the UNION and CONCATENATION of L_1 and L_2 is also recursively enumerable. [7]

OR

c) Show that the Acceptance problem for CFLs is decidable. [7]

d) Show that the class of Recursive Languages is closed under the following operations: [7]

i. Star

ii. Complement