PART C — (1 × 15 = 15 marks)

16. (a) Give the regular expression of the language generated by the context free grammar (CFG) given below:

$S \rightarrow aS \mid bS \mid a \mid b$

Convert the regular expression to an $\in$–NFA. (7)

(b) Design a Turing machine that accepts the language $L = \{a^n b^n c^n \mid n >= 1\}$. (8)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 20369

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fifth/Eighth Semester

Computer Science and Engineering

CS 6503 – THEORY OF COMPUTATION

(Common to Information Technology)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give the difference between a deterministic finite automaton (DFA) and a non deterministic finite automaton (NDFA).

2. State pumping lemma for regular languages.

3. Consider the context-free grammar (CFG) given below. Give the leftmost derivation for the string *bbaa* using the grammar.

$S \rightarrow bS \mid aT \mid \in$
$T \rightarrow aT \mid bU \mid \in$
$U \rightarrow aT \mid \in$

4. Show that the following grammar is ambiguous: $S \rightarrow SbS \mid a$.

5. What is an instantaneous description (ID) of a push down automaton (PDA)?

6. Convert the following CFG to a push down automaton:

$S \rightarrow aS \mid bS \mid a \mid b$.

7. Differentiate multihead and multitape Turing machines.

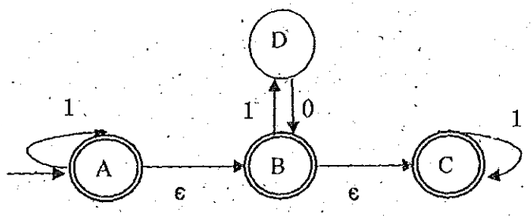
8. Give the Chomskian hierarchy of languages.

9. If L and its complement are recursively enumerable languages, prove that L is recursive.

10. Define the primitive recursion operation.

PART B — (5 × 13 = 65 marks)

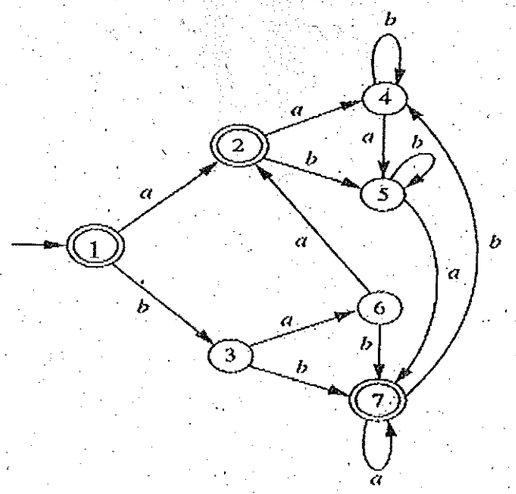
11. (a) Convert the following ∈-NFA to NFA and then convert the resultant NFA to DFA. (13)



Or

(b) (i) Prove that a language L is accepted by some NDFA if and only if L is accepted by some DFA. (6)

(ii) Minimize the following automaton: (7)



12. (a) Simplify the following grammar by eliminating null productions, unit productions and useless symbols and then convert to Chomsky Normal Form (CNF). (13)

$S \to ABC \mid BaB$

$A \to aA \mid BaC \mid aaa$

$B \to bBb \mid a \mid D$

$C \to CA \mid AC$

$D \to \in$

Or

(b) Convert the following grammar to Greibach normal form (GNF): (13)

$S \to AB, A \to BS \mid b, B \to SA \mid a$.

13. (a) (i) Prove that the language $L = \{a^n b^n c^n \mid n >= 1\}$ is not context free using pumping lemma: (8)

(ii) What is a deterministic push down automaton? Comment on the language accepting capabilities of a deterministic push down automaton. (5)

Or

(b) Convert the following PDA M to CFG: (13)

$M = (\{q_0, q_1\}, \{0,1\}, \{X, Z_0\}, \delta, q_0, Z_0, \Phi)$ and δ is given by

$\delta(q_0, 0, Z_0) = \{(q_0, XZ_0)\}, \delta(q_1, 1, X) = \{(q_1, \in)\}$,

$\delta(q_0, 0, X) = \{(q_0, XX)\}, \delta(q_1, \in, X) = \{(q_1, \in)\}$,

$\delta(q_0, 1, X) = \{(q_1, \in)\}, \delta(q_1, \in, Z_0) = \{(q_1, \in)\}$.

14. (a) (i) Give the five-tuple representation of a Turing machine and explain the representation. Define the language accepted by a Turing machine. (5)

(ii) Consider the following Turing machine M = ($\{q_1, q_2, q_3, q_4\}$, {0, 1}, {0, 1, X, B}, δ, q_1, B, q_4) where δ is given as

$\delta(q_1, 0) = (q_2, X, R)$
$\delta(q_2, 0) = (q_2, X, R)$
$\delta(q_2, 1) = (q_3, X, R)$
$\delta(q_3, 0) = (q_2, X, R)$
$\delta(q_3, 1) = (q_3, X, R)$
$\delta(q_3, B) = (q_4, X, R)$

What will be the initial and final configurations of the Turing machine for the input string w = 0101? (8)

Or

(b) Design a Turing machine that accepts the language $L = \{ss \mid s$ is in {a, b}*}. (13)

15. (a) (i) If L1 and L2 are recursively enumerable languages, prove that the union of L1 and L2 is also recursively enumerable. (8)

(ii) Write notes on polynomial-time reductions. (5)

Or

(b) What is a universal Turing Machine? Explain the procedure to construct the universal Turing machine. (13)