**53 (IT 503) THCP**

**2013**

(December)

# THEORY OF COMPUTATION

*Full Marks : 100*

*Pass Marks : 30*

Time : Three hours

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

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

1. *(a)* Construct DFA equivalent to the NFA 7 $(\{p, q, r, s\}, \{0, 1\}, \delta, P, \{S\})$, where $\delta$ is given by

| | 0 | 1 |
|---|---|---|
| $p$ | $p, q$ | $p$ |
| $q$ | $r$ | $r$ |
| $r$ | $s$ | – |
| $s$ | $s$ | $s$ |

*Contd.*

(b) Construct a PDA for language 8

$$L = \left\{ WW^R \middle| W \text{ in } (a, b)^+ \right\}$$

(c) Define Chomsky hierarchy of languages. 5

2. (a) Define deterministic push down automata DPDA. Is it true that DPDA are equivalent in the Sense of language acceptance is concern ? Justify your answer. 4+3

(b) Convert the grammar $G$, into Greibach Normal form. 8

$$S \rightarrow AB$$

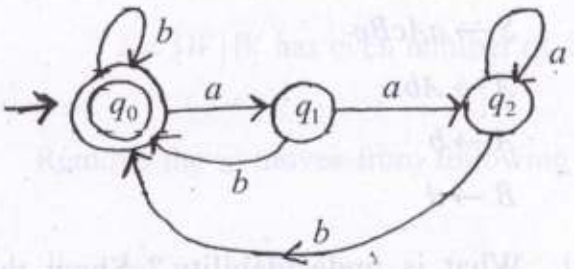
$$A \rightarrow BS \,|\, b, \quad B \rightarrow SA \,|\, a$$

(c) Prove that the following grammar of arithmetic expressions is ambiguous. 5

$$E \rightarrow E + E \,|\, E^* E \,|\, (E) \,|\, id$$

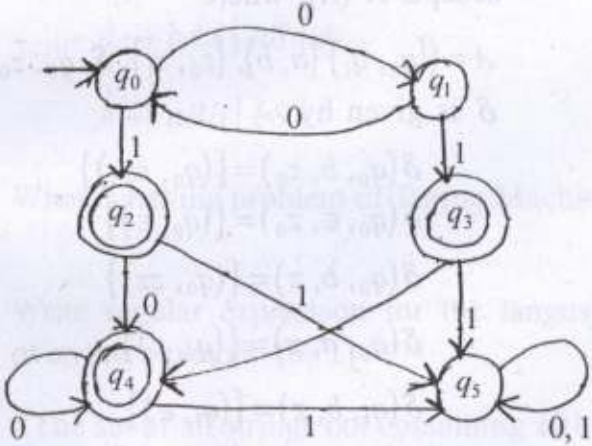
3. (a) Define a TM (Turing Machine) mathematically. Also differentiate the deterministic and non-deterministic Turing Machine. 3+4

(b) Give the regular expressions accepted by following FA. 8




(c) Describe difference between Context-free and Context-sensitive grammar. Also describe basic defects of Context-free grammar. 3+2

4. (a) Obtain a minimum state DFA equivalent to the following 8



(b) Find the Parse tree for the expression abbcde considering the productions. 6

$S \rightarrow aAcBe$

$A \rightarrow Ab$

$A \rightarrow b$

$B \rightarrow d$

(c) What is undecidability ? Show that the problem "Given an arbitary Turing Machine $M$ and arbitary string $W$, does $M$ halts on $W$" is undecidable. 2+4

5. (a) Differentiate between DFA and NFA with suitable example. 4

(b) Construct a Context-free grammar $G$ which accepts $N(A)$, where 8

$A = (\{q_0, q_1\}\{a, b\}, \{z_0, z_1\}, \delta, q_0, z_0, \phi)$,

$\delta$ is given by

$\delta(q_0, b, z_0) = \{(q_0, zz_0)\}$

$\delta(q_0, \in, z_0) = \{(q_0, \in)\}$

$\delta(q_0, b, z) = \{(q_0, zz)\}$

$\delta(q_0, a, z) = \{(q_1, z)\}$

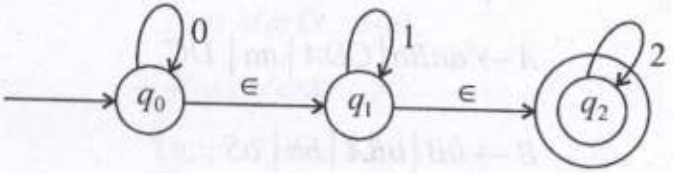
$\delta(q_1, b, z) = \{(q_1, \in)\}$

$\delta(q_1, a, z) = \{(q_0, z_0)\}$

(c) Construct TM accepting the language 8

$$L = \{W \mid W \text{ has even number of } 2\}$$

6. (a) Remove the $\epsilon$-moves from following NFA 8




(b) Obtain the Chomsky normal form equivalent to the grammar. 4

$$S \rightarrow bA \mid aB$$

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

$$A \rightarrow aBB \mid bS \mid b$$

(c) What is halting problem of Turing Machine. 3

(d) Write regular expression for the language over the alphabet {0, 1}. 5

"The set of all strings not containing 101 as a substring".

7. *(a)* Discuss the properties and limitations of Finite State Machine. 2+2

*(b)* Remove the Unit Production from the following CFG : 6

$S \rightarrow AaA \mid CA \mid BaB$

$A \rightarrow aaBa \mid CDA \mid aa \mid DC$

$B \rightarrow bB \mid bBA \mid bb \mid aS$

$C \rightarrow Ca \mid bC \mid D$

$D \rightarrow bD \mid A$

*(c)* Draw the DFA for the following language over {0, 1} 5+5

*(i)* language that accepts all the strings that contain 01 as a subword.

*(ii)* language that accepts all the string $W$

$L = \{W \mid W$ has even positive number of 0$\}$.