Reg. No. : 2 2 5 0 8 1 0 4 0 1 4.

Question Paper Code : 66281

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2011.

Fifth Semester

Computer Science and Engineering

CS 2303 — THEORY OF COMPUTATION

(Common to Seventh Semester Information Technology)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is structural induction?
2. State the difference between NFA and DFA.
3. Construct a DFA for the following :
   (a) All strings that contain exactly 4 zeros.
   (b) All strings that don't contain the substring 110.
4. Is the set of strings over the alphabet $\{0\}$ of the form 0^n where n is not a prime is regular? Prove or disprove.
5. Is the grammar below ambiguous $S \rightarrow SS \mid (S) \mid S(S) \mid E$?
6. Convert the following grammar into an equivalent one with no unit productions and no useless symbols $S \rightarrow ABA \quad A \rightarrow aAA \mid aBC \mid bB$ $B \rightarrow A \mid bB \mid Cb \quad C \rightarrow CC \mid cC$.
7. Design a TM that accepts the language of odd integers written in binary.
8. State the two normal forms and give an example.

9. How to prove that the Post Correspondence Problem is Undecidable.

10. Show that any PSPACE-hard language is also NP-hard.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Prove that $\sqrt{2}$ is not rational. (8)

(ii) Construct a DFA accepting all strings w over $\{0, 1\}$ such that the number of 1's in w is 3 mod 4. (8)

Or

(b) Construct a minimized DFA from the regular expression $(x + y)x(x + y)^*$. Trace for a string $w = xxyx$. (1

12. (a) State and explain the conversion of DFA into regular expression using Arden's theorem. Illustrate with an example. (16)

Or

(b) (i) What are the closure property of regular sets? (8)

(ii) Define regular expression. Show that

$(1 + 00 * 1) + (1 + 00 * 1)(0 + 10 * 1) * (0 + 10 * 1) = 0 * 1(0 + 10 * 1) *$ (8)

13. (a) (i) Is NPDA (Nondeterministic PDA) and DPDA (Deterministic PDA) equivalent? Illustrate with an example. (8)

(ii) What are the different types of language acceptances by a PDA and define them. Is it true that the language accepted by a PDA by these different types provides different languages? (8)

Or

(b) (i) Convert the grammar $S \to aSb \mid A$, $A \to bSa \mid S \mid \in$ to a PDA that accepts the same language by empty stack. (10)

(ii) If $S \to aSb \mid aAb$, $A \to bAa$, $A \to ba$ is the context free grammar. Determine the context free language (6)

14. (a) (i) State the techniques for Turing machine construction? Illustrate with a simple language. (6

(ii) Explain the different models of Turing machines. (10)

Or

(b) (i) What are the closure properties of CFL? State the proof for any two properties. (8)

(ii) State the Pumping lemma for CFLs. What is its main application? Give two examples. (8

15. (a) (i) State the halting problem of TMs. Prove that the halting problem of Turing Machine over {0, 1}* as unsolvable. (8)

(ii) Let $\sum = \{a, b\}^*$. Let A and B he lists of three strings as given below :

$A = \{b, bab\ 3, ba\}$ $B = \{b3, ba, a\}$

Does this instance of PCP have a solution? Justify your answer.(8)

Or

(b) Write short notes on :

(i) Recursive and recursively enumerable languages. (8)

(ii) NP hard and NP complete problems. (8)