## 2019

## THEORY OF COMPUTATION

Paper : CS 502

Full Marks : 100

Time : Three hours

*The figures in the margin indicate*
*full marks for the questions.*

Answer **Question No. 1** and
**any four** from the rest.

1.  Attempt **all** questions :                    2×10=20

    (a)  Define non-regular language with an example.

    (b)  What do you mean by a language accepted by a DFA ?

    (c)  What do you mean by a language accepted by an NFA ?

    (d)  Give the interpretation of $\delta(q, \varepsilon) = q$.

                                                    *Contd.*

(e) What do you mean by a minimum DFA?

(f) Define Pigeonhole principle.

(g) Find all the strings of length less or equal to three of the language
$$L = \left\{ aw : w \in \{a, b\}^* \right\}.$$

(h) Define the transition function of an NFA.

(i) Does the regular expression $r = a(a+b)^* b$ generates the string $a^{100}$?

(j) Does the regular expression in question (i) is equivalent to the language in question (g)?

2.

(a) Define NFA.

(b) Design an NFA for
$$L = \left\{ w \in \{a, b\}^* : abb \text{ or } baa \text{ is a substring of } w \right\}$$

(c) Design a DFA for
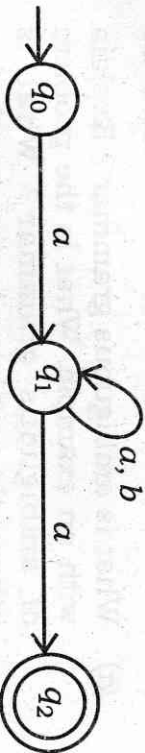$$L = \left\{ w \in \{a, b\}^* : \text{number of } a \text{ in } w \geq 3 \right\}$$

5+7+8=20

3.

(a) Define regular expression.

4+4+6+6=20

(b) Write a regular expression for the language given in question 2. (b).

(c) Convert the following NFA to its equivalent DFA:



(d) If $L_1$ and $L_2$ are regular language, then prove that $L_1 - L_2$ and $L_1 \cap L_2$ are also regular.

4.

(a) State and prove the pumping lemma for the regular language.

(b) Using pumping lemma, show that
$$L = \left\{ a^m b^n : m, n \geq 0 \text{ and } m > n \right\}$$
is not regular.

10+10=20

5.

(a) Write a Context-free grammar for
$$L = \left\{ w \in \{a, b\}^* : |w_a| = |w_b| \right\}$$

6+14=20

(b) Define the CNF and GNF, convert the following grammar into CNF —

$$S \rightarrow ASA \mid aB$$
$$A \rightarrow B \mid S$$
$$B \rightarrow b \mid \varepsilon$$

6.                                                          12+8=20

(a) What is ambiguous grammar ? Explain with an example. What is the problem of ambiguous grammar ? What is inherently ambiguous grammar ?

(b) Design a PDA for the language —

$$L = \left\{ ww^r : w \in \{a, b\}^* \right\}$$

7. Give the brief description of :        5×4=20

(a) Turing machine

(b) Chomsky hierarchy of languages

(c) Difference between DPDA and NPDA

(d) Primitive recursive function.

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53 (CS 502) THCP/G      4                    100