53 (IT 503) THCP

2014

THEORY OF COMPUTATION

Paper : IT 503

Full Marks : 100

Time : Three hours

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

Answer ***any five*** *questions out of* ***seven.***

1. *(a)* Define the following with examples 3×2

   (i) alphabet

   (ii) string

   (iii) language

   (b) Draw the DFA for th following languages 5+5

   (i) languages over the alphabet $\Sigma = \{0, 1\}$ that have the set of all strings that either begins or ends or both with '01'.

(ii) languages over the alphabet $\Sigma = \{0,1\}$ that have the set of all strings where the second last symbol from the start is '0' and second last symbol from the end is '1'.

(c) Define Chomsky hierarchy of languages. 4

2. (a) Define deterministic push down automata DPDA. Is it true that DPDA are equivalent to PDA in the sense of language acceptance concern ? Justify your answer with an example. 2+4

(b) Construct the CFG for the PDA

$P = (\{P, q\}, \{0,1\}, \{X, Z_0\}, \delta, q, Z_0)$, if δ is given by 8

$$\delta(q, 1, Z_0) = \{(q, XZ_0)\}$$

$$\delta(q, 1, X) = \{(q, XX)\}$$

$$\delta(q, 0, X) = \{(P, X)\}$$

$$\delta(q, \varepsilon, X) = \{(q, \varepsilon)\}$$

$$\delta(P, 1, X) = \{(P, \varepsilon)\}$$

$$\delta(P, 0, Z_0) = \{(q, Z_0)\}$$

(c) Find a context free grammar with no useless symbols equivalent to 6

$$S \rightarrow AB \mid CA$$
$$B \rightarrow BC \mid AB$$
$$A \rightarrow a$$
$$C \rightarrow aB \mid b$$

3. (a) Define regular expression and its importance in automata theory. 3+2

(b) Write down the regular expression for the following languages. 5+5

(i) Set of all strings from alphabet $\sum = \{0,1\}$ such that first symbol must be equal to the last symbol.

(ii) Set of all strings from alphabet $\sum = \{0,1\}$ such that each string does not end in '01'.

(c) Prove that the language $L = \{0^n \mid$ where n is a power of 2 $\}$ is not regular. 5

4. (a) Define Turing Machine (TM). Differentiate the deterministic and non-deterministic Turing Machine. 4+4

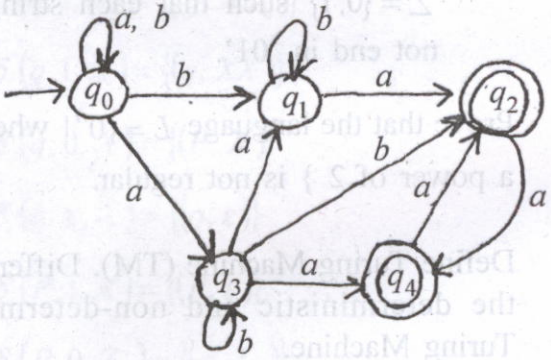
(b) Construct a Turing Machine for the language L 8

$$L = \left\{ \omega\omega^R \mid \omega \in \{0,1\} \right\}$$

(c) Define left-linear and right-linear grammar with examples. 4

5. (a) When a problem is said to be decidable or undecidable ? Show that the problem "given an arbitrary Turing Machine M and arbitrary string W, does M halts on W" is undecidable. 4+4

(b) Determine the DFA equivalent to the following NFA and by taking suitable example prove that both will accept or reject the same set of strings. 4+2

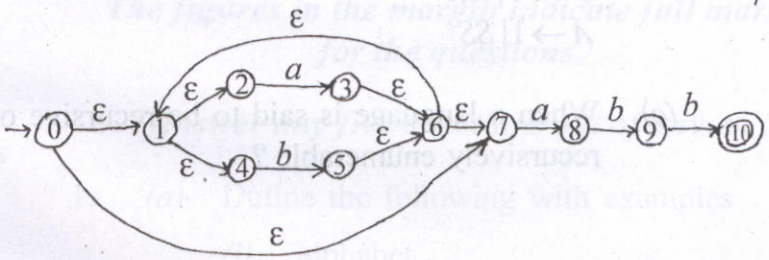


(c) Construct a PDA for the language L. 6

$$L = \left\{ a^n b^m c^n \mid m, n \geq 1 \right\}$$

6. (a) Define Context Free Grammar (CFG) and write down its differences from Context-Sensitive Grammar. What are the disadvantages of CFG in compared to CSG. 2+2+2

(b) Convert the following NFA with ε-transition into NFA without ε-transition. $\Sigma = \{a, b\}$ 7



(c) Convert the following grammar into Chomsky Normal Form (CNF) 7

$S \rightarrow bA \mid aB$
$A \rightarrow bAA \mid aS \mid a$
$B \rightarrow aBB \mid bS \mid b$

7. *(a)* Consider the following grammar 6+2

$S \rightarrow bA \mid aB$

$A \rightarrow bAA \mid aS \mid a$

$B \rightarrow aBB \mid bS \mid b$

Find out Left-most and Right-most derivation for the string "baaabbabba". Also construct the parse tree for that.

(b) Obtain Greiback Normal Form (GNF) equivalent to the following Context-free-grammar 8

$S \rightarrow 0 \mid AA$

$A \rightarrow 1 \mid SS$

(c) When a language is said to be recursive or recursively enumerable ? 4