B 2151

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Fifth Semester

Computer Science and Engineering

CS 332 — THEORY OF COMPUTATION

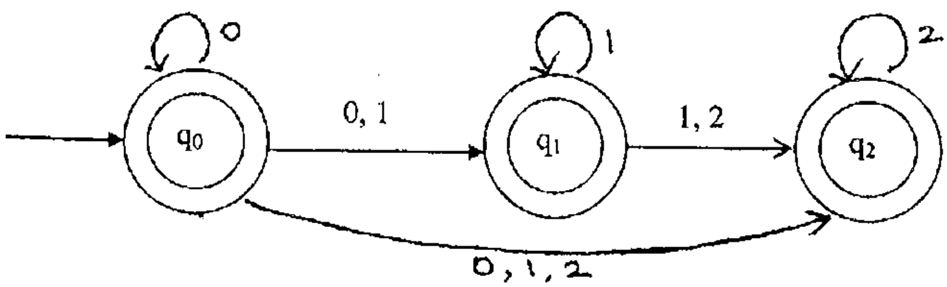
Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Construct a finite automaton that accepts $\{0,1\}^+$.

2. The transition diagram for the NFA (without $\in-$ transitions) is given below. Find the transition function $\delta(q,a)$.



3. Construct a derivation tree for the string 0011000 using the grammar $S \to A0S|0|SS, A \to S1A|10$

4. Give an example for a context-free grammar.

5. State pumping lemma for context – free languages.

6. Define the term "Instantaneous description".

7. Define "recursively enumerable language"

8. What is the role of checking off symbols in a Turing machine?

9. Give an example for a non-recursively enumerable language.

10. Give an example for an undecidable problem.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Define NFA with $\in$ - transitions. (2)

(ii) Prove that if L is accepted by an NFA with $\in$-transitions, then L is also accepted by a NFA without $\in$-transitions. (14)

Or

(b) (i) Construct a NDFA accepting all strings in $\{a,b\}^+$ with either two consecutive a's or two consecutive b's. (8)

(ii) Define a regular set. Using pumping lemma show that the language. $L=\{0^{i^2} / i \text{ is an integer}, i \geq 1\}$ is not regular. (8)

12. (a) (i) Explain the construction of an equivalent grammar in CNF for the grammar $G=(\{S,A,B\}\{a,b\},P,S)$

where $P=\{S \to bA \mid aB,\ A \to bAA \mid aS \mid a,\ B \to aBB \mid bS \mid b\}$. (10)

(ii) Give a detailed description of ambiguity in context – free grammar. (6)

Or

(b) (i) Prove that for every context-free language L without $\in$ there exist an equivalent grammar in Greibach normal form. (8)

(ii) Given $G=(\{S,A\},\{a,b\},P,S)$ where $P=\{S \to AaS \mid S \mid SS, A \to SbA \mid ba\}$

S – start symbol. Find the left most and right most derivation of the string w = $aabbaaa$. Also construct the derivation tree for the string w. (8)

13. (a) (i) Define a pushdown automaton. Give an example for a language accepted by PDA by empty stack (4)

(ii) Construct a grammar for the following PDA.

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

$\delta(q_0,0,Z_0)=\{(q_0,XZ_0)\}$, $\delta(q_0,0,X)=\{(q_0,XX)\}$,

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

$\delta(q_1,\in,X)=\{(q_1,\in)\}$, $\delta(q_1,\in,Z_0)=\{(q_1,\in)\}$, (12)

Or

(b) (i) Prove that if L is $N(M_1)$ for some PDA M_1 then L is $L(M_2)$ for some PDA M_2. (8)

(ii) Is $L=\{a^n b^n c^n / n \geq 1\}$ a context – free language? Justify your answer. (8)

14. (a) Construct a Turing machine that recognizes the language $\{wcw/w \; in \{a+b\}^+\}$. (16)

Or

(b) Prove that a language L is recognized by a Turing machine with a two-way infinite tape if and only if it is recognized by a Turing machine with a one – way infinite tape. (16)

15. (a) Prove that the universal language L_u is recursively enumerable. (16)

Or

(b) State and prove Rice's theorem for recursive index sets. (16)

———————