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Question Paper Code : 75494

5 Year M.Sc. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fifth Semester

Software Engineering

ESE 055 — THEORY OF COMPUTATION

(Regulation 2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Given $L = \{a^n b^{n+1} : n \geq 0\}$. Prove or disprove that $L = L^*$ for the given language L.

2. Let $\Sigma = \{a, b\}$. Write regular expression for the set of all strings in r with a number of a's divisible by three.

3. Define a nondeterministic finite automaton.

4. Give a context free grammar generating the set of palindromes over alphabet $\{a, b\}$

5. State Pumping theorem for context-free languages.

6. What is meant by a Turing machine with two way infinite tape?

7. Mention any two problems which can only be solved by Truing machine.

8. When a problem is said to be undecidable? Give an example of undecidable problem.

9. What do you mean by Universal Turing machine?

10. When is a Turing machine said to be polynomially bounded?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Construct a non-deterministic finite state automaton accepting all strings in $\{a, b\}^+$ with either two consecutive **a's** or two consecutive **b's**. (8)

(ii) Show that the set $L = \{a^n / b^n / n \geq 1\}$ is not regular. (8)

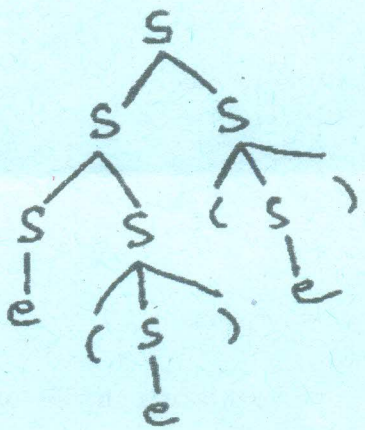
Or

(b) (i) Construct an NFA equivalent to the regular expression $(0+1)^*(00+11)(0+1)^*$. (8)

(ii) Show that the class of languages accepted by finite automata is closed under concatenation and Kleene star. (8)

12. (a) (i) Construct a PDA that recognize the language $\{a^i bjc^k / i, j, k > 0 \text{ and } i = j \text{ or } i = k\}$ (8)

(ii) Find the left most and right most derivation corresponding to the tree given below : (8)



Or

(b) (i) Show that $\{0^n 1^n 2^n / n \geq 1\}$ is not a context-free language. (8)

(ii) Show that every context-free language is accepted by some pushdown automaton. (8)

13. (a) (i) Design a Turing machine to implement proper subtraction. (8)

(ii) Find grammar that generates the language $\{a^{2n} : n \geq 0\}$. (8)

Or

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

14. (a) (i) Prove that the following problem is undecidable :

Given a context-free grammar G, is $L(G) = \Sigma^*$? (10)

(ii) Explain the Halting problem. Is it decidable or undecidable problem? (6)

Or

(b) (i) Show that the class of recursively enumerable languages is not closed under complement. (8)

(ii) Show that the following problem is solvable : Given a Turing machine M, an input string w, and a number k, does M use k tape squares on input w? (8)

15. (a) (i) Show that the traveling salesman problem is in NP. (6)

(ii) Show that $E = \{\text{“}M\text{”}\ \text{“}w\text{”}: M \text{ accepts input } w \text{ after at most } 2^{|w|}\text{”} \text{ steps}\}$ is not in P. (10)

Or

(b) (i) Show that NP is closed under union intersection, concatenation and kleene star. (8)

(ii) Write a short note on ambiguity in context free grammar. (8)