Master of Computer Application (Sem.–3)
THEORY OF COMPUTATION
Subject Code : PGCA1927
M.Code : 90800
Date of Examination: 13-12-2023

Time : 3 Hrs.

Max. Marks : 70

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION - B & C. have FOUR questions each.
3. Attempt any FIVE questions from SECTION B & C carrying TEN marks each.
4. Select atleast TWO questions from SECTION - B & C.

SECTION-A

l. **Attempt the following :**

a) Briefly Discuss Russel's Paradox in the context of theory of computation.

b) Draw a FA accepting the language L over {a, b} where L = "The language of all strings in which the number of a's is even."

c) Give the mathematical definition of Mealy Machine.

d) What are the closure properties of regular languages?

e) How can we determine that a given grammar is ambigious?

f) Are Deterministic PDA (DPDA) and Non-deterministic PDA (NDPA) equivalent? Give an examples.

g) Give an example of language which is accepted by Turing machine but not by linear bounded automata.

h) Show that if L1 and L2 are recursive languages, then L1 $\cap$ L2 is also recursive.

i) Does the PCP with two lists $x = (b, bab^3, ba)$ and $y = (b^3, ba, a)$ have a solution?

j) What are P and NP class of problems? Give examples of each type.

SECTION-B

2. Prove that Deterministic Finite Automata (DFA) and Non-deterministic Finite Automata (NFA) are equivalent.

3. Minimize the following Automata:
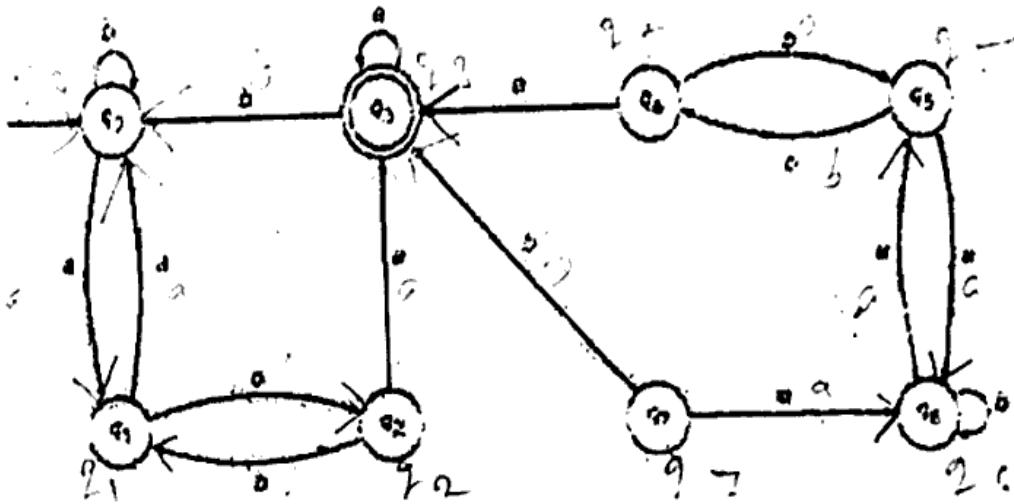
4. a) Using Pumping Lemma, show that $L = \{a^p | p$ is a prime$\}$ is not regular.

   b) Find a regular expression corresponding to each of the following subsets of $\{a, b\}$.

      i) The set of all strings containing exactly 2a's.

      ii) The set of all strings containing at least 2a's.

      iii) The set of all strings containing at most 2a's.

      iv) The set of all strings containing the substring aa.

5. Convert the grammar $S \rightarrow AB, A \rightarrow BS | b, B \rightarrow SA | a$ into GNF.

SECTION-B

6. Construct a Pushdown automata which accepts all palindromes over $\{a, b\}$.

7. Design a Turing Machine that accepts $L = \{1^n 2^n 3^n | n \geq 1\}$

8. Show that the Halting Problem of Turing Machine is undecidable.

9. a) State the Church Turing Thesis. What is the importance of this Thesis in the context of Theory of Computation?

   b) Give at least five examples of problems which are intractable.