Register Number:………………..

B.E., DEGREE EXAMINATIONS MAY/JUNE 2013

Fifth Semester

COMPUTER SCIENCE AND ENGINEERING

CSE111: Theory of Computation

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions:-

PART A (10x1=10 Marks)

1. The basic limitation of FSM is that
   A) it cannot remember arbitrary large amount of information
   B) it sometimes recognizes grammars that are not regular
   C) it some times fails to recognize grammars that are regular
   D) it also recognizes other grammars
2. Which of the following set can be recognized by deterministic finite automaton?
   A) The numbers 1, 2, 4, ..2^n, .. written in binary
   B) The numbers 1, 2, 4, ..2^n, .. written in unary
   C) The set of binary strings in which the number of 0's is same as the number of 1's
   D) The set containing {1, 101, 11011, 1110111, …}
3. What is the minimum number of states of the NFA that accepts the language
   $L = \{ abab^n + aba^n \mid n \geq 0\}$?
   A) 9 B) 5 C) 4 D) 3
4. The regular expression for the set of strings that consists of alternating 0's and 1's is
   A) $(\in \cup 1)(01)^* \cup 1$ B) $(01)^* (10)^* 0(10)^* 1(01)^*$
   C) $(01)^* \cup (10)^* \cup 0(10)^* \cup 1(01)^*$ D) $(\in \cup 1)(10)^* \cup 1$
5. A Context free grammar G is said to be ambiguous if
   (i) it has two or more leftmost derivations
   (ii) it has two or more rightmost derivations
   (iii) More than one parse tree
   A) (i) only B) (ii) only C) (i) and (ii) only D) (i) (ii) and (iii) are all true

6. The language generated by the CFG G given below is
   $S \rightarrow aSb \mid aAb \mid aBb$ $A \rightarrow aA \mid a$ $B \rightarrow Bb \mid b$
   A) $\{a^nb^m , m > 0, |n-m| \geq 2\}$ B) $\{a^nb^m , m > 1, |n-m| \geq 1\}$
   C) $\{a^nb^m , m > 0, |n-m| \geq 1\}$ D) $\{a^nb^m , m > 0, |n-m| \geq 0\}$
7. Consider a CFG, $S \rightarrow aS \mid XY$ $X \rightarrow \lambda$ $Y \rightarrow \lambda$
   After eliminating null productions:
   A) $S \rightarrow aS \mid X \mid Y$ B) $S \rightarrow aS \mid X \mid Y \mid XY \mid a$
   C) $S \rightarrow aS \mid XY \mid X \mid Y$ D) $S \rightarrow aS \mid X \mid Y \mid a$
8. Turing machines are similar to finite automaton but have
   A) Finite and read only memory B) Unlimited and read only memory
   C) Finite and read – write memory D) Unlimited and read-write memory
9. A language is said to be recursive if
   A) both the language and its complement are not recursively enumerable
   B) it is recursively enumerable while its complement is not recursively enumerable

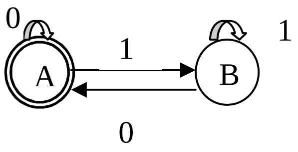
C) it is not recursively enumerable while its complement is recursively enumerable
D) both the language and its complement are recursively enumerable

10. It is undecidable whether
    A) an arbitrary Turing machine halts on all inputs
    B) an arbitrary Turing machine halts after certain time say 10 minutes
    C) a Turing machine prints a specific letter
    D) A Turing machine computes the product of two numbers

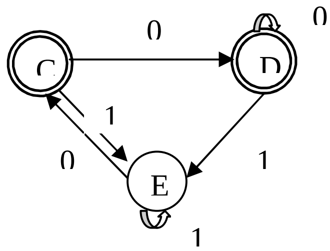
PART B (10 x 2 = 20 Marks)

11. Construct a finite automata accepting all strings over {0,1} ending in 0010.
12. Find out whether the following DFA's D_1 and D_2 accept the same language.

D_1:



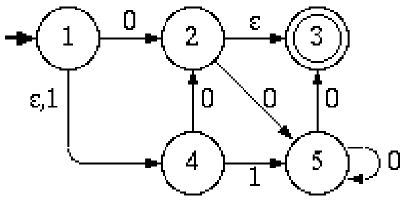
D_2:



13. State the closure properties of regular languages.
14. Prove that the equivalence between the regular expressions
    $(10 + 1)^*1 = 1(01 + 1)^*$
15. Give two examples of Context free languages (CFL) where design of the same is possible only by deterministic pushdown automata.
16. Determine whether the following CFGs are ambiguous or not?
    S $\rightarrow$ ab | aSb | BA   A $\rightarrow$ a | ab | ε   B $\rightarrow$ aSB | ε
17. Eliminate 'Σ" productions from the following grammar
    S $\rightarrow$ ab | aSC | BA   A $\rightarrow$ a | Cb | bb   B $\rightarrow$ aB | ε
18. State the Church's Turing thesis
19. Prove that there exists a recursively enumerable language that is not recursive.
20. Define Post Correspondence Problem (PCP). Does a PCP solution exist for the following instances. Justify.
    A = (01, 001, 10); B = (011, 01, 00)

PART C (16 x 5 = 80 Marks)

21. a) Consider the Finite Automaton below. Construct the deterministic Finite Automaton which accepts the same language. Draw a regular expression that represents the language accepted by the machine. Trace for a string.



(OR)

b) (i) Differentiate between Deterministic finite automata(DFA) and Non – Deterministic finite automata (NFA). (4)

(ii) State and prove the equivalence between Deterministic finite automata and Non – Deterministic finite automata. (10)

22. a) Design a minimized DFA for the regular expression (a+b)a*(a+b)*bb. Trace a string for acceptance and rejection.

(OR)

b) (i) State the pumping lemma for regular languages. Prove that the language of palindrome are not regular. (6)

(ii) Design a finite automata that accepts all decimal integers divisible by 3. (8)

23. a) (i) Show that the CFG G1 with productions

$S \rightarrow aSaSbS \mid aSbSaS \mid bSaSaS \mid \epsilon$

and CFG G2 with productions

$S \rightarrow aSaSb \mid aSbSa \mid bSaSaS \mid \epsilon$

generates the same language. State whether these grammars are ambiguous by constructing parse trees. Construct a leftmost derivation and right most derivations for any string accepted by the grammars. (8)

(ii) Construct an equivalent pushdown automata for the language of balanced parenthesis (Assume with two kinds of parenthesis like [ ] or { }) (6)

(OR)

b) (i) Specify the two types of moves in PDA. What are the different types of language acceptances by a PDA either acceptance by empty store or acceptance by final state and define them with their configurations. (7)

(ii) Design an equivalent pushdown automata for the CFG with productions

$S \rightarrow aSA \mid \varepsilon$ $A \rightarrow bB$ $B \rightarrow b$

Trace a string accepted by the grammar. (7)

24. a) State the definition for the two Normal forms – Chomsky Normal form and Grieback Normal form. Convert the following CFG to the above normal forms.

$S \rightarrow aA \mid bB \mid cC$ $A \rightarrow Sa$ $B \rightarrow Sb$ $C \rightarrow \varepsilon$

(OR)

b) (i) Construct a Turing machine for the language $L(h) = \{ 0^n1^n2^n \mid n > 0 \}$. (8)

(ii) State the pumping lemma for the CFL and also state the closure properties of CFL. (6)

25. a) (i) How does reducibility help solve undecidable problems? Why halting problem is considered undecidable? (7)

(ii) Are the decidable languages closed under concatenation? That is, if A and B are decidable languages, is the language C = {ab |a ЄA and b ЄB} a decidable language? (7)

(OR)

b) Explain recursive and recursively enumerable languages with examples and Prove that if a language L and its complement L are both recursively enumerable, then the language L is recursive.

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