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Question Paper Code : 51386

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Computer Science and Engineering

CS 2303/CS 53/10144 CS 504/CS 1303 – THEORY OF COMPUTATION

(Common to Seventh Semester Information Technology)

(Regulations 2008/2010)

(Common to PTCS 2303 – Theory of Computation for B.E. (Part-Time) Fifth Semester – CSE – Regulations 2009)

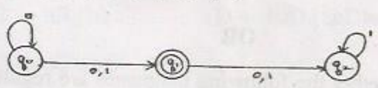
Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Prove by Mathematical Induction that for $n \geq 2$, then $n^3 - n$ is always divisible by 3.

2. Give two strings that are accepted and two strings rejected by the following finite automata M = ({q0, q1, q2}, {0, 1} q0, q1, ∂).



3. Find a string of minimum length in $\{x, y\}^*$ not in the language corresponding to the given regular expression.

   (a) $x^*(y + xy)^*x^*$

   (b) $(x^* + y^*)(x^* + y^*)(x^* + y^*)$

4. State whether regular languages are closed under intersection and complementation. Give an example for intersection.

5. Show that the context free grammar with the following productions is ambiguous. G = ({S, A, B}, {a, b}, {S → AB, A → aAB |ab, B → abB|λ},S).

6. Define Pushdown automata.

7. State the advantages of Turing machine over other automata.

8. State the pumping lemma for context free languages.

9. Differentiate between recursive and recursively enumerable languages.

10. State the classes of P problem with an example.

PART – B (5 × 16 = 80 Marks)

11. (a) Use mathematical induction to solve the problem of Fibonacci series and examine the relationship between recursive definition and proofs by induction. Also state the inductive proofs. **(16)**

OR

(b) State the Thomson construction algorithm and subset construction algorithm. Construct finite automata for generating any floating point number with an exponential factor for example numeric value of the form 1.23 e^{-10}. Trace for a string. **(16)**

12. (a) Design a minimized DFA by converting the following regular expression to NFA, NFA-λ and to DFA over the alphabet Σ = {a, b, c}*. RE = a (a + b + c)* (a + b + c). **(16)**

OR

(b) (i) Determine whether the following languages are regular or not with proper justification. **(8)**

(i) $L_1 = \{a^n bc^{3n} | n \geq 0\}$

(ii) $L_2 = \{a^{5n} | n \geq 0\}$

(ii) Construct deterministic finite automata that recognize the regular expression defined over the alphabet Σ = {0, 1}. RE = (1 + 110)*0. Trace for a string acceptance and rejection. **(8)**

13. (a) Consider the grammar :

$E \rightarrow E + T \mid T$

$T \rightarrow T * F \mid F$

$F \rightarrow (E) \mid id$

(i) Give a rightmost derivation and leftmost derivation for the sentence $w = id * (id + id) * id$. **(8)**

(ii) Is the above grammar ambiguous ? Justify. **(4)**

(iii) Construct the parse tree for the sentence in 13 (a) (i). **(4)**

OR

(b) (i) Differentiate between Deterministic Pushdown automata and Non-Deterministic Pushdown automata. **(6)**

(ii) Construct Pushdown automata to recognize the Grammar G with following productions and trace for a string of acceptance and rejection. **(10)**

$S \rightarrow aSA/\epsilon$

$A \rightarrow bB/cc$

$B \rightarrow bd/\epsilon$

14. (a) (i) Define the two normal forms that are to be converted from a context free grammar (CFG). Convert the following CFG to Chomsky normal forms : **(4 + 6)**

$S \rightarrow A \mid B \mid C$ $A \rightarrow aAa \mid B$

$B \rightarrow bB \mid bb$ $D \rightarrow baD \mid abD \mid aa$

$C \rightarrow aCaa \mid D$

(ii) Convert the following CFG G to Greibach normal form generating the same language.

$S \rightarrow ABA$ $A \rightarrow aA \mid \lambda$ $B \rightarrow bB \mid \lambda$ **(6)**

OR

(b) (i) Design a turing machine to recognize the language $L = \{a^n cb^n \mid n \geq 0\}$. **(12)**

(ii) State the closure properties of Context free languages. **(4)**

15. (a) What are undecidable problems ? Explain the same using Post Correspondence Problem (PCP). Does a PCP solution exist for the following set. (16)

(10, 101), (01, 100) (0, 10) (100, 0), (1, 010)

OR

(b) (i) State and explain any four applications of NP complete problems. (10)

(ii) Prove that if L1 and L2 are recursively enumerable language over Σ, then L1 U L2 and L1 $\cap$ L2 are also recursively enumerable. (6)